RESEARCHES ON THE
PATHOLOGY OF OBSTRUCTIVE PHLEBITIS,
AND
THE NATURE AND PROXIMATE CAUSE
OF
PHLEGMASIA DOLENS.

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SINCE the publication of the admirable paper of the late Professor Davis, in the 12th volume of the 'Transactions' of this Society, the profession has very generally recognised the important relations which subsist between certain lesions of the crural veins and the general phenomena of phlegmasia dolens. The facts brought forward by Dr. Davis have been fully substantiated by the investigations of various pathologists, and no doubt can be said to exist at the present day as to their accuracy or authenticity. With regard, however, to the conclusions which have been drawn from them, there is less unanimity of opinion; and whilst many, concurring with Dr. Davis, consider the affection of the veins to be the proximate cause of the disease, others believe it to be of secondary importance, or an effect rather than the cause of the disease. It is the design of the following communication to inquire more particularly into the correctness of these respective opinions,—to determine more specifically than has hitherto been done, the pathology of obstructive phlebitis; and, if

possible, to assign its true relations to the other phenomena of the disease.

The characteristics of phlegmasia dolens are, in the words of Callisen, "tumor elasticus, albescens, renitens, calidus, dolens, foveam impressi digiti haud retinens." It is described by Dr. Hull as consisting in a "tense elastic hot painful swelling, which generally extends rapidly over the whole of one of the lower extremities; the skin retaining its natural colour, or even becoming whiter, and presenting more or less of a shining appearance."

In its local manifestations it would thus appear to be characterised by two principal conditions:

- 1st. By a persistent and peculiar swelling of the affected limb not depending upon simple œdema, but possessing a degree of tension, heat, firmness, and elasticity, which is not common to ordinary œdema, and
- 2dly. By an impairment of the nervous and muscular functions of the limb, as indicated by pain, tenderness, and loss of motor power.

I will proceed, in the first place, to consider how far these conditions are producible by inflammation of the pelvic or crural veins, by comparing them with those which follow upon such inflammation artificially induced.

To determine this question I had recourse to the following series of experiments, in which I was kindly assisted by Mr. Briggs, Demonstrator of Anatomy at University College, whose valuable services I cannot sufficiently acknowledge. First, to ligaturing the iliac veins, and observing the resulting phenomena at definite periods after the operation. Secondly, to extensive irritation of the lining membrane of the iliac veins by means of chemical and mechanical irritants. Thirdly, to sustained compression of the femoral veins by means of firm metallic compresses. I will proceed, in the first place, to give the results of ligaturing the iliac veins, as noted at periods of 24, 48, 72, 96 hours, and nine days after the operation.

EXPERIMENT I.—The right common iliac vein of a dog was ligatured on the 26th November, 1851, and in twenty-four hours the animal was killed and the parts immediately examined. For some hours after the operation he remained quiet and refused food, but before the expiration of the twenty-four hours he had greatly recovered, took food, and was able to walk about. There had been much swelling of the ligatured extremity subsequently to the operation, but this was inelastic, and readily pitted on pressure.

Dissection.—There was considerable inflammation of the wound, by which the vein had been exposed; and the cellular tissue throughout the limb was infiltrated with serum, as was also the adjoining part of the right side of the abdomen. In the neighbourhood of the wound, the abdominal muscles were soft, swollen, and œdematous. The common iliac vein was empty above the ligature; but below it, there was a soft, dark-coloured coagulum, of about two inches in length. It was no where adherent to the vein, nor did it possess any other characters than those which are common to an ordinary post-mortem coagulum. The vein at the seat of ligature was slightly thickened and somewhat opaque; and on its interior a few small vessels could be seen, immediately where the ligature had been applied. Beyond this there was no other evidence of inflammation; and the lining membrane of the vein was smooth, and contained neither pus, lymph, nor any other inflammatory product. The morbid appearances were confined to the immediate seat of the ligature, and did not extend more than half an inch above and an inch below it. The vena cava was healthy, as were also the femoral vein and its branches on the right side, and the pelvic and femoral veins generally on the left.

EXPERIMENT II.—The right common iliac vein of a dog was ligatured on the 4th December, 1851, and the animal was killed and the parts examined exactly forty-eight hours afterwards. For some hours after the operation he refused food, remained quiet, and walked with extreme difficulty. There had also been considerable œdema of the affected

extremity, but this was soft and inelastic. In thirty-six hours the swelling had somewhat subsided, and the dog had generally recovered from the effects of the operation. He took food and was able to walk about.

Dissection.—The limb generally was cedematous, and there was considerable inflammation of the wound, by which the vein had been exposed. The abdominal muscles around were cedematous, and the intermuscular cellular tissue contained some purulent looking matter. The iliac vein both above and below the ligature was adherent to the surrounding tissues. The portion above the ligature was empty; that below contained a soft uniformly black coagulum, of about 2 inches in length, which was no where adherent. On removing it the inner surface of the vein was found to be morbidly vascular at the seat of ligature. Here also the vein was thickened and opaque, and its coats were partially divided by ulceration. There was no lymph or purulent matter anywhere observable in it, and the morbid appearances terminated at little more than an inch both above and below the ligature. The other pelvic veins, the femorals and the vena cava, were healthy.

EXPERIMENT III.—The left common iliac vein of a dog was ligatured on 1st December, 1851, and the animal was killed and the parts examined seventy-two hours afterwards. The immediate effects of the operation were similar to those which occurred in the preceding cases. Considerable swelling of the extremity took place, of a soft inelastic character, and during the first day he remained quiet and refused food. The following day he was better, ate well, and was able to walk about; and from this time the swelling gradually subsided, so that very little was perceptible on the third day subsequent to the operation.

Dissection.—Considerable inflammation had taken place throughout the wound, by which the vein had been exposed. The subcutaneous vessels of the upper part of the thigh, and those of the corresponding side of the abdomen, were much injected, and the subcutaneous cellular tissue of the limb

contained a small quantity of serum. The muscles of the left side of the abdomen were swollen, and the intermuscular cellular tissue contained some purulent-looking matter. The left common iliac vein was nearly ulcerated through at the seat of ligature. The vein above the ligature was empty, but the portion below contained some coagulated blood, which extended nearly to the femoral vein, and was of a uniformly black colour, soft consistence, and could be easily removed. The vein below was morbidly vascular, and almost uniformly red; this, however, was partially the effect of staining. The vein was thickened and opaque at the seat of ligature, but throughout its interior there was no fibrinous, purulent, or other inflammatory product. The morbid appearances terminated about two inches above and below the ligature. The vena cava was healthy and empty, as were also the other veins generally.

EXPERIMENT IV.—The right common iliac vein of a dog was ligatured on the 19th December, 1851, and the animal was killed and the parts examined exactly ninety-six hours afterwards. The dog at first was quiet and disinclined for food; but after the first day ate well, and was able to walk about. At first there was considerable œdema of the limb, of a soft inelastic character, but this gradually subsided after the first day.

Dissection.—The wound through which the vein had been exposed, had in a great measure contracted. The tissues around the vein were found to have been considerably inflamed, and the abdominal muscles and intermuscular cellular tissue about the wound were still somewhat infiltrated. Very little serum was found in the cellular tissue of the affected limb. The iliac vein was completely divided at the seat of ligature, and the divided extremities were much thickened, morbidly vascular, and closed by adhesive inflammation. The upper portion of the divided vein was empty, the lower was closed by a coagulum which extended downwards for about an inch and a half. This coagulum was closely adherent to the vein at the point of its division, but below the

adhesion was less intimate, so that it could be easily separated. No puriform matter was observable in the vein.

EXPERIMENT v.—The left common iliac vein of a dog was exposed and ligatured on the morning of the 11th October, 1851, and it was killed on the 20th, nine days afterwards. On the day of the operation the dog was sensibly affected, refused food, and moved with difficulty; but the next day he was better, and from that time continued to improve. Considerable swelling of the limb followed the application of the ligature, but this began to subside the day after, and in the course of a few days was scarcely perceptible. It was throughout soft and inelastic.

Dissection.—The wound through which the vein had been exposed, had almost entirely closed. There was little or no serum perceptible in the cellular tissue of the limb. The vein was found to have been completely divided by the ligature, and a considerable quantity of blood had escaped from it into the surrounding cellular tissue, which extended upwards as high as the left kidney. It was of a dark colour and grumous consistence. The ligatured vein had contracted intimate adhesions to the surrounding parts. Its coats were much thickened about the seat of ligature, and its divided edges were somewhat tuberculated, and of a violet colour. The upper portion of the vein was closed at the point of division by adhesive inflammation, and its calibre was somewhat contracted. It was empty, and greatly thickened. The lower portion of the vein was also much thickened, and of a violet colour immediately below the ligature. Within it fibrine had been deposited, which was so adherent that it was scarcely possible to detach some portions of it. The morbid appearances of the vein were limited to the space of about an inch and a half below the ligature. The vessel contained neither pus nor a coagulum, and although its colour was of a deep red or violet tint, no distinct vascularity could be observed.

The foregoing particulars may be said to comprehend the

more important phenomena which follow upon ligature of the iliac veins, and afford some data for comparing the effects of inflammation of these vessels thus induced with the general symptoms of phlegmasia dolens, and the comparison will perhaps be assisted by the following summary of the principal facts which were observed :

The constitutional effects which follow upon ligature of the iliac veins, would appear to be of a very transient character, and to be rather referable to the extensive wound which is necessary to expose the vein, than to the actual operation itself. They were most marked and severe on the day of the operation, during which the animal remained quiet, subdued, and disinclined to take food. At the end of twenty-four hours they had in a great measure subsided, and from this time almost rapidly disappeared. The local effects were also of a transient rather than of a persistent character. They were confined in a great measure to swelling, stiffness, and an inability or disinclination to move the affected extremity. For, as far as could be judged, there was neither tenderness on pressure, nor any preternatural heat of the limb, except in the immediate neighbourhood of the wound. These symptoms, moreover, were not of long continuance. The swelling was greatest during the first and second days following the operation, and it then steadily and quickly disappeared. Its character, again, was that of ordinary œdema—it readily pitted on pressure, and was nearly equally diffused over the ligatured extremity.

The morbid condition of the ligatured veins may be thus recapitulated. At the end of twenty-four hours after ligature, the coats of the vein were slightly thickened, and opaque at the immediate seat of ligature, and a loose, thick, unadherent coagulum, of about two inches in length, occupied the interior of the vein, immediately below it. In forty-eight hours there was increased opacity, thickening, and vascularity of the vein at the seat of ligature, and these appearances extended for about an inch above and an inch and a half below it. Ulceration of the coats of the vein had now commenced, and the vessel had contracted ad-

hesions to the surrounding parts. The upper or proximal portion of the vein was empty, the lower or distal contained a loose, black, unadherent coagulum, not solid for more than two inches. In seventy-two hours the inflammatory appearances were more marked, the coats of the veins were now nearly ulcerated through, and there was increased vascularity, redness, and thickening of the vein, extending to about an inch above and two inches below the ligature. A black-looking coagulum occupied the lower part of the vein, of about two inches in length, and this was very slightly adherent. On removing it, the lining membrane of the vein was left perfectly smooth, and hitherto no fibrinous, lymphic, or other inflammatory product would appear to have been exuded from, or deposited upon it. In ninety-six hours the vein was completely divided by the ligature, and both above and below this its coats were infiltrated, swollen, and vascular. The upper portion of the divided vein was closed by a transparent fibrinous-looking matter, and its coats were thickened and opaque at the point of division. The lower portion contained a firm coagulum, which extended downwards for about an inch and a half. It was intimately adherent at the point of division, but elsewhere was very slightly, if at all so. The coats of the vein were here thickened, reddened, and morbidly vascular, and on removing the coagulum, a shreddy, patchy appearance was left, from the adhesion of portions of it to the lining membrane. The morbid appearances, both in regard to the blood and the vein, were limited to the immediate seat of ligature. The pathological changes observed nine days after ligature were very similar, in regard to the vein, to those which have just been noted, but apparently, from the softening down of the coagulum in the distal portion of the vein, a considerable quantity of blood had escaped from it into the adjacent cellular tissue, forming a grumous black coagulum, which extended upwards to the kidney of the corresponding side. With regard to the vein, it should be observed that its divided extremities had retracted from one another, that its coats were thickened and deeply reddened

at the seat of ligature, and that it had contracted intimate adhesions to the surrounding parts.

Now, in this general review of the consequences of crural phlebitis, as induced by ligature of the iliac veins, it must, I think, be admitted, that the phenomena differ very widely from those which are met with in phlegmasia dolens, whether looked at with reference to the symptoms observed during life, or the state of the veins after death. The former were far more transient and ephemeral, seldom lasting more than forty-eight or seventy-two hours; and whilst in phlegmasia dolens the swelling is firm, tense, and elastic, in these cases it was otherwise. It was compressible, soft, and inelastic, and hence readily pitted upon pressure, and, as far as could be judged, there was neither pain, tenderness, or preternatural heat of the affected extremity, or any remarkable loss of motor power. The dissimilarity, in regard to the symptoms, was again preserved in the post-mortem appearances which were presented by the veins; there was an absence of any extensive or considerable obstruction of these vessels, or of any disposition on the part of the inflammation to extend itself. To this, indeed, we may ascribe the transient character of the local symptoms, for inasmuch as the inflammation and obstruction of the veins were limited to the immediate seat of the ligature, a collateral circulation could be readily established, and thus the consequences of such inflammation and obstruction speedily done away with.

But whilst the consequences of inflammation of the iliac veins, thus induced, do not accord altogether with the phenomena of phlegmasia dolens, as ordinarily observed, they are, upon the whole, strictly in accordance with those which have been observed, from time immemorial, in connection with wounds, injuries, and operations upon these vessels. "The ancients," says Mr. Travers, "treated the veins with singular rudeness—pricking, cutting, tying, and burning them, without ever adverting to any other than the mechanical effects of such operations upon the diseases for which they were instituted. . . . Hippocrates punctured

varices: Cetus, Paulus, Avicenna, and Albucasis describe the operation of excision. This seems to have been the practice of Fallopius and Severinus. Fabricius Aquapendens and Fabricius Hildanus inclosed the varicose vein between two ligatures, and emptied it by incision. Ambrose Paré, Petit, Dionis, and others, emptied it by punctures and brought its sides into contact by compression. Many of the older operating surgeons in the country, army and navy, still adopt the practice of tying veins after amputation, and are unwilling to believe that it can ever be productive of mischief. I have frequently," says Mr. Travers, "seen the femoral vein tied without any obvious ill effect; and one of the most experienced and successful operators in the West of England lately assured me that he had been in the constant practice of tying the main vein distinctly from the artery in amputation. Neither do the Continental surgeons entertain any apprehension of a ligature upon a vein, nor are they, I believe, in any degree aware of the extensive inflammation to which the interior tunic of these vessels is in consequence exposed." The experiments I have related fully attest the accuracy and justness of these remarks, and it will be sufficiently shown in the sequel that operations upon veins are not in themselves productive of either serious or dangerous consequences, and that the formidable symptoms which sometimes follow upon such operations, have another origin, and may be traced to a very different cause.

I proceed, in the next place, to detail the results of more extensive irritation of the iliac veins, as observed in the following experiments. In the first place, a strong solution of the nitrate of silver was applied to the whole extent of their lining membrane. In the second, a solid piece of bougie was passed into them, so as to occupy their interior, and therein secured for several days.

EXPERIMENT VI.—The right femoral vein of a dog was ligatured on the 8th of June, 1852; and an opening having been made in it above the ligature, a solution of the nitrate of silver (ʒij to ʒj) was freely introduced upon lint, and

applied to the whole interior of the corresponding iliac veins. The opening in the femoral vein was now closed by ligature, and the effects of the operation were carefully watched for several consecutive days.

In 24 hours there was very little constitutional disturbance. The leg was somewhat swollen; but it could be moved without any apparent difficulty, and the swelling was soft and inelastic. There was no particular tenderness of the limb, nor was there any indication of the inflammation having extended to the femoral vein. In 48 hours the appearances were much the same: the inflammation had not extended to the femoral vein, nor was there any increased swelling or loss of motor power. In 72 hours no fresh symptoms had developed themselves; on the other hand, the swelling and stiffness had begun to subside, and the dog appeared to be otherwise perfectly well. It was allowed to live for ten days subsequently to the operation, but without any fresh symptoms occurring in connection with the operation.

Dissection.—On tracing the femoral vein upwards, from the opening which had been made into it, it was found that the external and common iliac veins were filled with a firm coagulum to within half an inch of the cava, forming a solid, corded body. On opening them, it was found that this coagulum was firmly adherent to their lining membrane, and was for the most part of a yellowish-brown colour, except at its superior extremity, where it was deep red. Its central portion had begun to soften down, and was of a semi-pultaceous consistence; but its exterior was firm, and adhered closely to the vein. The coats of the vein were generally thickened, and externally vascular; and on removing the coagulum, the lining membrane was left roughened, patchy, and opaque. The femoral vein below the ligature was healthy, pervious, and empty. The inflammation had not extended beyond the irritated portion of the veins. There was no œdema of the extremity or any other morbid appearances met with, which were attributable to the operation.

EXPERIMENT VII.—On the subsidence of the local symptoms in this case, the left femoral vein was opened, and a solid piece of bougie, about five inches long, was passed into the left external and common iliac veins as far as the cava, and therein secured by means of a ligature. The effects of this operation were carefully noted for several days, and may be thus recapitulated :—24 hours afterwards the limb was but little swollen, and scarcely at all painful ; the dog had eaten food, and was not perceptibly the worse for the operation. It could stand, walk, and even run without any apparent difficulty. In 72 hours the swelling had disappeared, and the dog was not otherwise worse than on the preceding day. No fresh symptoms developed themselves ; and five days subsequently to the operation the dog was killed, and the parts immediately examined.

Dissection.—The bougie was found to have occupied the entire length of the external and common iliac veins, and to have extended about two and a half inches into the vena cava. It had become softened down in places, and was covered with a thin layer of coagulum. It was adherent to the track of vein with which it was in contact, but could be easily detached ; and on removing it, the lining membrane was left smooth, free from redness or vascularity, and apparently perfectly healthy. No other morbid appearances were observed throughout the veins of this extremity, except a little thickening and obstruction of the femoral at the point at which it had been ligatured.

I shall conclude this part of the subject by detailing the particulars of a case in which prolonged irritation and compression of the femoral vein was maintained by means of a firm metallic compress.

EXPERIMENT VIII.—The right femoral vein of a dog was exposed on the 10th of December, 1851, and a strong metallic compress was secured upon it, so as to maintain firm compression of its coats, and at the same time to arrest the circulation through it. It was kept on for six hours,

and then removed. No perceptible swelling of the limb, or loss of motor power, followed the operation; and after examining the limb daily until the 16th, without any morbid appearances having been perceived, the dog was killed, and the vein examined.

Dissection.—The limb presented no œdema, or any other abnormal appearance. The coats of the vein were thickened, indurated, and opaque at the part at which the compress had been applied; but there was no redness or morbid vascularity. These appearances were limited to about half an inch of the extent of the vein. A small thin coagulum was found in this part of the vessel, of about an inch and a half in length; but it was nowhere adherent, and the vein was otherwise perfectly healthy.

We are now, I think, in a position to appreciate the full force and influence of inflammation of the iliac and femoral veins in the causation of the symptoms of phlegmasia dolens, or rather, to speak more specifically, in the causation of a general, abiding, and elastic swelling of the affected limb, attended with an impairment of its sensory and motor powers; and the conclusion, I submit, must inevitably be, if the foregoing experiments possess any value or reality, that such symptoms are not producible by mere inflammation and obstruction of these vessels, however rapidly induced. Thus, as the result of obstruction, inflammation, ulceration, and total division of the common iliac vein, produced by the application of the ligature, we fail to observe more than the necessary effects of mechanical and temporary obstruction of the vessel, and of inflammation of it, limited to the immediate seat of ligature. There is an absence of any constitutional fever or disturbance; the swelling of the limb is neither elastic nor abiding, but simply œdematous, and there is no impairment of either its sensory or motor functions. With such facts, clearly demonstrated, there is, I submit, no other conclusion than that the affection of the veins is not the sole or essential lesion, or the proximate cause of the complaint.

But whilst I believe that this conclusion is not only deducible from the foregoing experiments, but will be found upon the whole to be supported by the clinical history of phlegmasia dolens, it must ever be remembered that an inflamed and obstructed condition of the iliac veins constitutes one of the most important and indeed pathognomonic features of the complaint; and therefore, in seeking for a theory of the disease, we must exclude any which does not equally account for this as well as its other pathological characters. The problem, then, which has to be solved is, what are the specific causes or conditions which can simultaneously affect the sensory, the motor, the secretory, and the vascular organs of the affected extremity, so as to give rise to the concurrent phenomena by which the disease is characterised. Are they local or constitutional? and in what do they respectively consist? Now, these are questions which cannot be satisfactorily answered until we have correctly determined the pathology of *obstructive* phlebitis, and more particularly to what extent it is dependent upon local as distinguished from constitutional causes.

I have accordingly pursued the investigation of this subject at some length, from a conviction that it was absolutely necessary to a correct appreciation of the pathology of phlegmasia dolens; for, if we look to standard works or to recognised authorities for information, we shall find very different, and indeed contradictory, opinions expressed in regard to it. Thus, by the majority of writers, the phenomena in question have been attributed generally to phlebitis. But phlebitis in a variety of ways may and does constantly occur without giving rise to it. John Hunter, for instance, informs us that in all violent inflammations of the cellular membrane, whether spontaneous or in consequence of accident, as in compound fractures, or of surgical operations, as in the removal of an extremity, that the coats of the larger veins passing through the inflamed part become also considerably inflamed. Again, in the numerous operations which have been performed upon the veins for the cure of varix, varicocele, and other morbid

conditions, including ligature, excision, and cauterisation, it is certain, that while venous inflammation must ensue from their performance, such inflammation is not ordinarily productive of any serious or extensive obstruction of these vessels. I submit, then, that the theory of phlebitis, as the supposed cause of such obstruction, is not only vague, but in some degree inaccurate—inasmuch as it is not mere phlebitis which gives rise to it, but something peculiar in or superadded to it. Phlebitis, as I have remarked, may occur in a variety of ways without occasioning it; and, therefore, it is less phlebitis than these peculiar or super-added circumstances which should more especially claim our attention.¹

Again the phenomena of *obstructive* phlebitis have been attributed to causes acting primarily upon the blood, and to retardation or coagulation of this fluid in the veins, either from extreme vital exhaustion, or the direct action of diseased secretions upon it, and here it is assumed that phlebitis, if at all produced, is secondary to or consequent upon such primary coagulation of the blood. Between these opposite, and it may be said contradictory, opinions, it is difficult to decide, if we are guided solely by authority, or the weight of individual testimony. I have therefore pursued the investigation of this subject irrespectively of

¹ As the use of the term phlebitis, in different senses, may appear to give rise to some ambiguity in the text, I would beg to observe, that it may be regarded as applying generically to three distinct species or varieties of venous inflammation—the *healthy*, the *obstructive*, and the *suppurative*. The first occurs on the reparation of all wounds, injuries, and operations upon veins, is of limited extent, and never productive of any serious or dangerous consequences—indeed, medical men practically act upon this conviction in the daily exercise of their profession. In certain rare or exceptional cases, however, operations, &c. upon veins are followed by extensive inflammation of their vessels of an obstructive or suppurative character, and the question arises, what are the causes of such peculiarities? how far do they depend purely upon inflammation of the coats of the veins? and how far upon other causes? It is this question, or rather that part of it, which relates to *obstructive* phlebitis, that I have more especially endeavoured to elucidate in the present inquiry.

either, and have more especially endeavoured to ascertain the respective influence of the blood and the veins, as well as their conjoint operation in its causation. Following, then, this plan of inquiry, I shall proceed to give in detail the results of irritating and otherwise injuring the external and the internal coat of veins; of such proceedings as were calculated to affect primarily the blood; and of such as were calculated to elicit the nature of their combined influence in giving rise to the phenomena in question.

*Of Irritation and Injury of the External Coat of Veins,
as connected with the causation of Obstructive Phlebitis.*

To determine the nature of this influence, I had recourse to the following experiments, in all of which the external coat of veins was either mechanically injured or irritated by the free application of some corrosive or chemical irritant.

EXPERIMENT IX.—The right jugular vein of a dog was exposed for about three inches, on the 21st of January, 1852, and its sheath having been opened, a solution of the nitrate of silver (9ij to 3j) was brushed several times over it, to the extent of about 2 inches. The dog continued perfectly well until the 23d, when it was killed, and the parts immediately examined.

Dissection.—The wound throughout was greatly inflamed. The tissues around the vein were morbidly vascular, and matted together by adhesive inflammation. The vein itself was contracted; and the portion to which the solution had been applied, was coated with a fibrinous looking deposit, and adhered closely to the surrounding tissues. The coats of the vein were here also somewhat thickened and reddened. On opening the vein it was found to be perfectly pervious, and to contain only a thin thread of coagulum, which was adherent at its superior extremity. The lining membrane was tinted with red striæ or spots, but no distinct vascularity could be seen; and between these striæ,

the lining membrane had an opaque blueish appearance. The coats of the vein were here also somewhat thickened. These appearances were strictly limited to the portion of vein which had been irritated, above and below which it was perfectly healthy.

EXPERIMENT X.—The right jugular vein of a dog was exposed for about three inches, on the 17th January, 1852, and its cellular sheath having been opened, the vein was lightly brushed two or three times over with a stick of lunar caustic. The dog remained well until the 19th, when it was killed, and the parts examined.

Dissection.—On opening the wound by which the vein had been exposed, it was found to be filled with coagulated blood. The portion of vein to which the nitrate of silver had been applied, had sloughed away, and within its interior there was a thin thready black coagulum, which was nowhere adherent. The coats of this portion of the vein were much thickened, and its calibre contracted.

On removing the coagulum, the interior of the vein had an opaque appearance, and was slightly reddened; but no fibrine or lymph had been anywhere exuded. The morbid appearances were limited to the injured portion of the vein, and both above and below this it was perfectly healthy and pervious.

EXPERIMENT XI.—The right jugular vein of a dog was exposed, on the 26th January, 1852, and its sheath having been opened, it was forcibly pinched and contused in several places. The wound was then closed by suture, and in forty-eight hours the dog was killed, and the parts examined.

Dissection.—The wound throughout was much inflamed, and the portion of vein which had been injured was covered with a fibrinous-looking matter which was adherent, but could be readily detached. This portion of the vein was somewhat contracted, but was pervious, and on opening it, it was found to be empty, and free from any coagulum or

deposit of any kind; indeed, the lining membrane may be said to have been perfectly healthy.

EXPERIMENT XII.—The right jugular vein of a dog was exposed for about three inches, on the 19th January, 1852. It was then ligatured in two places, intermediately opened, contused, and again ligatured. The dog continued well for forty-eight hours, and was then killed, and the parts examined.

Dissection.—The wound through which the vein had been exposed was found filled with coagulated blood, which had evidently escaped from the vein. The tissues around it were much inflamed, and the vein itself was adherent to them, and covered with a fibrinous looking matter. On removing this, the exterior of the vein was found to be morbidly vascular, and its coats thickened. On opening it, it was empty, but immediately below the superior or distal ligature there was a small unadherent coagulum of about half an inch in length. The lining membrane was smooth, except inferiorly, where the vein had been contused.

Here and there, there was some little vascularity, especially where the vein had been opened and the ligatures applied, but there was neither lymph, fibrine, or pus anywhere perceptible, and the morbid appearances were strictly limited to the injured portion of the vein.

From the facts elicited from the foregoing experiments, the following inferences appear to be deducible :

- 1st. That obstruction of veins is not a necessary consequence of all forms of venous inflammation, and in particular of that which follows upon irritation or injury of their external coat.
- 2dly. That inflammation of veins thus excited is not disposed in a healthy animal to extend itself indefinitely, but on the other hand is strictly limited to the immediate seat of such irritation or injury.

3dly. That the external coat of veins very readily reacts under the influence of irritating causes; this being, in these cases, morbidly vascular, covered with inflammatory lymph, and adherent to the surrounding tissues.

4thly. That such reaction, followed by considerable inflammation of the external coat, may occur without giving rise to any corresponding inflammation of the lining membrane: for, in these cases the latter was healthy, and the vein consequently pervious, or at least free from any inflammatory exudation.

And if we admit the accuracy of these conclusions, it must follow: that neither operations upon veins, such as ligature, excision, or division, nor rheumatic inflammation of their external coat, nor mechanical injuries, such as contusion or laceration, are essentially the causes of obstructive phlebitis, as has sometimes been supposed. Nor is it probable that irritation or injury of the orifices of the uterine veins, whether occasioned by instrumental operations or the forcible separation of the placenta, can excite inflammation or obstruction of the crural veins, by being propagated to them along the coats of the hypogastric; for we have seen that, in a state of health, inflammation of veins consequent upon mechanical injury is not so disposed to extend itself. Lastly, inasmuch as it would appear that the external coat of veins very readily reacts under the influence of irritating causes, we may conclude that irritation of their lining membrane may, in some cases, give rise to it, and so to those general changes in the consistence, opacity, and vascularity of the vein, which are ordinarily regarded as characteristic of phlebitis.

Of Irritation and Injury of the Internal Coat of Veins as connected with the causation of Obstructive Phlebitis.

The phenomena which follow upon irritation of the lining membrane of veins have been very differently described by

different pathologists, although in themselves they are sufficiently simple and uniform. When, for instance, an irritant is thrown into a vein, the almost invariable consequences are, obstruction of the vessel, stagnation and coagulation of the contained blood, and sooner or later, thickening, opacity, and increased vascularity of its coats. But the particular manner in which these phenomena take place, have been differently represented by different observers. Thus by some it is maintained that phlebitis is primarily induced, and that this gives rise to the effusion of coagulable lymph into the vein, and to coagulation of the contained blood. By others, however, it is considered that the action of the irritant is primarily upon the blood, and that coagulation of fluid precedes and gives rise to the phenomena of phlebitis.

To determine the correctness of these opinions, it is necessary to investigate, separately, the effects of irritating the lining membrane of veins under the circumstances of the blood being permanently excluded from, as well as subsequently readmitted into, the irritated vein, for without doing so it is impossible to distinguish between the share respectively taken by the blood and the vein in the causation of any consequent phenomena. I propose, therefore, to confine myself, in the first place, to a consideration of the effects of irritating the lining membrane of veins under the circumstance of the blood being permanently excluded, and will subsequently treat of the effects which follow upon such irritation, when the blood has been subsequently readmitted into the irritated vein.

Although it has been generally held, that the veins are not very susceptible of inflammation from mechanical injury, it is yet believed, that they are susceptible of rapid inflammation when irritating fluids are applied to their lining membrane, and that consequent upon this a plastic material is effused from the latter, which together with coagula derived from the blood, constitutes the material by which veins are obstructed, and eventually obliterated under these circumstances. This at least is the doctrine propounded by Hasse in his excellent treatise on 'Pathological Anatomy,'

and he quotes the following experiment by Gendrin in support of it. Having secured a portion of an artery between two ligatures, and entirely cleansed it of blood, this experimenter states that he discovered, after throwing in an irritant injection, a plastic substance deposited within the part so insulated, filling up the whole calibre of the vessel; and that similar trials with veins led to the same results. "Hence it is natural to infer," says Hasse, "that in vessels containing blood the plastic product partly exudes from the parietes of the vessels, and is partly deposited from the blood." Now, with reference to these remarks, I would observe, that in several instances in which I repeated very similar experiments to those described by Gendrin, the results were different; as shown in the following:

EXPERIMENT XIII.—The right jugular vein of a dog was exposed for about three inches, on the 15th January, 1852, and the exposed vein was included between two ligatures, so as to leave about two inches of it between them. An opening was now made in the included portion, and some tepid water having been injected for the purpose of washing away any blood, a solution of the bichloride of mercury (gr. iij to ʒj), was injected into it, and again removed after having been allowed to remain in about half a minute. In the operation some of the injection came in contact with the exterior of the vein and surrounding parts, but this was speedily wiped away. The dog appeared to be but little affected by the operation, and continued well until the 17th, when it was killed, and the vein examined.

Dissection.—The wound throughout was much inflamed. The vein adhered closely to the surrounding parts, especially where the injection had come in contact with it externally. Here also the exterior of the vein was covered with adherent lymph, which gave it a thickened, roughened, solidified appearance. On removing this, the outer coat of the vein was found to be of a deep red colour, and morbidly vascular. The vein itself was contracted and apparently empty, but

on opening it, a thin thread of coagulum was found in it, of a dark red colour, soft consistence, and nowhere adherent. The lining membrane was of a uniform dingy red colour, but was smooth, and free from lymph, fibrine, or pus. Its texture was good, and it was firm, elastic, and extensible. On the proximal side of the ligatured part the vein assumed a healthy character, immediately below the point which had been injected. The included part contained a small soft coagulum. At the seat of each ligature, the coats of the vein were somewhat thickened and vascular, but beyond, they were perfectly healthy in each direction.

EXPERIMENT XIV.—The jugular vein of a dog was exposed for about three inches, on the morning of 10th January, 1852, and after it had been emptied of blood, about two inches of it was included between two ligatures. An opening was then made in this portion, and a solution of the sulphate of zinc (gr. iij to ʒj), was injected into it. It was allowed to remain in for about two minutes, and then withdrawn, and the proximal ligature removed. The dog was very little affected by the operation, and was killed, and examined forty-eight hours afterwards.

Dissection.—There was considerable inflammation throughout the wound. The tissues around the vein were morbidly vascular, infiltrated, and matted together by adhesive inflammation. The exterior of the vein was covered with a fibrinous looking deposit, having a semitransparent appearance, and of a red colour. It adhered throughout to the vein, but could be easily removed; and on removing it the external coat of the vein was found to be dotted with vascular points. The portion of the vein which had been injected was somewhat shrunk and diminished in calibre, and its coats were thickened and opaque. On opening it, it was found to be empty, and the lining membrane had a pinkish-violet tint, with here and there distinct vascularity.

This vascularity was most apparent at the point at which the ligatures had been applied, and at the part which had

been opened for injection. Throughout this portion of the vein the lining membrane was perfectly smooth, and free from any lymph or fibrinous deposit. A small coagulum of about half an inch in length was found on the proximal side of the opening which had been made in the vein, and one of about a quarter of an inch in length on its distal side. The morbid appearances were strictly limited to the injected portion of the vein, beyond which it was perfectly healthy, in each direction.

EXPERIMENT XV.—The right jugular vein of a dog was exposed for about three inches, on the 19th January, 1852, and its sheath having been opened, two ligatures were applied, so as to include about two inches of it between them. This was then emptied of blood, and a solution of the nitrate of silver (3ij to ʒj) was freely passed into its interior, on lint. The dog did not appear to be sensibly affected by the operation, and continued well for three days, when it was killed, and the parts immediately examined.

Dissection.—The wound by which the vein had been exposed, was throughout much inflamed, and filled with coagulated blood. The vein had been completely divided by the distal ligature, and at the point of division its coats were much thickened and tumefied. Externally, the portion of vein which had been irritated was covered with inflammatory lymph, and was adherent to the surrounding tissues, and here also its coats were much thickened. The interior of this part of the vein was almost perfectly empty. It contained no coagula, and its lining membrane, although somewhat reddened and patchy, was apparently free from any lymph which had been exuded from the lining membrane.

The foregoing experiments having been performed solely for the purpose of determining the effect of irritation of the lining membrane of veins, in the absence of the blood, I will merely remark, that they are completely at variance with the observations of Mons. Gendrin,

as to the dependence of obstruction of veins upon the effusion of coagulable lymph from their lining membrane excited by inflammation. For in these cases it would appear, notwithstanding the application of such irritants to this membrane, as solutions of the bichloride of mercury, sulphate of zinc, and nitrate of silver, that the veins so treated remained either perfectly empty, or contained only some fibrinous looking matter, having no analogy to coagulable lymph, and evidently deposited upon, rather than exuded from, the vein. We cannot then suppose, that veins are ordinarily obstructed, by the effusion of such lymph, although it is far from my intention to affirm that this never takes place. On the other hand, I have fully ascertained that under certain circumstances lymph is actually exuded from the lining membrane of veins, but so far as I can judge, its tendency is to develop suppurative rather than obstructive phlebitis; and restricting my observations to the latter, I feel justified in affirming, upon the strength of the experiments I have related, that considerable irritation of the lining membrane of veins may be excited without giving rise to the effusion of any appreciable amount of coagulable lymph.

And, as bearing upon the general pathology of phlebitis, it should be particularly remarked, that in all these cases the morbid appearances were strictly limited to the irritated and injured portion of the vein. Beyond this it was perfectly healthy, pervious, and free from coagula; and in the application of this fact to the pathology of the veins, we may learn that artificial irritation of their lining membrane, as of their external coat, is not disposed to extend its effects beyond the original seat of irritation or injury, and consequently, in those cases in which the veins are extensively obstructed, as is the case in phlegmasia dolens, that the exciting cause of such obstruction must have been applied coextensively with the obstruction itself.

The origin of obstructive phlebitis from spontaneous coagulation of blood in the veins, may be considered under two heads:—first, coagulation of blood in these vessels from

extreme physical or vital prostration ; and, secondly, coagulation of this fluid from the direct action of morbid matters upon it. I proceed, in the first place, to treat of the former, and will subsequently consider the latter.

The doctrine of obstruction of veins from spontaneous coagulation of blood in them, consequent upon extreme vital exhaustion, is one which derives some support from the circumstances by which phlegmasia dolens is sometimes preceded. Thus the attack has often followed upon profuse losses of blood, is frequently ushered in with symptoms of feebleness and prostration, and occurs for the most part in persons who had been previously in a depressed state of health. But that these circumstances are not specifically its cause, is proved by the fact that it has occurred in persons possessed of much strength and vigour of constitution, and has been successfully treated by bloodletting and depletion. However, to test the question by direct experiment, I had dogs repeatedly bled and kept low, but without observing any consecutive obstruction of the veins to ensue. I had then recourse to ligature and compression of these vessels, after such depletion had been practised, but still no extensive coagulation of blood took place beyond the seat of such ligature or compression. On the other hand, there was less in these cases than in those in which no such depletion had been practised. These experiments need not be further particularised, as they were upon the whole almost uniform in their results ; but the two following are, on other grounds, worthy of attention. The first illustrates the effects of the ligature of veins in a parturient animal, after copious depletion. The second, the effects of severe and extensive injury of veins together with considerable loss of blood.

EXPERIMENT XVI.—The right femoral vein of a bitch, which had littered on the 14th April, 1852, was ligatured on the 16th of the same month, a large quantity of blood having been allowed to escape during the operation. On the 17th there was no swelling, and scarcely any lameness

of the affected extremity. On the 19th, matters being the same, the left femoral vein was tied close to the iliac, and this was followed by distension of the superficial veins of the limb. On the 20th there was some lameness, but no swelling, and on the 21st, as nothing further was perceptible, she was again bled to the extent of $\frac{3}{4}$ ij. The limb was examined for several consecutive days, but no swelling or stiffness could be discovered, nor was there any particular obstruction of the ligatured veins. After some days had elapsed, the animal was killed, and on examination a little induration and consolidation of the femoral veins were alone found at the immediate seat of the ligatures.

EXPERIMENT XVII.—The right femoral vein was exposed on the morning of the 19th December, 1851, and $\frac{3}{4}$ ij of blood having been taken away from a small artery in the neighbourhood, a strong elastic metallic compress was applied round the vein, and secured on it by ligature. This had the effect of compressing and contusing the coats of the vein, while at the same time it arrested the flow of blood through it. It was continued on for forty-eight hours, during which period the dog was not perceptibly affected, nor was there any particular swelling or stiffness of the corresponding extremity. It was now removed, but the vein had been so much contused by the pressure of the instrument, that its coats gave way in the operation, and hæmorrhage took place to such an extent that the animal's life was despaired of. After remaining for some time in a state of syncope, it gradually rallied, but no particular œdema or stiffness of the limb was at any time observable, nor any apparent obstruction of the femoral vein. On the 28th the dog was killed, and on examination it was found that, although the coats of the vein had been considerably contused, and in a great measure divided, the morbid appearances of the vein were limited to the immediate seat of injury. That no coagulum had formed in it, and that the only evidence of phlebitis consisted in a thickening and consolidation of the vein at the seat of ligature, and some

fibrinous deposit at the point of its laceration, which was closely adherent to this part of the interior of the vein.

Upon the whole, then, we may, I think, conclude that obstruction of veins from mere vital prostration is of rare occurrence, and never, probably, the sole cause of that which is met with in phlegmasia dolens. Nor can I assent to the opinion that a coagulum thus or otherwise formed in veins acts as a foreign body, and so produces irritation and inflammation of the containing vessel. For in the cases of ligature of the iliac veins, which I have reported, it was found that the coagulum formed on the distal side of the ligature was unadherent, and the vein healthy at periods of twenty-four and forty-eight hours after the application of the ligature. Bearing in mind these facts, and that where coagula formed in veins are not speedily organised, their tendency is to undergo degeneration, softening down, and removal, we may, I think, certainly conclude that coagulation of blood in veins, consequent upon mere vital prostration, is seldom the cause of extensive or persistent venous obstruction.

But, in the next place, it has been assumed that such obstructions may arise from the admixture of morbid animal secretions with the blood, whence coagulation of this fluid immediately results, and precedes and gives rise to the phenomena of phlebitis. This doctrine has been especially advocated by Mr. Henry Lee, in some valuable papers on the pathology of phlebitis. He is led to believe, from numerous experiments, that the admixture of pus and other morbid animal secretions with the blood, hastens very remarkably its coagulation, both within and without the vessels of the body; that through this agency extensive coagulation of the blood may take place whenever these fluids are received into the veins, and that from the coagulum so formed a pellicle is separated which becomes vascular, and finally so firmly united to the circumference of the containing vessel as to be inseparable from it. I will briefly consider the grounds upon which this opinion rests before appealing to the testimony of direct experiment.

The opinion in question would appear to rest upon two series of observations, the one having reference to the effects of pus when mixed with the blood out of the body, the other to its effects when introduced into the veins. In the former case it was observed that whilst healthy blood occupied fifteen minutes in completely coagulating, that this took place in only two when pus was mixed with it. In the latter it was found that when injected into a vein, the vessel became tense during the operation, and sensibly resisted the attempts which were made to propel its contents onwards towards the heart.

Now, with reference to the first of these series of observations, I would venture to suggest that more may have been deduced from them than is strictly warranted by the facts of the case, and that an inference has been drawn from them in regard to the action of pus and other morbid secretions upon the blood, which is true also of a variety of simple and perfectly normal fluids. Incidental to this inquiry I felt it necessary to make some observations upon the rate of the coagulation of the blood, out of the body, under different circumstances, and I found that such fluids as perfectly healthy serum, or even pure water, when added to it in a certain proportion and of a given temperature, exercised a remarkable power in accelerating its coagulation, and this more particularly when the blood so treated was maintained at the temperature at which it circulates in the body. Thus, whilst I found that the blood of the rabbit began to coagulate ordinarily in two minutes and a half, and was completed in five minutes and a half, I observed that when it was received into a basin which had been placed in warm water of the temperature of 110° , and was kept at this heat, that it began to coagulate in less than one minute, and was completely coagulated in a minute and a half.—That half an ounce of blood received into a vessel placed in warm water, containing a similar quantity of healthy serum, began to coagulate in less than half a minute, and that coagulation was completed in less than one minute.—That an ounce of rabbit's blood received into a vessel containing half an ounce

of water of the temperature of 110° , began to coagulate in one minute, and that coagulation was general in two minutes. I could adduce many other observations, if it were necessary, to show that that which is true of pus in accelerating the coagulation of blood, out of the body, is true also of a variety of harmless and, as I have said, perfectly normal fluids.

But, in the second place, it was observed by Mr. Lee, that when pus was injected into the jugular vein of a healthy ass, and propelled in the course of the circulation by pressure externally, the vein became tense during the operation, and sensibly resisted the attempts which were made to propel its contents onwards towards the heart: and hence it was concluded, that the blood in the vein had become coagulated from the direct action of the pus upon it. It may, however, be observed, that the facts referred to admit of a different interpretation, whilst in such an experiment there is a source of fallacy which may not have been sufficiently allowed for. I refer more particularly to the influence of the respiratory movements in modifying the circulation through the larger veins in the immediate vicinity of the thorax, and more especially to the effect of forced or prolonged expiration in arresting the flow of blood in these vessels. Now this influence I believe to be often very considerably exerted in these operations upon the veins; for, in consequence of the struggles of the animal, and the irregularity of the respiratory movements thereby induced, the onward progress of the blood is often retarded or arrested, and thus a feeling of tension or resistance is given to the finger when placed over the injected vein, which may be extremely deceptive.

I have often observed these phenomena when injecting various fluids into the veins; and even in regard to the femoral, the feeling of resistance from this cause would sometimes be so great, as to lead to the belief that the blood must have coagulated in the vein: nevertheless, on a full inspiration taking place, the injection would again pass readily onwards towards the heart. I am therefore unwilling to believe that mere tension, resistance, or firmness

of a large vein in the neighbourhood of the thorax, during the injection of foreign matters into it, is any proof of the coagulation of the contained blood.

But admitting the fact, that the blood does actually coagulate in the vein under these circumstances, it is yet possible, as I have remarked, to give a different explanation of it; for in such a case, the pus injected must equally come in contact with the lining membrane of the vein as with the blood; and it appears to me, that its coagulation under these circumstances may as much depend upon the reaction of this membrane, thus irritated, upon the blood, as upon an action primarily set up in this fluid. We know that the lining membrane of veins very readily reacts upon the application of irritating matters; and it will hereafter be shown, that coagulation of the blood very quickly follows upon such irritation. It will also be shown, that such coagulation is at first limited to the portion of blood which is in contact with the lining membrane of the vein, and does not, in the first place, extend to the whole column. Thus in one case I found, after throwing some dilute lactic acid into the femoral vein towards the heart, that a layer of coagulum had been deposited, within half an hour, upon the lining membrane of the iliac veins and the cava, which had at first the appearance of a solid coagulum occupying the entire calibre of the vessel. On further examination, however, it proved to be but a mere cylinder of coagulated blood, the blood in contact with the lining membrane of the veins having been coagulated, whilst its interior was perfectly fluid. Such an observation appears to me to invalidate the opinion that the blood is first coagulated in the veins by the contact of irritating matters, and that the morbid changes which may take place in the vein are consequent upon and occasioned by such primary coagulation of this fluid.

Further, on appealing to the testimony of direct experiment, I was unable to verify the observations of Mr. Lee as to the formation of coagula in veins, from the introduction of puriform and other abnormal fluids into these vessels, and their direct action upon the blood irrespectively of the veins.

For in all cases in which these were used in a concentrated form, it happened that the animal almost invariably died, without, as shown on a post-mortem examination, any attempt having been made to arrest their progress onwards towards the heart by the formation of coagula in the veins; whilst in others, in which they were used in a less concentrated form, although it is true, that the vein became obstructed from the formation of coagula, yet these effects, as will hereafter be shown, were not produced by any primary action taking place in the blood, but admit of explanation in a very different manner.

In illustration of these remarks I would observe, that in several cases in which impure lactic acid, largely diluted, was injected into the veins, death rapidly ensued, without, as shown on post-mortem examination, any distinct coagula having been formed in these vessels, or any barrier attempted to its transit onwards towards the heart. In these cases, indeed, death would appear to have resulted from the impression of the acid upon the lining membrane of this organ; and this would sometimes take place so quickly, as to forbid the notion that any such barrier had been attempted. The following example may be quoted as a type of many others. The left jugular vein of a dog was exposed on the 12th June, 1852, and 3iss of impure lactic acid diluted with 3jiss of warm water was slowly injected towards the heart. Before the injection was completed the dog became convulsed; his pupils dilated, he breathed with difficulty, and shortly afterwards died. On making a post-mortem examination, the vein down to the heart was found to be filled with a black tarry-looking matter, which adhered to the lining membrane of the vein, but in which no distinct coagula could be found. In injecting pus into the veins I have also been unsuccessful in obtaining any evidence of extensive coagulation of the blood, occasioned merely by its admixture with it. Thus in two cases in which half an ounce of pus, slightly diluted with warm water, was injected into the femoral vein towards the heart, both animals speedily died; and on examination no particular coagulation

of the blood was found to have taken place in the course of the injection, whilst purulent matter was plainly discernible in the right cavities of the heart, as shown in the following experiment.

EXPERIMENT XVIII.—The femoral vein of a dog was exposed on the 15th June, 1852, and half an ounce of pus, slightly diluted with water, was slowly injected into it towards the heart. In rather more than a minute the dog seemed distressed, the abdominal and respiratory muscles became convulsed, and respiration ceased within two or three minutes. On making a post-mortem examination shortly afterwards, the vena cava and the abdominal and thoracic veins were found generally turgid with blood. On opening the right iliac vein, a stream of dark-coloured fluid blood poured out; and on continuing the division of the veins upwards, the blood was still found to be fluid, with the exception of two or three small coagula, which were found about the middle of the cava. The right auricle contained a thin black coagulum, and small fibrinous coagula were scattered over and between the columnæ carneæ of the right ventricle, which contained a minute yellowish-looking matter closely resembling the pus which had been injected.

It appears to me unnecessary to pursue this question at greater length, not only because the subject of purulent injection of veins has been very ably investigated by several pathologists, but because my object being solely to consider it as the cause of obstructive phlebitis, I think the facts brought forward sufficiently subserve this purpose, and show that it does not ordinarily arise from actions thus excited in the blood irrespectively of any agency of the veins. I do not doubt, on the one hand, the power of pus to hasten the coagulation of blood out of the body, nor, on the other, that the jugular vein may have felt hard and obstructed after two ounces of pus had been injected into it. But in regard to the former of these facts, I would observe that other agencies besides pus, and some of a strictly normal character, will

produce the same results, whilst a different explanation may be given of the latter than that which has been assigned to it. Neither do I doubt that nature endeavours to hem in noxious matters when received into the veins by the formation of coagula in these vessels; but restricting my observations to the general pathology of obstructive phlebitis, it does not appear to me to have been conclusively shown, from the facts and arguments I have quoted, that this is the usual mode in which it is produced.

Of Irritation of the Lining Membrane of Veins, the blood being excluded during the operation, and subsequently readmitted.

EXPERIMENT XIX.—The jugular vein of a dog was exposed on the 4th February, 1852; and the several veins from which it arises having been ligatured, so as to prevent any blood from entering it, an opening was made in one of its branches, and through this a solution of the nitrate of silver was passed into its interior upon lint, and applied to about an inch and a half of its lining membrane. The opening in this branch was then closed by ligature, and the ligatures taken off the other branches, so as to allow the blood to circulate again through it. The external wound was then closed by suture, and in sixteen hours the dog was killed and the vein examined.

Dissection.—The cellular sheath surrounding the vein was much inflamed, and its external coat was thickened and injected. On opening it, a firm coagulum occupied the interior of the vein to the extent to which the irritant had been applied. This coagulum was of a uniformly dark colour, and adhered at its upper and lower extremity. On removing it, the lining membrane of the vein to which the irritant had been applied was found slightly reddened and discoloured; but no distinct vessels could be seen. Small portions of fibrine were adherent to it, apparently derived from the coagulum; but no coagulable lymph had been exuded. The coats of the vein were here generally thickened

and opaque; but immediately below the irritated portion the morbid appearances almost abruptly ceased, and elsewhere the vein was perfectly healthy.

This experiment was repeated in three different instances, and with essentially the same results. In each the jugular vein was irritated by a solution of the nitrate of silver, introduced upon lint through one of its superior branches; and on subsequently readmitting the blood which had been temporarily excluded, a firm coagulum was found in that portion of the vein occupying the extent of the vessel to which the irritant had been applied.

The results of these experiments, taken in conjunction with those which have been previously related, appear to me to be not only important in themselves, but to point to the true pathology of obstructive phlebitis. We may deduce from them :

- I. That irritation of the lining membrane of veins may so modify the vital properties of the blood circulating through them as to give rise to speedy coagulation of this fluid, and this to an extent commensurate with that of the irritation which may have been excited in their lining membrane.
- II. That such irritation of the lining membrane may take place without any mechanical injury of the corresponding vessel; the obstructed veins in these cases having been uninjured, inasmuch as the irritant was introduced into them through an opening in one of their superior branches.
- III. That coagulation of the blood in veins may take place from this cause without any primary or independent action having been set up in this fluid; for in these cases the blood was excluded from the veins both prior to and during the application of the irritant to their lining membrane. Thus, it must follow that the action of the irritant must have been exclusively upon the vein, and

that the resulting coagulation of the blood could only have arisen from some impression made upon the blood by the lining membrane thus irritated.

- iv. That from such irritation of the lining membrane of veins all the phenomena of obstructive phlebitis may follow; the coagula in these cases having undergone various changes in colour and consistency, adhesions having formed between them, and the veins and the coats of these vessels having become thickened, vascular, and opaque.
- v. That the morbid changes in such cases are limited to the extent to which the lining membrane of the veins may have been irritated; the blood and the veins beyond this having been found perfectly healthy in these cases.

It would thus appear that whilst phlebitis may occur in a variety of forms without giving rise to extensive obstruction of veins—whilst such obstruction is not producible by mechanical injury of these vessels, by irritation of their external coat, by actions primarily taking place in the blood, and does not arise from the effusion of lymph into their interior—it is yet readily produced by irritation of their lining membrane; that the obstructing material is not lymph, but blood; and that this is immediately coagulated in the vein by some impression made upon it by its lining membrane when thus morbidly irritated or excited.

In the experiments last related the pathological appearances of the veins were of a very marked and decided character: there was opacity, thickening, and morbid vascularity of their coats, with other changes, which together would be regarded as characteristic of phlebitis. But that extensive obstruction of veins may be excited by the passage of irritating fluids over their lining membrane without giving rise to inflammation; that, therefore, phlebitis forms no essential part primarily of the pathology of such obstruction; and that a state of mere excitation or irritation of this membrane, unattended by any appreciable alteration of

its structure, will alone suffice to give rise to it, is proved by the results of the following experiments :

EXPERIMENT XXII.—The left femoral vein of a dog was ligatured on the 23d July, 1852, and half an ounce of lactic acid, diluted with an equal quantity of water, was injected into it towards the heart. The animal was sensibly affected by the operation: he breathed heavily and irregularly, and shortly afterwards appeared to be faint and giddy and incapable of standing. He had now frequent gulplings, made efforts to vomit, and had apparently a disposition to tenesmus or diarrhœa; the breathing became more irregular, convulsions ensued, and he died in about half an hour from the period of the injection.

Dissection.—The iliac veins of the left side, from the femoral up to the cava, and a considerable extent of the cava, were found obstructed by what appeared to be a firm coagulum; and, on opening these vessels, this was found to be closely adherent to their lining membrane. After a short time, however, this apparent coagulum began to contract, and, in doing so, separated itself from the veins, exuding at the same time a serous fluid from its interior. This contraction proceeded until the coagulum, which had previously filled the entire cavity of the veins, now occupied but a small track of their interior. The coats of the veins which had been obstructed were perfectly healthy: no morbid redness, vascularity, or opacity was any where observable, and the lining membrane to which the coagulum had been adherent was perfectly smooth, white, shining, and free from any trace of inflammation.

Now, there cannot, I think, be any doubt that the blood had coagulated in these veins independently of any inflammation of the containing vessels, or that the coagulation was limited to the layer of blood immediately in contact with their lining membrane; and from these facts two inferences may be drawn: 1st, that phlebitis is not essential to the production of obstruction of veins; and 2dly, that the action of irritants thrown into the veins is not primarily or

exclusively upon the blood, and therefore, that obstruction of these vessels taking place under such circumstances does not depend upon actions independently taking place in this fluid. On the other hand, looking to the fact that it was not the entire column of blood which was coagulated in this case, but only the layer in contact with the lining membrane of the veins, it would rather appear that some reciprocal reaction had taken place between the blood and the vein, which was immediately due to irritation of the latter. The same facts are shown in the following experiment, in which, however, a longer interval was allowed to elapse between the irritation of the veins and the death of the animal :

EXPERIMENT XXIII.—The right femoral vein of a dog was ligatured on the 23d July, 1852, and ʒiij of lactic acid, diluted with ʒix of tepid water, was injected above the ligature towards the heart. In twenty hours it was found that the corresponding limb was swollen and tense, and that the dog used it apparently with difficulty and pain. He was now killed, and an examination immediately made of the parts.

Dissection.—The right femoral vein was throughout obstructed by a firm adherent coagulum, as far down as the popliteal. The right iliac veins and the cava, as far up as the renal, were also obstructed with what appeared to be a firm coagulum, and on opening them it was found that this adhered throughout to their lining membrane. By degrees, however, it was observed to contract, and in doing so to separate itself from the lining membrane of the veins to which it had been adherent, and a serous fluid was, at the same time, exuded from its interior. This contraction went on until the coagulum, which had previously filled the entire calibre of the veins, now formed a mere band within them, occupying little more than a third of their diameter. During its separation, small patches of red fibrinous matter were left upon the lining membrane of the veins; but these vessels were otherwise perfectly healthy. They were neither

thickened, vascular, nor opaque, and their lining membrane was smooth, white, and translucent, and free from any kind of inflammatory exudation.

I submit, then, that these experiments, conclusively show that obstruction of veins may occur independently of phlebitis; that phlebitis is not, therefore, an essential condition of its development, but rather a consecutive phenomenon; that such obstruction is producible by irritation or excitation of their lining membrane alone; and that such irritation may occur without any local injury of these vessels.

In the last place, I proceeded to investigate how far such irritation might be produced solely by a general vitiation of the blood; for such a presumption was rendered probable by the whole of the results of the preceding investigation. It had, for instance, been repeatedly shown that whilst wounds, injuries, &c. of veins were incapable of giving rise to extensive obstruction of these vessels in a healthy animal, otherwise in one whose blood was perfectly normal, that it yet readily followed upon irritation or excitation of their lining membrane in the absence of such causes. Reasoning, then, upon these facts, I was led to believe that such irritation of the lining membrane of veins might be produced by the presence of certain abnormal matters in the blood, circulating with it and acting upon particular veins or portions of the venous system. I accordingly proceeded to put this question to the test of direct experiment, and the result of a somewhat lengthened investigation enables me to affirm,—that not only particular veins, but considerable portions of the venous system, may become thus obstructed, in the absence of any mechanical injury of these vessels.

EXPERIMENT XXIV.—The right femoral vein of a dog was ligatured on the 16th June, 1852, and the effects of the operation were carefully noted for several days. In twenty-four hours there was some little œdema of the limb, but it was not painful or tender, and the dog moved it without

difficulty. In forty-eight hours the œdema was nearly gone. In seventy-two hours there was none perceptible, and the limb appeared to be perfectly natural. The left femoral vein was now ligatured, and above the ligature ziss of lactic acid diluted with 3xss of tepid water was injected towards the heart. In twenty-four hours the corresponding extremity was greatly swollen throughout, its temperature was raised, it was painful on pressure, and the dog moved it with difficulty. In forty-eight hours its general condition was the same, the swelling was still considerable, the limb was tender on pressure, and the dog still moved it with difficulty. It was now killed, and the parts examined.

Dissection.—The left posterior extremity was generally swollen. The subcutaneous and intermuscular cellular tissue was morbidly vascular and infiltrated, and the muscles themselves were in places swollen and congested. The iliac veins of this side were obstructed with a firm coagulum, which extended somewhat into the cava, *whilst the femoral and all the principal veins of this extremity were found similarly obstructed.* On opening these vessels it was found that the external and common iliac veins were filled with a firm coagulum, which was throughout adherent to their lining membrane, and, on removing it, some red gelatinous-looking matter was left upon the interior of the veins, which for the most part could be readily brushed away, but here and there portions of it were firmly adherent. The colour of the lining membrane of these veins was somewhat redder than natural, but the membrane itself was for the most part smooth and polished. At its junction with the femoral, the coats of the external iliac vein were thickened and opaque, and it did not collapse on being cut through. The left femoral vein was filled with a dark coagulum, which was somewhat soft and grumous immediately below the ligature, but which elsewhere was of firm consistence. It was slightly adherent, and, on removing it, a little gelatinous-looking matter was left upon the lining membrane, which could be easily brushed away. This vessel was neither thickened nor

opaque, nor was any increased vascularity of its coats observable. The principal branches of the femoral vein were all filled with firm coagula, but these were very slightly, if at all, adherent to the interior of the veins. The posterior tibial vein was thickened, and its coats did not collapse on being divided; it was throughout filled with a coagulum. The right femoral vein contained a firm coagulum which was slightly adherent, and, on removing it, a little red matter was left upon its interior. This vein was neither vascular, thickened, nor opaque. A small coagulum was also found in the right popliteal vein. On making transverse sections of the different coagula found in the veins, it was observed that their exterior was much firmer than their interior. The former consisted of firmly coagulated blood, the latter of little more than a grumous semi-fluid material. Hence it seems reasonable to conclude, that coagulation had commenced at the circumference of the coagula, where the blood was in contact with the lining membrane of the veins.

Now, should it be supposed that the extensive obstruction of these veins, which followed the injection of lactic acid into the blood, was in any way due to the operative proceedings had recourse to, I would beg to observe, that no such obstruction occurred in any of the preceding experiments, in which the veins were similarly ligatured or divided; and, further, that in this the right femoral vein had been previously ligatured without any such obstruction resulting. But, to put the question beyond a doubt, I repeated precisely the same operation upon another dog, with the sole difference of injecting tepid water into the blood, instead of lactic acid, and the result proved that no obstruction whatever of the veins took place, even after a longer interval had been allowed to elapse.

EXPERIMENT XXV.—The femoral veins of a dog were both ligatured on the 28th June, 1852, and above the ligature of the right an opening was made, and 3iss of tepid water injected towards the heart. The dog was examined regularly for several days, but no swelling was observable in

either of the posterior extremities, neither did the dog at any time appear to suffer from pain, weakness, or stiffness of either of these limbs. In seven days the animal was killed, and the veins immediately examined.

Dissection.—The pelvic veins were throughout perfectly pervious and healthy. The femorals at the point of ligature were slightly thickened and obstructed, and adhered to the surrounding parts, but elsewhere they were perfectly healthy, and no other morbid appearances were anywhere perceptible.

As, however, I was unwilling to let the question rest upon the evidence of a single observation, I repeated the same experiment in a variety of ways in different animals, and, upon the whole, with results which were affirmative of the correctness of the principle I have stated. In all, considerable obstruction of veins followed the track of the irritant in its progress onwards towards the heart, whilst in the majority there was also obstruction of the distal veins of the extremity which, consistently with the results of preceding experiments, could only have arisen from the action of the irritant after it had gone the round of the circulation. Thus, in one instance in which the jugular vein was opened, and some weak lactic acid injected, in the course of the circulation it was found that a firm coagulum occupied the whole of its interior, which extended down to the right auricle, and was in places fibrinous and decolourised. In another, in which ʒiij of lactic acid, diluted with ʒix of water, were injected from the right femoral vein towards the heart, it was found that not only had a layer of coagulum been deposited upon the lining membrane of the iliac veins and the cava, as high as the renal, but that a firm coagulum occupied also the right femoral, from its commencement to its termination in the popliteal. In a third, in which a similar quantity of dilute lactic acid was injected into the femoral vein towards the heart, it was found that not only were the iliac veins of the same side firmly obstructed, and a layer of coagulum deposited upon and adherent to the cava for some distance, but that the femoral vein of the

opposite extremity was also obstructed to a considerable extent. In a fourth, in which impure lactic acid, largely diluted, was injected into the right femoral vein towards the heart, it was found that not only were the right iliac veins and some of their branches obstructed by a firm adherent decolourised coagulum; but that the right femoral vein, down to the popliteal and several of its branches, were similarly obstructed, whilst a firm coagulum occupied also the left femoral vein down to the popliteal. In a fifth it was found where the same irritant had been injected into the femoral vein, that not only were the iliac veins of the same side and some portion of the cava obstructed with a firm adherent decolourised coagulum, but that the femoral veins contained also coagula on the distal side of the ligatures which had been applied to them.

It appears to me that the results of these experiments are essentially affirmative of the truth of the principle which I have advanced, for they show that not only may large tracks of the venous system become obstructed by the action of an irritant in its progress onwards towards the heart, but that other portions of this system may also become obstructed by its action, after it has gone the round of the circulation; and this I would submit has been shown to occur in a sufficient number of instances to justify the general conclusion, that whenever the blood is vitiated, whether from local or constitutional causes, that not only particular veins, but large portions of the venous system may, under certain circumstances, become obstructed and inflamed, and this independently of any injury of the veins themselves.

I have referred the obstruction of veins in these cases to irritation or excitation of their lining membrane, immediately induced by the presence of morbid matters in the blood, and I would now beg to explain the sense in which the term is used, and the extent to which it appears to be applicable to the phenomena in question. It has been shown, that when an irritant has been applied to the lining membrane of a vein whilst the blood is excluded, that the blood will immediately

coagulate on being again readmitted, and that consequently this coagulation must arise from some impression made upon it by the lining membrane thus irritated. It has further been shown, that this may occur without any evidence of inflammation of the vein, or apparent structural change of the vessel, and that the coagulation is limited in the first place to the portion of blood in contact with its lining membrane. Upon these data, I have assumed that the phenomena in question depend upon a disturbance of the relations which normally subsist between the blood and the lining membrane of the veins, and that this is immediately due to irritation of the latter. In this sense, then, the term is intended to signify a state of excitation of this membrane; in which the equilibrium is disturbed which naturally subsists between the blood and the membrane, and it points to that general principle of design, harmony, or adaptation in the animal economy, in virtue of which the different organs subserve their respective purposes, and respond to their appropriate stimuli. Thus we know, that pure atmospheric air gives no uneasiness to the respiratory mucous membrane, whilst impure air, or a drop of water, gives rise to violent irritation of it. That certain kinds of food are grateful to the mucous membrane of the stomach and alimentary canal, whilst others excite irritation and disorder, and so, also, in regard to the circulatory organs, we may assume that a certain quality, consistency, and vital condition of the blood, is best calculated to ensure its easy transmission through the blood-vessels. Now should these qualities, whether physical or vital, be greatly altered from their natural condition, it appears to me reasonable to conclude, that just as irritation may be set up in the former case, leading to various forms of disorder, so in regard to the latter, may irritation of the lining membrane of veins be excited without any visible change of structure; and that, in virtue of this, a disturbance may ensue in the relations which normally subsist between it and the blood. I know, at least, of no other way in which the phenomena in question can be as satisfactorily accounted for, seeing that they are not dependent upon

either inflammation of the vein or upon changes exclusively confined to the blood ; and I would further observe, that this opinion is strengthened by the fact, that in cases in which the irritation of the lining membrane of the vein has been slight, extensive coagula formed in veins may soften down and be removed without leaving any trace of inflammation of the vessel behind.

Let me not, however, be supposed to affirm, that irritation of the lining membrane of veins terminates thus favorably in all cases ; on the other hand, it must be distinctly understood, that whenever it has been violent or long-continued, vascular actions will sooner or later take place in the irritated vein, tending to its injury or permanent obstruction. Whenever, indeed, a layer of coagulated blood is thus deposited upon the interior of a vein, and is not speedily softened down and removed, its organisation must be expected, in the progress of which the coats of the vessel will become thickened and opaque, its vasa vasorum enlarged and injected, and the general phenomena of phlebitis developed. This is the condition in which obstructed veins have generally been met with in fatal cases of phlegmasia dolens, and hence the disposition on the part of the profession to attribute such obstructions exclusively to phlebitis.

The general conclusions, then, which appear to be deducible from the foregoing investigation, are the following:

1. That inflammation of the iliac or femoral veins will not alone give rise to all the phenomena of phlegmasia dolens.
2. That the extensive obstruction of the veins met with in this disease, is not producible in a state of health by merely local causes, such as injury or inflammation of these vessels.
3. That irritation of the lining membrane of veins independently of such local injury or inflammation may, under certain circumstances, give rise to obstruction of these vessels, and this to an extent

commensurate with that of the irritation which may have been excited within them.

4. That such irritation of the lining membrane of veins, giving rise to obstruction, and consecutively to all the phenomena of *obstructive* phlebitis, may be excited by the presence of various abnormal matters in the blood, circulating with this fluid, and acting upon particular portions of the venous system.
5. That the origin of *obstructive* phlebitis is therefore to be sought for rather in a vitiated condition of the blood, than in any local injury, inflammation, or disease of the veins.

And in arriving at these conclusions, I would venture to submit, that I have arrived at a solution of the problem which I proposed to myself at the outset of this inquiry, viz. : What are the specific causes or conditions which can simultaneously affect the sensory, the motor, the secretory, and the vascular organs of an extremity, so as to give rise to the symptoms by which phlegmasia-dolens is characterised. For in tracing obstruction and inflammation of veins to an abnormal condition of the blood, I have assigned to it a cause which can equally and simultaneously affect all these several organs; and by giving rise to irritation respectively of the nerves, the muscles, the lymphatics, the veins, and the cellular tissue of the limb, may occasion that tense, elastic, swelling, morbid sensibility, loss of motor power, affection of the lymphatics, and obstructed condition of the veins, which together constitute the pathognomonic symptoms of the disease.

It now only remains for me to consider how far the theory of the disease, deducible from the foregoing investigation, is supported by the clinical history of phlegmasia dolens. How far, in fact, it supports the opinion that the immediate cause of the disease is in the blood, and that the

affection of the veins like that of the nerves, the lymphatics, and the cellular tissue of the limb, is essentially secondary to and dependent upon an antecedent vitiation of this fluid.

The causes capable of giving rise to a morbid condition of the blood are, I need scarcely observe, of a two-fold character, the one being local the other constitutional. The former comprehend more especially unhealthy secretions, suppurations, or discharges from parts which are either inflamed, contused, or ulcerated. The latter, derangements of the primary or secondary assimilative processes, arrest or suppression of the natural excretions, redundancy in the system of effete or decomposing organic matter, epidemic or endemic influences, the products of febrile or inflammatory attacks, and diseases of the blood directly affecting its growth or development. When, then, in the history of a case we find that it has been obviously preceded and probably occasioned by such causes, we deduce a strong argument therefrom in favour of its blood origin. But, in the absence of such evidence, we may in general deduce a similar inference from another series of facts, viz., from the existence of various lesions in different organs of the body at the same time. This is a circumstance which has been constantly known to follow upon the artificial vitiation of the blood, and is one which is common, if not peculiar, to blood diseases. I propose, therefore, in carrying out this inquiry, to ascertain how far the histories of cases of phlegmasia dolens furnish sufficient evidence on these points to authenticate the theory of the disease which has been deduced from experimental investigation.

To determine this question I have carefully analysed and tabulated the principal facts of 100 cases of the disease, as reported in special treatises on the subject, or recorded in the periodical literature of this and other countries. These tables contain the particulars of sixty cases which occurred after or in connection with child-bearing, and of forty which occurred independently of this function,—the former comprise twenty deaths and forty recoveries; the latter twenty deaths and twenty recoveries. In arranging them I have

placed, under separate heads, their respective antecedents and probable causes, any coexisting affections, and the post-mortem appearances met with in fatal cases. I have also noted such general circumstances in their history as are calculated to throw light upon the question under consideration, of which the following may be regarded as the more important of the

I. PUERPERAL CASES.

Labour subsequently to which the attack occurred.—Of 35 cases in which this is noted—in 8, it occurred after the first; in 8, after the second; in 3, after the third; in 5, after the fourth; in 6, after the fifth; in 1, after the sixth; in 1, after the seventh; in 1, after the tenth; in 1, after the eleventh; and in 1, after the twelfth. We thus observe that the predisposition to the disease is considerably greater after the first and second than after any subsequent labour; and, without venturing to draw any positive inference from this fact, we may, I think, reasonably connect it with the more protracted parturient efforts, the greater injury of the soft parts, and the more considerable reaction which must occur in these than subsequent labours. Circumstances which, by inducing an inordinate disintegration of tissue, must manifestly tend to affect the general condition of the blood.

Character of Labour.—Of the 60 cases, this is noted in 38, and of these it is stated that in 22, it was natural; in 10, severe; in 1, preternatural; in 2, difficult and accompanied with instrumental injury; in 2, tedious; and in 1, protracted with retained placenta. If, then, we assume that it was natural in the remaining twenty-two, of which no mention is made, it will follow that in little more than a fourth only was it otherwise, and with a full knowledge of this fact, we cannot connect the origin of the disease with any peculiarity in the character of the labour, or with any local or mechanical injury of the uterus. Not that it is intended to affirm that mechanical injury of the uterus does not predispose to the attack, but rather that it is not an essential cause; one, indeed, of many others equally tending

to its occurrence, and all probably operating by giving rise to an abnormal condition of the blood.

Date of attack after Labour.—In 1, the attack began the day after delivery; in 4, on the second day; in 1, on the third; in 3, on the fifth; in 1, on the sixth; in 3, on the seventh; in 2, on the ninth; in 6, on the tenth; in 1, on the eleventh; in 4, on the twelfth; in 5, on the thirteenth; in 5, on the fourteenth; in 3, on the fifteenth; in 1, on the seventeenth; in 6, on the twenty-first; in 2, on the twenty-second; in 2, on the twenty-third; in 1, on the twenty-seventh; in 5, on the thirtieth; in 1, on the forty-first; and in 3 the date is not given. Now, on looking to these several dates, the first general inference which is deducible is, that there is no particular period after labour which is peculiar to the attack. But, bearing in mind that out of 57 cases in 47 it began within twenty-one days after delivery, we may deduce an argument therefrom in favour of its blood origin, for it is within that period that those great puerperal actions are inaugurated which powerfully tend to modify the general condition of this fluid, such, for instance, as the febrile reaction consequent upon labour, and the establishment of the milk, the modifications of the lochial secretion thereby or otherwise induced, the effects of injury or contusion of the soft parts, the reception of effete organic matter into the blood consequent upon febrile action, and the involution or disintegration of the uterus. These and other circumstances peculiar to the puerperal period, tend in an especial manner to modify its condition, and as such to predispose to various local diseases.

Extremity affected.—This is specified in 58 out of the 60 cases; and of these, in 1, the left arm was attacked, and in another, both lower extremities were concurrently affected. Of the remaining 56 the attack commenced in and was limited to the left lower extremity in 23; and commenced in the left and subsequently attacked the right in 10; whilst in 16 it began in and was limited to the right; and in 7 commenced in the right and subsequently attacked the left. Thus it would appear of the 56 cases that the affection

began in the left lower extremity in 33, and in the right in 23, making the frequency of the attack in the left, as compared with the right, in the proportion of about 3 to 2, whilst in rather less than a third of the whole number the opposite limb became subsequently affected.

The greater liability of the left lower extremity to the disease, as compared with the right, has been noticed by various authors, but I am not aware that any satisfactory explanation has been given of the fact. It is, however, worthy of remark that the relative frequency of the attack in these cases corresponds very nearly with that of the attachment of the placenta to the left side of the uterus as compared with the right, as given by Dr. Carriere, of Strasburg, in his Thesis on Obstetric Auscultation ; for he states that of 66 cases in which the placental sound was noted, that it was heard on the left side of the uterus in 38, and on the right in 28. I do not, however, lay any great stress upon this fact in the present state of the inquiry, because the cases I have tabulated, as well as those noted by Dr. Carriere, are too limited in number to justify any positive conclusion on this point. But should it hereafter appear that the liability of the left lower extremity to the attack, as compared with the right, corresponds with the relative frequency of the attachment of the placenta to the left side of the uterus, as compared with the right, it would furnish an argument in favour of the origin of the disease from vitiation of the blood. For it is where the placenta has been attached that the uterine wound will be left on its removal, and it is from this that unhealthy secretions will be poured forth in cases of local injury, inflammation, or constitutional disorder, whilst here, also, these secretions will be most favorably placed for re-absorption, by being in contact with the orifices of the uterine veins which had been torn across by the removal of the placenta. Thus the veins of the corresponding side would be especially liable to irritation and obstruction, for it has been clearly shown that when the blood is vitiated by the artificial introduction of foreign matters into it, the effects of such vitiation are principally manifested

in the veins and organs in the immediate seat of their insertion.

The frequent disposition to metastasis, or a subsequent affection of the opposite limb, observed in these cases, is worthy of remark, and would appear to be only explicable on the ground that the proximate cause of the disease is in the blood. Such disposition being almost peculiar to blood diseases.

Antecedents and probable Causes.—In 33 of the 60 cases, the attack followed upon some form of puerperal fever; in 13, upon exposure to cold, and consequent arrest of the cutaneous excretion; in 3, upon dietetic errors, and consequent derangement of the assimilative functions; in 3, upon the operation of epidemic influences; 4, occurred in the progress of pulmonary consumption, or some other constitutional disease; 2, followed quickly upon severe or protracted labour; whilst in 3, no specific information is given on this point. Thus it would appear, that in nearly all these cases the attack had been preceded, and was probably occasioned by some circumstance capable of vitiating the blood, such as fever of various kinds, suppression of the natural excretions, epidemic influences, derangement of the assimilative processes, or some constitutional disease. To appreciate more fully, however, the influence of these causes in giving rise to the attack, it will be necessary to indicate the particular sequence of morbid actions by which it was preceded in each case.

Thirty-three Cases followed upon some form of Puerperal Fever.—The nature of the fever does not appear to have been specified in all cases, nor is it necessary for the purpose of this inquiry to investigate very minutely this point. It may be sufficient to observe, that the fact alone is important, as showing that phlegmasia dolens is in a large proportion of cases a consequence of puerperal fever; and without entering upon a discussion of its nature, how far, for instance, it originates in a vitiation of the fluids or a primary inflammation of the solids, we may assume that with its accession and development a vitiation of the fluids must ensue. I will therefore address myself more parti-

cularly to a consideration of the several circumstances which may originate phlegmasia dolens in connection with puerperal fevers.

Of the 33 cases referred to, it would appear that in 14 the fever had been preceded by a severe, tedious, or preternatural labour, or some circumstance calculated to give rise to inflammation of the uterus, or to unhealthy uterine discharges, which received into the circulation, would tend to contaminate the blood; whilst in the remainder, the labour was either natural, or not such as to have required any particular mention. We may thus recognise a distinction in these cases, between those preceded by, and those irrespective of uterine injury; and believing that they are respectively typical of the influence of local and constitutional causes in vitiating the blood, and so giving rise to the phenomena of the disease, I will treat of them separately under these heads.

The 14 cases of puerperal fever which followed upon some kind of uterine injury or lesion, present respectively the following sequence of morbid actions:

- 1.¹ Severe labour with hæmorrhage; sixth day, fever and pleurisy; fifteenth day, phlegmasia dolens.
7. Protracted labour and retained placenta, followed by puerperal fever, which continued till the third week, when phlegmasia dolens began.
13. Difficult labour, having the lochia much disturbed. Date of attack not stated.
18. Difficult labour, and severe instrumental injury; fourth day, puerperal fever; fifth day, exposure to cold; sixth day, phlegmasia dolens.
22. Bad health before confinement, difficult labour; sixth day, peritoneal fever; fifteenth day, phlegmasia dolens.
23. Difficult labour; third day, puerperal fever; fifth day, phlegmasia dolens.

¹ These numbers refer to the Table of References appended to this Paper, the analysis of the 100 cases having been found too lengthened for publication in the Transactions.

25. Legs swelled before labour, labour difficult ; fifth day, fever; ninth, pleurisy; twenty-seventh, phlegmasia dolens.
29. Lingering and frightfully painful labour ; third day, metritis ; seventeenth day, exposure to cold, phlegmasia dolens evening of same day.
30. Tedious labour ; metritis a few days afterwards, which remitted, but returned on the twelfth day; thirteenth, phlegmasia dolens.
34. Laceration? of vagina during labour, mercurial frictions to pyalism ; fourteenth day, phlegmasia dolens.
39. Tedious labour, lasting three days, twin birth ; tenth day, peritoneal fever; fifteenth, suppression of the milk, followed by phlegmasia dolens.
43. Very hard labour, child dead and putrid, flooded twice before delivery, frequent rigors ; fourth week, phlegmasia dolens.
41. Labour preternatural, child still-born ; tenth day, peritoneal symptoms; fifteenth day, fever and diarrhoea; twenty-first, phlegmasia dolens.
49. Difficult labour ; uterine symptoms a few days afterwards ; ninth day, phlegmasia dolens.

The phenomena of these cases, following upon injury or lesion of the uterus, may, as I have remarked, be regarded as typical of those which result from various local diseases calculated to contaminate the blood, and as such are deserving of particular attention.

The general results which have been found to follow the artificial vitiation of the blood, show that two series of effects may be thereby produced, which are essentially similar to those which occur in various local diseases, attended with unhealthy secretions favorably placed for re-absorption. These respectively consist in irritation or inflammation of the part into which the vitiating matter is inserted, or of the vessel through which it is conveyed into the circulation ; and secondly, in a state of febrile or constitutional disturbance, which is consequent upon its circu-

lation with the blood. But these effects, it may be remarked, will vary in different cases according to the mode in which the vitiating matter is received into the system. When directly received into a vein, as happens in some cases after venesection, and doubtless sometimes after parturition, it will generally happen that irritation or inflammation of the vein will take place concurrently with febrile or constitutional disturbance. When, however, it passes through other channels into the circulation, it may happen that constitutional disorder will first ensue, and that the veins of the part may either remain perfectly healthy or become only secondarily affected, according to those general laws which determine irritation and obstruction of veins from constitutional causes. Thus we may account for the different appearances presented by the veins in cases of an apparently similar character, the difference mainly depending upon whether the morbid secretions of the part shall have passed through them or other channels into the circulation. That the products of uterine inflammation often pass into the system through other vessels than the veins is proved by the fact, that the vessels are often found healthy in fatal cases; and that phlebitis when thus induced depends rather upon the passage of irritating fluids through them, than the extension of inflammation along their coats, is proved by the circumstance, that in some cases the morbid appearances have not been continuous, but interrupted; portions of vein having been found perfectly healthy intermediately between others which had been inflamed or obstructed. The practical deduction to be drawn from these facts is, that the causes in question may give rise to phlebitis, both in a direct and indirect manner. In the former case, by passing directly into the veins left open on the interior of the uterus by the removal of the placenta; in the latter, by passing through other channels into the circulation, and so giving rise to the phenomena of fever, out of which the affection of the veins may become secondarily developed.

In 19 cases the attack followed upon some form of

puerperal fever, which had arisen independently of difficult parturition, or of any injury or lesion of the uterine organs, as indicated in the following sequences :

2. Second day, peritonitis, with fever, which continued until tenth day, when phlegmasia dolens began.
10. Twin birth, hæmorrhage, metritis ; fourth week, phlegmasia dolens, preceded by fever.
11. Obscure febrile symptoms till tenth day, when phlegmasia dolens began.
12. Third day, puerperal fever, offensive lochia, pelvic abscess ; tenth day, phlegmasia dolens.
17. Fell on back before labour ; fourth day, fever and pelvic symptoms, which continued until the thirteenth day, when phlegmasia dolens began.
20. Great mental distress before labour ; second day, fever ; third, swelling in ham ; fifth, suppression of lochia and milk ; eighth, abscess in calf ; tenth day, phlegmasia dolens.
21. Fifth day, metritis and suppressed lochia ; seventh, attack of phlegmasia dolens.
32. Febrile excitement followed labour, which continued until the twenty-first day, when phlegmasia dolens began.
33. Sixth day, peritoneal fever and suppressed lochia ; ninth, phlegmasia dolens.
35. Varicose veins of left leg ; fifth day, uterine symptoms and phlegmasia dolens.
36. Fifth day, puerperal fever ; twenty-first day, phlegmasia dolens.
38. Attacked with fever a few hours after delivery, which continued until the tenth day, when phlegmasia dolens began.
40. Labour followed by puerperal fever ; twenty-first day, phlegmasia dolens, preceded by general indisposition.
41. Third day, peritoneal fever, which continued till thirteenth, when phlegmasia dolens set in.

42. Child died during labour; third day, peritoneal fever; eighth, diarrhoea; tenth, phlegmasia dolens.
48. Fifth day, metritis and suppression of the lochia; seventh day, phlegmasia dolens.
54. Tenth day, attacked with pain in the abdomen, legs, and ankles; eleventh, phlegmasia dolens.
56. Fourth day, symptoms of metritis; seventh, rheumatism; twenty-second, phlegmasia dolens.
59. Second day, pyrexia, which had not abated on the twelfth day, when phlegmasia dolens set in.

In these cases puerperal fever would appear to have arisen in the absence of any local injury or lesion of the uterus, and may therefore be ascribed to those general circumstances connected with parturition which predispose to the disease. In nearly all, febrile derangement had preceded for some time the affection; and while from this circumstance we may learn that the latter was not the cause of the former, we may trace in it an analogy between these cases of phlegmasia dolens and those which have been described by various authors, as having occurred in the progress of fevers unconnected with the puerperal state; whilst it is probable that in each the same pathological causes may have been concerned in its production.

It may, then, be a fit question to consider, what are the peculiar circumstances which give rise to irritation and obstruction of veins in cases of fever, or in those in which the blood generally is in a morbid condition? To this question, it is difficult to give a very positive answer; but on a careful review of the several circumstances which precede the attack, we may, I think, recognise *three*, whose operation would be favorable to this result. 1. Constitutional debility. 2. A redundancy of the fibrinous element of the blood. 3. An affinity between the morbid elements in the circulation and the lining membrane of the veins.

1. *Constitutional debility*.—The general history of phlegmasia dolens, and the testimony of the highest authorities point to its frequent occurrence in depressed states of the

constitution, and to its commencement with symptoms which indicate extreme prostration. Thus the attack has often been preceded by a bad state of health, uterine hæmorrhage, or the long continuance of fever or some other malady of a debilitating character, and the operation of such causes would appear to consist, not only in rendering the excretory powers inadequate to the elimination of noxious matter from the blood, but in rendering the constitutional efforts incapable of localising the general diathesis upon any particular organ or structure. When then the organic powers are greatly enfeebled, as appears to be generally the case, in those who are attacked with phlegmasia dolens, it will happen that effete or noxious matters will accumulate in the blood in a greater proportion than they can be expelled, and these in circulating through the blood-vessels may give rise to irritation of the lining membrane of the veins in which they may be supposed to be accumulated in the greatest relative proportion.

2. *A redundancy of the fibrinous element in the blood.*—The influence of this condition of the blood in predisposing to obstruction of the veins must be obvious; and it is one which would appear to arise out of the several circumstances by which phlegmasia dolens is ordinarily preceded—viz., febrile, inflammatory, and rheumatic affections. But, further, it is shown, from the researches of Andral and Gavarret, that the fibrine of the blood is in considerable excess subsequently to parturition; that immediately after this process, and during the early period of lactation, the blood contains its largest proportion of fibrine; and that puerperal diseases are apt to occur correlatively with its amount. Let it further be added that the fibrinous element is proportionately undiminished by bleeding or hæmorrhage—that its relative proportion is sometimes higher in many states of debility and prostration than in health—and it must be obvious that the state of the constitution during the puerperal period, and subsequently to febrile and inflammatory attacks, is one which is highly favorable to the production of obstructive phlebitis.

3. *An affinity between the morbid elements in the circulation and the lining membrane of the veins.*—I venture to suggest this as a probable determining cause, from a general review of the circumstances which attend the action of poisons upon the economy—the operation of medicines and the phenomena which occur in the progress of various specific diseases. It is well known, for instance, that the action of poisons, whatever their nature or intensity, is not only definite, but limited to particular organs and structures; that the *modus operandi* of remedies is equally definite; and that the tendency of various constitutional diseases is to localise themselves upon particular parts, each observing its respective affinities. But, further, it would appear probable that these localised effects of particular remedies or poisons may in part be attributed to their being appropriated into the substance of the organs thus secondarily affected, and that to this in a great measure is due the various local affections which arise in the progress of constitutional diseases. To illustrate these views it is only necessary to refer to the general history of specific fevers and constitutional disorders; and without doing more than indicating the importance of this principle, as connected with the origin of various local diseases, we may, I think, consistently with it assume that an affinity may subsist between certain morbid elements in the blood and the lining membrane of the veins, whence irritation and obstruction of these vessels may ensue.

And if it should be asked why the veins are more especially liable to irritation and obstruction in cases of fever, or in those in which the cause of such lesions is diffused equally throughout the blood, it may be remarked that there are peculiarities in the venous as compared with the arterial system which reasonably account for such occurrence. Thus, the velocity of the circulation in the veins is much less than that in the arteries, and motion tends to retard the coagulation of the blood, and rest to hasten it. Aqueous fluids within certain limits also hasten its coagulation, and these are readily absorbed by the veins.

So also saline and various excrementitious matters hasten its coagulation, and these are directly received into the veins. And, lastly, various unhealthy secretions or discharges from parts, the dregs of the secondary assimilative processes, retained excreta, and those general causes which have been referred to, as calculated to vitiate the blood, primarily pass into the veins before being distributed to the several organs by which they are destined to be separated from the blood.

The last question to be considered in connection with this part of the inquiry is, what are the peculiar circumstances which determine irritation and obstruction of particular veins, or portions of the venous system, rather than others? Now, to this question it may be replied that the liability of the veins to take on morbid action, like that of all other organs and structures of the body, is determined by the operation of various predisposing and exciting causes. Among the former may be mentioned antecedent weakness or disease; among the latter, wounds, injuries, and surgical operations; and, as a general rule, it may be said that these veins, or portions of the venous system which may have been thus predisposed, will receive the force of any prevailing diathesis rather than others. Thus, it may be said that the utero-placental veins are predisposed to morbid action, by being torn across in the removal of the placenta; that the crural veins of parturient women are generally predisposed by the actions of pregnancy and the pressure of the gravid uterus; and that any vein, surgically or otherwise wounded or injured, becomes thereby predisposed to take on morbid action. One other circumstance only need be noted, which is the influence of cold partially applied to the body in predisposing veins to morbid action. This is true generally in regard to the nerves, muscles, and other structures of a part, and experience teaches that that which is true in regard to them is true also in regard to these vessels.

In 13 cases the attack followed upon exposure to cold;

and the particular sequence tending to the attack in these cases is given in the following summary:

5. Seventh day, exposure to cold, quickly followed by pleurisy, and this by phlegmasia dolens.
6. Three weeks after labour caught cold, upon which the attack quickly followed.
14. Fifth day, much purged during night, and exposed to cold; febrile symptoms, followed by phlegmasia dolens the evening of the same day.
24. Seventh day after labour undertook the management of the house; eleventh day, seized with rigors, followed by fever; twelfth, phlegmasia dolens.
27. Fourteenth day after labour caught cold, and phlegmasia dolens began a few hours afterwards.
29. Lingering and frightfully painful labour; third day, metritis; seventeenth, exposure to cold, phlegmasia dolens the same evening.
46. Twentieth day after labour exposed to cold, which was followed by rheumatism, and by phlegmasia dolens on the twenty-second.
53. Could not suckle infant, and probably caught cold in the attempt; eighth day, pain in left crural arch; thirteenth, phlegmasia dolens.
55. Attacked by cold, producing catarrhal and pneumonic symptoms, which were followed by phlegmasia dolens in forty-eight hours.
57. Had previously suffered from rheumatism: phlegmasia dolens followed exposure to cold.
58. Patient plethoric, and delirious in the last stage of labour; second day, phlegmasia dolens, which was caused by cold.
60. Ninth day after labour exposure to cold, followed by pain in the left side and by phlegmasia dolens.
45. Ninth day after labour attacked with pleurisy, and on the thirteenth by phlegmasia dolens.

The respective antecedents of these cases sufficiently

show that the attack of phlegmasia dolens had been immediately occasioned by exposure to cold; and in connecting them with an abnormal condition of the blood, it is only necessary to point out the general fact that, from such cause, two series of effects may be produced. The one, of a *dynamic* character, comprehends more especially a disturbance of the equilibrium of the circulation, and an intropulsion of blood, upon various internal organs. The other, of a *material* character, arises from an arrest or disturbance of the cutaneous functions, and the consequent retention of various effete or abnormal matters in the blood, which circulating with it may become localised upon particular organs or structures. Now, bearing in mind that the secretion of the skin constitutes one of the most general and perhaps constant emunctories of effete organic matter from the body, it must be obvious that an interruption to its functions must be productive of a highly morbid state of blood, and this more especially during the puerperal state, when, consequent upon febrile reaction, excessive disintegration of tissue, and other causes, a large amount of effete matter is thrown into the blood, and when accordingly the depurative functions require to be maintained in a state of unusual activity.

But we may further deduce an argument in favour of the blood origin of these cases from the general analogy which subsists between them and rheumatism. Thus in their respective origin from cold or suppressed perspiration, we may recognise a similarity of cause; in the pain, heat, swelling, and loss of motor power of the affected limb an identity of symptoms; and in the weakness and impaired condition of the limb, often left after a severe attack of either, a resemblance in their remote consequences. Between the two diseases, as affecting an extremity, there is indeed but this essential difference, that in one the principal veins of the limb are inflamed and obstructed, and in the other are pervious and healthy. Now, however, that it has been shown that the same exciting cause and the same pathological condition of the blood which gives rise to rheumatism

may also give rise to irritation and obstruction of veins, the analogy between the two is rendered more striking, and their sole difference would appear to consist in this, that in the one case the veins participate in the general irritation of the limb, and in the other are exempt. Let, for instance, a person be exposed to cold and wet, and if with rheumatism of an extremity an obstructed condition of its principal veins be concurrently produced, the symptoms of phlegmasia dolens will be developed in their most characteristic form.

Lastly, the experiments I have detailed in the course of this paper, conclusively show that lactic acid, an important constituent of the sweat, and the supposed materies morbi of rheumatism will, when thrown into the blood in certain quantities, produce marked irritation and obstruction of veins, while the presence of this acid in the blood of puerperal women, either in morbid excess, or as an abnormal agent, has been experimentally ascertained by Scherrer and Lehman. Thus, the latter informs us that Scherrer, who had paid especial attention to the occurrence of lactic acid in morbid blood, "observed during an epidemic of puerperal fever, that the blood had often an acid reaction, and as this fluid contained only free albumen and no albuminate of soda, it was clear that it must contain a free acid. Scherrer certainly did not demonstrate the actual presence of lactic acid in the blood; but as he actually separated lactic acid from the exudations which were simultaneously present, we cannot reject his conclusion that the acid reaction of the blood was due also to lactic acid. I have only thrice observed an acid reaction of the blood," says Lehman, "but under conditions similar to those described by Scherrer, viz., in a case of pyemia in a man, and in the blood of two women from six to ten weeks after delivery." (*'Physiological Chemistry,'* vol. i, p. 97.) I conclude, then, from a consideration of the several circumstances stated, that a vitiation of the blood from arrest or suppression of the cutaneous excretion, is a frequent and efficient cause of phlegmasia dolens.

In 3 cases the attack followed upon errors of diet, as shown in the following sequence:

16. Fifth day, fever and pleurisy; fifteenth day, improper use of wine, &c., followed by febrile reaction; thirtieth, pelvic suppuration; forty-first, phlegmasia dolens.
28. Sixth day, drank some cold ale, which was followed by fever and gastro-intestinal and cerebral symptoms; twelfth day, phlegmasia dolens.
51. Sixth day, great gastro-intestinal derangement, consequent upon eating a bulky rich meal; febrile symptoms followed, and phlegmasia dolens on twelfth day.

Having thus indicated the probable origin of the attack in these cases, I will merely suggest that the cause assigned may probably operate in a two-fold manner, in giving rise to a vitiated condition of the blood. 1. By directly furnishing a crude unassimilable matter, which passing into the circulation must necessarily give rise to an impurity of this fluid; and 2. By producing febrile disorder, and thereby an arrest or diminution of various excretory functions. Thus it has happened that the lochial, the lacteal, and the cutaneous secretions have been suddenly arrested by gastric disorder, and such arrest of these functions, coupled with the presence in the blood of the products of unhealthy digestion, may under certain circumstances prove a sufficient cause for the phenomena in question. In some cases, the error has consisted in the improper use of wine or porter; in some, in the quality, in others in the quantity of food eaten; but whatever the immediate cause, the ultimate results must be the same.

In 3 cases the attack followed upon the operation of epidemic influences, as indicated in the following sequences:

3. Twentieth day, attacked with epidemic diarrhoea; thirtieth, ditto and phlegmasia dolens.
15. Varicose veins during gestation; second day, attacked

with erysipelas, and with phlegmasia dolens a week afterwards.

19. Phlegmonous erysipelas immediately followed labour, giving rise to œdema, &c.

It is scarcely necessary to observe, in regard to all these influences, that their action is primarily upon the blood, and that the local effects observed in the progress of epidemic diseases are but secondary or tertiary phenomena. The erysipelatous poison was concerned in the causation of two out of the three cases, and as it would appear to be an important element in the pathology of many puerperal diseases, I will briefly advert to its probable relations to that under consideration.

The primary action of this poison is stated by Dr. Thomas Williams to be upon the blood, its secondary action upon the skin and cellular tissue, and its tertiary action upon the membranes of the brain and the mucous membrane of the alimentary canal; but bearing in mind that many cases of peritonitis are traceable to the erysipelatous poison, that "the infants of mothers labouring under puerperal fever often die of erysipelas, and that the assiduous attendants on puerperal fever patients are not unfrequently affected with erysipelas" (Ferguson), I think a strong case is made out in favour of the opinion that the serous membranes generally are liable to its secondary action, and if so, that the lining membrane of the veins may participate in this liability. It is certainly the case that phlegmonous erysipelas of the skin and cellular tissue of a limb often coexists with purulent inflammation of the lining membrane of its principal veins, and if in these cases it is shown that the erysipelatous poison can so affect this membrane as to give rise to purulent inflammation, it appears to me probable that the same poison, in a more mitigated form, or modified by the state of the constitution, may give rise to more mitigated consequences,—to irritation rather than to inflammation of the lining membrane of veins, or to obstructive rather than to suppurative phlebitis.

In 4 cases the attack followed upon pulmonary consumption or some other constitutional disease, viz. :

9. Phthisis before labour, in the progress of which, subsequently to parturition, the attack supervened.
37. Feeble constitution ; third day after labour diarrhœa supervened, which continued until the twenty-first day, when phlegmasia dolens began.
47. Febrile symptoms after labour, bad general health, livid blotches over surface, offensive vaginal discharge ; phlegmasia dolens in fourth week.
52. Bad health before labour ; much gastro-intestinal derangement, which continued until the fourteenth day, when phlegmasia dolens began.

The histories of these cases fully indicate the existence of a bad state of health prior to the attack ; and looking to the well-known fact that the disease has often been known to occur in connection with phthisical, gouty, and rheumatic states of the constitution, we can have no hesitation in recognising its origin from such causes, nor in connecting it in these cases with an abnormal condition of the blood.

Two cases followed upon severe and long-continued parturient action ; the first, No. 21, is taken from Hull's Essay. The second, No. 50, from White's Enquiry. In the former, the attack came on in thirty-six, in the latter, twenty-four hours after delivery. As these cases are almost peculiar in regard to their time of accession, I will quote somewhat more of their respective histories than I have generally introduced in the analysis.

The subject referred to in case 21 was a young woman, aged 27, who had been rather lame during pregnancy. Her legs, especially her left, had swelled, and the veins had been enlarged and blackish during the last month. She had a hard labour, which lasted four days, and her child died the morning after delivery. In the afternoon of the succeeding day she was suddenly attacked with extreme pain in her loins and hip on the left side, and soon afterwards with pain on the outside of her left thigh, a little

below the middle. The fore part of her knee next became pained, and the pain ascended from thence to the groin and labium pudendi, and afterwards descended to the leg and foot. She experienced no rigors or other symptoms of pyrexia before the pain seized her, but she subsequently became feverish, and her lochia diminished, became thin and offensive, and soon stopped altogether. The pain was of the most excruciating character, and after many weeks had elapsed a large abscess formed in the loins where the pain had first commenced.

With regard to the origin of this attack, it appears to me that two causes may be assigned:—1st, the absorption of unhealthy secretions from the parturient surfaces, consequent upon the mechanical injury sustained by four days severe labour; and, 2dly, some incidental exposure to cold giving rise to rheumatic irritation of the parts primarily affected. The entire absence of uterine symptoms previously to the local affection, the commencement of the pain in the back and hip, and its peculiar severity, would rather favour the latter opinion, whilst the further progress of the case might have been modified by the absorption of unhealthy discharges from the uterine organs. Feeling, however, uncertain as to the origin of the attack, I do not think myself justified in pursuing the question any further.

The history of case 50 is given very briefly: the patient was aged 34, her labour was very violent, and it is stated that the child rested a long time at the brim of the pelvis. Whilst she was in a standing posture, it is further stated, that she had a strong pain, and thought she perceived something within her break, just above the right groin. She was delivered upon the knee the next pain. In twenty-four hours after she was seized with violent pain and swelling in the groin and labium pudenda of the right side, which descended to the thigh and leg. Her lameness and swelling continued till the middle of her next pregnancy, and were always much increased upon walking.

The principal difficulty in this case consists in determining the nature of the supposed rupture, and its influence

in the causation of the disease. Such a circumstance appears to be peculiar in the history of these cases; and in the absence of any exact knowledge of the injury, it is difficult to know what consequences to assign to it. It should be borne in mind, however, that the reporter of this case was advocating a theory which would be supported by the fact referred to, viz., that the proximate cause of the disease consists in a rupture of the lymphatic trunks at the brim of the pelvis. The only other circumstance noted in the history of this case is that the labour had been very violent.

It would appear, that in one or two instances the attack followed upon sudden suppression of the milk; but not knowing how far it was attributable to such cause, I have not made a separate group of these cases. The following case, however, bears so closely upon the present inquiry, that I venture to introduce it. It occurred in the practice of MM. Tessier and Recamier. "A woman during lactation, experienced after a meal, during which she had felt much oppressed by heat, a sudden and total suppression of milk. Symptoms of meningitis soon displayed themselves, for which she was brought to the Hôtel Dieu. The inflammation was subdued by active measures; but the patient was soon after attacked by fever, attended with cough, expectoration, and all the symptoms of pneumonia. This in its turn gave way to a mild peritonitis, and this again to phlegmasia dolens." ('Gazette des Hôpitaux,' Jan. 21, 1843.) Now, whether we consider the suppression of the lacteal secretion in this case, as the cause of the several maladies which ensued, or not, it is equally important, as demonstrating in their succession and variety the connection of phlegmasia dolens with some constitutional condition.

It is thus shown, with the exception of the two cases I have referred to, that in 57 out of the 60 cases tabulated, the attack of phlegmasia dolens was preceded, and probably occasioned by some cause calculated to vitiate the blood, and with regard to the remaining three, I find on looking to their concomitant affections and post-mortem appear-

ances, that in 2 there was evidence of coexisting disease in other parts of the body. Thus in case 4, there were symptoms of inflammation of the lungs or pericardium, and in case 8, there was found after death two pints of thin purulent fluid in the left pleura, extensive recent adhesions between it and the lower margin of the superior lobe of the left lung, which portion was extensively inflamed, and contained about an ounce of cream coloured pus, whilst the inferior portion of the right lung was solidified and adherent to the pleura. I venture to suggest, that the coexistence of these several lesions with the affection of the extremity points to a common cause, which can only have existed in the blood.

Having thus deduced from the general history of these cases their probable origin from a morbid condition of the blood, I will only observe, with reference to their concomitant affections, that in 45 out of the 60, or in three fourths, there was some evident local or constitutional disorder co-existing with the malady. In 14, or in about one fourth, there was some form of thoracic inflammation or disease. In 14 there were symptoms of peritoneal inflammation, or of some disease of the abdominal viscera. In 9, or in rather less than one sixth, there were cerebral symptoms; whilst in many, various local lesions coexisted with the affection of the extremity. It would be inconsistent with the limits of this paper to enter into an analytical examination of all these circumstances; and having therefore indicated them thus generally, I will proceed to a consideration of the non-puerperal cases of the disease.

II. NON-PUERPERAL CASES.

These comprehend as already stated, 40 cases, of which 20 proved fatal, and 20 recovered. About two thirds the number occurred in females, and one third in males. I will commence with an analysis of their respective antecedents, which gives the following general results. In 10, or one fourth the whole number, the attack followed upon febrile derangement. In 11, or rather more than one

fourth, it followed upon exposure to cold. In 8, or one fifth, it occurred in the progress of pulmonary consumption, or some other constitutional disease. In 7, or in about one eighth, it followed upon the operation of local causes calculated to vitiate the blood, such as malignant ulcerations, &c. In 3, it followed upon suppression of the menses; whilst in 1, the antecedent history does not point to any particular cause.

The respective antecedents in each of these cases are given in the following summary.

In 10 cases the attack followed upon some form of fever, as shown in the following instances :

83. Had suffered from fever, and been largely depleted; seventeenth day afterwards, febrile symptoms set in, and the attack began.
84. Was convalescing from fever and intestinal inflammation, and whilst greatly debilitated the attack began.
85. Fever, followed by agueish symptoms, during which the local affection was discovered.
86. Patient convalescing from fever, and whilst greatly debilitated the attack began.
62. The attack began with fever, sickness, vomiting, and pain in all the limbs.
63. Before attack began, had frequent rigors and profuse perspirations.
64. Fever, headache, and pains in the side, for which she was bled with relief, preceded the attack.
65. Got wet four days before attack, which was followed by fever, subsequently to which phlegmasia dolens began.
76. Had been suffering for some time from fever, and was much reduced and emaciated when the attack began.
87. Gastric fever, &c.; three days afterwards catamenia appeared scantily, and next day the attack began.

In 11 cases, the attack followed upon exposure to cold, as indicated in the following series :

66. Had stood for two days, at work in a ditch, above his knees in water, fever followed, and in seven days phlegmasia dolens began.
74. Exposure of left lower extremity to cold, the patient being thinly clothed.
82. The attack was attributed to exposure to cold.
89. Exposure to cold : inflammation of the bowels and free depletion preceded the attack.
92. Got wet through when fatigued, and attack followed in two days.
93. Bilious fever, when convalescent exposed to a draught of cold air, followed by rheumatism, and then by the attack.
95. Bilious derangements, exposure to cold, and rheumatism, preceded the attack.
96. General bad health and exposure to cold preceded the attack.
97. Irregular menstruation and frequent exposure to cold preceded the attack.
98. Got wet through and had rheumatism, a week afterwards the attack began.
99. Attack preceded by rheumatic fever, brought on by lying upon the grass when much fatigued.

In 8, the attack occurred in the progress of pulmonary consumption or some other constitutional disease, as shown in the following summary :

67. Had laboured under symptoms of phthisis for nine months before attack.
68. Had laboured under symptoms of phthisis for sixteen months before attack.
61. Had suffered from rheumatism and pains in various parts of the body before attack.
75. Had been for several years in a bad and delicate state of health prior to the attack.

- 77. Had laboured for some time under diabetes mellitus, and had evidently tubercles in the left lung when attack began.
- 78. Had been addicted to drinking, and had gastric fever and pneumonia previously to the attack.
- 80. Bad health, hectic fever, and phthisis, preceded the attack.
- 81. Had been ill a fortnight before the attack began.

In 7 cases, the attack followed upon the operation of local causes calculated to vitiate the blood, such as suppurating sores, malignant ulcerations, &c., as follows :

- 71. Malignant disease and extensive ulceration of the uterus, preceded and attended the attack.
- 72. Cancerous ulceration of the uterus preceded and attended the attack.
- 73. A sanious discharge from the vagina and extensive ulceration of the uterus preceded and attended the attack.
- 90. Wound over a branch of the right saphena preceded the attack.
- 91. Varicose veins and an ulcer above the left malleolus.
- 94. Operation for the removal of a uterine polypus, followed by offensive puriform discharges; phlegmasia dolens nine days afterwards.
- 100. Operation for lithotomy; phlegmasia dolens thirteen days afterwards.

In 3 cases, the attack followed upon sudden suppression of the catamenia, which in 2 was occasioned by exposure to cold.

- 69. Sudden suppression of the catamenia from immersion of the body in cold water, immediately preceded the attack.
- 70. Sudden suppression of the catamenia followed by violent fever preceded the attack.
- 80. Attack referred to the sudden suppression of the catamenia from exposure to cold and wet.

It is scarcely necessary to point out the close analogy which subsists between the antecedent circumstances of these cases and of those which followed upon parturition. In some respects, indeed, they are identical, as in the instance of fever, constitutional disease, and exposure to cold; whilst in others, although the actual antecedents are dissimilar, we may yet recognise a resemblance in their ultimate modes of action. Thus, the influence of ulcerative disease of the uterus, independently of parturition, may be likened to that of inflammation of this organ subsequently to labour, inasmuch as both furnish unhealthy secretions capable, on reabsorption, of vitiating the blood; whilst we may also recognise a similarity between the effects of suppression of the lochia and that of the catamenia.

I proceed, in the next place, to an analysis of their concomitant affections. Of these, in 7 none are noted; whilst in 1 it is stated that the health of the patient was perfectly good. Of the remaining 33 the following is a general summary:—In 6 the local affection coexisted with some form of febrile or constitutional disorder; in 8, with thoracic symptoms, together with febrile disorder; in 2, with thoracic and abdominal symptoms; in 2, with thoracic, abdominal, and pelvic symptoms; in 3, with abdominal symptoms and some kind of constitutional disorder; in 2, with pelvic symptoms; in 3, with cerebral symptoms and constitutional derangement; in 3, with malignant ulceration of the uterus; in 1, with various local affections; in 1, with muco-enteritis, bronchitis, and ophthalmia; in 1, with delirium tremens, gastric irritation, disease of the lungs, pleurisy, and anæmia; and in 1, with diabetes mellitus, phthisis, pneumonia, pleurisy, and aphthæ. I need offer no commentary upon these facts as supporting the constitutional origin of the disease.

And turning, in the last place, to the evidence afforded by pathological anatomy, I find in all the fatal cases referred to in which a post-mortem examination was made, that it revealed the existence of various lesions in different organs of the body independently of those which were met

with in the veins of the affected extremity. In a large proportion there were appearances of inflammation in one or more of the serous membranes. In some the viscera were found diseased; whilst in others evidence of a diseased condition of the blood was furnished by the presence of fibrinous concretions in vessels remote from those of the affected extremity. These, with other points important to the present investigation, and favorable to the opinion which I have expressed respecting the nature of the disease, are fully set forth in the tables presented to the Society.

I conclude then this investigation, by observing that the results of clinical experience essentially harmonise with and support those which are deducible from physiological research; that both indicate the origin of phlegmasia dolens from a primary vitiation of the blood; and that, although the particular causes may vary in different instances, they all tend to the production of an abnormal condition of this fluid, out of which all the known phenomena of the disease may be deduced. Thus, in one series of cases we observe the attack to follow upon the long continuance of febrile action and the unhealthy condition of the blood thereby induced; in another, upon the operation of local causes calculated to vitiate this fluid, such as inflammatory, suppurative, and ulcerative diseases; in a third, upon arrest or suppression of the natural excretions, such as those of the skin, the lochia, or the catamenia; in a fourth, upon the operation of epidemic influences or poisons; in a fifth, upon derangement of the assimilative processes; in a sixth, upon constitutional disease of various kinds; and doubtless the series might be extended to many others equally tending to the causation of a vitiated condition of the circulating fluid.

Lastly, in submitting this inquiry to the profession, I venture to believe that it will not be altogether unimportant in its application to practice, and that a knowledge of the constitutional or blood origin of phlegmasia dolens will give greater effect and precision to our treatment of the disease. It would be inconsistent with the limits of this paper to enter at length upon this subject, nor would it be becoming

in me to point out to the members of this Society how the indications deducible from the foregoing inquiry can be best fulfilled. I may, however, be permitted to observe, that, without neglecting any of those measures which are required by the character of the local affection, that the treatment throughout should be of a general and eliminating character; that at the commencement of the attack emetics may be usefully given, not only with the view of equalising the circulation, but for the purpose of acting promptly and powerfully upon the secretions; that the actions of the liver and alimentary canal should be moderately sustained by mercurials and aperients; that active and continued diaphoresis should be promoted by such remedies as the acetate of ammonia, antimonials, opium, and colchicum, together with the external application of warmth and moisture, until the acute stage of the disease shall have subsided; that alkaline drinks or the nitrate of potass may be advantageously given both during the early and advanced stages of the disease for the purpose of correcting any acrimony of the fluids, and of dissolving, and thus aiding, the removal of the fibrinous coagula by which the veins are obstructed. These, with other measures calculated to subserve particular indications, as well as those of a local character which experience has sanctioned, I need not further enlarge upon, inasmuch as their various modifications will readily suggest themselves to the practitioner, by whom alone their application to particular cases can be properly estimated and determined.

REFERENCES TO THE CASES ENUMERATED AND
TABULATED IN THE FOREGOING PAPER.

1. Medico-Chirurgical Transactions, vol. xii, p. 427.
2. Ditto ditto p. 432.
3. Ditto ditto p. 435.
4. Lee; On some of the more important Diseases of Women, p. 138.
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