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ESSAYS

ON

SURGICAL PATHOLOGY

AND

PRACTICE.

BY

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PART I.—ON ABDOMINAL HERNIÆ.

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TO THE

GENTLEMEN WHO ATTENDED THE LECTURES ON CLINICAL SURGERY,

DELIVERED BY THE AUTHOR IN THE ROYAL INFIRMARY OF EDINBURGH,

THESE

ESSAYS

ARE

RESPECTFULLY INSCRIBED.

PREFACE.

The following Essays are founded on the Clinical Lectures on Surgery, which it was my duty to deliver when I became the Senior Acting Surgeon in the Royal Infirmary. Hence the elementary character of some of the remarks contained in them, which could not altogether be avoided.

These Essays are now published with a view to record several important and interesting cases which came under my observation, in the hope that they may contribute to the elucidation of the Surgical questions connected with them, or at least to confirm the observations of others.

A. W.

51 Queen Street,
Edinburgh, *December* 1842.

CONTENTS OF PART FIRST.

SURGICAL ESSAYS.

INTRODUCTORY REMARKS.

The Medical Profession or the Healing Art has been much improved and most successfully practised by "the division of labour" system. But though this may be said as to the *practice* of the profession and its *advancement* as a science, the *acquirement* of it at first can only be properly attained by the careful study of all the different branches of which it is composed. These different branches throw much light on each other. Anatomy and Chemistry, for example, have thrown much light upon Physiology—Chemistry on Materia Medica—Physiology on Pathology—and all these have contributed greatly to the improvement of the Practice of Physic and Surgery.

As the human body consists of one whole or entire system, formed by the combination and exact adjustment of its different parts, none of which can be materially disordered without affecting the whole machine; so, many of its diseases (even those which seem to be local), whether they appear externally or internally, arise from the general derangement of the health of the body or entire system.

The diseases of the human body, therefore, cannot be divided into external and internal diseases; neither can the duties of physicians and surgeons be limited to one or other of these. Whosoever supposes that they may, is lamentably ignorant of the structure or functions of the human body, and of the most elementary lessons regarding its pathology.

The Practice of Physic is founded on the study of the structure, functions, and diseases of the body; the Practice of Surgery has its foundation on the very same basis;—hence these two branches cannot differ very much from each other, arising as they do from the same parent stock. They have respect to diseases bearing the same names, affecting the same body, and requiring similar remedies. How then, the student may enquire, have they been disjoined? Their partial disjunction has been caused only by a conventional division of the diseases of the body between the Physician and Surgeon, without a very exact line of demarcation having been drawn.

The treatment of diseases has, in large towns, been divided into different departments. But a properly educated and well-informed physician or surgeon is acquainted, not only with the principles of the profession generally but also with its various branches. And just in proportion to his knowledge of these is the estimation in which he is held by the public and his success in practice. The most celebrated and esteemed surgeons have been noted for their knowledge of medicine; while those who are dexterous in manipulations only, have been unsuccessful and less esteemed, because of their want of proficiency in medical treatment. The correctness of such an inference is at once obvious, when we consider the treatment necessary for a case of inflammation of the bowels from a strangulated hernia. There is here an internal disease to be combated by medical treatment, as well as a manual operation required to remove the external derangement of parts.

Those diseases and injuries which require local remedies and manual operations, in addition to medical treatment, for their alleviation or cure, have been termed *Surgical* cases. The study of these has now become so extensive, as to require distinct courses of lectures; and, in large towns, their treatment is confined chiefly to those who attend exclusively to this class of cases. This arrangement has been followed with great advantage to the community,

on account of the concentration of experience, in cases of this nature, into the hands of those who have peculiar talents for manual dexterity, in addition to the other high qualifications required for the medical profession.

By this arrangement, Surgery has been much improved as a practical art; but in a scientific point of view, how has it been improved? Chiefly by the study of Anatomy, Physiology, and Pathology, together with attentive observation in actual cases. From these sources, the causes, the progress, extent, and terminations of diseases, have been ascertained, and surgeons have been directed to proper remedies.

It is in regard to the pathology and treatment of several important diseases that I am at present desirous to direct attention. Not that I purpose giving a complete exposition of any of the diseases treated of, but only to illustrate such points as I conceive to have been overlooked, or not sufficiently dwelt upon, by others.

Of late years, I have often had occasion to observe, that, in the education of surgeons, the medical treatment of patients is too much disregarded; so that students are led to imagine this to be of so little importance to the surgeon, that he may learn his profession in the anatomical rooms and operating theatre alone. But the operations, however dexterously performed by surgeons so educated, are often unsuccessful in their result, owing to the want of proper medical treatment. Such surgeons exhibit a great want of discrimination as to the actual state of their patients in regard to the condition of their general health—the degree of fever, inflammation, strength or weakness; so that at one time they are seen to do too little—at another, too much—for their recovery, which is too often a matter of chance. They also bring discredit on Surgery by making it too much a handicraft trade (not a liberal profession), far from ranking with that of a physician. In contrast with this, however, mark how the position of the surgeon is altered and elevated, when, in addition to surgical skill and manual dexterity, he combines the attainments and skill of the physician. Then has

the surgeon reason to be proud of his profession—then has he the capability of being extensively useful in his calling, and of achieving many noble conquests, against the most formidable foes of frail humanity, by saving the lives of fellow-men from the grasp of threatened death by injury and disease.

Uniform success in the practice of our profession is not to be expected. Whoever pretends to this, must be either ignorant or dishonest. A great combination of circumstances occurs, in every case, to militate for or against a patient: we are prompted to use certain *means* of relief; and, in doing so, we are the honoured instruments of God, often for good. But over life and death we have no controul. It is our duty, however—and it is our only source of comfort in unfortunate cases—to be properly informed in our profession; and to be prompt and ready in applying with humanity, care, and diligence, the remedies placed at our disposal which experience warrants. No surgeon has cause to be ashamed of unfortunate cases, when these do not arise from either ignorance, rashness, or carelessness.

In the practice of the different branches of the medical profession, the first, and by far the greatest, difficulty consists in determining the nature of the disease in particular cases. Here we are often left to form an opinion from obscure symptoms—often connected with disordered functions (common to many diseases), and from indications too slight to be appreciated by our imperfect senses. To combat this difficulty, much may be done by the careful cultivation of the mind by an attentive previous study of the phenomena of health and disease.

By the careful consideration of these subjects, and by the *tact* which is acquired by experience, that ready discrimination of diseases, which forms the most valuable qualification the physician or surgeon can possess, can only be attained.

When the exact nature of the complaint is ascertained, to determine the proper treatment, and the application of the remedies, are comparatively easy.

PART FIRST.

SECTION FIRST.

ON ABDOMINAL HERNIÆ.

There are no diseases more interesting to the surgeon than Abdominal Herniæ, or ruptures with protrusion of some of the viscera from the abdominal cavity. These are various, and form an extensive field of study. They are important, from the imminent danger in which they place the life of the patient; and are peculiarly interesting to the surgeon, from the relief his art can generally afford. Hence they have been the subjects of careful observation by the most eminent surgeons in different countries. Some of them, however, are of difficult investigation; and others are of rare occurrence.

The following remarks and delineations are intended to illustrate, 1. The tunics or coverings of common Oblique Inguinal Hernia; 2. Direct Inguinal Hernia; 3. Congenital, or Hernia within the Tunica Vaginalis Testis; 4. The complication of Hernia with Hydrocele; 5. Inguinal Hernia in the Female; 6. Umbilical Hernia; 7. Diaphragmatic Hernia.

The anatomical relations of the different parts implicated in Abdominal Herniæ, cannot be said to have been understood until the middle of the last century. To the elucidation of this subject the investigations and writings of the Hunters, Pott, and Monro *secundus*, contributed much; and still greater advance was subsequently made by Sir Astley Cooper, Professor Scarpa, Professor Hesselbach, and Mr Lawrence, to which Gimbernat, Camper, Langenbeck, and Cloquet, have each contributed. To these eminent individuals much merit is due for their very valuable expositions of a subject at once extensive, complicated, and difficult. But it must be admitted, that of all the labourers in this field, no one had greater opportunities, nor made better use of them, than the illustrious baronet. Possessed of high natural talents, well cultivated—very extensive experience—with energy,

zeal, and tact, combined with caution and just discrimination, Sir Astley's observations were generally accurate, distinctly stated, and ably applied to practice. In this, therefore, as in the other departments of Surgery of which he has treated, he has left little to be done by his successors. Indeed, any one who attempts to add to the information upon this subject which he has recorded, can scarcely expect to escape the imputation of presumption. With all due respect, however, called forth by the recollection of a name which cannot fail to be honoured by every enlightened surgeon, others may have opportunities of afterwards examining some portions of the subject more minutely, and of adding to the store of facts already known; some of the more difficult parts of this intricate subject may also be described more fully, and thus its boundaries extended. Indeed, to some extent, this has been already done in some of the more recent works upon the anatomy of Herniæ.

In many of the books I have examined upon this subject, the accounts given of the coverings of Hernial tumours are meagre, indistinct, imperfect, confused, or inconsistent. The descriptions of these parts are, therefore, difficult to be understood; particularly when merely verbal, and more so, especially, since various explanations are given, by different authors, of the same parts. In museums, too, we see abundance of preserved specimens, exhibiting the tunics of Herniæ; but few, if any, shewing whence these tunics are derived; whilst it is only by tracing these to their origin that we are able to determine their real nature, and that these coverings are constantly to be found. That they are constant, arises from their consisting of, or being derived from, natural healthy structures which are uniformly present. To investigate these minutely, therefore, both in their normal and abnormal states, forms both an interesting and instructive occupation.

These circumstances, and the belief that the detail of a few good cases is far superior to general descriptions in making the subject distinct, must plead my apology, if any be necessary, for attempting to add to the expositions already given of these diseases.

SECTION SECOND.

ON THE TUNICS OR COVERINGS OF OBLIQUE INGUINAL HERNIÆ.

The number of coverings, or layers of different tissues, which present themselves to the surgeon in performing an operation for the relief of a Strangulated Inguinal, or Scroto-inguinal, Hernia, is often not a little perplexing. This arises, not from their number only, but also from their greatly increased thickness in old ruptures, and the facility with which they can be split up or divided into several additional layers. In the dissection of ruptures of long duration, therefore, we not only see distinctly the different tunics which cover the protrusion, owing to their greatly increased size, as if displaying to us a magnified or exaggerated case; but we also see the greatest degree to which this may extend, and so become prepared for the ordinary appearances, as well as for what might seem unusual and embarrassing from greater complexity.

Authors who have written upon this subject have not always succeeded in making it distinct,—some from a confusion of terms, others from want of delineations, or not feeling the importance of the subject.

Having carefully dissected a considerable number of cases of Inguinal Hernia which have descended to the scrotum, I have prepared the accompanying sketch (Plate I.) as a representation of the coverings exhibited in ruptures of long duration,—where these parts had time to increase in their dimensions.

The coverings of an oblique Inguinal Hernia are very numerous. They are also very constant and uniform in their existence, because they consist of certain parts of the healthy structure of the body, which are always present. But they vary much in thickness in different individuals, both in their normal and abnormal states. In recent cases of Herniæ, and even in some of long du-

ration also, these coats or coverings of the protrusion are extremely thin, so that they are with difficulty separated into distinct layers. When the disease has existed for some length of time, and the protrusion is of considerable size, the tunics are, in general, greatly increased in thickness, so that they are easily distinguished, and may be separated from each other. They consist of different textures, but adhere together only by very fine cellular tissue, unless inflammatory action has caused their more complete and firm adhesion; which, to a partial extent, is not uncommon.

There being five different species of Inguinal Herniæ, namely, the Oblique Inguinal, the Direct Inguinal, the Scroto-Inguinal, Congenito-Inguinal, and the Labio-Inguinal, I confine myself at present chiefly to the Oblique Scroto-Inguinal Hernia.

The investing tunics of Oblique Scroto-Inguinal Herniæ consist of two classes;—*first*, The coverings of the Spermatic Cord; and, *secondly*, Within these, the coverings peculiar to the Hernia.

To the first class, belong the skin and adipose tissue,—the superficial abdominal fasciæ,—the superficial fascia of the spermatic cord and testicle,—the cremastic muscle,—and the funnel-shaped process of the fascia transversalis, which forms the proper fascia or sheath of the spermatic cord.

To the second class belong the subserous cellular membrane, which immediately invests the hernial sac or peritoneal covering of the protrusion, and this peritoneal sac itself.

The figure in Plate I. gives a representation of these tunics, as they appear in the dissection of an old Scrotal Hernia of the right side, which I shall now describe more fully.

Explanation of Plate First.

This figure represents the lower part of the right side of the abdomen where the inguinal canal is situated, the common integuments and superficial abdominal fascia having been removed. Descending from this canal the spermatic cord, hernial sac, and testicle, are seen,—the coverings or tunics of the hernia being cut open.

a b, Represents the tendinous portion of the external oblique muscle of the abdomen, which is inserted into the the pubes at *b*.

c, The testicle with its tunics covered by the superficial fascia, *d d*, of the spermatic cord, derived from the tendon of the external oblique. This covering is by some called the intercolumnar fascia.

e e, Represents the loose cellular tissue which lies beneath the superficial fascia of the cord, and connects it with the subjacent tunic.

f f f, The cremastic muscle, expanded upon *g g*, the proper sheath of the cord, consisting of the funnel-shaped process of the fascia transversalis, which descends to the testicle. (See Pl. VII. *g*.) This has been called by Scarpa and others the *fascia propria*, of the hernial sac.

All these tunics now described form the proper coverings of the spermatic cord and testicle.

h, The subserous cellular membrane investing the hernial sac, consisting of a prolongation of the layer of cellular tissue, which is found interposed between the fascia transversalis and the peritoneum, and which is pushed down along with, and in front of, the peritoneal covering or sac of the hernia. This, strictly speaking, constitutes the *fascia propria* of the hernial sac, and adheres intimately to it ; but, in many cases, portions of fat are interposed between these two coverings.

k, The peritoneal tunic or hernial sac, which is pushed down from the abdomen with the protruding bowel.

These last two coats form the only peculiar coverings of the hernia. They descend along the spermatic cord, generally in front of it, and interposed between the cord and its proper sheath. The distance to which herniæ descend may vary, but they are always arrested near the testicle, at that part where the sheath of the spermatic cord becomes more intimately and firmly connected to the vessels where the vas deferens emerges from the testicle. This adhesion of the sheath to the cord, about half an inch above the testicle, stops the further descent of the hernial tumour, and causes the sheath of the cord *g g* to bulge forward where it covers the tumour above the testicle.

i, A portion of small intestine protruding from the abdomen through the inguinal canal. In this particular case, at its lower part, the bowel adheres to the hernial sac by an effusion of dense lymph.

l, The situation and course of the epigastric artery, on the inner side of the hernial tumour.

SECTION THIRD.

ON DIRECT INGUINAL HERNIA.

This form of inguinal protrusion issues directly from the abdomen, not through the inguinal canal, and within the sheath of the spermatic cord, as in the oblique hernia, but through an opening which takes place between the muscles immediately behind the lower abdominal ring, having the epigastric artery on the outer side of the hernial tumour. (See Pl. VIII., f. 2. *g*). It has therefore been called ventro-inguinal hernia. In this, the coverings of the protrusion and the situation of the spermatic cord and epigastric artery are different from those in the more common oblique hernia. But though these circumstances can be shewn by dissection, the true nature of the hernia cannot always be ascertained in the living body. The apparently direct course of the protruding tumour may exist in a case of hernia originally oblique in its course, from the dragging and dilatation of the canal by the frequent descent of a large protrusion from the belly. But this does not constitute the ventro-inguinal species of hernia,—the distinctive characters of which it does not acquire. Although the course of the oblique hernia becomes shorter and more direct, yet its coverings, and the position of the epigastric artery, on the inner side of the neck of the sac, still continue the same.

In ventro-inguinal hernia the tunics consist of the skin, the superficial fascia, the inter-columnar fascia,—the fascia and tendon of the transversalis muscle, when it is not ruptured,—subserous cellular tissue, and the peritoneal sac. In place, therefore, of the cremastic muscle and the proper sheath of the spermatic cord which cover the oblique inguinal herniæ, in this we have the fascia transversalis; a difference which, in many cases, it would not be easy to appreciate in practice. But as the mode of operating in both cases should be the same, a distinction would not be of much importance.

The different position of the epigastric artery, too, in this kind of

hernia, does not lead to any difficulty in operating; for, by adopting the rule of cutting directly upwards in dividing the neck of the hernial sac, this vessel is avoided. In a very remarkable case preserved in the College of Surgeons, a branch from the epigastric artery, much enlarged (see Pl. VIII., f. 2. *h*), runs round the neck of the hernial sac, which, in following the above rule, would have been divided, and might have led to serious consequences in the hands of the best surgeon; but this exception, in the distribution of these arteries, would not be a circumstance sufficiently strong to cause any departure from the safest and best rule which can be laid down for all ordinary cases.

SECTION FOURTH.

OF CONGENITO-INGUINAL HERNIA, OR PROTRUSION INTO THE TUNICA VAGINALIS TESTIS.

In this form of Hernia, the protrusion from the abdomen takes place through the inguinal canal, along with the testicle, into the peritoneal projection or sac, which forms the tunica vaginalis testis, about the period of birth. Hence the name which this species of rupture has received. But it may occur in adults as well as infants, in consequence of the imperfect closure of the opening through which the testicle descends. The delineation of this form of Hernia, Plate II, was made from an adult in whom it occurred, and was the subject of operation, in the Royal Infirmary here, by Mr Fergusson. See also Pl. VIII., fig. 1.

Explanation of Plate Second.

a b, An incision through the scrotum and hernial sac from the inferior inguinal ring to nearly the lower part of the scrotum.

c, The integuments and fascia superficialis of the cord. The cremastic muscle and sheath of the cord are interposed between this and the T. vaginalis testis, *d*.

d, The tunica vaginalis testis, which, in this species of Hernia, forms the hernial sac; this pouch having remained pervious from the abdomen to the testicle, and continued so since birth.

e f, The protruding portion of bowel and omentum contained in the tunica vaginalis in contact with—

g, The Testicle, situated behind the protruding bowel at the posterior part of the T. vaginalis.

h, The lower abdominal ring at which a constriction often exists, preventing the return of the protruding bowel into the abdomen.

SECTION FIFTH.

OF THE COMPLICATION OF INGUINAL HERNIA WITH HYDROCELE.

The occurrence of Hydrocele, along with Inguinal Hernia, is very frequent, though very few surgical works make particular mention of it. This combination presents itself under several modifications, with which, in a practical point of view, it is of great importance to be acquainted. These are—

1*st*, Common Inguinal Hernia, complicated with Hydrocele of the Tunica vaginalis testis.

2*d*, Common Inguinal Hernia, complicated with Hydrocele of the Spermatic Cord.

3*d*, Congenito Inguinal Hernia, complicated with Hydrocele.

1. The combination of Common Inguinal Hernia with Hydrocele is a very frequent occurrence. It occurs chiefly in men above the meridian of life, and may happen on one side of the body or both. The hydrocele sometimes precedes the hernia; but, more commonly, it takes place subsequently. In some of these cases, I have considered the cause of it to have been the pressure of the truss worn by the patient, interrupting the circulation through the spermatic vessels.

This combination of the two diseases is known, by the trans-

verse indentation between the two swellings,—by the upper swelling being reducible when not strangulated, while the lower remains unaltered,—and the transparency of the lower swelling. Although the hernial tumour is generally situated above the hydrocele, it is, in some cases, behind it. If the hernia is in a state of strangulation, the history of the case, and the usual diagnostic marks of the two diseases, must be very carefully attended to.

The size of the hernia and the hydrocele vary according to circumstances, as in cases where the diseases are uncombined. When the hydrocele is large, it proves inconvenient and burdensome to the patient, but certainly has the mechanical effect, by its situation and bulk, to assist somewhat in keeping up the hernia, and in preventing its descent into the scrotum.

A case of double Scroto-Inguinal Hernia, complicated with double Hydrocele, is not unfrequent.

Case.—Explanation of Plate Third.

This plate is intended to represent the combination of Inguinal Hernia with Hydrocele, reduced in size.

Fig. 1. gives an external view of a case of double scrotal hernia combined with double hydrocele, taken from an elderly patient, in whom the diseases had existed for many years.

a a, The two hernial tumours in the groin about to descend into the upper part of the scrotum.

b b, The two Hydroceles of the T. vaginalis testis.

c c, The thighs. From the projection of the tumours, the penis appears sunk in its situation. In some such cases, the urine, when voided, dribbles over the scrotal tumours.

d, The lower part of the belly above the pubes.

Fig. 2. The hernial tumour and hydrocele with their tunics laid open.

a a, The superficial fascia of the spermatic cord and testicle.

b, The cremastic muscle and fascia propria of the cord.

c, A portion of bowel in the hernial sac.

d, The hernial sac, or peritoneal covering of the hernia, having the sheath of the cord closely attached to it (see Plate I. *g*).

e, The Testicle situated at the posterior part of the serous cavity formed by the T. vaginalis testis and its reflected portion.

f, The reflected part of the T. vaginalis testis much distended from fluid contained within the cavity which it forms.

It is particularly to be observed, that the lower part of the hernial sac is in contact with the upper part of the T. vaginalis testis, though forming two distinct cavities.

2. Hydrocele of the Spermatic Cord has been observed in combination with Inguinal Hernia, as exhibited in a specimen preserved in the Museum of the Royal College of Surgeons of this place. (1742, XXX. A.) Sir A. Cooper, in his large work on Hernia, mentions, and has delineated (in Plate V.), several cases in which the hernial sac, in cases of scrotal hernia, became contracted at the lower abdominal ring, while above it they remained open to the abdomen. In these cases fluid was collected in the lower portion of the sac. Such cases might be readily mistaken for Inguinal Hernia, complicated with encysted Hydrocele of the Spermatic Cord.

3. Hydrocele, in connection with Congenital Hernia, is not uncommon in children, and sometimes in adults. By the tunica vaginalis testis remaining open from the abdomen downwards, this form of hydrocele is often connected with ascitis. In other cases it takes place as an effusion from the interior of this peritoneal tunic, which forms the hernial sac; more especially in those cases where the protrusion has consisted of a portion of omentum which has adhered to the mouth of the hernial sac.

The diagnosis of the different forms of this species of complicated hernia requires great attention and discrimination. It is to be distinguished from common hydrocele, by the existence of a protrusion of bowel from the abdomen, being ascertained, along with the collection of fluid in the scrotum, without any line of separation between the hernia and the testicle,—and, when reducible, by the fluid being pressed into the abdomen along with the protruding bowel. When it occurs in the form of hydrocele with an adherent portion of omentum closing the mouth of the sac, the case very nearly resembles a common hydrocele, and has been cured in a similar manner.

Cases of congenital Hernia, combined with Hydrocele, may become cases of simple hydrocele in consequence of the hernia being cured, by the mouth of the peritoneal sac becoming closed from the operation of a proper truss.

Treatment of Hydrocele when conjoined with Hernia.

The treatment of Hydrocele when combined with Hernia should, in most cases, be only palliative. When the Hernia is reducible, and gives no trouble to the patient, except the inconvenience of wearing a truss, both he and the surgeon are apt to consider the Hydrocele to be the worst complaint of the two, and feel anxious to have it cured. But though the Hydrocele is formed by a sac quite distinct from that of the hernia, yet from its close vicinity to the latter, the production of violent inflammation in the former, by injection, would very probably extend to the hernial sac and peritoneum within the abdomen.* The consequence of which might be either fatal peritonitis, or an adhesion of the protruding bowel to the hernial sac, similar to that represented in Plate I, which proved fatal.

In cases of Hydrocele connected with congenital Hernia, and where the mouth of the sac has been closed by a portion of adherent omentum, the Hydrocele may be cured by incision, which, in such cases, is the preferable mode. Encysted Hydrocele of the cord might admit of similar treatment.

In young children where the disease is most commonly connected with ascitis, purgatives, diuretics, and astringent lotions, when conjoined with a properly adjusted truss, will often cure the hydrocele. The evacuation of the fluid by puncture may be necessary when the case proves obstinate.

* A case of this kind is mentioned by Dr Buchanan of Glasgow, in the Med. Chirurg. Trans. of London, 1831, where a surgeon operated on Hydrocele by injection, and caused violent peritonitis.

When the hydrocele remains, however, as a distinct disease after the cure of the hernia, by the closure of the abdominal aperture, the usual treatment for effecting the radical cure might, with caution, be employed; but not till a considerable length of time after the opening has appeared to be closed.

SECTION SIXTH.

OF LABIO-INGUINAL HERNIA.

In this species of rupture, the viscera protrude from the abdomen of the female through the inguinal canal, as in the male subject. But this canal, which, in the female, transmits the round ligament of the uterus, is of smaller diameter than in the male, and is more firmly closed at the pubes where the uterine ligament terminates. Hence this form of hernia is much less frequent in women than in men; and, it is the general observation of surgeons that, when it does occur, it seldom attains a large size. To this remark, however, the case here annexed forms a striking exception.

In most cases, labio-inguinal hernia protrudes *obliquely*, and very rarely *directly*, from the belly, so as to form a ventro-inguinal rupture. The following also shews that, in this case at least, the protrusion bears the same relation to the peritoneum that it does in the congenital hernia of the male; so that the portion of peritoneum which descends with the round ligament of the uterus at birth, forms the hernial sac. In the instance before us, too, the external opening has become very large and direct from the abdominal cavity, but the epigastric artery is situated on the inner or mesial side of the neck of the tumour, as in oblique inguinal hernia of the male.

Case.—Explanation of Plate Fourth.

This delineation represents a case of Labio-inguinal hernia which occurred in a female 39 years of age, in whom it had existed for 7 years and had attained a very large size. The protrusion had taken place on the right side, and was irreducible, but did not prevent her from going about and working as a domestic servant. In November 1832, she was attacked with inflammation of the bowels, the symptoms of which very much resembled Cholera (then prevalent) so that she was brought into one of the Cholera hospitals (which I attended) in a moribund state, and died in a few hours after her admission.

At a *post mortem* inspection the parts, when dissected, presented the appearance here represented (Plate IV.) The coverings of the protruding bowels consisted of the skin and superficial fascia within it,—a strong uniform fascia from the tendon of the external oblique (the inter columnar fascia), and the peritoneal sac. The round ligament of the uterus was situated at the posterior part of the neck of the sac, to which it closely adhered. The epigastric artery was on the inner side of the hernial sac.

The hernial sac hung pendulous upon the upper part of the right thigh, somewhat overlapping the left. The lower part of the belly is here represented as denuded of the skin and superficial fascia. *a*, the anterior and superior spinous process of the ilium. *b*, the superior pillar of the lower abdominal ring on the *left side*, formed by the tendon of the external oblique muscle. *c*, the ring on the right side very much enlarged by the passage of the viscera through it. *d*, the skin and superficial fascia of the hernial tumour. *e*, the fascia from the external oblique muscle, and the peritoneal sac.

The whole of the loose or floating bowels of the abdomen were protruding from it, and were contained in the hernial sac, except that portion of the duodenum which reached from the stomach to the sac, and the portion of large intestine which reached from the hernial sac to the rectum. The mesentery and mesocolon attached to the bowels were also pulled down into the sac. The protruding small intestine measured 12 feet in length, the large bowel two feet, but they would have measured much more had they been cut from the mesentery.

The whole of the small intestine which protruded was of a dark blue purple colour, while the colon was of its usual healthy appearance. Strangulation, in this case, seemed to have been caused by a wrong turn of the bowel near to the caput coli. In consequence of this, the passage through the bowels was obstructed, and inflammation, or at least vascular congestion, was produced. That there was no constriction caused at the neck of the hernial sac was obvious, from the unaltered healthy state of the colon.

This remarkable case shews the very great size to which this form of hernia may attain ; and, even though irreducible, the altered position of the parts may not interrupt the functions of the bowels, unless from the unfortunate occurrence of a wrong turn or twist of the bowel. But in consequence of the position of the parts, and their very thin coverings, the individual is exposed to great hazard from liability to external injury.

The difference between the coverings of the protruding viscera in this case of Labio-inguinal hernia, and those in a case of Oblique-inguinal hernia in the male, is very great. In this case the coverings, consisting of the cremastic muscle and the sheath of the spermatic cord, were of course wanting. Neither was the external surface of the hernial sac covered by the subserous cellular membrane, as in the common inguinal hernia of the male.

The whole of this hernial tumour is preserved in the Museum of the Royal College of Surgeons of Edinburgh.

SECTION SEVENTH.

OF UMBILICAL HERNIA.

Umbilical hernia takes place in consequence of the imperfect closure of the opening through which the umbilical vessels passed from the placenta of the mother into the body of the fœtus. This kind of rupture, though common in children, is comparatively rare in adults. The opening between the muscles through which the protrusion takes place is generally small, though the hernial tumour may attain a considerable size. But the opening being direct, and the parietes of the belly thin at the part, the surgeon, or even the patient himself (or the nurse when the patient is young), is commonly able to replace the protruding viscera, by pressure, into the abdominal cavity; strangulation of this species of hernia, such as to require an operation, is therefore a very rare occurrence.

The coverings of an umbilical hernia consist of the skin, a superficial fascia, and the peritoneal sac. These are, in general, thinner, even in old ruptures of this kind, than the natural state of these textures, probably from their extension; a circumstance which enables the surgeon, by sight and touch, to recognise the form of the bowel or omentum within the sac.

Case.—Explanation of Plate Fifth.

This delineation represents a case of strangulated umbilical hernia in a lady 71 years of age, who had an operation performed by my former colleague, Mr Ferguson, now of London. By his kind permission I am enabled to publish this case; and having accompanied him to the performance of the operation, I cannot refrain from stating the opinion I entertained of his dexterity on the occasion under very difficult circumstances, from having to make incisions through integuments and coverings which were remarkably thin and tense, from the distended bowel underneath. Though ultimately it proved unsuccessful, no operation could have been more admirably performed.

The protruding bowel *d*, and the omentum *c*, are here represented after being exposed by an incision through the skin *b b*, and the peritoneal covering or hernial sac *a*. The point *e* where the two extremities of the protruding intestine meet, marks the opening in the abdominal parietes through which the hernia has proceeded.

This individual had been affected with umbilical hernia for about 40 years, and on some occasions, the difficulty of reducing it was such, that operations were very nearly had recourse to.

Previous to the operation, the tumour was about 4 inches in diameter, was remarkably tense and hard, and strangulation, accompanied with urgent symptoms, had existed for 12 hours. The tension of the skin rendered the pinching up fold of it for division impossible; and Mr F. was obliged to divide this and the hernial sac (which seemed scarcely possible without injuring the bowel, both being so extremely thin), by the most careful strokes of the knife. Immediately on these being divided, the protruding turn of bowel started out as here represented, but was found to have protruded from the belly through a very small opening. By dividing the margin of this opening into the abdomen, the bowel, which was of a dark red colour, was easily returned, but the portion of omentum which protruded could not be separated from the hernial sac to which it was connected by old adhesions. The omentum was therefore allowed to remain, but the neck of the sac was more freely divided to prevent strangulation. The patient bore the operation well, but died on the 4th day after.

This exhibits one of those rare cases of umbilical hernia, in the adult, which become strangulated so as to require an operation for its reduction. It shews the parts which then require to be divided, and the difficulties to be encountered.

SECTION EIGHTH.

OF PHRENIC OR DIAPHRAGMATIC HERNIA.

Protrusions of the abdominal viscera take place into the cavity of the chest, either from malformation or deficiency of the diaphragm, or from wounds, which penetrate through it. In consequence of the convex projection of the diaphragm upwards into the chest, an instrument or weapon which passes through the lower intercostal spaces, in many cases, perforates the diaphragm also. These and similar penetrating wounds of the diaphragm, caused by the extremities of broken ribs being thrust in upon it, form the most common causes of diaphragmatic herniæ. To such cases, therefore, the following remarks are confined.

When any of the abdominal viscera are protruded into the chest through a wound of the diaphragm, there is no hernial sac of peritoneum, or other covering of the tumour; it projects into the thorax quite free and uncovered as it existed in the abdomen.

In one of the following cases, diaphragmatic hernia took place from a penetrating wound, by means of a knife, through the side of the chest;—in the other, from a perforation of the diaphragm by the broken extremity of a fractured rib.

Cases.—Explanation of Plate Sixth.

The very remarkable case of Diaphragmatic Hernia, represented in Fig. 1, occurred to Dr Shortt, in the Royal Infirmary here, by whose permission I made a drawing of the parts after their removal from the body, and here insert an account of the case. The plate has been made from the drawing, but much reduced in size. The case is interesting, not only in a pathological, but also in a medico-legal point of view. An account of the dissection of this case was published by Dr John Reid (now of St Andrews), in the Edinburgh Medical and Surgical Journal, No. 142. This account of the case is highly interesting and important, but in the following will be found some additional particulars.

W. Reid, æt. 45, a shoemaker, who lived in an obscure part of the town, and a

woman with whom he cohabited, being both given to intemperance and dissipation, had frequent drunken brawls. One of these occurred in December 1836, when a neighbour was attracted to the house by the noise of fighting. She then discovered the man lying on the floor with the woman above him, and that there had been a good deal of blood shed between them. Her timely interference prevented further mischief; but the man was seriously injured in the side, which confined him for some time. During his illness he complained of much pain and swelling above the middle of his body, and great difficulty of breathing.

After a length of time he recovered in a great measure, but was never so well as formerly. At different times he was afterwards affected with obstruction of the bowels, accompanied with great pain and swelling of the belly, vomiting, difficulty of breathing, and cough without expectoration. For these complaints he was admitted into the Royal Infirmary on three different occasions. On the first of these he was under the care of Dr Traill, from 10th March to 17th May 1837, when he was dismissed relieved. On the next occasion, he was under the care of Dr Borthwick, from 22d March to 15th May 1838, when he was dismissed relieved from complaints similar to those he had when previously in the Hospital. On the third and last occasion, he was admitted into Dr Shortt's wards on the 13th September 1838, affected with the same complaints, but to such an aggravated degree, that he was evidently in a dying state, and expired in 4 hours after his admission, having lived 21 months after receiving the wound in his side.

It is to be remarked, that on none of these occasions did he mention any thing of having received a wound in the side; and nothing of the kind was either seen or suspected by those who saw him. The wound being quite healed externally, leaving only a slight scar, did not attract any attention; and he seemed studiously silent regarding it, both to his neighbours and the physicians whom he consulted, probably to screen the individual who inflicted it from the consequences that might ensue.

When the symptoms of his case became unusually aggravated, as on the occasions of his seeking relief in the Infirmary, they seemed to proceed chiefly from obstruction of the bowels, which on some occasions continued for six or eight days before he was relieved. This obstruction of the bowels caused pain about the umbilicus, increased by pressure, vomiting, and a tympanitic state of the abdomen. To these were added the difficulty of breathing and cough without expectoration, which were so far peculiar, that they were unusual accompaniments of enteritis, and did not seem to depend on disease of the lungs. It appeared to be only on the last occasion of his admission into the Infirmary that any particular examination of his chest had been made. It was then found that the left side was dull on percussion, and neither respiration nor the sounds of the heart were audible in it.

Sectio Cadaveris. The following account is chiefly taken from that of Dr Reid, as extracted from the records of the Infirmary:—

The right lung and heart were sound, the latter somewhat displaced towards the right side. The left side of the chest contained the lung of this side condensed, and with-

out air in it; more than six pounds of reddish fluid, and a dark coloured soft mass, connected with the diaphragm (*c*), which it pressed downwards. On further examination, this mass was found to consist of part of the transverse arch of the colon (*f*), and a considerable portion of omentum (*d*), which had passed through an opening in the diaphragm, scarcely capable of admitting the points of three fingers. This perforation in the diaphragm corresponded to the cicatrix of a wound (*e*) through the parietes of the chest (*a b*) between the ninth and tenth ribs, to which a portion of omentum adhered. The protruding viscera had evidently become strangulated. The portion of colon situated in the chest was more than a foot in length, of a dark red colour, considerably dilated, thickened in its coats, which were in several places softened, and, at one point, had a perforation through them. The returning portion of the bowel was connected to the opening in the diaphragm by old adhesions of the omentum.

Figure 2 represents a small diaphragmatic hernia in a patient 78 years of age, caused by the broken extremity of a fractured rib *a*, having perforated the diaphragm *b*. This individual was thrown down by a carriage, the wheel of which passed over his chest. He died three days after, and had suffered much from difficulty of breathing. The protrusion consists entirely of omentum in this case *d*. The abdominal portion of the omentum is represented at *c*.

In the first of these cases it is highly probable that the hernial protrusion was at first small, and consisted only of omentum, as in the second case, but had afterwards gradually increased till it attained the great size found on dissection.

The diagnosis of these cases is attended with great difficulty and uncertainty during life; and even if the existence of the hernia were ascertained the treatment can only be palliative.

This species of hernia is of rare occurrence, and I am not aware of its existence, in any case, having been ascertained before death. But cases might occur where such a protrusion might be strongly suspected. When violent symptoms of enteritis occur suddenly, after a wound of the chest, or broken ribs, by which the diaphragm might have been perforated, accompanied by obstruction of the bowels, and cough, without disease of the lungs; and, if in addition to these, we should discover the gurgling of fluid and flatus in the chest to have taken the place of the respiratory murmur, there would be very considerable certainty of the existence of a diaphragmatic hernia.

SECTION NINTH.

ON THE TREATMENT OF STRANGULATED HERNIA.

A Strangulated Hernia always gives rise to more or less abdominal inflammation, threatening danger to the life of the patient. The indications of treatment, therefore, are,—1. The removal of the strangulation, and 2. The cure of the inflammation.

1. The strangulation may, in many cases, be removed by other means than operation, which is generally reserved as a last resort. These means, as well as operation, require to be employed with judgment and discrimination, according to the circumstances of individual cases. And it should be kept in mind that, even when operation is resorted to, the return of the bowel to the abdomen after the removal of the stricture, is not in all cases requisite or practicable. For in old, large, irreducible, intestinal, or omental herniæ, where the strangulation often depends on an accidental wrong position, twist, or adhesion of the viscera, rather than stricture at the neck of the sac, all that is required is, so far as practicable, to remove the cause of strangulation, whatever its nature or situation may be, leaving the contents of the hernial sac unreduced. In some such cases also, it may be unnecessary to divide the abdominal ring or neck of the sac; in others, it may be necessary to divide the parts surrounding the neck of the sac, leaving it unopened.

The means to be resorted to for the removal of strangulation in cases of hernia previous to having recourse to an operation, are, bloodletting, the application of ice or cold water to the swelling, cathartic enemata, the warm bath, and the "taxis." These remedies, when judiciously employed in cases of recent strangulation, very often prove successful in removing it. But in cases where the strangulation has existed for a considerable length of time, when the patient is old, feeble, or much exhausted by the disease,

their employment might not only be a loss of precious time, but might prove dangerous, or unfit the patient for an operation, by the too great sedative effects they might produce.

As no absolute rules can be laid down for the adaptation of these remedies to all cases, they must be employed by the surgeon in the manner he conceives to be most proper, upon a consideration of their effects and the circumstances of individual cases. Bleeding is very useful by causing relaxation of the parts implicated, so as to facilitate the return of the protruding parts; as also in lessening inflammation and preventing the further extension of it, even if an operation should be required. It may be employed with perfect safety and advantage in robust and plethoric individuals to a considerable extent; but not in delicate, aged, and worn out subjects.

The use of cooling applications, such as ice, cold water, evaporating lotions, or frigorific mixtures, to the strangulated hernia, is often attended with complete success in causing such a diminution in the bulk of the protruding parts, that they recede into the abdomen. Cathartic injections are often highly beneficial. These excite the natural action of the bowels, by which the strangulated portion is withdrawn from the hernial sac. The employment of infusion of tobacco for this purpose, has a further advantage by causing faintness and relaxation of the system;* a state which is conducive to the reduction of the hernia, and lessens inflammation.

The warm bath, when it can be promptly obtained, is often a useful auxiliary to the other means employed, by causing general relaxation of the system.

The Taxis, as it is technically called, or reduction of the hernia by the hands, must now be had recourse to, and continued with perseverance, but with gentleness, skill, and care, for a considerable length of time after the employment of other means, and

* When a patient is unaccustomed to the use of tobacco, smoking this substance has a similar depressing effect on the system.

while the patient is in the warm bath. This operation is apt to be continued too long by unskilful persons, who often use too much force, improperly directed, greatly to the injury of the patient.

These remedies, it must be obvious, are not all to be employed in every case in regular succession by fixed rule; neither is any one of them to be relied on for accomplishing the desired object; for example, bleeding might not be considered expedient in a particular case, and yet the other remedies might be had recourse to; but after a copious bleeding, in another case, where the patient became very weak and faint, tobacco injection might be improper, by causing dangerous depression of the system; and in a case of large irreducible hernia, which had become strangulated, little advantage could be expected from the application of ice.

These remedies are therefore to be employed in combination according to circumstances, but not continued for too great a length of time, so as to exhaust the patient and allow the most favourable time for an operation to elapse. When they have had a fair trial, the system having been affected, without success in removing the strangulation, the operation must be had recourse to.

When a surgeon is called to a patient after the above remedies have been unsuccessfully employed, even although he may be convinced they have been applied imperfectly, further delay in their use would, in most cases, be dangerous, as inflammation and gangrene of the bowel may only be arrested by *immediate* removal of the strangulation,—a relief which an operation is most certain to accomplish.

In the performance of operations for strangulated hernia, the instruments required are,—a small scalpel, a probe-pointed bistoury, dissecting forceps, a needle and ligatures, a compress and bandage.

The object of the surgeon being to expose the hernial sac and the seat of the stricture, the skin and other coverings are to be divided separately in succession. It is not necessary to dissect

the skin from the subjacent parts to any great extent, except at the seat of the stricture, in order to afford greater facility in accomplishing its division. The other coverings of the sac may be pinched up and divided by horizontal incisions, or by the introduction of the probe-pointed bistoury under them. The exposure of the bowel is known from the other parts by its shining smooth surface, which does not bleed like the rough external surface of the fasciæ and hernial sac. When the hernial sac is arrived at, a portion of it should be pinched up and moved between the finger and thumb before being opened, in order to ascertain that none of the contents of the hernia are immediately under it and in danger of being cut.

In inguinal herniæ the seat of stricture is generally at the internal or superior abdominal ring, but in some cases it is situated at the external or lower abdominal ring, or at the neck of the sac itself. But wherever situated, it is to be carefully divided by means of the probe-pointed bistoury, or Cooper's hernia knife (which is very similar, the cutting part being very short), directed to the part by the forefinger of the left hand.

The propriety of opening the hernial sac before dividing the stricture has generally been considered to be a necessary part of the operation, both because the neck of the hernial sac itself is sometimes a cause of stricture, and because it is necessary in order to ascertain the state of the contents of the sac. For cases have occurred where the strangulation continued and proved fatal from the sac having been returned unopened and its neck undivided; and, moreover, a twisted state of the bowel or of the omentum round it, or gangrene of the bowel, or a perforation through its coats, might render the return of the unopened sac and its contents improper and unsafe. But of late, the practice of completing the operation without opening the hernial sac has been practised to a considerable extent, and it is said with the greatest success (see Practical Surgery by Professor Ferguson, p. 525); not in large irreducible hernia only, but in all cases. In a large propor-

tion of cases this may be perfectly safe and successful, but in some instances, such as above specified, the state of which cannot be ascertained without opening the sac, this mode of operating might prove fatal,—a result which might otherwise have been averted. Experience may shew, however, that by operating without opening the sac, more lives will be saved, on an average of cases, than by the other mode.

Caution and deliberation are as much required as anatomical knowledge in performing operations for strangulated hernia. In some surgical operations, dexterity and skill may be displayed by celerity, combined with exactness, in their execution. But in those for hernia there is no room for the display of such expertness. A hernial operation is adroitly performed, when it is done with care and success,—the steps of it being gone through with regularity and precision,—with deliberation, yet without unnecessary loss of time. These circumstances alone shew that the operator has a skilful knowledge of his work. On the other hand, attempts to display dexterity by flourishing the knife in a rapid or hurried manner, not only manifests ignorance of his work, but a rashness which seldom fails to lead to fatal consequences. For here several important parts are grouped together in a small space, requiring the greatest care and attention to avoid wounding them; the slightest deviation, therefore, from the proper course, from either ignorance, rashness, or carelessness, is highly dangerous.

2. The symptoms of abdominal inflammation frequently subside when the strangulation of the hernia has been removed by taxis or operation, so that no other treatment is required than keeping the patient quiet in the horizontal posture, on low diet, and promoting the natural action of the bowels by gentle purgatives and enemata.

But where symptoms of enteritis or peritonitis continue after the removal of the strangulation, the most active treatment is required, as if the inflammation were idiopathic. The chief remedy to be relied on is bloodletting, general and local, blistering, anti-

monials, and purgatives. These must be employed with decision and perseverance till a remission of the symptoms takes place.

In applying these remedies, the state of the pulse, pain and tension of the abdomen, and the obstruction or movement of the bowels, are the criteria by which we are to be guided. If the patient, for example, has no evacuation from the bowels, in four or five hours after the removal of the strangulation of the hernia, and has tension and pain of the abdomen increased by pressure, feverish restlessness, and a quick pulse, a decided bleeding may be the means of saving his life. It is often gratifying to witness the beneficial effects of this practice in relieving the pain and general distress, followed by the evacuation of the bowels. But where the immediate remission of the symptoms does not take place, or where they recur, leeches to the abdomen,—castor oil, croton oil, or calomel and extract of colocynth, require to be repeatedly given,—also purgative enemata, warm fomentations, and a blister to the belly ; warm bathing of the feet and legs, and antimonial diaphoretics, are to be used and persevered in according to the state of the patient, supporting his strength, at the same time, by mild nourishment in small quantities.

Explanation of Plate Seventh.

Figure 1. Dissection of the lower part of abdominal parietes of the right side of a male subject, to shew the fascia transversalis, and the process from it, which forms the sheath of the spermatic cord.

a a, A portion of the tendon of the external oblique muscle.

b b, The cut edges of an incision through it, extending upwards and outwards from the external ring in the course of the inguinal canal.

c, The spermatic cord covered by the cremastic muscle.

d, A hook pulling upwards the internal oblique, the transversalis, and some fibres of the cremastic muscles, which have been detached from their union with Ponpart's ligament.

e, The outer or iliac portion of the fascia transversalis.

f, The inner or pubic portion of the same fascia.

g, The funnel-shaped process of the fascia transversalis which covers the spermatic cord, and forms its proper sheath nearly to the testicle. The spermatic cord makes its exit from the abdomen through a slit or chink between the iliac and pubic portion of the fascia transversalis, just behind the upper part of the spermatic process which descends from it.

h h, The fibres of the cremastic muscle which arise from the transversalis muscle.

i, The superior, and *k* the inferior, pillars of the lower or external abdominal ring, which have been separated by the incision through the tendon of the external oblique muscles.

Figure 2 represents an internal view of a case of strangulated femoral hernia in a male subject, from a preparation in the Royal College of Surgeons (No. 1717). It exhibits one of those cases in which the protruding portion of bowel had been reduced by operation, along with the hernial sac unopened. The stricture at the neck of the sac, which caused strangulation, having continued, proved fatal.

a b, The descending and ascending portions of the bowel.

c, The knuckle or doubling of bowel which is strangulated by the stricture at the neck of the hernial sac.

d, The peritoneal covering of the abdominal parietes.

e, The hernial sac surrounding the bowel cut open that the latter may be seen.

f, A portion of the abdominal parietes.

Explanation of Plate Eighth.

Figure 1. Case of congenito-scrotal hernia which occurred in an adult; from a preparation in the Royal College of Surgeons (No. 1778).

The subject of this case had a hernia at birth, which disappeared during infancy, but returned at the age of 28, in consequence of his lifting a heavy weight. It could not be reduced by the taxis, and he died in 12 hours after its descent. This case shews how strangulation takes place by the gradual increase of the size of the tumour from distension of the protruding bowel. In consequence of this the circulation in the bloodvessels of the gut becomes altogether obstructed, causing the dark bluish purple colour which it so often exhibits under such circumstances.

a b, The descending and ascending portions of bowel.

c, The portion which protrudes into the tunica vaginalis testis.

d d, The neck of the hernial sac surrounded by the abdominal muscles which form the lower part of the inguinal canal.

e, The tunica vaginalis testis.

f, The testicle.

Figure 2 represents the internal surface of the abdominal parietes, denuded of the peritoneum, in a case of direct or ventro-inguinal hernia, on the right side, taken from a preparation in the Royal College of Surgeons (No. 1705.) This preparation was presented to the College by Emeritus Professor John Thomson, who was the first to designate this species of hernia *ventro-inguinal*.

a a, Inner surface of abdominal parietes.

b, Section of os innominatum, separating the ilium from the os pubis.

c, A portion of the peritoneum surrounding the neck of the hernial sac.

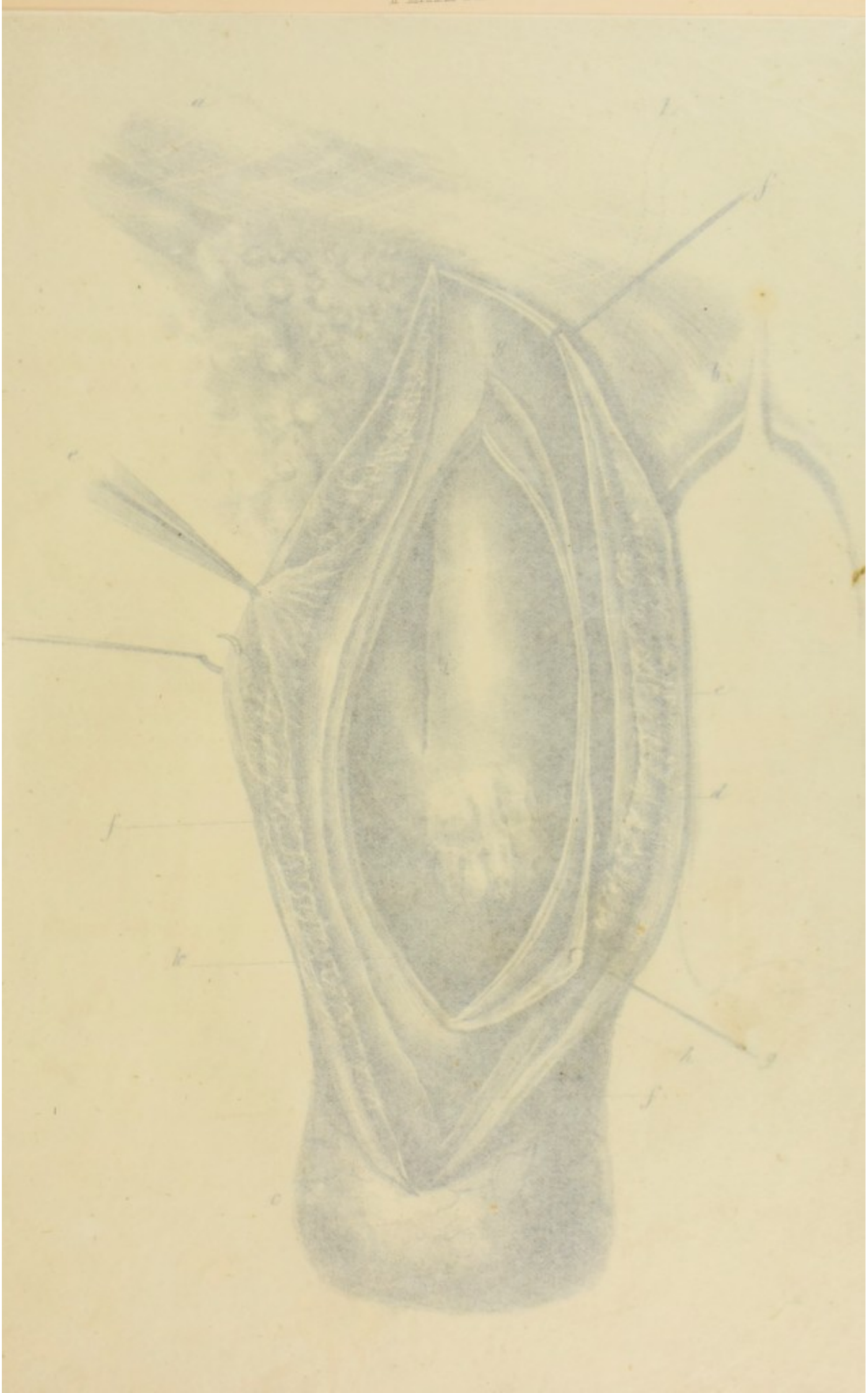
d, The hernial sac, formed by a process of the peritoneum.

e, The spermatic cord, just before it makes its exit from the belly into inguinal canal.

f, The external iliac artery.

g, The epigastric artery arising from it,—situated on the outside of the hernial sac.

h, The pubic branch of the epigastric artery, enlarged and running round the upper part of the neck of the hernial sac.



Explanation of Plate Eighth.

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e, The tunica vaginalis testis.

f, The testicle.

Figure 2 represents the internal surface of the abdominal parietes, denuded of the peritoneum, in a case of direct or ventro-inguinal hernia, on the right side, taken from a preparation in the Royal College of Surgeons (No. 1768.) This preparation was presented to the College by Emeritus Professor John Thomson, who was the first to designate this species of hernia *centro-inguinal*.

a a, Inner surface of abdominal parietes.

b, Section of os innominatum, separating the ilium from the os pubis.

c, A portion of the peritoneum surrounding the neck of the hernial sac.

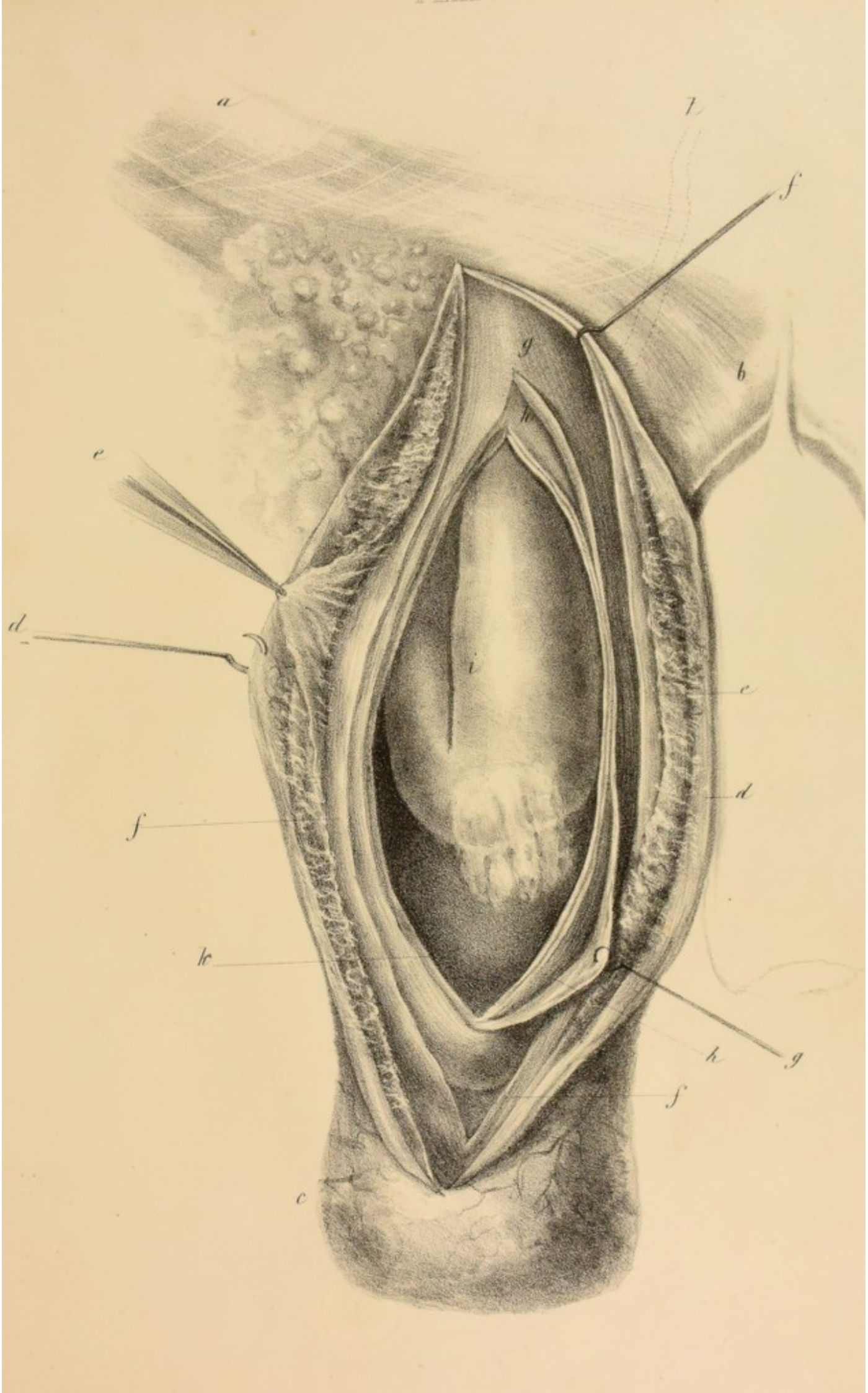
d, The hernial sac, formed by a process of the peritoneum.

e, The spermatic cord, just before it makes its exit from the belly into inguinal canal.

f, The external iliac artery.

g, The epigastric artery arising from it, and ascending on the outside of the hernial sac.

h, The pubic branch of the epigastric artery, enlarged and running round the upper part of the neck of the hernial sac.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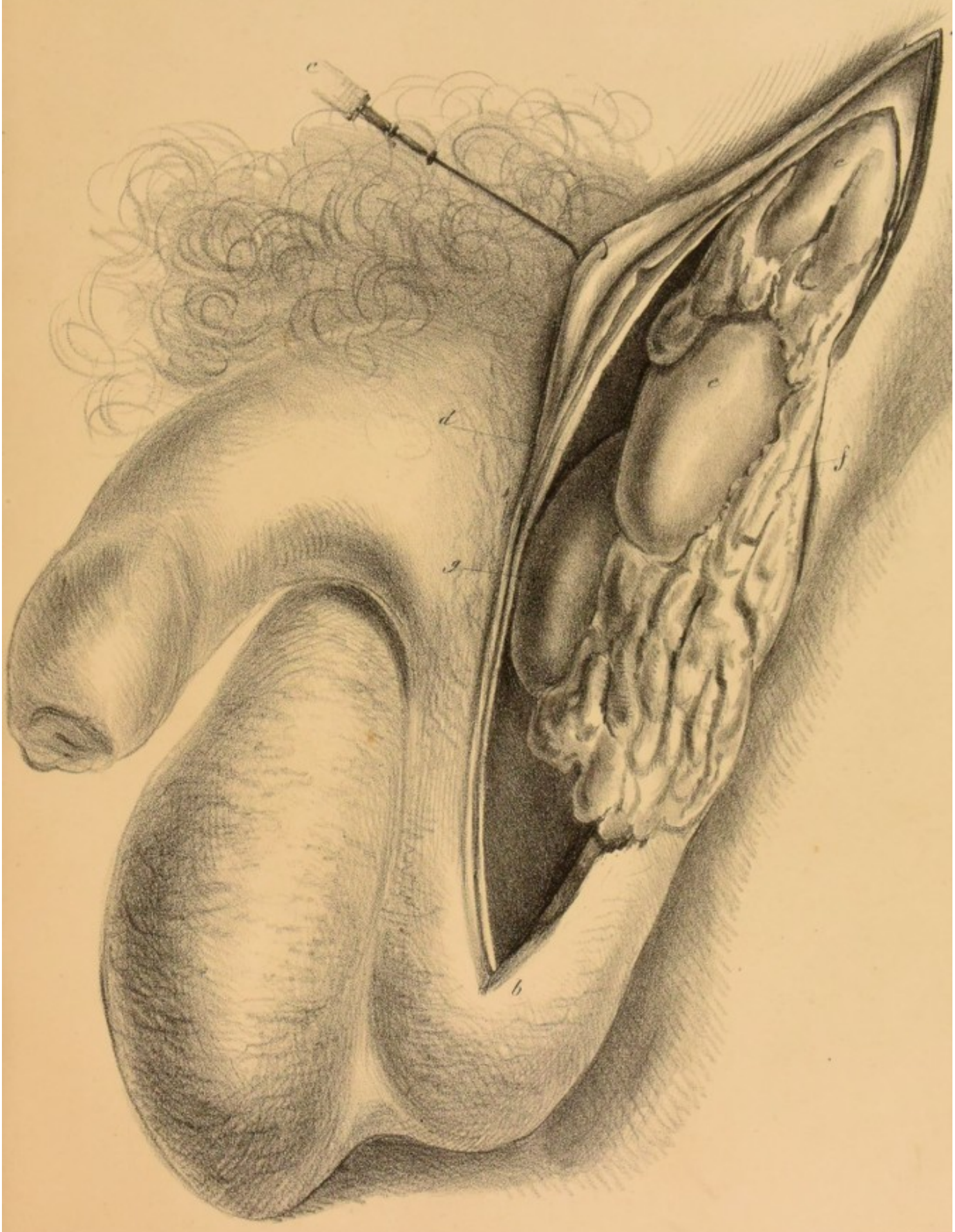
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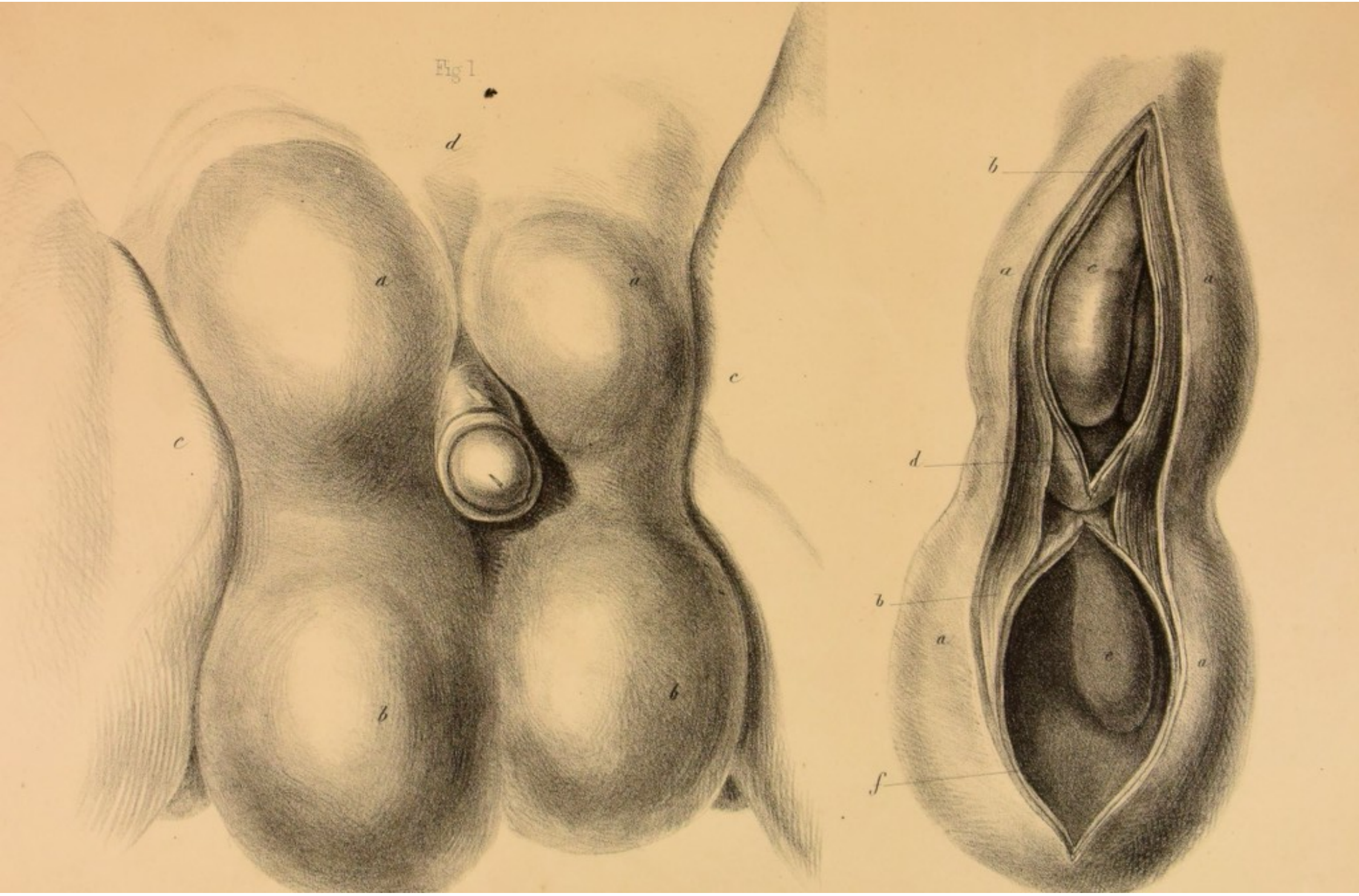
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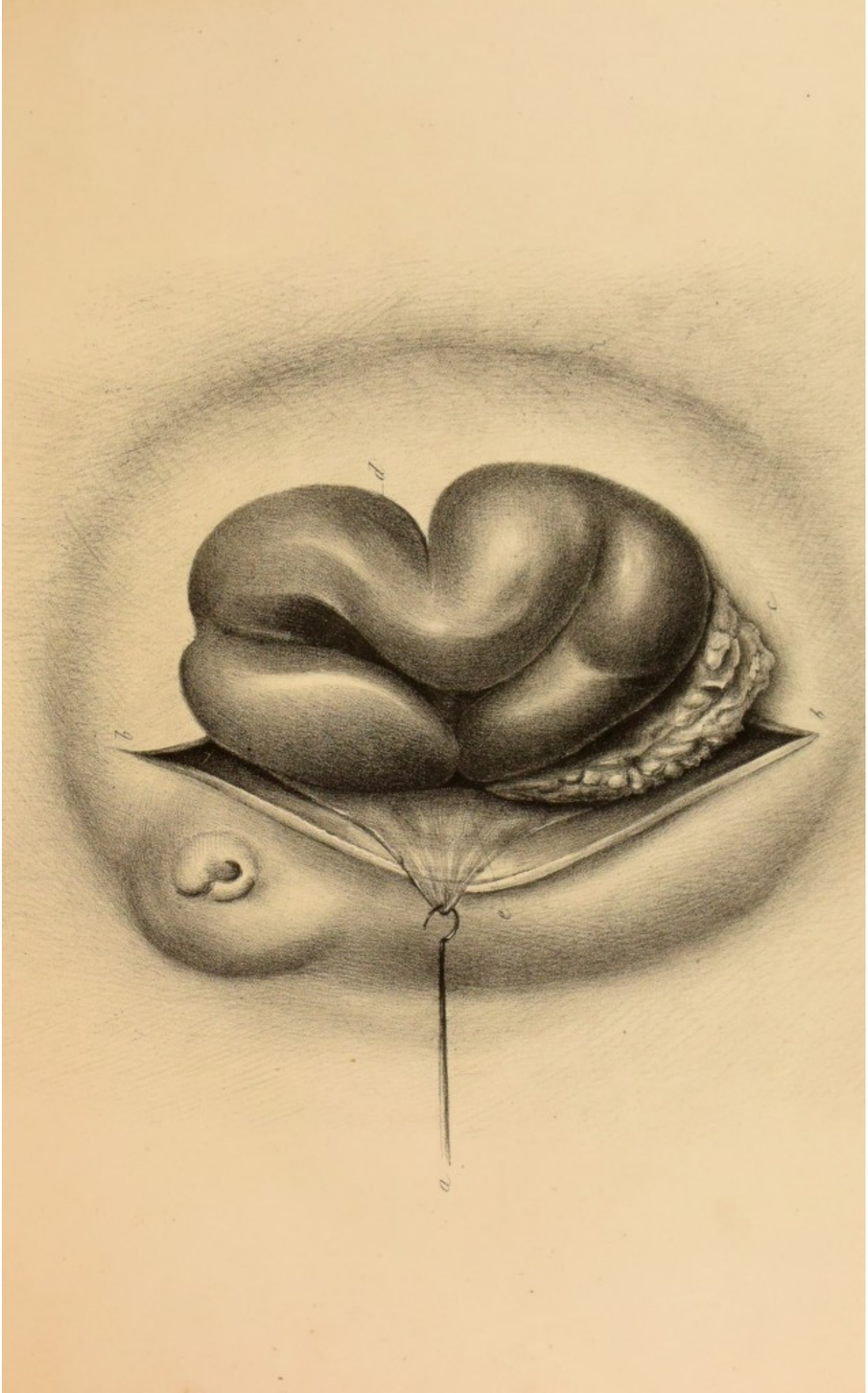

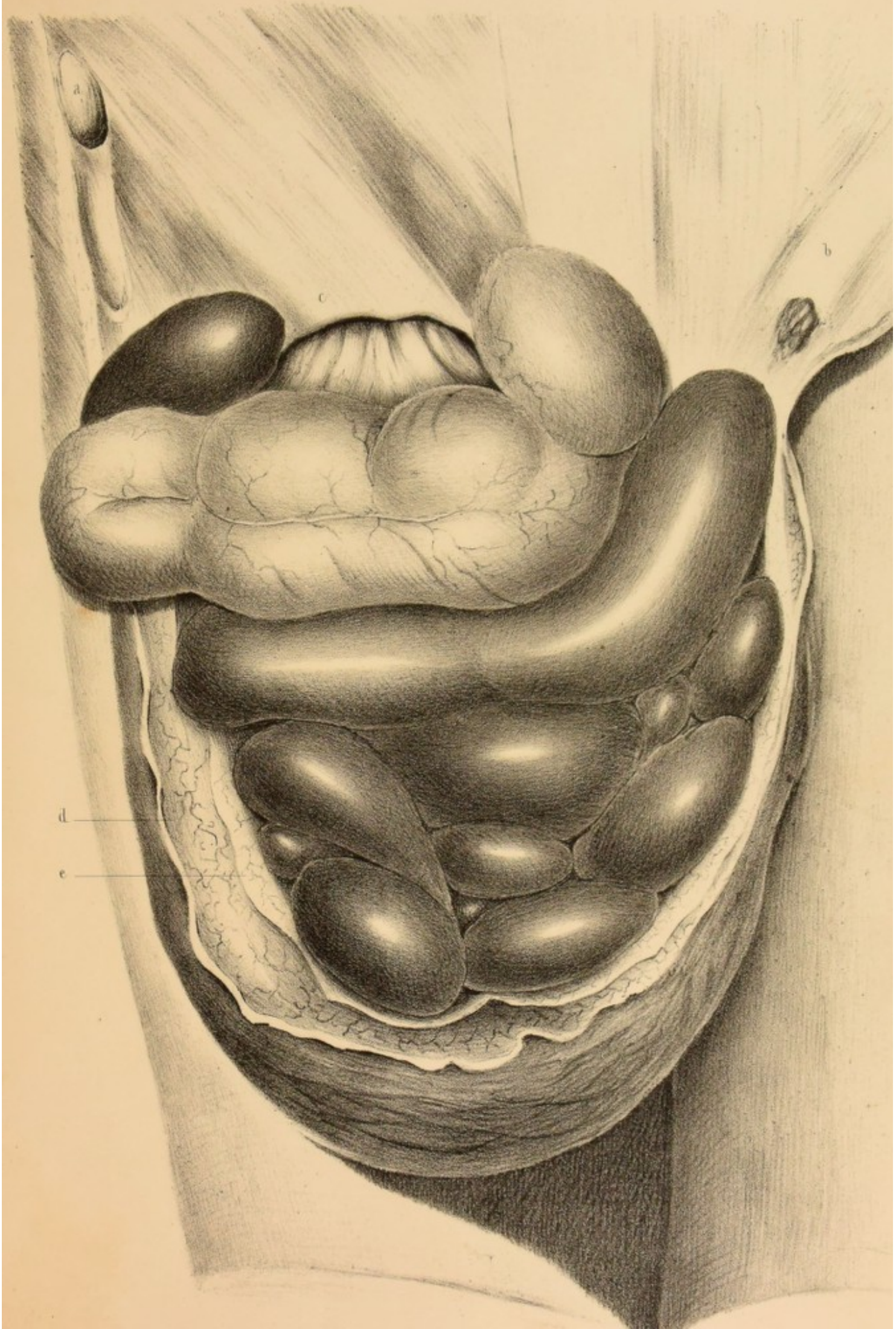
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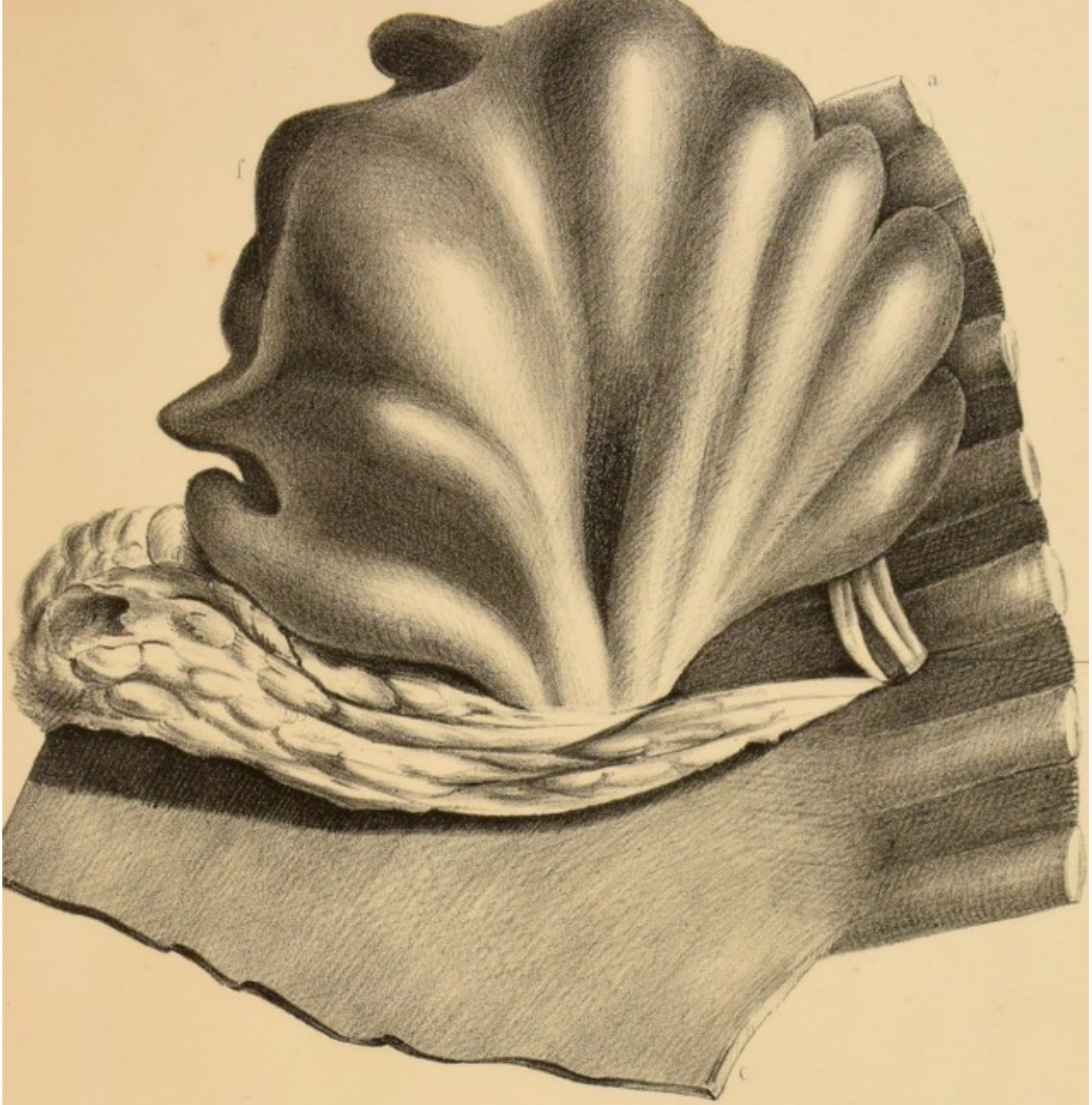
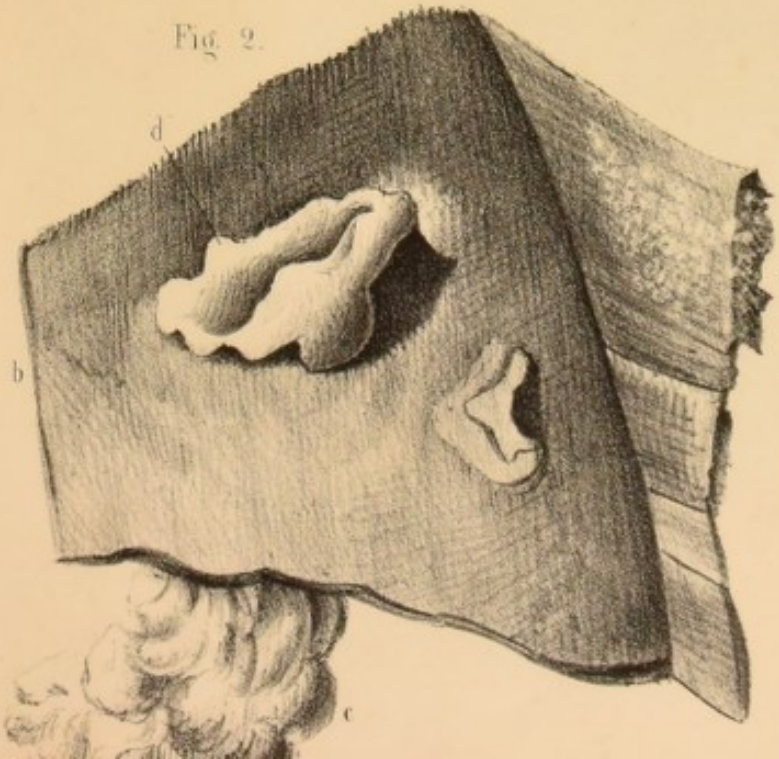
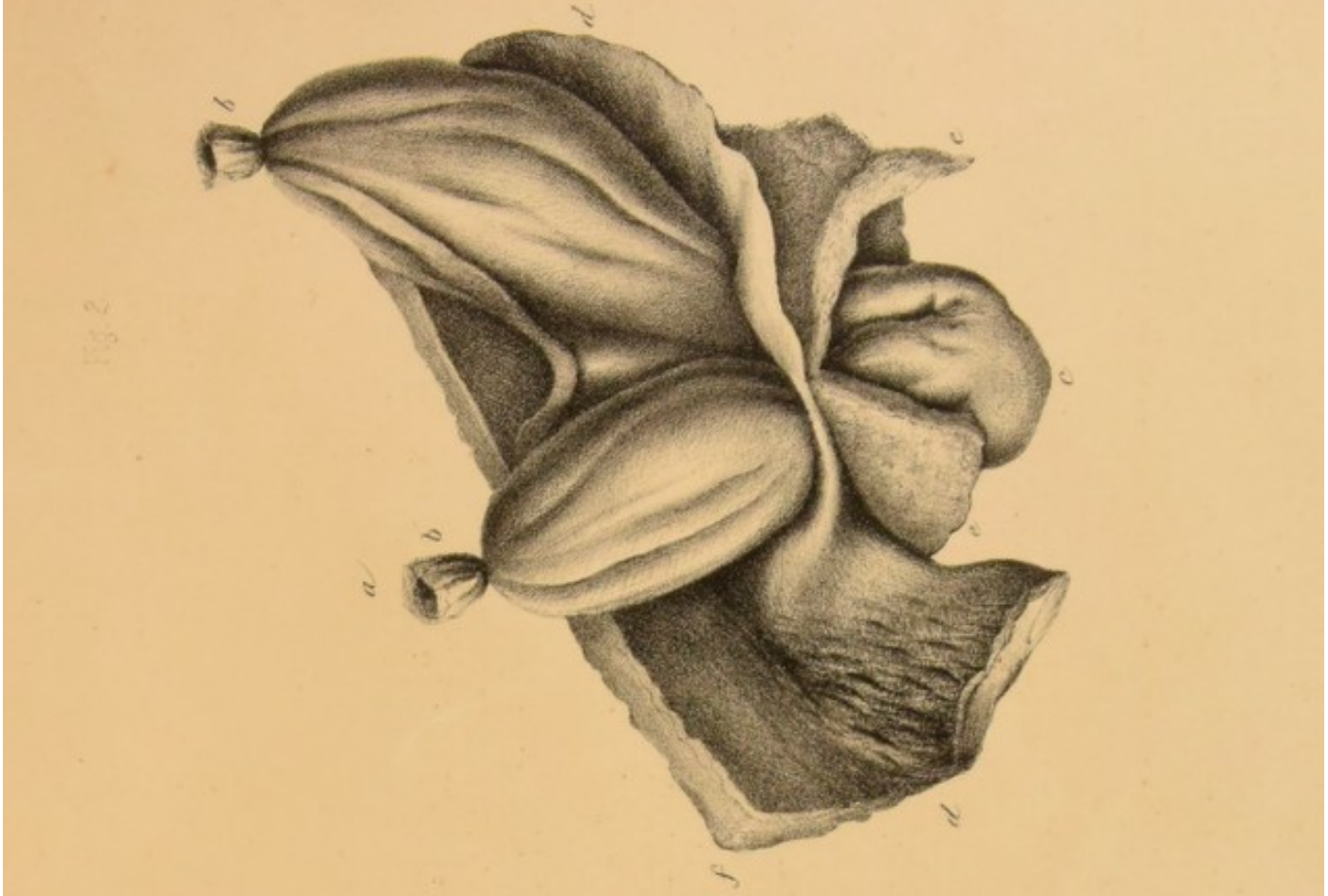
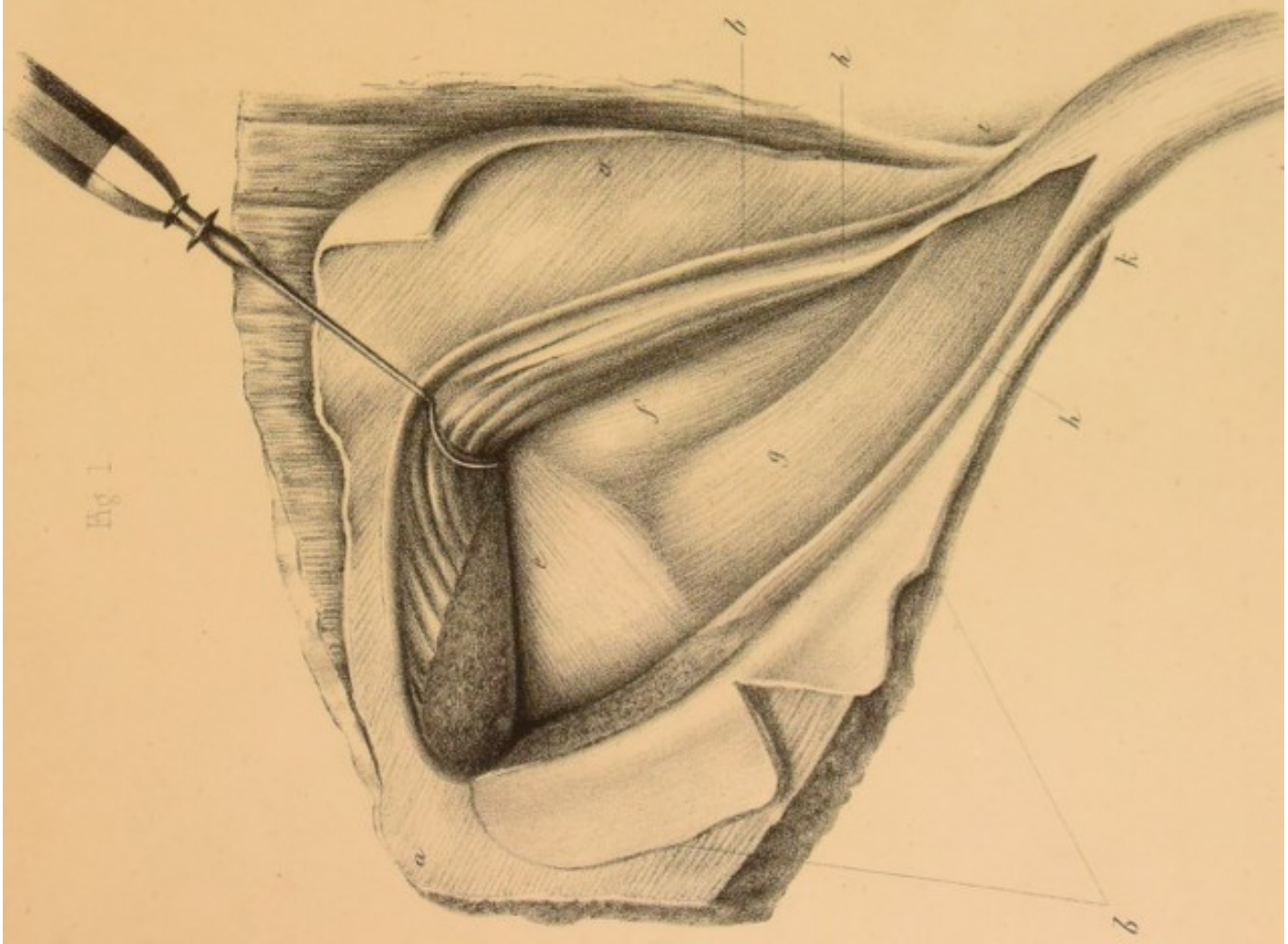
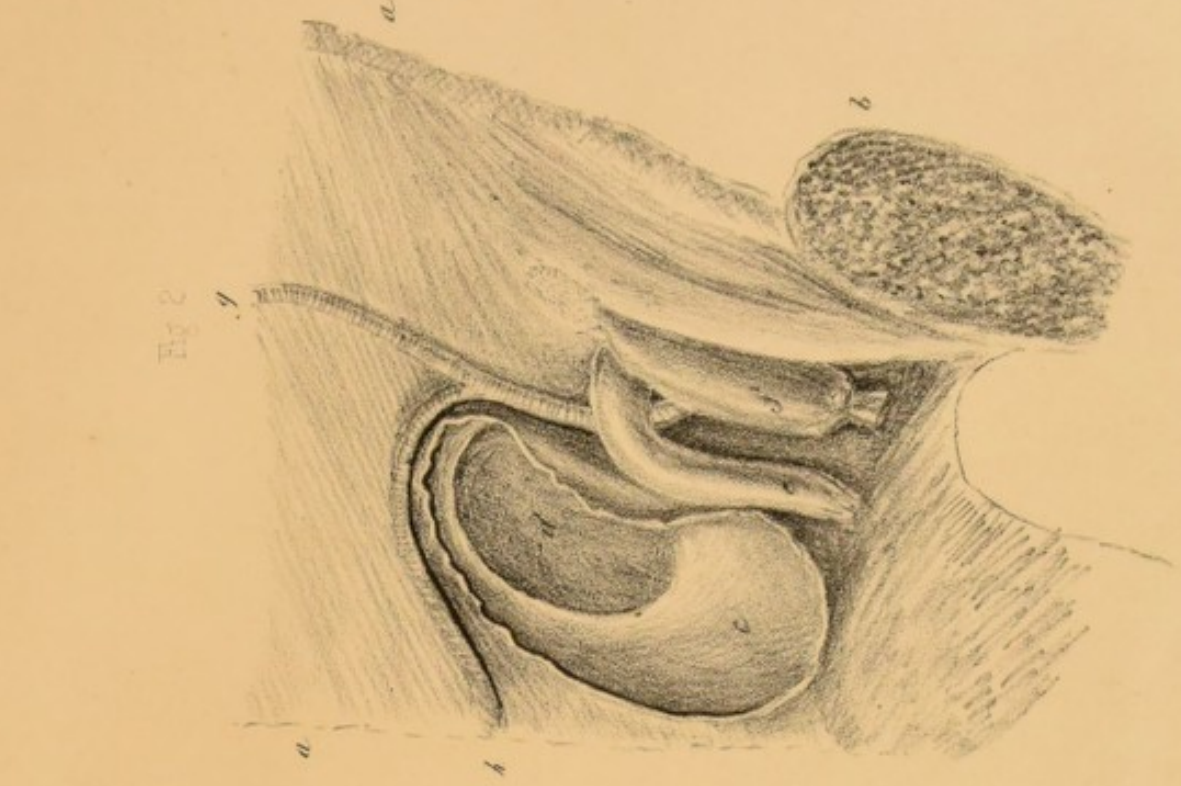


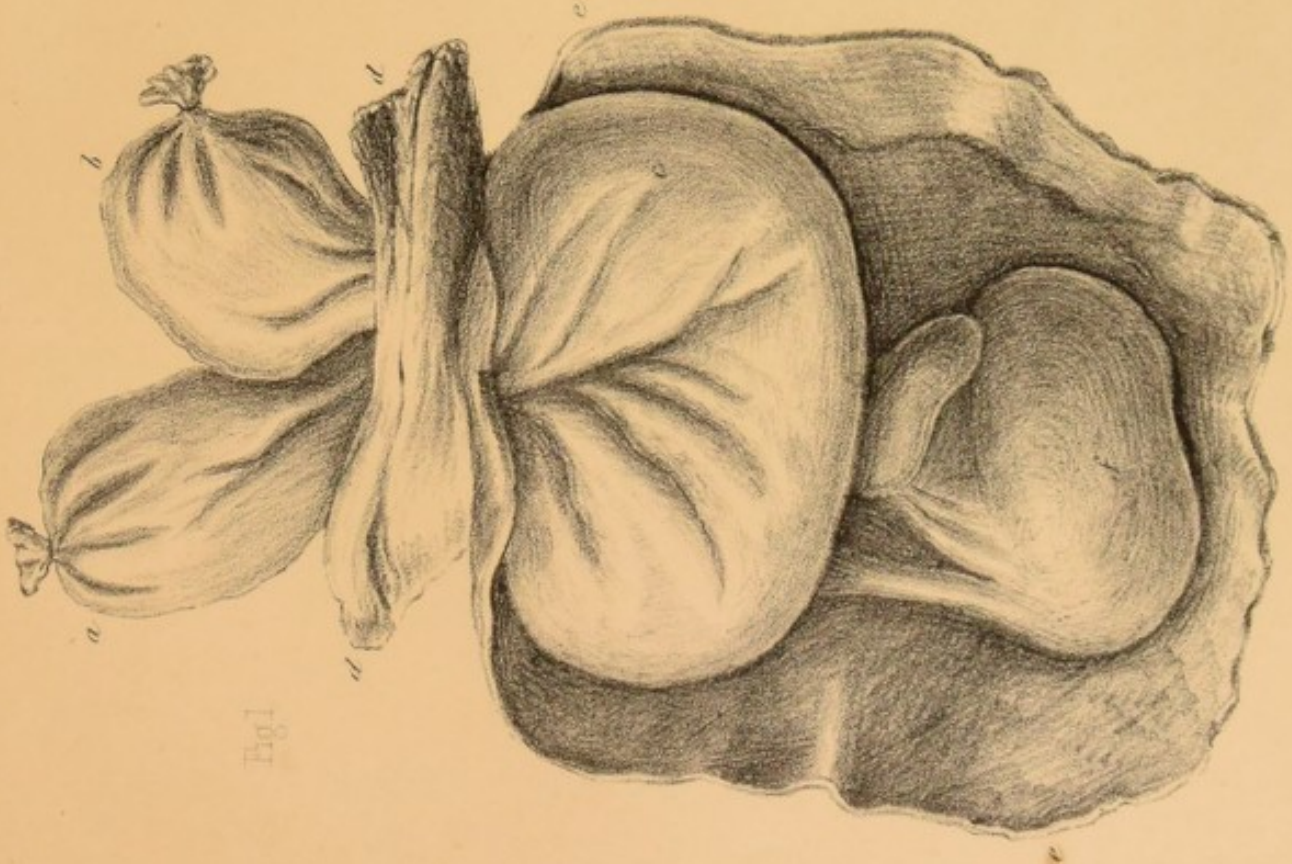
Fig. 2.











SURGICAL ESSAYS.

PART SECOND.

ON INJURIES AND DISEASES OF ARTERIES.

CONTENTS OF PART SECOND.

SURGICAL ESSAYS.

The Arteries of the human body require the constant attention of the surgeon, on account of their important functions, the accidents to which they are liable, and the diseases with which they are so frequently affected. The arteries have always formed a subject of peculiar interest to the surgeon. Formerly, from his ignorance, they were his unconquered foes; now, from his knowledge, they are under his complete subjection. As the practice of surgery was limited and retarded, from the structure and functions of the arteries being unknown or imperfectly understood; so, from the extensive application of the subject, in proportion to the attainment of this knowledge, has surgery advanced as a science and as an art. In no branch of surgery, is the difference between ignorance and knowledge more conspicuous, than in this relating to the arteries. A very slight knowledge of the history of our profession shews, that, in former times, lives and limbs were lost by those accidents and diseases which are now cured by very simple means.

The best works which we possess on this subject (few in number) are scarce, some of them obsolete, and others very imperfect. To obviate this deficiency, I have undertaken the present treatise, in which I have endeavoured to give a short but comprehensive view of the present state of our knowledge of the ANATOMY, PHYSIOLOGY, INJURIES, and DISEASES of ARTERIES.

In accomplishing my plan, though I may not be able to lay claim to much originality, its details have been chiefly composed from my own observations, as taken from nature. In most cases, these will be found to confirm the observations of others; where they differ, or where new views are stated, the responsibility lies with myself.

In illustrating my Essays, I have much pleasure in stating, that the very rich and valuable pathological museums in this city have, in the most kind and handsome manner, been thrown open to me. For this I am indebted to the Curators of the Museum of the Royal College of Surgeons, to my friends Sir George Ballingall, Dr Robertson, Dr Handyside, and Dr Duncan. From these sources I have gleaned largely, in addition to the illustrations in my own possession.

The account of the General Anatomy and Physiology of Arteries which I have inserted, will render the subsequent parts of the work more complete and more easily understood.

SECTION FIRST.

PRELIMINARY ACCOUNT OF THE GENERAL ANATOMY AND PHYSIOLOGY OF ARTERIES.

I. Form and Course.—The Arteries are those vessels by which the blood is conveyed from the ventricles of the heart to all parts of the body. But as it is the Systemic Arteries, or those connected with the left ventricle of the heart, which chiefly engage the attention of the surgeon, to these the following observations are confined.

The arborescent form of the distribution of arteries has caused anatomists to divide them into *trunks*, *branches*, *twigs*, and *capillaries*.

Arteries are, for the most part, cylindrical tubes, but they diminish in size as they give off ramifications; and the area of their subdivisions, taken together, is always greater than that of the artery from which they are sent. As they diminish in size, their parietes become proportionally increased in thickness.

The larger arteries generally follow a straight course, nearly parallel with the longitudinal axis of the body; but ramifications are generally given off at angles more or less acute. While the branches subdivide they communicate or anastomose with each other. These anastomoses become more numerous as the vessels diminish in size and recede from the centre of circulation. Their number and importance will be best illustrated by the fact, that the largest arteries, even the aorta itself, may be obliterated, and yet the circulation is carried on in the more distant parts by the anastomosing branches. The anastomoses of arteries favour and regulate the circulation of the blood.

Many branches of the arteries have a flexuous course, in order that they may accommodate to the varying size, form, and position, of particular parts and organs of the body.

II. Structure.—It is the commonly received opinion that the tunics or coats, of which the arterial tubes are formed, consist of three in number, although from their easy subdivision more have sometimes been enumerated.*

These three coats differ from each other both in structure and functions. They can be easily separated from each other; but they adhere together so intimately, that, in separating them, the portions in contact are apt to be torn.

* Examiners with the Microscope have enumerated *six* coats; they might as easily have made them into *sixteen*.

The *internal* tunic, or lining membrane, of arteries, is thin, smooth, polished, moistened, whitish, more or less transparent, uniform and continuous throughout, and without any apparent fibres in its structure. It is little elastic, and is easily torn in all directions. This coat bears a strong resemblance to serous membranes. In many parts it is corrugated from contraction of the other coats. It is covered internally by an Epithelium.

The *external* tunic of arteries, when separated from the loose cellular sheath which surrounds the vessel, is found to be thicker than the inner coat. It is fibro-cellular, formed of oblique filaments interlaced with each other, and connected intimately with the fibres of the middle coat. It is traversed by cellular tissue, which occupies the meshes or interspaces formed by the reticulated distribution of its fibres. This coat is tough, pliant, and possesses a very considerable degree of elasticity. Hence it admits of considerable elongation when stretched, both longitudinally and transversely.

The *middle* tunic of arteries, which is situated between the two above described, has a peculiar fibrous structure. From its extreme elasticity, this membrane has been termed *elastic fibrous tissue*. It is not peculiar to the arteries, being found in other parts of the body, as the ligamentum nuchæ, &c. This coat is the thickest of the three, but in certain viscera, as the brain, it is so thin as to be scarcely appreciable.

The fibres of this arterial tunic are opaque, of a yellowish-white colour, firm, and disposed in bundles parallel to each other, transversely surrounding the canal of the vessel. They are never interlaced or connected by cellular tissue, but are easily separable from each other.

This tunic differs both from muscular and ligamentous tissue; but in some respects it resembles the former, and seems to possess an intermediate structure between it and ligamentous or fibrous tissue.

The middle coat of arteries is exceedingly elastic, particularly in the longitudinal direction of its fibres. When thus elongated, and then suddenly left to itself, it quickly and forcibly contracts. This coat is less tough, and more easily torn, than the external coat. It is the thickness, firmness, and elasticity of this coat, which enable arteries to retain their circular form when empty.

In the larger arteries, the external coat is thicker, in proportion, than in the smaller branches and capillaries; while in the latter, the middle coat is thickest.

The parietes of arteries are supplied by *vasa vasorum*, but these cannot be distinctly traced into the substance of the inner coat. Arteries are also furnished with nerves from the spinal cord and great sympathetic nerve. They also possess exhalent and absorbent vessels.

As the elasticity of arteries depends much on moisture, their coats are copiously supplied with this, but the source of it has not yet been satisfactorily explained; unless it is absorbed from the blood which they contain.

Arteries are furnished with a cellular sheath, consisting chiefly of the common cellular tissue of the part where the artery is situated; and this allows more or less motion of the vessel within it, according to its quantity and density. In some parts it is loose and abundant, permitting free motion and easy sliding of the artery within

it; so that when the vessel is divided, the extremities retire into the sheath, from their longitudinal contraction. In other parts, this cellular sheath is more scanty and unyielding, or is altogether wanting, as in the arteries connected with serous membranes; in which cases, very little motion or retraction is permitted. This is a circumstance regarding the anatomy of arteries, which is very important in a pathological and practical view.

III. Functions.—Arteries are most remarkable for the firmness, tenacity, and elasticity of their structure. Their parietes preserve a circular form though empty of blood; and their thickness is also rather increased. The power of arteries in resisting force applied longitudinally, depends on the external coat; their transverse resistence is chiefly owing to the middle coat; while the internal tunic adds very little to the strength of the vessel.

The elasticity of arteries forms a most important property in the animal economy. Arteries yield and elongate when force is applied to them, either transversely (as in distension), or longitudinally (as when stretched), and they quickly contract when this ceases. When the force is applied transversely they yield less, but return with more force than when it is applied longitudinally.

In the living body, the arteries are in a constant state of elastic tension; so when they are divided, the cut or torn extremities retract. These properties are greatest and most distinct in the larger trunks, and less so as the arteries diminish in size.

No parts of the body are capable of greater change than the arteries. They are susceptible of gradual enlargement and diminution; so when a principal artery ceases to give passage to the blood, the collateral arteries enlarge and supply the means of conveying this fluid, which otherwise would have been withheld; while the superseded vessel becomes obliterated, shrivels, and may at last gradually disappear. Arteries also enlarge quickly, and exhibit much activity of function, for the reparation of injured parts; but their powers of reparation, when they themselves are injured, are often frustrated by being unable to overcome certain obstacles attending the process. New arteries are also quickly formed when occasion requires.

These circumstances, together with the anastomoses of arteries, have been of the utmost importance in suggesting the scientific treatment of injured and diseased arteries; and so imparting confidence to the surgeon on the one hand, and saving the lives and limbs of patients on the other.

The irritability or vital contractility of arteries has been the subject of much physiological discussion, into the details of which it is unnecessary here to enter. From direct experimental observation,—from the functions of the arteries, and from the phenomena they exhibit in disease, it seems quite reasonable to attribute this property to arteries. It is least distinct, however, in the larger, but more obvious in the smaller of these vessels.

While arteries, therefore, possess elasticity and irritability (or vital contractility), the former predominates in the large, the latter in the small arteries. When we con-

sider that the power of the heart's action, in propelling the blood, is greatest in the larger arteries, the relative proportion of these two properties possessed respectively by the larger and smaller arteries, is well adapted to the accomplishment of the circulation.

As age advances, the nourishment of the arteries diminishes, the middle coat becomes more dense, irritability lessens, and elasticity is greatly impaired.

The sensibility of arteries is very obscure and not well established; but several facts, as well as the abundant supply of nerves to these vessels, tend to confirm the opinion that they are possessed of this property.

When the circulation of the blood continues, the arteries dilate during the systole of the ventricles of the heart, in consequence of the impulsion of blood into them. The effect of this upon the arteries, already full of blood, is, by giving occasion to their contraction, to increase the velocity of the circulating fluid. The arterial tubes are also slightly elongated, and they assist in propelling the blood by their elastic resilience (which contracts and shortens them), together with their vital contractility; all which have the effect of diminishing their capacity. The velocity of the bood diminishes as the arterial trunks subdivide towards their ultimate twigs.

The coagulation of the blood in the vessels is prevented by a vital principle in itself,—by constant vital chemical changes going on,—its contact with living parts, and the continued motion imparted to it by the heart and arteries. Here it may be noticed that the blood, according to the observation of Physiologists, requires from 3 to 7 minutes for its coagulation when withdrawn from the body. When the action of the air is excluded, it requires a longer time.*

The action of the heart being the chief power which circulates the blood, is the cause of the jerks or pulsation of arteries. This is greatest near the heart, and diminishes as we recede from it. The number of pulsations, therefore, depends solely upon the contractions of the heart. The volume or fulness of the pulse depends on the quantity of blood in the arteries; its duration, upon that of the heart's contraction; its strength, upon the quantity of blood impelled by the heart; its force, upon the quantity contained in the arteries, and that which passes through the capillary vessels. Hence the pulse indicates the state of the circulation of the blood, from which we infer the state of its moving powers, the heart and vessels.

* This table shews the changes which take place in the blood when it coagulates;

Chemical Components.

Living Blood.	*Liquor Sanguinis.*	Water. Various Salts. Fatty Matters. Extractive Do. Albumen.	*Serum.*	Coagulated Blood.
		Fibrin.	*Crassamentum.*	
	Red Corpuscules.			

The heart, however, is not the sole cause of the circulation of the blood; for, though its contractions are interrupted, the flow in the smaller and capillary vessels is continuous. Hence, the blood, which is thrown into the larger arteries in jets, has at first an intermittent progress which gradually becomes remittent, and lastly uniform. The action of the arteries, therefore, keeps up the circulation of the blood during the diastole of the heart. This is to be attributed rather to the elastic resistance of the coats of the arteries, than to muscular contraction, which might tend to obstruct the motion of the blood.

In conclusion, it deserves particular attention, 1*st*, That the arteries are constantly subject to be influenced by the force of the heart's action in propelling the blood into them. 2*d*, That the arteries have, in themselves, a vital power or action independent of the heart. This is proved by several circumstances, viz., the propelling power of the artery in forcing forward the blood when the power of the heart is interrupted, the increased local action of arteries, by stimuli, in particular organs, and the action of arteries being capable both of increase and diminution in particular parts of the body, as in local inflammations, and in erectile tissues; in all which cases these phenomena appear to be independent of the heart.

By the elastic tension of arteries they are kept on the stretch and in the most favourable state for receiving the blood from the heart, and allowing its passage through them. The propulsion of the blood into the arteries by the impulse of the heart, distends them, and is responded to by their forcible contraction (from their irritability) which forces forward the blood towards their minuter ramifications. But as this contraction is excited and performed chiefly by the mechanical distension and elastic tension of the arteries, when these two causes are destroyed (as by the division of an artery, which allows the blood to escape), the vessel becomes as if paralyzed and unable to perform its functions. The circular contraction of the vessel takes place, but its dilatation by distension is prevented, while the longitudinal contraction is favoured, and takes place in a strong and forcible manner. Like any of the long muscles of the body, or the elastic string of a musical instrument, the arteries perform their peculiar functions when on the stretch; but when divided, they contract, and their former actions cease. Hence the flow of blood at the part ceases; it stagnates, and becomes coagulated, which are the phenomena forming the first steps of the process of the permanent closing of the wound.

Injury to the nervous filaments, derived from the spinal cord and great sympathetic nerve, which are distributed upon the coats of arteries, must also have an important effect in destroying the functions of these vessels.

Within the arteries, also, the BLOOD is not only formed and vitalized, but is again transformed into other compounds to be assimilated into the several tissues of the body. While the blood is thus formed, conveyed, and metamorphosed in the arteries, it cannot be supposed that they are passive tubes, merely conducting the blood to the various parts of the body, whilst it spontaneously undergoes its various changes. On

the contrary, we have evidence of the arteries performing most important functions, without which the blood loses its vitality, and quickly undergoes putrefactive decomposition.

The various chemical transformations of the blood into tissues, secretions, and excretions,—its vitality,—its temperature,—its fluidity,—and its motion in the living body, are all so dependent on, or so intimately connected with, the functions of the arteries, that they cannot take place apart from them. These depend on the vitality, tension, elasticity, and irritability, endosmosis, and exosmosis, of the coats of the arteries, though they may also arise partly from the attractions and repulsions which take place between the particles of the blood,—between the blood and the arterial tunics, —and between the different constituents of the blood within, and the tissues without, the arteries.

The constancy and importance of these vital changes may be conceived from the fact, that they necessarily occur at every beat of the heart,—every passing thought of the mind,—and every movement of any part of the body. In short, while life continues, there is a constant waste and renewal of the component parts of the body; which changes are effected by the arteries and the blood contained in them, which act and react on each other.

SECTION SECOND.

ON INJURIES OF ARTERIES.

Introductory Remarks.

Wounds and other injuries which perforate or divide the parietes of the larger arteries, have, since the earliest times, been regarded with the most lively interest by surgeons; and they have likewise excited the (not unfounded) fearful apprehension and alarm of patients. It is scarcely necessary to add, that the strong and rapid flow of blood, directly from the heart, which immediately takes place from a wounded artery, gives occasion to the interest which this subject creates, being often followed by fatal consequences. Other effects of such injuries may prove equally serious to the patient, by causing aneurism or gangrene. Hence the attention which has been directed to this subject,—an attention which has been crowned with the most signal triumphs of which modern science can boast. This success has been attained by well-directed experimental inquiry and judicious observation. Thus has accurate and extensive anatomical, physiological, and pathological knowledge of this subject been acquired; and it has been applied so as to shed a clear light upon that which was previously in obscurity, by which the surgeon has been enabled to employ the resources of his art with perfect confidence and success, not only in this, but in many other important branches of his profession. Indeed, to the advancement of our knowledge of this subject, is modern surgery chiefly indebted for its improvement and present state of perfection.

The results above alluded to, have redounded much to the greatness of those eminent men by whom they have been accomplished. And to the honour of Britain be it said, that our chief

and most valuable knowledge of this subject has here been conceived, fostered, and perfected; to the consummation of which the comprehensive knowledge and profound sagacity of our immortal HUNTER added the most important contribution, by devising and establishing the superior safety and expediency of interrupting the circulation of injured and diseased arterial trunks at a considerable distance above the seat of the lesion. Not that labourers in this field have been wanting in other countries, for these can boast of the important labours of Haller, Scarpa, Teidemann, and other eminent men; but while British surgery can proudly point to the original researches of John Hunter, of Jones, Cooper, and Travers, she only claims for her sons the justly merited honour of having been foremost, to elucidate, improve, and perfect this branch of the healing art. In ascribing what is due to those who have so ably contributed to the knowledge of this subject, from which accurate theoretical principles have been deduced, the important information which has been acquired by the experience of distinguished practical surgeons, in this and other countries, must not be overlooked. By their eminent talents and dexterity, Scarpa, Dupuytren, Mott, Bell, Cooper, and Liston, have not only greatly improved the mode of operating on arteries, but have shewn the success which may be obtained in cases previously considered hopeless and incurable; and so have led the way to the adoption of these operations by many followers.

Classification of Injuries of Arteries.

Injuries of arteries may be very different in their nature; and the consequences which follow, depend on the nature of the injury and other circumstances which may attend the case; but, under similar circumstances, the effects of these injuries are very uniform.

One of the larger arteries may be wounded in the form of a puncture; or it may be divided, either partially or completely, by an incision or laceration. The phenomena, which follow these different kinds of injury, are very different. No considerable bleeding may occur from the injury; in other cases, profuse hemorrhage may take place; while fibrinous exudation and obliteration of the artery, aneurism, or gangrene, may become the result. In some cases, several of these consequences take place in succession. But in order to study these injuries, together with the phenomena and the effects which follow, in a regular and systematic manner, the injuries of arteries may be arranged as follows:

Class First,—PUNCTURES of Arteries.

a, Longitudinal.
b, Transverse.
c, Circular.

Class Second,—INCISIONS of Arteries.

a, Producing complete division.
b, — partial division.

Class Third.—LACERATIONS of Arteries.

a, Producing complete division.
b, — partial division by lateral opening.
c, — do. by tearing of inner coats.

On each of these different injuries of arteries I shall make a few remarks, briefly to describe and illustrate the phenomena and effects which follow them. I shall then treat shortly of the resources of nature and of surgery for the cure of hemorrhage and wounded arteries.

Class First.—Of punctured Wounds of Arteries.

Wounds of the larger arteries in the form of puncture are of frequent occurrence. They may be occasioned by a great variety of different means; but they may all be arranged into three subdivisions.

a. Longitudinal punctures, as by a lancet in bleeding from the temporal or radial arteries, or as an accident in venesection. Punctures of this kind do not bleed with great violence; for the vessel being always on the stretch, by its elastic tension, tends to keep the lips of the wound approximated. The hemorrhage may also be stayed by the thickness of the superjacent parts, and the smallness of the external wound. It may also be controlled by compression. When wounds of this kind are not large, they may heal with or without the obliteration of the canal of the vessel. When of more considerable size, they generally terminate in the tumour called an aneurism.

b. Transverse punctures of arteries may happen in the same manner as the longitudinal punctures; but the chief circumstance which tends to lessen or stop hemorrhage from the latter, viz. the vessel being on the stretch, causes the former to bleed freely, by making the transverse wound gape, so that it is with difficulty stayed, even temporarily.

In cases of this kind, the complete division of the vessel (when it is not large, and where favourably situated for the extremities receding), or the application of a ligature, are generally required to stop the bleeding.

c. Circular punctures of arteries happen occasionally from wounds caused by sharp-pointed instruments, such as needles, forks, spicula of fractured bones, small shot, and the like. The bleeding from them may not be very considerable, owing to the thickness of the surrounding soft parts, and the smallness of the wound in them; but such wounds are very likely to terminate in aneurism. Under less favourable circumstances they occasionally prove fatal.

In two cases, fatal hemorrhage took place into the œsophagus, in consequence of the carotid artery having been punctured; in the one case, by a small fish-bone,* and in the other, by a needle,† having been swallowed.

Class II.—*Incised Wounds of Arteries.*

Incised wounds of arteries differ from punctures, not only in the mode of their infliction, but also in the size both of the more external wound of the soft parts, and that of the coats of the vessel. Wounds of this nature may consist in the complete or partial division of the artery; and each of these, may be either oblique or transverse.

a. The *complete division* of an arterial trunk by incision, is a very common occurrence, both from accident and in the performance of surgical operations.

When an artery of considerable, but not of very large, size is completely cut across, along with its surrounding soft parts, as in the amputation of an extremity, it bleeds very freely at first. In a short time, this gradually lessens till it ceases, by the contraction of the orifice of the vessel, and its receding into the surrounding soft parts. The contraction of the surrounding divided muscles, to the extent of several inches, also shews how much the cut artery has become shortened; for it recedes or contracts even more than the muscles.

If the artery which has been cut across is one of the larger trunks, the hemorrhage may be so profuse as to prove fatal, from the force and magnitude of the stream, before a sufficient contraction of the vessel has taken place to moderate and stay the current. The bleeding from large arteries requires the immediate application of pressure and a ligature to arrest it. Whether the extremity of the divided artery be surrounded by a ligature or is left untied,

* Edinburgh Medical and Surgical Journal, vol. xlviii., p. 93.

† Medical Gazette, Feb. 1843, p. 694.

it is soon occupied by a clot or portion of coagulated blood. Of this clot, the fibrin remains, while the other parts are absorbed. This is followed by an exudation or effusion of organizable lymph or fibrin, both into the tissues surrounding the extremity of the artery, into its coats, and into the canal of the vessel itself, occupying the situation of the coagulum of blood which it displaces. By this process, and the lymph becoming organized, the complete obliteration of the extremity of the divided artery is, in a short time, accomplished. See Pl. X., Figs. 2, 3, 4, and 5. The division of smaller arteries is followed by the same phenomena.

But when the coats of the divided artery are prevented from contracting, either by a diseased state of the vessel (by which it may be thickened or ossified), or its being surrounded by a dense tissue (as the dura mater or pleura, a morbid growth, solid infiltration, or bone,) the hemorrhage may not cease by the natural process above described. The bleeding may therefore continue when there is an external wound, which allows the blood to escape, —it may accumulate in a cavity, or an aneurism may be the consequence if it is retained.

If an incision divides an artery obliquely, so that its coats are sliced in a diagonal manner to a considerable extent, the natural process to stop or allay the bleeding is much retarded or completely prevented. The less favourable circumstances, of vessels so divided, for the suppression of hemorrhage, is daily seen in the oblique incisions made in flap amputations. In cases of amputation of the thigh by the circular incision (and consequently transverse division of the arteries), only three or four bleeding arteries require to be secured by ligature; while by the double flap amputation and oblique division of the arteries, generally 7 or 8, and sometimes 15, 16, or even 17 vessels require to be tied.

b. The *partial division* of an artery by incision, is that form of wound from which the hemorrhage is greatest, owing to the natural contraction of the vessel being prevented. See Pl. IX., Fig. 1. In consequence of the division of the vessel being incomplete, it is kept on the stretch while the orifice is gaping open.

Hence the hemorrhage which takes place in such cases from a large artery, is impetuous and dangerous, proving sometimes immediately fatal, before assistance can be obtained to arrest it. The complete division of the vessel, compression or ligature, may be necessary to stop the bleeding.

Class III.—*Lacerated Wounds of Arteries.*

Wounds or injuries of arteries by the laceration or tearing asunder of their coats, by which the vessel may be partially or completely divided, are very common. They occur in lacerated wounds of the extremities by machinery, the explosion of fire-arms, or by the over-stretching of the limbs in excessive muscular exertions and other accidents.

Injuries of this kind are attended with several interesting peculiarities which I shall now describe in detail.

a. Complete division of arteries from laceration, may have been occasioned either from a wound by an obtuse solid body, or by the vessel being over-stretched. In cases of such injuries, the divided extremities of the vessel very rarely bleed. From the different structure and powers of resistance possessed by the coats of the artery, they give way at different periods or stages of the injury. Owing to this circumstance, and the different degrees of contractile power possessed by these tunics, the structure of the torn extremity of the artery is very peculiar, and resists the flowing out of the blood in a very remarkable manner. When an artery is put on the stretch longitudinally, to a greater degree than it is able to withstand, its coats give way; *first*, by the rupture of the inner and middle coats, which generally give way together as if they consisted only of one coat; and, *secondly*, by that of the external coat. Before the external coat and the cellular tissue around it give way, they admit of considerably greater elongation than the other two coats. Hence, the external coat is drawn out to a point over the ruptured extremity of the coats within it, and gives way

at a short distance from their extremity. See Pl. IX., Figs. 3, 4, 5, and 6. By this natural binding up of the orifice of the vessel (by the external coat), and its own contractility, hemorrhage is completely prevented; so that in many cases of very serious accidents (such as the arm or leg being torn off), no danger has arisen from this cause.

On dissection, soon after such an accident, the extremity of the artery is found to contain a coagulum of blood within the inner coat; and another clot distinct from this, situated within the portion of the external coat which projects beyond the internal and middle coats. See Pl. IX, Figs. 5 and 6. These two coats also appear to be contracted, thickened, and corrugated.

Two other changes may, in such cases, also be observed. These are the contraction of the vessel, by which it becomes very considerably shortened, as well as lessened in breadth. The tortuous form which the artery assumes, and the greater length of the entire or divided soft parts around it, are very remarkable proofs of its contraction. See Pl. IX., Figs. 2, 3, and 4. The other circumstance to which I allude, is the extravasation of blood into the cellular tissue around the extremity of the vessel, which soon becomes coagulated. See Pl. IX., Fig. 3.

The extent to which the coagulum of blood is found to fill the canal of the vessel, depends on the distance from its extremity of any considerable branch given off by the artery. If this should be near to the extremity, the coagulum is small in proportion.

These are the phenomena observed immediately after the injury, but, in a short time, other important changes take place for reparation; these consist of effusion and organisation of fibrinous lymph, and ultimate obliteration of the divided orifice of the vessel. See Pl. IX., Figs. 2, 6, and 9. The lymph which occupies the extremity of the vessel, like the previous clot of blood, varies in size according to the distance of the first large branch given off from the artery above the orifice. It may not be above an eighth of an inch, or it may be several inches. An effusion of lymph to a considerable

extent also takes place into the cellular tissue around the extremity of the vessel, which tends to consolidate its extremity. See Pl. X., Figs. 2, 6, and 7.

The elongated portion of the external coat of the artery, which is situated beyond the extremities of the other coats, as above described, is apt to have its vitality destroyed by being over-stretched; so that, in a few days, it sloughs off from the extremity of the vessel where the other coats remain united. See Pl. IX., Figs. 2 and 9.

In addition to the above changes which take place upon the division of large arteries by laceration, the collateral and anastomosing vessels become enlarged in a remarkable manner, for the purpose of carrying on the circulation, in lieu of the main trunk, which has been obliterated.

When a portion of the body becomes mortified and separates from the living parts, or when an artery is surrounded by a ligature, nearly the same process of nature by which a lacerated artery becomes obliterated takes place. See Pl. X. Figs. 6 and 7.

In some cases where a large artery is torn across, either by over-stretching the vessel or by a fractured bone, without any external wound of the soft parts, the divided extremities may not be allowed to recede; blood is therefore poured out into the neighbouring soft parts, and an aneurism is formed. See Pl. X., Fig. 1.

When a large artery has been divided by a lacerated wound, hemorrhage may continue from several causes; 1. The contraction of the vessel being prevented; 2. Its oblique division; 3. One or more perforations in it above the division; 4. A large branch coming off near the divided extremity.

b. The *partial division* of an artery by laceration, causing a lateral opening, may occur from injuries by machinery, by small shot, and the like. In such injuries the hemorrhage usually continues till the vessel is secured by means of a ligature.

c. A peculiar modification of this partial division of an artery

consists in the laceration of its two inner coats, while the external coat remains entire. See Pl. IX., Fig. 8. This injury is the most common cause of aneurism from over exertion.

SECTION THIRD.

ON THE PROCESS OF NATURE BY WHICH HEMORRHAGE IS STAYED OR PREVENTED, AND BY WHICH THE PERMANENT CLOSING OF WOUNDED ARTERIES IS ACCOMPLISHED.

The descriptions which have been given of the structure and functions of arteries, as also of the phenomena which occur when these important vessels are injured, lead us to a few remarks on those beautiful processes of Nature which take place, in order to repair the lesions of important parts, and to compensate for the loss of organs whose functions are essential to vitality. These processes commence and proceed so uniformly (when under similar circumstances), that we ascribe them to an inherent disposition in the parts injured to assume them.

The natural processes for suppressing hemorrhage from wounded arteries are *Primary* and *Temporary*—*Secondary* and *Permanent*.

1. *Of the Primary or Temporary suppression of Hemorrhage from wounded Arteries.*

We have seen that the effusion of blood which takes place from wounded arteries is, in many cases, either prevented, or ceases spontaneously. Let us now enquire how this is accomplished.

It may here be noticed that the prevailing and favourite theory on this subject is, that hemorrhage is stopped by the coagulation of the blood at the wounded extremity of the artery,—the coagulated portion of blood acting as a plug which prevents the further escape of this fluid.

That a coagulum of blood forms in the extremity of the wounded artery, there can be no doubt. But how can the blood coagulate so long as its vitality continues, and so long as its motion is maintained by the action of the living artery which contains it? This appears to be impossible; for the normal action of the artery upon the blood has the effect of producing chemical changes and motion, by which its vitality and fluidity are preserved. We have also seen that the blood must be at rest (as one necessary condition) for a period of at least three minutes, to admit of its coagulation (see p. 46). But if the motion of the blood, and consequently the hemorrhage, stops for several minutes before the coagulum forms, this clot cannot be said to arrest the effusion of blood. Besides, this portion of coagulated blood never fills the extremity of the vessel completely, and it is often not only very soft but small; for its length depends on the distance of the cut extremity of the vessel from the origin of lateral branches given off from it; so that the force of the circulation could be opposed by the clot very slightly and imperfectly. Indeed, in the larger arterial branches, where the motion of the blood is much influenced by the action of the heart, or where a large branch is given off close to the cut extremity, such a clot is not allowed to form. Nevertheless, the hemorrhage stops; and, in many cases, the artery contracts so completely, that no space is left for the lodgement of a coagulum. Hence, we must infer that the normal action of the divided artery ceases, and that it assumes a new action, by the influence of which opposite effects are produced; in place, therefore, of motion and life, we have stagnation and coagulation.* In short, while the arteries, in their normal state, are endowed with power to prevent the coagulation of the blood, and maintain its motion,—in their injured state, a remedial action is assumed; they acquire a capability of arresting its motion,

* This view is confirmed by the examination of the divided web of the frog's foot by the microscope. The circulation at the cut extremities of the vessels is immediately arrested. The blood stagnates; there is no hemorrhage. When a limb is amputated, of hundreds of arteries, of various sizes, which are divided, only 3 or 4 of the largest require to be secured by ligature; the bleeding then ceases. It is, therefore, not in capillaries only, that hemorrhage is arrested, but also in larger arterial branches.

and, their other functions being interrupted, the blood is allowed to coagulate.

It may be answered to what has now been said, that where hemorrhage obstinately continues, no coagulum is found in the divided vessels. But this may be explained by the existence of other circumstances which occur in such cases. 1. These are cases of disease called the *hemorrhagic diathesis*, consequently they are exceptions to the general phenomena observed. 2. Both the arteries and the blood manifest a morbid condition, chiefly consisting of a deficiency of fibrin. 3. The arteries being unable to arrest the flow of blood at their divided extremities (from their morbid condition), its continued motion prevents coagulation.

The supposition that a coagulum, capable of arresting the flow of blood from a wounded artery, could form so instantaneously as to produce this effect, would be completely at variance with all our knowledge regarding the properties of the blood. If it did possess such a capability, hemorrhage from large arteries would be arrested as readily as it is in the smaller branches, which we know does not take place; and obstructions to the circulation in the vessels from this instantaneous coagulation of the blood, would probably be a very common and fatal occurrence (as in cases of Syncope), if the vessels and the blood itself had not a vital power inherent in them to prevent it; so that it is only when this power is interrupted or arrested, that coagulation can take place.

The theory of the natural stoppage of hemorrhage, which has been indicated by the above remarks, may be more distinctly and forcibly proved by the statement of a few further observations. Let us recall to recollection, then,

First, The power of the heart in propelling the blood is so great in the larger or main arterial trunks, that, when they are cut across, they bleed with such impetuosity as to cause immediate syncope and death, before time is allowed for the salutary efforts of nature. But the stream of blood from smaller arteries, when divided, gradually diminishes till it ceases altogether; while from divided capillaries scarcely any blood flows. The power of the di-

vided capillaries to carry forward the blood seems to be arrested by a power inherent in them in their healthy state. The smaller arteries are endowed with an exquisite sensibility of a kind proper to themselves. Whenever any part of the body is injured, or any main trunk is interrupted, a most extraordinary activity, to effect a reparation, is observed to take place in the arteries around the part. They seem ever ready to act when called upon; and when they are divided, their first action is to retain the blood by preventing its escape. This is accomplished by those inherent, vital, and indispensable properties, in the vessel, being called forth by the impressions or causes with which the vessels are designed to be affected, and which overcome the force of the action of the heart. It may be remarked further, that the primary stopping of hemorrhage must mainly depend on the vital contraction of the vessel; for, when this is prevented (as by the force of the heart's action, or when the vessel is surrounded by a dense tissue) the flow of blood continues.

Secondly, The power of a divided artery to carry forward, and so permit the escape of, the blood contained in it, may have been prevented by several circumstances which are quite independent of its coagulation. These are, the contraction of the vessel, —the pressure upon it caused by the contraction of the surrounding parts, or by the effusion of blood into them,—the rupture and contraction of the inner coats of the artery,—the mechanical closure of the extremity of the artery by the outer coat being drawn over it,—and, lastly, by the syncope caused by the shock occasioned by an injury, or loss of blood. (See previous sections.)

These circumstances operate in stopping hemorrhage independently of the formation of a clot in the extremity of the vessel; but their effect is to allow this to take place, by the blood remaining at rest for a sufficient time for its coagulation, the divided extremity of the artery being apparently unable to maintain the vitality and motion of the blood.

3*dly*, The blood does not coagulate in the end of the cut vessel by rest alone; for if it did, syncope would be followed by an ex-

tensive coagulation of this fluid. The blood must have lost that vitality which can only be imparted to it and maintained by the arteries,—a vitality which preserves its fluidity, and contributes to its motion. But deprive it of this vitality by the injury of an artery, or by its escape from the vessel (even into another part of the body), and it immediately coagulates; except in some special cases of sudden death or disease, in which the vitality of the blood may be destroyed, though its chemical composition may not be so altered as to admit of its coagulation. The chemical constitution of the blood may be retained, for a time, when it has lost its vitality;* but its vitality cannot exist after its chemical constitution is so far changed as it is by coagulation. But under certain circumstances, when blood coagulates in an artery, or is effused into the living tissues, the fibrin separated from it may become organized, by being assimilated into, or vitalized by, the neighbouring parts. Hence the fibrin of coagulated blood has, by HUNTER and others, been erroneously supposed to retain its vitality.

The coagulation of the blood has been considered by HUNTER and his followers to be a vital process,—the last act of its vitality. But the fact that, in the coagulation of the blood, the chemical constitution (upon which its existence depends) is changed, and that this is the first stage of its further decomposition, sufficiently confutes this supposition. No doubt some chemical changes of the blood are living (and only living) processes; but these are quite unlike the complete separation of the fibrin, and its coagulation, from the other constituents of the blood.

The coagulation of the blood, however, does not prevent the transformation of some of its parts into living tissues, when it is in contact with them.

The influence (in whatever it may consist) of the inner coat of the artery, must have a very important effect in maintaining the chemical integrity and vitality of the blood. Consequently, when

* This merely consists in the liquor sanguinis retaining the fibrin in solution. See p. 46. In cases of sudden death by lightning or by suffocation, where this takes place, the blood coagulates on being exposed to the air.

this function of the inner coat is deranged and destroyed, by injury of the artery or by disease, the blood stagnates at the part, and becomes coagulated. In larger arteries, however, the power of the heart may compensate for the want of the normal influence of the artery, and keep up the motion of the blood which flows into the more distant smaller arteries, where vital influences are continued to it. In this way the blood may pass along, by the force of the heart, through a diseased or injured artery, or escape from a divided artery, without being affected by the influences above alluded to, by which its motion and vitality are impaired or destroyed. Hence apparent discrepancies in the phenomena and the theory advanced are reconciled. But in regard to small arteries and capillaries, not much under the influence of the heart's action, the altered function of the artery, (more especially of its inner coat and epithelium,) must have the effect of stopping hemorrhage in the manner above described. I have said deranged or altered function; for, while the normal action of the vessel was to circulate the blood, the altered action seems to consist of a power or influence (into which the former is changed) to retain this fluid, and to produce other effects which may be called a REMEDIAL ACTION of the arteries.

Contraction of divided arteries, which is a chief cause of the stoppage of hemorrhage (whether spontaneous or induced by external stimulus), has this effect, not alone by the opposing resistance thus offered to the force of the blood, but by assisting the vital property inherent in the arteries to arrest its flow by altered function, and to bring about the coagulation of a portion of it as an effect which follows. This contraction of the arteries may be promoted by the application of stimulants, by syncope, or diminished power of the heart; or it may be retarded or prevented by the action of the heart, by relaxation of the vessels, their fixed situation in unyielding parts, or a morbid state of their coats.

In conclusion, the power of the arteries, when divided, to suppress hemorrhage, may shortly be said to consist of their influence

to produce three distinct phenomena,—*first*, to arrest the motion of the blood; *second*, to promote its coagulation; *third*, to pour out and organize fibrin. But this last belongs more properly to the secondary means or permanent causes by which hemorrhage is suppressed, as shall be afterwards shewn.

If we believe that the blood owes the preservation of its chemical constitution, vitality, fluidity, and motion, to the normal influence of the arteries, we must infer, when we find it coagulated in these vessels, that this influence has been withheld from it for some length of time previously; and consequently, that an alteration in the action of the artery arrested the flow of blood, and that its coagulation was only a subsequent effect or consequence of this stagnation.

The theory regarding the natural stoppage of hemorrhage, now advanced and so much dwelt upon, differs materially from those of POUTEAU, PETIT, and MORAND, with their further elucidation by JONES, TRAVERS, and others, by whom the phenomena have been very accurately described; but I find it to be that suggested by Sir CHARLES BELL in a Commentary on his brother's lectures, and in his essays "On the Powers circulating the Blood," published shortly before his death. My theory having been adopted, before I was acquainted with the opinion of Sir CHARLES BELL, may be considered, in some degree, to be a confirmation of its truth,—both having been led to arrive at nearly the same conclusion.

2. *Of the Secondary and Permanent suppression of Hemorrhage from wounded Arteries.*

The permanent suppression of hemorrhage from wounded arteries is effected in the manner already described at pages 53 and 54, by the organization of fibrin separated from the blood, in the process of reparation which takes place at the injured part.

3. *Of the suppression of Hemorrhage by Art.*

In order to suppress a flow of blood, either from large or smaller arteries, which might prove dangerous, the art of the surgeon can give essential aid. The means employed by the surgeon for this purpose are various, and require to be used with discrimination according to the nature of the case. They consist in Compression, Ligature, Astringents, Escharotics, and general Constitutional Treatment. On each of these, therefore, I shall make a few remarks.

a, *Compression*, whether applied to the bleeding orifice of a wounded artery, or to the trunk of the vessel nearer the heart, is the most immediate and simplest mode of stopping hemorrhage. Temporary compression with the hand or tourniquet is necessary to arrest any considerable arterial hemorrhage, until some of the more permanent means are applied.

When the bleeding is from one or several small arteries, but more especially if they are numerous, compression, when it can be conveniently applied by means of a compress and bandage, may be sufficient to suppress the hemorrhage, until the permanent obliteration of the vessels is effected, by the natural process. This mode is most advisable when the bleeding vessel can be pressed against a bone, such as the temporal artery. When the bleeding vessel or vessels are situated in a cavity, or are surrounded by bone, compression is employed by stuffing the cavity with lint or sponge.

b, *Ligatures*, applied around wounded arteries to effect their permanent obliteration, form the most complete and important means of suppressing hemorrhage. In this remedy, nature and art combine to accomplish the desired object, and enable the surgeon to secure the lives of those against fatal hemorrhage, in whom arteries have been wounded, either by accident or by surgical operation.

Hemorrhage may be suppressed either by the obstruction of

the artery at the seat of the wound, or at some distance above it. The ligature should be applied at the part in recent wounds of arteries of considerable magnitude; and, generally, both extremities of a large artery require to be so secured, on account of the blood getting to the lower extremity of the artery by the anastomosing branches. But if the bleeding is from a great many small arteries forming a bleeding surface, especially if at some distance of time from the receipt of the injury, the obstruction of the main trunk leading to the part, by the circumposition of a ligature, requires to be resorted to. In such cases only one ligature should be employed, and the artery should not be disturbed from its connection.

When an artery is surrounded by a ligature, and this tied with a firm knot, the first effect of it is to cause the division, or destroy the vitality, of the inner and middle coats. An effusion of fibrin then takes place, forming the process already described, while the complete division of the artery and separation of the ligature take place,—a process which generally requires from 5 to 16 days for its accomplishment. See Plate X. figs. 2, 3, 4, 5, 7, and 8. Another effect of the obstruction of an artery of considerable size, is to cause the enlargement of the collateral anastomosing branches, by having a greater current of blood directed to them, in order to convey a sufficient supply to the parts beneath.

The application of ligatures to the mouths of bleeding arteries may be effected in several different ways, by the assistance of forceps, tenaculum, needle, or pin and thread twisted over it. These different modes being severally most suitable under the particular circumstances of individual cases. Thus, when the bleeding extremity of the artery projects from a wound, or, being imbedded, can be drawn out to the surface, the forceps are most appropriate; for securing small arteries, which can only be done by including some of the surrounding soft parts, either the tooth-pointed forceps or tenaculum answer best; while to surround an artery imbedded in firm unyielding parts, the common needle and thread are necessary; and if the hemorrhage be from a number of small vessels

of or near the skin, the introduction of a pin through the latter, and twisting the ligature around it, is most effectual.

The ligatures most commonly used, and perhaps the best, consist of silk-thread, rubbed over with bees' wax. They should be of three different sizes, which are to be employed according to the size of the vessel to be tied. One yard of the thickest silk should weigh two grains, the next size $1\frac{1}{2}$ grain, and smallest 1 grain.

c. Astringents and Escharotics were long the only auxiliaries of the surgeon in stopping hemorrhage, but they are now little used, except in special cases where the preferable modes by compression and ligature are inadmissible.

The astringents commonly used for this purpose are solutions containing Tannin, Sulphate of Alumina—of Zinc, or Copper ;—The Escharotics ;—The actual Cautery, Nitrate of Silver,—and Solid Sulphate of Copper. These last form an eschar, which stays the bleeding till the processes of separation effect this more completely and permanently, and the slough is then separated.

d, General Constitutional Treatment in cases of hemorrhage from wounds or other lesions is of the utmost importance. This consists chiefly in diminishing the powers by which the blood is moved, which is most effectually accomplished by lessening the quantity of the circulating fluid. The abstraction of blood, therefore, and repose of mind and body, together with a strict antiphlogistic regimen, are to be enjoined.

Explanation of Plate IX.

Fig. 1. represents the femoral artery, *a b*, of a man who received a wound in the upper part of the thigh with a sharp-pointed knife. The artery is very nearly divided across at *d*, a little above the origin of the *profunda femoris*, *c*. The profuse hemorrhage which instantly followed proved almost immediately fatal. The very extensive extravasation of blood into the cellular tissue around the artery (part of which is here represented in the form of coagula) had no effect in arresting the hemorrhage. This was a medico-legal case, which is detailed in my Treatise on Homicide, p. 107.

Fig. 2. Popliteal artery of a woman which was torn across, along with a compound dislocation of the knee-joint, but in which no hemorrhage took place; from a preparation in the Museum of the R. C. S., No. 1213, presented by Sir George Ballingall. The torn extremities of the artery *a b* and *c d* have receded about 2 inches from each other. The patient died of gangrenous inflammation 10 days after the injury. The portions of the external coat of the artery, which had been drawn over the torn extremities of the other coats, seem to have sloughed away. More than half an inch of the artery at each of these extremities was contracted, empty, and almost obliterated. Nearly an inch of the artery beyond each of these parts is filled by a mass of fibrin *f* and *g*.

Fig. 3. Upper portion of the posterior tibial artery of a lad of 18, whose leg was nearly completely torn across by the rope of a canal boat, with which it got entangled. No hemorrhage took place, although the peroneal artery was also torn. The artery *a b* is here represented with a portion of the adjoining soft parts infiltrated with blood. This part of the artery was shrunk more than half an inch, as is seen by the space from *b* to *c*. The contraction of the artery has made it assume a tortuous form. Fig. 5. exhibits the extremity of this artery cut open. In this case I performed primary amputation.

Fig. 4. represents an artery precisely similar to that last mentioned, from a patient of Dr James Duncan, whose arm was torn off near to the shoulder, but without hemorrhage. The artery *a b*, contracted and tortuous from *b* to *c*, shews how much more it has contracted than the neighbouring soft parts.

Fig. 5. Extremity of the artery, fig. 3., cut open; *a b* that portion of the artery which consists of the whole three coats; from *b* to *c* shews the external coat drawn over the other coats after they had given way at *b*. There is a small coagulum of fibrin in the extremity of the vessel, but below *b* there is a coagulum of blood. In this case we see contraction of the artery, infiltration of blood into the cellular tissue around it, and the external coat drawn over the extremity of the other coats, which must all have contributed to prevent hemorrhage. The small coagulum of blood cannot be supposed to have had any share in this, but, on the contrary, must have formed subsequently.

Fig. 6. Torn extremity of the humeral artery, in a case of compound fracture, without hemorrhage. This case exhibits very distinctly the same appearances as in fig. 5. From *a* to *c* the extremity of the artery consisting of its three coats; *c* the point at which the two inner coats had given way; *c b* the longer projecting part of the exterior coat, occupied by a clot of blood; *d* a coagulum of fibrin within the coats of the artery. From a preparation in the Museum of the R. C. S., No. 1211, presented by Sir George Ballingall.

Fig. 7. Portion of the *dura mater* and middle meningeal artery of a man who fell from the top of a stage-coach. This artery was ruptured at *a*, but the extremities could not recede on account of their firm attachment to the *dura mater*. The consequence of this was hemorrhage to such an extent as to produce fatal compression of the brain.

Fig. 8. Popliteal artery of a gentleman whose leg was severely injured by the overturning of a mail coach. The artery *a b* had been overstretched to such an extent that the inner coats had become ruptured at *c d* and *e*, but the external coat from *c* to *d* remained entire. The portion of the inner coats at *e* was detached and became contracted. The passage of the blood through the vessel was completely stopped, and it was filled with a coagulum. From a preparation in Dr Handyside's Museum. The case occurred to Professor Lizars, of which he published an account in the Ed. Med. and Surg. Journal, vol. xix. p. 365.

Fig. 9. Extremity of the humeral artery of a young man, a patient of Dr Duncan, whose arm was torn off by machinery near the shoulder, without any hemorrhage having occurred. He died from *tetanus* 14 days after the injury. The artery had become much contracted, its extremity is occupied by fibrin, and the process of obliteration nearly completed.

Explanation of Plate X.

Fig. 1. Case in which the posterior tibial artery *e* was divided, near to its origin, by a fracture of the *fibula*, without any external wound, in consequence of a cart-wheel having passed over the leg. This upper extremity of the artery could not retract, owing to its position and the diseased state of its coats. The artery, therefore, poured its blood into the limb, and caused a large diffused aneurism, part of the cavity of which is here represented at *e f*. I amputated the limb 3 days after the injury, in consequence of the fracture, aneurism, and commencing mortification. The inner coat of the arteries was much diseased; and all the coats were much thickened, yet the patient, though a man of 56, recovered; he died by another disease two years after.

Fig. 2. Portion of artery from a stump after amputation. The ligature by which it was secured, and the part below it, have not separated. The lower extremity of

the artery *b c* is filled with fibrin which adheres to the inner coat. There is also a copious effusion of fibrinous lymph around the exterior of the artery. From a preparation in R. C. S. Museum, No. 1234.

Fig. 3. The extremity of the femoral artery 10 days after amputation. The ligature and the portion of artery below it having nearly separated. The divided edges of the coats were adhering, and a portion of fibrin occupies about a quarter of an inch of the canal above.

Fig. 4. The extremity of another femoral artery a few days after amputation. The noose of the ligature has divided the coats, but has not yet separated. The divided end was contracted and its edges adhered together. Portions of fibrin, adhering to the inner coat, occupy the interior of the artery, and lymph is copiously effused at the situation of the ligature.

Fig. 5. Portion of the femoral artery which had been obstructed by ligature for the cure of popliteal aneurism. The coagulum of fibrin within it extends about three inches upward. From Museum of R. C. S., No. 1226.

Fig. 6. Upper portion of the femoral artery of a gentleman who had a large femoral aneurism which suppurated and sloughed. *a b* the healthy portion of the artery which contracted at its extremity, the coats became thickened, and a large portion of fibrin *e* occupied its interior. From *b* to *d*, the coats of the vessel seem to be in a state approaching to ulceration; the sloughing mass had separated from the point *d*, but no hemorrhage took place. This case has been detailed by Dr Wardrop in his Treatise on Aneurism. I had an opportunity of seeing it with Sir A. Cooper and Dr Wardrop.

Fig. 7. Portion of the femoral artery *a e*, on which a ligature *f* had been placed by Dr Duncan for the cure of popliteal aneurism 14 days previously. The division of the artery by the ligature has been completed, and the ends *b d* have receded; but the thread has not yet come away, being still retained by the mass of effused lymph at the part. The interior of the vessel, above and below the division, is occupied by masses of fibrin. This is adhering to the inner coat, and is effecting the obliteration of the artery.

Fig. 8. Portion of femoral artery laid open to shew the effect of a ligature placed upon it for the cure of popliteal aneurism. From *a* to *b* the division of the inner and middle coats by the ligature is seen. But ulceration of the external coat took place at the point through which the probe *c* is introduced, and caused fatal hemorrhage. The coats of the artery were in a diseased state. Museum R. C. S., No. 1223.

PLATE IX.

Fig. 1.

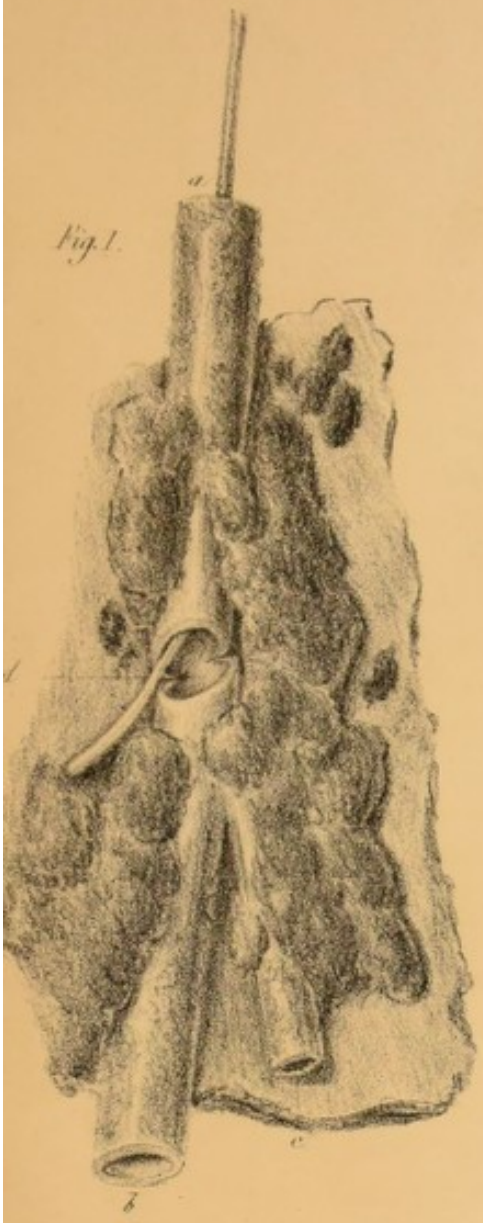


Fig. 2.

Fig. 3.

Fig. 8.

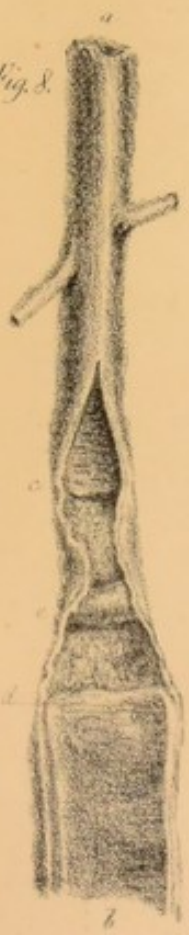


Fig. 9.

Fig. 7.

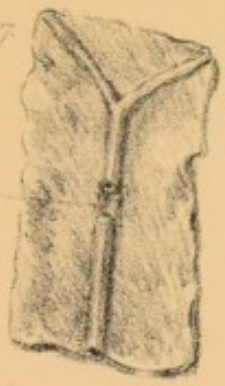


Fig. 5.

Fig. 6.

Fig. 4.

Fig. 1.

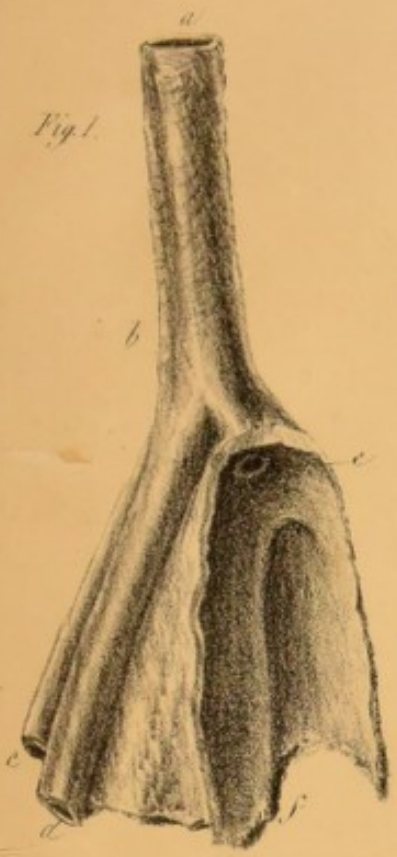


Fig. 2.

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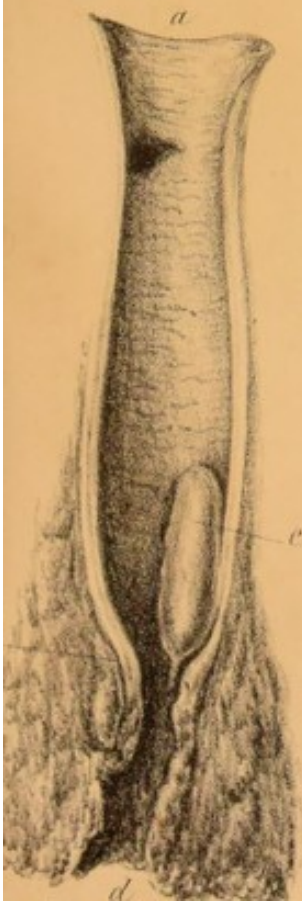

Fig. 7.

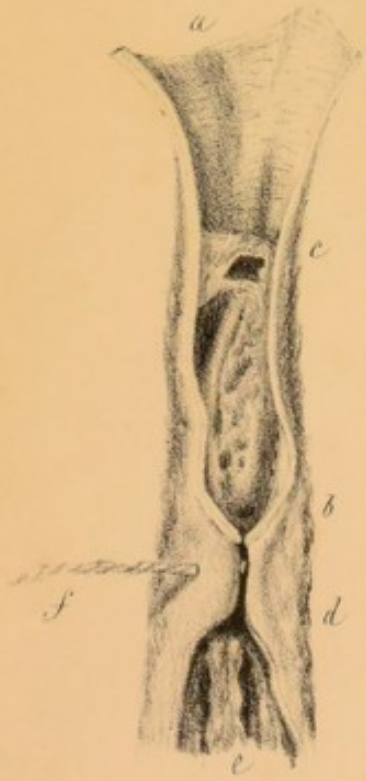

Fig. 8.