hour, for three hours; next morning three drachms of laudanum, and in two hours afterwards, two drachms more, were administered.

In another case, by the same author, a drachm and a half of laudanum was given in the evening; the following day half a drachm of solution of morphia every second hour, and in the evening, a grain of morphine. On the following day, two drachms and a half of laudanum; in two hours a drachm; and three drachms again in the evening, followed, in two hours further, by a drachm and a half. In neither case was any sleep, sounder than a doze, the result.

I treated two cases of the disease myself, on the same principle, some years ago, when in charge of a public institution, as resident officer; in both cases I repeated drachm doses of laudanum, every two or three hours, without success. In all these cases, due attention was paid to supporting the strength, by stimulants and by nourishment, but in all the patients died. In one of my own cases, the change from a state of high excitement to one of entire insensibility, with utter collapse, was fearfully rapid, and my notes of both the cases indicate evident signs of a tendency to prostration in the patients, by a feeble and rapid pulse, sobbing, respiration, tremulous limbs, and a surface bathed in perspiration. In a milder case, which occurred in the hospital the other day, you witnessed a similar failure of the opiate treatment. Now, in the history of delirium tremens, there is a circumstance of great moment in relation to the present subject—the great liability in the patient to degeneration of the heart, which, of itself, will sometimes bring the case to a suddenly fatal termination. To this I must add, that the secreting instruments of the kidney are rarely in a healthy condition. Various forms of advanced degeneration of the kidney are common results of intemperance; and, even when the disease has not attained this serious character, the epithelial cells will be found unhealthy, loaded with fatty and granular matter; as a consequence, the blood will probably be impure, and it is a well known fact, that impure conditions of the blood render the nervous centres more than usually exposed to the injurious operation of narcotic poisons. The extent of such changes will bear relation to the nature of the patient's habits, and to the length of time he has indulged in intemperance. Thus, in a first attack of delirium tremens, and in a tolerably healthy subject, but little anxiety need be felt for the result; the fit will probably subside of itself; whilst, on the other hand, when many previous attacks have occurred, the chances of recovery are much lessened.

Dr. Watson observes, that patients, in delirium tremens, "are apt to die much in the same way as patients who are poisoned by opium" (*Lectures*, 4th edit., i, 414). Now, when we recollect that what is commonly distinguished as apoplectic coma is sometimes induced by lowered nutrition of the brain, or by deficient supply of blood to that organ, it seems highly probable that such deaths are the consequence of failing power in the heart, more especially as we often find, after death, much increase in the subarachnoid fluid, together with pallid, shrunken, and widely-separated convolutions, evident signs of a wasted state of the cerebral tissue, a state most liable to suffer from any further depression in its nutritive conditions.

To apply these remarks to the case in question, I believe that it is better to introduce the element of time into our treatment of delirium tremens, and to endeavour to obtain the aid of opium, by administering it in moderate doses, but at regular intervals, whilst we combine with this plan of treatment all the aids we can obtain from quiet, darkening the room, cooling applications to the scalp, and the judicious employment of food and stimulants.

And I may add, that I think the regular administration of small doses of opium, at short intervals, will generally be more likely to be effectual, in obstinate cases of nervous disease, than single and powerful doses. We thus obtain the sustained operation of the remedy, which may succeed at last in overcoming the resistance opposed to it.

One word, before I conclude, on the employment of opium in fever. This is too wide a subject for me to do more than to make one remark in connection with it. We may sometimes notice, in the course of a single case of fever, or by comparing two cases with each other, two periods in the disease which present a very different, even an opposite relation to opium. In the early, and especially in the middle stage, we occasionally encounter a state of very wild delirium, approaching somewhat to mania; this happens chiefly in highly irritable, excitable subjects, and we noticed it in a girl, who died of fever some time ago, who had been exposed to a severe mental shock shortly before her illness; now, in this condition, we may meet

with considerable resistance to the calming influence of opium. On the other hand, in the later stage, when the temporary support afforded by the febrile reaction has subsided, or when the patient has been much prostrated by the operation of the poison, and the muscular fibres of the heart are softened, the greatest caution is needed in giving opium, on account of the powerful effects it induces. I have seen a patient, under these circumstances, thrown into a deep sleep, lasting for many hours, by six minims of Battley's solution.

On some future occasion, I may speak to you of the different medicines which are employed as substitutes for opium.

Original Communications.

ON INTRAVASATION, EMBOLIA, AND CYTOSTASIS, AS CAUSES OF CEREBRAL AND OTHER PARALYSIS.

By J. L. W. THUDICHUM, M.D.

[Read before the Medical Society of London, April 23rd, 1860.]

THE morbid conditions of the blood-vessels which, under the name of phlebitis and arteritis, had for many years been catalogued with typical inflammations, have during the last decennium received unexpected elucidation and a convenient nomenclature through the thoughtful labours of Virchow. It had no doubt many years ago been recognised by Cruveilhier that the coagulated masses found in veins, when in a state of so-called phlebitis, were not fibrine exuded from the wall of the vessel supposed to be inflamed, but coagula of blood simply, having no connexion with the contiguous membrane. The puriform substance, which is frequently found in the centre of these coagula, Cruveilhier continued to interpret as true pus, and admitted a migration of this pus from the membrane, on which it was supposed to have been bred, into the interior of the coagulum, by means of an unintelligible force termed by him "capillarity". The somewhat startling experience, that inflammation of the vein or phlebitis should always begin with a coagulation of blood in its lumen, caused the French pathologist to assume that all inflammations originally began with a coagulation of the blood contained in certain small veins, the existence of which was supposed, without further inquiry. Cruveilhier failed to work out the necessary deductions from his observations. Misunderstood and misinterpreted by many, his doctrines never obtained even general notoriety. For both the notice of Cruveilhier's somewhat mystical assumptions, and the true interpretation of his classical observations, the larger circle of medical readers is indebted to Virchow, who dissolved the doctrine of phlebitis, and substituted for it the expression of the simple fact, by arranging under the denomination of "thrombosis" those pathological conditions which consist in the closure of a vein by blood-coagula formed in the identical locality in which they are met with. The next step in this reform consisted in assigning its proper nature to the process by which a matter resembling pus was formed in the centre of these coagula. The differences from pus were in many cases so striking, inasmuch as the matter was often found destitute of the cellular elements characterising pus, and presented the granules simply of decomposing fibrine or decomposing blood-corpuscles, that even those cases where cells not distinguishable from pus-cells were found could be interpreted by those in which they were absent; in this sense, namely, that they were cases in which a thrombus consisting of coloured and colourless blood-corpuscles and fibrine had undergone the simple chemical process of softening; and that the fluid product was not pus, but *detritus*, the cellular elements of which were white blood-cells, which, by their greater durability, had outlived the destruction of the red corpuscles and of the fibrine.

The entrance of this *detritus* into the current of the venous blood had more frequently been assumed than observed. So long as it was confounded with pus, it was one of the principal factors in the theory of pyæmia, which, while almost entirely overlooking the possible mechanical effects of the entrance of this matter into the blood, attributed its main pathological importance to the poisonous nature of the liquid, which, by

engendering decomposition in the juices of the body, brought on toxic dissolution. But when Virchow proved that the entrance of fluid matter from softened thrombi into the blood was a much rarer event than the detachment from them of portions of coagulum destined to produce mechanical effects in distant places, and when he, moreover, proved that the entrance of such *detritus* into the blood from softened coagula in veins, or softened fibrinous concretions in the right heart, even when repeated, did not by any means produce the fatal disease known to surgeons under the name of pyæmia, it became necessary entirely to separate pyæmia from the effects of thrombosis and its immediate results, and to institute a new doctrine, to which its originator gave the name of embolia.

A case of embolia, then, presupposes an intravascular coagulum of blood or fibrine, formed in the vessel itself, and the detachment from that clot, by means of softening or mechanical action of one or several larger or smaller pieces, which are carried away by the blood-current, and thrown into distant vessels. On the other hand, we distinguish by the name of "intravasation" a process very similar in its effects, but different in its origin; namely, the entrance into the current of the blood of matters formed without the blood-vessels or in the substance of their walls, such as air or the contents of abscesses adjoining the vessels, the gritty matter of true atheroma, the calcareous plates and *detritus* of the tissue of degenerated arteries, or the pus from the circumscribed abscess occupying the wall, but leaving unaffected the lumen of larger blood-vessels, such as a vein in true phlebitis. In the heading of my paper, I have accused both embolia and intravasation as causing paralysis, and shall endeavour to substantiate the charge by the evidence of cases. I have joined with them the new name of a pathological process which has not hitherto been observed or distinguished. By "cytostasis" I desire to signalise the temporary or permanent arrest in capillaries or small arteries of blood-corpuscles, white and red, due to a peculiar glutinous condition of the blood, by which these bodies are enabled to adhere to each other with such tenacity as to form an effective bar to the arterial current of the blood. The word "kytos" (*κυτος*) for blood-corpuscle is indeed far-fetched, signifying a membrane, and next a membranous hold or bag, a cell; but you will excuse the application of the word in this instance, as it has been accepted in many others—to wit, cytoblastema, leucocythæmia, etc.—without any questions being asked about its origin. Of this cytostasis I have to bring before you a notable instance of great practical interest, inasmuch as it resulted first in temporary, ultimately in permanent hemiplegia, and was connected by a long train of symptoms with disease of the urinary organs. I have joined this case to several of intravasation and embolia, in which hemiplegia, or complete bilateral paralysis, paralysis of single organs, was produced; and hope that the variety of causes, processes, and terminations which these cases present, will make them deserving of consideration.

CASE I. Cytostasis. A medical friend transmitted to me two specimens of blood which had been taken from a patient by cupping at the nape of the neck. The gentleman who operated said that he never met with blood of such consistency. It had more the thickness of liquid glue, and flowed so very slowly that it took an hour to remove what was sent to me from three places. The note continued to state that the patient, a gentleman of above sixty years of age, although living regularly and well, was of very spare habits; that for the last four months he had been subject to a most obstinate vascularity of the conjunctivæ of the eyes, which the treatment under one of our best oculists failed to remedy. Symptoms of loss of power on the right side had suddenly appeared. The patient had the greatest dread of depletion in any form; but the medical gentleman insisted upon its performance, and the patient derived marked benefit therefrom. In the opinion of this practitioner, there was a vascularity over the membranes of the brain, which would have resulted in apoplexy, had the cupping been omitted. He accounted for it by the inability of the blood to pass freely through the smaller ramifications of the vessels, and the production of cerebral compression.

On examination, the blood appeared extremely viscid, like a substance between tar and treacle. It was not coagulated, but contained small lumps of fibrine sufficient in quantity to enable me to say that it was not altogether absent. These lumps, under the microscope, consisted of granular matter densely studded with blood-cells. The blood had the ordinary colour, but became darker on standing. Under the microscope, the first feature observed was the abnormal appearance

of the red corpuscles. Not only were they distorted in all possible shapes, but they also presented an extraordinary power of adhesion to each other, so as to form lumps and heaps, and the peculiar rolls, and could not be detached from each other by any manipulation. The next anomaly was the extraordinary number of white blood-cells, mixed with red ones; indeed, these two elements may be said to have been present in equal proportion, while in health one white cell accompanies about three hundred red ones. When the red corpuscles were made invisible by water, the white cells remained, mixed with many nuclei of white cells, which could also be traced in the blood not treated with water.

At my suggestion, the urine was now examined, and found to be albuminous. We also ascertained that, many years ago, the patient had been the subject of gonorrhœa and stricture, for which he had been salivated; anasarca appearing and going with the mercurial course.

The loss of power on the right side had repeatedly manifested itself before this last attack, but always again subsided. After the last attack, it became permanent; but the paralysis was for some time fluctuating in degree. When I saw the patient in consultation, all symptoms persisted; and I moreover found the presence of pus in the urine. All depressing and depleting measures were discontinued, and a tonic and diluent plan of treatment was adopted with benefit. When I last heard of the patient, his disorder had not made any unfavourable progress.

There is little doubt that the disease of the kidneys, produced by stricture and mercurial disease following after gonorrhœa, produced in an exceedingly slow manner a peculiar condition of the blood bordering upon leukæmia, and accompanied by an enormous increase of the solids of the blood and a viscous condition, whereby the blood-corpuscles not only passed slowly through the capillaries, causing vascularity among other membranes of the conjunctiva, but also adhered to each other, forming lumps, whereby some smaller arterial branches were, at first for a time, ultimately permanently obstructed, and paralysis was produced, probably not by compression, but by anæmia of some motor portions of the brain-substance.

CASE II. General Paralysis caused by Intravasation. A gentleman, aged 59, came under my care for slight disturbance of the digestive functions. Six years before, he had had an apoplectic attack, followed by paralysis of the left side. Contemporaneously with the occurrence of the apoplectic seizure, a tumour of the size of a fist, which the patient had for several years carried above the left clavicle, had suddenly disappeared, without any external opening having been effected. Subsequent to the first attack, the patient suffered from time to time from convulsions, which came on particularly during the night, and always left him worse. Breathing became so difficult that he had to sleep in a sitting posture. The right side also began to get weak, and soon became as palsied as the left. Six months before I first saw him, after another attack of convulsions, he had entirely lost his speech; and, with the exception of his eyes, he could in no part of his body perform the slightest voluntary movement. Yet he was perfectly conscious, felt pain, and saw and heard, as his eyes interpreted to the examiner by the performance of prescribed movements. The paralytic condition of the larynx and pharynx at last constantly threatened suffocation. The urine became albuminous, having been normal before; and the patient rapidly emaciated. The excretory functions remained unimpaired to the last. To such a sufferer, death was mercy.

The *post mortem* examination showed an atrophic condition of the dura mater. Between this very thin membrane and the arachnoid, there existed a considerable collection of serum, amounting to five ounces of fluid. The arachnoid was turbid, opaline, thickened, and easily separated from the brain-substance. The arteries of the arachnoid showed numerous white deposits in the substance of their walls. When an artery was slit open, the inner membrane could easily be separated from the outer; and the white deposits did not adhere to either, but could be perfectly enucleated. They consisted of a material of the hardness of fibrous cartilage, but were found to be fibrous only under the microscope. The hemispheres of the brain exhibited at their outer layers the condition of atrophy (by pressure?). A cortical layer, of the thickness of one-sixteenth of an inch, yellow and firm, was succeeded inwardly by a gelatinous glistening layer of about one-eighth of an inch in thickness, and upon that followed normal brain-substance. No vestiges of any extravasation could be discovered. The lungs exhibited numerous black spots, distributed all over

their surface, which to the touch appeared as granules imbedded in the tissue. Several were enucleated. The largest were the size of a pea. They consisted of amorphous black matter, being actually disintegrated blood, the residue, no doubt, of former extravasations. The abdominal walls contained an abscess under the peritoneum, probably of recent origin. The kidneys were in a state of fatty degeneration.

I dissected the region above the left clavicle where the tumour had been, which, at the time of the apoplectic seizure, had suddenly disappeared. Behind the clavicular portion of the sterno-cleido-mastoid muscle, just underneath the fulcrum of the omohyoid muscle, in the angle formed by the junction of the internal jugular and subclavian veins, lay a tumour of the size of a large walnut, firmly attached to the walls of the veins. The internal surface of the veins, corresponding to the parts in adhesion outside, were irregular, with several obliterated openings, and some fibres crossing the lumen of the subclavian vein. These appearances represented the residues of former perforations. The tumour was a fibrous husk, filled with thick, inspissated, and degenerated old pus. It no doubt represented the residue of the tumour, the disappearance of which accompanied the onset of the paralysis.

I have subjected to a most careful scrutiny all the anatomical detail of the case, and I have come to the conclusion that the paralysis was the consequence of the entrance into the cavities of the subclavian and jugular veins of pus contained in the abscess. This pus and *detritus* had passed with the blood to the heart, and thence was driven into the lungs. Here its first effect was to make the capillaries impervious; the heart becoming distended to its utmost on the right, empty on the left, would exert a great pressure backwards into the veins, and forwards into the pulmonary artery. Hence the capillary apoplexy in the lungs, which had left the black deposits of changed blood. The pressure in the venous system produced the symptoms of apoplexy by compression of the brain and subequent serous exudation.

CASE III. Embolia. I will shortly refer to a case of embolia, somewhat similar in its effects, which I read before this Society on March 26th, 1856, and which is published in the ASSOCIATION MEDICAL JOURNAL for April of the same year. An elderly female died of the consequences of kidney-disease, its stages modified in a remarkable manner in the left kidney. There was eccentric hypertrophy of the whole heart, producing fibrinous clot in the right auricle, softening and discharge of the *débris* into the lungs. Mechanical stasis and hepatisation of the lungs, with expectoration of blood, ensued; the pressure in the venous system produced œdema of the arachnoid, with convulsions and paralysis. In the heart was found the husk, hollow, and containing yet some *detritus*, of the fibrinous concretion. *Detritus* was discovered in the finer ramifications of the pulmonary artery.

Intravasation of air produces symptoms very similar to those of extensive embolia of the lungs. The entrance of air into the veins, in fact, kills by interruption of the pulmonic circuit, consequent pressure in the veins, with pressure upon the brain, and ultimate exudation or extravasation. Upon this point, I have made direct experiments by blowing air into the jugular vein of horses. The pressure in the venous system rises to an extraordinary degree.

CASE IV. Arterial Intravasation. A boy, aged 11 years, came under my care with symptoms of shifting rheumatism. He complained of pain in the left side, underneath the heart, which he ascribed to ill treatment from another boy. The pain shifted to the back; the left hand became swelled and painful, the left foot having been so a little before. I diagnosed rheumatic fever, with a query. On the fifth day, pain in the region of the bladder came on, with occasional changing. All outward symptoms disappeared, as well as all internal objective symptoms, with the exception of the high fever. The heart was expressly examined, and found healthy. Two days later, there was systolic murmur in the left heart.

The boy complained of constant pain in the belly. The scrotum was slightly œdematous, his feet and legs cool. The pain in the belly he also ascribed to ill treatment from another boy, who, he said, had kicked him all over his body while on the ground. He continued to fever, and died one night rather suddenly, all medical treatment notwithstanding.

On *post mortem* examination, I found that death was due to hæmorrhage from rupture of the aorta at its bifurcation, under the following circumstances. There existed what appeared to be an abscess of the right psoas muscle, in the cavity of which the right iliac artery terminated, being obliterated on the other side of the cavity. The left iliac was similarly enlarged, but

more in the manner of an aneurism. Both these cavities involved the bifurcation of the aorta, and had corroded and thinned the wall of the ascending cava. There was endocarditis, evidently of recent origin, and an abscess in the spleen.

The interpretation of this case was connected with great difficulty, as, owing to the continually repeated statement of the ill-treatment received, it became the subject of a coroner's inquiry. Abscess of the psoas muscle being a well-known idiopathic disease, due to causes not known, has also been observed as a consequence of violence applied to the abdomen. Aneurism, of a traumatic nature, has also been observed after kicks upon the belly, and the bifurcation of the aorta, situated as it is on the most prominent part of the spine, is a very likely part to be injured by such a cause. That the pseudo-rheumatic symptoms were due to pyæmic infection of the blood, I am inclined to believe. The case is open to different constructions in some respects, but the fact remains that an abscess and an artery communicated, that *detritus* was carried into two large arteries, which were thereby obliterated, almost entire paralysis of the lower extremities and sinking of the temperature being the consequence. It is not difficult to comprehend the infection of the blood to have been effected by the entrance into the iliac artery of fluid pus before its obstruction with *detritus*, and the return of this fluid with the venous blood to the general circulation, there to effect the swelling of hand and foot, the endocarditis and the abscess of the spleen.

The œdema of the scrotum is interesting in a diagnostic point of view, as it was caused by the compression of the seminal veins, which passed across the most prominent points of the abscesses. From the same cause the ureters down to the places of disease were considerably enlarged, and filled with urine.

CASE V. Arterial Embolia depending upon Heart-Disease. This I have observed in several cases. In one, that of an elderly lady, the heart disease was in apparent connection with former dropsy, from nephritis. A clot formed in the left heart was carried into the left crural artery. The left leg was quite cold, like a dead limb, and benumbed. The toes could not be moved. The leg became dark, and blistered, gangrene setting in, at the beginning of which the patient succumbed.

CASE VI. Entrance of Atheromatous Matter and Calcareous Plates into the Arterial System. I have observed the entrance of atheromatous matter and calcareous plates into the aorta of an elderly female, who died of somewhat sudden effusion of serum in the abdomen, connected with the effects of gastric ulcer upon the liver and portal vein. At the *post mortem* examination, a calcareous plate was found arrested at the bifurcation of the aorta, where it had been carried from a corroded portion of the thoracic aorta.

It deserves to be pointed out, that in two of the cases above related, the kidney disease was unaccompanied by dropsy in its later stages, which produced the paralysis. In one case the kidney disease was the consequence of the general paralysis. In two cases, the heart disease giving rise to clots, was due to kidney disease. And in the case of the elderly lady who died of gangrene, after embolia, no kidney disease could be discovered by examination of the urine, although she had been dropsical years ago.

In the cases related, the paralysis was mainly confined to the motor nerves, or was caused by the absence from the muscle of arterial blood. In most cases sensibility was only impaired, not absent.

The absence of extravasated blood from the brain is also a remarkable feature, proving that the blood vessels of the brain have not, or only little, tendency to rupture, unless they are in an idiopathically diseased state.

The case of cystostasis is closely allied to those cases of pseudo-fibrinous clot formation, where the clots are found to be made up of white blood-corpuscles mainly. These corpuscles are always very glutinous, as is evident from the manner in which, in the frog at least, they adhere to the walls of capillaries. But in the above case analogy is hardly needed to illustrate the direct observation.

I have thus laid before you results of the use of the scalpel and microscope mainly, results however which I hope will appear of some practical usefulness by combination with the clinical history of the cases. All new doctrines require frequent rectification and revision. And if to the doctrine of intravasation and embolia I have been able to add the novelty of cystostasis, I hope that my lucubrations will not be considered altogether unprofitable.