

On the cooling of the human body after death : Inferences respecting the time of death. Observations of temperature made in 100 cases / by Dr. Alfred S. Taylor and Dr. Wilks.

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ON THE
COOLING OF THE HUMAN BODY AFTER
DEATH.

INFERENCES RESPECTING THE TIME OF DEATH.

OBSERVATIONS OF TEMPERATURE MADE IN 100 CASES.

BY DR. ALFRED S. TAYLOR AND DR. WILKS.

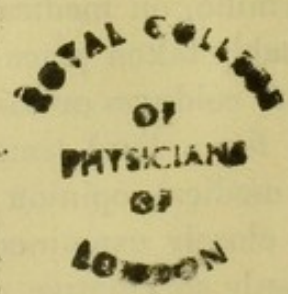
ON the discovery of a dead body, it is sometimes material for the purposes of justice to determine, on medical principles, the period at which death has probably taken place. One condition of the dead body, namely, the coldness or loss of heat as the result of dissolution, has been for a long time considered to furnish a scientific basis for a medical opinion; but when medical evidence on this point is closely examined, it will be found that the opinions are commonly speculative, and that no accurate observations have been made by the individuals. Hence when the question arises, it is not surprising that the medical opinions elicited are of the most conflicting kind. It is with a view to supply some information of a more accurate nature that we have here collected one hundred cases of deaths in Guy's Hospital, commencing with the present year, and have noticed in the respective columns—the age, the cause of death—the time of death—the temperature of the air, as well as wetness or dryness, and the temperature of the body at one or more intervals after death. As the object of these researches was of a practical character, the temperature of the body was taken by placing the naked bulb of a good thermometer uncovered on the skin of the abdomen. The trunk retains the heat longer than the limbs, and thus serves to mark the period of the duration of heat on the surface of the body.

No special notes have been made with regard to the amount

OF THE
COOLING OF THE HUMAN BODY AFTER
DEATH.

INTERESTS RESPECTING THE TIME OF DEATH.
OBSERVATIONS OF TEMPERATURE MADE IN TWO CASES.

By DR. ALFRED S. TAYLOR AND DR. WILLIAM



of post-mortem rigidity and degree of decomposition, except the body has presented anything remarkable in these respects.

Most cases are inspected within twenty-four hours after death, when, as a rule, the body is rigid, and no decomposition has taken place.

If after two or three days much change should be present, it is generally to be attributed to some peculiarity in the cause of death. The decomposition is not shown, as at a still later period, by a mere change of colour, as a greenish hue on the abdomen, but by a redness of the whole body, and by dark lines of staining in the course of the superficial veins. Even when these changes are scarcely observable, there may be found considerable alterations within the body, shown more especially by discoloration of the heart and arteries from the hæmatine of the blood. These changes are connected with a diseased state of the blood, and are met with in those who have died of fever, pyæmia, and similar maladies.

As a rule, the bodies of those who have been long ill and are emaciated, remain unchanged for a longer time than those who have died from acute disease.

It is observed, that the bodies of persons who have been killed whilst in good health, often undergo rapid decomposition. Of this class of cases also are those of strangulated hernia, where death speedily follows an operation : here the post-mortem changes are sometimes observed to be very rapid.

It is a fact of common observation, that the temperature of fat bodies is retained for a longer time than in those which are thin or emaciated.

It is also a common observation, that moisture in the atmosphere appears to favour decomposition much more than heat ; thus putridity is much more rapid on a moist winter's day than on a hot dry day in summer.

These facts might be illustrated by cases from the records, when a casual inspection affords examples of this kind.

September 30th.—The body of a man who had been killed was examined thirty-eight hours after death ; it had begun to undergo decomposition in the ordinary manner. The body of another man, who had died of phthisis, was examined forty-four hours after death, and in this, there was no trace of decomposition.

On the following day an inspection was made of the body

of a man who had died a few hours after fracture of the ribs. Only forty-eight hours had elapsed since death, but considerable decomposition had already taken place. Sometimes decomposition is so rapid that in a few hours the features of a person are unrecognisable, although the explanation is not apparent.

James C—, æt. 26, died on November 28th, of typhoid fever, and perforation of the ileum. The weather was cold and moist. When the examination was about to be made in sixteen hours, the body was totally unlike that of the man when alive. There was no rigor mortis; the whole body was bloated; the cellular tissue was emphysematous, so that when the skin was pierced the gas which escaped was easily ignited into a flame. The colour of the surface was of a reddish hue. The internal organs were also much decomposed; of a dark colour, soft, and emitting a very fetid odour. The liver was full of air. The patient was a temperate man, residing in the country.

Timothy C—, æt. 35, shot himself with a pistol, producing fracture of the skull and injury to the brain, from which he died in six days.

On December 13th, the atmosphere being cold but moist, the body was brought into the post-mortem room for examination, being thirteen hours since death. The rigor mortis was imperfect, but still present to a slight degree; the body was warm; when opened, it showed that a remarkable change had taken place internally, so that it was even suggested whether decomposition had not taken place during life. The brain, besides being sloughy, was rapidly decomposing; the lungs showed an early inflammation, and the tubes were deeply stained by imbibition; the interior of the heart and arteries was of a dark-purple colour, and the clots in the heart were mixed with air; the peritoneum was discoloured; the liver presented a very remarkable appearance, it was full of air, and thus resembled very much a mass of fermenting dough; on the surface were bubbles of air ready to burst; the organ contained two small pyæmic abscesses; the spleen was of a greenish colour; the kidneys closely resembled the liver, being, like it, emphysematous from decomposition, and containing air-bubbles throughout its substance.

It has been said that perforation of the stomach has, for one of its causes, a hot state of the weather, such as may promote decomposition, but our post-mortems do not prove this, indeed they fail to show any definite cause for the occurrence. It may be said, in a word, that a post-mortem perforation is extremely rare, not being found so often as once in five hundred cases. In the last two cases one was albuminuria, and the other a head affection; but in neither could there be found any peculiarities as regards the food, the time of the last meal, or the state of general decomposition, to account for the circumstance. There are, probably, some hidden chemical causes to account for its occurrence, than the more apparent ones which are evident to the eye.

We may also allude here to another point of interest, as it is one which does not seem to be generally known to the profession, and that is, that blood readily coagulates after death. When a body is examined within eight to ten hours after death, it is not unusual to find the blood which may have flowed from it forming a firm clot on the table; or, as is more usually the case, the blood which flows from the vena cava into the chest coagulates there, so that after removing the lungs and heart, and spending some little time in demonstrating their morbid alterations, on returning to the body a very firm coagulum may be found, occupying the chest on either side.

In the first 27 cases of the following table no note was taken of the time that the body was in the ward, and therefore the observations are only of comparative value, the temperature of the dead-house being considerably below that of the ward. As a rule, the body lies in the ward for two, three, or four hours. If death takes place late in the evening, it lies in the ward all night—for ten or twelve hours. The first note made of the temperature, was generally shortly after the body was brought to the dead-house, having been in the ward for very different periods. Beginning with the 28th case, a note has been taken of the temperature of the ward, and how long the body had lain in it. The most complete observations commence with case 62, where the temperature of the body, when first brought to the dead-house, was also taken.

Observations of Temperature

No.	Date.	Name and Age.	Cause of Death.	Time of Death.	Temperature of Ward.	How long in How long in
1	1863 Jan. 21	Joseph Salt, 53	Bright's disease and erysipelas	2 p.m.	—	—
2	„ 22	James Ellis, 72	Lithotomy ; pneumonia	11 a.m.	—	—
3	„ 26	Sarah Ann Bedford, 37	Tumour uterus ; hæmorrhage	12 nocte	—	—
4	„ 25	James Dodd, 60	Injury to leg ; fatty heart. Sudden death	8 p.m.	—	—
5	„ 27	John Ingram, 56	Bright's disease	9 a.m.	—	—
6	„ 28	Manuel Rajas, 17	Measles ; broncho-pneumonia	9 a.m.	—	—
7	„ 29	Jemime Goalter, 56	Removal of tumour ; hæmorrhage ; ligature of carotid	9 p.m.	—	—
8	Feb. 3	Elizabeth Dyke, 36	Pelvic cellulitis ; peritonitis	1½ p.m.	—	—
9	Jan. 30	James Goodwin, 56	Cut throat ; Bright's disease ; pneumonia	9 a.m.	—	—
10	„ 30	Alfred Gould, 22	Phthisis ; diffused tubercle	8½ p.m.	—	—
11	Feb. 1	Edward Mortimore, 25	Phthisis	1 a.m.	—	—
12	—	Andrew Dromedus, 26	Measles ; broncho-pneumonia	5 a.m.	—	—
13	„ 4	William Fosbury, 51	Softening of spine	12 noon	—	—
14	„ 5	Naomi Thimbleby, 65	Strangulated hernia	9½ a.m.	—	—
15	„ 5	Richard Suart, 27	Fractured spine	7 p.m.	—	—
16	„ 5	Samuel Frost, 32	Phthisis and Bright's disease	12 night	—	—
17	„ 7	George Lamport, 29	Tubercular meningitis	12 noon	—	—
18	—	Susan Bird, 40	Cancer—uterus	9 a.m.	—	—
19	—	Margaret Dunn, 37	Deformed chest ; bronchitis	7 p.m.	—	—
20	„ 9	John Montenegro, 26	Measles and broncho-pneumonia	9 a.m.	—	—

de in One Hundred Cases.

Dead House.	First Observation, dating from time brought to Dead House.	Second Observation, dating from same time.	Third Observation, dating from same time.	Fourth Observation, dating from same time.	No.
	2 h., 72°	4 h., 75°	6 h., 72°	12 h., 62°	1
	2 h., 74°	—	—	—	2
	9 h., 64°	12 h., 60°	14 h., 58°	—	3
	—	18 h., when inspected, 75° internal temperature	—	—	4
	4 h., 80°	6 h., 77°	—	—	5
	2 h., 70°	4 h., 66°	12 h., 61°. Post-m. inspection 2½ days, rigidity disappearing, but still present	16 h., 55°	6
t	13 h., 79°	17 h., 70°	—	—	7
	4 h., 86°	11 h., 58°	—	—	8
t	3 h., 87°	5 h., 70°. Inspection, warm and rigid	—	—	9
t	12 h., 68°	16 h., 63°	—	—	10
t	12 h., 63°	20 h., 56°	—	—	11
t	8 h., 72°	17 h., 58°	—	—	12
	—	5 h., 75°. Arms and legs pliant and not quite cold	10 h., 58°. Still pliant	12 h., 56°	13
	3 h., 65°. Warm; pliant	7 h., 63°. Warm; pliant	—	—	14
	—	13 h., 70°. Pliant	—	—	15
	—	12 h., 75°	—	—	16
	3 h., 86°	5 h., 82°	10 h., 63°	21 h., 46°	17
	—	6 h., 80°	8 h., 75°	10 h., 60°	18
	—	4 h., 75°	13 h., 68°	24 h., 50°	19
	—	4 h., 79°	8 h., 73°	13 h., 68°; 24 h., 52°	20

No.	Date.	Name and Age.	Cause of Death.	Time of Death.	Temperature of Ward.
21	1863 Feb. 9	William Richman, 25	Diseased heart and dropsy	5 p.m.	—
22	„ 11	Charles Denny, 28	Phthisis	10 a.m.	—
23	„ 13	Michael Lenway, 36	Disease of heart	11 p.m.	—
24	„ 14	Edward Bayfield, 40	Brought in dead. Fall from height	5 p.m.	—
25	„ 15	Mary Riley, 38	Heart and dropsy	8½ p.m.	—
26	—	John Landen, 44	Bronchitis	9 p.m.	—
27	„ 16	John Mappin, 47	Three weeks after injury to arm, died of hæmorrhage	8½ a.m.	—
28	„ 19	Charles Tritton, 24	Railway accident (arms, legs, skull, &c.)	1.55 p.m.	—
29	—	George Tenners, 34	Phthisis	12.30 p.m.	—
30	„ 20	Anne Annett, 72	Cancer of peritoneum	7.30 a.m.	—
31	—	James Ives, 50	Apoplexy	7 p.m.	58°
32	„ 23	Richard Stuvell, 60	Cancer of Chest	5 a.m.	60°
33	„ 24	Thomas Ralph, 34	Bright's disease	8 p.m.	62°
34	„ 25	George Robinson, 65	—	7 p.m.	56°
35	—	Robert Scholes, 14	Sloughing sore and Bright's disease	6 a.m.	56°
36	—	William Hunter, 25	Disease of heart	6.30 p.m.	60°
37	—	Sarah Pickering, 56	Disease of heart and dropsy	6 p.m.	60°
38	„ 26	Ambrose Gibbon, 50	Phthisis	11.30 a.m.	62°
39	„ 27	Michael Sullivan, 42	Sudden death in Accident Ward (no post-mortem)	7.30 p.m.	60°
40	„ 40	Sarah Stedehy, 36	Ovarian disease	8.30 p.m.	55°
41	March 2	John Jones, 22	Tubercular meningitis	7.15 a.m.	60°
42	—	James Brothers, 32	Phthisis	4 p.m.	60°
43	„ 4	Edgar Rouse, 10	Chronic pericarditis	1.30 p.m.	66°
44	—	Mary Anne Kemp, 5	Fractured skull	5 p.m.	—
45	„ 8	Ann How, 60	—	6.30 p.m.	59°
46	—	James Powell, 63	Ulcerated leg; pyæmia	11.30 p.m.	52°
47	„ 11	Michael Sullivan, 33	Albuminuria	11.30 p.m.	56°
48	—	George Grant, 57	Cancer of stomach	11 a.m.	56°
49	„ 12	John Cousins, 14	Fractured skull	9.30 p.m.	50°
50	—	Francis Cooper, 28	Cancer of leg and lung	11.30 a.m.	56°
51	„ 13	Ann Hall, 31	Abscess in brain	3 a.m.	54°

First Observation, dating from time brought to Dead House.	Second Observation, dating from same time.	Third Observation, dating from same time.	Fourth Observation, dating from same time.	No.
—	5 h., 72°	16 h., 62°	19 h., 60°	21
Arms and legs stiff. 80°	—	—	—	22
—	10 h., 74°	14 h., 68°. Arms and legs quite rigid	—	23
5 h., 84°. Arms and legs rigid	16 h., 69°. Rigid	22 h., 63°	28 h., 50°	24
2 h., 80°	13 h., 64°	16 h., 62°	—	25
12 h., 67°	15 h., 64°	17 h., 76°, when thermometer placed inside body at time of examination	Body felt warm out- and inside. Ex- tremities rigid	26
4 h., 84°	8 h., 80°. Arms and legs pliant	12 h., 74°	—	27
3 h., 80°	7 h., 73°	17 h., 63°. Left arm (only member left) rigid	—	28
3 h., 70°	7 h., 60°	17 h., 54°. Pliant in arms and legs	—	29
3 h., 75°. Getting stiff in arms and legs	5½ h. Post-mortem examination, 84° in interior. Limbs pliant	—	—	30
3 h., 73°. Beginning to be rigid	12 h., 66°. Quite rigid	15 h., 64°	18 h. Post-mortem examination, 60° in interior	31
2 h., 70°	4 h., 68°	6 h., 67°. Interior of body 85°; rigid	—	32
2 h., 75°. Pliant	12 h., 65°. Quite rigid	16 h., 64°	20 h., 60°	33
3 h., 73°. Quite rigid	13 h., 65°	17 h., 60°	—	34
2 h., 78°. Quite pliant	5 h., 70°	—	—	35
3 h., 70°. Not yet rigid	13 h., 62°	16 h., 60°	—	36
3 h., 76°	6 h., 70°	13 h., 68°	16 h., 63°	37
1 h., 80°. Quite pliant	4 h., 70°	—	—	38
2 h., 75°	11 h., 64°	15 h., 60°	20 h., 55°	39
2 h., 80°	11 h., 72°	16 h., 69°	20 h., 60°	40
2 h., 73°	4 h., 70°	—	—	41
2 h., 78°	5 h., 72°	14 h., 62°	17 h., 59°	42
2 h., 89°. Quite pliant	4 h., 84°	6 h., 80°	17 h., 60°; 20 h., 58°	43
2 h., 83°	5 h., 80°, and 4 h. pliant	6 h., 79°. Getting rigid	14 h., 67°; 18 h., 64°	44
2 h., 70°	11 h., 65°	15 h., 60°	—	45
2 h., 60°	4 h., 57°	7 h., 53°	10 h., 50°	46
2 h., 76°	4 h., 72°	7 h., 68°	10 h., 61°; 12 h., 58°	47
1 h., 82°	4 h., 78°	8 h., 72°	11 h., 68°; 21 h., 54°	48
1 h., 78°	10 h., 65°	12 h., 59°	—	49
1 h., 76°	4 h., 73°	6 h., 70°	9 h., 63°	50
2 h., 75°	4 h., 73°	—	—	51

No.	Date.	Name and Age.	Cause of Death.	Time of Death.	Temperature of Ward.
	1863				
52	Mar. 13	Mary Fennings, 19	Tubercular bronchial glands	2.30 p.m.	58°
53	" 14	Thomas Greenrod, 30	Melanotic cancer	8 a.m.	58°
54	" 20	John Boyd, 31	Fractured skull	1 a.m.	56°
55	—	Samuel Newton, 48	Scarlatinal nephritis	11.30 a.m.	54°
56	" 22	Ellen Holt, 19	Phthisis	6 p.m.	62°
57	—	Grace Whitmore, 73	Burn	1 a.m.	58°
58	—	William Barnes, 46	—	4 p.m.	62°
59	" 23	Sarah Edwards, 31	Empyema	1 a.m.	58°
60	" 24	James Bannon, 40	Cirrhosis of liver	7 p.m.	60°
61	—	Nancy Hoad, 74	Ovarian tumour	1.20 a.m.	62°
62	" 26	Thomas Snow, 67	Cancer of stomach. Very emaciated	11 a.m.	60°
63	" 27	Abraham Pepper, 41	Diseased spine and paralysis. Moderately wasted	11 a.m.	56°
64	—	William Osborn, 48	Bright's disease, and heart; dropsy	10 a.m.	68°
65	" 29	Richard Broughton, 70	Strangulated hernia; peritonitis	2 a.m.	58°
66	—	David Jones, 38	?	6 a.m.	60°
67	—	Robert Rotherwood, 11	Diseased heart; dropsy	11.15 a.m.	62°
68	April 5	Sarah Taylor, 20	Chronic bronchitis; dropsy	1.30 a.m.	58°
69	" 9	Edward Lloyd, 60	Erysipelas leg	2.30 a.m.	58°
70	" 10	George Harrod, 65	Diseased hand; pneumonia. Moderately wasted	2 a.m.	60°
71	" 12	Welby Sherwin, 51	Carbuncle; pyæmia	10.30 a.m.	60°
72	" 13	Rose Dunce, 27	Carcinoma breast. Wasted	1 a.m.	58°
73	" 14	Mary Parr, 34	Chronic dysentery. Much wasted	7 p.m.	64°
74	" 15	John Robertson, 42	Bronchitis; phthisis	4.30 a.m.	58°
75	—	Joseph Mallett, 4½	Diphtheria and croup	2.30 p.m.	65°
76	—	Thomas Good, 60	Enlarged prostate; diseased kidney	6.30 p.m.	58°
77	" 16	Rebecca Hillman, 39	Cirrhosis of liver; Bright's disease	4 a.m.	60°
78	—	Sarah Porter, 30	Puerperal phlegmasia dolens	12 noon	62°
79	" 23	Emma Everett, 46	Phthisis	12.15 a.m.	63°
80	" 24	Thomas Johnson, 60	Calculus bladder; kidney suppuration	6 a.m.	58°
81	May 1	Herbert Frost, 18	Tetanus, from wound arm	7.30 a.m.	58°
82	—	James Briffett, 22	Pneumonia or phthisis	10 p.m.	56°
83	" 2	John Hone, 63	Fractured leg. Amputation	7 a.m.	58°
84	—	Enoch Davis, 58	Tumour leg. Amputation	11 p.m.	58°
85	" 4	Augusta Aubery, 63	Fractured ribs	3 a.m.	58°
86	—	Elizabeth Barrett, 24	Typhoid fever	11 a.m.	67°
87	—	Thomas McDougell, 32	Cancer liver, &c.	11.30 a.m.	60°
88	" 5	Joseph Bowyer, 47	Cancer rectum, &c.	10 p.m.	62°
89	" 7	Thomas Letton, 13	Tetanus. Injured arm	6.45 a.m.	60°
90	" 10	George Williams, 43	Epilepsy, from diseased brain	4 a.m.	62°

First Observation, dating from time brought to Dead House.	Second Observation, dating from same time.	Third Observation, dating from same time.	Fourth Observation, dating from same time.	No.
2 h., 78°	7 h., 71°	10 h., 64°	17 h., 58°	52
2 h., 80°	4 h., 77°	5 h., 75°	7 h., 90°, in interior of body	53
2 h., 78°	4 h., 74°	7 h., 70°	17 h., 66°; 20 h., 64°	54
2 h., 80°	4 h., 78°	7 h., 74°	10 h., 70°; 20 h., 64°	55
2 h., 69°	4 h., 64°	13 h., 56°	15 h., 52°	56
2 h., 69°	4 h., 65°	7 h., 61°	9 h., 59°; 18 h., 57°	57
2 h., 78°	4 h., 74°	13 h., 69°	16 h., 66°	58
2 h., 70°	5 h., 66°	—	—	59
3 h., 80°	12 h., 73°	14 h., 71°	16 h., 70°	60
2 h., 78°	5 h., 75°	—	—	61
86°	2 h., 84°	4 h., 80°	6 h., 76°; 15 h., 62°	62
68°	2 h., 64°	4 h., 62°	6 h., 61°	63
88°	2 h., 87°	Post-mortem examination 29 hours after death. Rigidity almost gone	—	64
78°	2 h., 76°	5 h., 74°	9 h., 69°	65
80°	2 h., 78°	4 h., 76°	7 h., 70°	66
88°	2 h., 84°	4 h., 80°	7 h., 70°	67
70°	2 h., 68°	5 h., 66°	14 h., 60°	68
78°	2 h., 76°	4 h., 73°	7 h., 70°; 14 h., 64°	69
79°	2 h., 76°	5 h., 75°; internally 84°	—	70
78°	3 h., 72°	6 h., 70°	9 h., 68°; 19 h., 63°	71
86°	2 h., 84°	4 h., 82°	—	72
78°	3 h., 74°	12 h., 68°	15 h., 64°	73
82°	2 h., 80°	4 h., 76°	—	74
76°	2 h., 74°	4 h., 71°	7 h., 68°; 18 h., 60°	75
82°	3 h., 79°	12 h., 74°	15 h., 70°	76
86°	2 h., 84°	4 h., 82°	—	77
98°	2 h., 94°	—	—	78
76°	2 h., 74°	4 h., 73°	5 h., 76° (inside)	79
82°	2 h., 80°	5 h., 78°	7 h., rigid	80
78°	2 h., 76°	4 h., 72°	—	81
70°	2 h., 68°	4 h., 65°	—	82
84°	2 h., 80°	—	—	83
72°	2 h., 69°	—	—	84
80°. Pliant	2 h., 76°. Rigid	5 h., 73°	10 h., 68°	85
86°	2 h., 82°	6 h. Pliant	8 h., rigid	86
80°	3 h., 76°	4 h., 72°	11 h., 69°	87
85°	3 h., 82°	5 h., 80°. Pliant	7 h., rigid	88
86°	2 h., 84°	4 h., 82°	5 h., pliant; 8 h., rigid	89
84°	2 h., 82°; 4 h., pliant	5 h., 79°; 7 h., rigid	9 h., 76°; 14 h., 68°	90

No.	Date.	Name and Age.	Cause of Death.	Time of Death.	Temperature of Ward.	How long in How long in
91	1863 May 10	Emma Burrows, 22	Phthisis	8 a.m.	58°	11
92	—	James Riley, 21	Phthisis	11.30 a.m.	62°	77
93	„ 11	William Jones, 50	Diseased kidney	7.30 a.m.	64°	22
94	„ 17	John Godwin, 65	Fractured ribs; lacerated spleen; internal hæmorrhage	5.20 p.m.	58°	23
95	„ 22	Joseph Peart, 32	Inflammatory softening of spine	7 a.m.	60°	23
96	„ 26	William Ross, 29	Pyæmia, following operation	8 a.m.	58°	23
97	„ 29	Eliza Freeman, 50	Bright's disease	6 a.m.	60°	23
98	June 1	John Cooper, 35 (negro)	—	12 noon	59°	23
99	„ 3	William Mansell, 30	Tetanus	7 p.m.	59°	23
100	„ 7	Kate Arrowsmith, 50	Erysipelas and bronchitis	4 p.m.	59°	23

Dead House.	First Observation, dating from time brought to Dead House.	Second Observation, dating from same time.	Third Observation, dating from same time.	Fourth Observation, dating from same time.	No.
5°	80°	2 h., 78°	5 h., 74°; pliant; 7 h., rigid	9 h., 70°; 14 h., 64°	91
5°	78°	2 h., 75°	5 h., 72°; 7 h., rigid	14 h., 63°	92
5°	87°	2 h., 85°	4 h., 81°	5 h., pliant; 8 h., rigid	93
5°	84°	2 h., 82°	4 h., 80°; pliant; 6 h., rigid	13 h., 69°	94
5°	80°	2 h., 78°	4 h., 76°	6 h., pliant	95
5°	82°	2 h., 79°	4 h., 76°; 5 h., pliant; 7 h., rigid	9 h., 70°	96
5°	80°	2 h., 77°	4 h., 74°	5 h., pliant; 8 h., rigid	97
5°	79°	2 h., 76°	4 h., 73°	5 h., 68°; 6 h., pliant; 8 h., rigid	98
5°	82°	2 h., 80°; 5 h., pliant	12 h., 76°; rigid	—	99
5°	84°	2 h., 81°	4 h., 78°	15 h., 68°	100

A summary of the observations of the temperature of the dead body, recorded in this table, leads to the following conclusions. If the periods of time be divided, first, into those which are included between two and three hours; secondly, between four and five hours; thirdly, between six and eight hours; and fourthly, twelve hours, including one or two cases extending to fourteen hours; then we find that the results are as follows:

	First period, two to three hours	Second period, four to six hours	Third period, six to eight hours	Fourth period, twelve hours.
Number of observations	76	49	29	35
Maximum temperature of body	94°	86°	80°	79°
Minimum temperature of body	60°	62°	60°	56°
Average temperature	77°	74°	70°	69°

As the above periods date from the time at which the bodies were received at the dead-house, it is obvious that the temperatures above given are under rather than over stated. Thus in order to determine how long a period had elapsed since death, the time which the body remained in the ward, must be added to the time at which the observations were made. As this time varied greatly, we have found it impossible to include it in the calculations above given; but the facts show that the dead body cools slowly and progressively, and that, as a rule, the abdomen retains a considerable warmth for upwards of twelve hours after death.

This table illustrates some of those curious conditions which have been occasionally observed in the dead body, and which have as yet received no adequate explanation. In Case 1, of a man, aged fifty-three, who died from Bright's disease and erysipelas, in two hours the body had a temperature of 72°, but in four hours, it was 75°, having thus increased 3°, although the temperature of the dead-house was 42°. In six hours it had attained the same temperature (72°) which was observed after the lapse of two hours.

The long preservation of a high temperature in the interior of the body, is shown in several instances. Thus, in Case 4, when the body was inspected more than eighteen hours after death, the thermometer being 49° , the internal temperature of the viscera was 76° . In Case 26, more than seventeen hours after death, a thermometer placed in the body, indicated a temperature of 76° . In Case 30, the interior of the body examined seven hours after death, had a temperature of 84° . In Case 31, twenty hours after death, the temperature was 60° . In Case 32, examined ten hours after death, while the exterior of the body had a temperature of 67° , the interior was 85° ; and in Case 79, the internal temperature, fourteen hours after death, was 76° . This occasional increase and retention of temperature in the dead body, has led to doubts in certain cases respecting the reality of death, and has no doubt given rise to the absurd reports of the inspection of living bodies.

As the coverings of the body, at the time of death, have an influence on the rate of evolving, it may be stated, that the practice in the dead-house at Guy's Hospital is to place the body in an open shell. It is simply covered with a shirt, shift, or sheet; otherwise there is nothing to prevent or interfere with ordinary cooling by radiation.

On the Cooling of the human body after death.—One of the most striking characteristics of life is the power which the body has of retaining a temperature far above that of the medium in which it is ordinarily placed. Notwithstanding that the body is constantly subjected to the same laws of cooling as all other heated solids, *i. e.* by radiation, conduction, and convection, the supply of caloric internally is so constant and uniform as to counter-balance exactly the loss which is experienced. Some physiologists consider that animal heat depends entirely on the chemical changes produced by respiration; but it is probable that the nervous system plays an important part in its production. When, therefore, life is extinguished, the body will gradually lose the quantity of caloric which it possessed at the moment of death, just like so much inert organic matter artificially raised to the same temperature.

According to Dr. Symonds the mean time for the cooling of the dead human body is fifteen or twenty hours ('Cyc. Anat.

and Physiology,' Art. "Death"); but it will take place with varying degrees of rapidity, according to two orders of circumstances. 1. The manner or kind of death. 2. The physical conditions under which it is exposed.

1. Although the coldness of the adult body is rarely complete until after the lapse of *fifteen* hours from the cessation of life, yet it sometimes cools much more rapidly than this. Thus it may be found cold, even when death is occasioned by violence to an adult in a state of perfect health, in the short period of eight or nine hours, if the circumstances are favorable to the loss of heat. In the case of *Millie*, for the manslaughter of whom a man named *Bolam* was tried and convicted some years since, the body, although clothed, is reported to have been found cold about nine hours after death.

It is customary to judge of the degree of coldness by the sense of touch; but it must be remembered that the dead human skin is a good conductor of heat, and thus the surface may appear icy cold to a moderately warm hand. The condition of the hand itself may lead to an erroneous impression. If the two hands are of different temperatures, a recently dead body may appear cold to one and warm to the other. Another fact should also be borne in mind, that in the chest and abdomen the viscera may retain a well-marked warmth when the surface of the skin is actually cool or cold (see Case 32). The retention of heat may be better determined by applying a thermometer to the skin of the abdomen or of the flexures of the joints (as in the axillæ), or in the mouth, throat, or rectum. In the preceding table the first method of determining external temperature, has been selected for reasons elsewhere assigned.

When death has taken place suddenly, as from accident, apoplexy, or acute disease, a body has sometimes been observed to retain its heat for a long period. It is stated, upon the authority of Nysten, that the bodies of persons who have died from asphyxia by hanging, or suffocation, or from the inhalation of carbonic acid gas, do not cool, *cæteris paribus*, until from twenty-four to forty-eight hours after death; and that sometimes even *three days* have elapsed before the body had become completely cold. Too much importance must not be attached to this statement, since it is quite certain, from recorded facts,

that in some cases of fatal asphyxia, the body has cooled just as rapidly as in death from other causes.

According to Dr. W. B. Richardson, a loss of blood, as in cases of death from hæmorrhage, whether the blood is effused externally or internally, or even temporarily withdrawn from the heart as in syncope, is a cause of the rapid cooling of the body. He states that "the decline of the temperature in these cases is so great, that the external surface of the body may actually run down to that of the air without death" ('Medical Critic,' January, 1863, p. 31). The sudden cold of collapse observed on the surface of a living body is here confounded with the slow and progressive cooling of a dead body. But the cases which have been adduced in support of this view are exceptional instances of disease, and have no practical bearing on the question at issue, namely, the cooling of the body after the sudden death of healthy persons from wounds. Hence the conclusion drawn from them, "if the body is left dead from direct and absolute loss of blood, cooling to the temperature of the surrounding medium is completed, in regard to the external surface, in two hours," may lead to a serious error, and implicate an innocent person in a charge of murder.

It has been suggested that the coldness of the body as a result of disease, whether arising from malignant cholera, phthisis, or other chronic disease, or from death during the stage of collapse in poisoning, might create difficulty in reference to an opinion respecting the date of death. The bodies of persons who have died of these diseases have been found quite cold on the surface within *four* or *five* hours; at least, as cold as the bodies of healthy persons after the lapse of fifteen or twenty hours. In such cases, coldness of the body is commonly manifested before dissolution, in those parts which are the most exposed, as in the extremities of the hands and feet, the nose, and ears. Like all other diagnostic signs, when taken alone, coldness of the surface is open to this objection; but the obvious cause of death, and the emaciated state of the body, as well as the facts connected with the occurrence and disappearance of rigidity, even supposing that no history of the case could be obtained, would be sufficient to remove any doubt. The objection is of a speculative kind, and no instance has been adduced in which these morbid states have led to an erroneous medical opinion.

2. The physical circumstances which influence the cooling of a dead body are precisely those which influence the cooling of all heated inert bodies. 1. The medium in which it is immersed. A body will cool more rapidly in water than in air—a fact which may be important in a question of survivorship in drowning; and it will cool more rapidly in the open air than in a dwelling, on the floor than in bed, or under exposure to a current of air than in a warm, tranquil atmosphere. It will cool more rapidly in a large apartment than in one which is small. The dead human body cools, first, by radiation; second, by conduction; third, if naked and exposed, by convection: consequently its own mass, as well as the nature of the materials with which it is in contact, must modify the results. The body of an adult, *cæteris paribus*, cools more slowly than that of a child, or of an old person; and that of a fat or corpulent person cools with less rapidity than one which is lean and emaciated (p. 181). Again, when the dead human body is placed on good conducting substances, or is exposed to the open air in a naked state, the cooling process will be hastened. If, on the contrary, it is much covered with badly conducting materials, as cloth, flannel, or cotton, and is allowed to remain on a bed, it will require more than the usual period of time to become cold.

The dead body, like so much inert matter, continues to cool until it reaches the temperature of the medium (air or water) to which it is exposed. As the soft solids are not good conductors of heat, the inner parts of the body are much longer than the surface in acquiring the temperature of the surrounding air; and, for the same reason, when once cooled, it is long before they reach the temperature of the air, supposing this to have risen. Thus, if a dead body is cooled to 60° , and the air in the room suddenly increases in temperature to 80° , the viscera may be found to remain for some time at 60° . The dead body is not, therefore, like a minimum thermometer in marking a low temperature, but, like all dead flesh, its temperature rises and falls with the thermometer, although more slowly than other solids possessing better conducting powers.

Mere coldness of the body is not incompatible with a continuance of life; for many morbid causes may modify, or even altogether suspend the production of heat in the living subject. Thus, in syncope or hysteria, it is not unusual to meet with

extreme coldness of the surface ; but this differs from the coldness of death, in taking place over the whole body *suddenly*, and in even preceding the state of apparent lifelessness. It does not depend merely, as in death, on the slow and gradual loss of heat, because it is perceptible even when the body is placed in conditions under which a heated substance would not become cold. Besides, the interior of the body, as the rectum, or throat, will be found to have a higher temperature than the skin of the chest or abdomen. Let us take the opposite condition—Can the warmth of the human body be retained in its normal state for any length of time after death? We might suppose, *à priori*, that this question should be at once answered unhesitatingly in the negative ; but there are numerous authentic observations which show that heat may be sometimes long retained by the dead body, both on the surface as well as in the cavities ; and it has been noticed, in certain fatal diseases, that the temperature has actually risen in the body after death. This exceptional retention of heat has given rise to the erroneous suspicion that the person was still living, as in the following case, a report of which appeared in the ‘Lancet’ some years since :

A servant girl, who had retired to bed in apparently perfect health, was found the following morning, as it was supposed, dead. A surgeon who was sent for, pronounced her to be certainly dead, and stated that she had probably been so for some hours. A coroner’s inquest was summoned for four o’clock of the same day, to inquire into the cause of death ; and directions were given that a post-mortem inspection of the body should be made in the mean time. The reporter of the case was requested to give his assistance. Accompanied by the surgeon, who had been consulted, he went to the house about two o’clock, for the purpose of making the inspection. The deceased was found lying on the bed, in an easy posture, on her left side, her body forming somewhat of a semicircle. The countenance was pallid, but so perfectly placid and composed, as to give to her the appearance of being in a deep sleep. The heat of the body, although she must have been dead *eight or ten hours*, was not in the least diminished. The room was carefully searched, but nothing in the shape of poison, nor any other means of self-destruction, could be discovered :

every article of apparel lay around, as it might be supposed to have been left, by a person going to bed in perfect health as usual. The heat of the body not diminishing, a vein was opened, and various stimuli applied, but without producing any sign of resuscitation. Respiration and circulation had ceased; no artery could be felt pulsating in any part. Two hours had now elapsed since their arrival, and the parties still hesitated to perform the inspection, when a message was sent to them, stating that the jury were waiting for their evidence. The inspection was then commenced; but in moving the body for the purpose, the warmth and pliancy of the limbs were such as to suggest to the examiners that they were inspecting a living subject! The internal cavities were so warm that a copious steam issued from them when they were laid open. All the viscera were healthy, there were no signs of disease;—nothing appeared to account for death, and from what they saw the inspectors regretted that they had not postponed the examination until the signs of death had been more completely manifested! For obvious reasons, the name of the place where this extraordinary case occurred, and the name of the reporter, were suppressed. It is probable that a high temperature was retained by this body for a much longer period than usual after death. There were, however, two physical causes in operation, the influence of which does not seem to have been sufficiently appreciated. The girl died suddenly while in a state of perfect health and vigour; and until the time of inspection, the body appears to have remained in bed closely covered by badly conducting materials; *i. e.* the bed-clothes. The temperature of the room in which the body was found, is not stated; but as the month was October, it was probably not low. The temperature of the surface or of the internal organs was not measured by a thermometer. Although there can be no doubt that this girl was really dead, yet, as a rule, no medical man is justified in making an inspection of a body until after the signs of death (coldness and rigidity) have been clearly manifested. Respiration and circulation had ceased, and no pulsation could be felt in the heart or arteries; the body had been in this state for at least eight hours; hence it is evident that this was not a case of apparent death; the examiners were simply deceived by an unusual retention of heat. Among various cases

observed at Guy's Hospital, and recorded in the preceding table, there is one (No. 26) in which a thermometer placed in the midst of the viscera indicated, in a really dead body, a temperature of 76° more than seventeen hours after death, at a period of the year when the temperature was low (38°).

Doubts were entertained for several days respecting the death of the well-known Professor Dieffenbach, of Berlin. The unusual retention of heat, and the delay of the putrefactive process, led to the supposition that he was only in a state of apparent death. Dr. Symonds relates that the Abbé Prevost having been struck with apoplexy in the forest of Chantilly was taken home for dead, but recovered his consciousness under the scalpel, and died immediately afterwards. ('Cyclo. Anat. and Physiology,' Art. "Death.")

It is scarcely to be imagined that the production of heat should continue in a really dead body; and yet certain facts connected with the malignant cholera, yellow fever, and some other diseases, appear to establish the possibility of this. In some cases of death from malignant cholera, when epidemic in this country, in 1832-3, the body which had become moderately cold, was observed suddenly to resume its warmth, so that the temperature is stated to have risen some time after death as high as 87° , although circulation and respiration had entirely ceased. This singular phenomenon, like numerous others connected with that disease, has received no adequate explanation. The death of the persons may have been only apparent and not real; and possibly, a sudden reaction and distribution of blood through the capillary system, may have given rise to the effect observed. The fact of its occurrence must be taken as positive evidence of some latent vital power or chemical force still lingering about the circulating system; for in real death, the animal body, when it has once become cold, is no more capable of spontaneously generating heat within itself, than any of the inert and lifeless solids by which it is surrounded.

In a case of death from Asiatic cholera, Mr. Rumsey observed that half an hour after the complete cessation of respiration and circulation, the muscles of the arms underwent spontaneously various motions of contraction and relaxation, continuing for upwards of an hour, and that although previously cold, they

then became evidently warmer. The restoration of warmth after the body has become cold in such cases, can only be explained by supposing that there still remains about it some lingering trace of vital action; although this may not be indicated by the presence of the ordinary signs of active life. The facts connected with the production of heat in the dead body, have not received much attention from physiologists.

There is considerable discrepancy concerning the natural temperature of the *living* body. The average temperature of the interior of the body in health, varies from 98° to 100° . It is liable to be increased in some diseases, and to be diminished in others. In one case of typhoid fever, M. Piorry states that he found the blood to have a temperature of 113° ; and the temperature of the uterus during parturition, is said to have been found still higher.

Dr. John Davy met with some extraordinarily high temperatures in the *dead* body. In a case of rheumatism, after the viscera had been exposed for nearly ten minutes, the mercury of a thermometer, placed under the left ventricle, rose to 113° , and when in contact with the lobulus Spigelii of the liver to 112° . In a second subject, examined *six hours* after death, the thermometer under the left ventricle indicated a temperature of 108° , and when in contact with the lobulus Spigelii 107° . In these cases, the patients were ill but a short time, and died suddenly; and the temperature of the apartment in which the observations were made, was 86° . This increase of temperature after death has been referred to putrefaction; but Dr. Dowler has shown that it takes place soon after death, and before rigidity sets in. Some of the cases reported in the preceding table (Cases 4, 26, and 30), also show that it may take place independently of putrefaction. Dr. Dowler has called this condition, post-mortem caloricity; he has noticed it as a common occurrence, in a warm climate, in the bodies of persons who have died from yellow fever. The heat of the body, according to him, continues to increase for several hours after death; and in one case, after six hours, he found the axilla to have a temperature of 100° , and the abdomen, of 103° . In another, the temperature of the axilla during life being 100° , it was found that in three hours after death, the temperature of this part had risen to 104° ; in a third case, a

similar increase was observed in thirty minutes. The highest post-mortem temperatures were observed in the thighs. Thus in a case in which the axilla had during life a temperature of 104° ; in ten minutes after death it indicated a temperature of 109° , and in fifteen minutes after death, the thigh gave a temperature of 113° . When the maximum, which is variable in different bodies, has been attained, the body gradually undergoes the cooling process observed after death, and according to Dr. Dowler, this generally commences with the head. ('*Phil. Med. Examiner*,' Oct. and Nov., 1845, pp. 625 and 359.) In death from malignant cholera, he found that the dead body reached its maximum temperature of 109° in about an hour and a half. Dr. Hensley has published, in the same journal, a series of cases in old and young persons, who had died from different causes; these do not show a similar increase of heat, but they prove that after thirty hours, the dead body may retain a temperature two or three degrees above that of the room (March, 1846, p. 151).

These observations, corroborated as they are, to some extent, by others reported in the table, may serve to explain facts similar to those observed in the case of supposed premature inspection just now related, for they show that in some exceptional instances, a really dead body may retain for some hours a temperature as high, or higher, than that which is usually found in the living.

Dr. Dowler considers that the gradual loss of heat in the interior of the body, as determined by a thermometer, furnishes the best test to establish the reality of death. The living body maintains a uniform temperature, independently of that of the surrounding medium; but a dead body, like other inert matter, is governed in its temperature by purely physical conditions, "heating and being heated, receiving and radiating caloric. This is not the result of speculation, but of prolonged and varied experimental research." ('*Phil. Med. Examiner*,' Oct. 1850, p. 606.)

It may be observed that in temperate climates, the signs of death would be sufficiently well marked by the progressive cooling and rigidity of the body, before the application of the thermometrical test to the interior could be made; hence, although it may furnish information that death has certainly

taken place, a medical examiner could come to a safe conclusion without it. The occasional existence of post-mortem calorificity offers no objection to it, since cooling sooner or later follows this condition, as a result of ordinary physical causes. The coldness of the living body in cholera, congelation, hysteria, &c., is a physiological condition, and not the result of physical cooling. If death takes place, the coldness may continue, or the body may again become warm. In either case it passes ultimately, by physical cooling, to the temperature of the medium.

The changes which take place in a dead body before the commencement of putrefaction, may, if accurately observed, enable a medical witness to form an opinion of the time at which the deceased died. The dead body of a person may be found in a house with marks of murderous violence upon it; the crime may have been so recently perpetrated, that the body still retains the warmth and pliancy observed in the recently dead, or it may be found in a cold and rigid state. A person charged with the murder may be able to prove, that he had not been in the house for many hours, or days; or evidence may be adduced to show that he was there at a time which would correspond to the condition of the body when found. In cases of sudden death from violence, or suspected poisoning, a medical man, by observing the state of the body, may frequently form a judgment of the time at which death occurred, and, therefore, of the period at which poison was taken by deceased, or violence was inflicted on the body.

In the following case of murder and suicide, the murderer was clearly pointed out by the difference in the condition of the two dead bodies when they were first discovered. In March, 1836, a man and his wife were found dead in bed, and their bodies were covered with blood, from wounds inflicted on both. In the case of the woman there was a deep incision in the throat, besides a wound under the chin, and another on the side of the head. The man's throat was also severely cut; the razor with which the wounds had been inflicted, was found on the bed, within a short distance of his right hand, as if, in the last act of life, he had endeavoured to throw the weapon from him, but had failed in the attempt. The body of the woman was cold and rigid, that of the man was warm. The

nature and direction of the wounds, and the marks of violence on the woman's person, were such as to render it probable that she had not committed suicide; and the condition of her body showed that she had been dead many hours. On the other hand, the wound in the man's throat was such, that he could not have long survived its infliction; and as his body, when found, was warm and pliant, it was a reasonable inference that the wife had died first, and from wounds inflicted by her husband, as no other person had access to the house. If the body of the wife had been found warm, while that of the husband was cold and rigid, the inference of his having been her murderer (the wound in her throat being of a nature to produce instant or very speedy death) could not have been sustained. In forming a judgment of priority of death in such cases, the sufficiency of the wound to produce instant or rapid death must always be taken into consideration. A person may inflict on another a slight wound, which may prove fatal by hæmorrhage only after some hours, while he may afterwards inflict upon himself a wound which would instantly destroy life. In such a case, the body of a murderer would be found cold, while that of the victim, by reason of the death being more recent, would be warm. In the case of a female who was found dead in her apartment, with her throat cut, in November, 1847, it was ascertained that, when first discovered, the body was so warm as to render it highly probable that the crime must have been committed within an hour. This observation tended to prove the innocence of a party who was suspected of the murder, because it was known that he had been absent from the house for at least five hours.

In the following case, which is a type of many, the theory of suicide was sustained, and that of homicide completely rebutted, by a medical inference from the condition of the body. In August, 1830, the Prince de Condè, or Duke of Bourbon, was found dead in his bedroom, in the Château of St. Leu. When discovered, at 8 o'clock in the morning, the deceased was found partly undressed, hanging by his cravat to one of the window-shutters. The body was cold, and the lower extremities were quite rigid. As in asphyxia from hanging, the warmth of the body is usually preserved longer than under common circumstances, *i. e.*, from twelve to fifteen hours, before

which period rigidity is seldom complete, the medical examiners inferred that the deceased must have died very soon after he had retired to his bedroom on the previous night. As this was proved to have been 10 o'clock, it followed that only ten hours had elapsed—a short time for cooling and rigidity to have taken place. It was thus rendered medically probable that the hanging took place soon after the deceased entered his bedroom. It was alleged that the duke had been murdered, and his body afterwards suspended by his murderers to create the suspicion of suicide. The condition of the body, among other circumstances, was, however, adverse to this presumption. From 10 until 12 o'clock at night, it was proved that there were numerous attendants moving about, near to the duke's apartments. These persons must have heard any unusual noise, which the duke would probably have made in resisting his assailants. But no noise was heard in the apartment at that or any other time, and the presumption of this being an act of homicide was therefore strongly rebutted. Had the body been found warm and pliant, and the joints flexible, the inference would have been that the deceased had died more recently, and therefore at a time when murder might have been perpetrated without attracting the observation of his attendants. As it was, the coldness and rigidity of the body justified the medical opinion expressed, and tended to prove that this was really an act of suicide.

Criminals sometimes unknowingly furnish important evidence in reference to the condition of the dead body. At the Lewes Autumn Assizes, 1860, a schoolmaster named *Hopley* was convicted of flogging a pupil to death. There was reason to believe that the boy had died during the actual beating. The accused stated before the coroner that he went into deceased's bedroom about six o'clock in the morning, and found deceased dead, his body cold, and his arms stiffening. He suggested that he might have died from natural causes. It was proved that the prisoner was heard in the act of beating deceased up to 11.30 on the previous night, and as the body was cold when found, and rigidity was commencing, there was a strong probability that deceased must have been dead at least six or seven hours, and, therefore, at a time when the prisoner was last known to be with him. The body was well developed, co-

vered with bed-clothes, and the temperature not at the time low.

In the case of *Doidge* (Bodmin Aut. Ass., 1862), who was charged with the murder of a man, medical evidence derived from the state of the body of deceased when found, tended materially to corroborate the circumstantial evidence against the prisoner. The deceased was last seen alive at 10.30 p.m., on the night of the 7th June, 1862. He was found the next morning, about 9.30 a.m., dead in his house; he was lying on his face with his clothes on—one arm under the chest and the other by his side. He had received, on the back of the head, some severe blows, which must have proved speedily fatal. The body when found was quite cold, and the members were rigid. It was considered by Mr. Thompson, who saw the body, and myself, that deceased under these circumstances had been dead from eight to ten hours. There was no doubt that this was an act of murder, and that the deceased had been killed while taking off his boots to go to bed. The prisoner was connected with the act by a chain of circumstances. He was seen drinking and conversing on friendly terms with deceased at a beer-shop the evening before. Prisoner left the shop at a quarter-past ten, and deceased at half-past ten. They both lived near to the shop, and to each other. A neighbour of deceased's, who was out as late as twelve o'clock, heard at that time the voices of two persons in conversation in deceased's kitchen. One of them he recognised as that of deceased, and the other as the voice of the prisoner, with which he was well acquainted. This witness heard the voices for some minutes, returned into his house, and went to bed. He was soon afterwards suddenly awakened by a noise like that of a heavy fall proceeding from deceased's kitchen, in which the dead body was afterwards found. His evidence was corroborated by that of his wife, hence it is clear that deceased was alive for some time after twelve o'clock that night. It was further proved that, contrary to his usual practice, the prisoner did not return home to his lodging until one o'clock in the morning; and then, in order to account for his return at so late an hour, he made a statement which was proved to be untrue. The coldness and rigidity of the body, therefore, when discovered at 9.30 a.m., considering the season of the year, and the circumstance that

deceased was in his clothes, were facts in themselves quite consistent with the occurrence of death soon after twelve o'clock at night, or about the time when a heavy fall was heard by the neighbour. Other circumstances, which were proved, left no reasonable doubt of the prisoner's guilt, and he was convicted.

Perhaps no case has brought the importance of questions of this nature so prominently before the public as that of *Gardner*, a chimney-sweep, who was tried and convicted of the murder of his wife, at the Central Criminal Court, in October, 1862.

The prisoner lived with his wife and another woman named *Humbler*. The wife was found dead in her bedroom with wounds in her throat, at eight o'clock in the morning of the 15th September, 1862. The nature and direction of the wounds, the position of the body, and of the weapon, as well as other circumstances, conclusively proved that this was an act of murder; and as there were no persons in the house at the time of the occurrence excepting the woman *Humbler* (the servant) and the prisoner *Gardner*, it followed that one or both must have been concerned in the act. *Gardner* accused the servant, *Humbler*, of having perpetrated the murder during his absence from home; but as there was no evidence against this woman, he alone was subsequently called upon to answer the charge. The facts, as they bear upon the question which we are now considering, are very simple. Mr. *Sequeira* saw the body of deceased, a healthy well-developed woman, æt. 37, at eight o'clock in the morning. Her body was found lying on a wooden floor covered with a flannel petticoat and a chemise. The upper limbs were cold and rigid; the face, shoulders, and chest were cold; the neck was so rigidly fixed with the trunk, that the entire body was lifted up with it when the head and neck were raised; the thighs and legs were quite cold, but there was no rigidity in these parts. The only warmth found about the body was in the lower part of the abdomen; and this obviously arose from the contents of the uterus, the deceased being in the seventh month of pregnancy. The opinion given by Mr. *Sequeira* regarding the time of death, before its exact bearing on the guilt of the prisoner could have been known, was that the deceased had been dead *above four hours*,—certainly more than three, and that she could not have been dead

so short a time as two or three hours when he first saw the body. This opinion was corroborated at the trial by another medical witness, Mr. Comley, this gentleman affirming that, considering the general coldness of the body, the deceased when seen at eight o'clock, had been dead above, rather than under four hours. There was a severe wound on the throat involving the superior thyroideal artery and other vessels. From this, about two pints of blood had flowed on each side of the neck on the floor. The larynx had been laid open between the thyroid and cricoid cartilages. Blood had flowed into the windpipe through this aperture, and had thus, by obstructing respiration, produced death by asphyxia.

Without going into all those circumstances which tended to fix this crime beyond any reasonable doubt upon the man Gardner, it may be sufficient to state that the defence turned principally upon the condition of the dead body when found. It was proved that from four to eight o'clock in the morning, *i. e.* for about four hours, the prisoner was absent from home, following his usual occupation as a chimney-sweep. It was contended by his counsel that within this short period the body might have become cold and rigid as it was found, and, therefore, that the murder had been perpetrated by some one during his absence. On this theory the woman Humbler alone was guilty. The facts proved at the trial were, however, considered by the jury to be quite inconsistent with the innocence of the prisoner, and he was convicted of the crime. The commutation of the sentence to penal servitude for life is a clear proof that the authorities did not believe that the man was innocent.

The opinions given by the medical witnesses at the trial, regarding the inference derivable from the state of the dead body, were reasonable, and in accordance with scientific observations. In assigning *four hours* for the almost entire cooling and commencement of rigidity in the dead body of a woman suddenly dying in the prime of life, the body not being exposed to any specially cooling influences, it is obvious that they could not be charged with overstating, but rather with understating, the period of time required. Considering that death had taken place by asphyxia, if they had assigned six or eight hours, it would have been only consistent with ordinary

experience. It is, indeed, more probable that this time had actually elapsed, and that the woman had died in from two to four hours before the male prisoner had left the house, than that her body, under the circumstances proved, had become cold and partially rigid in less than four hours. Irrelevant experiments on animals and theoretical speculations of an *ex post facto* kind, advanced for a particular object after a conviction for murder, should not be allowed to weigh against opinions deliberately formed and expressed by professional eye-witnesses, who, by their evidence on oath, could have had no intention to exculpate one person, or to inculcate another. As this was clearly a case of murder, and one of two persons must have perpetrated it, the more the charge was removed from the man, against whom there was strong circumstantial evidence, the more completely it was fixed upon the woman Humbler, against whom there was nothing but an extemporised medical speculation, that a body dead from asphyxia, not, as it was erroneously assumed, from loss of blood, might become cold and rigid in less than four hours. Had this medical speculation been adopted as true, and acted on *bonâ fide*, it would have exculpated the man, and have led to the conviction and execution of the woman. By reference to the table at page 192, it will be perceived that the average temperature of the dead body, four to five hours after reception into the dead-house, as observed in forty-nine cases, was 74° . In addition to this, there was in this instance a state of rigidity of the trunk and upper limbs not commonly found at so early a period after death. In addition, it will be easy to show that this medical speculation is opposed to the observations of physiologists, who have really studied the changes which take place in the dead body.

As cadaveric rigidity had commenced in the upper part of the body of the deceased when it was first discovered, we may take this as a point of comparison with the actual observations of Nysten and Brown-Séquard. According to Nysten, in cases in which death took place suddenly in healthy persons, either from asphyxia or as a result of hæmorrhage, cadaveric rigidity did not commonly appear until sixteen or eighteen hours after death, and sometimes lasted six or seven days. Brown-Séquard states that in the bodies of healthy persons

decapitated or asphyxiated, cadaveric rigidity did not appear sooner than ten or twelve hours after death ('Proc. Royal Society,' 1861, No. 44, p. 211). Considering these facts, and the circumstances under which this body was found, the assignment of a period of six or eight hours would have been quite within the limits of experience and observation. It has been asserted that death by hæmorrhage, all other circumstances being equal, accelerates the cooling of a body and the access of cadaveric rigidity. This assertion has been made upon cases which have no similarity in their details. The cause of the death of Mrs. Gardner, according to the medical witnesses, was not hæmorrhage, but asphyxia. Admitting that two pounds of blood had been lost, this admission does not affect the medical opinions given at the trial, which were consistent with ordinary experience, and with the other facts proved in the case.

The case of *Jesse McPherson*, for the murder of whom a woman named *McLachlan* was tried at the Glasgow Autumn Circuit, 1862, furnishes an additional proof of the correctness of these views in reference to the bodies of persons found dead from loss of blood. Dr. G. Macleod saw the body of deceased on the night of the 7th July, when it was first discovered. The mean temperature of the air on that day had been 50°. "The rigor mortis was present in all the articulations, but it was then departing. The body was perfectly cold, even on the abdomen, and at the flexures of the joints. On the following day, at 10 a.m., the rigidity had gone from all the joints excepting the knees and ankles. There were no signs of decomposition, and the temperature was very cool, unusually so for the season. The room in which the body had lain was well ventilated, but without a draught. It was below the level of the street, and the body lay on a wooden floor, and was partially covered. Further, death had resulted from violence; it had been attended with profuse hæmorrhage, and the victim was free from disease, in the prime of life (aged 35), and of a thin, wiry frame." Dr. Macleod, considering that the rigor mortis commonly appears in from ten hours to three days after death, and that in sudden death from violence it is only slowly developed, thought it most probable that forty-eight hours after death (at the longest) would represent the time when rigidity

would appear. "The more rapidly it is developed, the sooner it disappears, and *vice versa*. The average period of its disappearance is from twenty-four to thirty-six hours. In the case under review, resting on the same considerations as influenced the opinion formed of the time of the establishment of the stiffening, it was thought that about thirty hours would probably represent the period of the continuance of the rigidity; and by summing these periods—forty-eight and thirty—together, the conclusion was arrived at that about *three days* had probably intervened since death; and it will be remembered that it was afterwards proved that this was, as nearly as could be, the time which had passed between death and the examination of the body."

"Putrefaction appears on an average under a mean temperature in from three to six days. It is influenced by many circumstances, of which the heat and moisture of the surrounding atmosphere, the obesity and age of the person, the cause of death, the position, and coverings of the body, are the chief. In the case of McPherson there was no appearance of decomposition. The cool atmosphere, thin body drained of its blood, the middle age, and thin covering, all opposed its development" ('Account of the Medical Evidence at the Trial of Jessie McLachlan, by G. H. Macleod, M.D.' Glasgow, 1862, p. 8). This medical opinion, formed from the state of the body, tended to confirm that part of the prisoner's story which related to the time of death.

On these occasions, unless we have a due regard to all the circumstances of a case, great errors may be committed. We may assign a period for death which is inconsistent with the proved facts, and thus give impunity to murderers. Ollivier and Devergie were once required to examine a medical report by two physicians, in which they stated that they had found the deceased, a woman, aged sixty, dead in her apartment from strangulation. When the body was found it was lying on the floor, clothed in her usual dress of cotton and flannel, in a state of cadaveric rigidity, with general lividity of the surface of the skin. It was cold, with the exception of a slight warmth which remained in the abdominal viscera when the inspection was made. ("Les viscères renfermés dans la cavité abdominale, ne nous paraissent pas dans un état de

refroidissement complet.") From these data the inspectors came to the conclusion that deceased had not been dead more than from fifteen to twenty hours before the time at which they saw the body. This would have fixed the date of the murderous assault at one o'clock p.m. on the 6th of March, whereas the general evidence tended to show that the crime must have been committed on the night of the 4th or of the 5th March.

Considering that the woman had died from asphyxia, in which case warmth is usually retained, that her body was well clothed, and yet rigid and cold, with the exception of a doubtful trace of warmth in the abdominal viscera, Ollivier and Devergie came to the conclusion that the woman must have been dead for a longer period than fifteen or twenty hours: and, without defining the precise time, which, under the circumstances, was not necessary, they affirmed that there was no medical ground on which such a restriction of the period of death was justifiable. They contended that cadaveric rigidity, when once established, might remain two, three, or four days, according to the season of the year, and other circumstances, and that when it existed, there was no rule by which it could be determined whether the body had been in this state for two or three hours or two or three days (*'Annales d'Hyg.,'* 1833, i, 212). The retention of warmth by the abdominal viscera may be met with after fifteen to twenty hours, in a much more marked degree than in this instance. In one case, already referred to in the table (No. 26), the temperature of the viscera of the abdomen, more than seventeen hours after death, was found to be 76° , although no care had been taken to preserve the warmth of the body.

The observations in this paper have been chiefly confined to the facts connected with the cooling of the dead body. It will be perceived in the table that the subject of rigidity as to its period of access and duration, has been incidentally noticed only in a few cases. At a future time the phenomena connected with rigor mortis may receive elucidation from a further collection of cases.

relaxation of the muscles. From these data the inspectors came to the conclusion that the body had been dead more than three hours before the time at which they saw the body. This would have fixed the date of the murder at not less than one o'clock p.m. on the 6th of March, whereas the general evidence tended to show that the crime must have been committed on the night of the 5th or of the 6th.

Consequently that the woman had died from asphyxia in which case rapidly, namely, within a few minutes, the body would have been cold, and the exception of a doubtful trace of warmth in the abdominal cavity, Officer and Doctor, in coming to the conclusion that the woman must have been dead for a longer period than three or four hours, and without meaning the person that, within the time, no traces were not necessary, they affirmed that there was no medical ground on which such a restriction of the period of death was justifiable. They considered that certainly, within three or four days, the body would remain in a state of decomposition, and that when it was found, there was no rule by which it could be determined whether the body had been in this state for two or three hours or two or three days. (Annals of Hyg., 1881, 1, 215.) The retention of warmth by the abdominal cavity may be met with after death in twenty hours, in a much more marked degree than in the instance. In one case, given in the report on the subject of the temperature of the body after death, the temperature of the abdomen was found to be 70°, although no heat had been taken to prevent the warmth of the body.

The observations in this paper have been chiefly confined to the facts connected with the cooling of the dead body. It will be perceived in this table that the subject of rigidity as to its period of occurrence and duration has been incidentally noticed only in a few cases. It is a fact that the phenomenon connected with rigor mortis may receive illustration from a further collection of cases.