On some of the principal effects resulting from the detachment of fibrinous deposits from the interior of the heart, and their mixture with the circulating blood / by William Senhouse Kirkes.

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ON

SOME OF THE PRINCIPAL EFFECTS

RESULTING FROM THE

DETACHMENT OF FIBRINOUS DEPOSITS

FROM THE

INTERIOR OF THE HEART,

THEIR MIXTURE WITH THE CIRCULATING BLOOD.

BY
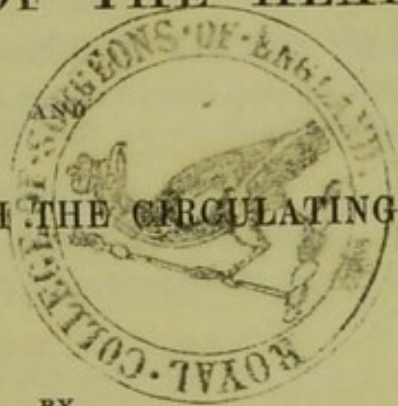
WILLIAM SENHOUSE KIRKES, M.D.

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LONDON:

1852.

THAT the fibrinous principle of the blood may, under
certain circumstances, separate from the circulating fluid
during life, and be deposited within the vascular system,
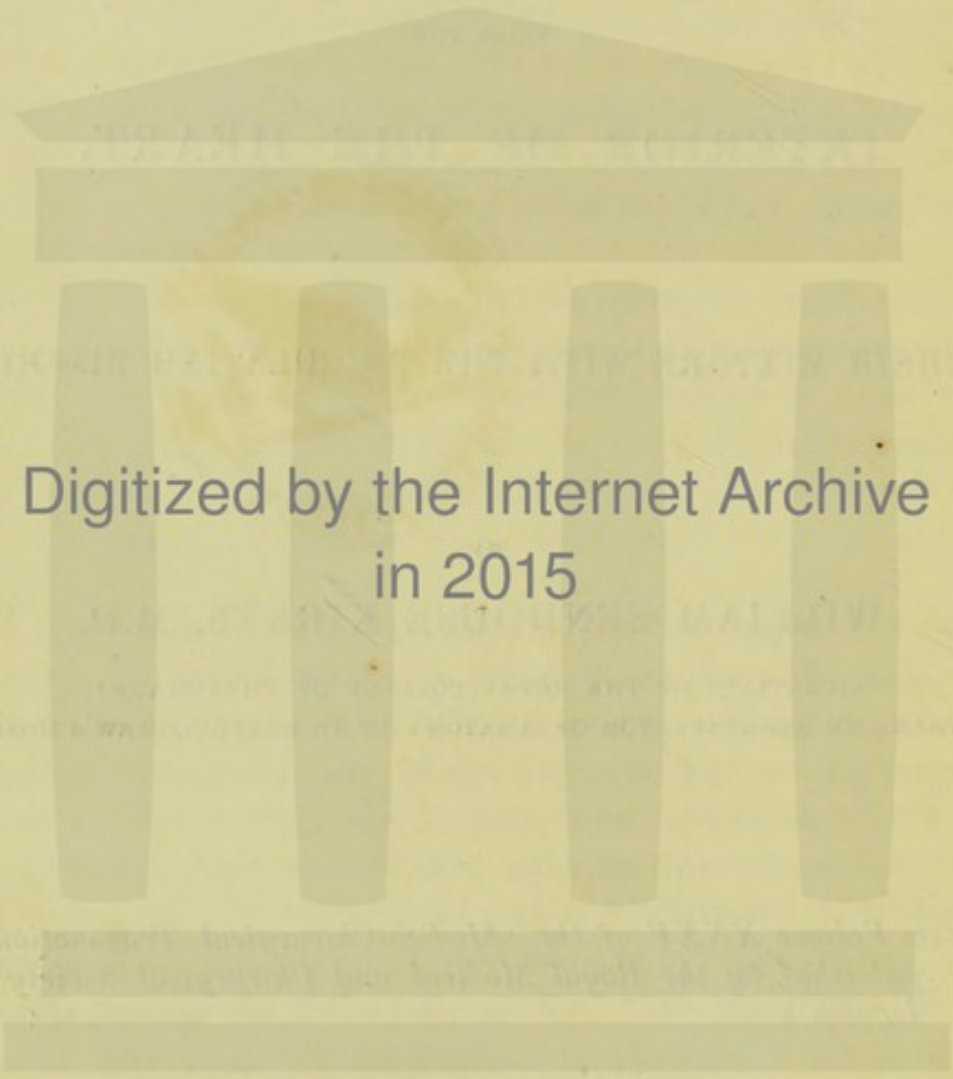especially on the valves of the heart, is a fact so clearly
established and so generally admitted, that I need only, at
the outset of the communication I have the honour to pre-
sent to this Society, allude to it as a settled truth, and refer,
for the proofs, to the various general works on diseases of
the heart and blood-vessels, and to such special essays on
the subject as those of Dr. Burrows[1] and Dr. Hughes.[2]
From these sources may also be gathered nearly all that is yet
known respecting the various conditions under which the depo-
sition of fibrine takes place, and the several forms which the
deposits assume. Into these general details I do not purpose
entering, my object being simply to consider the effects which
the deposits may produce on the system at large. It may, how-
ever, be premised that the forms of fibrinous concretions to

[1] Med. Gaz., vol. xvi, 1834-5.   [2] Guy's Hosp. Reports, vol. iv, 1839.

which my observations chiefly apply, are, first, the masses usually described as Laennec's globular excrescences; and, secondly, the granular or warty growths adhering to the valves and presenting innumerable varieties from mere granules to large irregular fungous or cauliflower excrescences projecting into the cavities of the heart.

Avoiding all discussion concerning the origin of these latter growths, I proceed at once to state that in whatever way they may originate, they are, when once formed, full of peril, and often remain so even long after the circumstances which gave rise to them have passed by. If of large size and only loosely-adherent, as they often are, one or more masses of even considerable magnitude may at any time be detached from the valves and conveyed with the circulating blood until arrested within some arterial canal which may be completely plugged up by it, and thus the supply of blood to an important part be suddenly cut off, and serious, even fatal results ensue. Or, the deposits on the valves may be detached in smaller masses, and pass on into arteries of much less size, or even into the capillaries, where, being arrested, they may cause congestion, followed by stagnation and coagulation of the blood, with all the subsequent changes which blood coagulated within the living body is liable to undergo. In this way are probably induced many singular morbid appearances often observed in internal organs, and rarely well accounted for. Again, the masses of fibrine may soften, break up, and discharge the finely granular material resulting from their disintegration; and this, mingling and circulating with the blood, may give rise to various disturbances indicative of a contaminated state of this fluid, producing symptoms very similar to those observed in phlebitis, typhus, and other analogous blood-diseases. In one or more of these several ways, and probably in others not yet clearly recognised, fibrinous material detached from the valves, or any other part of the interior of the heart, may be the cause of serious secondary mischief in the body.

It appears unnecessary to insist here on the possibility of any of the various forms of fibrinous deposit found within

the heart being detached either spontaneously or by the mere force with which the current of blood passes over the surfaces on which they are placed. For it is well known that after death a very gentle force, sometimes even the slightest touch, will loosen and dislodge both small granular particles and masses of considerable size from the valves and inner surface of the heart. Not unfrequently, indeed, lumps of old laminated fibrine of even considerable magnitude are found loose in the cavities of the heart, having probably dropped off before death; and sometimes a mass of this kind may be found some distance along the aorta or pulmonary artery.

It is clear, then, that such fibrinous deposits may admit of being very readily detached, and it must be equally clear that once floating freely in the blood they are exposed to the almost certain consequence of being transmitted with this fluid, and stopped at the first vessel too narrow to allow of their transit.

The parts of the vascular system within which these transmitted masses of fibrine may be found will of course depend, in great measure, upon whether they proceeded from the right or left side of the heart. Thus if they have been detached from either the aortic or mitral valves, they will pass into the blood propelled by the left ventricle into the aorta and its subdivisions, and may be arrested in any of the systemic arteries or their ramifications in the various organs, especially those which, like the brain, spleen, and kidneys, receive large supplies of blood directly from the left side of the heart.

If, on the other hand, the fibrinous masses are derived from the pulmonary or tricuspid valves, the pulmonary artery and its subdivisions within the lungs will necessarily become the primary if not the exclusive seat of their subsequent deposition. A division of the subject being thus naturally formed, I propose to embody the remarks I am about to submit to the Society under two principal heads, considering—

1st. The remote effects resulting from the separation of

fibrinous or analogous deposits from the valves or interior of the left side of the heart; and

2d. The corresponding effects produced by the detachment of like deposits from the valves or interior of the right side of the heart.

PART I.

On the effects which may result from the separation of fibrinous deposits from the valves or interior of the left side of the heart, and their circulation with the systemic blood.

In endeavouring to elucidate this part of the subject, I beg to draw attention, in the first place, to instances in which it seems probable that masses of considerable magnitude have been detached from the left side of the heart, and subsequently arrested in an arterial channel of notable size; secondly, to some of the effects which seem to ensue when smaller arterial vessels or capillaries are similarly blocked up; and, thirdly, to circumstances which make it probable that, not unfrequently, the introduction of particles of fibrine into the circulating blood gives rise to constitutional symptoms indicative of a poisoned state of this fluid.

1. The first three cases which I shall offer are in many respects identical; for in each death seemed to ensue from softening of the brain, consequent on obliteration of one of the main cerebral arteries by a mass of fibrinous material, apparently derived directly from warty growths on the left valves of the heart.

CASE I.—Margaret Shaw, æt. 34, a pale, weakly-looking woman; admitted into St. Bartholomew's Hospital, under Dr. Roupell, about the middle of July, 1850, on account of pains in her lower limbs, and general debility. A loud systolic murmur was heard all over the cardiac region. No material change ensued in her condition until August 7th, when, while sitting up in bed eating her dinner, she suddenly fell back as if fainting, vomited a little, and when

attended to was found speechless, though not unconscious, and partially hemiplegic on the left side. The hemiplegia increased, involving the left side of the face as well as the limbs, and gradually became complete in regard to motion, while sensation seemed to remain unimpaired. She continued speechless and hemiplegic, but without loss of consciousness, for five days, when she quietly died.

On examining the body, six hours after death, the skull and dura mater were found natural; but the small vessels of the pia mater were much congested, the congestion amounting, in some places, almost to ecchymoses. The right corpus striatum was softened to an extreme degree, being reduced to a complete pulp of a dirty greyish-white tint, and without any remains of its characteristic striated structure. The corresponding optic thalamus was healthy; but a condition of pale softening, similar to that affecting the corpus striatum, existed also to a considerable extent in the posterior lobe of the right cerebral hemisphere. The rest of the cerebral substance of this hemisphere was softer than natural, and appeared to contain less blood than ordinary. All other parts of the brain were healthy. The right middle cerebral artery just at its commencement was plugged up by a small nodule of firm, whitish, fibrinous-looking substance, which, although not adherent to the walls of the vessel, must have rendered its canal almost, if not quite, impervious. With the exception of a speck or two of yellow deposit in their coats, the rest of the vessels at the base of the brain were healthy and filled with dark blood.

The heart was enlarged; on its exterior were several broad white patches of old false membrane. The right cavities and left auricle contained recent separated coagula; the fibrine firm and whitish. The right valves were healthy; so also were the aortic, with the exception of slight increase of thickness. The mitral valve was much diseased, the auricular surface of its large cusp being beset with large warty excrescences of adherent blood-stained fibrine. There were a few scattered deposits in the coats of the aorta. The right common iliac artery, about an inch above the

origin of its internal branch, was blocked up by a firm, pale, laminated coagulum, which extended into the internal iliac, and for about a quarter of an inch down the external iliac, where it terminated rather abruptly. The lower portion of the coagulum was colourless, and softer and more crumbling than the upper, which was also more blood-stained and laminated. There was no adhesion of the coagulum to the walls of the vessels. No similar clot existed in the iliac vessels on the opposite side. The pleuræ were adherent in places; the lungs œdematous, and in places solidified by compact greyish-white masses, such as might result from uncured pneumonia. The pulmonary vessels were free from old coagula.

The liver and intestinal canal were healthy. The spleen was large, pale, and soft. One large portion, about a fourth of the organ, was converted into a mass of firm, yellowish-white, cheesy substance. The kidneys were pale, rough, and granular. Within the cortex of the right were several large masses of yellow deposit, surrounded by patches of redness. The portions of medullary structure passing to these deposits were compact, dryish, and yellow.

In the case just narrated death evidently resulted from softening of a large portion of the right side of the brain; and the cause of this softening appeared to be an imperfect supply of blood, consequent on the middle cerebral artery of the same side being obstructed by a plug of fibrine within its canal. I am not aware that there has yet been recorded a case in which fatal softening of the brain resulted from a cause like this; therefore in itself this case is one of value. That the existence of the fibrinous coagulum within the cerebral artery was the real cause of the changes in the brain, can, I think, scarcely admit of question. The sufficiency of such an obstruction to produce the effects ascribed to it is fully established by the many instances in which disturbance, or complete arrest of function in a part, with subsequent atrophy or disorganisation of its tissue, results from any circumstance which materially impedes or entirely cuts off its supply of blood. Examples of this kind

at once suggest themselves;—such as the weakened and subsequently degenerated heart, when the coronary vessels are diseased by deposits in their coats; the feebleness, atrophy, or even gangrene, ensuing in the whole or part of a limb whose arteries are similarly diseased or obstructed from any other cause; also the impairment of cerebral function and subsequent softening of the tissue of the brain when the cerebral vessels are much diseased. But perhaps the best illustration bearing on the case in question is afforded by the results sometimes observed after ligature of one of the common carotid arteries. Such an operation is not unfrequently followed, almost immediately, by giddiness, loss of speech, and unconsciousness, which may pass on even to fatal coma. When not thus speedily fatal, hemiplegia of the side opposite to that of the ligatured artery may ensue, and death may occur from that cause at a more remote period, while examination after death discloses a greater or less amount of disorganisation, amounting sometimes to gangrene, in the cerebral substance, especially on that side on which the operation was performed.[1] The effects of sudden diminution in the supply of blood to one half of the brain, are strikingly illustrated, too, by a most interesting case recently published in the 'Transactions' of this Society by Dr. Todd,[2] in which syncope, followed by hemiplegia and softening of one side of the brain, resulted from the sudden formation of a dissecting aneurism of the aorta, innominata, and right carotid arteries, whereby the current of blood along the carotid and vertebral arteries on this side was all but completely arrested. Effects such as these, resulting from sudden diminution in the quantity of blood sent to the brain, seem to have been, to a certain extent, imitated in the case just read to the Society, in which a considerable

[1] The whole subject of the effects produced on the cerebral circulation by ligature of the carotid artery has been so thoroughly discussed by Dr. Burrows, in his work on 'Disorders of the Cerebral Circulation,' (pp. 72—9,) that it seems quite unnecessary to add more to the remarks made on this subject in the text.

[2] Vol. XXVII.

part of one cerebral hemisphere, ceasing to receive its due supply of blood, in consequence of obstruction in one of its main arteries, at once failed in its functions, and ultimately became disorganised.

Admitting this explanation of the mischief which ensued in the brain, one is naturally led to inquire into the source of the fibrinous plug found in the middle cerebral artery. The suddenness with which the cerebral symptoms came on made it probable that the blocking up of the vessel was equally sudden, and not the result of a gradual coagulation of blood in this situation. The absence, too, of all appearance of local mischief in the coats of the vessel at the obstructed part, and of general disease of the arterial coats elsewhere, also pointed to some other than a local origin for the clot; and I formed the opinion at the time of the examination, that a portion of the fibrinous growths found on the mitral valve had become detached, and then carried with the stream of blood up the carotid artery, until arrested at the angle whence the middle cerebral proceeds. This explanation, which fits equally well for the origin of the plug impacted in the common iliac artery, appears so reasonable, that it is difficult to doubt its correctness; for, as already remarked, it is quite conceivable that portions of the loosely-adhering masses of fibrine might be readily washed off by the stream of blood continually passing over the valve; and that when once admitted into the circulating current, such portions would necessarily be arrested the moment they arrived at a vessel too small to allow of their transit along its canal.

Before commenting further on this case, or attempting to prove that the yellow masses found in the kidneys and spleen were also closely connected with the fibrinous growths on the mitral valve, I beg to offer the particulars of two other cases parallel to the last.

CASE II.—Louisa Richards, aged 24, a thin, pale young woman, was admitted into St. Bartholomew's Hospital, under Dr. Burrows, in November, 1851, on account of

hemiplegia on the right side, which had ensued suddenly, while at dinner, five days previously. The loss of motion was complete, that of sensation partial. Her intelligence was tolerably clear, though her articulation and memory of words were impaired. She appeared to have been in tolerable health at the time of the seizure, but had latterly been exposed to great privations. On auscultation, a loud systolic murmur was heard at the apex of the heart; the sounds clear at the base. At first the symptoms amended; but in a fortnight headache, vertigo, and increased difficulty of speech returned, and there was no steady improvement afterwards, but increasing emaciation, debility, and unconsciousness until her death, in a state of coma, three months after admission. A few petechial spots appeared on the body a few days before death, together with swelling of the right hand and foot. Throughout its progress, the case was regarded by Dr. Burrows as one of gradually-advancing softening of the left side of the brain; and the evident co-existence of extreme mitral disease invested the autopsy with unusual interest.

Examined 32 hours after death, the body was found extremely emaciated. Numerous minute petechial spots existed on the neck, chest, and extremities, and several dusky-red blotches on the ankles. The skull was thin, light, and deficient in blood. The tissue of the pia mater, over almost every part of the brain, was spotted and mottled by dark-red and pinkish blotches of extreme congestion, amounting in places almost to ecchymoses. In the midst of a few of these engorged patches were streaks of yellowish material, as if the neighbouring tissue was infiltrated with pus; but on microscopic examination the yellowish material was found to consist of multitudes of minute glistening granules, like particles of fat: nothing like pus-corpuscles could be found, and it is probable, therefore, that the yellow material was composed merely of degenerated blood or fibrine. The surfaces of the arachnoid were smeared over by a layer of soft pinkish material, like thin mucilage. There was considerable excess of watery fluid in the cavity

of the arachnoid and in the tissue of the pia mater. The general substance of the brain was soft and watery, and of about ordinary vascularity. The left corpus striatum, and the portion of cerebral hemisphere immediately around it, were reduced to a soft, shreddy, almost diffluent pulp, of a pale greyish or dull white colour. The left optic thalamus appeared of ordinary consistence, as did also the corpus striatum and optic thalamus on the opposite side. The septum lucidum was entire; the fluid in the lateral ventricles pale, rather turbid. No trace of either old or recent hæmorrhagic cyst could be found. The left middle cerebral artery, immediately after its origin, was completely plugged up by a firm, whitish, oval mass, about the size and form of a grain of wheat : this mass was tightly impacted within the vessel, the canal of which it completely obliterated, while it loosely adhered to its interior. The branches immediately beyond the obstruction were reduced to firm, narrow, yellowish or rust-coloured cords. These obliterated vessels were imbedded in the pulpy, diffluent, cerebral substance immediately below and in front of the softened corpus striatum already described. A similar though smaller fibrinous plug existed in the right middle cerebral artery, but did not quite block up the canal of the vessel. There was no trace of atheromatous disease of the arteries of the brain, nor of any other part of the arterial system examined. There were no old coagula in any of the cerebral sinuses, which contained recent clotted and fluid blood.

The pericardium contained a few drachms of clear fluid; there were several white patches of old lymph on the surface of the heart, and a few petechial spots. The heart was much enlarged, especially when contrasted with the general wasting of the rest of the body. The right cavities and valves were healthy; the left ventricle much hypertrophied. The mitral valve was the seat of numerous large fungous or condylomatous growths, consisting of pale, tolerably firm masses of fibrine, heaped up in warty excrescences along the auricular border of the valve, and extending for some distance along the posterior part of the interior of the auricle.

The individual masses of fibrine were of various shapes and lengths, some nearly half an inch long; they were pretty firmly attached to the thick and roughened surface of the valve, yet portions could be readily detached, and, when submitted to pressure, crumbled down beneath the finger. Several of the masses extended among the tendinous cords, which were thickened and united together in bundles; one of the thickened cords was distinctly ulcerated across, while portions of fibrine adhered rather firmly to each of the separated ends.

The right external iliac artery immediately above Poupart's ligament was blocked up by a pale, firm, laminated coagulum, which was loose, yet completely filled up the canal of the vessel, the interior of which was smooth and the coats of natural thickness. The coagulum was about an inch long, beginning and terminating abruptly: externally it was quite pale, while some of the inner laminæ were blood-coloured; in one or two places the interior was hollowed into little spaces, containing a thin reddish-brown pulpy fluid. The right femoral vein was also blocked up by an almost similar coagulum, which extended along the entire course of the vessel into the ham; yet in no part was there any undue adhesion between the clot and the interior of the vein, or any other evidence of inflammation of the vessel. There were no old coagula in any other of the vessels examined; and these included the principal arteries and veins of the left lower and both upper extremities, the common and internal iliacs, the carotid and subclavian arteries, the two venæ cavæ and the main venous branches entering them; also the pulmonary arteries and veins. The blood itself was properly coagulated and separated in the cavities of the heart; yet the fibrine was scanty and pale.

In the pleuræ were a few old adhesions, and several petechial spots scattered over the surface. The lungs were healthy, with the exception of some œdema and congestion of the lower lobes. The mucous membrane of the larynx and trachea presented several petechial-looking spots. Similar spots were also scattered over the peritoneum. The liver

was pale and soft, but healthy. The spleen was much enlarged, and its texture soft; while imbedded within it were numerous various-sized circumscribed masses of solid, yellowish, cheesy-looking substance. In consistence these masses varied,—some being compact and firm, others soft, some almost pulpy. A few of the deposits were quite small, others bigger than walnuts. The existence of old coagula in the branches of the splenic artery was not clearly determined. The kidneys, in general structure, were healthy; yet within the cortex of each were numerous yellow or buff-coloured masses similar to those in the spleen. They were of various sizes, and seemed also to vary in the length of time they had existed, some being compact, yellow, depressed on the surface, and presenting scarcely any appearance of redness at their circumference, while others appeared of more recent date, and were surrounded by a distinct halo of spotted redness. Although existing principally in the cortex, yet streaks occasionally extended from them into the tubular structure of the gland. Examined microscopically, ordinary urinary tubules were found in the neighbourhood of the yellow masses; yet sections of the masses themselves exhibited little else than small narrow canals, apparently blood-vessels, containing multitudes of minute dark particles, similar to those found in the vessels of the pia mater, and apparently consisting of degenerated fibrine. One kidney was injected through the renal artery: the fluid passed readily into those portions of the gland which were free from the yellow masses, yet into the parts where these masses were most numerous not a trace of the injection entered.

The stomach and intestinal canal were healthy, with the exception of a few ecchymosed dots on the mucous membrane of the stomach, and the existence of several congested patches on the peritoneal surface of the small intestine. These latter spots were distinctly caused by engorgement of the extremities of the mesenteric vessels, in which blood seemed to have been arrested some little time before death, for in the interior of the congested spots buff-coloured specks

were clearly observed. No doubt the various petechial-looking spots observed in the different serous and mucous membranes, including that also of the bladder, were of the same nature, consisting of blood stagnant in minute vessels, and subsequently partially decolourised; for in the centre of almost all these spots was a distinct yellow or buff-coloured speck. The uterus and its appendages, as well as other parts not specially named, were healthy.

The principal points of resemblance between this case and the one previously related may be briefly recapitulated. They were, softening of a limited portion of the brain, producing death by hemiplegia; obliteration of the cerebral artery supplying the softened part, the obliteration being caused by an old fibrinous coagulum impacted within, but not adherent to, the interior of the vessel; similar old coagula in one of the iliac arteries; fibrinous deposits in the spleen and kidneys; and the presence of large warty growths on the mitral valve.

There were other minor features of resemblance equally illustrative of the primary cause of all this mischief; but these may be reserved until after the narration of the following case, which affords a no less striking example of the class under consideration:

CASE III.—William Purdy, æt. 24, a gas-fitter, of intemperate habits, was admitted into St. Bartholomew's Hospital, under Dr. Roupell, January 22d, 1852, in a state of extreme emaciation and debility, with sloughs on his back, and hemiplegia of the left side. Both feet and legs were much swollen, while the femoral vein in each groin was found hard, cord-like, and painful on pressure. Several dusky blotches, composed of distended capillaries, were also observed on the right thigh. On auscultation a prolonged, harsh, systolic murmur was heard at the apex of the heart, fading towards the base, where the second sound was clear. It was learnt that three months previously, after exposure to cold, he was attacked with diarrhœa, to which he was subject, and severe pain across the back. He continued ill

and under treatment for about two months, suffering with diarrhœa and obscure pains in his joints, which his medical attendant considered to be rheumatic. At the end of this time he was suddenly attacked with severe pain in the region of the heart, accompanied by palpitation, both of which symptoms were relieved by the application of leeches and blisters, and in a week had almost disappeared; but he still continued too ill to leave his bed. One night, about a fortnight after the commencement of the cardiac symptoms, he suddenly got out of bed, quite contrary to his usual custom, and left the room, apparently for the purpose of relieving his bowels. His wife immediately followed, and found him in a confused, bewildered state, with his left hand and arm paralysed, his face drawn to one side, and his speech impaired. Shortly after being placed in bed the left leg became powerless like the arm, and both continued so until his admission to the hospital a fortnight afterwards, at which time the loss of motion was complete, though sensation was not much impaired. He had complained of headache a few days before the seizure, but at the time of the attack did not lose his consciousness, and he had no fit either previous or subsequent to the paralysis.

The swelling of the ankles had existed about three days previous to admission, having been preceded by pain in each thigh.

For a few days after admission he seemed to rally under the influence of tonics, nutritious diet, and wine, while the pain in the thighs was relieved by the application of leeches over the femoral veins. The amendment, however, was but temporary, and he died in ten days after admission.

An examination of the body was made twenty-eight hours after death. The emaciation was considerable. The lower limbs remained œdematous, especially the left, the foot of which was of a dark, livid colour. The tissues generally were very pale, especially about the scalp. The skull was pale and light. The membranes of the brain were healthy, but pale, while there was a considerable excess of clear fluid in the cavity of the arachnoid and the tissue of the pia

mater. The vessels of the pia mater were unusually deficient in blood, almost empty. The substance of the brain was remarkably pale, soft, and watery in every part; there was no trace of a clot, or any manifest product of inflammation. Impacted within the right middle cerebral artery, just at its origin, was a firm plug of pale fibrinous substance, about the size of a hemp-seed, completely blocking up the canal of the vessel, while the branches immediately beyond the obstruction were narrow, but filled with dark stagnant-looking blood, which had quite a different character to that in the other cerebral vessels. There was no trace of any disease in the coats of the cerebral arteries, and no obstruction in the left middle cerebral. Within the left lateral sinus was a large mass of old dryish colourless fibrine, somewhat adherent to the lining membrane, which was spotted red. A piece of similar fibrine existed also in the left internal jugular, but not connected with the mass in the lateral sinus. The other cerebral sinuses and right internal jugular were free from old coagula. The pericardium was healthy within, but externally it adhered to the left pleura. The heart was about natural in size, but much diseased in its interior, the tricuspid, mitral, and aortic valves being encrusted over with large, firm, warty vegetations. On the tricuspid valve these growths were attached along the auricular surface, just above its free border. They varied considerably in size and number at different parts of the valve; many of the masses consisted of small compact roundish or oval bodies about the size of hemp-seeds, or bigger, attached singly or in clusters to the edge of the valve and to the tendinous cords to which they more or less tightly adhered. In structure they were firm and solid throughout, of a yellowish-white colour, and evidently composed of a dense fibrinous substance. The free border of the mitral valve was thickly studded with a continuous ridge of rough cauliflower-like masses of firm white fibrine, which formed warty excrescences of various sizes and shapes. One mass was nearly as big as a hazel nut, firm, elastic, and solid throughout, and of a mottled yellow and red colour on section.

The aortic valves were studded by a similar crop of smaller warty vegetations. Lying loose in the cavity of the ventricle were several small brownish nodules of old blood-stained fibrine. The muscular tissue of the heart was generally healthy; but just beneath the lining membrane of the left ventricle, and occasionally deep within its substance, were numerous pale yellow or buff-coloured blotches and streaks surrounded by red borders, and having the general appearance of the changes described under the term of capillary phlebitis. The coronary arteries were healthy; so also was the general arterial system, though the aorta and its main branches were very narrow. The principal venous trunks contained recent coagula, but the two external and internal iliac veins, and both femoral veins, were blocked up by old variously-discoloured masses of firm, friable fibrine. These old coagula were very large, and produced great distension of the veins in which they occurred. There appeared to be no disease of the coats of the veins, and the coagula were nowhere adherent to them; and the arteries leading to the lower extremities were free from old coagula.

There was nothing peculiar in the blood generally; the coagula in the right cavities of the heart presented quite ordinary characters. There were a few scattered pleural adhesions. The lungs were generally very œdematous; both lower lobes were consolidated by masses of fibrinous deposit, consisting principally of reddish-brown pulpy material, surrounded by darker portions composed of recently extravasated or stagnant blood. In some parts of the right lower lobe were several collections of greenish thick pus, the majority being about the size of peas, a few as large as a walnut. All the branches of the pulmonary artery leading to the lower lobes, were completely plugged up by old, firm, variously-coloured laminated coagula. The branches going to the upper lobes also contained old coagula, though these were softer, apparently of more recent date, and did not so completely block up the canals of the vessels. The pulmonary veins contained recent coagula. The liver appeared healthy, though pale; and there were no old coagula in any

of the portal or hepatic vessels. The spleen was enlarged to about three times its natural size, and very dark from extreme sanguineous engorgement; its tissue was soft and pulpy, while within its substance were several various-sized circumscribed masses of fibrinous deposit. These masses varied in colour from dirty brown, spotted with red, to bright yellow; and in consistence from that of a firm, friable, cheesy substance, to that of a semi-fluid pulp. One of the collections of pulpy substance was contained in a kind of cyst bounded by the capsule of the spleen; at one point the capsule had given way, and a considerable quantity of the pulpy fluid was found in the peritoneal cavity, and smeared over the intestines. The absence of any signs of peritonitis makes it probable that the escape of this material had taken place either just previous or subsequent to death. There was nothing deserving particular notice in the state of the intestinal canal. The kidneys, though healthy in general structure, were the seat of numerous, large, yellow, fibrinous masses, similar to those in the spleen. In the left, these masses were so abundant and large as almost to replace the entire structure of the gland. All the masses were firm and compact; many of them were surrounded by zones of redness. The main artery of this kidney, from the point of its entrance and along all its traceable subdivisions, was filled up by pale, firm, old fibrine. Similar, though redder, old coagula existed in the renal vein. There were no old coagula in the artery or vein of the right kidney, which, moreover, was much less diseased than the left.

In all essential respects this case closely resembles the two previously narrated. In each there was pale softening of the brain; a plug of fibrine obliterating the canal of one of the main cerebral arteries; masses of fibrinous deposit in the kidneys and spleen; and, which seemed to be the source of the mischief elsewhere, large, warty, fibrinous excrescences on the left valves of the heart.

So many, and yet such rare features of resemblance, cannot fail in demonstrating a very close connection between

the several morbid appearances so exactly reproduced in each case.

Although in the autopsy of the last case it was not particularly noted that the right side of the brain, or any portion of it, was softer than the rest, yet the existence of hemiplegia on the left side, and the softening in each of the former cases being most marked at the parts supplied by the obstructed arteries, leave little room to doubt that in this case also, those portions of brain supplied by the right cerebral artery were more atrophied, though perhaps not manifestly much softer than other parts whose vessels were not thus obstructed.

Besides the existence of fibrinous vegetations on the valves of the left side of the heart, and the formation of fibrinous deposits in other parts freely supplied with blood by the left ventricle, it is worthy of particular attention that in this case there were also warty growths on the tricuspid valve, together with coagula in the pulmonary arteries, and masses of fibrinous deposit in the substance of the lungs. The importance of this fact, in support of the close and direct connection between deposits on the valves of the heart, coagula in the arteries, and fibrinous deposits in various organs, will be again noticed. At present I would allude to it merely in support of the view that the clot in the middle cerebral artery was in this, as in each of the other cases, directly derived from the vegetations on the left valves of the heart.

At first it appears singular that in each of these cases, as also in others I have had the opportunity of seeing, the clot should be found as nearly as possible in the same situation. But a glance at the arrangement of the arteries at the base of the brain, especially in an injected specimen, will make it clear that this point is, of all others, the one perhaps most likely to arrest a solid mass floating in the blood, transmitted to the brain by the internal carotid artery; for, almost directly after its entrance into the skull, the carotid divides into its two main branches, the middle and anterior cerebral, which immediately diverge in almost opposite direc-

tions. The sudden diminution in size, resulting from the division, and the different directions at once taken by the two branches, will together tend to make the angle whence the branches diverge well calculated to arrest any solid body transmitted along the carotid; while, since of the two branches, the middle cerebral is the largest, and also maintains more nearly than the anterior the original direction of the trunk from which they both sprang, a solid body seems more likely to pass into it than into the anterior division. And such is found to be the case; for, if the plug is not found sticking directly at the angle, it is found a short distance up the canal of the middle cerebral.

Once arrested at the angle, or within the canal of the middle cerebral artery, a mass of fibrine, if large enough to block up the vessel, becomes at once the cause of loss of function and subsequent atrophy to almost all that portion of the brain supplied by the obstructed vessel; for, although by the arrangement of the vessels composing the circle of Willis, ample provision is made against obstruction ensuing in any of the main arterial channels of either side *previous* to their arrival at the circle, there is comparatively little provision for an obstruction ensuing in any of the main branches into which this arterial circle breaks up. This remark applies especially to the middle cerebral artery, which, if plugged up at its origin, becomes at once almost useless as a blood-vessel; for nearly all its divisions, especially those for the central parts of the brain, proceed to their several destinations without receiving any anastomosing branch from the other divisions of the circle of Willis. The truth of this will be evident on examining an injected brain: and the fact at once explains why the portions of brain supplied by the branches of an obstructed middle cerebral artery are deprived of all nourishment, except the little they may receive from the minute inosculations provided by the ultimate divisions of other arterial branches of the circle of Willis.[1]

[1] Since writing the above I find an almost similar remark made by Dr. Todd, in his comments on a case already alluded to. Speaking of the fact of the softening of the brain in that case being limited to that part supplied by the

The anterior cerebral artery is, by means of the anterior communicating branch, in great measure guarded against the occurrence of a similar evil; and in this way may be explained the infrequency of softening of the anterior cerebral lobes compared with the more frequent occurrence of this condition in the parts supplied by the middle cerebral artery.

I trust that the details of the three cases just submitted to the Society will be considered sufficiently satisfactory to establish the two principal points I have been desirous of proving in this part of my communication, namely, that softening of a portion of the brain, with attendant loss of function, may result from obstruction of a main cerebral artery by the lodgement of a plug of fibrine within its canal, and that the foreign substance thus obstructing the vessel is probably not formed there, but is derived directly from warty growths situated on the left valves of the heart.

It has long been admitted that any disease of the cerebral arteries sufficient to impede the transit of a due quantity of blood may induce softening of the brain, from imperfect nutrition. But the diseased state of the vessels to which nearly all observations on the subject apply have reference only to the peculiar fatty or atheromatous condition so frequently presented by the coats of the cerebral arteries, especially in persons of advanced life. And I have been able to meet with very few recorded instances in which distinct fibrinous clots have been noticed blocking up the canal of any of the arteries of the brain : and even when their existence has been noted, the conditions leading to their formation, and the relation which they bear to the attendant cerebral softening, have, so far as I know, never received an explanation similar to that which I now beg to offer.

middle cerebral artery, he says, " this artery is the principal branch of the carotid within the cranium, and has a less free communication with the corresponding ramifications of the opposite side than any of the other arteries of the brain. Hence the parts supplied by it are more apt to suffer than those which are nourished by the other branches of the carotid."—'Med.-Chir. Trans., vol. xxvii, p. 321.

By further search I might possibly have increased the number of instances in which old coagula have been found by different observers in cerebral arteries, yet since this peculiar affection of the vessels of the brain seems never to have been suspected, it has never been specially sought for, and the part in which it occurs has perhaps rarely been closely examined, the mere absence of general disease of the coats of the cerebral arteries being considered as sufficient proof that the cause of cerebral softening was not dependent on any lesion of these vessels. Yet I feel convinced that had more minute attention been paid to the condition of the middle cerebral arteries, many otherwise obscure cases of white softening of the brain, especially where attended with disease of the heart, would have been cleared up by the detection of some such cause of obstruction as that in the cases I have related; and I trust that future observations will prove this to be a not unfrequent cause of cerebral softening, especially when occurring in young persons. One feels at once inclined to ascribe very many recorded cases of cerebral softening to this cause, and arguments in favour of such explanation readily suggest themselves; but, in absence of direct proof, one must, of course, remain satisfied with the mere supposition that such explanation is correct, waiting for future investigations to determine the comparative frequency of this affection of the cerebral vessels in cases of pale, non-inflammatory softening of the brain.

It is probable, too, that many cases of partial and temporary paralysis suddenly ensuing, in one or more limbs, in young persons, especially if accompanied with signs of cardiac disease, may be due to interruption of a due supply of nutriment to the brain by the temporary plugging up of a principal cerebral artery by fibrine detached from a diseased valve on the left side of the heart. Temporary loss of power in one or more limbs is not an uncommon circumstance in young persons affected with heart-disease. A good example of this class of cases was furnished by a pale, delicate girl, admitted into St. Bartholomew's Hospital, in

1849, under Dr. Roupell, with pain and weakness in both right limbs, numbness of the back of the right hand, and flexion of the fingers of the same extremity: these symptoms being of about a month's duration. Over the semilunar valves at the base of the heart, was plainly audible a double endocardial murmur; and this persisted all the time the girl was under notice. Many such cases of partial hemiplegia in young nervous women, are no doubt rightly attributed to hysteria; yet, on the existence of such distinct evidence of cardiac disease as that furnished by a double endocardial murmur, it would scarcely be right to deny to such affection of the heart some share in the production of the paralytic state. In what way the cardiac disease may induce the symptoms of paralysis in such cases, must perhaps always be matter of doubt; yet it seems not unreasonable to infer, that the cardiac murmur may be due to fibrinous deposit on the valves, and that portions of this deposit may have been detached, and subsequently arrested in the cerebral vessel supplying that part of the brain whence the paralysed limb derives its nervous influence.

Although the arrest of a plug of fibrine within the canal of a cerebral artery would naturally tend to impairment of function and atrophy of the portion of brain supplied by the obstructed artery, yet it is conceivable that such clot may ultimately soften, break up, and be removed, and thus the vessel become permeable again; or, as suggested to me by Dr. Burrows, it may sometimes happen that the coats of the artery may, by the pressure behind, be sufficiently dilated around the clot to allow of the transit of some blood along the canal. In some such way may, perhaps, be explained the recovery sometimes observed in certain cases of partial paralysis, apparently dependent on softening, or other structural disease of the brain. But, probably, in the majority of cases, the coagulum once firmly impacted within the vessel, will tend to form an organised adhesion to the walls, and so produce permanent obliteration of the canal. In consequence of the obstruction thus produced, the blood, continually impelled up to the obliterated part, will natu-

rally tend to induce distension of the coats of the vessel immediately behind the seat of obstruction. And it may be a question, whether many of the aneurismal pouches found in the cerebral arteries, may not originate in this way. In favour of such a view may be mentioned the facts, that the origin of one or other middle cerebral artery is the most frequent seat of such aneurisms; that they are commonly found uncombined with any disease in the coats of the rest of the cerebral arteries; that they are not unfrequent in young persons, in whom general disease of the arterial system is rare; and that in many instances they are found associated with valvular disease of the left side of the heart.

As might be supposed, the arterial branches, at the base of the brain, are by no means the only arteries in which fibrinous masses, detached from the valves of the left side of the heart, and mingled with the circulating stream, may be arrested. In Cases I and II coagula were found in the iliac and femoral arteries, and in Case III in the renal; and in each of these cases the coagula were, in all probability, derived from the same source as that which furnished the clot in the middle cerebral artery, namely, the warty masses on the mitral valve. Many specimens, put up in museums, and supposed to illustrate the spontaneous coagulation of blood, or the deposition of fibrine, within limited portions of an arterial trunk, are probably to be referred to the same origin. One, in the museum of St. Bartholomew's Hospital, is probably of this nature: it consists of a portion of a femoral artery, which, with the commencement of the profunda, is blocked up by a coagulum of firm, pale, laminated fibrine. There is nothing in the appearance of the coats of the vessel which make it in the least probable that they had induced coagulation of the blood, no thickening, no roughening of the interior, and no particular adhesion of the clot to the lining membrane, while it is also stated, that there was no disease in any other part of the arterial system. The source of this coagulum should, therefore, be sought for elsewhere; and I think it may be referred to the heart, for "the valves of the aorta were in part destroyed by ulcera-

tion, and there was a growth of soft, vascular fungus from their edges." It is of course easily conceivable that a portion of this soft, warty growth might have been detached, and carried to the part of the artery where it was subsequently found. The limb from which this artery was taken became, without any evident cause, pulseless and cold, some time before death.[1] Dr. Hughes[2] quotes a case from Legroux, very parallel to this:—a woman, who had suffered with symptoms of cardiac disease, was suddenly seized with paralysis, and loss of sensation in the left arm, terminating in gangrene of the part. On her death, which occurred suddenly, eighteen days afterwards, the brachial and ulnar arteries were found plugged up by old pulpy granular fibrine; while, together with an extremely diseased mitral valve, "a concretion of exactly the same colour, texture, and consistence was discovered in the left auricle." Viewed in connection with the previous cases, the inference in this case seems natural, that the coagula in the arteries of the arm had their origin in one or more masses of fibrine, formed within and detached from the interior of the heart. The suddenness with which the paralysis of the arm ensued, is also quite calculated to favour this view, although I ought to state that a different explanation is given by Dr. Hughes, who considers the clots to have originated in the parts where they were found. Cases of this kind might readily be multiplied: and I think that, for the majority of them, the source of the coagulum found in the arteries might be ascribed to portions of fibrine detached from the valves of the heart, and carried bodily to the vessels in question.[3]

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[1] Catalogue of the Anatomical Museum of St. Bartholomew's Hospital, vol. i, series 13, No. 22. In his valuable work on 'Diseases of Arteries,' Mr. Hodgson (p. 18) mentions the particulars of a case so exactly identical with this that I cannot but think they both refer to the same subject.

[2] Guy's Hospital Reports, vol. iv, p. 164.

[3] Although in the text I have spoken of the fibrinous coagula found in the large arteries as having been probably brought thither in mass from the heart, yet I should also add, in explanation of the laminated structure they sometimes present, that the size of the .mass originally detached from the

As bearing closely on this as well as other parts of the general subject under consideration, I may quote a few particulars from the case of a young woman, whose heart is preserved in the museum of St. Bartholomew's Hospital.[1] In the left ventricle of this heart is a large aneurismal pouch, filled by a pale, fibrinous laminated coagulum, portions of which hung into the cavity of the ventricle. For eighteen months the patient had suffered from palpitation and other signs of disordered circulation. About four months before death, she lost the use of the left arm: from this she recovered; and then the left leg became similarly affected, and was at the same time swollen and painful. This also nearly got well, and then she lost the use of the right leg; which, in turn, gradually recovered. Presently, however, the left leg again became much swollen and œdematous, and the skin affected with an erysipelatous inflammation. On the subsidence of this, the patient had an attack like fever; on recovering from which there was a recurrence of paralysis in both left limbs, succeeded shortly by convulsions, of which she had several attacks, at various intervals, and ultimately died in one. The body was subsequently examined by Mr. Paget; the brain was found soft, with rather deficient vascularity of itself and its membranes, and there was an old cavity containing clear fluid in the right corpus striatum. The spinal cord was healthy throughout. With exception of the heart, spleen, and kidneys, all the other parts examined were healthy. Within the spleen were several circumscribed deposits of yellow ochre-coloured substance; and one of the main branches of the splenic artery was nearly

heart, and arrested at an angle or recess of an artery, was probably much smaller than that of the coagulum subsequently found in the vessel, the increase in size having probably taken place gradually by the successive deposition of fresh layers of fibrine on the nucleus formed by the original mass.

The formation of laminated coagula in the corresponding veins in some of these cases is probably due, in great measure, to the slowness with which the blood will move along the veins when relieved from the pressure of the arterial current, which will be so greatly diminished by the obstructing plug within the vessel.

[1] Catalogue of the Museum, vol. i, series 12, No. 53.

filled by a firm and dark laminated coagulum adhering closely to its walls, and having internally some yellow substance like that in the spleen itself. In the cortex of each kidney were several deposits of various size, consisting of a firm, yellow substance like solid pus, surrounded by a vascular areola. Within the thin muscular wall forming the outer boundary of the aneurismal pouch in the heart, " were a number of small yellow ochre-coloured deposits, just like those found in the spleen."

The fibrinous deposits in the kidney, the spleen, and the splenic artery were, in all probability, derived from portions of fibrinous clot detached from the interior of the cardiac aneurism, and transmitted with the circulating blood to those parts in which they were found. It is also not unreasonable to infer that some, at least, of the strange paralytic and phlebitic symptoms which marked the progress of the case were due to the circulation of other particles of the fibrinous substance, and their arrest in the vessels of the limbs affected with temporary paralysis and signs of phlebitis.

The hemiplegia ultimately ensuing on the left side was probably associated with an affection of the brain ; but it is not unlikely that in this, as in other cases, obstruction by means of a portion of coagulum detached from the heart had ensued in the right middle cerebral artery, and induced a state of softening, of which the cavity found in the right corpus striatum was the remains.

2. Having considered some of the principal circumstances apparently connected with the detachment of comparatively large masses of fibrine from the interior of the left side of the heart, I proceed, in the second place, to offer a few observations on some of the effects which smaller portions, similarly detached and arrested in minute arterial branches or in capillaries, appear capable of producing. One of these effects seems to be displayed by the singular masses of yellow fibrinous-looking substance not uncommonly found in the spleen, kidneys, and other organs, and hitherto described under such names as " capillary phlebitis," " metastases," or " fibrinous deposits."

In the details of the three cases already narrated to the

Society, several varieties of these deposits have been rather fully described; and it seems unnecessary, therefore, to offer any further description of them here. They are familiar to all who have seen much of the inspection of bodies after death, and their several peculiarities have furnished subjects of former communication to this Society by Dr. Hodgkin and others. My present object is to show that these morbid appearances are very commonly associated with valvular disease of the heart, especially with those forms of disease attended with the deposition of fibrinous vegetations on the valves; and that in the majority of cases, if not in all, they result from the direct transmission of particles of fibrine from the valves of the heart or elsewhere, and their subsequent arrest in the vessels of the parts in which these morbid deposits are found.

Out of 21 cases in which I have observed these deposits in the spleen, kidneys, or other parts supplied with blood directly from the left side of the heart, and in which I have noted the condition of the heart and other principal organs, I have found disease of the valves or of the interior of the left side of the heart in every instance but two; and of these two exceptional cases, one was a case of cholera, in which a doubtful mass of capillary phlebitis existed in the liver, the other a case of aneurism of the aorta,—which, as I shall afterwards show, tends rather to prove than disprove the explanation I offer of the fibrinous masses existing in the various organs. Omitting these two cases, however, I find that of the remaining 19 it is not merely stated that the heart or the valves were diseased in each of them, but that in 14 there were fibrinous growths on the surface of the left valves or interior of the left cavities, while in the remaining 5 there is simple mention of valvular disease, without any statement as to whether fibrinous deposits existed or not.[1] The mere fact of so large a number of cases of so-called capillary phlebitis in internal organs being distinctly associated with the presence of fibrinous material on the valves of the heart is sufficient to suggest a very close

[1] For similar confirmatory cases see Dr. Jackson (Med.-Chir. Transactions, vol. xxix, p. 280,) and Dr. Ormerod, (Gulstonian Lectures, Med. Gaz., 1851.)

relation between these two morbid states; and the existence of some such close relation is rendered more probable by the absence, in all these cases, of any other condition likely to have induced a poisoned state of the blood, to the existence of which the formation of these deposits has not unfrequently been ascribed. In many of the cases, cardiac dropsy is noted as the fatal disease, while in none of them does there seem to have been any proof of the existence of a so-called blood-disease, such as typhus, purpura, or the like.

That such blood-diseases have, indeed, nothing to do with the deposits in question seems proved by the fact that, out of the examination of a large number of fatal cases of fever, I have never yet met with an instance in which masses of capillary phlebitis existed in any part of the body in this disease. From their general absence in other diseases, then, as well as from their frequent occurrence in diseases of the heart, we have equally strong reason for believing in the existence of a close connection between these morbid deposits in internal organs and the presence of fibrinous growths on the inner surface of the heart or on its valves.

The close connection subsisting between endocarditis and fibrinous deposits in distant organs has, I am aware, been strongly insisted upon by Rokitansky, and has also attracted the notice of Hasse; therefore it may seem superfluous to have said so much on the subject. But I would plead a two-fold excuse for so doing: first, because, so far as I know, the connection pointed out by Rokitansky has never yet been confirmed, scarcely even recognised, in this country; and secondly, because I believe, with all deference, that it may admit of an interpretation somewhat different from that which Rokitansky has given. After careful and repeated perusal of all I can find bearing on this subject in Rokitansky's great work on Pathological Anatomy, I cannot find that he in any place even hints at the explanation I have ventured to offer of the real cause of the secondary deposits in distant organs in cases of valvular disease of the heart. His observations seem to show quite plainly that he ascribes them to a poisoned state of the blood, consequent on the admixture of the products of endocarditis with this fluid,

whereby it acquires an increased tendency to coagulate, which tendency cannot well be manifested in the arteries, owing to the velocity of the current, but is brought about within the capillaries on account of the slowness with which the blood there moves, and the increased facility which is thus afforded for the morbid material derived from the inflamed heart to exercise its influence on the composition of the blood.[1] The view, however, which I have ventured to take is, that the deposits in the various organs are the direct mechanical results of the arrest of solid particles of fibrine detached from some part of the heart or arteries, and too large to traverse the minute capillary canals to which they are brought by the circulating blood. By the obstruction which their arrest occasions, they may induce coagulation of blood behind them; while, by their mere presence, they may act as local irritants, and so induce secondary processes of inflammation and suppuration, like any other foreign body. In either or both of these ways may be produced the various appearances characteristic of these singular deposits. This view, which seems supported by the other evidence I have adduced of the direct transmission of masses of fibrine from the valves of the heart, has the advantage, too, of explaining some of those cases in which very similar fibrinous deposits are found in various organs, independent of any warty or other growths within the heart. For example, in a fatal case of aneurism of the abdominal aorta, to which I have already alluded, several patches of capillary phlebitis existed in one of the kidneys, though for the origin of these there seemed to be no other explanation than that afforded by the existence of fibrine abundantly deposited in laminated masses within the sac of the aortic aneurism. It is easy to conceive that portions of such fibrine might be broken up, mingled with the circulating blood, and subsequently arrested within the capillaries of the kidney or spleen. An example even more marked than this was afforded by the case of a man admitted, under Dr. Burrows, in a dying state, in whom, after death, there was found a

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[1] Handbuch der Pathol. Anat., Bd. i, s. 242, e. s. Bd. ii, s. 437.

small aneurismal pouch, about the size of a Spanish nut, immediately behind one of the aortic valves. Its interior was lined by old laminated fibrine; and the aortic valves, which were themselves greatly diseased, being thick, hard, and rigid, had their roughened edges and surfaces covered with recent fibrinous fringes. The spleen was enormously enlarged, being upwards of 9 inches long and 6 inches broad: the increase in size was principally due to several large masses of firm, yellow, cheesy-looking substance, one being as big as a good-sized apple. The kidneys were large and firm, and presented on their surface numerous spots of a deep-red colour, in several of which was a yellowish central dot: these changes were manifestly the result of a similar morbid process to that in the spleen, only in an earlier stage.

In this as in the last instance, the mere mechanical detachment of fibrine from an intra-vascular part whereon it was deposited seemed to be the true explanation of the masses of fibrinous substance found in the spleen and kidneys; for in no other way could their origin be reasonably accounted for.

In some few instances, in which masses of capillary phlebitis are found in internal organs, the artery supplying the affected part may be found plugged up by old dry colourless fibrine, as was observed in the renal artery in Case III. When this occurs, it may be a question whether the deposits in the organ do not result from the sudden arrest of a plug of fibrine in the artery, and the consequent coagulation and subsequent change of the blood in the vessels beyond the seat of obstruction. But although this may be the explanation in some instances, yet since the coagula found in the large arteries can usually be traced onwards into their various subdivisions, it seems reasonable in such cases to ascribe the coagula in the various arterial tubes to gradual stagnation of the blood in them, consequent on the more minute vessels being successively blocked up by the entrance and arrest of fresh fragments of fibrine, which though small enough to pass through the arteries, may be too large to traverse the capillaries.

Although, however, there may thus be a doubt in some cases, whether the primary obstruction took place in an artery or in the capillaries, yet in other instances it appears to be quite manifest that the fragments of fibrine have been arrested in the minutest vessels of the affected organ. The ordinary masses of capillary phlebitis are often of large size ; but if the tissue of an organ, such as the kidney, in which these large masses are found, be closely examined, the surface will usually be seen presenting reddish spots or blotches of various size and shape, like patches of extreme congestion or even small ecchymoses, while towards their centres these patches frequently exhibit a pale yellowish or buff-coloured appearance, as if the stagnant blood of which they consisted was becoming gradually decolourised at these parts. There can be little doubt that these patches are in their nature identical with, though smaller, and in an earlier stage of transformation than, the large yellow masses with red zones in other parts of the gland. Together with these distinct patches one may also often find in the same organ, spots of such extreme minuteness as to be scarcely visible without a lens : they are mere red dots, like minute petechiæ, yet in the centre of almost every one may be discerned a distinct yellowish or fawn-coloured speck, showing that in nothing but their extreme minuteness do they differ from the larger blotches of capillary phlebitis.

I would direct especial attention to the fact of the co-existence of these minute spots with the large and clearly-discernible masses, for since it seems to prove the identity of the two forms of disease, it likewise makes it probable that the small red spots with their yellowish centres, even when found uncombined with the larger masses, have originated in the same cause which led to their formation in other cases. By thus regarding them as mere modifications of ordinary capillary phlebitis, we seem to obtain an explanation of several otherwise unintelligible morbid appearances, and at the same time advance another step towards the elucidation of various pathological phenomena. Thus in Case ii, it was mentioned, that besides the coagula in the cerebral and iliac arteries, and the masses of distinct capillary phlebitis in

various internal organs, minute red petechial-looking spots were found in many parts of the body, namely, the pericardium, pleuræ, and peritoneum, and the mucous surface of the larynx, trachea, stomach, and urinary bladder, and elsewhere; also that nearly all these red spots presented a pale-yellowish or buff-coloured centre. The characters exhibited by these spots was so exactly like, on a small scale, those presented by the ordinary patches of capillary phlebitis with which indeed they co-existed in some of the organs, that their identity was considered unquestionable. Associated too as they were with large friable masses of fibrine on the valves of the left side of the heart, it seems scarcely to admit of doubt that they as well as the larger patches of capillary phlebitis were caused by the coagulation and gradual de-colorisation of blood rendered stagnant by the arrest of minute particles of fibrine separated from the deposits on the valves and circulating with the blood. This view of their origin is strongly supported by the results of the direct intro-duction of minute particles of any material into the blood: for in nearly all such cases similar small congested or ecchymosed spots, with more or less of a yellowish centre, have been found after death in the lungs and other parts. The results of some of M. Gaspard's experiments are especially to the point : thus in one quoted by Mr. Lee,[1] half an ounce of fluid resulting from the decomposition of some beef placed in dog's blood was injected into the jugular vein of a bitch. After death the lungs were found gorged with blood, and they " presented many petechial spots, like small ecchy-moses." Similar spots existed also on the left ventricle of the heart, in the spleen, mesenteric glands, gall-bladder, mu-cous membrane of the intestines, and sub-cutaneous cellular tissue. This, and other analogous experiments, as well as the appearances after ordinary phlebitis, strongly favour the opinion that the ecchymosed spots sometimes found so abundantly in various parts of the body, may result from the arrest of fragments of fibrine separated from warty excres-cences on the valves of the heart and circulating in the blood. The numerous parts in which these spots are found

[1] On Phlebitis and Purulent Deposits, 1850, p. 34.

in some cases, clearly indicate that the blood has been highly charged with some such material; and one cannot wonder at the serious and even fatal results which not unfrequently attend such cases, particularly when various organs, including the brain, simultaneously become the seats of these congested spots. The symptoms in such cases are sometimes most obscure, apparently because of the vitiated state of the blood, which produces constitutioual effects very similar to those observed in continued fever or phlebitis. This brings me to the consideration of the third series of effects which I stated at the commencement of this paper to result sometimes from the introduction of fibrinous particles into the circulating blood, namely, the manifestation of phenomena like those indicative of the existence of a morbid poison in the blood. The following case, selected from several similar to it, may be narrated as affording a good illustration of this part of the subject.

Case iv.—Richard Griffith, æt. 14, a healthy-looking boy, but who had been lately badly off and much stinted for food, was admitted into St. Bartholomew's Hospital under Dr. Roupell, Feb. 12th, 1852, with obscure typhoid symptoms, and a petechial eruption on the skin. He was conscious, but gave an imperfect account of himself, and it was only after his death that a clear history of the case was obtained. It was to the effect that he had been in good health until a fortnight before admission, when he began to complain of pain in the right groin; this pain continued without material abatement and without particular affection elsewhere, for about ten days, and then he was suddenly seized with shivering, headache, and pains in the back and calves of the legs, followed by heat, thirst, and general illness. On the onset of these symptoms he was brought to the Hospital and prescribed for,—his condition not being one of such urgency as to call for admission. He continued to attend for two days, and then, at the request of his mother, was taken in, and was put on a plan of treatment suited to an attack of fever, under which he was supposed to be

labouring.   He was confused and rather delirious the first
night, but was quite rational the following morning, and
said he felt ill and thirsty.   The second night he was more
quiet; and on the ensuing morning, shortly after taking a
dose of his saline medicine, he went to sleep, but from this
sleep he passed into a half comatose state, in which he con-
tinued until his death, about twenty-four hours afterwards.

The body was examined about thirty hours after death; it
was rather emaciated, while over every part of the surface
were numerous petechial spots, some recent and of a pinkish
colour; others apparently older and of a dusky-red hue;
the majority of the spots were small, but a few were as big
as split peas.   The rigidity was universal and very marked;
the skull natural; the dura mater healthy.   Almost every
part of the tissue of the pia mater, including the folds
between the convolutions, was infiltrated with what seemed
to be recently extravasated blood, which gave a blotchy
dark-red appearance to the surface of the brain.   In the
midst of these red blotches were several yellow or buff-
coloured spots and patches of various size; and even when
the dark-red spots were very small, the central part had a
similar light yellow colour; some of the patches had a
greenish yellow appearance, as if smeared over with pus.
The brain itself was unduly congested; the blood-vessels on
section being numerous, and singularly large and turgid
with dark blood; there were a few small spots like ecchy-
moses near the surface.   The cerebral arteries and sinuses
were healthy.   The pericardium was healthy, except in the
existence of several petechial spots on the surface of the
heart; the heart itself was of natural size; the right valves
healthy.   The auricular surface of the mitral valve, just
above its free border, presented a ridge or fringe of whitish
fibrinous vegetations, which adhered very slightly to the
thickened surface of the valve, and when scraped off were
found remarkably soft and friable.   Large warty masses of
similar soft whitish vegetations adhered to the ventricular
sides of the " surfaces of contact" of the aortic valves; these
deposits were chiefly arranged in little heaps along the lower

festooned border of each cusp, but in places they extended over almost the entire surface of the valve. The central portions of each of the contiguous halves of two cusps were destroyed by ulceration; parts of the ulcerated tissue hanging loose and covered by flakes of fibrine. The general tissue of the heart was healthy, yet the substance of each ventricle, especially on the inner surface, was marked by numerous scattered petechial spots, in the centre of almost every one of which was a small yellow dot. The lungs were generally healthy; there was some congestion of the lower lobes, with puriform mucus in the smaller bronchial tubes. The pleuræ were healthy, excepting several petechial spots on their surface. The spleen was very large, dark and soft; there were several yellow masses of fibrinous deposit near its surface. The kidneys were healthy in texture, yet on stripping off the capsule the surface of each was found studded with minute petechial spots, in the centre of almost every one of which was a small buff-coloured dot; besides these dark red spots there were several large yellowish blotches extending deeply into the substance of the cortex, and surrounded by a reddish halo; between these large masses and the minute petechial dots, were several other stages evidently connecting together these two extreme forms of one and the same morbid condition. No old coagula were found in any of the renal vessels. The intestinal canal was healthy, except that along almost its whole extent the mucous membrane was spotted with petechial and larger ecchymosed patches. Similar petechial spots existed in the mucous membrane of the bladder, of the pharynx, œsophagus, stomach, larynx, and trachea; also on the folds of the peritonæum. Some of the spots from the latter were examined carefully with the naked eye as well as microscopically, and it was observed that the minute vessels about them were gorged with blood, while within several of these distended vessels, solid coarse lumps, apparently of fibrinous matter, were clearly discerned with the microscope. The liver, and other parts not specially named, presented nothing worthy of note.

This was a case full of obscurity from the commencement, and the obscurity increased as the symptoms of cerebral

oppression came on, and proved so rapidly fatal. The lad's depressed languid aspect, with an abundant petechial eruption, seemed to indicate, in the absence of a clear history, the existence of low fever, and the restless, delirious manner in which he passed his first night in the Hospital, favoured this view, and justified the employment of wine and simple salines; yet the fatal coma which rapidly supervened two days after admission, was quite unintelligible on this supposition, and could only be understood by an examination after death.

Then the whole mystery seemed to be cleared up; and the most reasonable interpretation which can be offered of the phenomena observed during life and the appearances presented after death seems to be this:—The pain in the right groin with which the attack set in was rheumatic; then ensued rheumatic inflammation of the mitral and aortic valves, with ulceration of the latter, and deposition of fibrinous vegetations on both. From these fibrinous deposits, many of which were loose and easily detached after death, portions had probably separated during life, and, being mingled with the blood, were transmitted with it to all parts of the body; then, arrested in the capillary networks and smaller arteries, they produced the various petechial-looking spots in the skin and most of the serous and mucous surfaces of the body, the buff-coloured blotches and streaks, and the solid fibrinous masses in the kidneys and spleen, while they probably caused the fatal issue of the case by the pressure resulting from the extreme engorgement of the minute vessels of the pia mater and the substance of the brain.

Viewed by itself alone, this case is of extreme interest; but taken in conjunction with others it seems to possess features of great pathological value, as illustrating the serious effects which may result from direct poisoning of the blood, by the products of rheumatic inflammation of the valves of the heart being mingled with it. In the typhoid symptoms noticed during life, and the secondary deposits found after death, the case presents features almost exactly parallel with those ensuing in phlebitis after wounds. In both cases, indeed, the exciting cause of the morbid phenomena seems to be

nearly the same, namely, the introduction of some morbid material into the blood, and its subsequent transmission with that fluid to various parts of the body. It sometimes happens, too, that in the progress of rheumatic disease of the valves of the heart, the similarity to phlebitis is made more striking by the formation of abscesses in various parts of the body, and the deposition of pus within the joints. A good example of this seems to be furnished by the case of a young woman admitted under Dr. Burrows in February, 1851, suffering from rheumatic affection of several large joints, of three or four weeks' duration. The articular pains ultimately settled in one shoulder, which joint continued to suffer until the patient's death, about two months subsequently. From the period of admission the case assumed an unfavorable aspect, the subsidence of the rheumatism being attended by no improvement in her general condition. In about three weeks, after occasional rigors and a state of almost constant profuse perspiration, a painful swelling formed behind the right angle of the lower jaw, and seemed likely to suppurate; but it disappeared. Then both lower limbs gradually became œdematous, with tenderness in the popliteal space and in the groin. The œdema increased, the patient became more exhausted and hectic, and so died. After death a large abscess was found in the right axilla. Yellowish turbid fluid existed in the left shoulder-joint, the cartilage of the head of the humerus being somewhat ulcerated. The inferior caval vein, as well as both common iliacs and their branches, were blocked up by old de- colourised fibrine, the left external iliac vein containing, besides old fibrine, about a teaspoonful of yellowish puriform fluid. There was an old clot in one of the large branches of the pulmonary artery; also several buff-coloured spots of capillary phlebitis on the kidney, and extreme disease of the aortic and mitral valves, one cusp of the aortic and a large patch of the mitral being destroyed by ulceration; while shaggy flakes of soft fibrine loosely adhered to the irregular borders of the ulcers, and to other parts of the valves.

Without commenting on any of the pathological features

of this case, I offer it as an illustration of the occasional co-existence of the signs and effects of phlebitis with rheumatic ulceration of the valves of the heart; and I would suggest that in this, as in the previous case, the vitiated state of the blood leading to the secondary deposits in various parts of the body, was the direct result of the introduction of morbid material from the inflamed and ulcerated valves of the heart, over which the blood would be continually flowing, and thus almost necessarily washing away the solid matter deposited on the diseased surfaces of the valves. It seems, indeed, quite obvious that the blood may be contaminated in this way almost as certainly as when fibrine, or pus, or any other organic or inorganic material in a state of fine division, is directly introduced into it by experiment or otherwise. The kind of constitutional effects produced may in some measure be determined by the nature of the foreign material mingled with the blood; yet the mechanical effects will probably in each case be nearly the same; for whether the foreign particles introduced be those of fibrine or of quicksilver, or anything else, if they are too large to traverse the first set of capillaries they reach, they will be arrested there, produce obstruction, and possibly lead to circumscribed inflammation and suppuration.

Materials introduced into the blood by experiment, absorption, or otherwise, commonly enter the venous blood, and with it are transferred to the lungs, where they exercise their primary and, perhaps, their only effects. But when the blood is contaminated by materials derived from the valves of the heart, it is arterial blood which is especially affected, and all the systemic organs and tissues are liable to suffer, because of the far greater frequency with which the left valves, compared with the right, are diseased. One wonders, indeed, why well-marked symptoms of contaminated blood do not more commonly accompany deposits on the left valves of the heart. It may be that such symptoms only arise when the morbid matter mingled with the blood is derived from the soft, semifluid, perhaps almost putrid, material resulting from the decay of old-standing masses of

fibrine, while recently deposited granules, washed away and mixed with the blood, may merely cause symptoms of irritation in the parts through which the blood circulates, or, at the same time, produce the fibrinous masses of so-called capillary phlebitis in various organs. It seems not improbable that many anomalous symptoms ensuing in the course of certain diseases, acute rheumatism for example, in which there exists a great tendency to the deposition of fibrine on the valves of the heart, may have their explanation in the irritation or other effects resulting from the existence of minute fragments of fibrine in the blood circulating through the organ whose functions are disordered. I would suggest that many functional disorders of the nervous system, especially chorea, may be thus explained. The frequent existence of a cardiac murmur in chorea, and the presence of warty vegetations on the valves of the heart so commonly found in fatal cases of this disease, are in favour of such a view.

PART II.

On the effects which may result from the detachment of fibrinous deposits from the right valves of the heart.

If, from what has been stated, it be assumed as probable that deposits of fibrine occurring on the valves of the left side of the heart may, by being detached, be productive of serious affections of remote organs, it may be inferred also that similar deposits occurring on the right valves may induce corresponding secondary affections of the lungs. And there seems to be sufficient evidence for believing that such is really the case. For it may, I think, be clearly shown, that most of the fibrinous or other similar secondary deposits in the lungs, also many of the old coagula found in the pulmonary artery or its branches, and possibly some forms of pulmonary apoplexy, are closely connected with, if not actually dependent upon, fibrinous deposits on the valves, or interior of the right side of the heart, or materials transmitted through the heart by venous blood. It is of course conceivable that

when the deposits on the right valves consist of large warty masses, as they occasionally do, portions of considerable size may be detached, and transmitted along the pulmonary artery, and so plug up one of the large branches of this vessel, just as similar masses detached from the left valves may be arrested in one of the main systemic arteries; but I have not yet met with a decided instance of such an occurrence. Probably the more usual manner in which the separation of fibrinous masses from the right valves leads to the formation of coagula in the pulmonary artery, is by the transmission of small particles to the minuter divisions of the artery, or to the capillary plexus, arrested at which they induce stagnation of the blood in those branches of the artery distributed to the seats of obstruction. Such a result is almost necessarily consequent on the peculiar mode of distribution of the branches of the pulmonary artery, which pass to their destination without anastomosis. In a paper on the formation of coagula in the pulmonary artery, published in the Transactions of this Society, Mr. Paget has clearly shown the influence which certain obstructions in the pulmonary capillaries, such as œdema, chronic pneumonia, and pulmonary apoplexy, sometimes exercise in inducing coagulation of blood in the arteries supplying the obstructed parts. And I have likewise noticed a similar influence apparently resulting from other circumstances, such as extensive old tubercular disease, and extreme compression of the lung by false membrane on the pleura, which have obliterated large portions of the pulmonary tissue. Mr. Paget also narrates instances in which particles of cancerous matter brought from remote organs to the right side of the heart, and thence transmitted to the lungs, became arrested in the pulmonary capillaries, and so induced stagnation and subsequent changes of the blood, in branches of the pulmonary artery. Cases like these, of which I have seen several examples, seem to leave no doubt that a like coagulation of blood in the pulmonary arteries may result from obstruction caused by the arrest of particles of fibrine detached from the right valves of the heart, and transmitted to the pulmonary capillaries. An instance of this is fur-

nished by one of the cases already narrated (Case III), in which, together with large, nodular, and warty masses attached to the tricuspid valve, nearly every branch of both divisions of the pulmonary artery were blocked up by old fibrinous coagula.

Another equally striking illustration is afforded by a specimen in the museum of St. Bartholomew's Hospital, in which, with extreme disease of the pulmonary valves, accompanied with the deposition of thick irregular layers of soft fibrine on each of them, there were old coagula filling many of the branches of the pulmonary artery. In this case there were also several large, solid, fibrinous masses in the substance of the lung; and it seems reasonable to believe that these, as well as the coagula in the pulmonary artery, had their origin in the deposits of fibrine on the pulmonary valves, portions of which were probably detached, arrested in the capillary plexus of the lungs, and so caused the fibrinous masses in the pulmonary tissue, and the consequent coagulation of blood in the arterial branches distributed to these parts.

The fibrinous masses in the lungs which the specimen just mentioned presents, appear not unlike portions of old pulmonary apoplexy, from which most of the colouring matter of the extravasated blood has been removed; and it is not improbable that many similar masses in other cases may have originated in a like cause, and not in hæmorrhage into the pulmonary tissue. Such masses, indeed, represent one form of the appearances described as capillary phlebitis of the lungs, or, in other words, one stage in the transformation undergone by blood stagnant and coagulated in the pulmonary capillaries. This blood passes through the same changes in the lungs that it undergoes when similarly situated in other organs; and the various examples of these changes are not unfrequently met with in the lungs. Thus, in Case III were found various gradations, from firm compact coagula, through soft, brownish, disorganised blood, to collections of yellowish, puriform material, which in places formed ordinary abscesses. Masses of such large size, and

with such obvious characters as these, are of course readily recognised. Yet not unfrequently deposits of a similar nature exist in the lungs, though of such extreme minuteness as to elude detection, unless specially sought for. These consist of small, slightly-elevated, red dots, with a pale-yellow or buff-coloured centre, scattered, sometimes thickly, over the surface and within the interior of the lung. They are exactly identical with that spotted form of capillary phlebitis already mentioned as often occurring in systemic organs and in various tissues, either combined with other forms or alone. When met with in the lungs I have hitherto invariably found it either as the result of some morbid material in the venous blood, or in direct connection with affection of the right valves of the heart; such affection, namely, as is attended with the deposition of fibrinous granules on the surface of the valves. To quote but one instance out of several of the kind, I would mention the case of a girl under the care of Dr. Hue, early in the year 1851. This patient died suddenly, after suffering for some months with symptoms of extreme disease of the heart. Besides general enlargement of the heart, and narrowing of the mitral orifice, the free border of the tricuspid valve was studded with small, pale, fibrinous granules, a few of which existed also on the pulmonary valves. At first sight the lungs appeared healthy, but, on closer inspection, they were found freckled throughout with small, dark-red spots, like minute ecchymoses, in the interior of several of which was a distinct buff-coloured speck. The view which may not unreasonably be taken of these spots is, that they consisted of congested capillaries, in which minute fragments of fibrine, transmitted from the right valves of the heart had been arrested, the appearances, indeed, being just such as resulted from the injection of softened meat into the blood in one of M. Gaspard's experiments.

Under whatever form these various deposits are met with in the lungs, I believe that careful examination will show them to be almost invariably associated either with the presence of fibrinous growths on the right valves of the heart,

or with some other condition leading to the existence of particles of fibrine or other foreign matter in the blood transmitted to the lungs. Of these other conditions the most important seem to be the disintegration of old masses of fibrine situated within the right cavities of the heart, and a like disintegration of old coagula in some part of the venous system, and its subsequent mixture with the venous blood. It appears to be quite usual for the old colourless or pale-reddish clots found in the right cavities of the heart, especially in the appendix of the auricle, to soften in the centre, and be converted into a dirty reddish-brown or fawn-coloured material. Sometimes the softening extends through the whole substance of the mass, with the exception of a thin layer at the circumference, which forms a kind of cyst or bag within which the softened material is contained. Sometimes too this cyst bursts and discharges its contents, leaving nothing but the outer shell attached to the interior of the heart. The softened material thus let loose and mingled with the blood will doubtless contaminate it almost as effectually as the direct introduction of a similar material by injection into a vein would do. And it is easy to imagine that the solid particles of fibrine may be arrested at the capillaries of the lungs, and produce the various forms, especially perhaps the spotted variety of deposit to which allusion has been made. Old coagula in the veins too, under whatever circumstances they may have originated, appear almost equally liable to undergo softening, and to break up and mingle their disintegrated particles with the venous current along which they may pass to the lungs, and produce effects similar to those consequent on the transmission of like material from the cavities of the heart.

Such are some of the principal effects which the transference of fragments of fibrine from the right side of the heart appear capable of producing in the lungs. Much more might be said on the subject, but the length to which this communication has already extended precludes any further remarks at the present time. I would only add the suggestion that possibly the peculiar form of the pneumonia

sometimes observed in rheumatic fever may, in some way, have its explanation in the transmission of fibrinous particles from the right valves of the heart to the lungs. The almost invariable existence of disease of the pulmonary or tricuspid valves in the fatal cases of rheumatic pneumonia I have examined after death strongly favours the opinion that there is some close relation between this peculiar inflammation of the lungs and the fibrinous deposits on the right valves of the heart.

In conclusion, let me briefly recapitulate the principal points I have endeavoured to establish to the satisfaction of the Society. They are, 1st, the general fact that fibrinous concretions on the valves or the interior of the heart admit of being readily detached during life, and mingled with the circulating blood: 2dly, that if detached and transmitted in large masses, they may suddenly block up a large artery, and so cut off the supply of blood to an important part; if in smaller masses, they may be arrested in vessels of much less size, and give rise to various morbid appearances in internal organs; while, under other circumstances, the particles mingled with the blood may be extremely minute, possibly the debris of softened fibrine, yet in sufficient quantity and with sufficient power to produce a poisoned state of the circulating fluid, as manifested in the production of typhoid or phlebitic symptoms: 3dly, that the effects produced and the organs affected will be in great measure determined by the side of the heart from which the fibrinous masses have been detached; for, if the right valves have furnished the source of the fibrine, the lungs will bear the brunt of the secondary mischief, displaying it in coagula in the pulmonary arteries, and various forms of deposit in the pulmonary tissue: but if, as is far more commonly the case, the left valves are affected, the mischief is more widely spread, and may fall on any systemic part, but especially on those organs which, such as the brain, spleen, and kidneys, are largely and directly supplied with blood from the left side of the heart.