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## AN ACCOUNT

OF THE

APPEARANCES OBSERVED IN THE DISSECTION OF TWO OF  
THREE INDIVIDUALS PRESUMED TO HAVE PERISHED  
IN THE STORM OF THE 3<sup>d</sup>, AND WHOSE BODIES WERE  
DISCOVERED IN THE VICINITY OF LEITH ON THE MORN-  
ING OF THE 4<sup>th</sup>, NOVEMBER 1821;

WITH

SOME REFLECTIONS

ON THE

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## PATHOLOGY OF THE BRAIN.

By GEORGE KELLIE, M. D. &c.

PART I.

(Read 6th February 1822.)

**O**N Sunday morning, the 4th November 1821, three dead bodies were discovered in the immediate vicinity of Leith:—the body of one man was found a little to the east of the Links, not far from Seafield Baths,—that of another near to Hermitage Place, also in the links,—and the body of an elderly female was discovered in the neighbourhood of Crown Street. The preceding night had been remarkably

tempestuous, cold, and dark ; and as the discovery of three dead bodies extended on the ground, was an occurrence as singular as it was shocking, there seemed, from the first, little reason to doubt that these unfortunate individuals had fallen victims to the severity of the weather.

One of the bodies was immediately recognised as that of a well known pauper of the parish, and removed by his friends. The other two bodies were exposed in the portal of the church ; and remaining still unclaimed on Monday, Mr Cheyne and I were requested by the Magistrates to inspect these, and report to them our opinion respecting the cause of death.

The one body was that of a middle-aged man, perhaps about forty years ; the other that of an elderly female.

The countenance of the man was alike free from turgescence and collapse ; the complexion was pallid, and somewhat sallow ; his features were calm, and without distortion. No mark of external injury or violence could be discovered on any part of his body ; even the neck, shoulders, back, and hips, were quite free from that redness, livor or ecchymosis, so commonly observed in the bodies of the dead. There was no discharge of blood or other fluid from his mouth or nostrils. The body, generally, might be described as presenting the appearance of more than usual freshness and soundness. The abdomen was flat, and not at all tympanised. The trunk and limbs had the usual rigidity of death. On di-



viding the scalp, it was remarked by Mr Cheyne, that very little blood flowed from the integuments of the head. On exposing the dura mater, its surface, where torn from the cranium, was observed to be studded with numerous bleeding points; the whole membrane was somewhat congested, suffused, and heightened in colour; and its sinuses were loaded with dark blood. The veins of the pia mater were very turgid, and extensively injected, so that the whole membrane had a more than usual vascular appearance, and somewhat heightened colour. Following the convolutions of the brain, there was a milky or œdematous appearance, arising from effusion of serum, between the arachnoid coat and pia mater. The cerebrum itself, in texture and colour, seemed perfectly sound. The choroid plexus presented no appearance of turgescence. In the ventricles of the brain, and at the basis cranii, were found between three and four ounces of serous fluid; perhaps rather more than one half of this quantity at the basis cranii, the remainder within the ventricles.

On opening the abdomen, our attention was arrested by the very deep colouring of the small intestines. The ileum in particular, through its whole extent, was very red, and presented a very beautiful example of vascular congestion. A fine net-work of injected vessels spread under the peritoneal coat, over the whole extent and periphery of the ileum and jejunum. The stomach and colon had nothing of this congestion or colouring; and



the contrast between the appearances of these and of the small intestines was very striking. The stomach indeed was remarkably contracted and pale, nearly empty, or containing only about two ounces of a grey-coloured pultaceous fluid, having a faint animal odour. Its peritoneal and muscular coats were natural. On its internal or mucous membrane were observed a few spots, of a coffee-ground colour, and ecchymosed appearance. The liver was congested with blood, but had, in all other respects, the natural and healthy appearance. The spleen was rather empty and flaccid. There was no deviation from the usual appearances in the other abdominal viscera.

The woman appeared to have passed her sixtieth year. Her complexion was more sanguine than that of the man. The corpse was equally free from blemish or injury. Here, too, Mr Cheyne remarked that very little blood flowed from the integuments of the head, when divided. The dura mater was not so highly coloured as in the man; its veins, however, were injected, and its sinuses were loaded with blood. The pia mater, and the veins between the convolutions of the brain, were fully injected, and very turgid. About three ounces of serous fluid were found in the ventricles of the brain, and at the basis cranii.

In the abdomen, the omentum was found large, and very much loaded with fat: the colon was also buried in fat. On raising the omentum, it was a very striking coincidence to observe, that here also



the small intestines exhibited precisely the same appearance as in the man ; the same redness, not in patches, but over the whole extent of the bowel ; and occasioned by the same general and minute injection of the vessels, profusely ramified beneath the peritoneal coat. The stomach and colon, too, were in this case of the usual pale colour, having no vestige of the same vascular congestion. The bowels were not tympanised. The stomach was not so contracted and empty as in the man : it contained about four or five ounces of viscous fluid, and a few pieces of indigested beef. There were on the mucous membrane of the stomach a few congested spots, of a florid purple colour. The pancreas was of an unusually dark flesh colour. The liver, spleen, and other viscera presented no uncommon appearance.

In our report, therefore, to the Magistrates, we considered ourselves justified in stating our conviction, that these unfortunate victims had not fallen in consequence of any violence or injury inflicted by themselves or others ; and our belief that they had perished from the severity of the weather, to which they had, in some way or other, been exposed during the whole of a very tempestuous, cold, and dark night. That storm began early on Saturday evening. During the whole night it blew a furious gale, at first from the N. E., then from E. S. E., and again from the N. E., accompanied by violent drifts of rain, of sleet, and of snow. The night



was besides very dark ; and from the violence of the wind, and the drifts of sleet, the air felt much colder than the temperature actually indicated by the thermometer, which, in this neighbourhood at least, never perhaps fell lower than, if indeed so low, as the freezing point. One thermometer, I have been informed, was observed at midnight to indicate  $30^{\circ}$  ; but a register-thermometer, kept by an accurate observer in our immediate neighbourhood, at Hermitage Hill, had not sunk lower than  $34^{\circ}$ .

The neighbouring hills, and those on the opposite side of the Firth, were next morning seen whitened with snow ; but no snow remained on our own roads or lower grounds, nor was there observed any appearance of actual congelation. This was not, therefore, a temperature capable of producing frost-bite, nor such as might not have been resisted by vigour of constitution, and persevering exercise. But the furious gale which blew, and the sleet and snow which fell, would greatly increase the benumbing influence of even this degree of cold, and impede the exertions of those who were exposed to it. If the struggle were once given up,—if those individuals, benighted, fatigued, faint, and worn out,—from the darkness of the night despairing of recovering their way,—lay down, and continued exposed for hours to such chilling blasts, we cannot wonder that they slept to wake no more. Nor does there appear any other probable cause which can be assigned for the simultaneous death of three individuals, but the one common to all,—the influence



of the cold and tempestuous wet weather, to which they had been for many hours exposed. I know besides, from the case of a boy whom I attended some years ago, and of which an account was published in the 1st volume of the Edinburgh Medical and Surgical Journal, that a degree of cold short of congelation may produce great torpidity, after long exposure, in a state of inactivity, to its influence.

I have not been able to collect any very accurate history of our three victims. The pauper, who perished at Hermitage Place in the Links, was seen by a gentleman, who gave him weekly alms, between nine and ten o'clock on Saturday night, then in his usual health; and it is presumed that about this time he had walked towards the neighbourhood, where his dead body was found next morning, to call on another benefactor. The woman, we are informed, left her house sober about the same hour, to procure water from a pool near to where she was found dead: so that, with regard to these individuals, we are pretty sure that they had been exposed to the influence of the storm from an early hour on Saturday night. The man who was found to the east of the Links, we have learned was on his way to Musselburgh; but of the rest of his history I know nothing. My own opinion is, that all three had lost their way, and from the extreme darkness of the night, and the violence of the wind and rain, had been unable to recover it, until they dropt or lay down from fatigue or despair. As it was Saturday night, when the labouring classes



usually receive their wages, and too often indulge to excess in spirituous liquors, it might indeed be that these individuals had been in some degree intoxicated when exposed to the sedative power of the weather. But there is no positive proof of this; while, on the contrary, the few particulars which we have learned bear rather against the supposition. Again, the contents of the man's stomach did not exceed two ounces, and were free from any spirituous or vinous odour; those of the woman's stomach Mr Cheyne did think had the smell of ale or beer, but this was not recognised by my own sense. It may still be alleged, that the want of this test is yet no argument against the presumption of previous intoxication. But, in the absence of other proof of the fact of intoxication, we must give some weight to this negative observation; as the state of torpor and insensibility would seem to be one rather incompatible with an activity of digestion and assimilation, such as could have altogether decomposed and changed any intoxicating fluid previously existing in the stomach; and, indeed, the pieces of unchanged meat found in the stomach of the old woman, are proof that the digestive process had been suspended.

In reviewing the appearances observed in the dissection of these two bodies, our attention cannot fail to be arrested by the striking resemblance which the one, in almost every particular, bears to the other. In both we observed the same soundness



and freshness of the bodies,—in the abdomen the same congestions of the same viscera, and especially the same remarkable redness of the small intestines, from turgescence of their bloodvessels,—the same absence of fœtor, putrescency, and tympanites,—the same perfection of the other viscera, with the exception of the pancreas of the woman;—in the head, the same bloodless state of the scalp,—the same turgidity of the vessels on the surface of the brain,—the same congestion of the sinuses,—the same soundness of the cerebral texture,—and the same serous effusion, amounting in the one to nearly four ounces, in the other to about three.

These cases appear to me the more interesting, that there are probably few histories of the dissections of those who have died of torpor from cold on record. My search at least after such cases has not been very successful. But the single case which I have met with agrees in what I am disposed to consider the most important point, with the cases of which an account has just been given. The case is related by Quelmalz, in the 6th volume of Haller's "Disputationes." On dissection, the vessels of the brain were observed turgid with blood, and in the ventricles was found an effusion of serous lymph\*.

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\* "Confirmat id evidenter ipsa anatome senis septuagesimum ætatis annum transgressi, quam ann. 1726, demonstrationibus publicis tunc præfixus instituti. Cujus in itinere, mense Januarii, constituti, prope Zwenckaviam, frigore vehementi extincti oppressique, cadaver theatrum anatomo-



The effect of low temperature on the nervous system, in producing a torpid and lethargic state in certain circumstances of exposure to a cold atmosphere, is familiarly known by many recorded instances; and the progressive symptoms of this short but fatal disease, if so we may call it, appear to be weariness and faintness, debility, languor, lassitude, torpor, irresistible drowsiness, lethargy, profound coma, and death.

This state, then, seems, in its symptoms and progress, to bear a striking resemblance to other diseases of the order Comata. This affinity was remarked by Galen, and has been admitted by succeeding writers. Sauvages notes both a Carus and Lethargus à frigore, and gives examples of each; and Dr Cullen, after enumerating all the more acknowledged cases of apoplexy, admits this

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“micum delatum, blandoque calore, ob rigiditatem ejus fo-  
 “tum, præter alia in cunctis vasis sanguifluis, tam arterio-  
 “sis, quam venosis paullo capacioribus polyposas concreciones  
 “longas, teretes, figuram de reliquo vasorum suorum post ex-  
 “tractionem æmulantes, simulque vasa meningum sanguine  
 “turgida lymphamque viscidam in ventriculis observanda præ-  
 “bebat. Illorum igitur plerosque, quotquot gelu excessivo  
 “intereunt, ex apoplexia, perrupto vel sanguine, vel sero ac-  
 “cumulato in cerebri ventriculis succumbere, vero videtur  
 “simillimum. Ipse sopor vel somnus, in quem adeo proclives  
 “sunt, ante mortem, serumque largius in cerebri ventriculis  
 “post mortem repertum, non obscurum ejus rei præbet testi-  
 “monium.”—Quelmalz, Progr. quo frigoris acrioris in corpore  
 humano effectus expedit, Lipsiæ 1755. Halleri Disp. Medic.  
 tom. vi. Lausannæ 1758.



one; remarking, however, that cold is one of those causes which produce apoplexy, not by compression, but by destroying the mobility of the nervous power. The signs, however, of what is considered compression, were found to exist within the heads of our cases, and of that related by Quelmalz. Congestion, indeed, and the effusion of from three to four ounces of fluid within the head, are appearances commonly considered as indications of compression, and as affording no unsatisfactory explanation of the phenomena of a previous disease, the symptoms of which had been those of disorder or suppression of the functions of the brain. If, on the dissection of a patient, who had died of a disease characterised by all the ordinary symptoms of any of the comata, the physician were to discover such appearances as were found in these cases, he would be satisfied, congratulate himself perhaps on the accuracy of his diagnosis, and admire the correspondence between the symptoms of functional derangement, and the lesions discovered in the organs of those functions. In various head cases, I have certainly seen a less satisfactory concordance between the symptoms and the organic changes discovered on dissection; and many such examples might easily be produced from the recorded experience of other physicians. I am quite aware of the objection, that these indications of what is called compression, discovered in the brain of those who have died from cold, are rather to be regarded as contingent effects than the cause of the apoplexy which terminated in death; or, in



other words, that the observed congestion and effusion are the effects of the retarded return of the blood from the head, the consequence of a general immobility of the nervous power induced by the sedative action of cold. The objection has been thus stated by the illustrious Cullen: "With respect, however, to the circumstances which may appear upon the dissection of persons dead of apoplexy, there may be some fallacy in judging, from those circumstances, of the cause of the disease. Whatever takes off or diminishes the mobility of the nervous power, may very much retard the motion of the blood in the vessels of the brain, and that perhaps to the degree of increasing exhalation, or even of occasioning rupture and effusion; so that, in such cases, the marks of compression may appear upon dissection, though the disease had truly depended on causes destroying the mobility of the nervous power."

In admitting the force of this objection, I must remark, that the explanation cannot be limited to those cases arising from the action of narcotics and cold on the nervous system, but may, with great truth, be extended to many of Dr Cullen's cases of apoplexy from compression. In many, for example, where one or more attacks of simple apoplexy have been recovered from, and one at last proves fatal,—where a gouty, paralytic, or epileptic individual is suddenly taken off by a paroxysm of apoplexy,—where headaches, vertigo, sickness and lethargy, have slowly led on to fatal carus or apoplexy,



—or when death has been ushered in by hydrocephalic fever,—we may, on dissection, discover congestions and effusions of blood or of serum, which we justly regard as connected, in the order of cause, with the last fatal attack, or with the symptoms of the more advanced disease; but to which we should, I apprehend, err in attributing all the symptoms which marked the approach, or constituted the earlier stages of such cases. I am disposed, indeed, to consider the appearances of congestion of the brain observed in dissections, as always somewhat questionable and equivocal. It is certain, I think, that the appearances exhibited by the vascular system after death, give no very true or accurate representation of the balance of circulation as carried on during life. During life, the blood is shared, in some proportion or other, between the arterial and venous systems; and however much the balance may at different times vary between these systems, still the circulating fluid is constantly passing from the one to the other, and must, at every instant of time, be divided between them in such a way, that neither can ever be perfectly depleted or congested at the expence of the other. Not so when life has ceased; for then the arterial is found to be comparatively deprived of, and the venous system to be congested with blood. This is strikingly true in particular parts, and in none more remarkably than in the brain. In no part of the body, with the exception perhaps of the cavæ and sinus venosus, do we find on dissec-



tion so much of venous congestion as in the brain; the sinuses of the dura mater are almost always loaded, and the veins at the basis and on the surface of the brain are commonly distended with blood. In some cases this congestion is certainly more remarkable than in others; and often we are enabled to connect this greater than usual congestion, with symptoms which during life had seemed to predicate such a state. But here, too, we find but little blood in the arteries, and the less perhaps the more the veins appear congested. It may, therefore, be concluded, that the blood which after death we find congested within one set of vessels in the brain, is just that quantity of blood which was circulated within the head, and at every instant of time distributed, in some proportion or other, between the arteries and veins during life.

With regard to effusions, there seems less obscurity. Where three or four ounces of fluid are found extravasated, we can hardly doubt that this had been effused during life,—was the effect of some modification of the circulation, and the cause of some of the phenomena of that disease which terminated in death. The effusion which was discovered within the heads of our subjects, can hardly be regarded as a post-mortem production; nor can it be presumed that it existed previous to their exposure on that night which terminated their existence. The perfect parallelism of the two cases,—their agreement with another case by Quelmalz,—their simultaneous exposure and death on the same



night that another individual died under similar circumstances, render such a supposition highly improbable. If this serous effusion were not a post-mortem effect, and if it had no existence previous to the exposure of the individuals, then we must conclude that the whole, or the greater part, was effused in the short interval between their exposure and their death.

What this interval was we have not the means of determining with perfect precision; but we know that the maximum cannot exceed ten hours, and the probability is, that the interval was considerably less than this. Be it then from six to eight hours, and in this short interval from three to four ounces of fluid are effused within the membranes of the brain. When, however, the cavity of the cranium is actually encroached upon by the depression of its own walls, or by an effusion of fluid within its cavity, one of two things it is obvious must follow,—either the compression of its previous contents into less space, or the displacement and removal of an equivalent bulk of those contents. Adopting the latter alternative, some physicians have inferred, that the brain itself, in the case of serous effusion, has been, to a corresponding extent, wasted or absorbed; and Dr Cheyne, who favours this opinion, has, in his work on Hydrocephalus, considered effusion in the light of a salutary and counteracting event, by which that requisite equality of pressure, which would otherwise have been lost by the wasting or absorption of the brain, is continued and maintain-



ed \*. I am not prepared to deny this doctrine in all cases; I believe, on the contrary, that in some instances such a diminution of the mass of the brain by absorption may take place. But in our cases it seems highly improbable that, in the course of a few short hours, from three to four ounces of brain could be wasted or removed by absorption; and the supposition is in some other instances, as in that of the sudden effusion of blood upon, or within, the brain, and of the fracture, or depression of the cranium, absolutely impossible.

It seems more probable that, in most cases of intrusion on the brain, compensation may be made at the expence of the circulating fluid within the head; or, that less blood is then admitted and circulated within the cranium than before such encroachment on its capacity had been effected. The argument has been already taken up and illustrated by Dr Abercrombie, who, in his ingenious analysis of apoplexy, has, from a consideration of the peculiarities of the circulation within the head,—of the physical necessity of the constant plenitude of the cranium, and of the incompressibility of its contents, endeavoured to shew the improbability of any intrusion being made on the brain without a corresponding displacement of some portion of its circulating blood †. I agree in most of the reasonings and conclusions of

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\* Cheyne's Essay on Hydrocephalus.

† Observations on Apoplexy, Edinburgh Medical and Surgical Journal, vol. 14.



this intelligent pathologist and observant physician. I admit, that when the arteries are enlarged by plethora, the veins are not only prevented from a corresponding enlargement, but must, probably to the same extent, be narrowed and compressed, and that a certain derangement of the circulation will necessarily follow. My conception, however, of this derangement of the circulation is somewhat different from his: and if we differ only in terms, it may still be of some consequence to contrast these, as I cannot help thinking the language in which Dr Abercrombie has stated his opinions has led to still greater misconception of what was probably intended by him, of what, at least, I conceive to be the true state of the question. I cannot conceive an interrupted circulation of blood within the brain while life is continued; nor can I admit that the derangement being once established, more blood can continue to be admitted by the arteries, than is transmitted by the veins. If the tonicity of the arteries by any means become impaired, and their capacity be enlarged, if they receive an overcharge of blood, and do not transmit this directly to the veins, the arteries will become permanently plethoric; but the veins must, at the same time, discharge from the head a quantity of blood, equivalent to the permanent increase of blood in the arteries: Or, if the total quantity of circulating fluid within the head be  $Z$ , and the quantities contained respectively in the arteries and veins be  $X$  and  $Y$ , then  $X + Y = Z$ . If now, the circulation become de-



ranged in the way supposed, and if the surcharge  $a$  become permanently congested in the arteries, the accumulation within those vessels will now be  $X + a$ , and the contents of the veins  $Y - a$ ; for on any other supposition than  $X + a + Y - a = Z$ , the total quantity of blood within the head would be increased, or diminished, which is at least contrary to the hypothesis.

Whilst, then, such derangement of the circulation is producing within the head, to whatever extent the one set of vessels is becoming overcharged, to the same extent, it seems probable, is the other set becoming voided. But this derangement must have its limits, for were it repeated at every systole of the heart, one set of vessels would at length become entirely voided and compressed; the circulation would then indeed be interrupted, and instant death rather than apoplexy be the consequence. While life continues, the effect of this derangement, whether in the case of *arterial* or *venous* congestion will, in truth, be a retarded rather than an interrupted circulation of blood through the brain; for, in the one case, the diminished quantity of blood which is transmitted from the head by the narrowed veins will be the exact measure of that which, at each systole of the heart, can be forced into the plethoric and congested arteries; and, in the other, the quantity which the compressed or contracted arteries can admit, will measure the quantity carried from the head by the enlarged and congested veins; or the derangement once established, more blood



cannot continue to be admitted by the one than is discharged by the other.

The circulation within the head is, in truth, of a very peculiar description. The brain itself, little compressible, is contained within a firm and unyielding case of bone, which it exactly fills, and by which it is defended from the weight and pressure of the atmosphere,—a force constantly acting on every other part of the system,—a force, therefore, which must be constantly operating to maintain the plenitude of the vascular system within the head.

If these premises be true, it does not then appear very conceivable how any portion of the circulating fluid can ever be withdrawn from within the cranium, without its place being simultaneously occupied by some equivalent; or how any thing new or exuberant can be intruded, without an equivalent displacement.

One of my oldest physiological recollections, indeed, is of this doctrine having been inculcated by my illustrious preceptor in anatomy, the second Monro,—a doctrine which he used to illustrate by exhibiting a hollow glass ball, filled with water, and desiring his pupils to remark that not a drop of fluid escaped, when inverted with its aperture downwards. His opinions, however, on this subject stand recorded in his work on the Brain and Nervous System. “For,” he observes, “as the substance of the brain, like that of the other solids of our body, is *nearly incompressible*, the quantity of blood within the head must be the same, or



“ very nearly the same, at all times, whether in health or disease, in life, or after death, those cases only excepted in which water or other matter is effused, or secreted, from the blood-vessels; for in these, a quantity of blood, equal in bulk to the effused matter, will be pressed out of the cranium \*.” It can scarcely, I think, be supposed that this doctrine should have been thus broadly maintained by so practised an anatomist, so acute an observer, and so excellent a pathologist, on speculative grounds only. The fair presumption, on the contrary, seems to be, that, in the course of his very extensive experience, he had observed nothing in the appearances of the vascular system of the brain, under the varied circumstances of health and disease, which seemed to militate against the hypothesis. It is, at least, by such an appeal to nature that the merits of the hypothesis are to be tried.

*1st*, Is it then true and consistent with experience, that we cannot lessen, to any considerable extent, the quantity of the blood within the cranium, by arteriotomy or venesection? In diseases of the head, in those, especially, presumed to arise from plethora and congestion of the vascular system of the brain, and distinguished by such symptoms as have been conjectured to indicate compression of that viscus, we bleed generally and topically, with the intention of obviating or removing this local

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\* Monro on the Brain, &c.



plethora; the brain, in fact, recovers its energies as we thus lessen the quantity of the circulating mass; and it seems natural to infer, that the vessels within the head have been proportionally unloaded.

By bloodletting we may, indeed we must, lessen the force of that general pressure, which, through the medium of the circulation, is constantly exerted on the brain;—a pressure, however, which (like that applied to water, or other inelastic and incompressible fluids) I can conceive to be increased or diminished to a great extent, without compressing it; and yet, to modify and influence the functions of this wonderful viscus. Nay, as Monro has well remarked, “the less compressible we suppose the substance of the brain to be, the more readily we understand how the whole of it may be affected by a plethora, or increased momentum of the blood.”

By abstracting, then, from the general mass, we perceive, at least, the possibility of relieving the brain from inordinate pressure, and of restoring the disturbed balance of its circulation, without having actually lessened the quantity of fluid circulating within its own vessels. It would seem, indeed, that a certain range of pressure is necessary for the due performance of the cerebral functions, as comatose and convulsive symptoms are induced by depletion and diminished pressure, as well as by plethora and inordinate pressure\*.

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\* “Σπασμὸς γίνεται ἢ ὑπὸ πλεθρῶσι, ἢ κενωσι.”—Hippocratis Aphorism. s. vi. λ. θ.



I believe it will be found nearly true, that there are such obstacles as the hypothesis supposes to the free depletion of the vascular system within the head.

In our dissections, we do not meet with very striking varieties in the appearances of those vessels: the sinuses of the dura mater, and the veins in general, are found filled, or congested. Even the brains of those who have been largely depleted during life, or who have sunk from inanition, do not appear much voided of their blood\*. The brains of our apoplectic patients themselves, whom we have, in the course of one or two days, of a few hours perhaps before death, bled to a great extent, with the very purpose of unloading their vessels, are still found

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\* "There may be determination of blood to the head, and great turgescence of vessels, even when the patient appeared to have died of hæmorrhage."—An important observation, to which Mr Cooke, in his abridgment of Morgagni, adds the following: "After uterine hæmorrhage, and also after copious depletion, on account of pulmonary and other inflammations, I have frequently observed the symptoms of cerebral congestion, and which has generally appeared to arise from the excitement occasioned by some mental effort, though occasionally it has arisen without an evident cause; whilst the other parts of the body appear comparatively bloodless, the vessels of the head throb violently; there is severe pain; confusion of intellect, sometimes to such a degree as to threaten delirium."—*Cooke's Morgagni*. I have myself seen many such instances. I may add here another observation which I have frequently made,—that fits resembling Apoplexy and Epilepsy, as well as fits of Syncope, occasionally supervene to ordinary venesection at the arm.—G. K.



congested with blood. In animals bled to death, the brain still retains much of its blood; the vessels on its surface are red, well filled, and sometimes exhibit the appearance even of turgidity and congestion. I had hoped, without any new cruelty, to have been able to determine the extent of this fact by a reference to the brains of the sheep and oxen which are daily slaughtered, by bleeding, in our markets. But, it was objected, that, by the division of the intercostals and eighth pairs of nerves in the way in which these animals are killed by the butcher, their death might be accelerated, and time not allowed for a more full and perfect depletion of the sanguiferous system.

While meditating this subject, I learned indeed, that some experiments of this kind had been already made with another view, by Dr Sanders and Dr Seeds, of which an account had been published by the latter in his Inaugural Dissertation, "De Sanguine Misso," printed at Edinburgh in 1815. These experiments consisted in bleeding dogs to death, with the view of determining the comparative effects of arteriotomy and of venesection; and the results, in so far as they affect the subject of our present enquiry, appear to be, that the brain could never be entirely depleted of its red blood;—that the sinuses and veins of the brains of animals bled to death from veins, are commonly more turgid, than they are found to be in those which have died from arterial hæmorrhage;—and



that in both, there was found more or less of serous effusion within the head\*.

So far, then, these experiments seem to confirm the proposition, that no part of the circulating fluid can be withdrawn from within the cranium, without its place being simultaneously occupied by some equivalent.

Having obtained permission from a butcher, I opened the carotid artery of one of his sheep, and the jugular vein of another, in presence of Dr Duncan junior, Dr Anderson, and Dr Combe. The moment the artery was opened, the blood was projected with great force to a distance of several feet; soon after, it flowed more slowly, and per saltum only, and the jet gradually became smaller and smaller. We observed (as Dr Parry had done) the gradual contraction of the calibre of the artery as the vascular system became emptied, and we saw that it has itself no pulsatory motion, or alternate dilatation and contraction.

Ten minutes after the carotid had been opened, the breathing was hurried and laborious, and the animal was slightly convulsed. The blood for ten minutes trickled more slowly down the neck; the eye became heavy and listless, and the breathing more and more oppressed; and at twenty minutes from the commencement of the experiment, there

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\* Si sanguis plurimus sive ex arteria, sive e vena efflueret, aqua intra caput effunditur.—Seeds, *Dissert. Inaug. de Sanguine Misso*, &c. 1815.



was a general convulsion, and the animal instantly expired.

When the vein was opened, the blood gushed out in a copious stream, but soon began to issue more slowly. In twelve minutes, the sheep was convulsed; and in twenty-one minutes from the time of opening the vein, he died. These sheep were immediately fleeced, and cut up in the usual way by the butcher; and the heads were separated, labelled, and set aside for examination on the following morning.

A, The sheep bled from the carotid artery.—The dura mater contained but little blood; the sinuses were full; the pia mater was well injected; and the vessels following the convolutions of the brain were seen full, tortuous and anastomosing freely; the choroid plexus was well filled with florid blood.

B, The sheep bled from the jugular vein.—The integuments of the head of this sheep were observed to yield more blood when divided than the head of the former. The dura mater was rather paler; the larger vessels of the pia mater were well filled, but the minute injection and colouring of the membrane was less remarkable than in the sheep bled from the carotid. The sinuses at the basis cranii were loaded with dark coloured blood. The choroid plexus was not so well injected, and not so florid as in the first animal.

C, We examined the heads of two sheep, which had been slaughtered for the market by the butcher



in the usual way. Blood was found in all the sinuses; several florid red vessels were seen ramifying over the brain and membranes; but these brains were decidedly paler, and we all agreed that they contained less red blood than the brains of the two sheep whom we had bled. They had a more watery and serous aspect as it were, but there was no palpable effusion of serum on their surface, or within their ventricles.

Some days after, having obtained three other sheep, one of them was slaughtered in our presence after the usual manner by the butcher, that we might ascertain the quantity of blood lost by the animal, and note the time, and manner of its death.

D, Sheep slaughtered in our presence by the butcher.—The blood rushed out in torrents. In one minute after the infliction of the wound, the animal became convulsed, and in two minutes died. The quantity of blood lost was exactly thirty-four fluid ounces.

The heart was found to contain about two drachms of blood. There was nothing remarkable in the other thoracic or abdominal viscera. The sinuses at the basis of the brain were full of blood. The veins on the surface of the brain, cerebellum, and medulla oblongata, were also filled. A fine web of vessels over the corpora striata, was beautifully injected with florid blood. A very little serum was found in the ventricles.

E, In this sheep, I first tied both carotids; and



four minutes after, I opened the jugular veins. The blood flowed at first very freely, but afterwards more slowly, unless when the animal was convulsed, when the hæmorrhage was constantly observed to increase. In two minutes after the veins had been opened, the breathing became very laboured, and even convulsive. In seven minutes the sheep was powerfully convulsed, and again, and repeatedly afterwards for ten minutes more, the last convulsion observed being at eighteen minutes from the time of opening the jugulars. The blood now flowed slowly and by occasional drops only, and at twenty-three minutes after the veins had been wounded, the animal died. The quantity of blood lost was thirty-eight fluid ounces.

The ventricles of the heart were nearly empty, or contained no appreciable quantity of blood. The sinuses of the head were in their usual state; those at the basis of the brain contained less blood than we have hitherto found in them, and the veins on the hemispheres of the brain were less filled; the choroid plexus was pale and empty; the vessels on the basis of the cerebrum were better filled, those ramifying on the basis cerebelli were minutely injected. There was a slight but very decided serous effusion within the ventricles.

F, In this I commenced by passing ligatures on both the jugular veins, and thus obstructing the return of blood from the head; and in five minutes thereafter I opened the right carotid. The bleeding was profuse and rapid. In two minutes after-



wards, there was strong convulsion, and uneasy respiration; and in nineteen minutes from the commencement of the hæmorrhage, this sheep died; the quantity of blood lost being thirty-seven and a half fluid ounces. The heart was nearly voided. The sinuses of the dura mater were found loaded with blood. The veins of the pia mater were also well filled. Numerous vessels on the basis of the brain, on the medulla oblongata, the tuber annulare, and the quadrigemina, were beautifully injected with florid blood. The choroid plexus was remarkably turgid, and there was a fine web of vessels well filled on the corpora striata. No serous effusion.

G, A dog weighing twenty pounds, and bled to death from the femoral arteries. In a few minutes he was convulsed; he survived the experiment fifteen minutes, having lost just fifteen fluid ounces of blood. There was somewhat more than one drachm of blood in each ventricle of the heart. The arteries were every where empty. The cava contained blood and air. The mesentery and intestines were pale and bloodless. Not a drop of blood could be expunged from the liver or the spleen, when divided and pressed. The kidneys were also drained of their blood. The sinuses within the head were loaded with dark blood. The dura mater was pale; but the vessels of the pia mater were delicately filled with florid blood. There was no palpable serous effusion.

H, A dog weighing between forty and fifty



pounds bled from the carotids, lost thirty-seven ounces of blood, and died in seventeen minutes. The heart and larger vessels were found nearly empty; the lungs were much blanched; the liver too was pale, and nearly bloodless. The viscera in general were well drained of their blood. The dura mater contained little blood. On the pia mater were several vessels of a florid colour, but not turgidly filled. This brain seemed upon the whole more depleted than usual. The lateral sinuses were however well filled; and a small quantity of serum was found within the ventricles, and at the basis of the brain.

I, Both jugular veins of a dog weighing eighteen pounds, were opened at the same instant. In three minutes he was convulsed, and died in rather less than six, having lost eleven ounces of blood. The left side of the heart was found empty, but the right was filled with blood. The lungs were pale. The abdominal viscera were nearly bloodless, with the exception of the liver and spleen, which still retained a moderate quantity. The dura mater was pale, and the sinuses moderately filled. There were numerous vessels on the surface of the brain and pia mater moderately injected with red blood. The membranes were slightly coloured red, exhibiting somewhat the appearance of what is called bloodshot; and there was slight serosity in the ventricles.

K, This dog had both carotids tied; the nerves (it is believed the eighth pairs), being inci-



dentally included in the ligatures. The dog became instantly uneasy and much agitated. The respiration was slow; there were attempts to cough and vomit, and two or three times a little bloody froth was expectorated. For several hours he could move about when roused. He was dull, but not lethargic. He refused food and drink, and died in about eleven hours. Many vessels of a florid colour, but not greatly distended with blood, were seen ramifying on the dura mater. The veins on the surface and between the convolutions of the brain, were neither so numerous nor so distended, as we have seen them on other occasions. But the membranes were covered with numerous minute vessels, delicately injected with bright red blood. The sinuses at the basis of the skull were filled with dark blood.

L, Both carotids, (including nerves), and both jugulars, were tied in this dog, an operation which he survived twelve hours. The symptoms were much the same as in the preceding dog.

His eyes (especially the left), were red and suffused. The vessels of the dura mater were remarkably turgid, and all the sinuses were much loaded with blood. Both the larger and the smaller vessels of the pia mater were fully injected with red blood. Not only the pia mater through its whole extent, but the cineritious substance of the brain itself, had a suffused, reddened, and as it were bloodshot appearance. In short, this brain was



gorged with blood in all its minuter vessels, and there was a little serum in the ventricles.

M, This dog was poisoned with prussic acid.—He became insensible and motionless in one minute from its administration, and in three minutes the heart ceased to pulsate. The brain was every where turgid with blood. The veins and sinuses were loaded and congested; and it was quite evident, that this and the brain of the dog L, contained beyond all doubt or dispute, a much larger quantity of red blood than the brains of any of the animals which had been bled to death.

A, G, and H, are examples of depletion from simple arterial hæmorrhagy; B and I, of uncompliated venous hæmorrhagy. C and D afford examples of more rapid hæmorrhagy and death, from the knife of the butcher. In E the carotids were tied, with the view of arresting the supply of blood to the brain, and the jugulars were opened for the purpose of general depletion, and with the expectation of voiding the brain to the greatest possible extent. In F, on the contrary, the jugulars were tied with the view of obstructing the return of blood from the head, while one carotid artery was laid open, and the animal allowed to bleed to death as a comparative experiment. The brain of E was accordingly found to be much more depleted of blood than the brain of F.

I know that the carotids, jugulars, or both, may be tied in dogs with impunity. We attribute, therefore, the death of K and L to the inclusion of the



eighth pair of nerves in the ligatures. K and L, therefore, afford examples of brains not depleted by previous hæmorrhagy. With the same view, the dog M was killed by the prussic acid. And these comparative experiments afforded us the most satisfactory proof, that the other brains had been really depleted by bleeding, and their vessels drained of a very sensible proportion of the red blood usually contained by them.

It is remarkable, I think, that in whatever manner these animals were bled to death, whether from arteries or veins, or both,—whether the hæmorrhage was rapid or slow,—whatever time, in short, was necessary to terminate their life, death did not take place till nearly the same or a proportional quantity of blood was lost. The sheep D, slaughtered by the butcher, died in two minutes; E, bled from the jugular, survived twenty-three minutes; and F, killed by arterial hæmorrhage, lived nineteen minutes; and the quantities of blood lost by them respectively, were thirty-four, thirty-eight, and thirty-seven and a half fluid ounces. Of the dogs, one of twenty pounds weight lost fifteen ounces from the femoral arteries; another weighing between forty and fifty pounds, lost thirty-seven ounces from the carotids; and a third, whose weight was eighteen pounds, lost from the jugular veins eleven ounces of blood\*.

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\* Drelincourt obtained sixty ounces of blood from a mastiff in half an hour: “Sanguis, universè collectus, uncias



The summary of these observations, in so far as they apply to our present subject of inquiry, may be thus stated,—that though we cannot, by any means of general depletion, entirely or nearly empty the vascular system of the brain, as we can the vessels of the other parts of the body, it is yet possible, by profuse hæmorrhagies, to drain it of a sensible portion of its red blood ;—that the place of this spoliation seems to be supplied both by extra and intravascular serum, and that watery effusion within the head is a pretty constant concomitant or consequence of great sanguineous depletion.

If, instead of bleeding, as in our examples, “*us-que ad mortem*,” we were to bleed animals more sparingly and repeatedly, I have no doubt that we should succeed in draining the brain of a much larger quantity of its red blood ; but in such experiments we should, I think, find a larger effusion of serum, and be satisfied that many vessels, destined to circulate red blood, were filled with serum only, and even the larger trunks with a very thin and diluted blood.

In cachexies, in cases of inanition, and in cases of great sanguineous depletion, whether by venesection

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“*quadraginta octo pependit. Amissam reputo libram unam : sint ergò medicæ libræ quinque intra horam dimidiam, arteriis molossi propulsæ.*” He does not give the weight of this dog, which, according to our observed proportions, must have exceeded seventy pounds at least.—*Drelincourtii Canicidia*, can. 1ma.



tion or by spontaneous hæmorrhage, we might expect the brain to exhibit such appearances as are here supposed. Lieutaud, in his *Précis de la Médecine Pratique*, has described a cachexia of this kind, by the very characteristic name of *Anæmia*. In this disease the vessels are found nearly drained of their red blood; and Lieutaud tells us, that he has met with cases in which, on opening the head, the chest, and abdomen, all the vessels, large as well as small, were found containing scarcely any blood; and he mentions one case of a man forty-five years of age, who, after having been most profusely bled for an acute disease, under which he had for some time before laboured, died suddenly of syncope, and in the vessels of whose brain he could scarcely discover a trace of blood\*. There is an account of a singular disease, which is said to have appeared some years ago as a local epidemic amongst the workmen of a particular gallery in the coal-mines near Valenciennes, by Professor Hallé, in the 9th volume of the *Journal de Médecine*. This disease seems to have begun with symptoms of gastric and intestinal irritation, and to have terminated in anæmia. Four individuals suffering under this disease, were sent to Paris for examination. The whole surface of the body was without colour; not the skin only, but the conjunctiva, the inside of the eyelids, of the lips, mouth and tongue, were deprived of their na-

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\* *Précis de la Médecine Pratique*, p. 72.



tural colour. Even the larger veins in the bend of the arm and on the back of the hand, we are told, were so empty, or at least so devoid of colour and convexity, that they could not be discerned. One of these died, and on dissection all the vessels, arteries, and veins, in the three cavities of the body, were found nearly destitute of blood, or containing only a small quantity of serous fluid. The vessels of the trunk were equally empty. In the left ventricle of the heart a coagulum was observed, without any perceptible portion of colouring matter, and the heart itself was as pale as muscles are found to be after washing or maceration. Within the cranium the sinuses were nearly empty, the brain itself was white, its cineritious substance was pale, and little distinguishable from the medullary. Between two and three scruples of serum were found in the left ventricle, and the choroid plexus was of a palish red\*.

Now, in cases like this, where little or no red blood remains in any part of the system, it seems no way surprising that the vessels of the brain should exhibit at least the appearance of great depletion, while they might, in fact, contain no small quantity of serous fluid, or of the almost colourless blood, which was circulated during life. I do not hazard this observation on mere conjecture. I have just had

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\* Journal de Médecine, Chirurgie, et Pharmacie, &c. par Corvisart, Leroux, et Boyer, tom. ix.



an opportunity of examining, along with my friend Dr Combe, the body of a man who exhibited, during life, as perfect an example of anæmia, as any perhaps on record. This man had been for eight months under the regular care and observation of Dr Combe, by whom, perhaps, a full account of this interesting case may at some future meeting be laid before the Society. At Dr Combe's request, I had visited *Hind* two or three times while under his care; and, after the most minute examination, I confess I was unable to give to his complaint any other more definite designation than that of cachexia or anæmia. His countenance and his skin every where was of a pale transparent yellow bombycinous colour, such as, on a first inspection, would naturally suggest the possibility of a liver disease; but then the conjunctiva had nothing of this yellow tinge, neither the urine nor stools gave evidence of any hepatic obstruction, and neither pain nor fulness could be detected in the hypochondriac or epigastric regions. His lips were pallid and bleached; and thus he languished for months, without his complaints assuming any more marked or decided character. For some days before his death his breathing became more difficult than usual; the last twenty-four hours of his existence were passed in a state of lethargy; and on the 29th of January he died.

For our present purpose, it is enough to remark, that the viscera of the thorax and abdomen exhibited no appearance of structural disease. The



heart was flaccid and remarkably pale, containing no blood, with the exception of a web-like, soft, and pale coloured coagulum, loosely attached to the valves and columnæ carneæ. The large bloodvessels were quite empty, with the exception of the abdominal cava, in which was found a thin darkish-coloured fluid, which seemed also scantily to pervade other vessels of the abdominal viscera. The body in general was, however, nearly bloodless. On dividing the integuments of the cranium, a reddish serum only flowed out. The bones themselves were bleached, insomuch that the cranium, instead of its usual blue and sanguineous hue, displayed a whiteness as perfect as the best prepared skulls in our anatomical museums. The dura mater was uncommonly pale, bloodless, and transparent, except only in the course of the longitudinal sinus, which was distinguished by a faint pink tint. About an ounce of thin pink-coloured serum seemed to escape from between the membranes. The sinuses contained only a serum of the same description. The larger vessels ramifying over the hemispheres, and between the convolutions of the brain, were all conspicuous, from the colour given to them by the same pale pink-coloured fluid, with which they were filled, though not distended. The vessels of the basis of the brain, cerebellum, and medulla elongata, contained little or no coloured fluid. The medullary part of the brain was uncommonly white, and the cineritious part was of the palest grey colour. About



three ounces of pink-coloured serum were found occupying the basis cranii and vertebral theca. The choroid plexus was very pale, but its vessels not emptier than usual. The ventricles, corpora striata and thalami, were pale and bloodless, and within the ventricles there was perhaps about a drachm of fluid. The brain generally might be described as soft and watery. Upon the whole, in the examination of this body, we could find little to which the pathologist could attach any importance, other than the want of the usual circulating fluid, and a remarkable ossification of a portion of the dura mater.

The vessels of this brain, however, are far from furnishing an example of unqualified depletion. Compared with the rest of the body, I would say that they contained more than the usual relative quantity of fluid which had circulated during life; a pale and colourless blood, it is true, but in such quantity within the head, that had it been less serous,—more highly coloured,—more, in short, like true blood,—the vascular system of this brain would have presented little more striking or remarkable to the eye of the dissector, than a somewhat less than usual turgescence perhaps of the sinuses and larger vessels, and a profusion of effused and interstitial serum.

Having brought these reflections on the depletion of the vascular system of the brain to a close,



we should next have proceeded to investigate the question relative to the repletion or congestion of those vessels, had I not already too far encroached on the time and patience of the Society;—the subject, however, will be resumed at a future meeting.