Pathological researches on death from suffocation and from syncope, and on vital and post-mortem burning : suggested by the case of the alleged Bridgnorth matricide / by Samuel Wright.

PATHOLOGICAL RESEARCHES

ON

DEATH FROM SUFFOCATION AND FROM SYNCOPE;

AND ON

VITAL AND POST-MORTEM BURNING.

SUGGESTED BY THE CASE OF THE ALLEGED BRIDGNORTH MATRICIDE.

BY

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The *Medical Times* of August 18th, 1849, p. 147, in giving an abstract of the trial of Mercy Catherine Newton, the alleged Bridgnorth matricide, observes, that it is "perhaps the most extraordinary of its kind in the annals of English judicature."

In that opinion, all who are intimate with the details of this remarkable case, will no doubt fully concur.

It happened to myself, in conjunction with my colleague, Mr. Bolton, to be summoned on the part of the Crown, to give testimony based upon the evidence of the surgeons who had examined the body of the woman supposed to have been murdered. The internal appearances of any note, were stated to be—marked congestion of the brain; excessive congestion of the lungs, which were unusually dark, and spumous wherever incised; and complete engorgement of the right cavities of the heart with black semi-coagulated blood. Externally, there were signs of burning, variously severe, over a considerable portion of the trunk, limbs, and face: in some places, these were simply scorched brown; in others, burnt to blackness; but in no part whatever, could the least trace of redness be

detected. There was a small blister containing what was suspected to be serum, on the inner side of the right leg, about four inches above the ankle, but neither around nor beneath this blister was there the slightest mark of redness.

The body was discovered lying in an out-house, a few yards from the kitchen door, and was supposed to have been dead some two or three hours. The burning had occurred in the kitchen.

The medico-legal questions involved were—What was the cause of death? and, Were the burns vital, or post-mortem?

It having been affirmed that the deceased was in her usual good health three or four hours prior to the finding of her remains, I expressed my belief that she had died of suffocation, and that the burning was post-mortem. In this opinion Mr. Bolton entirely agreed.

The learned counsel for the defence,[a] exercised a laudable ingenuity and ability in endeavouring to furnish substantive exceptions to the pathological data upon which the above opinions were based; and it is but due to them to say, that had their veritable province been medical instead of legal, they could scarcely have displayed more scientific acuteness or judgment.

In the process of cross-examination, I was more than once obliged to advance an opinion at variance with that of a reputable authority;[b] but in so doing, I was simply expressing the results of my own experience, and reasoning, and research. These only was I called upon to give—and in endeavouring to give them faithfully and without fear, I was impressed with the conviction, that, to be influenced, in any degree, by the opposite views of an author however distinguished, would

(a) Mr. Huddlestone and Mr. Kettle. Mr. Whitmore and Mr. Phillimore conducted the prosecution.

(b) Dupuytren.

be to fulfil, only in part, the obligation which an oath required me to answer to the best of my individual ability.

It occurred to me, subsequently to the last trial,[c] that the questions at issue might be of sufficient interest to the profession to merit further investigation. That possibly some new fact, important to pathology, might be elicited: or, in the absence of this *desideratum*, that the opinions of various writers might be collected, and arranged for the convenience of those who should not chance to enjoy the advantages of a library of reference. And this seemed to be the more desirable, inasmuch as none of our standard works on pathology give, in sufficient detail, the relative morbid appearances which indicate varieties of sudden death.

Under this belief I have prosecuted my inquiries of experiment and research, in so far as leisure from more active and onerous duties has permitted me. The results are contained in the following pages: and it is simply in the hope of not writing altogether in vain, that the observations and references herein embodied are strung together.

It were unnecessary to say that, towards the prisoner or the prosecution I have no prejudiced feeling whatever: it concerns not me whether she be innocent or guilty. I was merely summoned upon her trial as a scientific witness, and in that character only, I obeyed my mandate. The melancholy cause of it will not be again alluded to, nor indeed would any mention thereof have been made at all, except that I felt bound to say from what occasion I had derived the inducement to my inquiries.

(c) The prisoner was first tried at Shrewsbury, in March, 1849, before Mr. Justice Coltman; and again, in July of the same year, before Mr. Baron Rolfe. On each occasion the jury were discharged, because unable to agree to a verdict. There had previously been nine several coroner's jury sittings, without a verdict being obtained.

I shall endeavour, in my remarks, to speak as impersonally as I can; for my object is rather to communicate or to elicit truth, than to place myself in polemic opposition to those whose reputation is deservedly better than my own. If this intention shall be fulfilled, my best wishes will be answered.

I cannot forego the pleasure of expressing my thanks to my colleague, Professor Knowles; to my excellent clinical clerk, Mr. Ellis; to Dr. Stewart, Mr. Moore, and Mr. Mason, for the kind assistance they afforded me in my experiments; and to Mr. Frederick Lines, who has placed me under much obligation for the faithful illustrations which accompany these pages.

I.

MORBID APPEARANCES AFTER DEATH FROM SUFFOCATION.

Suffocation is the result of arrested respiration. It may occur in a variety of ways, as by hanging, drowning, spasm, and œdema, of the glottis, impaction of a foreign body therein,[d] spasm of the muscles of the chest, &c.:[e] but whatever the cause of it, the phenomena are pretty much the same, and the post-mortem appearances little dissimilar. These *united* appearances do not materially correspond with those which indicate death from any other cause than suffocation. They chiefly consist in fulness of the vessels of the brain—congestion of the lungs, which are much darker than usual, turgid,[f] pouring out frothy blood when incised—and complete engorgement of the right cavities of the heart.

Of these several conditions, the last is the most constant and obvious.[g] I have invariably remarked it in the instances, not few, of examining bodies that

(*d*) I have a pellet of tough mucous in my possession, which was found in the *rima glottidis* of an old woman, who, in a violent fit of coughing, suddenly threw back her head, struggled convulsively, and in a few seconds expired. She was literally suffocated with her own phlegm, less than a drachm in weight! An instance of suffocation by a bit of potato-skin, that had been swallowed the day before, is recorded by Dr. Jackson.—Ed. *Med. and Sur. Journ.*, April, 1844, p. 390.

(*e*) Certain affections of the respiratory organs, as pneumonia, bronchitis, congestion, œdema, and apoplexy, of the lungs, sometimes occasion death by suffocation.

(*f*) Turgescence of the lungs is less marked after drowning than after strangulation. In the process of the former, air can be discharged from the lungs, but not admitted into them: in that of the latter, neither can happen.

(*g*) In the case of the woman Campbell, murdered by Burke, Dr. Christison found black fluid blood "accumulated in the right cavities of the heart and great veins," and "a little more turgescence of the vessels of the brain than usual," although the lungs had a natural aspect, and were unusually free of infiltration."—Ed. *Med. and Sur. Journ.*, vol. xxxi, p. 329. Mr. Taylor refers to the cases of four men who died, most probably from suffocation, by having shut themselves up in the forecastle of a coal brig. In one of them "the lungs showed no congestion, but the right cavities of the heart were much distended with blood."—*On Poisons*, p. 803.

have died of one or other form of suffocation. Of course it is not to be relied upon singly: an interruption to the passage of blood along the pulmonary artery, or its immediate branches, would occasion corresponding accumulation in the right cavities of the heart: and if the interruption were complete and persistent, death would occur in the same space of time as in suffocation, and, the lungs excepted, would leave similar morbid appearances. The vessels of the brain would be turgid, and the right side of the heart completely filled with black blood, but the lungs would be paler and less distended than natural. I have several times produced these conditions by putting a ligature round the pulmonary artery of a dog. In such case, death results from the right side of the heart standing still upon its contents—it has become filled to fulness, and can act no longer. If an incision be made, and blood allowed to escape, the contractions will be renewed as the mechanical obstruction is lessened. This is precisely the condition that obtains in death from suffocation, except that the interruption to the passage of blood is in the capillaries of the lungs, instead of in the pulmonary artery alone. The capillary circulation, however, is not absolutely at rest, for it may be seen slowly continuing some time after death. The right side of the heart becomes loaded, because the circulation through the lungs is not rapid enough to enable them to receive the blood which it would fain transmit.[h]

Neither has the retarded circulation through the brain, nor the presence of black blood in its arteries, any direct share in causing death in suffocation. An animal will live a long time with both its internal and external jugulars tied. Of a series of experiments which I performed ten years ago,[i] the following was one.

Each of the common carotid arteries, of a strong healthy dog, was secured with a ligature. The left internal jugular vein was then opened, and the animal instantly plunged under water. Life was extinct in two minutes and forty seconds. The post-mortem appearances were, congestion of the lungs, and complete distension of the right cavities of the heart, with black blood: the substance of the brain was paler than usual, and its large vessels, and sinuses, only moderately filled.

In this instance, not only was half the cerebral circulation arrested by tying

(*h*) Some of Dr. Kay's *Experiments*, especially the 15th and 16th, are excellently illustrative of this fact."—*On Asphyxia*, p. 162.

(*i*) *Prize Essay on Asphyxia from Submersion.*—Vide Traill's *Medical Jurisprudence*, 2nd edition, p. 78.

the carotid arteries, but the possibility of venous congestion was further prevented by the opening in the internal jugular. That these precautions were effective, the state of the brain sufficiently testified: yet, the phenomena and duration of dying, and the appearances, after death, in the heart and lungs, were exactly what are observable in ordinary suffocation.

This form of experiment was several times repeated, and always with similar results.

From personal experience, not inconsiderable upon this subject; from conversation and correspondence with professional friends and acquaintance of large opportunity and ability; and from a consultation of the best authors, both ancient and modern, I am neither able to furnish an exception to what I have stated as the post-mortem aspects in death from suffocation, nor to say that these can indicate death from any other cause.

Of the writers who speak of congestion of the lungs and brain, and engorgement of the right cardiac cavities, as marked features, after death from suffocation, the following are the most important.

Lungs.—Gummer;[k] Haller;[l] De Haen;[m] Jaeger;[n] Plenk;[o] Godwin;[p] Coleman;[q] Hopffenstock;[r] *Report of the Royal Humane Society for* 1816, p. 43; Smith;[s] Devergié;[t] Evans;[u] Herapath;[x] *Annales d'Hygiène*;[y] Beck.[z]

Brain.—Haller;[a] Jaeger;[b] Kite;[c] Fothergill;[d] *Report of the Royal Humane Society for* 1816, p. 43; Chaussier;[e] Orfila;[f] Devergié.[g]

(k) *Dissertatio Medica de Causa Mortis Submersorum eorumque Resuscitatione Experimentis et Observationibus Indagata.* Groningæ, 1761, Ext. in Sandifort, Thesaur, vol. 1, No. xviii, pp. 495, 496.

(l) *De Respiratione—Opera Minora*, 1762, tom. i, pp. 320 et seq.

(m) *Ratio Medendi Continuata*, Vienn., 1771, tom. i, cap. 2, p. 40.

(n) *Dissertatio Medico-Forensis, sistens Experimenta de Submersis cum subjuncto examine phaenomenorum in iis observandorum*, Tubingæ, 1779, Ext. in Frank, *Delect. Opusc. Medic.*, tom. vi, No. ii, pp. 82 et seq.

(o) *Elementa Medicinæ et Chirurgiæ*, Vienn., 1786, pp. 30, 31.

(p) *Experimental Inquiry into the effects of Submersion, Strangulation, &c.*, London, 1788, pp. 4, 5.

(q) *On Suspended Respiration from Hanging, Drowning, and Suffocation*, London, 1791, pp. 2, 3.

(r) Quoted by Mahon, *Médecine Légale et Police Médicale*, Paris, 1801, tome iii, p. 29.

(s) *Principles of Forensic Medicine*, London, 1821, p. 208.

(t) *Médecine Légale, Théorique et Pratique*, Paris, 1836, tome ii, pp. 319, 320.

(u) *Lancet*, June 15, 1839, p. 435. (x) *Lancet*, May 27, 1843, p. 287. (y) *Lancet*, vol. xviii, p. 485.

(z) *Medical Jurisprudence*, 7th edition, p. 558.

(a) *Op. cit.*, exp. 139. (b) *Op. cit.*

(c) *Essay on the Recovery of the Apparently Dead*, London, 1788, p. 40.

(d) *Suspension of Vital Action in Cases of Drowning and Suffocation*, Bath, 1795, pp. 17-19.

(e) *Recueil de Mémoires, Consultations et Rapports sur divers objets de Médecine Légale*, Paris, 1824, pp. 355-358.

(f) *Leçons de Médecine Légale*, Paris, 1823, pp. 554, 555. (g) *Op. cit.*

HEART.—Godwin ;[h] Coleman ;[i] Fothergill ;[k] *Report of the Royal Humane Society for* 1816, p. 43 ; Male ;[l] Curry ;[m] Smith ,[n] Chaussier ;[o] Orfila ;[p] Devergié ;[q] Bichat ;[r] Kay ;[s] Semple ;[t] Herapath ,[u] Traill.[x]

(*h*) *Op. cit.*

(*i*) *Op. cit.*—Coleman found the proportions of blood in the right cavities, comparatively with that in the left, as 3 2-8 to 1 6-8.

(*k*) *Op. cit.*, pp. 17-19, and p. 175. (*l*) *Epitome of Juridical or Forensic Medicine*, London, 1816, p. 142.

(*m*) *On Apparent Death from Drowning, Suffocation, &c.*, London, 1816, pp. 40, 43.

(*n*) *Principles of Forensic Medicine*, London, 1821, p. 208.

(*o*) *Op. cit.*, pp. 355-358. (*p*) *Op. cit.* (*q*) *Op. cit.*

(*r*) *Sur la Vie et la Mort*, p. 229—Bichat says, "the right ventricle, and auricle, and the pulmonary artery, are distended to the utmost with a dark fluid blood."

(*s*) *On the Physiology, Pathology, and Treatment of Asphyxia*, London, 1834, p. 120 and p. 161.

(*t*) *Lancet*, 1841, May 29, p. 328. (*u*) Ibid, 1843, May 27, p. 287.

(*x*) *Medical Jurisprudence*, 2nd edition, p. 80. See also *Annales d'Hygiéne*, tom. xviii, p. 485. Druitt, *Surgeon's Vade Mecum*, 4th edition, p. 3, note. *Beck's Medical Jurisprudence*, 7th edition, p. 558. *Principes de Médecine Légale ou Judiciaire, traduits de l'Allemand du Docteur J. Dan. Metzger, et augmentés de notes*, par le Dr. J. J. Ballard, p. 109.

II.

DOES POISONING BY THE GASEOUS PRODUCTS OF COMBUSTION LEAVE MORBID APPEARANCES RESEMBLING THOSE OCCASIONED BY SUFFOCATION?

The chief gaseous products of ordinary combustion are carburetted hydrogen, and carbonic acid. These gases act, *positively*, as poisons, when respired; and not *negatively*, because of the absence of free oxygen.

The post-mortem appearances after poisoning by the former, bear no similitude whatever to those resulting from suffocation. In one case, quoted by Christison, the blood was unusually florid, even in the right side of the heart; and in another, there was "scarlet redness of the lungs."(y) Taylor, in referring to the same cases (Ann. d'Hyg., Jan., 1842), says that "the whole surface of the brain was intensely red."(z) In two cases of poisoning by this gas, recorded by Mr. Teale, there was a "light florid colour of the muscles; absence of all indications of venous congestion; fluidity of the blood; florid colour of the blood, which approached more nearly to the colour of arterial than of venous blood."(a)

In a series of experiments, illustrative of the physiological action of poisonous gases, which I made some years ago,(b) I invariably found the following appearances after death from the inhalation of carburetted hydrogen.

Joints flaccid; eye bright and somewhat prominent; inner surface of skin, and superficial muscles, paler than natural; large veins in the abdominal and thoracic regions full of bright-red blood; all the cavities of the heart filled with

(y) *Treatise on Poisons*, 4th edit. p. 812. (z) *On Poisons*, p. 808. (a) *Guy's Hospital Reports*, vol. iv, p. 112.
(b) *Harveian Prize Essay* for 1838-9.

blood of the same colour; lungs slightly collapsed, and marked with red and whitish patches; trachea and bronchi containing a little frothy mucus, and their membrane occasionally, but not frequently, streaked with vascular lines; brain pinkish upon its surface, and its vessels moderately filled with florid blood. In some cases, the blood coagulated imperfectly; in others, not at all.

In poisoning by carbonic acid, the morbid appearances bear some resemblance to those occasioned by suffocation, but the similitude is not actual, and its exceptions are numerous.

The post-mortem aspect generally indicates that the brain has been the organ chiefly affected. Its membranes are usually injected; its vessels always turgid; its substance studded with spots of blood wherever incised; and not unfrequently is there extravasation upon its surface, or effusion within its ventricles or at its base. Comparatively with the heart and lungs, the brain is most implicated in poisoning by carbonic acid: in suffocation, the converse obtains.

The *mechanical* act of respiration is perhaps not secondary to the process of oxygenation, in aiding the passage of blood through the lungs. In suffocation, this act is suspended, whilst in poisoning by carbonic acid, it continues until death. Hence, though in both cases the lungs are equally dark, in the former they are much more congested, and more spumous when incised, than in the latter. For the same reason we usually find all the cavities of the heart moderately full of black fluid blood after carbonic acid poisoning; but after suffocation, the right cavities *only*, are *distended* with this fluid: the left cavities are generally empty, or, at most, contain but little blood.

The primary action of carbonic acid is doubtless upon the brain,[c] inducing a sort of artificial apoplexy; but the poison has also that sedative property which enables it to destroy the powers of life much sooner than they could be destroyed by accumulating cerebral oppression.

This sedative influence, indeed, is sometimes manifested in a very remarkable degree. Taylor mentions a case of poisoning by carbonic acid, in which the cavities of the heart were found empty;[d] and one of poisoning from the products of

(*c*) "Carbonumque gravis vis, atque odor, insinuatur
Quam facile in cerebrum"—*Lucretius De Rerum, Natura*, lib. vi, l. 801, 2.

(*d*) *On Poisons*, p. 802.

slow combustion of wood, in which there was the same post-mortem peculiarity.(e) Dr. A. T. Thomson concluded from a series of interesting experiments, that the physiological action of carbonic acid is strictly sedative.(f) I have myself seen one or two instances in which its sedative action was decidedly the chief physiological feature—all the cavities of the heart containing less blood than usual, and the lungs having a natural aspect.

Though the results of my own experiments and observations lead me to the conclusion, that the indications are sufficiently obvious and precise to enable us, in the majority of cases, to distinguish between poisoning by carbonic acid and suffocation, yet knowing how certain acknowledged pathological conditions are liable to vary, I should assuredly let this fact restrain me from the expression of an absolute opinion on the subject in point, did it involve a question of criminal responsibility.

(e) *On Poisons*, p. 802. (f) *London Medical Gazette*, April 6, 1839, p. 62.

III.

"THE MERE SUFFERINGS IMMEDIATELY OCCASIONED BY A BURN, MAY PROVE INSTANTANEOUSLY FATAL—DEATH TAKING PLACE FROM EXCESSIVE PAIN: AT LEAST SUCH IS THE EXPLANATION OF THE FACT GIVEN BY DUPUYTREN, WHICH, HOWEVER, IS RATHER DIFFICULT TO RECONCILE WITH HIS SUBSEQUENT OBSERVATION, THAT IN SUCH CASES THERE IS CONGESTION OF NEARLY EVERY ORGAN IN THE GREAT CAVITIES."—*Cooper's Surgical Dictionary*, 7th edition, art. Burns, p. 292.

Dupuytren is a great authority, and deserves that a disputant should treat his opinions with deference; but it may be fairly asked, What would be the nature of the *instantaneous* death above alluded to? What other could it be than fatal fainting,[g] or a paralysing shock to the whole nervous system! Is either consistent with "congestion of nearly every organ in the great cavities?" Congestion is fulness, more or less complete, of the capillary and other vessels of an organ. The instantaneous production of a condition such as this, is a physical as well as a physiological impossibility. To produce it is really a work of time! In fatal fainting, the heart is suddenly paralysed, and the momentum of the circulation at rest for ever.[h] After this form of death, the heart is found to be flaccid,

(*g*) Violent impressions upon nervous expansions may produce a dangerous weakening of the heart's contractile power; this is the case, for example, with extensive burns, which may produce faintness, and even death, especially in children, by the depression which they induce. ("Causæ quæ syncopen subitaneam et lethalam excitant—dolor ingens, animi affectus, &c."—Hiradus—*De Animi Defectione*, lib. i, cap. 3.)—*Carpenter's Manual of Physiology*, 1846, p. 336, s. 581. "The quick fatality of burns is more frequent in children and nervous females than in adult or old persons."—*Cooper's First Lines of Surgery*, 7th edition, p. 107.

(*h*) Under these circumstances, the heart stands still from a loss of its own *vis vitæ* ("Subitanea virium dejectio,

and its cavities nearly or entirely empty—a condition the reverse of that which would be found in congestion of the chief internal organs.

In my professional experience I have met with five decided cases of fatal fainting. The first was a man of weakly habit, who suddenly swooned and died after having taken only an average dose of colchicum, with sulphate and carbonate of magnesia. He was a patient of the late Dr. Moffat of Erdington, at whose request I attended the post-mortem. The heart did not contain a dessert-spoonful of blood in the whole of its cavities. The brain and lungs were paler than natural, and the only vascular fulness anywhere observable, was in the large venous trunks. The second was a chlorotic girl in Queen's Hospital, who, having gone hastily into the kitchen, complained, on returning, of faintness, sat down upon her bed and died instantly. The heart was quite empty: the other internal organs were healthy. The third was a patient the subject of typhoid fever. An anomalous discharge of blood, *per vaginam*, suddenly occurred, and although she lost only a few ounces, she did not respond to stimuli, but fainted and died. The heart was nearly empty: a trifling congestion of the brain and lungs being the only other morbid appearance. The fourth was a porter of a wine-merchant in this town. He had frequently suffered from attacks of syncope. On coming from a distance one day, he walked up a steep hill to relieve his horse; then got into the cart; laid his head upon the seat, and neither stirred nor spoke again. A relative, who was present, tried to rouse him, but he was quite dead. Emptiness of all the cavities of the heart was the only peculiarity discernible. In the fifth case, death was instantaneous, and clearly occasioned by sudden mental emotion, occurring to a debilitated and very sensitive subject. Here, again, the heart did not contain a tea-spoonful of blood, and all the organs were paler than usual.

Medical writers, in all ages, have observed this emptiness of the heart after death from syncope.

superstite pulsus vigore."—*Sauvages*). In suffocation, an opposite state exists—all the powers of the organ being exerted against accumulating mechanical obstruction, and it is not until this obstruction becomes complete, that pulsation is arrested. Coleman says that "the heart has frequently been observed to contract, or more properly to vibrate, for more than two hours after respiration was suspended."—*Op. cit.*, p. 12; Fothergill—*Op. cit.*, pp. 17, 18.* "In syncope," says Dr. Kay, "the circulation is suddenly arrested from the cessation of the heart's motion, and from the diminution of the activity and power of the capillary vessels."—*Op. cit.*, p. 235.

* "The cavity which first ceases to contract at death, is the left ventricle; secondly the left auricle; thirdly the right ventricle; and lastly the right auricle, which continues the longest to vibrate."—*Anatomical Descriptions*, p. 144.

" Sic in historia, Cl. Gretzii (Disp. de Hydr. Pericard. in Proem.), cum in mortua ex continuis lipothymiis, nihil sanguinis in cordis caveis deprehensum est."(i) Morgagni mentions another case of a lady, who, when pregnant, had a fear of not surviving her labour. She died in two hours and a half after delivery. There was scarcely any blood in the auricles, or right ventricle, and the left was empty. " Cor supra quod dici possit flaccidum, nihil fere sanguinis in auriculis, dexteroque ventriculo, nihil autem prorsus in sinistro continebat."(k)

Piccolhominus remarked similar appearances after syncopal death, which he thence believed to result from paralysis of the heart.(l)

Cælius Aurelianus held the same opinion.(m)

Van Swieten, also, calls syncope paralysis of the heart. " Sed cor in syncope perfecte se habet, ut dictum fuit in definitione Paralysis; quod nempe sit musculi laxa immobilitas, nullo nixu voluntatis vel vitæ superanda."(n)

Bonetus mentions the case of a female who died suddenly after symptoms of fainting, and in whose heart and adjoining vessels not a drop of blood was found. " Neque cor, neque vasa adsita, vel guttam sanguinis continebant."(o)

Forestus alludes to this pathological peculiarity in noticing the distinguishing signs of apoplexy and syncope.(p)

Hoffman, in speaking of quiescence of the heart as the leading feature in syncope, says "ejus expansio, qua recipitur sanguis aboleatur, unde immotus sanguis, et homo moritur."(q)

Hecquet makes a similar observation,(r) as also do Gregorius Horstius,(s) Alex. Benedictus,(t) and Paulus.(u)

Mr. Chevalier records three remarkable cases of fatal fainting, in which the heart was empty. The first was in the person of a lady, who complained of faint-

(i) *Morgagni De Sedibus et Causis Morborum*, epist. xxv, art. 13. (k) *Op. Cit.*, epist. xlviii, art. 44.
(l) *Anat. Prælect.* lib. 5, 6, et *Prælect.* 4, lib. 4.
(m) *Morb. Chron.* l. 2, cap. 1.
(n) *Comment. in Aphor.*, Boërh., tom. iii, p. 365., edit. Lugd. Batav., 1755.
(o) *Sepulchretum Anat.*, tom. i, p. 88. (p) Lib. x, obs. 97.
(q) *Medic. Rational. Systematic*, tom. i, p. 71, et tom. vii, p. 249, edit. Francfort ad Moen, 4to, 1738.
(r) *In Aphor. Hippocratis Comment.*, sect. 1, aph. xli, p. 67.
(s) *Opera Medic.*, 4to, Goudæ, 1661, tom. i, p. 305; et tom. iii; edit. Amstel. p. 62.
(t) *De Medend. Morb.*, lib. ii, cap. 1.
(u) *De re Med.* lib. iii, cap. 34. *Vide* Philumenus—*De Animi Deliquio*, serm. i, cap. 7; Albertinius—*De Affectionibus Cordis*; Castellus—*Exercitationes ad omnes Thoracis affectus, decem Tractatibus absolutæ.* 10 *De Syncope*; Theophrastus—*De Animi defectione.*

ness, desired to be laid down, and died almost immediately. On opening the heart, Mr. C. was "struck with its extreme flaccidity and the entire emptiness of all its cavities, in none of which was the smallest quantity of blood." It appeared to him "that this lady died from a syncope in which the action of the heart had ceased for want of the regular supply of blood from the returning vessels." The second was a man who fell suddenly from his chair and ceased to breathe in a few minutes. "All the cavities of the heart were empty, but uncontracted; and the vena cava was also empty to the distance of several inches from the auricle. No other appearance could be detected in any other viscus, by which death could be at all accounted for." The last was the case of a lady who died shortly after having been delivered of twins. She had been for some time impressed with the belief that she should not survive her accouchement. The labour was not untoward, and the loss of blood "very moderate," but she became faint about two hours after delivery, and shortly died. "All the viscera were free from disease. The uterus contained the placenta (which the accoucheur had thought fit not to extract in her exhausted state), with a small quantity of blood. But all the cavities of the heart were in a state of relaxation, and completely destitute of blood. There was no blood in the venæ cavæ near the heart, and the emptiness of the ascending branch extended as low as the iliac veins. In all these cases the heart itself, and its valves, were free from any disease or alteration of structure."(x)

In the *Lancet*, vol. i, pp. 28, 29, is recorded a case of death from syncope, in which "both sides of the heart were found empty." In the same journal of April 13, 1839, p. 123, is a similar case, wherein only a "small quantity of dark fluid blood was found in the auricles." Another, detailed by Mr. Pratt, *Lancet*, May 25, 1839, p. 345, of sudden death, with nothing to account for it except that the heart was "empty and flaccid." The deceased was a maiden lady, aged 53, addicted to brandy-drinking: she probably died of fainting from want of her accustomed stimulus.

Pringle relates the case of a man who suddenly died from violent purging, successive of fever, that had also been followed by extreme intestinal tympany. The "belly subsided all at once," says Pringle. There can be no doubt that the cause of death was fainting. "The heart was small, without any clot, or scarce a drop of blood in the ventricles."(y)

(x) *Medico-Chirurgical Transactions*, vol. i, pp. 157-160. (y) *On Diseases of the Army*, 3rd edit., pp. 226-228.

In *Journal der Praktischen Heilkunde*, for October, 1828, is a case of fatal fainting occurring during convalescence from typhus. The heart contained scarcely any blood. Dr. Hufeland, in commenting upon this case, says he has met with many such in convalescence from nervous fever.

In the *London Medical Gazette*, March 26, 1841, p. 353, is an instance of fatal fainting, related by Mr. Downes, "in which not the smallest vestige of disease was found in any of the viscera that could at all account for death, except the heart, which was empty of blood."

Louis mentions the case of a phthisical patient "who, after having had a motion, and been put back to bed, died suddenly, to the great surprise of the occupants of the neighbouring beds, as they had just before been conversing with her. The heart was somewhat soft, and contained no blood."(z)

Respiring an atmosphere unusually hot and moist, is a very active and effectual cause of faintness. In animals thus experimented upon, Mr. Erasmus Wilson found the heart empty.(a)

"Bichat says he has ascertained, by a large number of observations, that (in death from syncope), the lungs are always empty of blood, and that if otherwise free from disease, they are found collapsed, and do not fill the thorax."(b)

The only case on record with which I am acquainted, that would seem to furnish an exception to the cases I have quoted, is one narrated by Rouchoux,(c) and referred to by Christison,(d) of a woman, "who, while in a state of perfect health, suddenly grew pale, slipped off her chair, and died on the spot. The auricles of the heart contained a great deal of blood."

This case would have possessed more pathological interest, had it been stated whether the heart was absolutely free from disease, and what was the precise condition of the other internal organs. To speak of "perfect health," again, as the antecedent of instantaneous death, throws some little doubt upon the probable accuracy of Rouchoux's observation and mode of expression. But setting aside these things, the condition mentioned is not incompatible with

(z) *On Phthisis*, trans. by Walshe, pp. 396, 397.

(a) *Treatise on the Healthy Skin*, 3rd edit., p. 41, note. See, also, *Adair's Physiological Essays*, 1787, p. 132. *Philosophy of Medicine*, 1799, vol. ii, p. 326. *Edin. Med. and Sur. Journ.*, vol. xxxi, p. 441. Gardien—*Traité complet d'Accouchemens*, tom. iii, p. 137.

(b) *Cyclop. of Pract. Med.*, p. 141, art. Syncope. (c) *Annales d'Hygiène, publique* xx, 173.

(d) *Op. cit.*, p. 685.

death from fainting, for it shows nothing more than, that the capillary and other vessels, pulmonary and systemic, continued to propel their blood for some little time after the heart had ceased to beat. It found its way to both auricles, and there lodged—these organs not having the power to transmit their contents to the ventricles. This post-mortem passage of blood is, to a more limited extent, not unfrequently observable in cases of fatal fainting; for whilst the ventricles may be completely empty—the auricles, especially the right one, may contain a very small quantity of blood. In a rabbit that was killed by a blow on the head, after having been in an atmosphere of azote until its breathing had become laboured, Dr. Alison observed the right side of the heart contracting feebly, and that the movement of blood to it by the great veins, continued to a certain degree.(e)

Instances of sudden death from excessive mental emotion, whether arising from joy or terror, are numerously recorded,(f) but unhappily without any evidence of the post-mortem condition. Paralysing shocks to the whole nervous system, such as these, would, however, probably leave very little morbid aspect behind them.

I was once present at an intended surgical operation of considerable moment, upon a female, thirty-six years of age. About five minutes elapsed between the time of her being brought into the room and the completion of the necessary preliminaries; but before making an incision, it was remarked how pale she had become, and the surgeon, on feeling for her pulse, found that she was quite dead. The necropsy revealed no morbid appearances except fulness of the large venous trunks, and flabbiness of the heart, which contained very little blood.

In death from lightning, though there is sometimes observed undue cerebral vascularity, and even extravasation, yet the instances are numerous enough in which there has been no internal appearance whatever to account for death. Dr. Shirley Palmer informs me that he once superintended the examination of

(e) *Edin. Med. and Sur. Journ.*, vol. xlv, p. 103.

(f) Vide *Fienus De Viribus Imaginationis tractatus*, Lugd., Batav., 1635, tom. ii, 12mo.; *Platerus, Observ.*, lib. 1; *Valerius Maximus*, lib. ix, cap. 12; *Charron, De La Sagesse*, cap. 6; *Schenckius, Obs. Medic.*, lib. 1; *Tulpius, Med. Observ.*, lib. 2.

fourteen sheep that had been killed by lightning, and in not one of them was there anything unnatural.

The following was one of a set of experiments which I performed some years ago, to illustrate what Devergié calls " death from nervous asphyxia."

In a room at a temperature of 70° Fah., the hair was carefully clipped off the entire body of a rabbit, so as to render the skin completely bare. The animal was then wrapped up in flannel, carried into an adjoining room, and plunged into a vessel of water artificially cooled down to 25°. It made one violent struggle, and died in an instant. The body was examined after the lapse of twenty minutes. The vessels of the skin, and subjacent cellular tissue, were quite empty, and the large veins in the abdominal and thoracic cavities much fuller than usual; but beyond these things there was nothing of note, except that the limbs never stiffened, nor did the blood coagulate.

This form of experiment was twice repeated, and the results were so similar as not to require a separate detail.

IV.

HOW ARE THE INTERNAL ORGANS AFFECTED BY SUDDEN AND PERMANENT COLLAPSE OF THE SUPERFICIAL VESSELS?

Under this head it is not intended to enter into a consideration of internal congestions as a sequence of vital burning in its several varieties. Besides that it is not necessary to the purposes of this work to discuss such a subject, its very details would fill a volume with diversities, the issue of age—sex—temperament—previous state of health—circumstances of the accident—severity, suddenness, and extent of the burning—the period intervening between the receipt of injury, and death—character of the treatment—mode and duration of dying, &c. These, and other such, are the things which chiefly diversify the internal post-mortem appearances in vital burning.

The question simply to be considered is, What would be the *immediate* effect of suddenly driving the blood from the superficial vessels?

We know that one of the physiological offices of the skin is *respiratory*. Edwards interrupted the breathing of frogs by tying bladders over their heads; and though the ligatures were so tight as to occasion paralysis, yet they lived in air for two, and some of them for five, days. But when immersed in water, or their skins covered with oil, they died in a few hours. A salamander thus treated, lived in air for twelve days, until its head became gangrenous from the effects of the ligature. Punctures of the skin, and the phenomena of blushing, tell us of the arterial character of surface blood. These premises would indicate that the first consequence of a sudden collapse and emptying of the superficial vessels, would be an undue filling of those deeper seated, with blood more florid than that which they usually contain. And such is the fact.

Dupuytren found that when people were burnt to death at once, or perished very shortly after extrication from the flames, there were bright red patches, of greater or less extent, throughout the mucous tract of the intestines, and similar bright patches throughout the bronchi, with a large distribution of red capillary vessels.(g) I once examined the body of a girl, who died within twenty minutes after having been most extensively, though not very deeply, burnt. All the large internal veins, and the sinuses of the brain, were full of bright red blood; and all the cavities of the heart were moderately filled with a similar fluid. The lungs were almost scarlet, but were scarcely turgid enough to be called congested. The mucous membrane of the trachea, bronchi, stomach, and intestines, was extensively marked with patches of redness, and with florid capillary vessels. The liver was engorged with blood much brighter than usual.

In the experiments which I instituted, before alluded to, illustrative of Devergié's "death from nervous asphyxia," I found the blood of the interior veins universally florid. No organ was congested, properly speaking (death was too rapid for it), but the right cavities of the heart contained blood which had an arterial colour, as did the sinuses of the brain; and the lungs, though not more vascular than natural, were yet of a bright red hue throughout their extent. In places, and these not numerous, was the mucous membrane of the large and small intestines slightly patched with lines of redness.

When last at Shrewsbury, a medical gentleman intimated to me that he had performed an experiment upon a rabbit, which consisted in killing it by burning, at the same time that he allowed it a full and uninterrupted opportunity of breathing pure air. By what mechanical contrivance the feat was accomplished, I could not learn. But I understood that there was more or less congestion of the internal organs, and that their distinguishing feature was undue redness.

I should have little desired to repeat this form of physiological assassination, even with a consciousness of the important pathological data to which it might lead: but it occurred to me that, possibly the experiment might be so varied as to lose none of its interest or truth, and yet the poor animal be saved a considerable amount of suffering.

A rabbit killed by a severe blow at the back of the head, though dead to all

(g) *Clin. Chir.*, tom. i, p. 440.

intents and purposes, has yet (as in death from hanging), a mysterious remnant of organic life. This is especially shown in the continuance, for a variable period, of its capillary circulation. Acting upon this suggestion, I killed a rabbit by a smart blow upon the back of its head. Satisfied that life was extinct, I threw the body upon a bright gleed-fire, and burnt its entire surface for half a minute.

On examination, it was found that the vessels of the skin, and subcutaneous cellular tissue (where not destroyed by the burning), were completely empty. The membranes and surface of the brain were quite pale, but its sinuses were full of blood much redder than natural. The lungs were slightly collapsed, and of a bright red colour. More than a tea-spoonful of blood, of arterial hue, was found in each thoracic cavity. The several chambers of the heart contained a moderate quantity of blood: that on the right side had a decidedly arterial colour. The abdominal viscera were all pale, but the veins were full of bright red blood.

This form of experiment was several times repeated, and with no deviation, meriting notice, from the results obtained in the first instance.

V.

IS VITAL BURNING, IN A HEALTHY SUBJECT, EVER UNATTENDED WITH MARKS OF REDNESS?

The term redness, is not here intended to signify the blush of *inflammation* consecutive of burning. Vital burns, wanting this blush, are not unfrequent; for in some instances the sufferers die too soon for the occurrence of inflammatory reaction; and in others, though life may be more prolonged, the patients do not rally sufficiently from the first shock, for the opportunity of a definite inflammatory process. The word redness, is simply meant to apply to that peculiar congestive colouration which we meet with beneath the blister, or beneath the crust, of a burn; and to that line, usually encircling a dead-white one, which forms the external boundary of a vital burn, and has its outer margin either abruptly defined and terminated, or gradually shaded off until its colour is lost in that of the natural skin.

Of course an opinion upon this subject can only be given consistently with individual experience. In fact, it can but be simply the result of personal observation. As far as my own applies, and it has not been inconsiderable in this department of pathology, it is against the occurrence of vital burning, in a subject otherwise healthy, without lines or patches of redness. I have seen scores of cases of vital burning, and have examined them with as much interest as anxiety, but not one of them furnished an exception to what I have stated. Nor would *a priori* reasoning, upon physiological principles, lead to an opposite conclusion.

Taylor says, "this line of redness is not always met with in severe burns."[h] It is to be regretted that this passage has not received its due qualification, were any intended; and that its able author did not also refer to the red marks found beneath the blisters and crusts of vital burns. The latter, in fact, are by far the more obvious and constant, according to my own experience; for I have often remarked their unvarying peculiarity and distinctness, when the encircling red line has been only imperfectly displayed.

Of course the observations here made are intended to apply only to the vital burning of a *healthy subject*. I can readily imagine burning to occur in certain states of disease, or even of vital depression, and the special characteristics I have mentioned, to be altogether wanting. I have known the actual cautery applied on each side of the spine, for nearly its entire length, in a case of paralysis, without occasioning any redness, either immediately or subsequently. It is not improbable that the subject of this treatment might have been singed from head to foot without any red lines or patches being the result of it.

I once endeavoured, in a case of extreme emergency, to obtain an instant blister by the application of boiling water. I used this unsparingly, but it merely whitened and detached the epidermis, leaving the subjacent tissue destitute of colour. Here, again, vitality was so low, that no kind or degree of burning would have been likely to have produced appreciable redness.

I have more than once painted, abundantly, the epigastrium of a cholera patient, with one of the undiluted mineral acids, to allay the agonizing and fruitless retching which is sometimes a marked feature in the collapse stage, but without producing any other effect than a mere shrivelling and loosening of the cuticle. In these cases, again, no inflamed or heated material, applied to the skin, would have caused the least redness.

Hot turpentine, and *aqua ammoniæ*, if their evaporation be prevented, are amongst the most powerful rubefacients we possess; yet I have met with one or two instances in which their application to the skin, by means of spongio-piline, produced neither warmth nor redness. These things simply show a very depressed state of organic vitality.[i]

(*h*) *Medical Jurisprudence*, p. 398.

(*i*) I have never seen a case of burning during a fainting fit, nor do I know of one on record; but I should expect in such a case, that the marks of redness, if there were any, would be only imperfectly developed. The condition of the internal organs, however, would tell whether death had been the result of syncope.

VI.

CAN A BLISTER BE PRODUCED BY POST-MORTEM BURNING?

This is only another way of asking what amount of organic vitality may be left, and how long may it linger, after death properly so called? The possibility of raising a post-mortem blister, would of course be contingent upon the persistence, and the degree, of this physiological condition. We have many instances of its obvious continuance, and manifestation, for a definite period.[k] It is well illus-

(*k*) The ancients, in the licenses of their poetry, clearly anticipated this interesting fact.

"Et caput, abscisum calido viventeque trunco,
Servat humi voltum vitalem, oculosque patenteis;
Donec reliquias animaï reddidit omneis."—LUCRETIUS, *De Rer. Nat.*

"Te decisa suum, Laride, dextera quærit:
Semianimesque micant digiti, ferrumque retractant."—VIRGIL, *Æn.*

"Tum caput orantis nequicquam, et multa parantis
Dicere, deturbat terræ."—*Ibid.*

"Compressam forcipe linguam
Abstulit ense fero radix micat ultima linguæ.
Ipsa jacet, terraeque tremens immurmurat atræ.
Utque salire solet mutilatae caudæ colubrae,
Palpitat, et moriens dominae vestigia quaerit."—OVID, *Metam.*

Even in the prosaic surgery of a more recent age, we find physiological curiosities scarcely inferior to the above. Blegny (*Zodiacus Medico-Gallicus*, March, 1680) tells us of a man whose nose was lopped off by a sword, and although separated from the face for some minutes, subsequent re-union took place, and the injury was completely repaired. Fioravanti informs us, in his *Rational Secrets and Chirurgery Reviewed*, that he witnessed a combat in Africa between two military officers: one cut off the other's nose, which fell into the dust. Fioravanti took it up, washed and carefully replaced it, and in eight days the parts were entirely healed. Taliacotius relates a similar case. Garengeot alludes to a like restoration of a nose that had been bitten off in a quarrel (*Traité des Operations de Chirurgie*, vol. 3). See also Carpue's *Account of two successful Operations for restoring a Lost Nose*. In the *Journal der Chirurgie und Augen-Heilkunde* are two cases of restored noses, one of which is said to have been off nearly two hours. There are two others in the *Journal Hebdomadaire*. A singular instance of the union of a detached ear is recorded in the *Gazette de Santé* for March, 1817. In the *London Medical Repository*, vol. 6, is an

trated in certain of the experiments of Le Gallois, Marshall Hall, Fleurens, and others. Dr. Kellie says he has known the pupils of a recently dead body contract irregularly from the stimulus of light.(l) Dr. Macartney says that after the eye has been removed from its orbit, if light be suddenly admitted upon its sentient nerve, the iris contracts. Ingleby gives an instance of the uterus "continuing its contractions and expelling the child after the death of the mother."(m) In the barbarities of earlier ages, many parallels to this case occurred at the stake.

Dr. Bennett Dowler, in his "Researches," mentions, amongst other cases, the following curious one of post-mortem contractility of muscles. "A young man, twenty-five years of age, died; two hours after death, when the arm was extended to an angle of 45° from the trunk, and was struck with the hand, or still better, with the side of a hatchet, he carried his hand to his epigastrium, but when the arm was extended upon the floor, so as to form a right angle with the body, he slapped himself upon the mouth and nose. The contractility began to decline in the third hour; and by the fourth hour, all motions of the limbs ceased, though the pectoral muscles assumed the ridgy, or lumpy, form, when percussed. Five hours after death the contractility had ceased, and rigidity prevailed. It is remarkable, that in all the cases mentioned, the heat of the body remained at a very high standard for some time after death, and, in some instances, even rose after the cessation of respiration. In the case above, the heat was far above the usual standard of health for seven hours, only sinking in that time from 111° to 102°."(n)

Dr. Ward records a curious instance of "the face becoming more coloured, and a perspiration appearing upon the cheeks and forehead," two days after death.(o)

Professor Christison made a very interesting and instructive series of investi-

instance of the union of a finger which had been detached at the middle joint so as to hang by a bit of skin not thicker than a probe. Druitt mentions a more remarkable case. "Part of the left forefinger, an inch and a half long, having been cut off for twenty minutes, was replaced, and perfectly united in four days. The case is related by Dr. Balfour, of Edinburgh, and is quoted in Sir Astley Cooper's lectures."—*Surgeon's Vade-Mecum*, 4th edit., p. 112.

(l) *Med. and Phys. Journ.*, vol. xiv, p. 268. (m) *Facts and Cases in Obstetric Medicine*, p. 30.

(n) *Medical Times*, Aug. 7, 1847, p. 476. See *Dr. Davy's Physiological and Anatomical Researches*, vol. i, pp. 228, et seq.; and *Medical Times*, Sep. 15, 1849, p. 229.

(o) *London Journal of Medicine*, October, 1849, p. 969.

gations on the subject of post-mortem bruises, from which he concludes that, "in respect to external contusions, the experiments shew that for some hours after death, blows will cause appearances which in point of colour do not differ from the effects of blows inflicted recently before death."(p) It happened, in one of his experiments, that "blood drawn from the femoral and jugular veins, *eight hours after death*, flowed out quite fluid, and in a few minutes *formed a firm coagulum*, with separation of serum. The clot was firm enough to bear tossing from hand to hand without breaking."(q)

"An instance has been communicated to me," says Taylor, "on respectable authority, in which, for the sake of experiment, blows were inflicted on the recently dead body of a female, while still warm. The body was afterwards accidentally seen by non-professional persons, who were not aware of the performance of these experiments, and so strong was the impression from the appearances, that the deceased had been mal-treated during life, that a judicial inquiry was actually instituted, when the circumstances were satisfactorily explained."(r)

Orfila performed a set of twelve experiments upon post-mortem hanging, some shortly after death, and others at periods varying from six to eighteen hours, from which he concluded that the appearances produced upon the skin, and subjacent parts, were precisely the same as those occasioned by strangulation.(s)

Beaude's investigations led him to a similar inference.

More recently, Dr. Casper undertook a series of practical researches on this subject, and amongst his other conclusions, the following are conspicuous:

"The *mark* produced by the ligature, cannot be relied on as evidence of hanging during life.

"A ligature applied to the neck, a few hours *after death*, produces the same local changes as are met with in most of those subjects who have been hanged *during life*.

"These local changes consist in the skin becoming *brown or yellow in the course of the cord*, as if it had been burnt. There may be, also, a well-marked depression. In more rare cases, *i. e.*, about 1 : $3\frac{1}{2}$, a true ecchymosed impression is produced by the ligature.

(p) *Edin. Med. and Sur. Journ.*, vol. xxxi, p. 247. (q) Ibid. (r) *Medical Jurisprudence*, pp. 209, 210.
(s) *Leçons*, 2nd edit., vol. ii, p. 381.

"The mark produced on the neck of a subject hanged *long after death*, presents none of these characters."(t)

Guyon observed, in nine instances of hanging, that priapism continued for an hour after death.(u)

In the case of Ursula Lambert Berenger, who was found dead, with extensive marks of burning upon her, there were no red lines anywhere; but on the abdomen, and left knee, were blisters containing a red serum. Dr. Seguy was of opinion that she had been strangled, and subsequently burnt. Her husband, the suspected party, was found guilty.—Annales d'Hygiène, vol. xiv, p. 370, quoted by Beck, who dwells upon "the want of vital action around the burns" as favouring the supposition of death having occurred before the burning.(x)

Dr. Christison performed some interesting experiments in reference to post-mortem burning. He found that when boiling water is poured upon a body ten minutes after death, the skin is merely "shrivelled and rumpled; but the cuticle does not become raised into a blister. At a longer period than ten minutes, the same effects have been observed, while the body retained its warmth. Dr. Christison, on one occasion, had an opportunity of trying the experiment, on the same subject, before and after death: this was in the case of a young man who had poisoned himself with opium. While he was lying in a hopeless state of coma, four hours before death, a hot iron was held on the outside of the hip-joint; and half an hour after death, a red-hot poker was applied to three places on the inside of the arm. Vesication followed the burns in both instances; but those caused during life contained serum, and those formed after death, *air*. On the whole, Dr. Christison thinks that a vesication containing serum indicates a vital, and one containing air, a post-mortem, burn."(y) Taylor says, "I have performed many experiments on the bodies of infants eighteen and twenty-four hours after death, both with boiling water and heated solids, but in no case have I observed any kind of vesication to follow at that period. The skin became shrivelled, and was partly destroyed by the heat, but there were no blisters produced. It has been ascertained that under certain morbid states of the body,

(t) *Wochenschrift für die gesammte Heilkunde*, Januar., 1837, quoted in *British and Foreign Medical Review*, vol. v, p. 618.

(u) Quoted by Beck—*Medical Jurisprudence*, 7th edition, p. 643, note. (x) *Op. cit.*, p. 573.

(y) Taylor, *Medical Jurisprudence*, pp. 397, 398.

blisters containing serum may be produced in the dead subject, even twenty-four hours after death. M. Leuret observed that this took place in an anasarcous subject, in the vicinity of which a heated brazier had been placed. The cuticle became hardened, then raised and blistered; and the blister contained an abundance of reddish coloured serum. In repeating this experiment on other dead bodies, not infiltrated, it was observed that no vesications containing serum were produced. (Ann. d'Hyg., 1835, ii, 387.) Mr. Champouillon has recently repeated the experiments of M. Leuret, on anasarcous bodies, and he finds that blisters may be produced in these cases, at almost any period after death. Thus, they occurred when heat was applied to the anasarcous subject recently dead—to another when in a state of cadaverous rigidity—and to a third when putrefaction had commenced. The blisters do not appear immediately—the time which he found requisite for their production, varied from two to six hours. The serum effused beneath the raised cuticle was rarely tinged with blood." (Ann. d'Hyg., 1846, i, 421.)(z)

I have made a great number and variety of experiments on post-mortem burning and blistering, and have observed with every care of which I have been capable, the particularities connected therewith. I have constantly remarked that the results of such experiments as these are liable to be influenced by various circumstances. Boiling water, for instance, is an objectionable agent of vesication, for even under favourable conditions it does little more than scald, and wrinkle, and detach the skin. We often, indeed, meet with instances of vital scalding without any blistering whatever. The application of a red-hot iron, again, to the skin of a dead body, has usually the effect of scorching it, and of destroying what organic vitality may linger in the subjacent parts—thus preventing the opportunity of vesication. To hold it about the eighth of an inch from the surface is more effective, but it often happens that the iron begins to cool before a sufficient impression has been produced, or that it is requisite to touch the skin for an instant, when the difficulty already alluded to may chance to arise. Burning materials that are liable to deposit carbon, are of course objectionable in such experiments.

After many and various trials, I have found nothing equal to the flame of a

(z) Taylor—*Op. cit.* p 398.

spirit lamp. It is perfectly clean, constant in its action, and capable of being commanded and regulated at will. Yet even with this appliance, it is requisite to use some caution. If the flame be either too fierce, or be brought too quickly into contact with the skin, or too long retained there, it is very possible that the intention of the experimenter will be frustrated. The flame should be made gradually to approach the part intended to be acted upon—and this part should rather be *heated* than *burnt*. At most, the flame should glide over the skin only very lightly, and should be removed directly that the bleb begins to appear.

The precautions thus indicated as necessary, militate nothing against the application of the results to cases of suspicious burning, because it must be borne in mind that these experiments are performed upon *dead subjects*, and that the flame is limited and defined, and has not that variable intensity, and freedom of play which characterise accidental burning.

But beyond these things, there are others meriting notice. In some instances serous blisters can neither be produced immediately after death, nor even some hours before it, by any heated materials whatever. These are the cases we sometimes meet with, in which the cold insensible surface would seem to tell us that its organic life was gone. I need not dwell upon the many examples that are furnished by cholera, typhus, apoplexy, paralysis, and their analogues. In these I have never been able to raise other than gaseous blisters, how soon soever after death I may have applied the flame.

Though the results of my experiments tell me that the production of a post-mortem serous blister is no impossibility, yet, *cæteris paribus*, it is dependent entirely upon the amount of organic life remaining in the body admitted to be dead, in the ordinary sense. Or it may be stated, in other words, to depend upon the nature of the death of the body experimented upon.

If the process of dying shall have been protracted,[a] and the body cold before death, or marked by any of the other features of collapse, the raising of a post-mortem serous blister is altogether out of the question. I have tried the experi-

(*a*) In some cases of more sudden death, as from hemorrhage, it is not possible to raise a serous blister. A stout athletic man, in good health, cut his throat frightfully, and bled to an enormous extent before he died. Fifteen minutes after death, I could not produce a serous blister in any part of his body, though it was still faintly warm. The exsanguined condition of the surface, however, sufficiently accounted for the fact. I have met with other cases corroborative of this.

ment in a number of instances, in some, ten minutes after death, but only a gaseous blister was produced.

The separated skin, in these and similar cases, is of a brownish colour (of intensity varying with the degree and duration of the applied heat), and perfectly dry, crisp, and shrivelled (See plate III, fig. 1.): the subjacent skin has also a scorched appearance, is quite dry, and has a somewhat coriaceous feel. See plate III, fig. 2. These conditions contrast, most strikingly, in every particular, with those which characterise a serous blister.

This term is of course intended to designate a blister containing *serum*. Provided this fluid be actually present in a blister, it little signifies what may be the quantity of it. In vesications by cantharides, and indeed in vital burnings, we not unfrequently find, that though the epidermis be detached from its contiguous tissue, the quantity of serum effused is no more than suffices to moisten the separated surfaces. Yet these are, to all intents and purposes, serous blisters—and they are incapable of being raised, by any means whatever, in a body *organically dead*. But they *are* capable of being produced in certain cases, after death, the body being yet warm.

The vesication here alluded to, presents the following appearances.

The detached skin is loose, and wrinkled, and sodden—being saturated with serum, and having very much the appearance of a woman's hand after continued work at the washing tub. This skin has a soft, pulpy feel between the fingers, which it moistens on pressure. See plate III, fig. 3. The subjacent tissue is quite pale, and glistening with serum, which is sometimes in quantity only sufficient for lubrication, and again will amount to one or two drops in the space of a square inch. The serous blister I now speak of, I have produced, post-mortem, more than a dozen times—twice within half an hour, and once within fifteen minutes after death, though the opportunities, without being unfavourable, were certainly not the converse, to the purposes of the experiment. The remaining trials were upon amputated limbs.

In these latter cases, the success of the investigation is somewhat marred by the unavoidable loss of blood which occurs before the flame can be applied. I have endeavoured to obviate this as much as possible, by having a ligature placed below the incision made by the first sweep of the knife, and immediately after it;

but notwithstanding this precaution, the loss of blood, from the surface vessels, has been considerable.

Yet in the face of these difficulties and disadvantages, I have produced the blisters referred to, several times, in from half a minute to four minutes and a half, after amputation. Beyond this period, the vesications have been simply gaseous, and have answered to the descriptions previously given of them. On the same limb, I have had two distinct and well-contrasted specimens of each of these forms of blistering—the results of flame applied at different intervals.

In experimenting upon a dead body, the difficulty is, as before observed, to meet with one favourable to the objects of the investigation. This is the more to be regretted, because in the cases of suspicious death to which such experiments only could apply, the deceased might have died a violent death, and would most likely have been burnt immediately afterwards. The opportunities of voluntary practical inquiry, of course give us no parallels to this, for whatever investigations we can make, are for the most part upon bodies that have died from some form of disease, and to apply flame to any part of them within a quarter of an hour after dissolution, is next to impossible. At least my own experience, now somewhat ample upon this subject, tells me so. This is, therefore, a reason why results, apparently trifling, should be estimated both according to their absolute and their comparative weight.

As I have before said, the production of a post-mortem serous blister, is simply a measurement of the amount of *organic life* remaining in a body otherwise dead. Where this remnant physiological condition most abounds, the facilities for serous blistering are the greatest. It continues longer, and more largely, after suffocation, than after any other form of violent death. Cases such as these, however, adapted though they are to the purposes of experiment, are seldom met with until after the subject has become cold. Feeling this difficulty, and desiring to avoid it, I applied to the Secretary of State for permission to try some experiments upon the body of Manning, but was informed by Sir George Grey, that to grant such a request would not consist with the duties of his office. I shall still not lose sight of the inquiry, or of any future occasions of its illustration.

The only really favourable opportunity I have had for producing, post-mortem, a serous blister, was in the person of a female, thirty years of age, who died

suffocated from acute congestion of her lungs. She was slightly anasarcous, but this condition was so insignificant, that at a casual glance it was not recognizable.

Three hours and a half after death, when the body was quite warm, and the joints flexile, the flame of a spirit lamp was applied to the lower and back part of the left leg, and to the lower and anterior part of the left thigh—in the latter place, the anasarcous state was scarcely manifest. After the lapse of an hour, blisters had arisen, filled with serum of a pale straw colour, and readily coagulable by heat. But neither around nor beneath these blisters, was there the least shade of redness. See plates I and II. The quantity of serum in the lower blister was upwards of three drachms; that in the upper, rather more than two drachms.

Trifling as was the anasarcous condition, I thought it desirable to know whether this had any share in the production of the blisters.(b)

Ten hours after death, therefore, when the body had become *cold* and *rigid*, I again applied flame to it, and repeated the application at the end of *fifteen*, and of *twenty*, *hours*. In each instance only a gaseous blister was produced—the detached skin, and subjacent surface, having the appearances previously described, as peculiar to such vesications. See plate III, fig. 1. It is obvious then, that the first blisters were in no wise dependent upon the anasarca, which was a constant condition in the three last experiments, when warmth and all organic vitality were gone.

(b) I have several times, subsequently, tried the effects of flame upon bodies conspicuously anasarcous, after they had become cold and stiff, but in every instance the blisters were gaseous.

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PLATE 1.

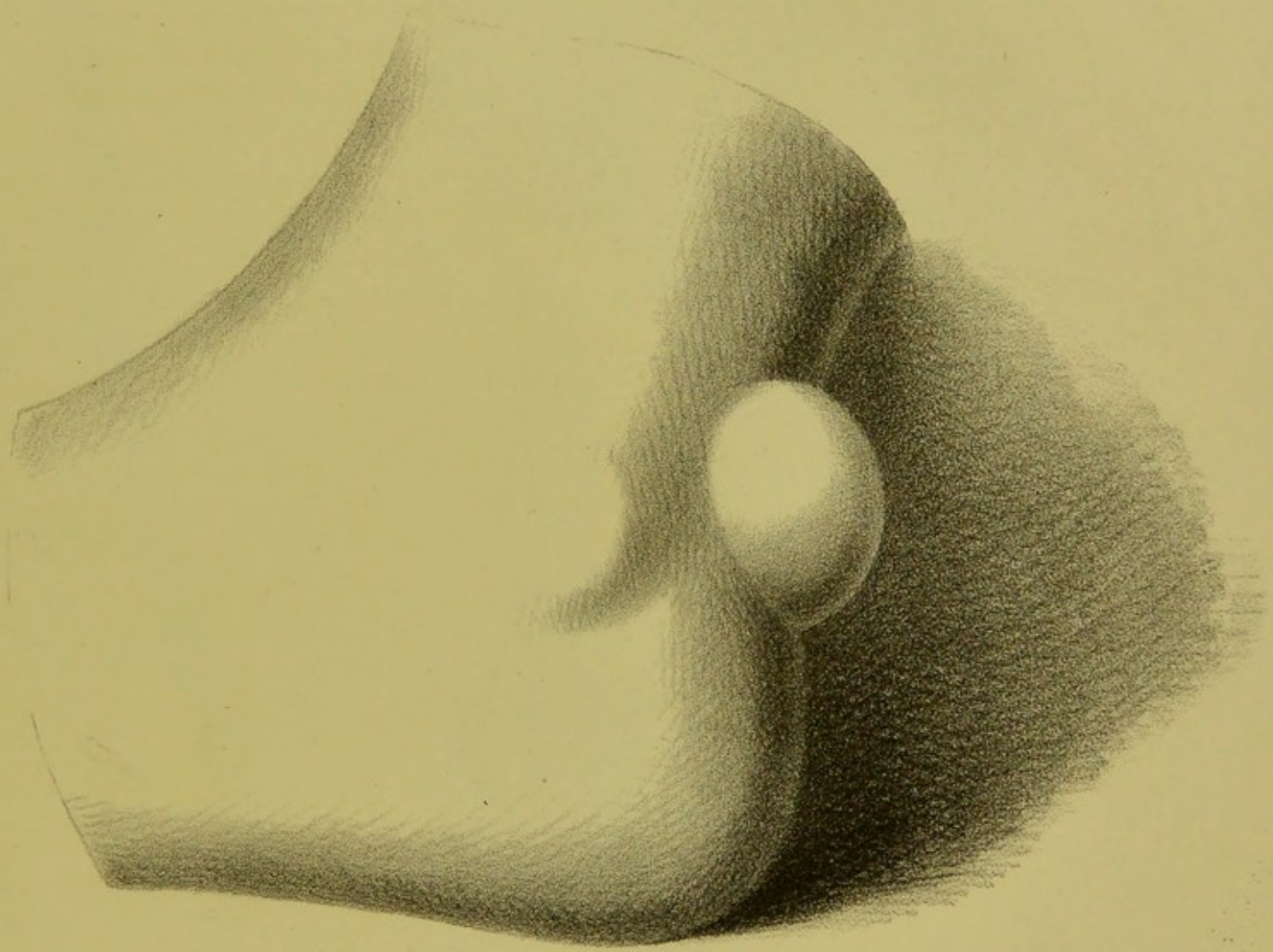

PLATE 2.

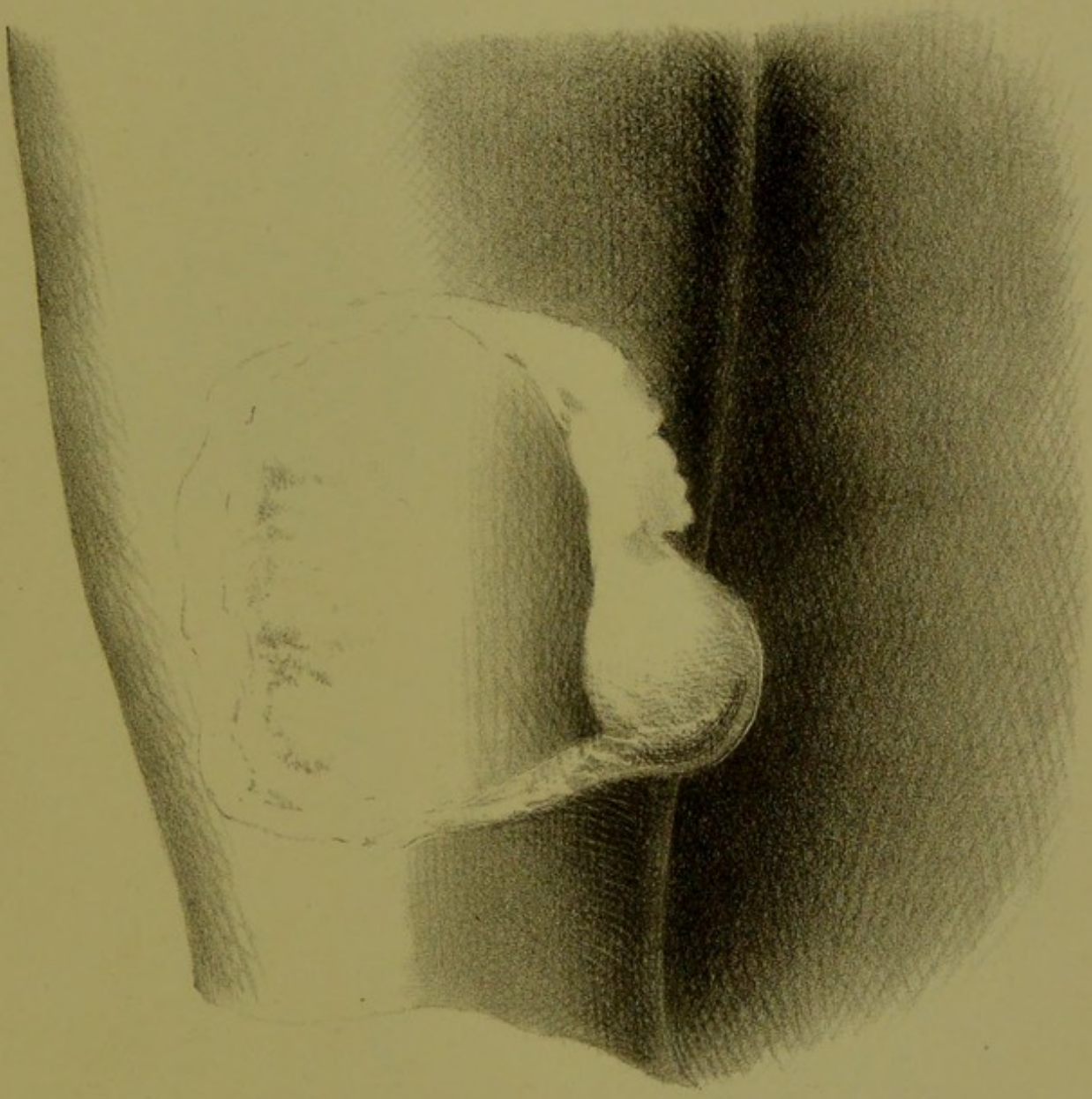

PLATE 3.

Fig. 1.

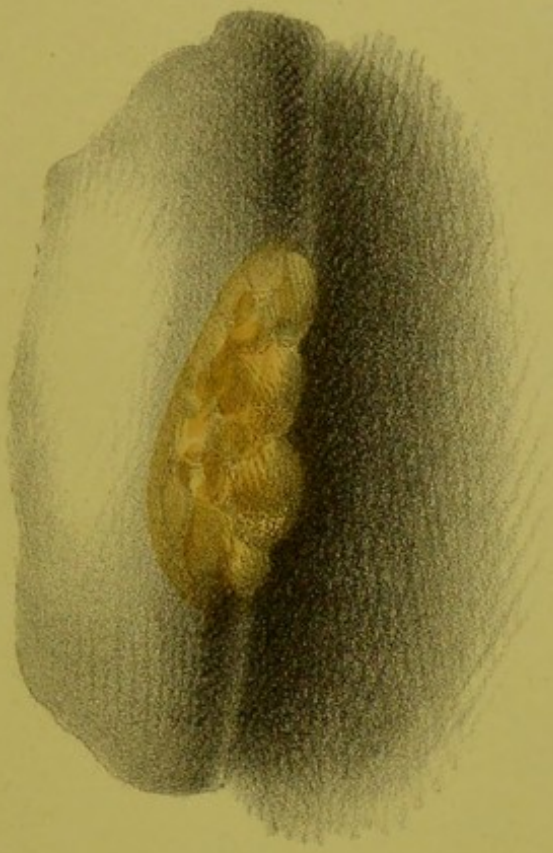

Fig. 2.

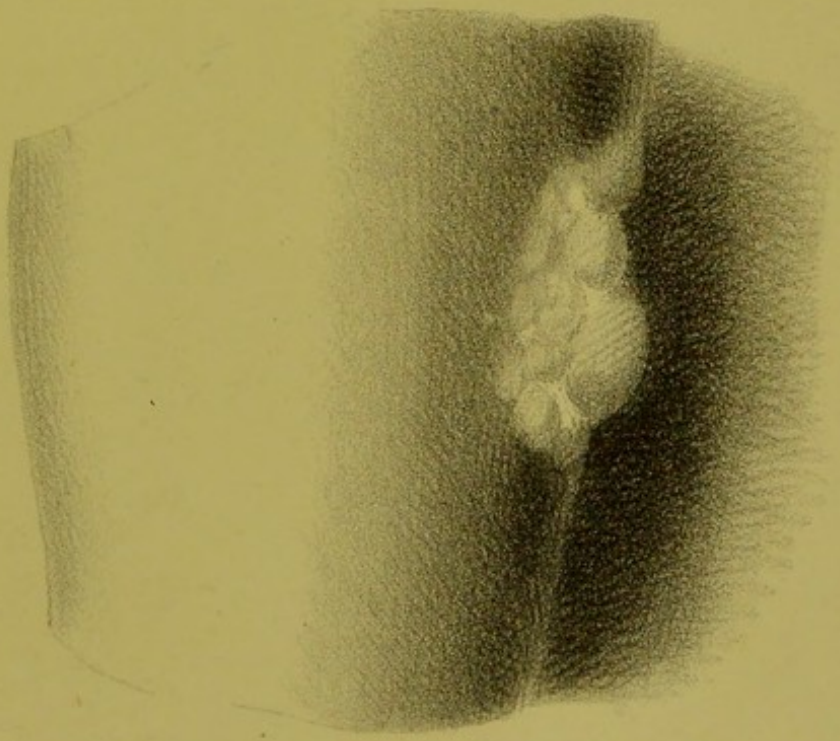

Fig. 3.