LECTURES

ON

SURGICAL ANATOMY

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ON

SURGICAL ANATOMY

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ILLUSTRATED BY 31 PLATES (78 FIGURES) DRAWN ON STONE
BY CHARLES BERJEAU, FROM ORIGINAL DISSECTIONS

EDINBURGH
DAVID DOUGLAS
1878

TO

WILLIAM TURNER, M.B., F.R.S.,

PROFESSOR OF ANATOMY IN THE UNIVERSITY
OF EDINBURGH.

" Above all, improve yourselves in Anatomy."

JOHN BELL.

PREFACE.

The following pages are an abstract of the lectures on surgical anatomy which form one division of the summer course on practical surgery delivered by the Author.

These lectures are now published in the hope that they may be of some use to the student of surgery. They are also intended to encourage the student of anatomy, and to show him the important practical bearings of the details of anatomy. They do not embrace the surgical anatomy of the female organs of generation, the eye, and ear, as these subjects do not come within the scope of a course of lectures devoted to the relations of anatomy to general surgery.

The Author has to acknowledge the able assistance of Mr. Charles Berjeau, who has drawn on stone, from original dissections, the figures which are intended not only as illustrations of the text, but also as guides to the senior student when dissecting the body, with special relation to practical surgery. These drawings are not intended to tempt the student to neglect dissection. They are introduced in order to encourage him to draw for himself each dissection as he makes it. However homely his first attempts may be, they will, from the first, be useful; gradually, by practice, every student will be able to make an effective diagram. To do this most efficiently, he should draw the main features of the dissection *at the time* in a note-book, and, if he possesses a black board, he can re-draw the dissection in the evening with coloured chalks, with which he will soon become expert. He may also, in his surgical studies, give diagrammatic expression to his ideas. The author is satisfied of the teaching value of diagrams made *during* a lecture on anatomy or surgery; self-teaching on the same principle is of the greatest value. A constant appeal is made to the sense of sight as an assistance to the memory.

The drawings of the transverse sections were made from bodies hardened in spirit. The spectator is supposed to be looking upwards towards the vertex. There is one exception, Plate XVI. fig. 1, in which the spectator is looking downwards towards the feet. The sections of the limbs should be made in successive order from the distal parts towards the trunk; the muscles, vessels, and nerves in each portion, as it is removed from the body, can be dissected out, and may be used as a key to the unravelling of the different structures in the transverse section last exposed.

The method of illustrating the relations of the arteries to the bones, used by Professor Turner in his *Introduction to Human Anatomy*, has been adopted in Plate III. fig. 1; Plate IV. fig. 1; Plate VIII.; Plate X.; Plate XV. fig. 2; Plate XXIV. fig. 1.

The text is written as concisely as possible. While it is hoped that nothing important is omitted, the author is well aware of the imperfections of an attempt to weld together anatomical detail and surgical practice.

The Author has to thank Dr. D. J. Cunningham, Mr. J. C. Ewart, M.B., Dr. John Brown, and Mr. David Hart, M.B., for much valuable help in revising the text, and preparing the dissections for the artist.

EDINBURGH, *March* 1878.

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INTRODUCTION.

After the student has mastered the details of anatomy, and has also gained a knowledge of the principles of surgery, he is in a position to apply his anatomical knowledge to the practice of surgery, in other words he is prepared for the study of surgical anatomy. Before any one can practise surgery he must be well grounded in the principles of surgery. In like manner to understand surgical anatomy the student requires an accurate knowledge of anatomy, which is chiefly to be acquired in the Dissecting-Room.

The following pages are intended for, and can only be properly understood by the senior student after he has attended lectures on anatomy and surgery, and dissected the human body once.

During the time devoted to a second dissecting course he may find suggestions for thought, if along with his dissection he will read the following pages. By their perusal he will see the direct bearing of anatomy upon surgery, and it is hoped that he will find them useful when engaged in practice.

The body is described under four divisions—A. Upper Extremity; B. Lower Extremity; C. Abdomen and Pelvis; D. Head, Neck, and Thorax. Each division is divided into certain regions. The anatomy of each of these regions will be described under the following heads:—1. External Anatomy. 2. Surgical Anatomy of the Spaces. 3. Surgical Anatomy of the Arteries. 4. Anatomy of Fractures and Dislocations.

1. *External Anatomy.*—A definition of this term is perhaps necessary. Under this head is included all that can be seen and felt without removing the skin. Instruments may

be used to aid sight, as the laryngoscope and ophthalmoscope. A speculum may aid in the examination of the cavities of the mouth and rectum, the nose and ear. Instruments may be used to assist the sense of touch, as the sound in examining the bladder.

External anatomy is to be studied on the living subject, which should be well developed and not much loaded with fat. The advantages of the study from life are self-evident; the tissues are more natural, both in appearance and to the sense of touch, than they can be even shortly after death; the blood-vessels can be traced with accuracy by their pulsations; the best method of compression at any given point can be tested by the effect on the vessel beyond; the subject, if intelligent, can aid the student in his examination. The position of the blood-vessels, bones, muscles, nerves, viscera, and boundaries of the spaces, can be marked out on the skin with charcoal. When it is remembered that injuries, requiring for their diagnosis a knowledge of external anatomy, are more frequent than operations, requiring a knowledge of dissected anatomy, it is evident that a careful study of the external anatomy of the human frame is of great importance to the practical surgeon.

External anatomy will be considered under the following heads:—A, Bony points and ridges; B, soft parts—the skin and subcutaneous tissues, their peculiarities; the muscular fasciæ; the muscular eminences; the depressions or fossæ; the blood-vessels and nerves.

2. *Surgical Anatomy of the Spaces.*—Their situation, shape, boundaries, coverings, floor, contents, and their relations.

In studying the shape of a space it must be remembered that the removal of the skin and fascia, and the separation of the muscles from their fascial connections, along with the clearing away of the fat and lymphatics which fill the space, will necessarily alter its shape. Each space must therefore be studied, and its boundaries marked out on the undissected subject before commencing the dissection. In the dissection care should be taken, in displaying the space-contents, not to displace the boundaries. This object will be best attained by defining only the edges of the muscles which bound the space.

3. *Surgical Anatomy of the Arteries.*—Situation, extent, divisions, relations, branches, anastomoses.

The change in direction of the vessel in varying positions of the limb should be noted. Its exact course should be traced in ink. The chief anastomoses should be carefully studied. Diagrams of the principal anastomoses are given in Plates XXX. and XXXI. The student should practise the formation of such diagrams. His own work will be of greater personal value than any diagrams made by another.

4. *Anatomy of Fractures and Dislocations.*—The bones, joints, and the muscles which act on them.

Under this head the attention of the student is directed to the importance of studying the muscles according to the *direction* of their fibres. The power of each muscle, or group of muscles, in a region, may be resolved into one or more of three main directions—*longitudinal* in the vertical axis, *transverse* in the transverse axis, and *antero-posterior* in the antero-posterior axis. The power of each muscle, when it contracts, may be regarded as applied in one or more of these directions; the result is a corresponding displacement. The sterno-mastoid muscle may be taken as a good example of this triple action. It runs from its sternal attachment upwards, outwards, and backwards. It has, therefore, a longitudinal, transverse, and antero-posterior displacing power. In consequence of its upward direction, or longitudinal power, it draws the mastoid process downwards—longitudinal displacement; in consequence of its outward direction, or transverse power, it draws the mastoid process inwards—transverse displacement; in consequence of its backward direction, or antero-posterior power, it draws the mastoid process forwards—antero-posterior displacement. Another example of this triple action of muscles is given in the muscles of the thigh. The muscles of the leg and forearm may be considered from the same point of view.

When a bone is broken, the normal action of the muscles is necessarily more or less altered. Rotation is to a great extent lost in the distal fragment, because the fixed point necessary for rotation is gone, while in the proximal fragment the tendency still remains in an increased degree, because the resistance is less. If the femur is broken below the trochanter minor, then rotation outwards of the upper fragment by the psoas and iliacus will take place; all adductor fibres attached to the upper fragment will assist the psoas and iliacus; on the other hand, the principal action of the adductor fibres attached to the lower fragment, in addition to their longitudinal power, will be to displace it laterally, or transversely, their rotatory power is to a great extent lost.

In fractures the distortion of the limb is primary and secondary. The primary displacement is due to the direction of the force causing the fracture, the secondary displacement is due to muscular action. For example, in Pott's fracture of the fibula by indirect violence the foot is in the first instance displaced outwards. If the foot is restored to its normal position, and if no retentive apparatus is applied, the foot again becomes everted, partly in consequence of the natural tendency of the foot to fall outwards, but principally by the action of the peronei. Their power is increased, because the internal lateral ligament of the ankle-joint is torn, and the fibula is broken. It is also to be noted that the primary passage of the foot outwards has, so to speak, prepared the way, by the tearing of the tissues, for the occurrence of the secondary displacement—the effect of the peronei is increased, the natural resistance to their action is removed.

UPPER EXTREMITY.

THE anatomy of the UPPER EXTREMITY will be considered under Five Regions:—Chap. I., *The Shoulder;* Chap. II., *The Upper Arm;* Chap. III., *The Elbow;* Chap. IV., *The Forearm;* Chap. V., *The Wrist and Hand.*

CHAPTER I.

REGION OF THE SHOULDER.

The anatomy of this region will be considered under the following heads:—(a) *External Anatomy;* (b) *Clavicle;* (c) *Scapula;* (d) *Shoulder-Joint;* (e) *Neck of Humerus;* (f) *Axilla;* (g) *Axillary Artery.* (Plate II. figs. 1 and 2; Plate III. figs. 1 and 3.)

External Anatomy.—1. The *Clavicle* is to be traced subcutaneously from its sternal extremity to its articulation with the acromion process, which is also subcutaneous and forms the tip of the shoulder. Posteriorly the general shape of the *Scapula* can be distinguished, the spine being subcutaneous. Under the acromion process the head of the humerus can be felt covered by the deltoid muscle; when the arm is abducted, and firm pressure made upwards into the axilla, the inferior aspect of the neck of the bone can be felt at its junction with the articular head. The *Coracoid* process can be felt in the groove between the pectoralis major and deltoid muscles. The *Axillary Artery* can be compressed against the second rib in this situation. If the arm is abducted, the boundaries of the floor of the axilla will be noticed, and the strong axillary fascia is seen stretching from the pectoralis major anteriorly to the latissimus dorsi posteriorly. The horizontal groove separating the clavicular and sternal portions of the pectoralis major is also to be noticed. The cephalic vein lies in the vertical groove between the deltoid and pectoralis major. Note the extensive rotatory movements of the scapula: when the arm is raised, the inferior angle passes forwards; when the arm is brought across the back, the same angle passes backwards. The principal muscles which effect these movements are the serratus magnus, drawing the bone forwards; the trapezius, levator anguli scapulæ, and rhomboid muscles, drawing it backwards. The coraco-clavicular ligament restrains the movements of the scapula. Care should be taken that the surgeon is not deceived by these scapular movements when inquiring into the amount of anchylosis of the shoulder-joint in diseased conditions of this articulation. The latissimus dorsi acts as a strap binding down the inferior angle of the bone; its displacement greatly weakens the power of the arm.

Clavicle.—2. This bone is subcutaneous throughout its whole length; any irregularity in it can therefore be easily observed. The double curve of the bone is characteristic, and varies in different individuals; as a rule, the more muscular the development the better marked is the curvature. It is the only bone which unites the upper limb to the trunk; all shocks to the arm which reach the trunk are therefore transmitted through it. Its curved form lessens their violence, the bone acting in the same way as a spiral spring.

3. DISLOCATIONS.—The clavicle is attached, at its inner extremity, to the manubrium of the sternum by powerful ligaments, the anterior and posterior sterno-clavicular; to the cartilage of the first rib by the strong costo-clavicular ligament; and, stretching across the notch of the manubrium, the inter-clavicular ligament connects both clavicles together. The inter-articular cartilage is thick, and acts as a pad, lessening shock. The strength of this joint is chiefly ligamentous. These strong ligaments render dislocation a rare injury. In consequence of the superficial position of the joint, the diagnosis is easy. The head of the bone may be dislocated *backwards* or *forwards;* the former injury is dangerous in consequence of the close proximity of the large veins at the root of the neck. In consequence of the shallow nature of the articulation, reduction of the dislocation, by bracing

back the shoulders, is accomplished with ease; and, for the same reason, retention of the head of the bone in its proper position is a source of great difficulty, the ligaments to which the joint owes its strength having been ruptured.

4. The clavicle articulates at its outer extremity with the tip of the acromion process of the scapula. The capsular ligament forming this articulation is not specially strong. This joint owes its strength to the strong coraco-clavicular ligament which stretches from the under surface of the clavicle, about an inch from its acromial extremity, to the base of the coracoid process. This ligament slings the scapula to the clavicle, and largely shares in supporting the weight of the arm. Dislocation of the *Acromio-clavicular* joint generally occurs in consequence of a blow on the tip of the shoulder driving the acromion process downwards; it is not necessary that the coraco-clavicular ligament be ruptured. The dislocation is easily reduced by bracing back the shoulder. It is retained in position with difficulty in consequence of the shallow form of the articulation. Although unreduced, the arm gradually regains its former power.

5. Fractures.—Fracture of the collar-bone is a frequent injury, because, as has already been pointed out, all shocks to the arm, severe enough to reach the trunk, must necessarily be transmitted through the bone. Five muscles are attached to the clavicle—the sterno-mastoid and trapezius to its upper border; the pectoralis major and deltoid to its lower border; the sterno-mastoid is antagonistic in its action to the pectoralis major; the trapezius to the deltoid. The fifth muscle is the subclavius, stretching from the cartilage of the first rib to the deep groove on the under surface of the clavicle.

6. When this bone is fractured in consequence of indirect violence—as, for example, from a fall upon the hand, elbow, or shoulder—it generally gives way at its middle third. The displacement is a triple one, the tip of the shoulder and the outer fragment passing *downwards, forwards,* and *inwards.* (*a.*) *Downwards.* The injured shoulder is lowered. This is

due to the weight of the arm, its bony attachment to the trunk having given way. (*b.*) *Inwards.* The tip of the injured shoulder is nearer the middle line than the tip of the opposite shoulder. This displacement is principally due to the pectorales and subclavius muscles. (*c.*) *Forwards.* The tip of the injured shoulder is also displaced forwards in consequence of the action of the pectoralis major, pectoralis minor, and serratus magnus muscles. The object of the various plans of treatment is to counteract this triple displacement;—the forward and inward tendency by bracing back the shoulder, the downward tendency by supporting the arm in a sling.

7. The normal level of the sternal fragment, to which the pectoralis major and sterno-mastoid muscles are attached, is unchanged; its apparent uprising is due to the subsidence of the acromial fragment. A comparison with the opposite clavicle will at once show that the level of the inner fragment is unaltered.

8. The clavicle is sometimes fractured close to its acromial extremity by direct violence, as when a heavy body falls on the shoulder. When the fracture takes place at the attachment of the coraco-clavicular ligament, the displacement is slight, unless the ligament is ruptured, when the triple displacement already described will be apparent. When the bone is broken external to the coraco-clavicular ligament, the tilting forwards of the tip of the shoulder, along with the outer fragment, is very marked. In this injury there is *no downward displacement* of the short outer fragment, because the scapula is firmly attached by the coraco-clavicular ligament to the long inner fragment of the clavicle which retains its normal level. The shoulder and arm cannot pass downwards in consequence of their firm attachment to the scapula, which retains its normal level, being slung to the inner fragment of the clavicle by this powerful ligament. The *marked forward displacement* is due to the action of the pectorals and serratus magnus, which pull the shoulder and arm forwards, carrying the outer fragment along with them; rotation taking place

through a circle, the centre of which is the coraco-clavicular ligament. It is worthy of note that injuries of the acromial extremity of the clavicle, the acromial process of the scapula, and the acromio-clavicular joint, are comparatively rare, on account of the great mobility of the shoulder, which enables these parts to give way before the blow, thereby greatly lessening its force.

Scapula.—9. DISLOCATION.—By dislocation of the scapula is meant the slipping of the latissimus dorsi off its inferior angle, the muscle lying between the scapula and the ribs. This accident is irremediable; the arm is much weakened, and a strong leather belt must be worn to take the place of the displaced latissimus dorsi muscle. Attempts have been made to remedy the deformity by stitching the muscle to the angle of the bone. It must, however, be remembered that in the normal condition the angle glides backwards and forwards under the muscle during scapular movements.

10. FRACTURES.—The *body* of the bone is rarely fractured, because it is protected by the powerful supra-spinatus and infra-spinatus muscles; the sub-scapularis and serratus magnus muscles form a soft muscular pad between the scapula and the ribs, and also assist in protecting the bone.

11. Fracture of the *Acromion Process* may occur in consequence of a blow on the shoulder; the mobility of the shoulder renders this a rare accident. It is to be remembered that non-ossification of the epiphysis of the acromion process to the spine of the scapula is not unfrequently met with, and that therefore many so-called ununited fractures of the acromion are in reality cases of arrested development.

12. Fracture of the *Neck of the Scapula* is a rare injury. If the glenoid cavity alone is broken off, then the arm will fall by its weight, and the injury will closely resemble in its characters dislocation downwards of the head of the humerus. The feeling of crepitus, and the return of the deformity when the arm is unsupported, will enable the surgeon to diagnose this injury from dislocation. If the fracture passes through the scapula internal to the coracoid

process, there will be no downward displacement unless the coraco-clavicular ligament is ruptured.

13. The *Coracoid Process* is very rarely fractured, because it lies in a hollow formed by the head of the humerus externally, the chest wall internally, and the clavicle superiorly, these bones protecting it from injury.

Shoulder-Joint.—14. Any interference with the movements of this important joint greatly lessens the usefulness of the upper extremity. Injuries are frequent, in consequence of its exposed situation and extensive movements; a knowledge of the anatomy of the healthy joint is necessary in order to the understanding of their pathology. A mistaken treatment, consequent on a mistaken diagnosis, may permanently impair the usefulness of the arm.

15. ANATOMY (Plate II. fig. 2).—It is necessary to have an accurate acquaintance with the relative position of the head of the humerus (surmounted and protected by the bony arch formed by the acromion and clavicle), and the coracoid process, which lies about an inch below the level of the lower border of the clavicle, and an inch internal to the inner edge of the head of the humerus. In addition to the bony arch surmounting and protecting the head of the humerus, it is to be remembered that the coraco-acromial ligament bridges across the interval between the coracoid and acromial processes, and forms an additional protection to the exposed shoulder-joint (Plate III. fig. 3). The ease with which these points can be made out will depend on the muscularity of the patient and the amount of subcutaneous fat. Every opportunity should be taken, in the dissecting-rooms and in the wards of the hospital, of becoming acquainted with external anatomy; when called to an injury, it should always be remembered that the sound shoulder of the injured person is accessible both for comparison and as an accurate anatomical guide to what should be the natural appearance of the injured shoulder. This holds true of all injuries of the extremities.

16. The roundness of the shoulder is due to the V-shaped deltoid muscle, which arises from the bony arch and

completely covers the head of the bone. Sometimes this muscle is atrophied, either from long-continued disuse, or perhaps from injury to its nerve of supply (the circumflex), as for instance in dislocation of the head of the humerus, in which rupture of the nerve is said sometimes to occur. Care must be taken not to confound flattening of the shoulder, due to atrophy of this muscle, with flattening due to dislocation of the head of the humerus downwards.

17. To expose the head of the bone the deltoid must be reflected upwards; in doing so a large bursa, which lies between it and the head of the humerus, will be opened; the tuberosities of the humerus are now exposed, to which the muscles surrounding the joint are attached. The greater tuberosity is external, and lies in the same line as the external condyle of the bone. The supra-spinatus, infra-spinatus, and teres minor muscles, are attached to the greater tuberosity, and clothe the joint superiorly and externally; the subscapularis muscle is attached to the lesser tuberosity and supports the joint internally. When the arm lies by the side, the only part of the articulation which is not closely surrounded by muscular tissue is the inferior aspect; it will be found that the capsular ligament is in this situation specially strong. In the abducted position of the arm the head of the bone rests on this portion of the ligament, and is supported by the long head of the triceps. The bicipital groove, which can be indistinctly felt in the undissected limb, is occupied by the long tendon of the biceps, which acts as a strap binding the large articular head of the humerus to the shallow glenoid cavity; to the anterior lip of this groove the pectoralis major muscle is attached, to the posterior lip the teres major, and to the bottom of the groove the latissimus dorsi. The coracoid process is seen internal to the head of the bone; the coraco-acromial ligament, stretching from it to the acromion process, assists in the protection of the joint; the short head of the biceps the coraco-brachialis, and pectoralis minor muscles are attached to the apex of the coracoid process, and will tend to displace it downwards when it is fractured. The close relation of

the axillary vessels and nerves to the inner aspect of the head of the humerus is to be noted. If the arm is abducted, these structures will be seen to be stretched over the head of the bone. Winding round the posterior aspect of the surgical neck, the circumflex nerve and artery are seen entering the deltoid muscle. If the muscles attached to the tuberosities are divided, the joint will be opened, and the long tendon of the biceps, acting as a strap and binding the head of the bone to the glenoid cavity, can be traced to its origin from the upper extremity of the glenoid cavity; the large head of the humerus, and the shallow glenoid cavity, deepened by the glenoid ligament, are now exposed.

18. DISLOCATIONS.—A comparison between the shoulder-joint and the sterno-clavicular joint already described will, perhaps, best illustrate their surgical peculiarities. They are both shallow joints; in the shoulder the ligaments are weak, in the clavicular joint specially strong; powerful muscles surround the shoulder-joint, the clavicular joint is unsupported by muscles; the movements at the shoulder are extensive, the movements at the sterno-clavicular joint are restricted. In the former dislocation is common, in the latter rare. Both joints are strong; the strength of the sterno-clavicular joint is ligamentous, while the strength of the shoulder-joint depends on muscles. Take these muscles at a disadvantage, when lax, and when the shock is unexpected, and dislocation of the joint is easy. On the other hand, when the strength of the joint is ligamentous, as in the sterno-clavicular articulation, the movements are necessarily restricted, and dislocation rarely occurs.

19. The dislocations at the shoulder-joint are primary and secondary. The *primary* displacement is always, in the first place, *downwards* into the axilla. When the arm is abducted, the head of the bone rests against the lower part of the glenoid cavity, and presses on the inferior part of the capsular ligament; and if, with the arm in this position, the patient falls forwards on the hand, or if, the arm being fixed in this position, the patient receives a blow upon the shoulder, the result in all probability is rupture of

the capsular ligament, and a dislocation downwards of the head of the bone, which passes between the subscapularis and teres minor muscles into the axilla. It is to be remembered that the long head of the triceps strengthens the inferior aspect of the capsular ligament in the abducted position, and tends to prevent dislocation. The muscles attached to the bicipital groove tend to draw the head of the bone inwards and forwards in the direction of least resistance; hence it is generally found that in this, the primary and most frequent dislocation, the head of the bone lies under the pectoral muscles, external to and at a lower level than the coracoid process. This process is the best landmark to judge of alterations in the position of the head of the humerus.

20. The *secondary* displacements are (*a*) *forwards*, the head of the bone lying internal to the coracoid process; (*b*) *backwards*, the head of the bone lying under the spine of the scapula; in both, the bone first passes downwards, as already described, and then, if the dislocating force is from behind, the head of the bone is driven forwards internal to the coracoid process; if from the front, and of great severity, the head of the bone passes backwards under the spine of the scapula; there is less resistance to the passage of the bone forwards, as the displacement of the vessels and nerves and fat in the axilla is a much easier matter than the displacement or rupture of the powerful subscapularis, and teres major muscles, which are the obstacles to the passage of the bone backwards under the spine of the scapula. The latter is therefore an extremely rare injury; the former comparatively frequent.

21. When the dislocation is downwards, or, still more, when downwards and forwards, severe pain is complained of, in consequence of the pressure of the head of the bone on the axillary plexus of nerves. Pressure on the axillary vein interferes with the venous flow, and œdema of the arm is the result. The natural elasticity of the axillary artery prevents its rupture at the time of the accident; great care must however be taken in the reduction of old-standing dis-

locations, more especially in old people, in whom the arteries are probably atheromatous, not to rupture the axillary artery, because it may be adherent to the dislocated head, as I have myself seen in a case in which Mr. Annandale resected the head of the bone. The operation was performed to relieve pain caused by pressure on the axillary nerves, the dislocation being irreducible by ordinary means.

22. In this common dislocation the arm is lengthened; the biceps, triceps, and deltoid muscles are stretched; the forearm is supinated and flexed by the action of the biceps; the tense deltoid tilts the elbow outwards from the side; the shoulder is flattened, and the acromion process prominent. This accident would occur more frequently if the scapula were immovable. The muscles attached to the tuberosities draw the head of the bone against the glenoid cavity, and they must be lax and taken at a disadvantage in order that the accident may occur.

23. The principle of the manipulative treatment in the reduction of this dislocation is to abduct the arm; then, by circumduction of the elbow inwards, to carry the head of the bone downwards and outwards, so as to bring it opposite the rupture in the capsular ligament; and then, by bringing the arm rapidly down to the side, the head of the bone passes upwards between the subscapularis and teres minor muscles through the ruptured opening in the capsular ligament to its natural position in the glenoid cavity.

Fracture of the Neck of the Humerus.—24. Fracture of the anatomical neck of the humerus is generally a separation of the epiphysis before complete ossification has occurred; it is a rare injury. Fracture of the *surgical neck* of the humerus is a common injury, and resembles dislocation of the head of the bone into the axilla; its distinguishing features are—1st, the upper arm is shortened; 2d, the head of the bone can be felt in its normal position; 3d, when extension is made, and the elbow is brought to the side, crepitus is generally elicited; if no retentive apparatus is applied the deformity will again take place. In it the axis of the humerus runs downwards and outwards, the upper extremity of the fractured bone is drawn inwards by the muscles attached to the bicipital groove, the elbow is tilted outwards by the deltoid, the arm is shortened by the contraction of the biceps and triceps muscles; if the contour of the injured arm is compared with the sound side, a distinct hollow will be observed immediately above the attachment of the deltoid; the acromion process is not prominent as in the dislocation, because the head of the bone remains in its normal position.

The Axilla.—25. This space lies between the upper extremity and the trunk; it is conical in shape, the apex of the cone looking upwards. It is bounded anteriorly by the pectorals; posteriorly, by the subscapularis, latissimus dorsi, and teres major muscles, internally by the chest wall, clothed by the serratus magnus; externally, by the neck of the humerus, covered by the short head of the biceps and coraco-brachialis muscles; its floor is formed by the strong axillary fascia, stretching from the anterior to the posterior boundaries. The skin of this region is dark coloured, furnished with hair and numerous sebaceous glands; the apex of the space is bounded by the clavicle, upper border of the scapula, and first rib. The large vessels and axillary plexus of nerves enter the space at the apex. They lie in connection with the outer wall of the cavity. When the arm is abducted, the head of the humerus can be distinctly felt. The space is occupied by cellular tissue, fat, and lymphatic glands, which receive the lymphatic vessels from the upper extremity and mammary region; they are therefore subject to inflammatory and cancerous enlargement. When suppuration occurs an incision into the axilla is necessary; this should be made midway between the anterior and posterior boundaries of the space close to the chest wall; by so doing, the axillary artery in connection with the outer wall, the long thoracic artery under cover of the pectoralis major, and the circumflex and subscapular arteries in relation to the posterior boundary will be avoided. When these glands are the seat of cancerous infiltration great care must be taken in their removal not to injure the axillary vein, which lies to the thoracic side of the artery.

Axillary Artery.—26. This artery, as its name implies, lies in the axilla. It is a direct continuation of the subclavian artery. It extends from the outer border of the first rib along the outer wall to the lower border of the teres major muscle, where it becomes the brachial artery. Its direction varies according to the position of the arm; this should always be kept in remembrance in performing operations in the axilla. This vessel is divided into three parts by the pectoralis minor. The *first part* extends from the outer border of the first rib to the upper border of the muscle; the *second part* lies behind the muscle; the *third part* extends from the lower border of the muscle to the termination of the vessel.

27. The axillary artery can be compressed from the floor of the axilla, against the neck of the humerus. It can also be compressed against the second rib if firm pressure is applied inwards and backwards in the groove between the pectoralis major and deltoid muscles.

28. *First Part* (Plate II. fig. 2).—To expose this portion of the artery, the arm should be abducted to a right angle from the side, and an incision should be made from the coracoid process towards the sterno-clavicular articulation. After division of the skin and superficial fascia, the fibres of the clavicular origin of the pectoralis major are exposed and divided; the arm is then brought down to the side in order to relax the sternal portion of the pectoralis major and the pectoralis minor. A quantity of loose cellular tissue and fat, in which the branches of the thoracic axis, the anterior thoracic nerves, and the cephalic vein lie, is now to be turned aside in order to expose the axillary sheath, which is a direct continuation of the subclavian sheath, here greatly strengthened by fibres from the costo-coracoid membrane. The cephalic vein is seen piercing the sheath to join the axillary vein; the sheath should be opened in a longitudinal direction, and the first part of the axillary artery is exposed, the axillary vein overlapping it, and lying to its thoracic side. The cords of the brachial plexus are external to the vessel, and are on a deeper plane. The artery lies upon the first intercostal

space, and first digitation of the serratus magnus; it gives off the thoracic axis. The aneurism needle is to be passed under the vessel with its back to the vein.

29. *Second Part.*—In order to reach this portion of the vessel both pectorals require to be freely divided and turned aside; the axillary sheath is to be opened in the line of the vessel. The artery is exposed with the vein to its thoracic side. The three cords of the brachial plexus here surround the vessel, one external, one internal, and one posterior; the aneurism needle is to be passed with the same precaution as in ligature of the first part.

30. *Third Part.*—This portion of the trunk is comparatively superficial, and is best reached through the floor of the axilla. The arm is abducted from the side, the pulsation of the artery is felt, an incision is made in the line of the vessel through the skin, superficial fascia, and strong axillary fascia, which forms the floor of the axilla. The axillary sheath is then opened, care being taken not to injure the axillary vein, which lies to the thoracic side of the artery, and requires to be drawn aside before the operator can see the vessel. The nervous cords have now divided into their terminal branches; the inner head of the median crosses the artery from within outwards, the trunk of the median and the external cutaneous nerve lie to its outer side, the ulnar and internal cutaneous lie to its thoracic side, the musculo-spiral and circumflex nerves lie behind the vessel. Four branches, the subscapular, the long thoracic, the anterior and posterior circumflex arteries, arise from this part of the vessel; in passing the aneurism needle, care must be taken not to injure these branches, nor to include any of the nerves which surround the vessel in the ligature.

31. ANASTOMOSES.—When the *first part* of the axillary artery is ligatured the blood will reach the axillary trunk below the ligature; (*a*) through the anastomoses of the *subscapular* branch of the axillary, and its *dorsalis-scapulæ* branch, with the *supra-scapular, transversalis colli,* and *posterior-scapular* branches of the thyroid axis arising from

the *first* part of the subclavian; (*b*) through the anastomoses of the *subscapular* and *thoracic* branches of the axillary artery with the lateral branches of the *intercostal* arteries from the aorta and with branches of the *superior intercostal*, from the second part of the subclavian; and (*c*), when the ligature is placed external to the origin of the thoracic axis of the axillary, through the anastomoses of the *thoracica-acromialis* and *humeraria* branches of the axis with the *circumflex* branches of the axillary artery.

When the *third part* of the axillary artery is ligatured beyond its branches, the blood will reach the brachial through muscular anastomoses between the *anterior* and *posterior* circumflex branches of the axillary with the *superior* and *inferior profunda* branches of the brachial. (Plate XXX. figs. 1 and 2.)

Chapter II.

REGION OF THE UPPER ARM.

The anatomy of this region will be considered under the following heads :—(a) *External Anatomy ;* (b) *Shaft of the Humerus ;* (c) *Brachial Artery.* (Plate III. Figs. 1 and 2.)

External Anatomy.—32. The humerus is clothed anteriorly by the coraco-brachialis, biceps, and brachialis anticus muscles; posteriorly by the triceps muscle. The deltoid muscle attached to the deltoid impression on the outer surface of the bone lies between the anterior and posterior muscular elevations. The musculo-spiral nerve lies in the musculo-spiral groove which crosses the posterior aspect of the bone in its middle third ; its direction is from within, downwards and outwards. The situation of this nerve must be remembered when deep incisions are required in the middle third of the upper arm, on its posterior aspect. The pulsations of the brachial artery can be felt throughout its entire course; the vessel in the upper two-thirds of its course lies internal to the shaft of the bone, and it can be compressed against the shaft by pressure in an outward direction; in the lower third it lies in front of the bone, and the pressure, to be efficient, must be in a backward direction. The basilic vein is to be traced in the subcutaneous tissue along the inner aspect of the arm in the line of the artery; the cephalic vein runs upwards in the subcutaneous tissue, in the interspace between the biceps and triceps muscles, along the outer aspect of the upper arm.

Fracture of the Shaft of the Humerus.—33. Fracture may occur either above or below the deltoid impression. *First, above the deltoid impression.*—This fracture occurs through the shaft of the bone between the attachments of the pectoralis major, latissimus dorsi, and teres major muscles, and the attachment of the deltoid. The lower extremity of the upper fragment is drawn inwards by the muscles attached to the bicipital groove; the upper extremity of the lower fragment is drawn outwards by the deltoid. If the fracture is transverse in direction, the shortening will be comparatively slight; if oblique, the shortening will be considerable, the result of contraction of the biceps and triceps muscles. *Second, below the deltoid impression.*—If this fracture occurs from direct violence, the line of fracture will be transverse. There will be great mobility but little shortening, as the action of the biceps, brachialis anticus, and triceps muscles will tend to draw the broken surfaces together. When the fracture occurs from indirect violence, the line of fracture is generally oblique, and the shortening considerable, the fragments being drawn past one another by the biceps, brachialis anticus, and triceps muscles.

Brachial Artery.—34. This vessel extends from the lower border of the teres major muscle to the neck of the radius. It is superficial in its whole extent, lying, in the upper two-thirds of its course internal to the shaft of the humerus, in the lower third anterior to the shaft of the bone; it lies at first on the triceps and afterwards on the brachialis anticus. The coraco-brachialis and biceps muscles form the guide to the vessel, lying external to it. The artery is covered by the skin, superficial fascia, and muscular fascia. Near its termination it is crossed by the median basilic vein, and the fascial prolongation from the biceps muscle to the internal condyle; the basilic vein lies in the subcutaneous fat in the line of this vessel. The artery is accompanied by venæ comites, which communicate by numerous transverse branches. The median nerve accompanies the vessel, lying at first external to it; about the middle of the upper arm it crosses the artery, and is afterward internal. The musculo-spiral nerve lies behind the artery in the first two inches of its course; the ulnar nerve lies internal to the vessel in its upper half. The artery gives off four named branches:—the superior profunda, which winds round the back of the humerus in the musculo-spiral groove, along with the musculo-spiral nerve, to reach the external condyle; the inferior profunda, which accompanies the ulnar nerve to the posterior aspect of the internal condyle; the anastomotica magna, which runs to the anterior aspect of the internal condyle; and the nutrient artery to the shaft of the humerus. In order to reach the vessel a longitudinal incision is to be made along the inner edge of the biceps muscle in the line of the artery. Care must be taken not to injure the basilic vein in the superficial dissection; the median nerve, the venæ comites, and the branches of the vessel, must be avoided in passing the aneurism needle. Not unfrequently high division of the artery takes place, and two vessels instead of one may be exposed in the dissection.

35. Anastomoses.—When the brachial artery is ligatured the blood will reach the forearm—(*a*) round the external condyle, through the anastomoses of the *superior profunda* of the brachial, with the *radial* and *interosseous recurrent* arteries; (*b*) round the internal condyle, through the anastomoses of the *inferior profunda* and *anastomotic* branches of the brachial, with the *ulnar recurrent* arteries (Plate XXX. fig. 2).

CHAPTER III.

REGION OF THE ELBOW.

The anatomy of this region will be considered under the following heads :—(a) *External Anatomy ;* (b) *Dislocations ;* (c) *Fractures.* (Plate IV. fig. 1 ; Plate V. figs. 2 and 3 ; Plate VI. figs. 3 and 4.)

External Anatomy.—36. The bony points to be noted in this region are the rounded external condyle of the humerus, the pointed prominent internal condyle, the moveable olecranon, the head of the radius, and the coronoid process of the ulna. If a line is drawn through the condyles of the humerus, it will be found to be at right angles to the axis of the shaft of the bone. When the forearm is fully extended, the tip of the olecranon is slightly above the line joining the condyles; when the forearm forms with the upper arm an angle of 130°, the three bony points are in one line; when the forearm is further flexed the tip of the olecranon passes to the distal side of the line joining the condyles. The characteristic shape of the head of the radius can be easily distinguished posteriorly in close connection with the external condyle ; it lies external to the outer margin of the anconeus in the hollow behind the muscular mass formed by the supinator longus and the extensors of the carpus. The coronoid process of the ulna can be indistinctly felt, if firm pressure is made in the triangular space in front of the joint.

When the forearm is fully extended, it is to be observed that the axes of the upper arm and forearm are not in one straight line; this is in consequence of the slope of the trochlear surface of the humerus, which is directed downwards, and with an inclination outwards, so that the axis of the forearm forms an angle outwards with the axis of the upper arm. As a necessary result the axis of the forearm crosses the axis of the upper arm, as the arm passes from the extended to the flexed position. The line, which passes through the condyles of the humerus, is at right angles to the axis of the upper arm, while it forms an angle with the axis of the forearm; in other words, the internal condyle lies at a higher level than the external condyle if we look to the forearm. If we look to the upper arm, they are on the same level. The muscular masses, which clothe the joint laterally, are to be observed;—externally, the supinators and extensors—internally, the pronators and flexors. These muscular masses form respectively the external and internal boundaries of a triangular space in front of the elbow-joint —the base of which is a line joining the condyles. The arrangement of the subcutaneous veins should be carefully studied; three sets in the forearm—the median centrally—the radial veins to the radial side—the ulnar veins to the ulnar side—the median vein bifurcating into the median-basilic and median-cephalic; the median-basilic joined by the ulnar veins, the median-cephalic by the radial veins, to form the basilic and cephalic veins respectively. The brachial artery and the tendon of the biceps can be easily traced into this space; the median nerve may be felt in its passage into the space. The artery lies between the tendon and the nerve, the tendon to its outer side, the nerve to its inner side. The musculo-spiral nerve lies deeply in the hollow between the brachialis anticus and the muscles arising from the external condyle. The brachialis anticus and supinator brevis muscles form the floor of the space.

37. Posteriorly, the hollows on either side of the prominent olecranon should be noted. They are well marked in the extended position of the limb. In gelatinous degeneration and in acute synovitis these hollows disappear, and the prominence of the olecranon is effaced. The ulnar nerve lies in the hollow between the inner edge of the olecranon and the internal condyle. There is a superficial bursa over the tip of the olecranon which is often the seat

of inflammatory enlargement. A bursa is also situated under the tendon of the triceps above the apex of the olecranon. There is also a small lymphatic gland above the internal condyle, over the condyloid ridge.

38. ANASTOMOSES.—There is a free anastomosis between the brachial and radial and ulnar arteries around the elbow-joint, in order to carry on the circulation when the brachial artery is compressed in the flexed position of the limb. The superior profunda anastomoses with the radial recurrent on the anterior aspect of the external condyle, and with the interosseous recurrent on the posterior aspect of the same condyle. The anastomotic artery anastomoses with the anterior ulnar recurrent in front of the internal condyle; the inferior profunda and anastomotic anastomose with the posterior ulnar recurrent in the hollow behind the internal condyle. These anastomosing channels communicate freely above the olecranon on the posterior aspect of the joint.

Dislocations.—39. In order clearly to understand the pathology of these injuries, it is necessary to refer shortly to the anatomy of the joint. The lateral ligaments are specially strong, and are supported by the lateral muscular groups; the anterior and posterior capsular ligaments of the joint are specially weak, in order to allow of the movements of flexion and extension; the radius is firmly bound to the ulna by the orbicular ligament; it has no direct ligamentous attachments to the humerus; it therefore follows the ulna in the movements of flexion and extension, while in the movements of pronation and supination it freely rotates upon that bone. There is no lateral movement in a healthy elbow-joint, and therefore if such exists it is evident that the joint has received some injury, or is diseased. The powerful grasp which the olecranon and coronoid processes of the ulna take of the humerus is to be remembered—the olecranon taking the principal share in extension, the coronoid in flexion.

40. The elbow-joint owes its antero-posterior strength to the shape of the bones, to the great vertical length of the olecranon and coronoid, the upper end of the ulna

powerfully grasping the lower end of the humerus, and to the triceps clothing the joint posteriorly, the biceps and brachialis anticus, anteriorly. The joint owes its lateral strength to the fact that the humerus is hollowed out to receive the olecranon and coronoid processes of the ulna, to the powerful lateral ligaments, and to the muscular masses which clothe the joint externally and internally. It may be well here to recall the comparison between the sterno-clavicular and shoulder-joints (page 8), in order to note in what they differ from, and in what they are similar to, the elbow. The sterno-clavicular joint is ligamentously strong, its movements are restricted; the shoulder-joint is muscularly strong, its movements are extensive. Both joints are osseously weak. The elbow-joint is osseously and ligamentously strong as regards lateral displacements. The strength is such that there is no lateral movement. On the other hand the strength of the joint in the antero-posterior direction is osseous and muscular, but the bones are so shaped that the movements in this direction are extensive. In these three joints of the upper extremity we have examples of the three sources of joint strength—bone, ligament, and muscle. In the lower extremity it will be found that the hip-joint is strong osseously, ligamentously, and muscularly—the knee-joint ligamentously, and the ankle-joint osseously.

41. Dislocations of this joint are frequent, in consequence of its exposed position and the great strains which it has to bear. They are divided into two main classes.—*First, antero-posterior dislocations; second, lateral dislocations.* The former are more common than the latter, because the extensive movements in this direction—namely, flexion and extension—tend to weaken the osseous strength of the joint in certain positions. For example, when the forearm is fully flexed the olecranon has a comparatively weak grasp of the humerus, and therefore this position of the limb is associated with dislocation of the ulna forwards; on the other hand, when the forearm is fully extended the coronoid process has a comparatively weak grasp of the humerus, and therefore this position of the forearm is associated with dislocation of the

ulna backwards. It is hardly necessary to state, when we remember the strong ligamentous attachment of the radius to the ulna, and its weak attachment to the humerus, that the radius must necessarily follow the ulna in its displacements, and that complete dislocation of the ulna alone cannot occur.

42. Dislocation of the radius from the ulna is rare, in consequence of the great strength of the orbicular ligament. It is, however, to be remembered that in any fall upon the hand the radius necessarily receives the greater part of the shock; and if it does not give way close to its carpal extremity, dislocation of the head of the bone may occur either backwards or forwards. The injury is easily diagnosed, in consequence of the superficial situation of the head of the bone. The strength of the radio-ulnar articulation is purely ligamentous, resembling in this particular the sterno-clavicular articulation. Reduction is therefore easy, retention is difficult; the retentive apparatus must be applied and the joint kept perfectly quiet for a considerable period, in order to allow the orbicular ligament to heal. On the other hand, passive movement may be begun early in dislocation of the ulna, because the joint between the humerus and ulna is osseously strong. Lateral dislocations at the elbow-joint are rare, because, *first,* the joint is purely a hinge joint, and there is no normal lateral movement; *second,* the lateral ligaments are powerful; and *third,* because of the great transverse breadth of the joint, and the close adaptation of the olecranon and coronoid processes to the transversely concave trochlear surface of the humerus. When dislocation at the elbow-joint occurs, the relative position of the bony points to one another is changed, the normal movements of flexion and extension are lost, and abnormal lateral movement is present. Care must be taken, in eliciting the last symptom, that the humerus is firmly fixed, in order that the surgeon may not be deceived by rotation at the shoulder-joint, simulating abnormal lateral movement at the elbow.

Fractures.—43. The most frequent fracture in this region is a *transverse fracture through the lower end of the* *humerus* above the condyles. To a superficial observer this fracture resembles dislocation of both bones backwards. In this fracture the forearm and the lower fragment of the humerus pass backwards, because the injury is the result of indirect violence, as, for instance, a fall upon the hand. The diagnostic between it and dislocation of both bones backwards is, that in the fracture the normal relative position of the olecranon and condyles is unchanged; while in the dislocation the olecranon alone has passed upwards and backwards, the condyles retaining their normal position. The importance of the early diagnosis of dislocation from fracture is so great that, if the surgeon has any doubt, chloroform should be administered, in order that a thorough examination of the joint may be made. If the surgeon fails to discover a dislocation at the time of the injury, changes occur so rapidly after this joint is dislocated, more especially in young children, that it may be impossible to reduce the dislocation, and a stiff elbow for life will be the result. When this fracture occurs in young children, bony crepitus is absent, because in them a separation of the epiphysis or diastasis has taken place. In both injuries the antero-posterior diameter of the joint is increased. In the fracture the lower end of the long upper fragment of the humerus projects anteriorly; in the dislocation the lower end of the humerus forms the anterior projection.

44. Fracture of the *olecranon process* is the result of direct violence. If the strong fibrous periosteum is untorn, or if the ligamentous fibres stretching transversely on the inner side from coronoid to olecranon are entire, there will be little displacement, and the principal symptom will be severe pain when pressure is made over the line of fracture. The fibrous periosteum, however, is generally torn, and the olecranon is drawn upwards by the triceps muscle. In order to relax this muscle, the forearm is retained by an anterior splint in the extended position. When the olecranon is broken, the principal obstacle to dislocation of the ulna forwards is removed, and therefore this fracture is

sometimes complicated by dislocation of the bones of the forearm forwards.

45. The *coronoid* process is sometimes fractured. When this occurs it is drawn upwards by the brachialis anticus. This process is the principal obstacle to the dislocation of the bones backwards, and therefore this dislocation may occur as a complication of the fracture. This fracture must be treated by flexing the forearm, in order to relax the brachialis anticus.

Chapter IV.

REGION OF THE FOREARM.

The anatomy of this region will be considered under the following heads :—(a) *External Anatomy ;* (b) *Fractures ;* (c) *Radial Artery ;* (d) *Ulnar Artery.* (Plate IV. figs. 1, 2, and 3 ; Plate V. fig. 1.)

External Anatomy.—46. The ulna is subcutaneous throughout its whole extent; therefore, when fractured, the injury can be easily diagnosed. The lower extremity of the bone is divided into the head and styloid process; both can be felt under the skin. The head of the radius and a small portion of the shaft below the head are subcutaneous, lying in the hollow separating the supinator longus and extensors of the carpus from the anconeus. The lower half of the bone can also be felt under the skin; the intermediate portion lies deeply under the extensor group of muscles. The general shape of the lower extremity of the bone can be traced with ease. The well-marked anterior projection to the radial side of the flexor tendons under the radial artery, and the well-marked hollow above that projection, are to be made out. Note also the bony tubercle on the posterior surface of the carpal extremity of the radius, indicating the situation of the oblique tendon of the secundi internodii pollicis. Observe the well-marked posterior projection of the head of the ulna, and the difference in level of the styloid processes of the radius and ulna—the radius extending half an inch farther down than the ulna.

Fractures.—47. The muscles of the forearm are divided by anatomists into four great groups—the flexors and pronators, and the extensors and supinators. In connection with our present subject, the flexors and extensors of the carpus and fingers may be considered to counterbalance one another. Their tendency will be to shorten the forearm.

This can only occur to any extent when both bones are broken, and when the line of fracture is oblique. The supinators, more especially the supinator biceps, both pronators, and the flexor biceps, are the powerful displacing causes in fractures in this region. When *both bones are fractured*, generally as the result of direct violence, they give way opposite one another; and the great difficulty the surgeon has to contend with is the adduction of the fragments towards one another by the action of the pronators. The powerful biceps muscle also tends to tilt the upper fragment of the radius forwards by its flexor action, and it would also supinate it by its supinator action if the pronator teres did not counteract this tendency. It is to be remembered that in the treatment of this fracture all pressure must be applied in an antero-posterior direction, in order to separate the bones from one another, and retain the normal breadth of the interosseous space. If this is not done, the movements of pronation and supination will afterwards be imperfect. There must be no pressure upon the radial and ulnar edges of the forearm, because such pressure would only tend to press the bones together.

48. *Fracture of the ulna alone* generally occurs from direct violence, as, for instance, when the arm is raised above the head to ward off a blow. The broken extremities pass towards the radius, in consequence of the direction of the force; the pronator quadratus tends to maintain the lower fragment in this abnormal position, and therefore this fracture must be treated on the same principle as fracture of both bones.

49. *Fracture of the radius alone.*—The radius may be broken at any part. When it is remembered that all the pronators and supinators are inserted into this bone, it will be easily understood that the displacements will be considerable, and vary according to the seat of fracture. If broken between the attachments of the supinator brevis and biceps, the upper fragment will be supinated by the supinator brevis; the lower fragment will be flexed by the biceps, its supinator action being counteracted by the pronator teres.

When broken between the attachments of the biceps and pronator teres, the upper fragment will be supinated and flexed by the biceps; the lower fragment will be pronated by the pronator teres. When broken between the attachments of the pronator teres and pronator quadratus, the supinator biceps will counteract the pronator teres, and the upper fragment will simply be flexed by the flexor biceps; the lower fragment will be adducted to the ulna by the pronator quadratus. There can be no better way of learning the action of these muscles than a study of the radius such as has been here indicated. Fractures of the shaft of the radius, however, are so rare, chiefly because the bone is protected from the effects of direct violence by the supinator and extensor group of muscles, that they are of little practical interest. It is very different with the fracture which has now to be considered.

50. *Fracture through the carpal extremity of the radius*, commonly called *Colles' fracture*. This common injury is the result of indirect violence from falls on the hand. The radius gives way within three-fourths of an inch of its carpal surface, where the bone consists of cancellated tissue enclosed in a thin shell of dense bone. (Plate VII. fig. 3.) The fracture is generally directly transverse. The symptoms of this injury are—(*a*) a projection on the back of the wrist; (*b*) a hollow above the projection; (*c*) a projection on the anterior surface of the forearm opposite the hollow; (*d*) the hand and carpus are drawn to the radial side; (*e*) an abnormal projection of the styloid process of the ulna; (*f*) a disappearance of the normal projection of the head of the ulna on the back of the wrist; (*g*) flexure of the fingers.

51. To understand the explanation of these symptoms, it is necessary to consider the displacement of the lower fragment. The displacement is a triple one: (*a*) backwards, as regards the antero-posterior diameter of the forearm; (*b*) rotation backwards of the carpal surface on the transverse diameter of the forearm; (*c*) rotation through the arc of a circle, the centre of which is situated at the ulnar attachment of the triangular ligament, the radius of the circle

being a line from the ulnar attachment of the triangular ligament to the tip of the styloid process of the radius. (*a*) When a person in falling puts out his hand to save himself, at the moment the hand reaches the ground the force is received principally by the ball of the thumb and passes into the carpus, and thence into the lower end of the radius. If, at the moment of impact, the angle between the axis of the forearm and ground is less than 60°, the line representing the direction of the force passes upwards in front of the axis of the forearm; the whole shock is therefore borne by the lower end of the radius, which is broken off, and the force being continued, the lower fragment is driven backwards. When at the moment of impact the angle is greater than 60°, the line of the force, instead of passing in front of the axis of the arm, passes up the arm, and the usual result is either a severe sprain of the wrist, or dislocation of the bones of the forearm backwards at the elbow-joint. (*b*) The carpal surface of the radius slopes forwards, and therefore the posterior edge of the bone receives the greater part of the shock; there is, as a result, rotation of the lower fragment backwards on the transverse diameter of the forearm. (*c*) The carpal surface of the radius slopes downwards and outwards to the radial edge of the arm; therefore the radial edge of the bone receives the principal part of the shock through the ball of the thumb. As a result this edge of the lower fragment is displaced upwards to a greater extent than the ulnar edge of the fragment, which remains firmly attached to the ulna by the triangular ligament. The fragment of bone, in other words, rotates through the arc of a circle, the centre of which is the ulnar attachment of the triangular ligament, the radius of the circle extending from this point to the apex of the styloid process of the radius.

52. Some years ago I had an opportunity of dissecting a recent example of this fracture. In it the upper fragment had passed into the lower fragment, crushing the cancellated tissue. *There was well-marked penetration, but no impaction.* I make a distinction between penetration and impaction.

Penetration is the passage of the one fragment into the other; when the distortion cannot be remedied by any justifiable force by the surgeon, then impaction has occurred. In every case of fractured radius with displacement backwards of the lower fragment, there is more or less penetration of the upper fragment into the lower, more especially towards the radial edge of the arm. The fracture occurs at the moment that the hand reaches the ground. The hand is fixed; the body passes forwards, the arm becomes more vertical, and as a necessary result of the weight of the body, acting through the arm, penetration of the upper into the lower fragment must take place. The examination of radii in which this fracture has taken place, and which have united with deformity, seems to me to corroborate this. The normal radius is longer posteriorly than anteriorly. In a radius which has united with deformity after this fracture, the posterior length is in the great majority of cases less; in some few cases equal to, but is never of greater length than the anterior measurement, as is the case in the normal radius. It is impossible to believe that after this injury the anterior surface of the bone is lengthened; we must therefore come to the conclusion that there is shortening of the posterior surface, and necessarily overlapping of the fragments. It can, however, never be more than half an inch, and that only to the radial edge of the arm if the ulna is unbroken, and the ligament joining the radius to the ulna remains entire; if the ulna is broken, or if this ligament is ruptured, then the triple displacement already described cannot occur; the case is not one of Colles' fracture. An interesting question here arises: Can this penetration—never more than half-an-inch, and that only at the radial edge of the arm—account for the impaction, sometimes so great as to prevent the surgeon restoring the radius to its normal shape? When we remember the great traction that can be applied to the lower fragment by pulling on the hand, it is in my opinion highly improbable that the penetration of the upper fragment into the friable cancellated tissue of the lower fragment can account for these cases of firm impaction.

I have already tried to show that this fracture generally occurs in consequence of falls on the hand, when the angle formed by the axis of the arm and the ground is less than 60°—generally about 45°. When at the moment of impact the angle is greater than 60°, the result (as already mentioned) is usually a sprain of the wrist or dislocation at the elbow. If, however, in such cases the radius gives way, it will be by the upper rounded articular surface of the carpus acting as a wedge, and splitting the lower end of the radius. A continuance of the force drives the carpus upwards into the cancellated tissue of the radius; it there becomes locked between the anterior and posterior surfaces of the bone, and will in such a position be firmly impacted. It is grasped by the radius, and held in position by the flexor and extensor tendons surrounding the bone. The more the surgeon pulls, the more tense do these tendons become, and the more firmly the carpus is held in its abnormal position. Smith of Dublin has denied that there is penetration, while Voillemier, and more recently Callender, hold that there is always penetration. While agreeing with them that penetration always occurs, I am of opinion that this penetration, as held by them, cannot account for these cases of firm impaction. The question can only be settled by the dissection of a recent case of impacted fracture, in which the surgeon has previously failed, during the life of the patient, to reduce the deformity. I am not aware that any such case has as yet been described. The primary penetration is the result of the direction of the force causing the fracture; a return of the deformity, in consequence of improper treatment, is due to muscular action. Too much stress has been laid on the action of the supinator longus and the extensors of the thumb; they no doubt act, but it must be remembered *that all the muscles (flexors and extensors) which pass from the forearm to the carpus and hand to the radial side of the ulnar attachment of the triangular ligament, assist in causing the deformity.*

53. *There is no change in the position of the ulna.* The normal projection of the head of the bone on the back of

the wrist disappears, in consequence of the passage backwards of the carpus and hand. The projection of the styloid process of the ulna at the ulnar edge is due to the passage of the carpus and hand to the radial side, as already described. I have never been able to satisfy myself that the transverse diameter of the forearm above the line of fracture is diminished. If this is the case, then there is no appreciable adduction of the radius to the ulna by the pronator quadratus. The projection on the anterior surface of the forearm is, in my opinion, only apparent, in consequence of the passage backwards of the lower fragment. The sternal fragment of the clavicle, in fracture, is apparently tilted upwards; but, as is well known, there is no real change in the position of this fragment, the passage of the acromial fragment downwards, in consequence of the weight of the arm, fully accounting for the apparent tilting upwards of the sternal fragment. The anterior projection in Colles' fracture is explained in the same way. It is not due, as is generally supposed, to the pronation of the long upper fragment by the pronator quadratus, which action will be counteracted by the powerful supinator action of the biceps. The locking of the fragments, which I have tried to show is a constant occurrence, will also prevent any appreciable pronation of the upper fragment by the pronator quadratus. Lastly, the flexion of the fingers, always observed in this fracture, is easily accounted for by the fact that the flexors are more powerful than the extensors. Flexion is the position of rest.

54. The common plan of treatment, by straight anterior and posterior splints stretching to the tips of the fingers, has not in my hands been followed by good results. The objection seems to me to be the anterior splint, which cannot, however well padded, be applied so as to accommodate itself to the convex anterior surface of the lower end of the radius. If the bandages are applied sufficiently tight to keep the splints in position, the anterior splint must, by its pressure on the anterior surface of the lower fragment, on the carpus and ball of the thumb, tend to counteract the action of the

posterior splint, which is the *essential* in the treatment of these cases, thickly padded over the lower fragment, so as to compel it to pass forwards, the bandage being applied from above downwards, so as to remedy the rotation backwards of the lower fragment. The posterior splint should only extend to the bases of the fingers; the anterior splint should only pass downwards to the lower end of the upper fragment; or if it passes to the palm of the hand, the portion of it corresponding to the normal projection of the lower end of the radius, the carpus, and the ball of the thumb, should be removed, so as to have no counter-pressure on these projecting points acting in opposition to the posterior splint. The fingers should be free from the commencement of the treatment; they should be moved by the surgeon daily, in order to prevent stiffening, which is easily prevented by these simple means, but most difficult to cure after it has once occurred. A careful examination of radii which have united with deformity after this fracture indicates that the bone is frequently splintered into the wrist-joint. Stiffness of the wrist—a most persistent and annoying sequela—is, in such cases, to be attributed to this complication, and not, as is generally supposed, to inflammatory adhesions taking place in the flexor and extensor sheaths. These adhesions account for the stiffness of the fingers, so often observed when the splints, extending to the tips of the fingers, are kept on for too long a period after the occurrence of the fracture.

55. Now that the fractures of the upper extremity have been discussed, it will be noticed how intimately associated the biceps muscle is with all fractures above and below the elbow-joint. It is therefore apparent that in their treatment the movements of the elbow-joint should be restrained by a rectangular splint. If this were done, ununited fractures of the humerus, radius, and ulna would be less frequent.

Radial Artery. 56 (Plate V. fig. 1).—This vessel is a direct continuation of the brachial artery. It extends from the neck of the radius to the radial edge of the anterior surface of the carpus, where it leaves the anterior aspect of the forearm, passing under the tendons of the extensor metacarpi pollicis and extensor primi internodii pollicis to reach the back of the wrist, where its course will be afterwards traced. The line on the surface of the body which corresponds to the situation of the vessel beneath, is one reaching from the neck of the radius to a point half-an-inch to the ulnar side of the styloid process of the radius. The vessel follows the line of the radius, and lies upon the muscles attached to that bone. The artery is divided into two parts: *the upper half*, which lies deeply, having the muscular belly of the supinator longus to its radial side, the muscular bellies of the pronator radii teres and flexor carpi radialis to its ulnar side; *the lower half*, which is superficial, and lies between the tendons of the supinator longus, and the flexor carpi radialis, the supinator longus to its radial side, the flexor carpi radialis to its ulnar side. There is no difficulty in reaching the lower half of the vessel; the only difficulty in the upper half is to strike the interspace between the muscular belly of the supinator longus and the bellies of the pronator teres and flexor carpi radialis. The artery is accompanied by venæ comites, and the radial nerve is in relation with the middle third of the vessel to its radial side. After ligature of the radial, the blood will reach the hand through the ulnar artery.

Ulnar Artery. 57 (Plate V. fig. 1).—From its origin at the termination of the brachial over the neck of the radius, this vessel runs in a curved direction towards the ulnar edge of the middle of the forearm; from that point it runs directly downwards in the line of the ulna, and passes out of the forearm into the palm, superficial to the annular ligament, to the radial side of the pisiform bone. It is divided into two parts. The first half lies deeply, and is crossed by the pronator teres, flexor carpi radialis, palmaris longus, and flexor sublimis digitorum muscles, which arise from the internal condyle; the lower half is superficial, lying between the tendons of the flexor sublimis digitorum and flexor carpi ulnaris,—the latter to its ulnar side. It lies upon the brachialis anticus and the flexor profundus digitorum. It is accompanied by venæ comites, and the ulnar nerve lies to its ulnar side in the lower half of its course. It is crossed by the median nerve one inch from its origin, and gives off the common interosseous trunk about two inches from its commencement. To reach the lower half of the vessel an incision has to be made to the radial side of the tendon of the flexor carpi ulnaris; to reach the upper half of the vessel it will be necessary to divide the muscles which arise from the internal condyle. When the ulnar artery is ligatured the blood reaches the hand through the radial.

58. When both radial and ulnar are ligatured, the blood reaches the hand through the anastomoses between the interosseous arteries, with the carpal arches which anastomose with the deep palmar arch. (Plate XXX. fig. 3.) Hence the inutility of ligaturing the radial and ulnar arteries in cases of wounds of the palmar arches. The proper treatment is to ligature the wounded artery at the bleeding point, or to stop the hæmorrhage by direct pressure by means of a graduated compress.

CHAPTER V.

REGION OF THE WRIST AND HAND.

The anatomy of this region will be considered under the following heads :—(a) *External Anatomy* ; (b) *Excision of the Wrist-Joint* ; (c) *Palm of the Hand* ; (d) *Fingers*. (Plates VI. and VII.)

External Anatomy.—59. Observe at the base of the muscular prominence forming the ball of the thumb, the bony prominence formed by the tubercle of the scaphoid bone and the anterior surface of the trapezium. On the anterior surface of the wrist, to the ulnar side, note the well-marked bony prominence formed by the pisiform bone and the hook-shaped process of the unciform ; they cannot be separated from one another by the sense of touch in the undissected limb. The posterior projection of the head of the ulna, and the relative positions of the styloid processes of the radius and ulna, have already been noticed (page 25). The relative positions of the tendons have now to be noted. (Plate VII. fig. 2.) *Anterior aspect.*—Commencing at the radial side, the thumb being extended, the tendinous ridge formed by the extensores metacarpi and primi internodii pollicis can be felt ; to its ulnar side the radial artery is felt pulsating ; next, the flexor carpi radialis ; next, the common flexors of the fingers ; next, the ulnar artery and nerve ; and lastly, the tendon of the flexor carpi ulnaris, running to its attachment to the pisiform bone. *Posterior aspect.*—If the thumb is extended, the oblique tendon of the extensor secundi internodii pollicis becomes prominent ; in the hollow to its radial side the radial artery is felt pulsating. If the forefinger is extended, the indicator tendon is visible. This tendon forms an angle with the tendon of the extensor secundi internodii pollicis over the centre of the lower extremity of the radius. The common extensors of the fingers and the extensor minimi digiti lie to the radial side of the prominence of the head of the ulna; the tendon of the extensor carpi ulnaris lies to its ulnar side.

60. *The radial artery* has already (page 32) been described on the front of the forearm. It leaves that region by passing under the extensors of the metacarpal bone and first phalanx of thumb to the distal side of the styloid process of the radius. From this point it passes obliquely across the back of the wrist, to reach the interspace between the bases of the first and second metacarpal bones, between which it passes to join the deep palmar arch. In its course it is crossed by the oblique tendon of the extensor of the second phalanx of the thumb, and lies upon the external lateral ligament of the wrist-joint.

Excision of the Wrist-Joint.—61. The object of this operation is to remove the carpus, the carpal extremities of the radius and ulna, and the carpal extremities of the metacarpal bones. The incisions required to obtain proper access to these bones have been planned by Mr. Lister in such a way that the extensor and flexor tendons of the fingers and thumb, and the radial and ulnar arteries, are uninjured. The *ulnar incision* (Plate VI. fig. 1) runs along the ulnar edge of the carpus, and is continued upwards along the ulna, downwards along the fifth metacarpal bone for a sufficient distance. The *radial incision* (Plate VI. fig. 2) commences over the centre of the lower end of the radius, in the angle formed by the extensor tendon of the forefinger and the extensor secundi internodii pollicis. From this point it runs along the ulnar side of the tendon of the extensor secundi internodii pollicis, until it reaches the radial edge of the metacarpal bone of the index-finger, along which it is continued towards the knuckle. By such an incision the radial artery will be avoided.

The Palm of the Hand. 62 (Plate VII. figs. 1 and 4).—The close connection of the dense cuticle with the subcutaneous fat, and powerful palmar fascia, is to be remembered; also the position of the anterior annular ligament of the wrist, stretching from the scaphoid and trapezium on the radial side, to the pisiform and unciform bones on the ulnar side. Under the annular ligament the flexor tendons lie, enveloped in their common synovial sheath (Plate VII. fig. 4). When fluid collects in this sheath, the annular ligament gives it the characteristic hour-glass appearance—a prominence in the palm and a prominence in the lower part of the forearm. When matter collects under the palmar fascia early incision is called for. The situation of the palmar arches and their branches should be remembered. The *superficial palmar arch* (Plate VII. figs. 1 and 4); a line drawn transversely across the palm from the angle formed by the fully-extended thumb with the palm, indicates the situation of the superficial palmar arch. The *deep palmar arch* lies about half-an-inch to the proximal side of this line. (Plate VII. figs. 1 and 4). The digital arteries from the superficial palmar arch arise opposite the intervals between the fingers, and bifurcate, half-an-inch from the clefts of the fingers, into the terminal digital arteries, which run along the sides of the fingers. If these facts are remembered when incisions are necessary, injury to these arteries will be avoided.

The Fingers.—63. It is to be remembered that the metacarpo-phalangeal joints admit the movements of flexion and extension, and lateral movement, and their combination—a rotatory movement; while the phalangeal joints admit only of flexion and extension. Each digit has a well-marked synovial sheath. The flexor sheaths of the thumb and little finger frequently communicate with the common flexor sheath; and therefore, in cases of suppuration within the digital flexor sheaths, early incision, although necessary in all the digits, is specially called for in inflammation attacking the flexor tendons of the thumb and little finger. Plate VII. fig. 4 illustrates the close proximity of the flexor sheath of the middle finger to the common flexor sheath in the palm. The extensor tendons on the back of the wrist are also enclosed in synovial sheaths, frequently the seat of chronic inflammation or ganglion.

These sheaths are compartments of the posterior annular ligament. They are six in number:—(1) for the extensors of the metacarpal bone and first phalanx of the thumb; (2) for the extensors of the radial side of the carpus; (3) for the extensor tendon of the second phalanx of the thumb; (4) for the common extensor; (5) for the extensor of the little finger; (6) for the extensor of the ulnar side of the carpus.

64. *Synovial membranes of the wrist* (Plate VII. fig. 3).—There are five separate synovial sacs:—(1) for the radio-ulnar articulation; (2) for the joint between the carpus and the radius and ulna; (3) between the cuneiform and pisiform bones; (4) between the first metacarpal and trapezium; and lastly (5), a large synovial sac, common to the articulations between the remaining carpal bones and the joints between the second, third, fourth, and fifth metacarpal bones and the carpus.

LOWER EXTREMITY.

THE anatomy of the LOWER EXTREMITY will be considered under Four Regions :—Chap. I. *The Hip and Thigh ;* Chap. II. *The Knee ;* Chap. III. *The Leg ;* Chap. IV. *The Ankle and Foot.*

CHAPTER I.

REGION OF THE HIP AND THIGH.

The anatomy and injuries of this region will be considered under the following heads :—(*a*) *The Hip—External Anatomy ;* (*b*) *The Thigh—External Anatomy ;* (*c*) *Femoral Artery ;* (*d*) *The Hip-Joint ;* (*e*) *The Muscles which act on the Hip-Joint ;* (*f*) *Dislocations at the Hip-Joint ;* (*g*) *Disease of the Hip-Joint ;* (*h*) *Fracture of the Neck of the Femur ;* (*i*) *The Muscles of the Thigh ;* (*j*) *Fractures of the Shaft of the Femur.*

The Hip.—65. EXTERNAL ANATOMY (Plate VIII. fig. 1 ; Plate X. fig. 1).—The crest of the ilium can be traced subcutaneously from the sharp and pointed anterior superior spinous process to the rounded posterior superior spinous process. As the finger is passed backwards along the crest, a bony prominence will be felt at that point of the curve farthest from the middle line of the body ; this point lies in the lateral line of the body, and marks the junction of the middle curved line with the crest. The upper border of the symphysis pubis, the crest of the pubis, and the spine of the pubis can be felt. Poupart's ligament stretches from the spine of the pubis to the anterior superior spine of the ilium ; it arches downwards in the undissected limb. If the limb is flexed, a well-marked sulcus will be observed running across the thigh, parallel to and at a lower level than Poupart's ligament. The anterior edge of the arch of the pubis can be traced backwards to the rounded tuberosity of the ischium. In the sitting posture this projection is subcutaneous, and is clothed by a bursa, which is sometimes enlarged; in the erect posture the lower edge of the gluteus maximus overlaps the tuberosity. The quadrilateral shape of the trochanter major can be traced with ease; the tendon of the gluteus maximus plays over it. This is facilitated by a bursa between the bone and the tendon; a bursa also exists between the tendon and the skin. The trochanter major is mobile, and if the limb is rotated outwards and inwards, it will be felt passing along the circumference of a circle, the centre of which is the bottom of the acetabulum, the radius of the circle being the neck of the femur. If a transverse line is carried inwards from the tip of the trochanter, it will in the adult pass through the centre of the head of the femur. The relation of this line to the head of the bone will necessarily vary with the obliquity of the neck to the shaft, the angle being greater in the child than in the adult, in the adult than in the aged person.

66. An accurate knowledge of the normal relation of the trochanter to the os innominatum is of great value in the diagnosis of injuries of the hip-joint. Its position must be fixed both vertically and antero-posteriorly. In the erect posture its upper border is on the same level as the upper border of the symphysis pubis. If the patient stands in the military position of "attention," the heels together and the toes turned outwards—the feet forming an angle of 60°—a vertical line drawn along the anterior edge of the prominence will pass through the bony projection on the crest of the ilium, already described as marking the junction of the middle curved line with the crest. The outer surface of the trochanter faces in the same direction as the external condyle of the femur, the head of the bone in the direction of the internal condyle.

67. The lymphatic glands in the groin can be distinctly felt. They form two chains; (Plate XXI. fig. 1)—(1) the *inguinal*, passing along the line of Poupart's ligament; (2) the

femoral, running along the line of the internal saphenous vein, which passes through the saphenous opening to join the femoral vein. The hollow of the saphenous opening can be made out; in it femoral hernia first appears internal to the femoral vein. (Plate XXII. fig. 3.) The femoral artery can be felt pulsating midway between the symphysis pubis and the anterior superior spine of the ilium. In compressing this vessel, pressure must be made in a backward direction; care must be taken to compress the vessel against the fixed brim of the pelvis, and not over the mobile rounded head of the femur, where displacement is apt to occur if any movement of the limb takes place. It is to be remembered that a comparison can always be made between the bony points on both sides of the body. Any obliquity of the pelvis will be at once indicated by a difference of level in the anterior superior spinous processes.

68. The crest of the ilium has already been traced backwards to the posterior superior spinous process; this prominence corresponds to the centre of the sacro-iliac synchondrosis. In the middle line the spines of the sacral vertebræ can be felt; also the tubercles of the last sacral vertebra and the triangular shape of the coccyx, the tip of this bone lying in the groove between the buttocks. The projection of the buttock is formed by the gluteus maximus, with a dense thick pad of fat over it. The transverse fold of the buttock corresponds to the lower border of the muscle. In the extended position of the limb the lower fibres of the muscle are lax, and the fold is well marked; when the limb is slightly flexed the fold becomes oblique, and loses its well-marked transverse character, the muscular fibres being stretched, and their true oblique direction becoming more evident. This obliquity in the fold has been described in the early stages of hip-joint disease as due to a wasting of the muscle. In this disease the patient flexes his limb, for reasons to be afterwards described (par. 82), and it is to this flexure that the obliquity of the fold is due.

69. It is of importance to fix upon the surface of the body the points which correspond to the exit from the pelvis

of the gluteal, ischiatic, and pudic arteries, through the great sacro-sciatic notch. (Plate XI. fig. 1.) If a line is drawn from the posterior superior spinous process of the ilium to the tuberosity of the ischium, the gluteal artery issues from the pelvis at a point about an inch external to the junction of the upper and middle thirds of this line; the ischiatic and pudic arteries a couple of inches lower down. The great sciatic nerve issues from beneath the border of the gluteus maximus muscle, midway between the tuberosity of the ischium and the trochanter major, and runs vertically down the posterior aspect of the thigh, amongst the flexor muscles, to the apex of the popliteal space, where it divides into the internal and external popliteal nerves.

The Thigh. 70. External Anatomy (Plate VIII. fig. 1; Plate X. fig. 1).—The oblique line of the sartorius can be made out on the living subject if the patient is asked alternately to flex and extend the knee. The breadth of the muscle varies with the muscularity of the individual. Its upper border crosses the femoral artery three or four inches below the commencement of the vessel at Poupart's ligament. This point corresponds to the apex of Scarpa's triangle, the sartorius muscle forming the outer boundary of the triangle, the adductor longus its inner boundary, Poupart's ligament its base. It is to be remembered that the area of the space is much smaller in the undissected than the dissected limb. The anterior prominence of the thigh is formed by the mass of the extensor group of muscles; the adductor group forms the internal prominence; and posteriorly the flexor group of hamstring muscles can be felt arising from the tuberosity of the ischium, and forming one muscular mass until their divergence to form the external and internal boundaries of the popliteal space. The femur is nearer the anterior than the posterior surface of the limb.

Femoral Artery.—71. This vessel is a direct continuation of the external iliac. Commencing at Poupart's ligament, it extends from a point midway between the anterior superior spinous process of the ilium and the symphysis pubis to the opening in the adductor magnus muscle, through which it passes to become the popliteal artery. If the limb is semi-flexed at the knee and rotated outwards, a line drawn from the commencement of the vessel to the internal condyle of the femur indicates on the surface of the body the situation and direction of the artery. If pressure outwards is made on this line in the middle of the thigh, the artery will be compressed against the femur. The artery is divided into two parts, the upper half lying in Scarpa's triangle, the lower half in Hunter's canal.

72. *The femoral artery in Scarpa's triangle* (Plate IX. fig. 1).—This portion of the vessel is superficial, being covered by skin, and the superficial and deep fasciæ. It enters the triangle at Poupart's ligament, and leaves it at the apex of the space where the sartorius and adductor longus muscles meet. It is enclosed along with the vein in a distinct sheath, derived from the transversalis and iliac fasciæ of the abdomen. The vein lies at first on the same plane as the artery, and to its inner side; towards the apex of the triangle, although still lying to its inner side, it tends to pass to a deeper plane behind the vessel. The long saphenous nerve lies on the front of the sheath at the apex of the space. The vessel lies upon the psoas and pectineus muscles; it gives off, in addition to several cutaneous branches, the deep femoral artery, which generally arises about a couple of inches below Poupart's ligament. The cutaneous branches arise above the origin of the deep femoral. The artery below the origin of the deep femoral is free from branches.

73. This portion of the vessel is generally ligatured at the apex of the space. The limb being semi-flexed at the knee and rotated outwards, the knee resting on a pillow, an incision, the centre of which corresponds to the apex of the triangle, is made in the line of the vessel; the skin, subcutaneous fat, and muscular fascia, are divided; the inner edge of the sartorius which overlaps the artery is exposed, the muscle is drawn outwards, and the sheath comes into view. This is carefully opened, and the artery is gently separated from its connections to an extent sufficient to

enable the operator to pass the aneurism needle round the vessel from within outwards, so as to avoid injury to the vein.

74. *The femoral artery in Hunter's canal* (Plate IX. fig. 2).—To understand the relations of this part of the vessel it is necessary to study a transverse section of the thigh. (Plate IX. fig. 3.) Hunter's canal is an interspace occupying the middle third of the inner aspect of the thigh, and extending from the apex of Scarpa's triangle to the opening in the adductor magnus. It is bounded externally by the vastus internus; internally and posteriorly by the adductor group of muscles; anteriorly and internally by the sartorius muscle. These muscles are enveloped by strong fascial prolongations from the fascia lata, the sartorius muscle being enclosed in a specially distinct fascial sheath. The artery lies in this canal, the vein lying behind and external, and the long saphenous nerve in front of the vessel. (Plate IX. fig. 2.) It gives off the anastomotica magna branch just before it passes through the opening in the adductor magnus muscle.

To reach the vessel an incision is made over the sartorius muscle in the line of the artery, the superficial structures are divided, the sheath of the sartorius is opened, the outer or anterior edge of the muscle is exposed, and the muscle is drawn inwards and backwards. The posterior layer of the sheath is then seen; this is divided in the line of the vessel, and the artery is seen lying in the canal; the internal saphenous nerve is avoided, and the aneurism needle is passed under the vessel, care being taken to avoid injury to the vein.

75. Anastomoses.—When the *femoral artery* is ligatured above the profunda femoris the blood will reach the limb beyond the seat of ligature, through the anastomoses between (*a*) the *gluteal* branch of the internal iliac and the ascending branches of the *external circumflex* branch of the profunda femoris; (*b*) the *ischiatic* and *obturator* branches of the internal iliac, and the *internal circumflex* branch of the profunda femoris; (*c*) the *pudic* branch of the internal iliac

and the *external pudic* of the femoral. (Plate XXXI. fig. 1.) When the *femoral artery* is ligatured below the origin of the profunda femoris the blood will reach the limb beyond the seat of ligature through anastomoses between (*a*) the descending branches of the *external circumflex* branch of the profunda femoris and the *external articular* branches of the popliteal; (*b*) the *perforating* and *terminal* branches of the profunda femoris and the *anastomotica magna* of the femoral, the *internal articular* branches of the popliteal, and the *recurrent branch* of the anterior tibial artery. (Plate XXXI. fig. 2.)

To acquire a proper understanding of the injuries of the region of the hip, it will be necessary to consider the anatomy (*a*) of the *Hip-Joint*, (*b*) of the *muscles which act on the Hip-Joint.*

The Hip-Joint.—76. The great strength of this joint is necessary in order to withstand the great strains to which it is subject in consequence of the powerful leverage due to the length of the femur. It is so arranged that its strength is of a threefold character—osseous, ligamentous, and muscular. It is a ball-and-socket joint—the spherical head of the femur fitting accurately into the hollow of the acetabulum, which is deepened by the cotyloid ligament. The accuracy with which the head of the femur fits the acetabulum is illustrated by the fact that if all muscles and ligaments around the joint are cut across, a force greater than the weight of the limb is necessary to separate the articular surfaces. The ligamentum teres is so placed that it restrains excessive rotation outwards. The posterior capsular ligament is weak as regards its longitudinal fibres; it is, however, strengthened in a transverse direction by circular fibres (Plate XI. fig. 3), which support the posterior aspect of the head of the bone when the thigh is fully flexed upon the abdomen. The anterior part of the capsular ligament is specially strong in longitudinal fibres, which have received a special name—the ilio-femoral band; it stretches from the anterior inferior spinous process of the ilium to the anterior intertrochanteric line (Plate XI. fig. 2). This ligament is tense when the limb is extended and forcibly rotated inwards; it therefore restrains excessive movement in either of these directions.

The Muscles which act on the Hip-Joint (Plate XI. figs. 1, 2, and 3).—*77.* The hip-joint is supported anteriorly by the conjoined psoas and iliacus tendon, and by the rectus femoris; posteriorly it is in intimate relation with the obturator internus and pyriformis tendons, internally and posteriorly with the obturator externus tendon. The muscles which arise from the pelvis and are inserted into the trochanter major, and upper extremity of the linea aspera of the femur, and fascia over the trochanter, are the gluteus maximus, the gluteus medius, tensor fasciæ femoris, the gluteus minimus, the pyriformis, obturator internus and gemelli, the obturator externus, and quadratus femoris. This group of muscles has a triple action in connection with the movements at the hip-joint;—(*a*) extension, (*b*) rotation outwards, (*c*) rotation inwards. In consequence of their posterior position and the downward direction of their fibres, the gluteus maximus, the posterior fibres of the gluteus medius, and the gluteus minimus, are powerful extensors. Inasmuch as their fibres run forwards to their femoral insertions, they also act along with the pyriformis, obturator internus and externus, gemelli, and quadratus femoris, as powerful rotators outwards at the hip-joint. On the other hand, the fibres of the anterior part of the gluteus medius, and the tensor fasciæ femoris act as weak rotators inwards, as their fibres are almost vertical, and have only a slight tendency backwards to their femoral insertion. A comparison of the relative size of the osseous areas behind and in front of a vertical line drawn through the pit of the acetabulum will best illustrate the *power* of the rotators outwards and the *weakness* of the rotators inwards; the extended osseous surface posterior to the vertical line passing through the acetabulum, from which the rotators outwards take their origin, is to be compared with the small area of the osseous surface, from which the rotators inwards take their origin, anterior to the same vertical line. It is also to be remembered that several of the rotators outwards arise within the pelvis, and leave the pelvis through the sacro-sciatic notches to reach their femoral insertion, practically increasing the area of the surface posterior to the vertical line through the acetabulum. The conjoined psoas and iliacus is a powerful flexor of the femur at the hip-joint; it also assists the rotators outwards, in consequence of its attachment to the posterior part of the trochanter minor. The adductor group of muscles adduct the thigh; and as their insertion into the linea aspera is posterior to their origin from the pelvis, they also act as rotators outwards. The hamstring muscles extend the lower extremity at the hip-joint; the rectus femoris assists the psoas and iliacus as a flexor at the hip-joint; the pectineus acts partly as an adductor, partly as a flexor.

Dislocations at the Hip-Joint.—78. These accidents are rare, on account of the great osseous and ligamentous strength of the joint. The muscles are also specially strong, and dislocation can only occur when they are taken at a disadvantage, as for instance when a miner is stooping, and receives a blow from falling earth on the back, driving the body forwards, and dislocating the head of the bone backwards. The powerful leverage of the femur, when a force is applied at and below the knee, tends to result in this injury, if the bone does not give way in consequence of its greater relative weakness.

79. These dislocations have been divided into four great classes:—1st, *Dislocation upon the dorsum of the ilium;* 2d, *Dislocation towards the sciatic notch;* 3d, *Dislocation into the foramen ovale;* 4th, *Dislocation upon the pubis.* This classification is of practical value, inasmuch as it has reference to the ultimate abnormal position of the head of the bone; but it must not be lost sight of that the *primary* displacement is always in the first instance in a downward direction, and that the position which the head of the bone ultimately assumes is due to the direction of the force which causes the dislocation; for example, in dislocation upon the dorsum the

head of the bone first passes downwards out of the acetabulum, and then upwards and backwards to its abnormal position. The head of the bone follows the same course in dislocation towards the sciatic notch. Bigelow's explanation of the distinction between these two dislocations is, that in the former, namely dislocation upon the dorsum, the head of the bone in its upward and backward passage passes between the tendon of the obturator internus and the pelvis, while in the latter, dislocation towards the sciatic notch, the head of the bone in its backward course passes behind the tendon of the obturator internus muscle, the tendon lying between the neck of the bone and the pelvis. I have myself seen a dissection of a case, which proved the truth of Bigelow's statement as far as regards the dislocation towards the sciatic notch. In dislocation into the foramen ovale the head of the bone first passes downwards, then forwards into its abnormal position. In dislocation upon the pubis the head of the bone first passes downwards, then forwards and upwards to its abnormal position. In all these dislocations the ilio-femoral band remains entire, while the posterior part of the capsular ligament and the ligamentum teres are ruptured. When the head of the bone in its abnormal position is above the level of the acetabulum, as in the dislocations upon the dorsum, and towards the sciatic notch, there will be shortening of the limb. When the head of the bone lies below the level of the acetabulum, as in the dislocation into the foramen ovale, there will be lengthening of the limb. In dislocation upon the pubis the length of the limb is unchanged, because the head of the bone lying upon the pubis is on the same level as the acetabulum. Inversion of the limb is a marked symptom in dislocation on to the dorsum ilii, and in dislocation towards the sciatic notch. This must necessarily occur if the ilio-femoral band remains intact. In these injuries the ilio-femoral ligament is stretched, because the distance between the anterior inferior spinous process and anterior inter-trochanteric line—its pelvic and femoral attachments—is increased in consequence of the passage backwards of the head of the bone. The integrity of the ligament causes the inversion. Any attempt to evert the limb will, with the head of the bone in its abnormal position, tend still further to stretch the ligament; hence the powerlessness of the rotators outwards to cause eversion. Before eversion can take place the ligament must be ruptured. In dislocation into the foramen ovale, when the patient stands erect, the limb is flexed, because, in consequence of the lengthening of the limb, the ilio-femoral band and the psoas and iliacus tendon are stretched, and they by their elasticity necessarily flex the limb; and if an attempt is made to extend the limb, the body will then be flexed upon the thigh. In dislocation upon the pubis eversion of the limb occurs, chiefly in consequence of the fixed position of the head of the bone, but also because the posterior rotators-outwards are stretched; the ilio-femoral band, lax in consequence of the approximation of its attachments, affords no ligamentous obstacle to the action of these muscles.

80. A consideration of the causation of these dislocations enables us to divide them into two great groups—(1) those dislocations in which *the head of the bone* lies *posterior to a vertical line through the acetabulum;* and (2) those dislocations in which *the head of the bone* lies *anterior to the same vertical line.* Under the first head are dislocation upon the dorsum, and dislocation towards the sciatic notch. Under the second head are dislocation into the foramen ovale, and dislocation upon the pubis. A recollection of this primary division of these injuries will be of great assistance when we attempt their reduction by the so-called flexion treatment, first recommended by the French surgeons, and lately prominently brought before the notice of the profession by the American surgeon Bigelow of Boston. The points to be remembered are;—*First,* the ilio-femoral band is uninjured; *Second,* the powerful leverage of the femur,—the long arm of the lever stretching from the knee-joint to the intertrochanteric line, the short arm of the lever being the neck and head of the bone, the fulcrum or fixed point being the femoral attachment of the ilio-femoral band; *Third,* that the head of

the bone, in passing from its abnormal position into the acetabulum, must be made to retrace its steps along the same course which it followed when the dislocation occurred. The necessary manipulations are;—*first,* forcible *flexion* of the thigh on the abdomen, in order to relax the ilio-femoral band; *second, circumduction* of the limb *outwards* in the dislocations upon the *dorsum* and towards the *sciatic notch, circumduction* of the limb *inwards* in the dislocations into the *foramen ovale* and upon the *pubis,* in order to carry the head of the bone opposite the rupture in the posterior part of the capsular ligament; *Third,* extension of the limb, in order to compel the head of the bone to pass through the opening in the capsular ligament into the acetabulum.

81. A comparison between the flexion treatment of dislocations of the shoulder and hip shows their close similarity. In both the head of the bone first passes in a downward direction, and then either backwards or forwards, according to the direction of the force causing the injury. The shaft of the humerus corresponds to the shaft of the femur; the muscles attached to the tuberosities of the humerus take the place of the ilio-femoral band; abduction of the arm from the side corresponds to the flexion of the thigh on the abdomen; circumduction outwards or inwards, as the case is one of displacement backwards or forwards, carries the head of the humerus or the femur opposite the opening in the capsular ligament; and lastly, the bringing of the upper limb down to the side corresponds to the forcible extension of the femur; and the result in either case is the reduction of the dislocation.

Disease of the Hip-Joint.—82. As is well known, one of the first symptoms of this disease is flexion of the thigh, the toe of the affected limb touching the ground, the heel being raised. There is also more or less obliquity of the pelvis, and a drooping and rotation forwards of the affected side, in order that the patient's toes may reach the ground easily, without excessive extension of the foot. This position is taken up in order that the patient may use the affected limb to balance himself in standing, the main weight of the body being supported by the sound limb. If the disease is recent the obliquity of the pelvis disappears when the patient is laid in bed; the limb, however, still remains flexed, and if the surgeon, by pressing on the knee, attempts to extend the limb, the back is at once arched. To understand the anatomy of this symptom, it must be remembered that there is in the early stages of the disease an inflammatory tenderness of the joint, an increase in the amount of the synovial fluid, as indicated by an abnormal fulness over the joint anteriorly; pain also is experienced when pressure is made in this region. If the limb is extended, the back being unarched, the ilio-femoral band is rendered tense, and the psoas and iliacus tendon is also of necessity stretched. In order to relax these structures, and thereby relieve the tenderness caused by the pressure of the ligament and tendon, the patient naturally flexes the limb; and if, in the supine posture, any attempt is made to extend the limb, the patient arches the back in order to relax the ligament and tendon.

82*a*. It may be well to refer here to the fact that flexion of the limb is one of the earliest symptoms of commencing suppuration under the psoas fascia. As a result of caries of the bodies of the vertebræ, the patient flexes the limb in this disease in order to relax the psoas muscle and its fascia. It is therefore always right, in cases of suspected hip disease, to examine the spines of the vertebræ, in order to see that the seat of the mischief is not really the vertebræ, the hip being unaffected.

82*b*. If we examine the buttocks in a healthy person in the erect posture, the transverse character of the folds will be noticed. If we now ask him to bear the weight of the body on one limb, and rest the toes of the other limb only on the ground, the transverse character of the fold on the buttock on that side will at once disappear, and it will become oblique, as in the early stages of hip-joint disease. This simple experiment will at once show that the obliquity of the fold in the *early* stages of hip disease is simply due to the position of the limb, and not to any wasting of the gluteus maximus muscle. This explanation will recall the description already given of dislocation into the foramen ovale, in which it will be remembered that the flexion of the limb is due to the stretching of the ilio-femoral band and psoas and iliacus tendon.

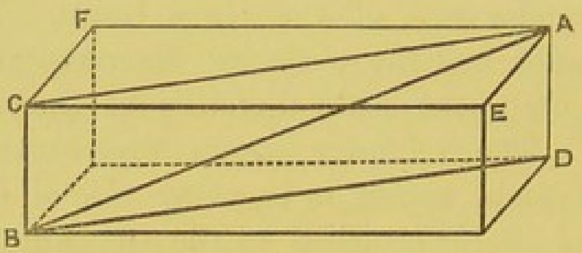
Fracture of the Neck of the Femur.—83. This fracture generally occurs in old people, because in them the angle between the neck and shaft of the bone is less than it is in the adult, and the neck of the bone has therefore to bear a greater strain, applied in the same direction as the vertical axis of the limb. In this fracture *shortening* is considerable, and is caused by all the muscles which arise from the pelvis and run downwards to be attached to the distal side of the fracture; for example, the psoas and iliacus, the rectus femoris, and the mass of the gluteal muscles and hamstrings, act in this way. The limb is *everted*, partly by its natural tendency to fall outwards, but also by the action of the powerful rotator outwards. In this fracture sometimes *inversion* is met with. An attempt has been made to explain this symptom by muscular action. Mr. Guthrie has said that the line of fracture in these cases passes through the trochanter major and upper part of the shaft of the femur, and emerges below the trochanter minor. As a result, the digital fossa, to which powerful rotators outwards are attached, and the trochanter minor—into which the psoas and iliacus tendon (also a powerful rotator outwards) is inserted—are connected with the upper fragment, while the outer surface of the trochanter major remains attached to the lower fragment; into it the gluteus medius, and into the fascia over it the tensor fasciæ femoris are inserted, and act as rotators inwards, forcibly inverting the limb.

Can it be possible to believe that this is the true explanation when we remember the weakness of the rotators inwards, the small leverage they have, inserted as they are close to the upper extremity of the lower fragment, and the great weight of the limb which they are required to invert? The explanation of Smith of Dublin, viz. that the inversion in this fracture is due to impaction, is, in my opinion, the true explanation. Muscular action has, I believe, nothing whatever to do with it.

The Muscles of the Thigh.—84. To understand the action of these muscles in fractures of the shaft of the femur, it must be remembered that the power of each muscular fibre in the region can be resolved into one or more of three directions;—(*a*) *longitudinal* in the long axis of the limb; (*b*) *transverse* in the lateral diameter of the limb; (*c*) *antero-posterior* in the antero-posterior diameter of the limb. Rotation is the result of the combined action of the transverse and antero-posterior fibres. The great majority of the muscular fibres have a compound action. While this is true, there are muscles whose main action entitles us to class them under one of the three heads. The anterior *extensor* muscles and the posterior *flexor* muscles are types of the *first* group, the main direction of their fibres being *longitudinal*. The *adductor* group represents the *second* group; their main action is to cause *lateral* displacement. The *psoas* and *iliacus* attached to the trochanter minor, and the *gastrocnemius* attached to the condyles, represent the *third* group; their main action is to cause antero-posterior displacement. While these muscles may be taken as types of the three great directions in which displacement may occur, it is evident that the majority of their fibres have a compound action, the adductor group for instance (with the exception of the upper transverse fibres of the adductor magnus) have a triple action, longitudinal, transverse, and antero-posterior; the psoas and iliacus have also a triple action; the rectus femoris, crureus, and the hamstrings may, on the other hand, be considered as fibres which have only one action, namely longitudinal.

Let A represent the point of origin of the adductor longus from the pubis; A F the longitudinal axis of the limb; A E the transverse axis; A D the antero-posterior axis. Let A B represent in direction the downward, outward, and backward direction of the adductor fibres, and in length the power of contraction of the same fibres; complete the solid rectangular figure A F C B D, of which A B is the diagonal.

By the parallelogram of forces, the force represented by A B is the resultant of two forces which are represented by A D and A C; and the force represented by A C is the resultant of two forces represented by A F and A E. Therefore the force represented by A B can be resolved into the three forces represented by A D, A E, and A F. A B represents the adductor fibres, and the three lines A D, A E, and A F represent the direction of the three axes of the limb (A D = antero-posterior, A E = transverse, A F = longitudinal), therefore the power of the adductor fibres can be resolved into and is represented by an antero-posterior, a transverse, and a longitudinal force.



Fractures of the Shaft of the Femur.—85. These fractures may be divided into; (*a*) *fracture below the trochanter minor,*—(*b*) *fracture above the condyles,*—(*c*) *fracture of the middle third of the shaft.* In the first variety (*a*) the upper fragment is tilted forwards by the action of the psoas and iliacus (antero-posterior displacement); the lower fragment is drawn inwards by the adductor fibres (lateral displacement). In the second variety (*b*) the lower fragment is tilted backwards by the gastrocnemius (antero-posterior displacement). The upper fragment is drawn inwards by the adductor muscles (lateral displacement). In the third variety (*c*) the plane of the fracture is generally oblique from above downwards and forwards; in it the adductor fibres attached to the lower fragment have a twofold action, they draw it inwards (lateral displacement), and they also cause shortening (longitudinal displacement). In all three varieties there will necessarily be longitudinal displacement, or shortening, caused principally by the extensors and flexors, assisted by the longitudinal force of the adductors. In all three varieties there will be rotation outwards of the limb, because the rotators outwards are more powerful than the rotators inwards. The natural tendency of the limb when at rest to be everted will assist the action of the rotators outwards.

86. To apply these considerations to the treatment, it will be seen that the action of the longitudinal fibres causes shortening, and is counteracted by the extending and counter-extending forces of the perineal band and the handkerchief fixing the foot, if the long splint is used; or if the modern extension treatment is adopted, then the extending force will be the weight hanging over the pulley at the foot of the bed, the counter-extending force, the weight of the patient's body obtained by raising the foot of the bed. One or other of these means is necessary in all fractures of the femur, because in all there is shortening. In consequence of the attachment of the adductor fibres along the whole length of the linea aspera, lateral splints will be necessary in all fractures, in order to counteract lateral displacement. In fractures high up below the trochanter minor, and in fractures low down above the condyles, the antero-posterior displacement is marked, therefore anterior and posterior splints are necessary to counteract in one case the psoas and iliacus, in the other the gastrocnemius muscle. Rotation outwards, or eversion of the limb, is counteracted by the long splint, or by the use of a sand-bag along the outer aspect of the limb, if the case is treated with the "extension apparatus" alone. As a general rule it will be found that a combination of the long splint to prevent eversion, and the extension apparatus to counteract shortening, along with lateral, or anterior and posterior splints, according to the situation of the fracture, is the most efficacious way of treating the majority of cases of fracture of the femur.

The irksome perineal band and the handkerchief fixing the foot are not required, the patient's body and the weight over the pulley taking their place as counter-extending and extending forces.

Chapter II.

REGION OF THE KNEE.

The anatomy and injuries of this region will be considered under the following heads:—(a) *External Anatomy;* (b) *Popliteal Artery;* (c) *Injuries of the Patella;* (d) *Dislocations of the Knee-Joint.* (Plates XII. figs. 2 and 3; XIV. fig. 1.)

External Anatomy.—87. The bony points to be noticed in this region are—*first,* the flat external condyle of the femur, in which the groove for the popliteus tendon can be felt; *second,* the internal condyle on which the sharp bony prominence to which the long tendon of the adductor magnus is attached can be made out; *third,* the anterior tubercle of the tibia to which the ligamentum patellæ is attached; *fourth,* the lateral tubercles of the bone, external and internal, the internal tubercle lying more posterior than the external; *fifth,* the well-marked head of the fibula on the same level as the anterior tubercle of the tibia; note how far back it lies behind the external tubercle of the tibia; *sixth,* the patella freely moveable in the extended position of the limb, firmly fixed between the condyles when the leg is flexed. The bony prominence on the internal condyle for the attachment of the tendon of the adductor magnus is on the same level as the highest cartilaginous point on the femur. When the leg is fully flexed, the anterior surface of the internal condyle becomes prominent; there is a distinct hollow above the patella, indicating the upper part of the trochlear surface; the sharp anterior edge of the external condyle can also be distinctly felt. In this position of the knee the ligamentum patellæ becomes tense and prominent; on either side of it a well-marked hollow is to be observed; these hollows disappear when there is an accumulation of synovial fluid within the joint. The bursa patellæ enlarged in housemaid's knee lies over the ligamentum patellæ in the extended position of the limb, when the knee is bent it lies directly over the patella. The synovial membrane of the joint extends inferiorly to the level of the head of the fibula, superiorly it ascends about two inches above the upper border of the patella, passing beneath the quadriceps extensor cruris; it rises to a higher level internally than externally (Plate XIV. fig. 1). There is a synovial membrane between the head of the fibula and the tibia. As a general rule this joint is separate from the knee-joint; in some cases, however, there is a communication. Posteriorly and externally the rounded tendon of the biceps can be felt descending to the head of the fibula (Plate XII. fig. 2); the peroneal nerve lies immediately to the inner side of this tendon. Posteriorly and internally the semi-tendinosus and semi-membranosus can be made out (Plate XII. fig. 3). The two heads of the gastrocnemius stand out prominently in the extended position of the limb. The hollow of the popliteal space disappears in this position of the limb in consequence of the stretching of the strong popliteal fascia. Superficial to the fascia the external saphenous vein runs vertically upwards and pierces the fascia at the level of the articular surface of the tibia to join the popliteal vein. The internal popliteal nerve runs vertically downwards in the mesial line through the space. This nerve lies immediately under the deep fascia, the popliteal vein lies under the nerve, the popliteal artery under the vein. The floor of the space is formed by the triangular surface of the lower end of the femur, by the posterior ligament of the joint, and by the popliteus muscle. The knee-joint owes its great strength to powerful ligaments; the lateral ligaments are specially strong. The ligamentum patellæ and the patella support the joint anteriorly; the posterior ligament of the joint is strengthened by the insertion into it of the tendon of the semi-membranosus muscle; the strong crucial ligaments bind the tibia to the femur, and, along with the lateral ligaments, prevent any lateral movement of the joint. When this joint is diseased these ligaments become softened or destroyed, and allow of lateral movement. There is a bursa between the ligamentum patellæ and the upper part of the tibia; there is another large bursa between the semi-membranosus and the inner head of the gastrocnemius. Mr. Holden states that this bursa communicates with the knee-joint in every fifth person.

Popliteal Artery.—88. This vessel lies in the popliteal space. It is a direct continuation of the femoral, and extends from the opening in the adductor magnus to the lower border of the popliteus, where it divides into the anterior and posterior tibial arteries. It lies upon the floor of the popliteal space; the vein lies superficial to it, and the internal popliteal nerve lies superficial to the vein. The popliteal space is filled by a quantity of fat which surrounds the vessel. Five branches are given off from the artery—four articular branches, which supply the superficial structures, and an azygos branch, which supplies the joint. The vessel is only ligatured in cases of wound. It is very evident that the operation will be a difficult one, in consequence of the great depth of the artery and the important structures which lie superficial to it. There is a free arterial anastomosis around the patella and over the condyles, formed by the articular branches of the popliteal, the anastomotica magna and descending branches of the external circumflex of the femoral, and the recurrent branch of the anterior tibial.

Injuries of the Patella.—89. Dislocations.—This bone may be dislocated outwards or inwards; this injury occurs most frequently in the outward direction, and when the limb is in the extended position. The angle outwards at the knee, formed by the leg and thigh, predisposes to dislocation outwards of the patella. The reduction of the dislocation will be facilitated by extension of the limb. The patella is sometimes dislocated, so that it lies on its outer or inner edge in the hollow between the condyles. This dislocation will be easily reduced if the limb is extended.

90. Fractures.—These occur either from direct or indirect violence. When the knee is flexed the patella is fixed, and is not displaced by the blow. The extended position of the limb predisposes to dislocation; the flexed position to fracture. The patella is also sometimes fractured in consequence of the powerful contraction of the quadriceps extensor; the fracture is generally transverse. The quadriceps extensor muscle draws the upper fragment upwards, and if the knee is bent the interspace between the fragments is greatly increased, enabling one to feel the hollow between the condyles of the femur. The ligamentum patellæ may be ruptured, or torn from its tibial attachment, by the muscular contraction of the quadriceps extensor. These injuries are to be treated with the limb in the extended position, in order to relax the quadriceps extensor.

Dislocations of the Knee.—91. These injuries are rare, in consequence of the great ligamentous strength of the joint. The great transverse breadth of the joint is also an obstacle to lateral dislocation.

Chapter III.

REGION OF THE LEG.

The anatomy and injuries of this region will be considered under the following heads :—(a) *External Anatomy ;* (b) *Fractures of the Tibia and Fibula ;* (c) *Anterior Tibial Artery ;* (d) *Posterior Tibial Artery.*

External Anatomy (Plate VIII. fig. 2 ; Plate X. fig. 2).—92. The tibia is subcutaneous throughout its whole length. In this particular it resembles the ulna. Its sharp anterior edge can be felt under the skin ; its internal edge is more rounded, and can also be traced subcutaneously. The upper fourth of the fibula is superficial ; the middle half of the bone lies deeply between the extensor and peroneal muscles ; the lower fourth of the bone again becomes superficial between the extensor and peroneal tendons. The fibula is on a plane posterior to the tibia. This is to be remembered in performing amputation by skin-flaps and in sawing the bones ; care is also to be taken not to pass the knife between the bones in making a long posterior flap by transfixion. The hollow between the bones anteriorly is filled up by the tibialis anticus, extensor longus pollicis, and extensor longus digitorum. The tendon of the tibialis anticus becomes prominent when the foot is forcibly flexed upon the leg. The peroneal muscles form a muscular projection over the fibula ; the projection of the calf is formed by the gastrocnemius and soleus muscles. These muscles are to be traced downwards to their termination in the tendo Achillis. The internal saphenous vein runs upwards in the line of the internal edge of the tibia ; the external saphenous vein lies in the middle line posteriorly. Both veins are subcutaneous.

Fractures of the Tibia and Fibula.—93. When the tibia alone is broken there is no great displacement, the fibula acting as a splint. When the fibula alone is broken the same rule holds good—the tibia acts as a splint. Fracture of the fibula low down, with eversion of the foot—the result of indirect violence—is no exception to this rule, because in it there is rupture of the internal lateral ligament, or the tip of the internal malleolus of the tibia is broken off; it therefore loses the support of the tibia; those cases of fracture of the fibula in which there is no displacement are the result of direct violence; in them there is no injury at the tibial side of the ankle. These fractures, in which the tibia or fibula alone is broken, generally occur from direct violence, and are comparatively rare.

94. Fracture of both Bones.—This is the common fracture in this region, and generally results from indirect violence, the tibia giving way at the junction of the middle and lower thirds, the fibula in the upper fourth, because in these situations respectively the bones are weakest. In this fracture the anterior group of extensor muscles is balanced by the deep flexors. When the line of fracture through the tibia is transverse, these muscles will only tend to draw the broken surfaces together. When the line of fracture is oblique, they will tend to cause shortening. The powerful muscles of the calf, and the quadriceps extensor of the thigh, through its attachment to the tubercle of the tibia, are the principal displacing causes in the common fracture. When the fracture is low down, the muscles of the calf will act most powerfully by drawing back the foot and lower fragment. When the fracture is high up, the quadriceps extensor will tend to tilt the upper fragment forwards. In either case there will be an angular projection anteriorly; and if the fracture is at all oblique, the sharp point of bone, generally of the lower end of the upper fragment, will be very apt to pass through the skin, in consequence of the subcutaneous position of the bone. When the principal displacement is the drawing of the heel backwards by the muscles of the calf, the fracture should be treated by flexing

the leg, and laying it on its outer side. When the principal displacement is tilting forwards of the upper fragment by the quadriceps extensor, the limb should be placed in the extended position, in order to relax this muscle. When the line of fracture is oblique, and the tendency to shortening is well marked, the fracture should be treated by the application of a weight passing over a pulley, the so-called modern extension treatment. In whatever position the limb is placed, lateral splints should be applied to steady the fragments; they should be so shaped that they pass along the tibial and fibular sides of the foot, in order to counteract its eversion, a deformity which is always present, and is due to the action of the peroneal muscles and to the natural tendency of the foot to fall outwards by its own weight. In a properly formed leg the ball of the great toe, the internal malleolus of the tibia, and the inner edge of the patella, lie in the same plane. As it is easier to observe the relation of these three points when the limb is in the extended posture than in the flexed position, the extended position of the limb should be chosen in preference to the flexed position in every case in which either position is available.

95. Fracture of the Fibula low down.—This fracture sometimes occurs as the result of direct violence. In such cases displacement is slight, the tibia acting as a splint. The accident, however, is generally the result of indirect violence, as for instance when the foot is forcibly twisted outwards, or when, the foot being fixed, the body is thrown outwards. In either case there is marked eversion of the foot, because this is in reality a fracture of both bones of the leg, the fibula giving way immediately above the external malleolus, the injury to the tibial side of the leg being either rupture of the internal lateral ligament of the ankle-joint or fracture through the tip of the internal malleolus. The deformity is primarily due to the direction of the force causing the injury, the peroneal muscles retaining the foot in its abnormal position, and the object of the retentive apparatus is to counteract the action of these muscles.

When this fracture occurs in consequence of a force, which tends to drive the foot backwards as well as outwards, the principal deformity is elongation of the heel, the foot and lower fragment being displaced backwards; it is primarily due to the direction of the force, and the object in applying the horse-shoe splint anteriorly is to draw the heel forwards and to counteract the action of the muscles of the calf.

Anterior Tibial Artery (Plate XII. fig. 1; Plate XIII. figs. 2, 3; Plate XIV. fig. 3).—96. The popliteal artery divides at the lower border of the popliteus muscle into the anterior and posterior tibial arteries. The anterior tibial artery passes forwards between the tibia and fibula, above the interosseous membrane. From that point it runs downwards amongst the extensor muscles, lying in the upper two-thirds of its course on the interosseous membrane, and in the lower third upon the tibia. It ends over the front of the ankle-joint by becoming the dorsal artery of the foot. In its course it is related to three muscles, tibialis anticus, extensor longus digitorum, and extensor pollicis. The tibialis anticus muscle is the guide to the artery, and lies to its tibial side; in the first two inches of its course the vessel lies between the tibialis anticus and the extensor longus digitorum; it then lies between the tibial muscle and the extensor proprius pollicis. It is accompanied by venæ comites. The anterior tibial nerve lies at first to its fibular side; its relation to the vessel is afterwards inconstant. The artery lies at first deeply on the interosseous membrane, amongst the muscles. It gives off its recurrent branch, immediately after it has passed to the front of the leg, above the interosseous membrane.

To reach the vessel in the upper two-thirds, the surgeon must strike the interspace between the tibialis anticus and extensor muscles. This interspace is generally, in a moderately muscular individual, two finger-breadths to the fibular side of the anterior edge of the tibia. Care must be taken, in passing the aneurism needle, to avoid the venæ comites. In the lower third of its course the vessel is superficial, and lies upon the tibia, between the tendons of the tibialis anticus and the extensor pollicis; the latter tendon crosses the vessel immediately above its termination.

The artery can be easily compressed against the tibia in the lower third of its course. There is a striking similarity between the *anterior tibial* and *radial* arteries. Both are related to three muscles; in both the upper part of the vessel lies deeply among the muscles; the lower part lies superficial amongst the tendons. The supinator longus corresponds to the tibialis anticus.

Posterior Tibial Artery (Plate XIII. figs. 2, 3).—
97. This vessel is the direct continuation of the popliteal trunk. From its point of origin at the lower border of the popliteus it runs directly downwards; in the upper two-thirds of its course under cover of the muscles of the calf midway between the tibial and fibular edges of the leg; in its lower third it is comparatively superficial, and lies upon the tibia, amongst the deep flexor tendons, in the hollow between the tendo Achillis and the posterior edge of the bone (Plate XIII. fig. 1). The artery ends by dividing into the two plantar vessels midway between the tip of the internal malleolus and the point of the heel. The artery is accompanied by venæ comites. The posterior tibial nerve lies at first to the tibial side of the artery; it crosses the artery at the junction of its upper and middle thirds, and then runs down the fibular side of the vessel. The posterior tibial artery gives off the large peroneal branch about two inches from its origin. This vessel follows the line of the fibula, and is not unfrequently as large as its parent trunk. For a proper understanding of the anatomy of this vessel in the upper two-thirds of its course, it is necessary to refer to a transverse section through the limb in the thickest part of the calf (Plate XIII. fig. 2). Two methods are adopted in order to apply a ligature to the vessel—(*a*) the limb being flexed and laid on its outer side, the vessel may be reached by an incision along the posterior border of the tibia; the internal saphenous vein must be avoided, the deep fascia divided, the tibial edge of the gastrocnemius exposed and drawn backward; the tibial origin of the soleus is then seen

and divided. This muscle is also displaced backwards, and the strong fascia which binds down the deep flexor muscles is then visible. This fascia is now divided at its tibial attachment, and care being taken not to raise the deep flexors along with the fascia, the surgeon has to dissect between the fascia and the muscles in order to reach the artery. Care must be taken not to injure the venæ comites and the posterior tibial nerve, which lies for two inches to the tibial side of the artery; it then crosses the vessel, and for the rest of its course lies to its fibular side. The other method, (*b*) first recommended by Mr. Guthrie and adopted by Mr. Spence, is to lay the patient upon his face, and to dissect directly down upon the vessel through the muscles of the calf. A vertical incision is made in the middle line, care being taken to avoid the external saphenous vein and to strike the fibrous intersection between the heads of the gastrocnemius. After passing through the gastrocnemius, the plantaris tendon is seen lying on the soleus and avoided. The soleus is then divided in a longitudinal direction; the fascia covering the deep flexors is then exposed and divided, and the artery is seen lying upon these muscles. In passing the aneurism needle care must be taken not to injure the venæ comites or the posterior tibial nerve. This method is the preferable one, because the operation is only performed in consequence of wounds of the artery; and as the bleeding may be either from the posterior tibial or its large peroneal branch, both vessels can be reached by the same incision. To reach the artery in the lower third of its course is a comparatively easy operation: an incision is made parallel to the posterior border of the tibia; the skin, superficial and deep fasciæ are divided, and the artery is found lying on the tibia after the surgeon has passed the tendons of the flexor longus digitorum and tibialis posticus. The nerve lies to the fibular side of the vessel; care is to be taken not to injure the venæ comites. The point in this operation is to dissect towards the tibia; if this is not done, the surgeon may go past the vessel in his dissection. The *posterior tibial* artery resembles the *ulnar* in its relations, the muscles of the calf taking the place of the pronator teres and flexor muscles which arise from the internal condyle, the upper half of each vessel lying deeply under muscles, the lower half superficially amongst the tendons of these muscles.

CHAPTER IV.

REGION OF THE ANKLE AND FOOT.

The anatomy of this region will be considered under the following heads:—(a) *External Anatomy*; (b) *Ligaments of the Ankle and Foot*; (c) *Tendons which surround the Ankle-Joint*; (d) *Dorsal Artery of the Foot*; (e) *Sole of the Foot*; (f) *Synovial Membranes of the Foot*. (Plate XIII. fig. 1; Plate XIV. figs. 2, 3, and 4.)

External Anatomy.—98. The internal and external malleolus are first to be traced under the skin. Note carefully their peculiar shape—the external prominent and pointed, the internal flattened. The apex of the external is on a lower level and in a plane posterior to the apex of the internal malleolus. A knowledge of this fact is of importance in connection with amputation at the ankle-joint according to Mr. Syme's method. The general description now given is that the incision is to extend across the sole of the foot, from the tip of the one malleolus to the tip of the other. Mr. Syme's rule was that the incision is to extend from the tip of the external malleolus across the sole of the foot to the point on the inner ankle which is opposite the tip of the external malleolus, a point necessarily nearer the sole than, and posterior to the tip of, the internal malleolus. If this rule is followed a properly shaped flap will result. The following short rule will best guide the operator in making his incisions: Find the tip of the external malleolus; find the point on the inner ankle directly opposite, the foot being held at right angles to the axis of the leg. Join these points by the shortest road, first across the sole, second across the dorsum of the foot. The upper surface of the astragalus lies an inch above the level of the tip of the internal malleolus.

The bony points along the tibial edge of the foot to be noticed are ;—*first,* the projection of the sustentaculum tali; *second,* the tubercle of the scaphoid bone; *third,* the joint between the first metatarsal bone and the internal cuneiform bone (this joint lies about an inch in front of the tubercle of the scaphoid); *fourth,* the projecting extremity of the first metatarsal bone. The bony points to be observed along the fibular edge of the foot are—*first,* the external malleolus; *second,* the osseous tubercle on the outer surface of the os calcis, to which the middle fasciculus of the external lateral ligament of the ankle is attached; *third,* the projection of the tarsal extremity of the fifth metatarsal bone. The joint between the os calcis and cuboid bone lies in the space between the tip of the external malleolus and the tarsal extremity of the fifth metatarsal bone. It is somewhat nearer the latter projection than the former.

Ligaments of the Ankle and Foot.—99. The lateral ligaments of the ankle-joint are specially strong; the joint is further strengthened by the powerful grasp which the malleoli have of the astragalus. The astragalus is firmly bound to the os calcis by the powerful interosseous ligament; the os calcis in its turn is firmly attached to the internal malleolus by the internal lateral ligament, to the external malleolus by the middle fasciculus of the external lateral ligament. The arch of the foot is maintained by the calcaneo-scaphoid ligament internally, by the long and short calcaneo-cuboid ligaments externally. The plantar fascia stretching from the os calcis to the distal extremities of the metatarsal bones also assists in maintaining the arched form of the foot. (Plate XIV. fig. 4.) In *Flat-Foot* the arch of the foot disappears, in consequence of the relaxation of, *first,* the plantar fascia; *second,* the calcaneo-scaphoid ligament, on which the head of the astragalus rests. In well-marked cases the head of the astragalus passes downwards between the os calcis and scaphoid, and forms an abnormal projection on the inner edge of the foot. In one case of well-marked *flat-foot* in an adult, I found, on dissection, a powerful muscle, which arose along with the tibialis posticus, passed along the inner ankle, and was inserted into the under surface of the sustentaculum tali of the os calcis. Its action would be to draw back the os calcis, and increase the distance between that bone and the scaphoid. The result was flat-foot. The majority of cases of flat-foot occurs in weakly young girls, who, walking long distances, stretch the plantar fascia and calcaneo-scaphoid ligament.—THE MOVEMENTS OF THE FOOT are flexion and extension, inversion and eversion. FLEXION and EXTENSION take place at the ankle-joint; INVERSION and EVERSION take place at the astragalo-calcaneoid and the astragalo-scaphoid joints.

100. *Dislocation at the Ankle.*—Dislocation laterally is prevented by the malleoli; dislocation antero-posteriorly is prevented by the powerful interosseous ligament binding the astragalus to the os calcis, which in its turn is firmly bound to the malleoli by the internal and external lateral ligaments of the ankle-joint. The bones of the anterior tarsus are firmly bound together by interosseous ligaments; the metatarsal bones are bound to the tarsus by dorsal, plantar, and interosseous ligaments. The bases of the metatarsal bones are bound together by transverse, dorsal, plantar, and interosseous ligaments. These powerful ligamentous structures prevent the metatarsal bones from being separated from each other and from the anterior tarsus. The weight of the body in the erect posture is principally supported by the os calcis, the ball of the great toe, the ball of the little toe.

The Tendons which surround the Ankle-Joint (Plate XIII. fig. 1; Plate XIV. figs. 2 and 3).—101. These tendons may be divided into four groups—(*a*) *anterior*, (*b*) *posterior*, (*c*) *internal*, (*d*) *external*. (*a*) ANTERIOR. From the tibial to the fibular side there are—*first*, the well-marked tendon of the *tibialis anticus* running downwards, to be inserted into the internal cuneiform bone, and the base of the first metatarsal bone; *second*, the tendon of the *extensor longus pollicis*, which crosses the anterior tibial artery and nerve over the ankle-joint; *third*, the common tendon of the *extensor longus digitorum*, and *peroneus tertius* muscles

These tendons are retained in position by the anterior annular ligament, which sends septa between them, and for each there is a separate synovial sheath, into which effusion takes place in sprains of the joint. (*b*) POSTERIOR—the *tendo Achillis;* between it and the os calcis there is a *bursa.* (*c*) INTERNAL. The tendons over the inner ankle are arranged in the following order from before backwards—*first,* the *tibialis posticus* immediately behind the malleolus, running to be inserted into the tubercle of the scaphoid bone; *second,* the tendon of the *flexor longus digitorum; third,* the posterior tibial artery; *fourth,* the posterior tibial nerve; *fifth,* the tendon of the *flexor longus pollicis.* It is of importance to remember that the posterior tibial artery lies in this region, upon the posterior surface of the lower extremity of the *tibia* (Plate XIV. fig. 3) and the narrow posterior surface of the astragalus. If this fact is forgotten, the operator is very apt to injure the artery when performing Syme's amputation at the ankle-joint—*first,* in disarticulation of the foot—as it lies upon the astragalus; *second,* in sawing off the lower extremity of the tibia and fibula—as it lies upon the posterior surface of the former bone. If either of these mistakes is committed, the vitality of the heel-flap may be interfered with. (*d*) EXTERNAL, the *peroneus longus* and *brevis* run downwards immediately behind the external malleolus, the latter next the bone. These different tendons around the ankle frequently require division, in order to relieve the deformity termed *club-foot.* The most frequent form of this disease is termed *talipes equino-varus.* In this malformation the heel is drawn upwards, the foot is inverted and shortened, and the sole of the foot looks inwards. The tendo Achillis, the tibialis anticus, the tibialis posticus, and the plantar fascia, require division. In *talipes equinus,* in which the heel is raised from the ground, the tendo Achillis requires division. In *talipes valgus,* which must not be confounded with flat-foot, the foot is everted, and the peronei require division. In *talipes calcaneus,* a very rare form, in which the toes are elevated, the anterior group of tendons requires division. The following rule is applicable in every case:—Begin with the most tense tendon, and divide it where it is most tense.

102. *Bunion.*—The starting-point of this disease (which is really a dislocation outwards of the great toe) is any pressure outwards applied to the point of the great toe. After a time the extensor and flexor tendons of the toe are dislocated outwards from their sheaths, and their action then is adduction of the point of the great toe towards the middle line of the foot. The abductor pollicis is also dislocated outwards over the head of the metatarsal bone, and in consequence of its abnormal direction it becomes an adductor of the toe to the middle line of the foot. The deformity may to a certain extent be remedied by subcutaneous division of these tendons, and by the removal of all outward pressure from the apex of the great toe.

Dorsal Artery of the Foot.—103. This vessel is a direct continuation of the anterior tibial. It commences over the anterior surface of the ankle-joint, and runs downwards upon the bones forming the inner column of the foot, to the interspace between the first and second metatarsal bones, between which it passes to join the external plantar artery. The guide to the artery is the tendon of the extensor longus pollicis, which lies to its tibial side. If the artery is wounded, either accidentally or during an operation, at the point where it passes downwards between the metatarsal bones, there will be considerable difficulty in applying a ligature.

Sole of the Foot.—104. Note the close connection of the skin, dense subcutaneous fascia, and strong plantar fascia. If matter collects under the fascia early incision is necessary to relieve tension; to avoid injuring the plantar vessels, their general direction must be remembered. The posterior tibial artery ends at a point midway between the tip of the internal malleolus and the apex of the heel; from this point the internal plantar artery runs directly forwards to reach the under surface of the ball of the great toe. The external plantar artery runs obliquely across the sole of the foot towards the tarsal extremity of the fifth metatarsal bone;

it then changes its direction, and runs almost transversely across the foot, lying deeply upon the bases of the fourth, third, and second metatarsal bones, and joins the dorsal artery of the foot in the interspace between the first and second metatarsal bones. The digital branches of this trunk have a distribution, and general direction, closely resembling the digital branches of the palmar arch in the hand.

Synovial Membranes of the Ankle and Foot.—105. They are seven in number: *first,* the synovial membrane of the ankle-joint, which passes up between the tibia and fibula to form the inferior tibio-fibular articulation; *second,* the posterior astragalo-calcaneoid articulation; *third,* a synovial membrane common to the anterior astragalo-calcaneoid articulation, and calcaneo-scaphoid articulation; *fourth,* the calcaneo-cuboid articulation; *fifth,* the joint between the cuboid and fourth and fifth metatarsal bones; *sixth,* the joint between the internal cuneiform and first metatarsal bone; *seventh,* a synovial membrane common to the joints between the remaining bones of the tarsus and their articulations with the second, third, and fourth metatarsal bones, as well as the articulations between these three bones.

ABDOMEN.

THE Abdomen is divided into two divisions—the abdomen proper and the pelvis. The pelvis is divided into the false and true pelvis. The true pelvis will be considered along with the perineum ; the false pelvis with the abdomen proper. The anatomy of the abdomen will be considered under three regions:—Chap. I. *The Abdomen Proper and False Pelvis ;* Chap. II. *The Perineum and True Pelvis ;* Chap. III. *The Region of the Groin ; Hernia.*

CHAPTER I.

ABDOMEN PROPER AND FALSE PELVIS.

The anatomy of this region will be considered under the following heads:—(a) *External Anatomy ;* (b) *Formation of the Abdominal Wall ;* (c) *Abdominal Aorta ;* (d) *Iliac Arteries ;* (e) *Anastomoses.*

External Anatomy.—106. Trace the free edge of the ribs superiorly, the crest of the ilium, Poupart's ligament, the spine, crest, and symphysis of the pubis, inferiorly. The recti can be felt anteriorly, stretching from the ribs to the pelvis. The umbilicus lies in the middle line, on the same level as the highest part of the crest of the ilium. The *liver* lies principally in the right hypochondriac and epigastric regions ; when the patient leans forwards it can be felt projecting beyond the free margin of the ribs. The *gall-bladder* is situated opposite the apex of the costal cartilage of the ninth rib. The *spleen* lies deeply in the left hypochondriac region in connection with the greater curvature of the stomach. The spleen can only be felt when enlarged.

The stomach lies in the left hypochondriac and epigastric regions. The shape of the organ varies with the amount of distension; when empty its long axis is vertical; its lesser curvature looks to the right, its greater curvature to the left; its anterior surface looks forwards, its posterior looks backwards. As it fills with food its greater curvature looks forwards; its lesser curvature looks backwards, a rotation forwards of the greater curvature of the stomach having taken place. The position of the great intestine is well marked. The caput cæcum lies in the right iliac fossa; from it the ascending colon passes upwards to the liver; the transverse colon crosses the cavity till it reaches the spleen, when it descends as the descending colon, to end in the sigmoid flexure which lies in the left iliac fossa. A fæculent collection if in any quantity can be felt in the great intestine. This is more especially true of the sigmoid flexure. The small intestines lie centrally, occupying principally the umbilical and hypogastric regions. The omentum hangs down as an apron, from the greater curvature of the stomach. In a paper by Surgeon-Major Kenneth M'Leod, in the *Edinburgh Medical Journal,* 1877, he points out one use of the omentum, that it acts as a plug in punctured wounds of the anterior abdominal wall. In this way protrusion of the small intestines is prevented. The kidneys lie in the lumbar regions; they cannot be felt externally.

107. In the examination of the abdominal cavity the shoulders should be supported by pillows, the thighs flexed. The hand being warmed, it is placed gently upon the surface, the whole surface of the hand being in contact with the wall; then by a gentle to-and-fro motion the tendency to contraction of the abdominal muscles will be gradually overcome; the position that the patient has been placed in will still further relax them. It is also well to converse with the patient, and to ask him to take a full expiration. By these means, in the great majority of cases, the surgeon will be able to make a thorough examination of the abdominal cavity. In a few, however, it will be necessary to give chloroform before this can be done efficiently.

Care should be taken not to mistake the muscular recti for tumours; so also in regard to fæculent masses in the intestinal canal. A collection of ascitic fluid enables the student to gain a clear knowledge of fluctuation.

108. The lines on the surface of the body which correspond to the situation of the termination of the abdominal aorta and the iliac vessels may be mapped out as follows (Plate XV. fig. 2): The aorta terminates a little to the left of the middle line at the level of the highest part of the crest of the ilium; the external iliac arteries end at Poupart's ligament, midway between the anterior superior spinous processes and the symphysis pubis. If a line is drawn from the point corresponding to the termination of the aorta to the termination of the external iliac, this line will correspond to the position of the common and external iliac arteries. The upper two inches of the line indicate the position of the common iliac; the rest of the line corresponds to the external iliac, and the point of junction of the common and external iliacs indicates the point of origin of the internal iliac vessel. It must not be supposed that the iliac arteries follow always a straight course; the above line indicates only their general direction; their tortuosity is frequently considerable.

Formation of the Abdominal Wall.—109. To understand clearly the exact position of the iliac system, and the structures which require to be divided in order to reach the vessels, it is necessary to consider shortly the formation of the wall of the abdomen.

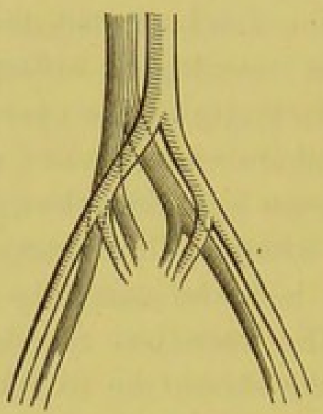
After the skin and superficial fascia are reflected, certain muscular and tendinous structures are exposed. The muscles are arranged in three divisions—*first,* an anterior; *second,* a posterior; *third,* a lateral group. The fibres which form the anterior and posterior groups are vertical; the erector spinæ and quadratus lumborum posteriorly; the recti abdominis and pyramidales anteriorly. The fibres which form the lateral group are oblique and transverse in their direction. The lateral group consists of three layers, the external and internal oblique and transversalis. The internal oblique and transversalis muscles arise by a tendon of origin, commonly called the *lumbar fascia*, from the lumbar vertebræ. This structure ensheaths the posterior vertical group. The three muscles are inserted into the linea alba anteriorly by a common tendon of insertion, which forms a sheath for the anterior vertical group.

If these lateral muscles are removed, a fascial layer is exposed, different parts of which have received different names, according as they are in relation to different muscles; for example, fascia transversalis, fascia psoas, and fascia iliaca.

It must, however, be remembered that these different fasciæ are anatomically continuous with each other. An understanding of this fact greatly simplifies the description and comprehension of the femoral sheath (page 103). If this fascial envelope is removed, a layer of fat, termed *extra-peritoneal*, is seen. This varies greatly in thickness, being specially abundant around the kidneys. If it is turned aside the parietal peritoneum is exposed. The blood-vessels we are now considering lie in the extra-peritoneal fat; and in order to reach them without opening the peritoneal sac it would be necessary to divide skin, superficial fascia, the three muscles which form the lateral group, the fascial layer which lies beneath these muscles, and then to search in the extra-peritoneal fat for the arteries which lie in it in connection with the posterior wall of the abdomen and pelvis. These different structures must be divided where they form the anterior abdominal wall, because the lower part of the cavity in which the arteries lie is bounded laterally and posteriorly by the expanded alæ of the ossa innominata. The incision is to be made as far as possible from the middle line, in order that the peritoneal sac may be avoided, and in order to lessen as much as possible the extent of displacement of the fatty layer; in other words, the anterior superior spinous process of the ilium is the main guide to the primary incision.

Abdominal Aorta.—110. This vessel stretches from the diaphragm to the left side of the body of the fourth lumbar vertebra; at this point it divides into the two common iliac arteries. Its termination is on a level with the highest part of the crest of the ilium; the inferior vena cava lies to its right side; it is surrounded by the aortic plexus of nerves. The only part of the vessel of interest to the surgical anatomist is that part below the origin of the inferior mesenteric branch, which generally arises about two inches above the bifurcation. The following dissection is required to expose the vessel: An incision is made from the apex of the tenth rib on the left side to a point internal to the anterior superior spinous process of the ilium; the three lateral muscles are then divided; the fascia transversalis is exposed and carefully opened; the opening is enlarged, the peritoneum being protected by the finger of the operator or by a director. The peritoneal sac and its contents are drawn forwards and inwards by broad copper spatulæ; the operator then feels for the pulsation of the common iliac artery, which guides him to the aorta, which is to be carefully cleared in order to enable him to pass the aneurism needle around the vessel. The back of the needle should be to the peritoneum. Care must be taken in raising the peritoneum to raise the ureter along with it; this is generally accomplished with ease, because the ureter rises with the peritoneum, being connected to it by loose cellular tissue.

Iliac Arteries.—111. From the bifurcation of the aorta at the left side of the body of the fourth lumbar vertebra the common iliac arteries diverge, and after a course varying in length from one and a half to three inches, divide as a rule over the fibro-cartilage, between the last lumbar vertebra and the sacrum, into the internal and external iliac vessels. The internal iliac runs downwards into the pelvis, and after a course of one and a half inch, divides into numerous branches for the supply of the pelvic viscera and the muscles of the buttock. The external iliac runs along the bony ridge between the false and true pelvis, and ends at a point midway between the anterior superior spinous process of the ilium and the symphysis pubis, by passing below Poupart's ligament into the thigh to become the femoral. The psoas muscle and a chain of lymphatic glands lie to its outer side; it is crossed close to its termination by the spermatic vessels, the genito-crural nerve, and circumflex ilii vein. The common iliac artery has no branches. The branches of the internal iliac artery are given off in a brush-like manner from its termination. The only branches of the external iliac artery of importance are the deep epigastric and the deep circumflex ilii, which arise from the vessel immediately above Poupart's ligament. The veins corresponding to the iliac arteries terminate in the vena cava inferior.



This diagram is introduced to illustrate the relations of the iliac veins to the iliac arteries. The student is recommended to cut out in separate pieces of cardboard the veins and arteries, and by placing them in position he will at once understand their relations.

The external iliac veins lie internal to their corresponding arteries, and pass between the corresponding internal iliac arteries and the bone, to join the common iliac veins. The internal iliac veins lie posterior to their arteries. The left common iliac vein lies internal to the left common iliac artery; the right common iliac vein lies between its corresponding artery and the bone. The difference in the relation of the common iliac veins to their corresponding arteries necessarily follows from the fact that the vena cava lies to the right of the aorta (Plate XV. fig. 1).

112. One description of the operation for ligature of the iliac arteries is sufficient. A curved incision, extending, in ligature of the external iliac, from a point above the centre of Poupart's ligament upwards and outwards to a point internal to the anterior superior spinous process—and an incision of a similar nature, but at a higher level, in ligature of the

common and internal iliac arteries—is carried through the skin and superficial fascia. The muscular layers are then divided. The circumflex ilii artery and its branches will be met with between the internal oblique and transversalis muscles; all bleeding points are secured by ligature. The fascia transversalis is exposed; an opening is made in it as near as possible to the anterior superior spinous process, because in this situation there is a considerable quantity of extra-peritoneal fat, which reduces to a minimum the risk of injury to the peritoneum. The opening in the fascia is then enlarged on the finger; the peritoneum, along with the caput cæcum on the right side, and the sigmoid flexure on the left side, is drawn inwards, and the artery to which the ligature is to be applied is sought for in the extra-peritoneal fat. The ureter passes into the pelvis at the junction of the three iliac arteries, and is raised along with the peritoneum, with which it is intimately connected. In tying the right common iliac artery great care must be taken not to injure the corresponding vein which lies between the artery and the bone. In tying the left common iliac artery there is little chance of injuring its vein, because it lies internal to the artery. In tying both internal iliac arteries care must be taken in passing the needle not to injure the external iliac veins which lie between the internal iliac arteries and the bone. In passing the aneurism needle round these vessels its back should be kept to the peritoneum, in order to prevent injury to this important structure. Before any of these operations just described, the bladder should be emptied by the use of a catheter, the contents of the bowel being previously removed by purgatives and an enema.

Anastomoses (Plate XXXI. figs. 1, 2, 3).—113. Before considering in detail the anastomoses, which are enlarged after ligature of the aorta and iliac vessels, it will be well to consider the general arrangement of the anastomosing channels:—1st, An *anterior* anastomosis from the first part of the subclavian to the external iliac, the internal mammary anastomosing with the deep epigastric. 2d, A *lateral* anastomosis, stretching from the axilla to the external condyle of the femur. The vessels, named from above downwards, which enter into its formation are—superior intercostal (subclavian); aortic intercostals; musculo-phrenic (internal mammary); phrenic; renal; capsular; lumbar; ilio-lumbar; deep circumflex ilii; gluteal; external circumflex and external articular. 3d, A *mesial* anastomosis, stretching from the bifurcation of the aorta to the internal condyle of the femur. The vessels which enter into its formation are—sacra media; lateral sacral; visceral branches of internal iliac; superior hæmorrhoidal; ischiatic; obturator; external pudic; internal circumflex; perforating branches of profunda; anastomotica magna; internal articular and recurrent tibial.

114. When the *abdominal aorta* is ligatured below the origin of the inferior mesenteric, the blood will reach the iliac system—1st, Through a posterior abdominal anastomosis of the *phrenic, musculo-phrenic, renal, capsular,* and *lumbar* branches of the aorta, with the *ilio-lumbar* of the internal iliac and *deep circumflex ilii* of the external iliac; 2d, Through an anterior abdominal anastomosis of the *internal mammary* and terminal branches of the *aortic intercostals* with the *deep epigastric* of external iliac; 3d, Through an anastomosis of the *superior hæmorrhoidal* branch of inferior mesenteric artery with visceral branches of internal iliac. The first and second of these anastomosing areas are bilateral, the third is unilateral.

115. When the *common iliac* is ligatured, in addition to the anastomoses already described in ligature of the aorta, the blood will reach the internal iliac on the same side as the ligature, through its *visceral* and *pudic* branches, anastomosing in the pelvis and perineum with the corresponding branches from the opposite internal iliac, and through the *sacra media* from the bifurcation of the aorta with the *lateral sacral* of the internal iliac.

When the *internal iliac* is ligatured, the anastomoses described under the common iliac will be enlarged; also anastomoses between the *lumbar* of aorta with *ilio-lumbar* of internal iliac. The blood will also reach the pelvis through the *superior hæmorrhoidal* branch of the inferior mesenteric.

116. When the *external iliac* artery is ligatured, the anastomoses enlarged will be—(*a*) *ilio-lumbar*, with *deep circumflex ilii*; (*b*) *gluteal*, with *ilio-lumbar* and *deep circumflex ilii*; (*c*) *gluteal*, with *ascending branch* of *external circumflex*; (*d*) *internal mammary* with *deep epigastric*; (*e*) *obturator* with *deep epigastric*; (*f*) *obturator* and *ischiatic* with *internal circumflex*; (*g*) *pudic* of internal iliac, with *external pudic* of femoral.

117. In cases of stricture of the œsophagus, in which the patient is dying of starvation, the stomach has been opened (Plate XVI. fig. 3). An incision should be made along the outer edge of the left rectus from the free edge of the ribs downwards in the left hypochondriac region. After division of the three muscles—external oblique, internal oblique, and transversalis—which form the abdominal wall, the transversalis fascia will be exposed, next the extra-peritoneal fat, and then the parietal peritoneum. The peritoneal cavity is opened, and the stomach is then drawn forwards and carefully stitched to the cut edges of the peritoneum and muscles. It may be well to avoid opening it until the second day after the operation, in order that adhesions may form between its surface and the edges of the incisions. These adhesions will greatly lessen the risk of extravasation into the peritoneal cavity.

In cases of stricture of the rectum, the descending colon has been opened in the left lumbar region (*Amussat's operation*, or *Colotomy*, Plate XVI. figs. 1 and 2). The landmarks in this operation are the last rib, the crest of the ilium, and the outer edge of the left erector spinæ muscle. An incision is made along the outer edge of the erector spinæ, the sheath of the muscle is opened, the edge of the muscle exposed and drawn inwards; the anterior layer of the sheath arising from the apex of the transverse processes is seen and divided; the quadratus lumborum is then seen and drawn inwards; the anterior layer of its sheath, which arises from the bases of the transverse processes, is then exposed and divided; next the fascia continuous with the fascia transversalis is divided, and the extra-peritoneal fat in which the colon lies is seen the posterior surface of the colon, uncovered by peritoneum, is then seen. In the dissection the lumbar arteries will be divided and tied. If the incision already made does not afford sufficient room, it may now be enlarged with a probe-pointed bistoury, by transverse division of the firm resistant lumbar fascia, which forms the outer edge of the incision. The colon is now drawn into the wound; it is recognised by the longitudinal bands of muscular fibre which are characteristic of the great gut. An opening is now made in the gut, and after escape of the fæculent matter this opening is carefully and closely stitched to the edges of the wound. An *artificial anus* is the result.

Chapter II.

PERINEUM AND TRUE PELVIS.

An accurate knowledge of the anatomy of the male perineum and true pelvis is necessary in order to understand certain common, and therefore important, surgical diseases and their treatment. *Abscess in the ischio-rectal fossa, fistula in ano, hæmorrhoids, diseases of the sphincter ani, stricture of the urethra, the passage of a catheter, puncture of the bladder, infiltration of urine, perineal section, or external urethrotomy, and cutting for the stone or lithotomy.*

The true pelvis contains the bladder and lower end of the rectum. The perineum is the space which corresponds to the inferior outlet of the true pelvis. It includes the *neck and floor of the bladder, the prostatic, membranous, and spongy divisions of the urethra, the penis, scrotum, and testicles, the lower end of the rectum*, and the *anus*, the muscles and fasciæ which support these structures, and the blood-vessels and nerves which supply them. The relative anatomy of the structures forming the perineum will be described as if the subject were tied up for the operation of lithotomy.

The anatomy of this region will be considered under the following heads: (a) *External Anatomy;* (b) *Posterior or Anal Division of the Perineum;* (c) *Anterior or Urethral Division of the Perineum.* (Plates XVII. XVIII. XIX. XX.)

External Anatomy (Plate XVII. fig. 1).—118. The perineum is bounded by the scrotum in front, by the buttocks and thighs posteriorly and laterally. The anus lies in the centre of the space, the skin around the opening being dark coloured and corrugated. A mesial ridge, termed the raphe of the perineum, runs forwards from the anus to the scrotum. Under this ridge, the bulb of the corpus spongiosum can be felt. On either side of the anus, a more or less distinct hollow, termed the ischio-rectal fossa, is seen. If the finger is oiled and gently introduced into the anus, it will be grasped by the sphincter ani muscle. The under surface and general shape of the prostate gland can be felt through the wall of the rectum. If the gland is of normal size, the finger will reach the trigone of the bladder, a name which has been given to that triangular portion of the floor of the bladder which lies between the diverging vesiculæ seminales, and which is bounded posteriorly by a line joining the openings of the ureters into the bladder. If a catheter is passed into the bladder, it will be felt lying in the membranous portion of the urethra, which intervenes between the triangular ligament and the apex of the prostate gland. In cases of doubt as to the direction of the instrument, and in cases of difficulty in the passage of the instrument behind the triangular ligament, great assistance will be given either in ascertaining the exact situation of the catheter, or in directing it in cases of difficulty, by the introduction of the finger into the rectum.

To understand the osseous and ligamentous boundaries of the perineum it is necessary to examine a ligamentous pelvis. The symphysis pubis bounds the space anteriorly, the coccyx posteriorly; laterally and anteriorly, the rami of the pubis and ischium, and the tuberosity of the ischium; laterally and posteriorly, the great sacro-sciatic ligament stretching from the sacrum and coccyx to the tuberosity of the ischium. With the exception of the great sacro-sciatic ligament, the perception of which is somewhat masked by the edge of the gluteus maximus, these boundaries can be traced in the undissected pelvis. The transverse diameter of the space measures three inches at its broadest part; the antero-posterior diameter about four inches. It is, however, to be remembered that these measurements vary greatly in different individuals. The perineum is divided by a transverse line, joining the anterior extremities of the ischial tuberosities, into a posterior or anal division and an anterior or urethral division.

Posterior or Anal Division of the Perineum

(Plate XVII. fig. 2).—119. After the skin and superficial fascia are reflected, the circular fibres of the external sphincter ani muscle are seen. This muscle has an attachment posteriorly to the tip of the coccyx, and anteriorly to the central point of the perineum, which lies in the middle line in the raphe of the perineum, about an inch in front of the anus, and to which the majority of the perineal muscles are attached. The sphincter muscle is liable to disease—*first, spasmodic contraction*, which is often the result of a fissure, or ulcer of the mucous membrane immediately within the opening of the anus. Its long axis is vertical, and the educated finger will at once recognise its position. Very frequently a small external pile guides the surgeon to the exact situation of the ulcer. *Second*, a *relaxed condition* of the muscle, the result of which is *prolapsus recti*. This condition is associated with general relaxation of the levator ani, and rectal prolongation of the pelvic fascia. In these circumstances, at each act of defæcation there is a tendency to protrusion of the lower end of the rectum through the anus. The skin and mucous membrane are necessarily also relaxed, and the aim of the surgeon in the adult is to remove the redundant mucous membrane, along with portions of the relaxed external sphincter, in the hope that cicatricial contraction may restore the parts to a normal condition. In young children removal of the redundant skin is unnecessary; attention to the bowels, cold bathing, and prevention of excessive straining by not allowing the feet to touch the ground during the act of defæcation, are sufficient to effect a cure. Prolapsus is a frequent symptom of stone in the bladder in the young child.

120. HÆMORRHOIDS.—The lower end of the rectum, the anus, and surrounding skin, are richly supplied with blood-vessels. The veins communicate directly with the portal system, and any retardation of the flow through it is certain to be followed by their enlargement, termed hæmorrhoids or piles. Piles have been divided into two classes—*external* and *internal*. In the former the subcutaneous veins at the margin of the anus are enlarged; in the latter the sub-mucous veins within the opening of the anus are enlarged

Both are primarily a varicose condition of the vessels. The external pile soon loses its vascular appearance, and in consequence of inflammatory attacks the coats of the vein become thickened, and the cavity of the vein gradually obliterated. For these reasons, and as a necessary result of the constantly-exposed situation of the projection, an external pile can be clipped off with curved scissors, without any risk of bleeding. The internal pile, on the other hand, is of a cherry-red colour, and very vascular. It is within the margin of the anus, is kept constantly moist by the secretions which lubricate the gut; it cannot be cut off with safety. It must either be tied or it may be clamped, then cut off, and the cautery applied to the cut surface before removing the clamp. Care must be taken not to confound large projecting internal hæmorrhoids with prolapsus recti.

121. Ischio-Rectal Fossa (Plate XVII. fig. 2).—This space lies between the ischium and the rectum, and is filled with a quantity of loose cellular tissue and fat, in which the inferior hæmorrhoidal branches of the pudic artery and nerve lie. The pudic artery runs, with its accompanying nerve, along the outer wall of the space, under cover of the tuberosity of the ischium, in a strong fascial sheath, derived from the obturator division of the pelvic fascia. It is situated about an inch from the surface, and if in the operation of lateral lithotomy, in which the knife is sunk into this space, any of the anterior branches of the pudic artery are divided, the vessel can be temporarily compressed if the finger is passed into the wound and pressure is made in an outward direction, pressing the artery against the bone. The fossa is bounded externally by the obturator internus muscle, the parietal layer of the pelvic fascia separating the muscle from the space. The fossa is bounded internally by the levator ani muscle, which is also covered by a prolongation from the same fascia. If the finger is passed upwards into the space, the splitting of the pelvic fascia into its parietal and rectal layers will be felt. The loose cellular tissue and fat in the space do not interfere with the necessary relaxation of the sphincter during the act of defæcation. Note the transverse

direction of the inferior hæmorrhoidal vessels and nerves. In opening abscesses, which are not unfrequent in this region, the incision is to be made parallel to these vessels, radiating towards the anus.

Anterior or Urethral Division of the Perineum (Plate XVII. fig. 2; Plate XX. fig. 1).—122. The anatomy of this portion of the perineum is more complicated than that of the posterior or anal division. It is necessary, in the first place, to understand the anatomy of the urethra. This tube passes from the bladder to the point of the penis. As it passes under the arch of the pubis it pierces a fascial structure which stretches across the interval between the rami. This is called the *triangular ligament;* it has received this name in consequence of its shape. It supports the urethra, which pierces it three-quarters of an inch below the symphysis. The urethra may be divided into two divisions—an *anterior,* in front of, and a *posterior* behind, the triangular ligament. The *anterior* division lies in the corpus spongiosum penis. The penis consists of the corpora cavernosa, which form the mass of the organ, and are attached by their crura to the edges of the pubic arch. The corpus spongiosum runs along the under surface of the organ, stretching from the triangular ligament to the extremity of the penis. The posterior bulbous portion of the corpus spongiosum is firmly attached to the anterior surface of the triangular ligament. Immediately after piercing the triangular ligament the urethra passes into the corpus spongiosum, becomes incorporated with it, and, running forwards to the point of the penis, ends as the meatus urinarius. The average length of the urethra in front of the triangular ligament is six inches. The penis is slung to the symphysis pubis by the suspensory ligament.

123. *The Posterior Division behind the Triangular Ligament.*—The urethra begins at the neck of the bladder. It lies at first in the prostate gland, the apex of which is situated about three-quarters of an inch from the posterior surface of the triangular ligament. That portion of the urethra which extends from the apex of the prostate to the triangular

ligament is termed, in consequence of its structure, the *membranous* portion. The compressor urethræ muscle surrounds and supports this part of the canal. The *prostatic* portion, supported by the firm prostatic gland, measures one inch and a quarter in length; the membranous portion measures three-quarters of an inch. The mucous membrane of the urethra is continuous with the mucous membrane of the bladder; the submucous tissue is a layer of involuntary muscular fibres and elastic tissue; it is also continuous with the submucous fibres of the bladder. Organic stricture of the urethra is caused by inflammatory deposit in, or by contraction the result of inflammation of, the submucous tissue. The seminal ducts open into the floor of the membranous portion of the urethra on either side of the verumontanum.

124. Calibre of the Urethra.—The urethra is narrowest at its orifice. During its course through the corpus spongiosum the diameter remains pretty constant until it reaches the posterior or bulbous portion of the corpus spongiosum (the bulb of the urethra), when the canal widens out, more especially towards its floor, again contracting as it pierces the triangular ligament. With the exception of the orifice, the urethra is narrowest in the membranous portion. It again widens out as it passes through the prostate gland. It is surrounded at its commencement at the neck of the bladder by a dense ring of fibrous tissue, which is incorporated with the prostate gland.

125. In passing a full-sized instrument along the healthy urethra, the surgeon should stand on the left side of the patient; the point of the instrument should be directed downwards, until it reaches the triangular ligament; it will do this more easily if the perineum is supported with the fingers of the left hand. If the point of the instrument does not at once pass through the opening in the triangular ligament, it will be stopped by coming against this firm fibrous structure. This is apt to occur in consequence of the large size of the urethra at this part. No force must be used to overcome the obstruction; the instrument must be withdrawn for an inch, and again gently pushed onwards, care

being taken to keep the point of the instrument in the middle line, and in close connection with the upper wall of the canal, where the probability of hitching against the triangular ligament is least, because the enlargement of the canal at this part is principally due to a relaxation of the mucous membrane forming the floor of the canal. After the point of the instrument has passed into the membranous portion, all that is necessary is to depress the handle of the instrument, when the point of the instrument will glide upwards and backwards along the membranous and prostatic portions of the canal into the bladder (Plate XX. fig. 2).

126. In cases of difficulty in front of the triangular ligament, the support of the perineum by the fingers of the left hand will assist the surgeon. If there is any difficulty behind the triangular ligament, the surgeon should pass his finger into the rectum, when the instrument will be felt in the membranous portion of the canal, the prostate lying between the finger and the instrument. The surgeon will thus at once discover if the instrument is in its proper channel. If it lies in a false passage, it will be felt to one or other side of the middle line, or lying between the prostate gland and the rectum, the coats of the rectum alone separating it from the finger. If the difficulty is due to organic stricture of the urethra, it will be either in front of, or at the triangular ligament. If beyond that point, the difficulty will be due to enlargement of the prostate gland. The surgeon can find out the exact condition and size of the gland by passing the finger into the rectum. Retention of urine, the result of prostatic inflammation or hypertrophy, is generally caused by an increase in the size of the middle or third lobe of the gland, which projects upwards and obstructs the flow of urine, acting as a ball valve (Plate XX. fig. 3). This condition of the gland cannot be made out by rectal examination with the finger. Enlargement of one or other of the lateral lobes of the gland will result in a more or less well-marked tortuosity of the prostatic portion of the canal. General enlargement of the gland will lengthen and render more vertical the prostatic portion of the canal, necessitating

great depression of the handle of the instrument, in order that the point may pass into the bladder.

127. Puncture of the Bladder (Plate XIX. fig. 1).—The surgeon takes advantage of the anatomical fact that the anterior surface and base of the bladder are uncovered by peritoneum, and in rare cases, in which an instrument cannot be introduced into the bladder along the urethra, the bladder has been punctured, either above the pubis or from the rectum; the latter operation can only be performed when the prostate is of normal size, because if it is enlarged it is impossible to reach the base of the bladder, behind the gland, between the vesiculæ seminales. The supra-pubic operation is, therefore, alone applicable when the obstruction is due to prostatic enlargement. After the surgeon is certain, by dulness on percussion and by manipulation, that the bladder is distended with urine, a small incision is to be made through the skin, in the middle line, immediately above the symphysis pubis; then a trocar and canula is to be passed between the recti abdominis and through the wall of the bladder into the cavity of the viscus, the canula is withdrawn and the contents evacuated through the trocar. The bladder is often punctured when the surgeon is unable to pass an instrument through a stricture. Such an operation will only afford temporary relief, and, in my opinion, an operation which will at one and the same time cure the stricture and relieve the distended bladder is to be preferred.

128. Having described the anatomy of the urethra, it is now necessary to return to the consideration of the *anterior or urethral division* of the perineum. If the patient is tied in the lithotomy position, a large-sized catheter passed into the bladder, the scrotum drawn upwards, and the skin reflected, the dense subcutaneous fascia is exposed (Plate XVII. fig. 2). To understand the attachments of this fascia, an incision large enough to admit the finger is to be made over the cord, about an inch below the external abdominal ring, through the skin and fascia, on either side; if the finger is passed through this opening downwards into the

perineum, it will be checked at the level of a line which runs transversely across the perineum, in front of the anus; this check indicates the situation of the attachment of the perineal fascia to the base of the triangular ligament. If an attempt is now made to carry the finger outwards under the skin of the thigh, it will be again checked by the attachment of this fascia to the *fascia lata* of the thigh. If, with a finger in either pouch, an attempt is now made to join the fingers mesially, it will be found impossible to do so in consequence of a mesial septum of the same fascia. This septum has a firm attachment to the bulb, and is continuous with the mesial septum of the scrotum, into which the finger can be easily passed along the cord to the testicle. It will be evident from this description that when urine, in cases of *infiltration*, is situated under this fascia, it will, after filling up the scrotum to a greater or less degree, pass upwards along the cord on to the anterior wall of the abdomen; it will neither pass back into the ischio-rectal fossa nor outwards over the thigh.

129. If this fascia is reflected, the superficial perineal branches of the pudic artery and nerve are seen running forwards to supply the skin of the scrotum. When incisions are required in this region, in cases of infiltration of urine, they should be made in an antero-posterior direction, parallel to the superficial perineal vessels. The incision should, if possible, be in the middle line, or as near as possible to the middle line, because the risk of hæmorrhage is in this situation reduced to a minimum, the mesial anastomoses being capillary. The accelerator urinæ muscle envelops the bulbous portion of the corpus spongiosum; the erector penis covers the crus of the corpus cavernosum; the transverse perineal muscle runs transversly inwards from the pubic arch to the central point of the perineum, immediately behind the bulb. These three muscles form the sides of a triangle, the floor of which is formed by the triangular ligament (Plate XVIII. fig. 1). The erectores penis and the crura are now detached from the bone; the accelerator urinæ, and transverse perineal muscles are detached

from the central joint of the perineum, the accelerator urinæ thrown upwards exposing the bulb, the transverse perineal muscles thrown outwards. The fibrous attachment of the bulb to the triangular ligament is now divided, along with the urethra, as it pierces the ligament to enter the bulb. The artery to the bulb, which also pierces the triangular ligament, is to be cut across. The whole extent of the triangular ligament will now be exposed, and it will be seen to be a strong fibrous membrane stretching across the interspace between the bones (Plate XVIII. fig. 1).

130. STRUCTURES POSTERIOR TO THE TRIANGULAR LIGAMENT.—The triangular ligament is now to be carefully removed from its attachments, when the structures beneath it will be exposed—namely, the membranous portion of the urethra, the compressor urethræ, and the deep transverse perineal muscle, the pudic artery, and its terminal branches —namely, the artery to the bulb, the artery to the corpus cavernosum penis, and the dorsal artery of the penis ; the corresponding branches of the pudic nerve are also seen. It will be evident that as the main terminal branches of the pudic artery are for the supply of structures in front of the triangular ligament, they must pierce the ligament in order to reach them. The dorsal vein of the penis carries the blood from the penis through the triangular ligament, to join the prostatic plexus of veins. If these structures are now removed, the apex of the prostate gland will be seen (Plate XVIII. fig. 2 ; Plate XIX. fig. 1). In order to expose the gland more fully, the anterior attachment of the external sphincter of the anus to the central point of the perineum is now divided, and the lower end of the rectum thrown downwards. The anterior fibres of the levator ani muscle will in this way be stretched, and will be seen to lie upon either side of the prostate gland, acting as a support to it, hence the name levator prostatæ. The prostate gland is ensheathed by the pelvic fascia, which passes off the gland near its apex, to be attached to the posterior surface of the symphysis pubis, and to the posterior edge of the descending rami of the pubis. These attachments form the anterior true

ligaments of the bladder, and are sometimes called the posterior layer of the triangular ligament. The normal prostate gland resembles in general shape and size a horse-chestnut, its apex looking forwards, its base backwards; it lies upon the rectum, three-quarters of an inch below the level of, and three-quarters of an inch behind, the symphysis pubis; it is pierced by the urethra nearer its upper than its lower surface. The prostate is surrounded by a venous plexus, into which the veins of the penis empty themselves; this plexus is continued backwards into the internal iliac and inferior hæmorrhoidal veins.

131. THE OPERATION OF LITHOTOMY.—A stone may be removed from the bladder through an incision either above or below the symphysis pubis. The operation of lithotomy is divided into the *supra-pubic* and *sub-pubic or perineal.*

132. *The Supra-pubic Operation* (Plate XIX. fig. 3).—The anterior surface of the distended bladder is uncovered by peritoneum. If, after the bladder has been distended with fluid of sufficient quantity to raise it above the upper border of the symphysis, an incision is made in the middle line through the skin, superficial fascia, and sheath of the rectus, the adjoining edges of the pyramidales and recti will be seen; if they are separated, the anterior surface of the distended bladder will be exposed, after the fascia, fat, and cellular tissue are turned aside. The bladder is to be opened vertically, as near as possible to the symphysis pubis, in order to avoid any risk of injury to the peritoneum. The size of the opening will depend upon the size of the stone, which is to be grasped by a pair of forceps and withdrawn. Plate XIX. fig. 2 is introduced in order to illustrate the abdominal situation of the bladder in the young child.

133. *The Sub-pubic or Perineal Operation.*—The bladder has been reached through the perineum in various ways. Two only need be alluded to here—the *median* operation and the *lateral* operation. First, the *median* operation. The patient is to be tied in the lithotomy position after a curved staff, with a deep mesial groove on its convexity, has been passed into the bladder. An incision is to be made in the middle line in front of the anus. The object which the

surgeon has in view is to strike the groove of the staff in the membranous portion of the urethra; he is to avoid the bulb anteriorly, and the anus posteriorly. After the point of the knife is fairly in the groove, the knife is to be pushed along the groove into the bladder, the back of the knife in the groove, the edge of the knife looking directly downwards towards the anus. As the knife is pushed home, the floor of the membranous portion of the urethra, the constrictor urethræ muscle, the floor of the prostatic portion of the urethra, the prostate gland, and the fibrous ring at the neck of the bladder, will be divided. The knife is withdrawn, and the forefinger of the left hand is introduced through the wound into the bladder; the staff is now withdrawn, the wound dilated with the finger, lithotomy forceps introduced into the bladder, the stone grasped and withdrawn. In consequence of the limited space between the bulb and the anus, this method is only applicable when the stone is small. Small stones are generally now crushed, therefore the median operation is now seldom employed. The bleeding in this operation is always slight, because the mesial anastomoses of the pudic arteries are capillary. This fact is to be remembered in the performance of external urethrotomy or perineal section. A mesial division of the structures, in order to reach the stricture, is never followed by hæmorrhage of any consequence.

134. LATERAL LITHOTOMY.—This is the method of cutting for the stone which is most frequently used. The principles of the operation are—free division of the superficial structures, limited division of the deeper structures, more especially of the left lateral lobe of the prostate gland. The rectum is to be emptied on the morning of the operation by means of an enema; the patient is desired to retain as much water as possible in his bladder; if he cannot do this in consequence of irritability of the bladder, then a few ounces of tepid carbolised water are to be injected into the bladder after the patient is placed on the operating table. The staff is then passed into the bladder; it should be of as large a size as possible; the groove should be deep, running

along the left side of the convexity of the instrument. The patient is now tied up in the lithotomy position, the knees steadied by two assistants; the surgeon should see that there is no tilting of the pelvis to one or other side, and should direct the assistant to hold the staff with the left hand steadily, vertically, drawn up as much as possible to the pubis, and touching the stone—the primary essential is that the point of the staff should touch the stone, in order that the point of the instrument may certainly be in the bladder, so that when the knife is pushed home to the end of the groove the fibrous ring surrounding the urethra at the neck of the bladder will be divided. The drawing of the staff up to the pubis will raise the bulb, and will draw the artery to the bulb as far as possible from the rectum. The risk of injuring these structures will in this way be lessened. It must be remembered that this is of secondary importance in comparison with the point of the staff touching the stone. The surgeon now introduces the finger of his left hand into the rectum, and feels for the groove in the staff in the membranous portion of the urethra. The knife is now entered a little to the left of the raphe of the perineum one inch in front of the anus; the knife should pass at once to the depth of the membranous portion of the urethra; the incision should be carried downwards and outwards, midway between the anus and tuberosity of the ischium, into the ischio-rectal fossa, cutting the skin, superficial fascia, inferior hæmorrhoidal vessels, posterior fibres of the accelerator urinæ, transverse perineal muscle, and posterior part of the triangular ligament. The finger of the left hand is now introduced into the incision, to feel for the groove of the staff in the membranous portion of the urethra; the finger nail is laid in the groove, the posterior surface of the finger looking to the left side of the patient. With the finger nail as a guide, the point of the knife is introduced into the groove of the staff, and then pushed steadily homewards to the end of the groove, the back of the knife lying in the groove, and the edge of the knife looking towards the left tuberosity of the ischium. The staff generally used is curved; it is a matter of some difficulty to keep the knife accurately in the groove. This step in the operation will be simplified by using an angular staff; the curve will in this way be got rid of, and it will be found that it is an easy matter to push the knife along the groove.

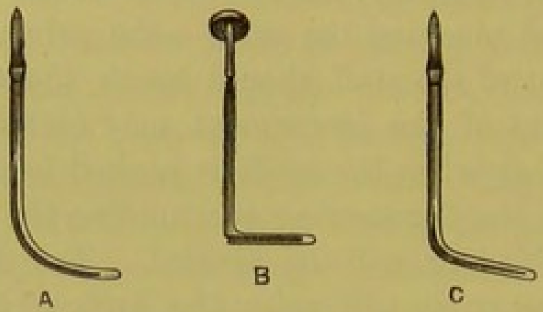


Diagram of three varieties of lithotomy staff. The instruments are foreshortened in the woodcut. A, curved staff of Cheselden; B, rectangular staff of Buchanan; C, angular staff used by the author. Its advantages are—(1st) the angle which guides the surgeon to the membranous portion of the urethra; (2d) the straight groove along which the knife is more easily directed than in the curved staff.

135. The following structures are divided: the floor of the membranous portion of the urethra, the constrictor urethræ muscle, the anterior fibres of the levator ani, the floor of the prostatic portion of the urethra, the left lateral lobe of the prostate gland, and the fibrous ring surrounding the urethra at the neck of the bladder. The knife is now carefully withdrawn, care being taken to keep the back of the knife in the groove of the staff, so that there will be no further division of any of these structures in the withdrawal of the knife. The finger of the left hand is now introduced along the incision into the bladder, and when the surgeon is certain that the point of his finger is in the bladder—the surest test of this is touching the stone—the staff is then withdrawn, and the prostatic tissue is dilated by the finger.[1] Lithotomy forceps are now passed along the finger into the bladder, the blades separated, the stone seized, and by gentle traction withdrawn. If the surgeon finds that he cannot withdraw the forceps grasping the stone,

[1] If the prostate is enlarged, it may be impossible to touch the stone with the finger. This is one of the difficulties of the operation. If the staff touches the stone, and if the knife is pushed to the end of the groove, the staff may be withdrawn.

he must try, without leaving hold of the stone, to grasp it in a shorter axis, in order that its withdrawal may be simplified. If he does not grasp the stone at once, he is to take a handle of the forceps in either hand, and separate the hands as widely as possible in a transverse direction in order to separate the blades ; keeping the hands apart, he is to rotate the forceps, so as to bring the blades in a vertical direction, the right hand being superior, the corresponding blade lying on the floor of the bladder. The stone, by the force of gravity, will now rest upon this blade, and the right hand being held steady, the left hand is to be raised to the right hand. The result will be a descent of the corresponding blade upon the stone, which will be grasped between the blades and withdrawn. This manœuvre will be specially useful in the case of a small stone, which is very apt to elude the grasp of the forceps when they are first introduced into the bladder.

136. The surgeon has to avoid cutting the bulb, the rectum, the artery to the bulb, the pudic artery, and the sheath of the pelvic fascia which surrounds the prostate. If the method just described is followed, these structures being in their normal position, they will not be injured ; sometimes, however, the artery to the bulb does not arise from the pudic artery behind the triangular ligament and run transversely inwards to reach the bulb, but arises from the vessel in the ischio-rectal fossa, and runs obliquely forwards and inwards from its point of origin to the bulb, across the anterior part of the ischio-rectal fossa. In this abnormal situation it can hardly escape division, and will require to be ligatured. This can be generally done without much difficulty, the pudic artery being temporarily compressed against the ischium until the ligature is applied ; if there is any difficulty in securing it, the incision must be enlarged in a forward direction, in order to get a clearer view of the bleeding point. The surgeon having assured himself that no stone remains in the bladder, a tube is to be introduced into the bladder, fixed with tapes passing round the thighs to a bandage round the pelvis, and the patient is released from his uncomfortable position.

Chapter III.

REGION OF THE GROIN—HERNIA.

The anatomy of this region will be considered under the following heads :—(a) *External Anatomy ;* (b) *Abdominal Division of the Space—Inguinal Hernia ;* (c) *Crural Division of the Space—Femoral Hernia.*

External Anatomy (Plate XXI. fig. 1).—137. This space, in which inguinal and femoral herniæ lie, is bounded by the following lines :—*Superiorly,* by a transverse line from the anterior superior spinous process of the ilium to the middle line of the body; *inferiorly,* by a transverse line across the upper part of the thigh, at the junction of its upper and middle thirds; *externally,* the space is bounded by the lateral edge of the body, *internally* by the middle line of the body. At the upper and external angle the anterior superior spinous process can be felt under the skin, and, running downwards and inwards from it, Poupart's ligament can be traced to the spine of the pubis. This structure divides the region into two divisions—an upper, *abdominal ;* and a lower, *crural.* Inguinal hernia is associated with the former, femoral with the latter. The superficial arteries, veins, and lymphatics are all directed towards that portion of the space below the inner end of Poupart's ligament. The lymphatic glands are arranged in two chief chains, one running along Poupart's ligament, another running along the internal saphenous vein in the upper part of the thigh. The long axes of the former are inclined outwards and upwards, the long axes of the latter are vertical. The former receive the lymphatic vessels from the genital organs, the latter from the lower extremity.

Abdominal Division of the Space — Inguinal Hernia (Plate XXI. fig. 2).—138. This division of the region is triangular in shape, and is bounded by Poupart's ligament, the middle line, and a horizontal line from the anterior superior spinous process to the linea alba. It is through this triangle that the cord passes in the male, and the round ligament in the female. In their passage through the abdominal wall they receive coverings from the different structures forming the wall. They pass obliquely through the wall, and the passage is termed the *inguinal canal.* To understand the anatomy of this region it is necessary to consider—*first,* the formation of the abdominal wall before the descent of the testicle in the fœtus in the last months of pregnancy; *second,* the descent of the testicle from its situation in the iliac fossa to the lower part of the scrotum. As the testicle descends, it carries before it coverings from the different layers which form the abdominal wall at this part; as it descends an elongation of its blood-vessels, nerves, and duct takes place; these structures form the cord. First, *the formation of the abdominal wall.* After the skin and superficial fascia are reflected, the tendinous expansion of the external oblique muscle is exposed. If this is removed, the transverse fibres of the internal oblique muscle are seen arising from the outer half of Poupart's ligament, and attached internally to the spine and crest of the pubis. If these fibres are removed, the transverse fibres of the transversalis muscle are seen arising from the outer third of Poupart's ligament, and running inwards towards the middle line, where they unite with the tendon of the internal oblique to form the conjoined tendon. There is a distinct interval between the lower border of the transversalis muscle and Poupart's ligament; in this interval the transversalis fascia is observed. Under the fascia the extra-peritoneal fat lies, and in it the deep epigastric artery will be seen crossing the interval, and running in an upward and inward direction to reach the under surface of the rectus abdominis.

139. Second, *the Descent of the Testicle.*—During the last months of intra-uterine life the testicle gradually de-

scends from its situation below the kidney, through the lumbar and iliac regions behind the peritoneum in the extra-peritoneal fat. It reaches the fascia transversalis above the centre of Poupart's ligament. From that point it passes obliquely through the abdominal wall, carrying along with it the spermatic artery and vein, its lymphatic vessels, and the duct of the gland or vas deferens. It first pushes before it the transversalis fascia; it then passes under the lower free border of the transversalis muscle, and reaches the transverse fibres of the internal oblique; they in their turn are pushed before the descending gland. It now reaches, above the inner end of Poupart's ligament, the strong tendon of the external oblique, which in its turn is pushed before it; the testicle now glides down into the scrotum. It will be observed that the testicle commences its course through the wall above the centre of Poupart's ligament, while it terminates its course through the wall above the inner end of Poupart's ligament. Its passage is therefore oblique. This obliquity reduces the necessary weakening of the wall to a minimum. The channel is termed the *inguinal canal,* and the structures which lie in the canal are termed the cord. The commencement of the canal in the transversalis fascia is termed the *internal abdominal ring;* the termination of the canal in the external oblique tendon is termed the *external abdominal ring.* The coverings which the cord receives as it passes through the wall have received special names:—First, the *infundibuliform* covering from the transversalis fascia; second, the *cremasteric* fascia, or cremaster muscle, from the internal oblique; third, the *spermatic* or *intercolumnar* fascia, from the tendon of the external oblique. The external and internal edges of the opening in the external oblique tendon are well marked, and are termed the columns or pillars of the ring. The spermatic fascia stretches across the interval between the columns, hence the name intercolumnar.

140. Oblique Inguinal Hernia.—This variety of hernia passes out of the abdomen into the scrotum, along the inguinal canal. Its coverings are the coverings of the cord

with the addition of a covering from the extra-peritoneal fat which is pushed before the descending sac before it enters the internal abdominal ring to descend along the canal. As a general rule it lies in front of the cord. Two varieties of oblique inguinal herniæ are described; they are termed *congenital* and *infantile.* To understand their anatomy it is necessary to recur to the descent of the testicle. As the testicle leaves the abdominal cavity it pushes before it a portion of the parietal peritoneum; this membrane is elongated, and passes into the scrotum in front of the testicle. There is at this period an elongated cul-de-sac of peritoneum stretching down along the cord to the bottom of the scrotum; the lowest part of this cul-de-sac remains unobliterated, and forms the tunica vaginalis testis; the remainder of the cul-de-sac, from the upper end of the testicle to the internal abdominal ring, closes, and nothing remains to indicate its former existence but a thin fibrous cord. If this closure does not take place, there is no obstacle to the passage of the bowel from the abdominal cavity into the scrotum. The result is a *congenital hernia,* the bowel lying in contact with the testicle. When the obliteration is only partial and that usually at the upper end of the cul-de-sac, the passage of a hernial tumour down along the cord, behind the unobliterated tube of peritoneum, is called an *infantile hernia.* In order to reach the sac in this variety of hernia, it will be necessary to divide both the anterior and posterior walls of the tube.

If the abdominal cavity is opened by an incision from the anterior superior spinous process on the one side to the corresponding process on the other side, and if the inner surface of the parietal peritoneum below the level of this line is examined, certain irregularities on its surface are seen. (Plate XXIII. fig. 2.) First, a vertical ridge in the middle line running upwards from the bladder to the umbilicus, the obliterated urachus; second, two oblique elevations on either side of the urachus, formed by the obliterated hypogastric arteries; external to these elevations, two ridges running upwards and inwards, which correspond to the situation of the deep epigastric arteries. On either side of the last-named ridge there is a distinct depression; the external depression corresponds to the situation of the internal abdominal ring—in other words, to the point where oblique inguinal hernia commences, the internal depression, bounded internally by the hypogastric ridge, externally by the epigastric ridge, inferiorly by Poupart's ligament, indicates the point of origin of *direct inguinal hernia.*[1] As the epigastric artery separates these two depressions, where the two varieties of inguinal hernia commence, of necessity the neck of the sac will lie external to the artery in the oblique variety, internal to the artery in the direct variety: hence, oblique inguinal hernia is sometimes called *external hernia;* direct inguinal hernia is called *internal hernia.* (Plate XXIII. fig. 1.)

141. DIRECT INGUINAL HERNIA.—This form of hernia passes directly through the abdominal wall above Poupart's ligament; in its course it pushes before it—*first,* the extra-peritoneal fat; *second,* the transversalis fascia; *third,* the conjoined tendon, formed by the junction of the internal oblique and transversalis muscles; *fourth,* it has now reached the external abdominal ring, through which it passes, receiving a covering from the spermatic fascia as it passes into the scrotum. Some cases of direct inguinal hernia escape from the abdominal cavity below the free lower border of the conjoined tendon, passing through a triangle, bounded externally by the deep epigastric artery, internally and superiorly by the free border of the conjoined tendon, inferiorly by Poupart's ligament.

142. When strangulation of the contents of a hernial tumour occurs, an operation has to be performed in order to divide the constricting cause, which, in the case of oblique hernia, is either the external or internal abdominal ring, which, in the case of direct hernia, is either the external abdominal ring or the conjoined tendon. Many cases of direct hernia are rapidly formed, and the strength of the conjoined tendon is such that the hernial protrusion bursts through the

[1] The hypogastric artery may lie so near the epigastric artery that both structures may be external to the neck of the sac in direct inguinal hernia.

conjoined tendon, hence the frequency with which this structure acts as the constricting cause. It is to be remembered that very frequently an inflammatory thickening in the neck of the sac is the cause of strangulation in both varieties of inguinal hernia. In such cases, in order to divide the constriction from within outwards, it will be necessary to open the sac. When the surgeon is called to an inguinal rupture of any size, it is frequently impossible to say whether the case is one of oblique or direct hernia; in other words, there is uncertainty regarding the relation of the epigastric artery to the neck of the sac. In an old-standing case of oblique hernia, the inguinal canal is enlarged, shortened, and more direct in its course through the abdominal wall. The epigastric artery is displaced inwards and encircles the inner aspect of the neck of the sac. (Plate XXII. fig. 1.) If the direct hernia is of any size, it tends to push the epigastric artery outwards, which, in such a case, encircles the outer aspect of the neckof the sac. (Plate XXIII. fig. 1.) In operating on a case in which the diagnosis is uncertain, it is right to follow Sir Astley Cooper's rule, and divide any constricting cause directly upwards, in order to avoid any risk of wounding the epigastric artery.

Crural Division of the Space—Femoral Hernia (Plate XXII. fig. 3).—143. If a ligamentous pelvis is examined, it will be seen that there is an interspace between Poupart's ligament and the os innominatum. Certain structures pass through this interspace out of the abdomen into the thigh. The principal of these are—the psoas and iliacus muscles, the anterior crural nerve, and the femoral vessels. These vessels are surrounded by a sheath, which is a prolongation from the fascial envelope lining the abdomen between the muscles and the extra-peritoneal fat. Different parts of this fascia have received different names from the various muscles to which it is related, but it is to be understood as one continuous structure. To understand the formation of the femoral sheath, the lower part of the abdominal wall is to be turned down, the parietal peritoneum which lines it is to be turned aside, the extra-peritoneal fat cleared away, and the fascial envelope exposed. It will then be seen that the fascia covering the iliacus muscle joins the fascia covering the transversalis muscle along the line of Poupart's ligament, to the outer half of which they are firmly attached. The external iliac artery and vein are seen passing under the inner half of Poupart's ligament. The fascia covering the iliacus muscle can be traced under the vessels into the thigh; the fascia covering the transversalis muscle can be seen passing under Poupart's ligament in front of the vessels. It is in this way that the femoral sheath is formed. The artery lies external to the vein, and the lymphatic vessels are seen lying in a quantity of extra-peritoneal fat internal to the vein. The artery is separated from the vein by an antero-posterior septum; a similar septum separates the vein from the lymphatic vessels. By these *septa* the femoral sheath is divided into three compartments, the outer containing the artery, the middle the vein, and the inner the lymphatics. (Plate XXII. fig. 2.)

144. FEMORAL HERNIA.—If the point of the finger is introduced into the inner compartment of the sheath, displacing the fat and lymphatic vessels, the finger will lie in the *crural canal*, through which femoral hernia passes from the abdomen into the thigh. The upper part of this canal, at the level of Poupart's ligament, is called the *crural ring*. It is important to understand exactly the structures that surround the finger as it lies in the canal. Examine on a ligamentous pelvis the inner attachment of Poupart's ligament, and observe that, while the main portion of the ligament is attached to the spine of the pubis, it has also a linear attachment to the ilio-pectineal line, running backwards and outwards from the spine for about an inch. This linear attachment is called *Gimbernat's ligament*. It will be seen that the free external edge of the ligament is sharp, resistant, and falciform. This free edge forms the inner boundary of the interspace between Poupart's ligament and the os innominatum. As the finger lies in the crural canal, the inner end of Poupart's ligament will lie in front of the finger, the bone will lie behind the finger, the sharp free

edge of Gimbernat's ligament will lie internal to the finger. These firm resistant structures are separated from the finger by the femoral sheath; they form respectively the anterior, posterior, and internal boundaries of the crural ring. The external boundary of the ring is formed by the antero-posterior septum, which separates the vein from the crural canal.

145. To understand the subsequent course of femoral hernia, it is necessary to consider the anatomy of the superficial structures in the crural portion of the space. When the skin is reflected the superficial vessels will be seen converging to an opening in the fascia lata of the thigh. (Plate XXI. fig. 1.) This opening is termed the *saphenous opening*, because, in addition to the smaller superficial vessels which pass through it to join the femoral vessels, the large internal saphenous vein passes through it to reach the femoral vein. As the superficial fascia crosses the opening it is riddled with holes by the numerous blood-vessels which pass through it: hence its name, the *cribriform fascia*. If this fascia is removed the femoral sheath will be exposed (Plate XXII. fig. 2), and it will be seen that the outer edge of the opening is sharp and falciform, and that this edge passes in front of the femoral sheath to be attached to Poupart's ligament. It will also be seen that, towards the inner side of the opening, there is no free edge, the fascia lata is seen passing beneath the femoral vessels to become incorporated with the posterior aspect of the sheath. The form of the opening is such—its external and internal boundaries being on a different plane—that, in whatever position the limb is placed, the opening remains patent, and the blood-vessels and lymphatics which pass through it are never obstructed. In order to demonstrate the compartments of the femoral sheath they should now be opened, and their contents exposed. To make sure of opening the small inner compartment or crural canal, the point of the finger should be replaced in it, to act as a guide to the knife.

146. *Course and Coverings of Femoral Hernia.*—The hernial sac first passes downwards into the crural canal; it

receives a covering from the plug of extra-peritoneal fat which fills the canal,—this plug has received a special name, the *septum crurale*,—it then pushes before it the femoral sheath. It has now reached the saphenous opening in the fascia lata, through which it passes forwards, receiving a covering from the cribriform fascia which closes the opening. It is also covered by the subcutaneous tissue and skin. As the hernia increases in size it passes upwards in front of Poupart's ligament; this is due to the fact that the sharp edges of Poupart's ligament and of the saphenous opening offer greater friction to the anterior portion of the sac than the smooth bone does to the posterior surface of the sac. This course of the femoral hernia downwards, forwards, and upwards, is to be remembered in attempting reduction by taxis. The pressure must be made downwards, backwards, and upwards. The constricting cause when strangulation occurs is generally Gimbernat's ligament. This ligament must be divided with the greatest care, because not unfrequently the obturator artery winds round the neck of the sac immediately behind the ligament. This abnormal situation of the artery occurs when it arises from the deep epigastric. If it arises from the epigastric close to the origin of that vessel from the external iliac, it will in all probability be out of the way of danger, running behind the neck of the sac to reach the obturator foramen. If, on the other hand, it arises from the epigastric artery at a higher level, it will pass round the anterior aspect of the neck of the sac; hence the care necessary in dividing the edge of Gimbernat's ligament. Mr. Spence has described a case in which the artery was the cause of strangulation. (Plate XXII. fig. 1.)

HEAD, NECK, AND THORAX.

THIS region will be considered under the following heads—Chap. I. *The Cranium ;* Chap. II. *The Face ;* Chap. III. *The Neck ;* Chap. IV. *The Thorax ;* Chap. V. *Arteries of the Region.*

CHAPTER I.

REGION OF THE CRANIUM.

The anatomy of this region will be considered under the following heads—(a) *External Anatomy ;* (b) *Scalp.*

External Anatomy (Plate XXIV. fig. 1).—147. The cranium proper is bounded by a line drawn round the skull, passing through the occipital protuberance posteriorly and the superciliary edges anteriorly. The principal bony prominences are the frontal eminences on either side of the middle line anteriorly; laterally the parietal eminences; posteriorly in the middle line, the occipital protuberance, and the mastoid processes behind the ears. Note the exact position of the occipital protuberance, and remember that in applying a bandage round the cranium it must be carried below the level of the protuberance posteriorly, and the frontal eminences anteriorly; if this is done it cannot slip off the head, because the circumference through the protuberance and eminences is greater than the circumference below these prominences. The vault of the cranium varies in thickness in different individuals, and in different situations in the same individual. The average thickness is about quarter of an inch. In the adult it is one continuous bony arch. In every child at the time of birth, and in weakly children for some months after birth, the ossification of the frontal parietal and occipital bones is not complete; the result is that at the point of junction of the parietal and frontal bones—developmentally, the frontal bone is double—there is a quadrilateral space, bridged over by a fibrous membrane, termed the *anterior fontanelle ;* also between the parietal bones and occipital bone a triangular interval exists, termed the *posterior fontanelle.* The vault of the cranium consists of two bony layers, termed the inner and outer tables, and an intervening layer of cancellated tissue, in which large veins ramify. These veins anastomose with the sinuses within the cranium, and with the subcutaneous veins of the scalp. The inner table is brittle, and, in cases in which force sufficient to cause a fracture has been applied to the bone, the result frequently is that the inner table is much splintered.

The Scalp.—148. This structure consists of various elements, skin and subcutaneous tissue, which are closely united ; under the subcutaneous tissue, and closely united to it, is the occipito-frontalis muscle ; its expanded tendon forms the cranial aponeurosis, which is separated from the periosteum of the cranium, termed pericranium, by loose cellular tissue. The looseness of this tissue enables the scalp to move freely on the bone. The arteries of the scalp ramify in the subcutaneous tissue superficial to the occipito-frontalis, hence the most superficial cuts often bleed profusely ; in them there is not the same tendency to speedy stoppage of the blood flow by the natural arrest of hæmorrhage, as in wounds of the face. In the scalp the vessels lie in dense tissue, retraction cannot take place ; in the face the cellular tissue is loose, the vessels retract easily, and natural arrest is to be looked for. The arteries in both situations are large, hence in both bleeding is at first profuse ; in the scalp it is at the same time persistent. When matter forms superficial to the occipito-frontalis, it has little tendency to spread ; when it forms under the occipito-frontalis it separates the tendon from the pericranium, spreading in all directions, and is only stopped by the firm attachment of the muscle to the superior curved line of the occipital bone, the superciliary ridges of the frontal bone, and the temporal ridges on the parietal bones. The density of the scalp also explains the abrupt definition of the boundaries of a collection of fluid blood, which closely resemble and have been mistaken for a depressed fracture. The defined edge around a depressed fracture is on the same level as the surrounding bone, while the edge of the collection of blood is at a higher level.

149. ARTERIES OF THE SCALP.—The principal vessels are the *temporal* and *supra-orbital* laterally and anteriorly; the *posterior auricular* and *occipital* laterally and posteriorly. The *temporal* artery is a terminal branch of the external carotid; it runs up in front of the ear over the zygoma, against which it can be compressed. The *occipital* is also a branch of the external carotid; after running backwards under cover of the mastoid process, and the muscles which arise from that process, it appears in the occipital region, and can be compressed by pressure applied immediately posterior to the base of the process. The *posterior auricular* is also a branch of the external carotid; it runs upwards behind the ear, and can be easily compressed in that situation. The *supra-orbital* appears at the supra-orbital notch, at the junction of the inner and middle thirds of the orbital ridge; it is one of the terminal branches of the ophthalmic branch of the internal carotid.

150. The position of the middle meningeal artery should be remembered. The best guide to its situation is the external angular process of the frontal bone. The artery grooves the anterior-inferior angle of the parietal bone, $1\frac{1}{2}$ inch posterior to the frontal process. The principal communications between the intra-cranial and superficial veins should be noted; (*a*) the communications between the lateral sinus and the occipital vein through the mastoid vein, behind the mastoid process; (*b*) between the internal jugular (lateral sinus) and external jugular veins in the substance of the parotid gland; (*c*) between the ophthalmic (cavernous sinus) and facial veins at the inner angle of the eye. The practical deduction from these facts is, that, in the application of leeches in venous intra-cranial congestion, the best situations are behind the ear, over the parotid gland, and at the inner angle of the eye. (Plate XXIV. Fig. 1.)

Chapter II.

REGION OF THE FACE.

The anatomy of this region will be considered under the following heads :—(a) *External Anatomy;* (b) *Lower Jaw;* (c) *Arteries and Nèrves;* (d) *Parotid Gland;* (e) *Region of the Orbit;* (f) *Cavity of the Nose;* (g) *Cavity of the Mouth.*

External Anatomy (Plate XXIV. figs. 1 and 2).—151. The osseous edge of the orbit, formed by the frontal, malar, and superior maxillary bones, can be felt. Any irregularity in cases of fracture can therefore be made out by a careful comparison of the sound with the injured side. The pulsation of the supra-orbital artery is the guide to the supra-orbital notch. Trace the general outline of the nasal bones; their inferior borders articulate with the lateral cartilage of the nose. The line of junction can easily be made out. Remember how these bones are strongly wedged between the ascending processes of the superior maxillary bones; they are joined to the frontal bone superiorly by a strong articulation. Great violence is therefore necessary in order to their displacement or fracture, their exposed situation rendering them specially liable to injury. The projection of the cheek is formed by the malar bone. This bone articulates posteriorly with the temporal by the zygoma; with the frontal and sphenoid superiorly and posteriorly; internally with the superior maxillary bone. It is in this way buttressed in all directions, in order that it may withstand the results of external violence. When this bone is displaced it generally passes forwards in mass into the antrum or hollow in the centre of the superior maxillary bone. The zygoma is sometimes broken in consequence of a direct blow; the strongest part of the superior maxillary bone is its alveolar edge and palatal surface; any irregularity in these parts can be discovered by digital examination in the cavity of the mouth. It is to be remembered that the wall of the antrum is specially thin above the second bicuspid tooth; in serous and purulent collections the cavity can be most easily punctured at this spot, or the fluid can be evacuated by pulling the first molar tooth, the fangs of which pass upwards into the cavity. The direction of the displacement in fractures of the bones in this region is the result of the direction of the force which causes the fracture; all, therefore, that is necessary is to mould the bones by pressure externally through the skin, and by counter-pressure internally, advantage being taken of the cavities of the nose and mouth.

The Lower Jaw.—152. The general shape of this bone can be traced subcutaneously; its coronoid process can be felt by passing the finger into the mouth between the cheek and the teeth; the bone may be broken at any part; rarely at the symphysis, in consequence of its thickness; rarely through the ramus, because it is protected by the masseter muscle; most frequently through the body, and, as as a rule, at that part of the body which is weakened by the mental foramen and deep socket for the canine tooth. This fracture is generally compound, the thin mucous membrane which covers its alveolar edge being torn; no teeth, however loose, are to be removed, because they frequently become firm as the fracture consolidates. The muscles which stretch from the hyoid bone to the genioid processes behind the symphysis tend to displace it downwards; it also falls away by its own weight; it must, therefore, be retained in position by a four-tailed bandage, the teeth of the lower jaw being pressed against the teeth of the upper jaw, which act, so to speak, as an internal splint. It is not necessary to insert anything between the teeth in order to keep them separate, because the patient must subsist for some time on fluid food alone, which, in the majority of cases, passes easily into the mouth in consequence of the irregularities or imperfections of the teeth. If the teeth are perfectly regular and complete, fluid nourishment will pass through a space which always exists between the last molar tooth of the upper jaw and the anterior edge of the coronoid process.

153. The *temporo-maxillary articulation* is formed by the condyle of the jaw fitting loosely into the glenoid hollow in the temporal bone, which is bounded anteriorly by the eminentia articularis, posteriorly by the glasserian fissure. The joint is strengthened externally and internally by lateral ligaments. An inter-articular fibro-cartilage divides the joint into two divisions, each with a separate synovial membrane. The internal maxillary artery runs between the neck of the lower jaw and the internal lateral ligament; care must be taken in disarticulating the jaw not to injure the vessel. The movements at this articulation are complicated, and will be best understood by observing the movements of the chin. It can be depressed, or elevated, a hinge movement; thrown forward and drawn backwards, an antero-posterior movement; lastly, it can move from side to side. When the chin is depressed, the articular surfaces of the condyles pass forwards on to the eminentia articularis. The condyles fitting loosely into the fossæ allow of slight antero-posterior movement; the lateral movement is caused by a passage forwards of one condyle only.

154. Dislocation of the Lower Jaw.—This dislocation is either unilateral or bilateral—one or both of the articular surfaces of the lower jaw passing from their normal position to the hollow in front of the eminentia articularis; the patient cannot close his mouth, and there is a distinct hollow in front of the ear in the normal situation of the condyle. In reducing the dislocation, it is necessary to overcome the action of the masseter, temporal, and pterygoid muscles; the thumbs are to be placed on the last molar teeth, the fingers on the projection of the chin; pressure is to be made by the thumbs downwards and backwards, by the fingers upwards and forwards, so as to bring the articular surface under the eminentia articularis, when the contraction of the temporal muscles will replace the condyle in its normal position—in order to give the operator sufficient purchase, the patient should be seated on a low stool, the surgeon standing above him.

155. *Excision of the Lower Jaw.*—When disarticulation of the bone is necessary, the close relationship of the internal maxillary artery, lying internal to the neck of the bone, between it and the internal lateral ligament, is to be remembered in order that it may not be wounded. In cutting across the attachment of the temporal muscle to the coronoid process, the bone is to be forcibly depressed, as this process lies under cover of the zygomatic process of the malar bone; if the ramus alone requires removal, care should be taken not to divide the mucous membrane; if the mouth is not opened into, the after treatment will be simplified, and the cure expedited.

Arteries and Nerves of the Face. 156. *Facial Artery.*—This vessel can be felt and compressed as it passes over the edge of the lower jaw, one inch in front of the angle; from this point, the artery runs tortuously upwards and inwards past the angle of the mouth, and terminates on the side of the nose, where its pulsations can be felt; as it passes the angle of the mouth it gives off the coronary arteries; their pulsations can be distinctly felt under the mucous membrane close to the edge of the lip. The artery inosculates in the substance of the cheek with the transverse facial branch of the temporal.

157. *Nerves of the Face.*—The motor nerves (the seventh pair of cranial nerves) issue from the substance of the parotid gland, and appear upon the face behind the posterior edge of the ramus of the jaw; the general direction of the branches is horizontal, and to avoid their injury, incisions in this region should be parallel to, and not at right angles to, their general direction. The parotid gland sends forwards a prolongation on to the cheek which accompanies the duct of the gland, which opens into the cavity of the mouth opposite the second molar tooth of the upper jaw; a line from the tip of the mastoid process to the centre of the upper lip corresponds to the situation of this duct; care should be taken not to injure it when operating in this region. The fifth cranial nerve is the sensory nerve of the face. Its chief terminations are three in number, the supra-orbital, the infra-orbital, and

the mental. In order to afford temporary relief in neuralgic affections, these terminations of the fifth nerve are sometimes divided; the infra-orbital and mental foramina lie slightly external to a vertical line passing through the supra-orbital notch. It is at present a question whether stretching of these nerves would not be more permanently advantageous. Experience in sciatica seems to encourage this hope; at all events it is worthy of a trial in severe tic-doloureux.

Parotid Gland (Plate XXIV. fig. 2).—158. This gland lies in the hollow between the mastoid process and the ramus of the jaw. It is bound down by a strong fascia stretching between these bones. When suppuration occurs in its substance, an incision is necessary in order to give vent to the matter; when we remember the important structures which lie in its substance (the internal carotid artery, the external carotid, giving off its posterior auricular, temporal, and internal maxillary branches; the facial, great auricular, and auriculo-temporal nerves, and lastly the venous plexus, consisting of the temporal, internal maxillary, and external jugular veins), it is evident that the incision must be made with care. To accomplish the operation with safety, a limited incision should be made over the angle of the jaw through the superficial structures down to the deep fascia; by this incision the mass of the facial nerve, the transverse facial artery, and the duct of the gland will be avoided, as they lie at a higher level. A grooved director is then to be pushed through the deep fascia, into the substance of the gland; when the matter is reached it will be seen to escape along the groove of the instrument, which will act as a guide to a pair of dressing forceps—the director is now withdrawn, the blades of the dressing forceps are separated in position, and withdrawn so as to enlarge the opening in the fascia, and give free exit to the matter. It will be evident that excision of the parotid gland is anatomically impossible. So called *parotid tumours* are tumours over the parotid. When of a simple nature and encapsulated they can be removed with safety; the incision should if possible be planned to avoid injuring the facial nerve and the duct of the parotid gland. If the tumour is of a malignant nature, infiltrating the gland tissue, no operation should be performed, because complete removal is impossible. The stylo-maxillary ligament, a prolongation from the cervical fascia stretching from the styloid process to the inner surface of the angle of the jaw, separates the parotid from the sub-maxillary gland. It is this structure which enables the surgeon to differentiate enlargements of these glands.

Region of the Orbit.—159. This cavity contains the eyeball, its muscles, blood-vessels, and nerves. The eye is protected by the eyelids, which are firmly attached to the bone at the inner and outer corners of the eye. The rounded tendo oculi, stretching from the inner canthus to the ridge of the lachrymal bone, can be distinctly felt when the eyelids are drawn outwards. The tarsal cartilages form the main thickness of the eyelids ; they are connected with the edge of the orbit by a fascial structure, continuous with the periosteum. The orbicularis palpebrarum lies between the cartilages and the skin. The Meibomian glands lie between the tarsal cartilages and the conjunctiva. The small cystic tumours, met with more especially in the upper eyelid, are enlargements of these glands. In order to lay them open and evacuate their contents, the eyelid is to be everted, and the conjunctiva which covers them is exposed and divided.

160. *Lachrymal Apparatus.*—The lachrymal gland lies in a hollow in the outer wall of the orbit. The secretion passes by numerous fine ducts into the space between the eyeball and the eyelids. It leaves this space by the canaliculi, two fine tubes which pass into the lachrymal sac, which lies in a groove formed by the nasal process of the superior maxilla and the lachrymal bone. The sac communicates with the nasal duct, which runs downwards and slightly backwards and outwards, to open into the inferior meatus of the nose half an inch behind the bony ridge. The ocular extremities of the canaliculi are termed the puncta lachrymalia; they are situated one eighth of an inch from the inner canthus at the edges of the eyelid. In passing a probe along the canaliculus, the point of the instrument

being introduced at the punctum, it is first carried slightly upwards in the superior canaliculus, slightly downwards in the inferior canaliculus, and then in a horizontal direction into the lachrymal sac. To pass a probe from the lachrymal sac into the inferior meatus of the nose, the direction of the nasal duct downwards, backwards, and outwards, is to be remembered. When the nasal duct is obstructed, the secretion collects in the lachrymal sac; if not relieved, it will cause inflammatory tension, which will result in an abscess. In order to allow the matter to escape, a narrow-bladed knife is to be pushed into the lachrymal sac immediately under the transverse tendo oculi, which crosses the middle of the sac, uniting the inner extremities of the tarsal cartilages to the nasal processes of the superior maxillary bone.

Cavity of the Nose.—161. The floor of this cavity is horizontal when the patient is in the erect posture. The septum of the nose, formed by the *vomer*, the central plate of the ethmoid and cartilage, is seldom *mesial*, having generally an inclination to the left. The turbinated bones lie in connection with the outer wall of the cavity; nasal polypi grow generally from the roof of the cavity, rarely from the outer wall, never from the septum. The vertical diameter is greater than the transverse; this is to be remembered in removing foreign bodies from the nose, the dressing forceps being introduced closed, and used as a probe to feel for the foreign body; the blades are then opened in a vertical direction, in order to grasp and withdraw it. The horizontal direction of the floor of the cavity is to be remembered in passing the Eustachian catheter, or in feeding a patient through this cavity by means of a gum elastic catheter. The opening of the Eustachian tube lies behind and slightly above the level of the posterior extremity of the inferior turbinated bone; the Eustachian catheter is to be passed along the horizontal floor, the point of the instrument looking downwards, until it strikes the posterior wall of the pharynx; it is then to be withdrawn about half an inch, rotated outwards through quarter of a circle, when its extremity will pass into the opening of the Eustachian tube

(Plate XXIX.) The posterior nares can be felt by passing the finger behind the soft palate; each measures vertically about one inch, and transversely half an inch. These measurements are to be remembered in shaping the plug of lint for the operation of plugging the posterior nares.

Cavity of the Mouth.—162. The changes that take place in the epithelium, on the upper surface of the tongue, are an indication of the condition of the intestinal canal generally. The normal condition of the frenum with the tongue is to be noticed, and it is to be remembered that a small artery lies in its substance. When it is necessary to divide it in tongue-tied children, this artery will be avoided by nicking the anterior edge with curved scissors, and by tearing across the posterior part with the finger nail. There is a distinct hollow upon either side of the frenum, in which the cystic disease, termed ranula, occurs. The cyst wall is thin, the contents transparent, giving a pellucid appearance to the swelling; to cure this disease it is necessary to lay hold of the cyst wall with a pair of artery forceps, and to cut out a portion of the cyst wall with curved scissors.

The condition, shape, and regularity of the teeth is to be noted. Mr. Hutchinson has described their notched, peg-like, irregular shape, and small size, in hereditary syphilis. These conditions are the result of mal-nutrition in consequence of stomatitis; it is a question whether this malformation is always pathognomonic of syphilitic stomatitis. If the patient has been affected with simple inflammatory stomatitis, may a similar malformation of the teeth result? The height of the arch of the palate varies greatly in different individuals; at its posterior edge the hamular processes can be felt. Note the condition of the soft palate, the tonsils, lying between the pillars and the fauces, and the posterior wall of the pharynx. This region can be seen most distinctly when the head is thrown back, the tongue depressed, and the patient asked to take a full breath. In operating upon the tonsil, its close relation to the internal carotid artery and the ascending pharyngeal branch of the external carotid is to be remembered, the pharyngeal aponeurosis and superior constrictor of the pharynx alone separating them. In opening abscesses, the knife is to be pushed into the enlarged gland directly backwards, the edge of the knife being directed towards the middle line; in excision of the gland, the cut is to be made vertically, in other words, parallel to the line of the internal carotid. The epiglottis can be reached and examined by the tip of the finger; the finger can even be passed over the epiglottis, in order to reach the opening of the glottis. (Plate XXIX.)

Any fulness in the posterior wall of the pharynx can be made out; this is the situation of post-pharyngeal abscess. In order to swab the larynx, the tongue is to be forcibly pulled out of the mouth, in order to stretch the glosso-epiglottidean folds, and in that way draw the epiglottis forwards. In passing the tube of the stomach pump or a large-sized gum elastic catheter into the œsophagus, the patient's head should be thrown back, the left forefinger of the operator laid in the middle line, the point of the finger protecting but not touching the epiglottis; the tube is then to be passed along the back of the finger until it reaches the posterior wall of the pharynx; if it is then directed in a downward direction, and the patient asked to swallow, it will slip easily into the œsophagus. When it is necessary to introduce the finger into the mouth, advantage should be taken of the normal laxity of the cheek, which should be pushed with the thumb and forefinger of the other hand between the molar teeth. If this is done, the patient will be prevented from inadvertently biting the finger of the surgeon.

External Meatus of the Ear.—163. This canal measures an inch and a quarter in length; it is directed inwards and forwards; it is not straight, but curved, the concavity of the curve looking downwards; its walls are partly cartilaginous and partly osseous; in order to examine its condition, the ear should be drawn upwards and backwards, in order to straighten the canal. If there is no wax or foreign body in the channel, the tympanum can be easily seen by reflected light at the inner extremity of the canal; it is to be remembered that this membrane is convex externally, concave internally; it lies obliquely, its outer surface looking downwards and slightly backwards; the result of this obliquity is that the inferior wall of the canal is longer than the superior wall.

CHAPTER III.

THE REGION OF THE NECK.

The anatomy of this region will be considered under the following heads:—(a) *External Anatomy;* (b) *Cervical Fascia;* (c) *The Middle Line of the Neck* (*Tracheotomy, Laryngotomy, Thyroid enlargements*).

External Anatomy (Plates XXIV. and XXV.)—164. This region is bounded superiorly by the edge of the lower jaw, and by a line from the angle of the jaw through the tip of the mastoid process to the occipital protuberance; inferiorly by the clavicles and upper border of the sternum; the sterno-mastoid muscle can be traced running obliquely across the space; note carefully its general direction, and mark out its anterior and posterior borders. Contraction of the sterno-mastoid gives rise to the deformity termed *wry-neck.* The face looks towards the opposite shoulder. If the chin is turned to one side, and the muscles of the face contracted, the fibres of the opposite platysma will become prominent; they run downwards and backwards across and superficial to the sterno-mastoid. Note the vertical direction of the external jugular vein, commencing at a point midway between the angle of the jaw and the tip of the mastoid process, terminating above the middle of the clavicle in the posterior triangle of the neck, where it pierces the deep fascia to join the deep veins; there is sometimes a communication between the cephalic and external jugular veins over the clavicle; the anterior jugular veins, lying on either side of the middle line in front of the sterno-mastoid muscle, only become visible when turgid, in consequence of dyspnœa. There is a distinct hollow above the manubrium sterni, in which the upper rings of the trachea can be felt. (The external anatomy of the middle line of the neck will be afterwards described.) If the neck is flexed in order to relax the sterno-mastoid muscles, the pulsations of the common carotid artery can be easily felt, and the vessel can be compressed at the level of the cricoid cartilage against the transverse processes of the cervical vertebræ. Note the shape and position of the hyoid bone; examine the condition, size, and consistence of the sub-maxillary gland under cover of the lower jaw; trace the anterior border of the trapezius muscle, and remember that the chain of lymphatic glands which lie along this border is frequently enlarged in syphilis.

165. Tumours in the lateral region of the neck lie either superficial to or beneath the sterno-mastoid. When under the sterno-mastoid, the muscle is stretched and thinly spread over the tumour. As a general rule, simple encapsulated tumours under the muscle may be removed with safety; if, on the other hand, the tumour is malignant and an infiltration, and placed under the sterno-mastoid, the surgeon should not, as a rule, interfere, because in all probability the carotid sheath and its contents will be implicated in the growth. There may, however, be exceptions to this rule—as, for instance, when the tumour is small. Mobility of the tumour is no test of non-adherence to the carotid sheath, because this structure is mobile, and will move along with the tumour. The subclavian artery can be compressed against the first rib, if firm pressure is made in the anterior-inferior angle of the posterior triangle of the neck; the pressure, to be efficient, must be inwards, downwards, and backwards.

Cervical Fascia (Plate XXV. fig. 2).—166. The arrangement of the cervical fascia will be understood by reference to a diagram. The fascia may be shortly described as arising posteriorly from the ligamentum nuchæ, running forwards, over the trapezius and posterior triangle of the neck, until it reaches the posterior border of the sterno-mastoid, when it divides into three layers. These layers may be designated A, B, and C, respectively. Layer

A passes superficial to the sterno-mastoid and depressors of the hyoid bone. This layer is closely connected with the platysma, which lies superficial to the fascia. Layer B passes beneath the sterno-mastoid and the depressors of the hyoid bone in front of the carotid vessels and thyroid body, giving off septa from its deeper surface to ensheath these

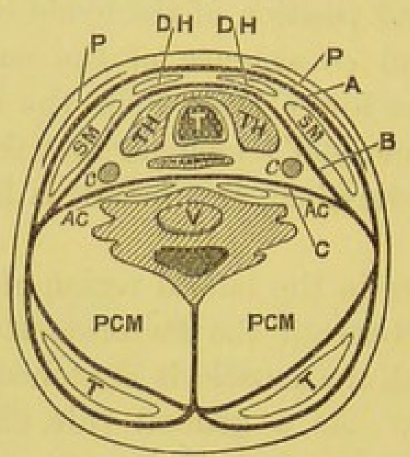


Diagram of a transverse section of the neck at the level of the isthmus of the thyroid body, illustrating the principal layers of the cervical fascia. V, cervical vertebra; T, trachea; T H, thyroid body; c, carotid vessels; S M, sterno-mastoid; D H, depressors of the hyoid bone; P, platsyma; A C, anterior cervical muscles; P C M, posterior cervical muscles; T, trapezius; A, B, and C, layers of cervical fascia described in the text.

structures. Layer C passes in front of the scalene and prevertebral muscles behind the œsophagus. Layer A is attached superiorly to the edge of the lower jaw, the mastoid process, the occipital bone, and, passing superficial to the parotid, is attached to the lower edge of the zygoma; inferiorly to the anterior surface of the manubrium sterni, and the clavicle. Layer B is attached superiorly to the hyoid bone, styloid process of the temporal, and the internal aspect of the angle of the lower jaw (stylo-maxillary ligament); inferiorly to the posterior surface of the manubrium sterni, and the clavicle. This layer passes into the thorax along the carotid vessels. Layer C is attached superiorly to the base of the skull; inferiorly it splits into two layers—an anterior, which is attached to the anterior edge of the first rib; a posterior, which passes into the thorax behind the œsophagus, in front of the prevertebral muscles. It is this anterior layer which, prolonged laterally from the outer edge of the scalenus anticus, forms the subclavian sheath, and passes under the clavicle to form the axillary sheath and strengthen the costo-coracoid membrane. Internal to the scalenus anticus, layer C unites with layer B, and forms with it an ensheathment for the large vessels at the root of the neck. A consideration of this arrangement will explain the fact, that matter, forming beneath B, may make its way into the anterior mediastinum, beneath C into the posterior mediastinum.

The Middle Line of the Neck (Plates XXVIII. and XXIX.)—167. An accurate and ready knowledge of this region is absolutely necessary, because the operations of tracheotomy and laryngotomy require, as a rule, to be performed without delay, and the surgeon has no time to refresh his memory by reference to works on anatomy. The middle line of the neck stretches from the chin to the sternum; the extent of the line will necessarily depend upon the position of the head. It is divided into two parts by the hyoid bone; above this bone it is connected with the anatomy of the floor of the mouth; between the bone and the sternum the larnyx and trachea are situated. From above downwards the following structures can be felt:—*First,* the hyoid bone; *second,* the thyroid cartilage, and its anterior projection, termed the pomum Adami; the thyro-hyoid membrane unites the hyoid bone to the thyroid cartilage; *third,* the cricoid cartilage, which is united to the thyroid cartilage by the crico-thyroid membrane; *fourth,* the rings of the trachea; the number of rings which lie above the sternum necessarily varies with the position of the head. This cartilaginous, osseous, and ligamentous column forms a basis for the soft structures which lie between it and the skin. Two structures cross the middle line:—*First,* the small crico-thyroid artery, which lies upon the crico-thyroid membrane; *second,* the isthmus of the thyroid body, which lies upon the second and third rings of the trachea, uniting the lateral lobes of the thyroid body. It is retained in this position by fascial attachments to the thyroid cartilage, which are continuous with the sheath of the thyroid gland, derived from the cervical fascia. The structures which lie between it and the skin are divisible by the muscular fascia of the region into two distinct layers. Between the fascia and the skin the anterior jugular veins lie in the subcutaneous fat, which varies greatly in amount, being in greater quantity in children and women than in the male adult; the sterno-hyoid and sterno-thyroid muscles lie under the fascia, their anterior edges meeting in the middle line; if they are separated and drawn outwards, the deep veins and the isthmus of the thyroid are exposed, lying in a quantity of loose cellular tissue. These veins are of insignificant size above the isthmus; of large size below the isthmus, where they receive the name of the inferior thyroid veins; their general direction is vertical; they join the innominate veins. It must also be remembered that the trachea slopes backwards, and the more nearly we approach the sternum, the more deeply do we require to dissect before reaching the trachea. (Plate XXIX.) Two operations for the relief of laryngeal obstruction have been described—*first,* laryngotomy; *second,* tracheotomy.

Laryngotomy.—168. This operation is, as a rule, performed in cases in which there is not time for the more serious operation of tracheotomy. It is a simple operation, in consequence of the superficial position of the crico-thyroid membrane, through which the opening is to be made. A vertical incision through the skin, the superficial and the deep fascia, divides the structures and exposes the crico-thyroid membrane. This membrane is to be divided transversely, close to the upper border of the cricoid cartilage, in order to avoid the crico-thyroid artery, which runs across the upper part of the membrane.

Tracheotomy.—169. The trachea is opened at two situations, either above or below the isthmus of the thyroid. They are termed respectively the *high operation* and the *low operation* of tracheotomy.

170. The High Operation.—The head being thrown back, and firmly held by an assistant, a vertical incision, exactly in the middle line, is to be made from the thyroid cartilage downwards towards the sternum. After the skin is divided, the subcutaneous fascia and fat, and the

anterior jugular plexus of veins, are exposed. These veins are avoided, and, if there are any transverse branches, a double ligature is passed under them with an aneurism needle; the ligatures are secured, and the vein or veins cut across. The deep fascia is then exposed and divided vertically. The mesial septum between the sterno-hyoid and sterno-thyroid muscles is then seen. The knife is now laid down, and a director (Mr. Spence's hernia director is the best for the purpose) is used to separate the muscles. They are held aside with blunt hooks, and the isthmus of the thyroid is seen crossing the trachea. That portion of the tube above the isthmus is now to be cleaned; this can, as a rule, be done with the director, which does no injury to the isthmus or deep veins. After the trachea is distinctly seen, the forefinger of the left hand pressing the isthmus downwards, a sharp hook is firmly fixed in the cricoid cartilage, and drawn upwards by an assistant. The knife is again taken up and pushed into the trachea, immediately above the isthmus, in the middle line; the cut is to be continued upwards, the back of the knife towards the isthmus, through the upper rings of the trachea, to the cricoid cartilage; the handle of the knife is inserted into this cut, and then, being turned transversely, the surgeon is able to introduce the tracheotomy tube through the opening. If a vein of any size is opened into, it must be ligatured before the trachea is opened.

171. The Low Operation.—The steps in this operation are the same as in the high operation: the only difference is that the trachea is to be cleared below the isthmus instead of above it. The difficulties of the operation are—(*a*) the depth of the trachea; (*b*) the large size of the deep or inferior thyroid veins; (*c*) the danger to which the isthmus is exposed, because the rings of the trachea require to be divided in an upward direction, in order to avoid the important structures which lie behind the sternum at the root of the neck; (*d*) the presence of the thymus body in young children; (*e*) the occasional presence of an artery termed the thyroidea ima, running upwards, in the middle line, from the innominate

artery to the thyroid isthmus. For these reasons the high operation is preferable. It has been objected that there is not room between the isthmus and the cricoid cartilage; this difficulty is met by depressing the isthmus, which, on account of its mobility, can be pushed downwards. Another objection has been raised to the high operation, namely, that the trachea is opened too near the seat of the obstruction, and that the disease may have extended downwards, and be present in the trachea above the isthmus, the trachea below the isthmus being still free of the disease. This objection has, in my opinion, no weight, because the operation is performed to relieve the obstruction which is situated in the box of the larynx, the narrowest part of the tube, and the presence of the membrane in the trachea does not interfere with the introduction of the tube.

172. The high operation has, it is to be remembered, certain manifest advantages over the low operation. *First*, its simplicity in consequence of the superficial situation of the trachea; *second*, the small size of the deep veins, rendering the tendency to hæmorrhage less during the operation, it is to be remembered, that, if blood passes through the tracheal opening into the bronchi, it may there cause irritation, and a lobular form of pneumonia result from its presence, which may carry off the patient; *third*, the less tendency there will be to the complication of bronchitis, because warmer air will reach the ultimate bronchi, the higher up the trachea is opened; for these reasons I am of opinion that the high operation is preferable to the low operation.

Thyroid Enlargements.—173. The thyroid gland is sometimes enlarged as the result of vascular engorgement, or it may be the seat of cystic formations or chronic hypertrophy. It rises and falls with the trachea in swallowing, and in this way can be diagnosed from tumours in this region, which are unconnected with the gland. Dr. P. H. Watson has devised and described a method by which the gland, when enlarged, may be removed by the knife. An incision is made from the chin to the sternum; by carefully keeping the mesial line, the capsule of the gland is reached without bleeding; with the finger, the tumour in its capsule is separated from its anterior connections, and the sterno-mastoid muscles are drawn aside, exposing the edges of the mass. The superior thyroid arteries enter at the superior angles, the inferior thyroid arteries at the inferior angles; the thyroid veins leave the gland on every side except its superior border. These vessels are secured with double ligatures, beginning at the superior angle and passing right round the mass back to the point where the surgeon commenced to apply the ligatures. The number of ligatures will depend on the size of the tumour; the principle is not to open the capsule, and to include everything going to the tumour in the ligature. The vessels are divided between the ligatures, and the tumour removed.

Chapter IV.

REGION OF THE THORAX.

The anatomy of this region will be considered under the following heads:—(a) *External Anatomy*; (b) *Fractures of the Ribs*.

External Anatomy.—174. The sternal extremities of the clavicles, the manubrium sterni, the body of the sternum and its ensiform cartilage, are first to be mapped out. Note the line of junction between the manubrium and the body of the sternum, and remember that the cartilages of the second pair of ribs articulate with the sternum at this line. Having in this way made out the second pair of ribs, the succeeding pairs can be counted until the floating ribs are reached; these cannot be felt with any distinctness. The inferior edge of the pectoralis major muscle runs along the lower border of the fifth rib. Note the horizontal groove between the clavicular and sternal portions. Note the vertical groove in which the cephalic vein lies, between its upper border and the deltoid muscle. The nipple lies between the fourth and fifth ribs, one inch external to their cartilages. A horizontal line through the nipple cuts the sixth intercostal space at the lateral edges of the body; this is a convenient situation for tapping the thorax. A circle with a diameter of two inches, the centre of which lies midway between the left nipple and the lower extremity of the sternum, indicates the portion of the heart uncovered by lung. It is in this region that tapping of the pericardium should be performed. If the extremity of a stethoscope is placed immediately to the left of the sternum, over the third intercostal space, it covers the aortic and mitral valves; the pulmonary valve lies behind the junction of the third costal cartilage with the sternum. The tricuspid valve lies in the middle line, between the costal cartilages of the fourth pair of ribs; the apex beat is felt between the fifth and sixth ribs, two inches below the nipple and one inch to its sternal side; it varies somewhat with the position of the body. The apices of the lungs project upward into the root of the neck. There is no lung tissue behind the manubrium sterni; between the second and fourth costal cartilages the anterior edge of the lung approaches the middle line. The anterior edge of the right lung diverges from the middle line, following the course of the sixth costal cartilage. The edge of the left lung follows the line of the fourth costal cartilage. Vertical lines through the nipples cut the lower edges of the lungs at the level of the sixth pair of ribs. Vertical lines at the lateral edges of the thorax cut the edges of the lungs at the eighth pair of ribs. Vertical lines midway between the lateral edges of the thorax and the spine cut the lower edges of the lungs at the tenth pair of ribs. The transverse part of the arch of the aorta crosses the sternum at the junction of the manubrium with the body; the innominate artery lies behind the manubrium sterni, extending from the sternal extremity of the second costal cartilage on the right side to the right sterno-clavicular articulation. The internal mammary arteries run downwards behind the costal cartilages, slightly external to the edges of the sternum. The intercostal arteries lie under cover of the lower edges of the ribs; a small arterial branch runs along the upper border of each rib. These facts are to be remembered in introducing the trocar in tapping the chest. The instrument should be introduced midway between the ribs, and in a downward direction, in order to avoid the intercostal artery. The mammary gland lies over the pectoral muscle, from the second to the fifth pair of ribs. In excision of this organ, the incisions should run parallel to the fibres of the pectoralis major. Its lymphatic vessels run upwards and inwards, under cover of the pectoralis major, to reach the axillary glands. When these glands are enlarged, the operator should carefully remove, along with the enlarged glands, the loose cellular tissue and fat, extending from the mamma to the axilla. By so doing, the lymphatic vessels will be removed, a matter of some importance, when we remember that they must necessarily be diseased in those cases in which the axillary glands are affected. The mamma receives its principal blood supply from the long thoracic branch of the axillary, which runs under cover of the lower border of the pectoralis major, and from the perforating branches of the internal mammary; the principal bleeding during the operation will come from the sternal and axillary extremities of the wound. The scapula extends from the second to the seventh pair of ribs. The spines of the dorsal vertebræ are subcutaneous; any deformity in an antero-posterior direction, or in a lateral direction, can be easily discovered.

175. *Fractures of the Ribs.*—This common injury occurs from either direct or indirect violence. This distinction is of practical importance when we remember the close relation of the inner surface of the ribs to the parietal pleura. When the fracture is the result of direct violence, the broken extremities are more apt to pass inwards, pressing on the pleura, than in those cases in which the ribs give way in consequence of indirect violence, as, for instance, by any force which approximates the sternum to the spinal column, one or more of the ribs generally giving way at the lateral edge of the body. The principal symptom of this injury is severe pain at each inspiration; this pain is at once relieved by the firm application of a flannel bandage, which should be passed frequently round the chest, because it is in reality a splint, taking the place of the normally rigid, although mobile, chest-wall.

CHAPTER V.

ARTERIES OF THE HEAD AND NECK.

(a) *Innominate;* (b) *Subclavian;* (c) *Common Carotid;* (d) *External Carotid;* (e) *Lingual.*

Innominate Artery (Plate XXVII. Fig. 2). 176. *Anatomy.*—This vessel is the first branch that is given off by the transverse part of the aortic arch; it is also the largest. It lies in the thorax, behind the manubrium sterni. From its origin it runs upwards to the right, and divides into the right carotid and right subclavian behind the right sterno-clavicular articulation. Its anterior relations are skin, superficial and deep fascia, the manubrium sterni, and the origins of the sterno-hyoid and sterno-thyroid muscles. It is crossed from left to right by the left innominate veins and the inferior thyroid veins. It lies upon the trachea and the pleural membrane. The right pneumogastric nerve, the right innominate vein, the right phrenic nerve, and the pleural membrane, lie to its right side. As a general rule no branches arise from the innominate; sometimes a small branch, the thyroidea ima, is given off to the thyroid body. This small artery is only important because it runs vertically upwards in front of the trachea to reach the isthmus, and might be wounded in the low operation of tracheotomy. The following dissection is required to expose the vessel in order to apply a ligature. Pillows are to be placed under the shoulders, in order to raise them, and the head allowed to hang backwards, in order to draw the vessel as much as possible out of the thorax into the neck. The skin and superficial fascia are reflected by a V-shaped incision; the apex of the V is situated over the sternal attachment of the sterno-mastoid; one limb of the

V runs along the clavicle, the other along the anterior border of the sterno-mastoid. The sternal origins of the sterno-mastoid, sterno-hyoid, and sterno-thyroid muscles are divided; the inferior thyroid veins are now seen lying in loose cellular tissue, they are drawn aside; the deep fascia unsheathing the large vessels is then exposed and divided; the right common carotid artery is seen, and traced downwards to the bifurcation in order to reach the innominate artery, which must be carefully separated from surrounding structures. The aneurism needle is passed behind the artery from right to left, in order to avoid injuring the right innominate vein. Great care is to be taken not to injure the pleural membrane on which the vessel lies.

Anastomoses (Plate XXX. fig. 1). When the innominate artery is ligatured, the blood reaches the *right internal carotid*, through the *circle of Willis*, from the *left internal carotid;* the *right external carotid*, from the *left external carotid*, through the mesial anastomoses between *superior thyroid, lingual, facial, temporal,* and *occipital* arteries; the *right subclavian*, through the *right vertebral*, from the circle of Willis; the *right thyroid* axis, through the *right inferior thyroid*, by the thyroid anastomoses with the *left superior* and *inferior thyroid* arteries; the *right internal mammary*, by the *deep epigastric* branch of the *external iliac* and the *terminal* branches of the *aortic intercostals;* the *right axillary*, through anastomoses between its *thoracic* and *sub-scapular* branches and the *lateral* branches of the *aortic intercostals.*

Subclavian Artery (Plate XXVII. fig. 2). 177. *Anatomy.*—This artery, as its name implies, lies behind the clavicle, arching over the apex of the pleura in the root of the neck. It is divided into three parts by the scalenus anticus muscle, the *first part* internal to, the *second part* behind, the *third part* external to, that muscle. The second and third parts have similar relations on both sides of the body; one description will therefore suffice. The origin of the artery is, however, different on the two sides of the body; a separate description of the first part of the right and left subclavian is therefore necessary.

178. *First part of the right subclavian artery.*—This portion of the vessel extends from the right sterno-clavicular articulation to the inner edge of the scalenus anticus. It lies deeply in the root of the neck. Its anterior relations are numerous and important. They are, skin, superficial and deep fascia, sterno-mastoid, sterno-thyroid, and sterno-hyoid muscles, and a strong fascia stretching inwards from the inner edge of the scalenus anticus. After these structures are divided, the right internal jugular and right vertebral veins, the right vagus, right phrenic, and cardiac branches of the vagus and sympathetic, are seen. These different structures require to be displaced in order to see the vessel. The recurrent laryngeal nerve and the trunk of the sympathetic lie behind the vessel. The artery lies upon the pleural membrane, the recurrent laryngeal nerve winding round between the artery and the membrane. The right subclavian and right internal jugular veins unite to form the right innominate vein at a lower level, and on a plane anterior to the artery. In addition to these complicated relations, three large branches (the internal mammary, vertebral, and thyroid axis) are given off from the first part of the subclavian. The operation of ligature of the first part of the right subclavian is one of the most daring in surgery. It is, in my opinion, hardly justifiable, when we remember the great physiological importance of the cardiac branches of the vagus and sympathetic. Their small size renders them invisible; it can only be by an accident that they escape injury during the dissection.

179. *First part of the left subclavian artery.*—This vessel arises from the arch of the aorta; its direction is vertical; it does not rise so high in the neck as the corresponding vessel on the right side. When we remember, in addition to the complicated relations of the first part of the right subclavian, that the vessel lies deeply in the thorax, that it is invested by pleural membrane, overlapped by the lung, and closely related to the thoracic duct, it will be evident that an attempt to apply a ligature would only be followed by disastrous consequences.

180. *Second part of the subclavian artery.*—This portion of the vessel lies behind the scalenus anticus upon the pleural membrane. The operation for ligature has only been performed in cases in which, after cutting down, the surgeon has found the third part of the artery diseased, and has, by dividing the outer edge of the scalenus anticus, then exposed the second part of the artery, and applied a ligature. The outer edge of the scalenus anticus may be divided with safety close to the tubercle of the rib, the phrenic nerve being well to the inner side in this situation.

181. THIRD PART OF THE SUBCLAVIAN ARTERY (Plate XXVII. fig. 1).—This division of the trunk is the most important to the surgical anatomist. It lies in the posterior triangle of the neck, and it is necessary to consider the anatomy of that triangle in order to understand the surgical anatomy of the vessel. The posterior triangle of the neck is bounded posteriorly by the trapezius muscle, anteriorly by the sterno-mastoid, and inferiorly by the clavicle. The portion of the triangle now specially under consideration is the anterior inferior angle. The shoulder is raised by pillows, and the arm drawn well down, in order to depress the clavicle. A V-shaped incision, the apex being at the point where the posterior border of the sterno-mastoid joins the clavicle, one limb running along that bone, the other along the posterior edge of the sterno-mastoid, enables the surgeon to turn upwards and backwards the skin, superficial fascia, and platysma. A venous plexus, consisting of the external jugular, transversalis colli, and suprascapular veins, is then exposed. Turn these aside, divide the deep fascia, and look for the omo-hyoid muscle running upwards and inwards. It is crossed by two arteries, the suprascapular and transversalis colli; the latter is in danger of being wounded. Having found the omo-hyoid, the surgeon now passes the finger into the loose cellular tissue internal to the muscle, and feels for the posterior border of the scalenus anticus. It may be necessary to dissect carefully before this can be felt; it may also be necessary to divide the posterior edge of the sterno-mastoid. Having exposed the

posterior border of the scalenus anticus, it will guide the operator to the tubercle of the first rib, to which the muscle is attached. The strong fascia from the scalenus is divided, and the artery is exposed, issuing from behind the muscle. The artery lies on the first rib ; the cords of the brachial plexus lie above and behind the vessel, the lowest cord lying immediately behind the artery. The subclavian vein lies in front of the vessel, from which it is separated by the scalenus anticus. It is out of the way of danger, being protected by the clavicle. In passing the aneurism needle, the back of the needle should be kept to the nervous cords, the point of the needle looking forwards. As a rule, no branches arise from the third part of the subclavian ; sometimes the posterior scapular may arise from it. It is a comparatively simple matter to ligature the subclavian artery on the dead subject ; if, however, the operation is performed in consequence of axillary aneurism, the clavicle may be raised by the tumour, and the difficulties of the operation greatly increased.

182. *Anastomoses* (Plate XXX. fig. 1).—When the third part of the subclavian is ligatured, the blood reaches the *subscapular branch* of the *axillary* and its *dorsalis scapulæ* branch, through the scapular anastomoses, between these vessels and the *suprascapular* and *posterior scapular* branches of the thyroid axis of the *first part of the subclavian.* The blood also reaches the *axillary* trunk through the anastomoses between its *thoracic* and *subscapular* branches and the *lateral branches* of the *superior intercostal* of the second part of the subclavian and the *lateral branches* of the *aortic intercostals.*

183. **Common Carotid Arteries** (Plate XXV. figs. 1 and 2).—These arteries carry the blood to the head and upper part of the neck. The right common carotid commences behind the right sterno-clavicular articulation, where the innominate artery ends. The left common carotid artery arises from the arch of the aorta ; it runs upwards and passes into the neck behind the left sterno-clavicular articulation. The thoracic portion of the left common carotid lies too deeply for the operation of ligature, and one description will suffice for the cervical portions of both caro-

tids. Only one feature of difference of great surgical importance requires to be noted. On both sides the internal jugular vein overlaps its accompanying artery; on the left side this is more evident than on the right; therefore the operation low down in the neck on the left side will be more difficult than on the right.

184. From the sterno-clavicular articulation, the vessel runs upwards and outwards, following and overlapped by the anterior border of the sterno-mastoid muscle, and ends by dividing opposite the upper border of the thyroid cartilage into the internal and external carotid arteries. A line upon the skin from the sterno-clavicular articulation to a point midway between the angle of the jaw and the mastoid process, indicates the direction and situation of the vessel. The common carotid artery is divided into two parts by the omo-hyoid muscle, which crosses the vessel opposite the cricoid cartilage in an oblique direction from below upwards and forwards; the first half of the vessel lies deeply, and is covered by the sterno-mastoid, sterno-thyroid, and sterno-hyoid muscles. The vessel above the omo-hyoid is more superficial (although overlapped by the sterno-mastoid), and lies in the anterior triangle of the neck. This vessel is contained in a distinct sheath from the cervical fascia; the sheath contains, in addition to the artery, the internal jugular vein, which lies to its outer side, overlapping the artery. The vagus nerve is also contained in the sheath, lying behind and between the artery and vein; the descendens noni nerve lies in front of the sheath; the sympathetic nerve lies behind it. The sheath of the vessel lies upon the prevertebral muscles (longus colli and rectus capitus anticus major). It is crossed above the omo-hyoid by the *superior thyroid* veins, below the omo-hyoid by the *middle thyroid* veins. The inferior thyroid artery and recurrent laryngeal nerve run upwards and inwards behind the sheath, between it and the prevertebral muscles; the thyroid body overlaps the sheath towards its lower part; a chain of *lymphatic* glands is related to its outer side. The artery gives off no branches.

185. In applying a ligature to the artery above the omo-hyoid, an incision is to be made along the anterior border of the sterno-mastoid, the centre of the incision being opposite the cricoid cartilage. After the skin, superficial fascia, platysma, and deep fascia are divided, the edge of the sterno-mastoid is exposed overlapping the sheath; this muscle is drawn outwards, and the sheath is exposed, with the superior thyroid veins crossing it, and the descendens noni nerve lying in front of it. These structures are drawn aside, and the sheath is *opened towards the tracheal side*, over the artery, which is cleared for a short distance, and the aneurism needle is passed under the vessel from without inwards, the back of the needle being towards the internal jugular vein, care being taken not to include the vagus nerve in the ligature.

186. In applying a ligature to the vessel below the omo-hyoid, an incision is to be made along the anterior border of the sterno-mastoid. When this muscle is exposed, it is to be drawn outwards; the sterno-thyroid muscle, which lies over the vessel, is to be drawn inwards; the omo-hyoid muscle is to be drawn upwards, or cut across if necessary, and the sheath is exposed, with the middle thyroid veins crossing it. The overlapping thyroid body is to be pushed inwards, the sheath is to be opened, and the aneurism needle passed with the same precautions, and in the same way, as in the operation above the omo-hyoid. The principal anatomical difficulties in these operations are the thyroid veins, the thyroid body, enlarged lymphatic glands, and the overlapping of the internal jugular vein.

Anastomoses.—187. (Plate XXX. Fig. 1). When the common carotid artery is ligatured, the *brain* is supplied with blood through the *vertebral artery* on the same side, and the *internal carotid* and *vertebral* of the opposite side of the body. The *thyroid* anastomoses, the anastomoses between the *princeps cervicis* of the occipital and the *deep cervical* branch of the superior intercostal, and the *mesial* anastomoses between the *facials, temporals,* and *occipitals,* all carry blood to the *external carotid artery* on the same side as the ligature.

External Carotid Artery (Plate XXIV. fig. 2).—188. The common carotid trunk divides, opposite the upper border of the thyroid cartilage, into the internal carotid which supplies the brain and contents of the orbit, and the external carotid, which supplies the face, scalp, and upper part of the neck. From its point of origin, the external carotid runs upwards and slightly outwards, and, passing between the angle of the jaw and the mastoid process, ends by dividing into the temporal and internal maxillary arteries behind the neck of the lower jaw. This vessel in its course lies superficial to the internal carotid. At first the artery is covered by the superficial structures; in the latter half of its course it lies more deeply in the substance of the parotid gland, and is crossed by the digastric muscle and hypoglossal nerve. The only difficulties which interfere with ligature of the artery in the first half of its course, are the numerous branches (superior thyroid, facial, lingual, occipital, and posterior auricular) given off by the vessel, and the venous plexus, formed of the facial and lingual veins, which lies over the vessel. The superior laryngeal nerve lies behind the artery. To reach the vessel, an incision is to be made parallel to and in front of the anterior border of the sterno-mastoid. Avoiding the branches and the venous plexus, no difficulty will be met with in the lower part of the vessel. After the vessel has passed under the digastric and hypoglossal nerve, the difficulties in applying a ligature will be considerable. When the external carotid artery has been ligatured, the blood reaches the scalp and face, through the *mesial* anastomoses between the *facials, temporals,* and *occipitals,* and through the *posterior cervical* anastomosis between the *princeps cervicis* of the *occipital* and the *deep cervical* branch of the *superior intercostal* from the second part of the subclavian.

189. *Lingual.*—(Plate XXVI. fig. 1; Plate XXIV. fig. 2). This is the only branch of the external carotid which requires a detailed description. The facial frequently requires ligature when wounded, so also the occipital; but the rule is to tie both ends of the wounded artery at the wounded point.

The lingual, on the other hand, may require to be ligatured in the submaxillary region, in cases of profuse hæmorrhage in malignant disease of the tongue. If an incision is made parallel to and a little above the hyoid bone, after division of the superficial structures, the lower edge of the sub-maxillary gland is seen; this is drawn upwards, and the tendon of attachment of the digastric muscle to the hyoid bone is exposed. In the angle between the anterior and posterior bellies of the muscle, the hypoglossal nerve will be seen running forwards, parallel to, and half an inch above, the bone, and lying upon the vertical fibres of the hyoglossus muscle; if the nerve is drawn upwards, and the fibres of the hyoglossus divided transversely, the lingual artery will be found lying on the genio-hyoglossus muscle. It may be well here to draw attention to Plate XXVI. fig. 1, with reference to the relative anatomy of the structures which form the floor of the mouth, and the position of the blood-vessels and nerves which supply the tongue. In excision of the tongue, it is of importance to take away the tongue-muscles, but to leave, if possible, the mylo-hyoid muscles. The nervous structures lie between the mylo-hyoid and hyoglossus; the main arteries lie between the hyoglossus and genio-hyoglossus muscles. If the mucous membrane is carefully divided along the alveolar edge of the teeth, it will be easy, without further dissection, to pass downwards internal to the mylo-hyoid, and the tongue can then be drawn forwards, and the ecraseur applied to its base, including in its grasp all the tongue-muscles; if this is done systematically, there will be no bleeding of any consequence, because the arteries lie amongst the tongue-muscles, the nerves only in the interspace between the mylo-hyoid and the hyoglossus.

APPENDIX.

CHIEF ARTERIAL ANASTOMOSES ARRANGED IN REGIONS.

A. HEAD, NECK, CHEST.

1. *Intra-cranial.* Circle of Willis (carotids × vertebrals).
2. *Extra-cranial.* Supra-orbitals × temporals × posterior auriculars × occipitals.
3. *Facial.* Transverse facials × facials
   - × Supra-orbitals.
   - × Infra-orbitals.
   - × Mentals.
4. *Cervical.*
   - Anterior
     - Lingual × lingual.
     - Superior-thyroids × inferior thyroids.
   - Posterior—princeps cervicis × deep cervical, occipital × vertebral.
5. *Thoracic.*
   - Superior intercostal / Intercostals } Lateral branches × { Short thoracic. / Long thoracic. / Subscapular.
   - Intercostals, terminal branches × internal mammary × deep epigastric.
6. *Scapular.* { Supra-scapular / Posterior scapular } × { Subscapular / Dorsalis scapulæ } × Posterior circumflex.

B. UPPER EXTREMITY.

1. *Shoulder.* { Thoracica humeraria / Thoracica acromialis } × { Anterior circumflex. / Posterior circumflex.
2. *Upper Arm.* { Anterior circumflex / Posterior circumflex } × { Superior profunda. / Inferior profunda.
3. *Elbow.*
   - External—superior profunda × { Radial recurrent. / Interosseous recurrent.
   - Internal—{ Anastomotica / Inferior profunda. } × Ulnar recurrent.
   - External and internal anastomoses communicate posteriorly.
4. *Forearm.* Muscular branches of radial, ulnar, anterior interosseous and posterior interosseous.
5. *Wrist.* Carpal arch × anterior and posterior interosseous.
6. *Hand.*
   - Radial × ulnar by superficial and deep arches.
   - Digital branches of superficial arch × interosseous of deep arch × dorsal interosseous from posterior carpal arch.
   - Radial edge. Radial on back of wrist by dorsal branches × digital branches from deep arch.
   - Ulnar edge. Ulnar × deep arch.
   - Anastomoses of digital arteries at sides and apices of fingers.

C. ABDOMEN.

1. *Parietal.*
   - Anterior
     - Superficial { Superficial epigastric / Superficial circumflex ilii } Intercostals.
     - Deep—deep epigastric × internal mammary × intercostals.
   - Lateral
     - Superior—musculo-phrenic × phrenic × intercostals.
     - Inferior—deep circumflex ilii × ilio-lumbar × lumbar.
2. *Visceral.* Colica media × colica sinistra. Cœliac axis × superior mesenteric.
3. *Viscero-parietal.* { Phrenic / Lumbar } × { Renal. / Capsular. / Mesenterica.

D. PELVIS.
- 1. *Parietal.* Sacra media × lateral sacral — obturator × deep epigastric, pudic of internal iliac × external pudic of femoral.
- 2. *Visceral.* Visceral branches of internal iliac with corresponding branches on other side of body, and with sup. hæmorrhoidal of inf. mesenteric.
- 3. *Viscero-parietal.* The visceral anastomoses with sacra media and lateral sacral.

E. LOWER EXTREMITY.

1. *Buttock, Thigh, and Knee.*
   - 1. *External.* Circumflex ilii × ilio-lumbar arch × gluteal × External circumflex × external articular.
   - 2. *Internal.* Ischiatic × int. circumflex × obturator × perforating of profunda × anastomotica magna × internal articular × recurrent tibial.

   External and Internal anastomoses with each other, more especially through circumflex branches in thigh, and through articular branches, anastomotica magna, and recurrent tibial around knee-joint.

2. *Leg.* Muscular branches of post. tibial, peroneal and ant. tibial, communicating branch between post. tibial and peroneal.

3. *Ankle.*
   - 1. *External.* Ant. peroneal × peroneal × ext. malleolar.
   - 2. *Internal.* Int. malleolar × branches from post. tibial.

4. *Foot.*
   - 1. *External.* Peroneal × branches of ext. plantar × tarsal and metatarsal.
   - 2. *Internal.* Ext. plantar × dorsal artery of foot.
   - 3. *Central.* Interosseous branches of metatarsals, with branches of plantar arch by means of ant. and post. perforating. Free anastomoses of digital arteries at sides and apices of toes.

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THE END.

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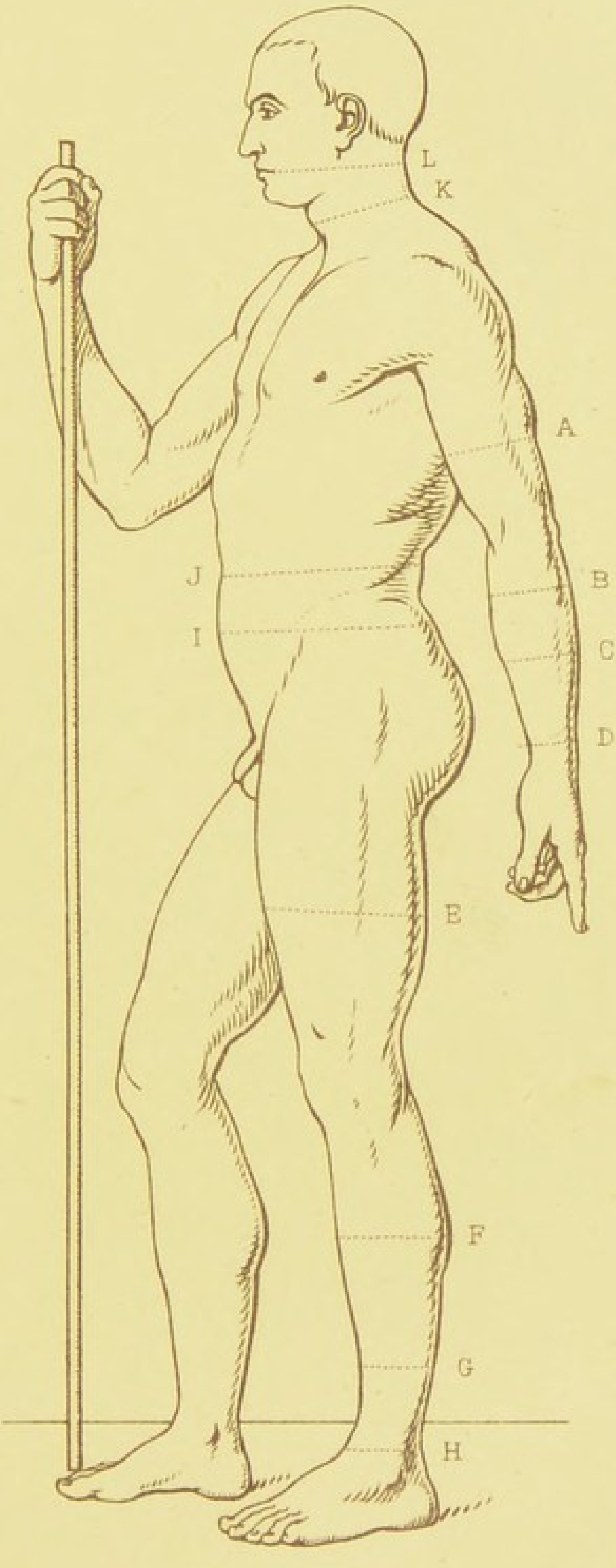

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PLATE II.

Fig. 1.—*Superficial dissection of Posterior Triangle of Neck and Infra-Clavicular region.* Skin, superficial fascia, and deep fascia, turned back. The sternum, clavicle, acromion, and humerus are in dotted lines on undissected side of figure.

C. Clavicle — superficial descending cervical nerves running over it.
S.M. Sterno-mastoid.
E.J.V. External jugular vein and branches.
O.H. Omo-hyoid.
D. Deltoid muscle.
P.M. Pectoralis major muscle.
C.V. Cephalic vein.

Fig. 2.—*Deep dissection of Infra-Clavicular region.* The clavicular origins of the pectoralis major (*P.Ma.*) and deltoid (*D.*) have been removed. The cephalic vein (*C.V.*) is also cut away. The coracoid process (*Co.*) is exposed. The bursa (*H.*) between the head of the humerus and deltoid is opened. *P.Ma.* Pectoralis major. *P.Mi.* Pectoralis minor. *C.B.* Coraco-brachialis and short head of biceps. *T.B.* Long tendon of biceps.

A. Axillary artery issuing from beneath the clavicle (*C.*), with the axillary vein (*V.*) to its thoracic side, the brachial plexus (*N.*) to its acromial side. This figure illustrates the relation of the coracoid process to the head of the humerus.

Fig. 2.

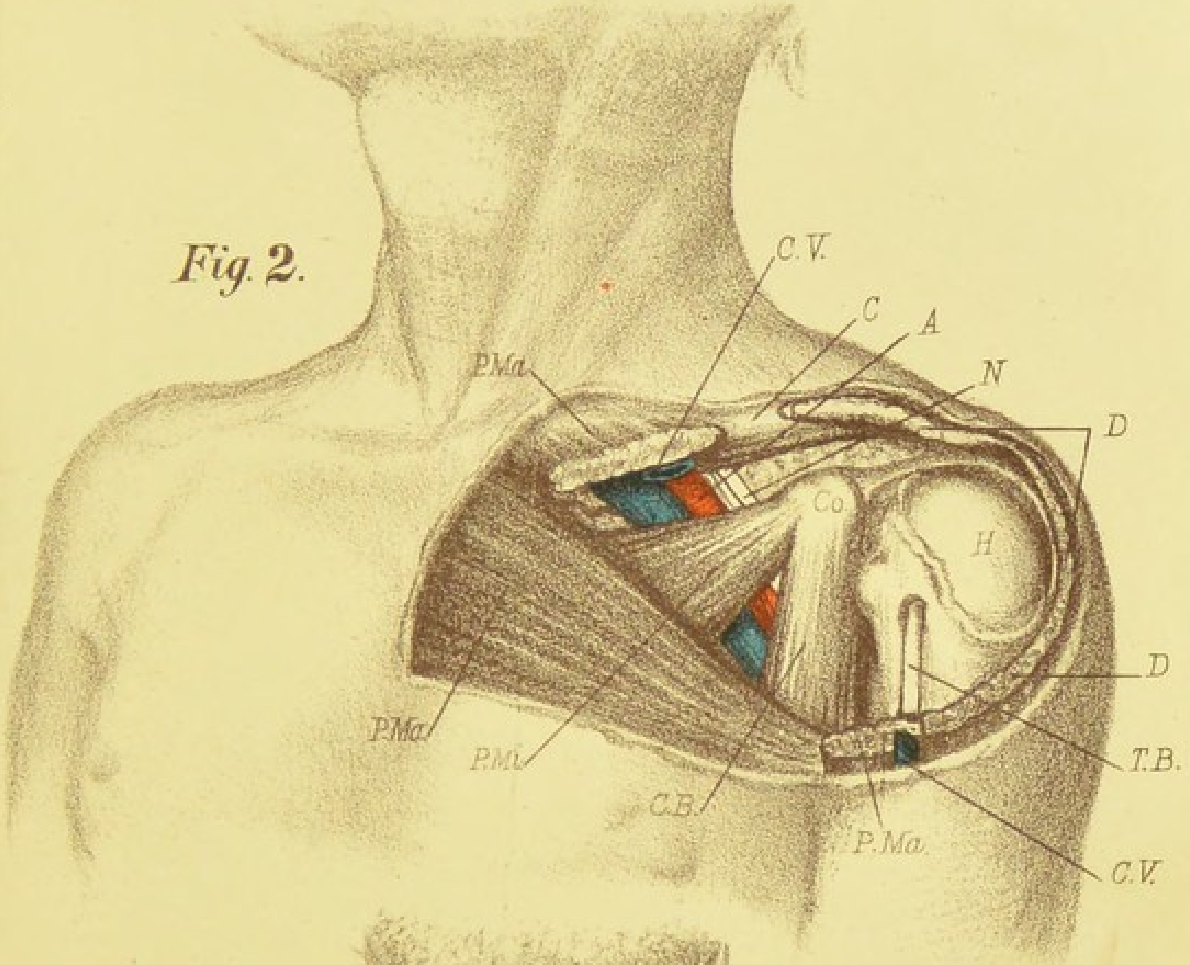

Fig. I.

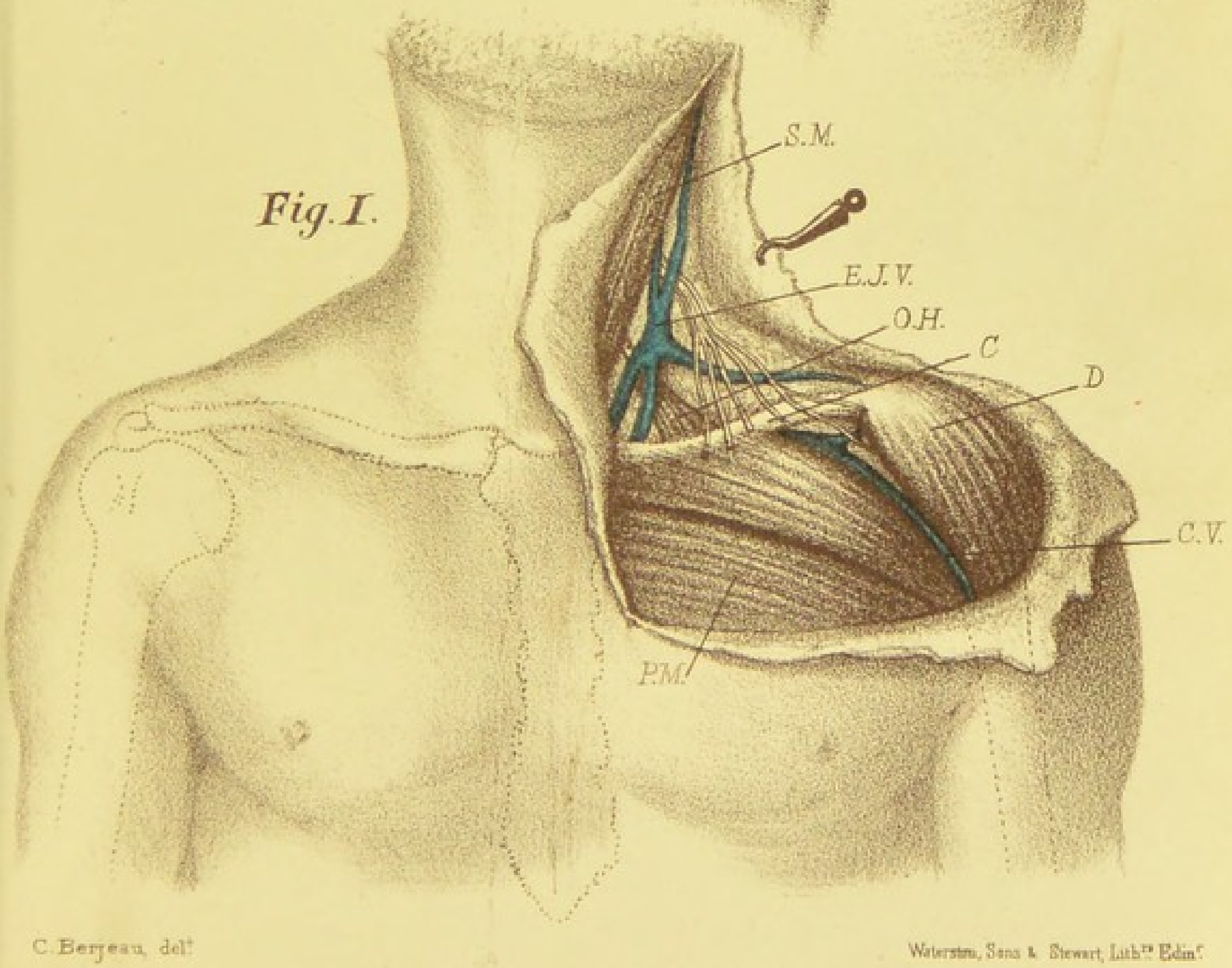

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PLATE III.

Fig. 1.—*Posterior aspect of Shoulder, Upper Arm, and part of Forearm.* The bones are in finely dotted outlines. The arteries are introduced to show their general position.

1. Axillary. 2. Posterior scapular. 3. Supra-scapular. 4. Brachial. 5. Sub-scapular. 6. Supra-scapular. 7. Superior profunda. 8. Inferior profunda. 9. Circumflex. 10. Anastomotic. 11. Interosseous recurrent. 12. Posterior interosseous.

Fig. 2.—*Transverse section of Upper Arm. Middle third.* .

Bi. Biceps.

B.A. Brachialis anticus.

M.S.N. Musculo-spiral nerve, with superior profunda artery.

TT. Triceps.

S.L. Supinator longus.

U.N. Ulnar nerve.

B. Brachial artery with venæ comites. *M.N.* Median nerve in front of the artery.

B.V. Basilic vein. *C.V.* Cephalic vein.

Fig. 3.—*Drawing of Ligaments of Shoulder.* The sketch illustrates the strong attachment of the clavicle (*C.*) to the coracoid (*Co.*) by the coraco-clavicular ligament (*C.C.L.*), and the protection to the shoulder-joint afforded by the coraco-acromial ligament (*C.A.L.*). *Ac.* Acromion. *S.* Scapula. *G.* Glenoid Fossa. *B.* Biceps.

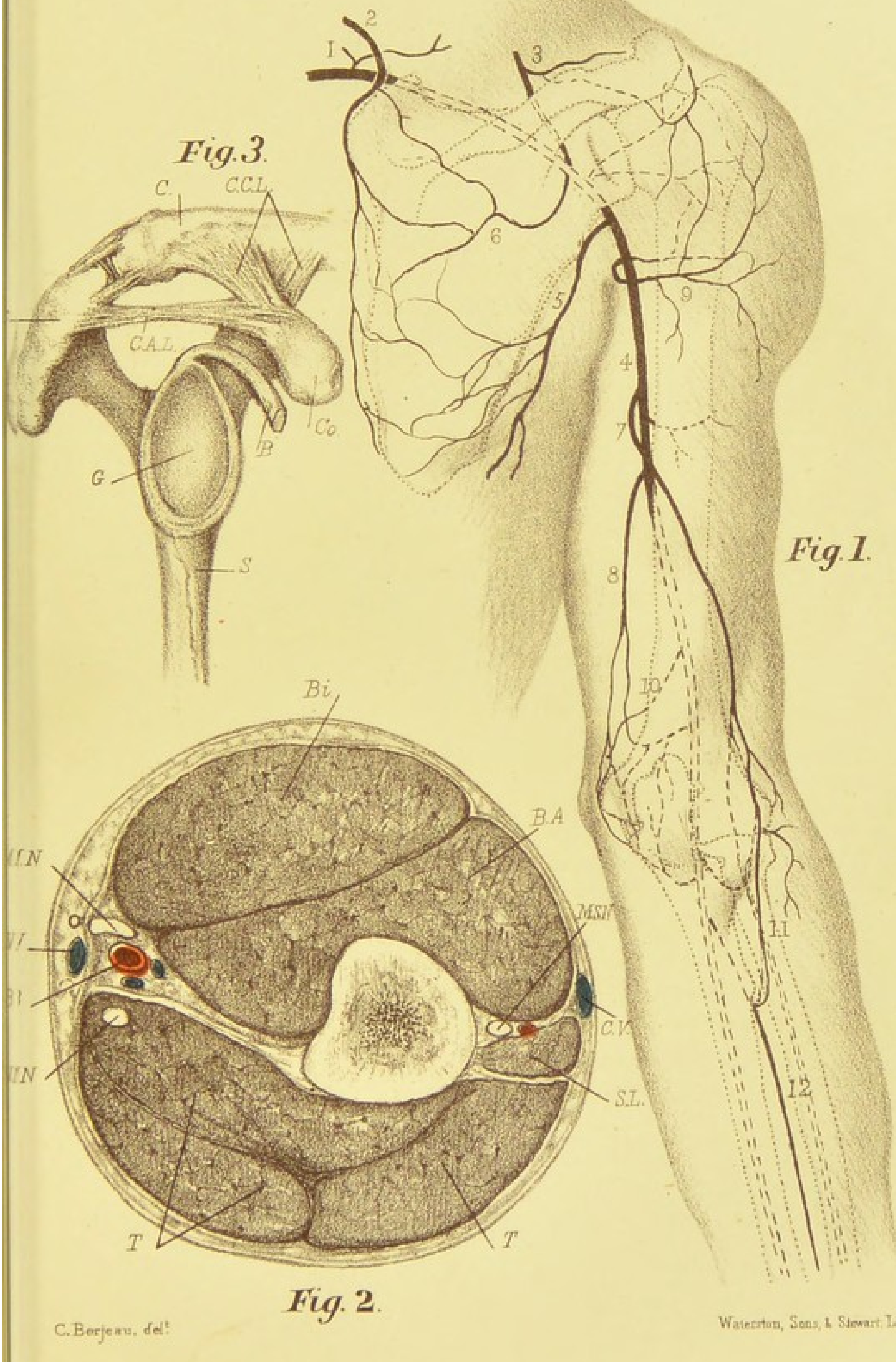

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PLATE IV.

FIG. 1.—*Anterior aspect of Elbow, Forearm, and Hand.* Bones in faintly dotted outlines. 1. Brachial artery. 2. Superior profunda branch of Brachial. 3. Inferior profunda. 4. Anastomotic branch. 5. Radial recurrent. 6. Ulnar recurrent arteries. 8. Interosseous recurrent. 9. Interosseous artery. 10. Radial artery. 11. Ulnar artery. 12. Deep palmar arch. 13. Superficial palmar arch.

FIG. 2.—*Transverse section of Forearm* at the level of the radial tubercle.

R. Radius. *U.* Ulna. *Bc.* Biceps. *B.a.* Brachialis anticus. *R.a.* Radial artery. *R.n.* Radial nerve. *M.n.* Median nerve. *U.a.* Ulnar artery. *F.c.r.p.t.* Flexor carpi radialis and pronator teres. *F.s.d.* Flexor sublimis digitorum. *U.n.* Ulnar nerve. *F.c.u.* Flexor carpi ulnaris. *F.p.d.* Flexor profundus digitorum. *An.* Anconeus. *E.c.u.* Extensor carpi ulnaris. *S.br.* Supinator brevis. The posterior interosseous nerve is seen lying in the substance of the muscle. *E.c.d.* Extensor communis digitorum. *E.c.r.* Extensores carpi radialis. *S.l.* Supinator longus.

FIG. 3.—*Transverse section of Forearm* at the level of the radial insertion of the Pronator teres. *R.* Radius. *U.* Ulna. *R.a.* Radial artery, with the radial nerve to its radial side. *F.p.* Flexor pollicis. *F.c.r.* Flexor carpi radialis. *M.n.* Median nerve, with accompanying artery. *F.s.d.* Flexor sublimis digitorum. *U.a.* Ulnar artery, with ulnar nerve. *F.c.u.* Flexor carpi ulnaris. *F.p.d.* Flexor profundus digitorum. The interosseous artery is lying in front of the interosseous membrane. *S.l.* Supinator longus. *P.t.* Pronator teres. *E.c.r.b.* Extensor carpi radialis brevior. *E.c.r.l.* Extensor carpi radialis longior. *E.d.* Extensor digitorum. *E.p.* Extensores ossis metacarpi et primi internodii pollicis. *E.m.d.* Extensor minimi digiti. *E.i.* Extensor indicis. *E.c.u.* Extensor carpi ulnaris.

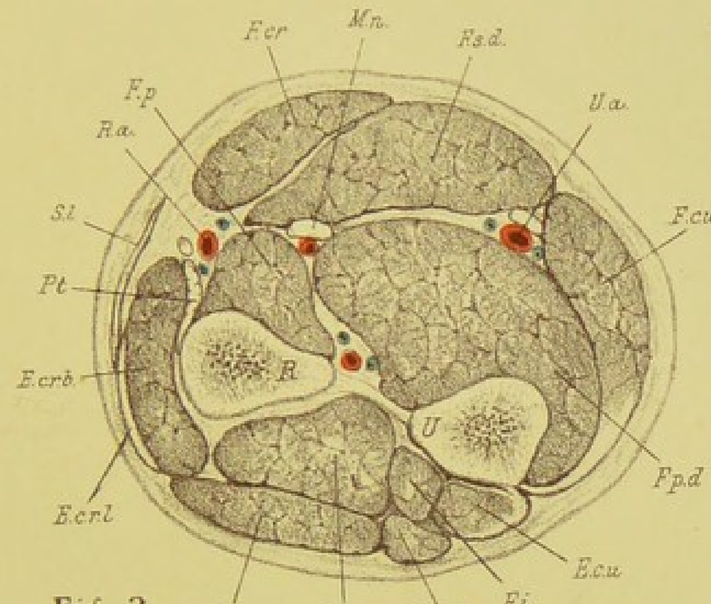

Fig. 3.

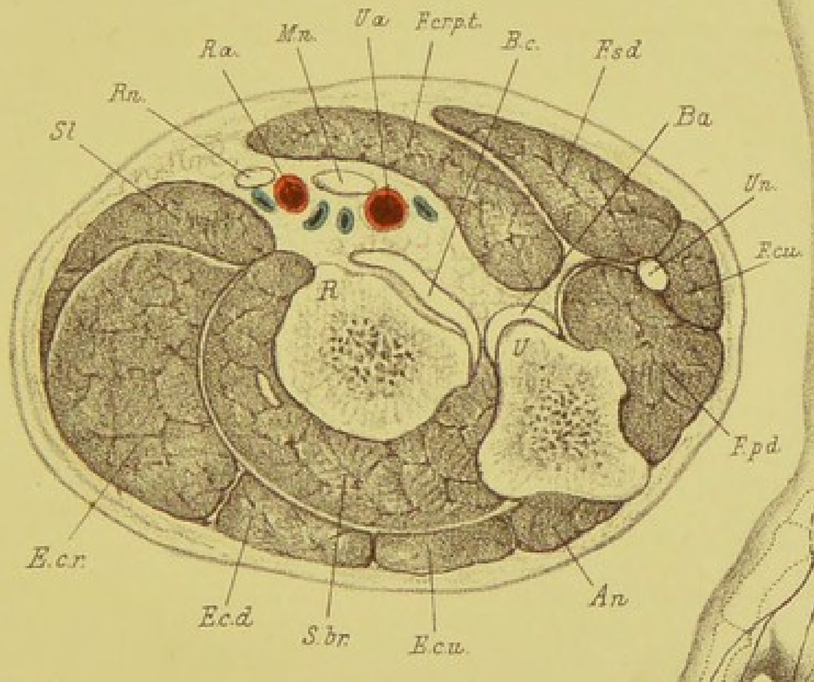

Fig. 2.

Fig. 1.

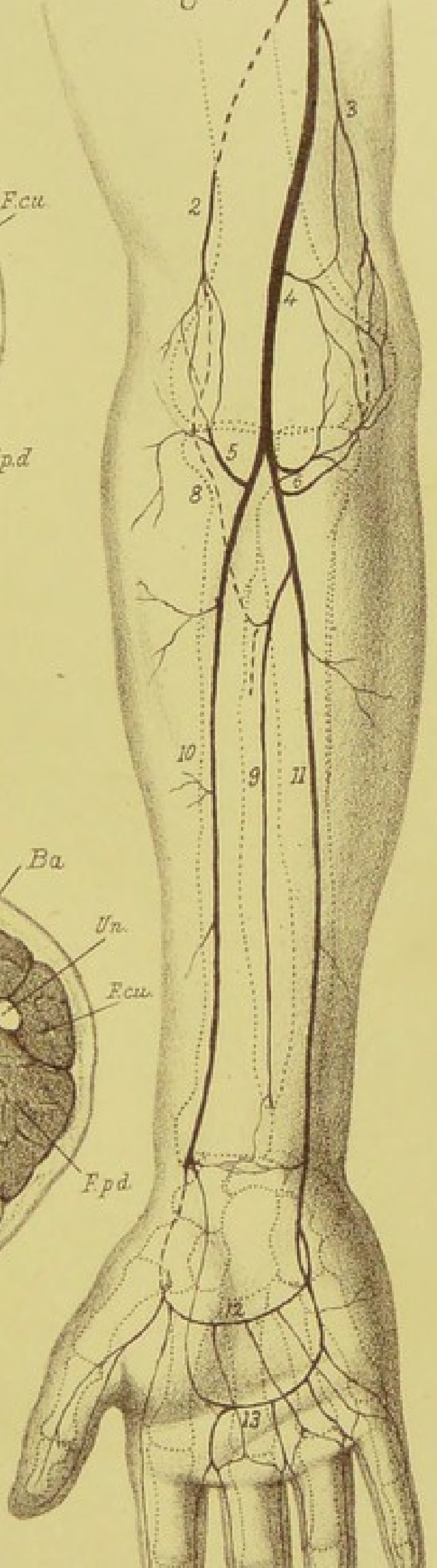

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PLATE V.

FIG. 1.—*Dissection of Anterior Aspect of Forearm.*

B. Biceps. *B.A.* Brachial artery. *M.N.* Median nerve. The bicipital fascia is crossing the artery and nerve to blend with the fascia of the anterior and inner aspect of the forearm. *R.A.* Radial artery. *R.N.* Radial nerve. *S.L.* Supinator longus. A portion of this muscle has been cut away in order to show the radial artery. *F.C.R.* Flexor carpi radialis. *P.R.T.* Pronator radii teres. *P.L.* Palmaris longus. *F.P.D.* Flexor profundus digitorum. *U.A.* Ulnar artery. *U.N.* Ulnar nerve. *F.C.U.* Flexor carpi ulnaris.

FIG. 2.—*Dissection of External Aspect of Elbow-Joint.*

B. Biceps. *S.L.* Supinator longus. *E.C.L.* Extensor carpi radialis longior. *T.* Triceps. *H.* External condyle of humerus. The external lateral ligament, the muscles arising from the condyle, and the supinator brevis have been cut away in order to expose the neck (*R.*) of the radius and orbicular ligament. The orbicular ligament is displaced downwards to expose the head of the bone. *O.* Olecranon. *Bu.* Bursa. *E.C.B.* Extensor muscles arising from the condyle. *Ac.* Anconeus. *M.S.N.* Musculo-spiral nerve in dotted line.

FIG. 3.—*Dissection of Internal Aspect of Elbow-Joint.*

Bi. Biceps. *B.A.* Brachialis anticus. *T.* Triceps. *B.* Brachial artery. *M.N.* Median nerve, crossing the artery at a lower level than usual. *U.N.* Ulnar nerve passing behind (*I.C.*) the internal condyle. *O.* Olecranon. *Bu.* Bursa.

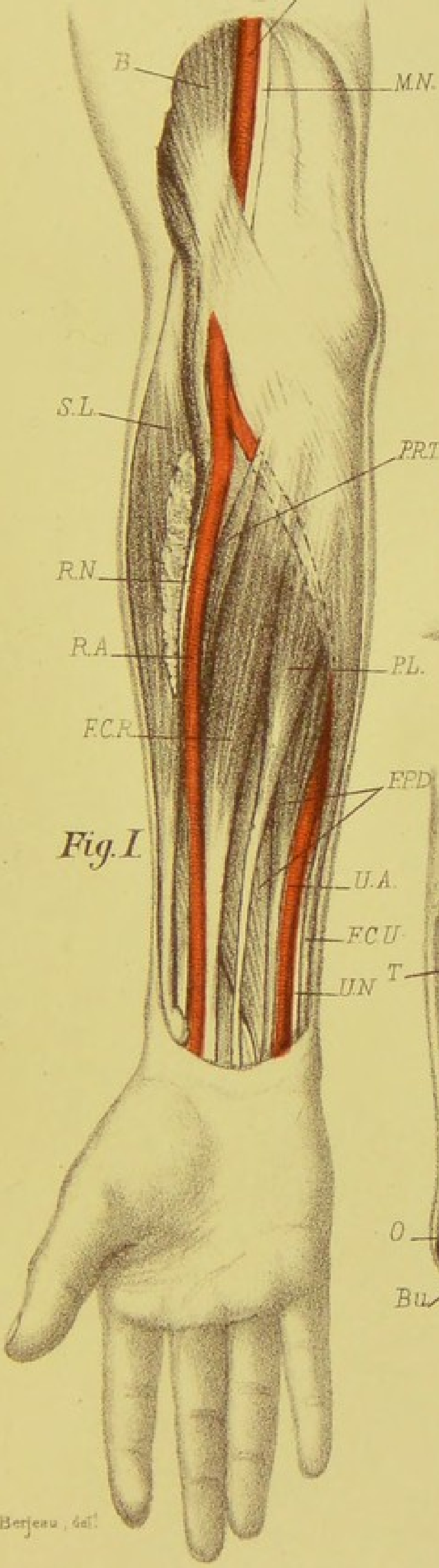
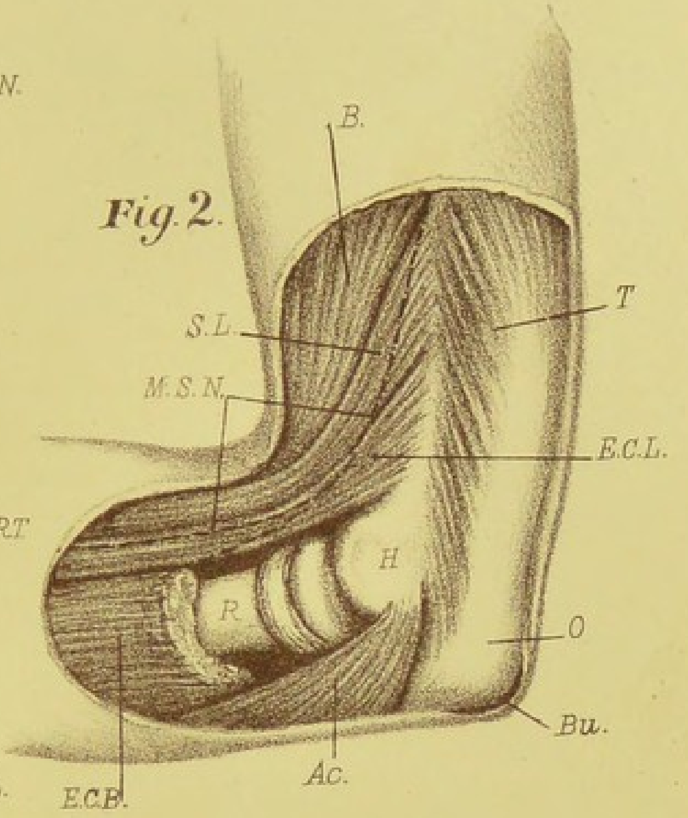


Fig. I.



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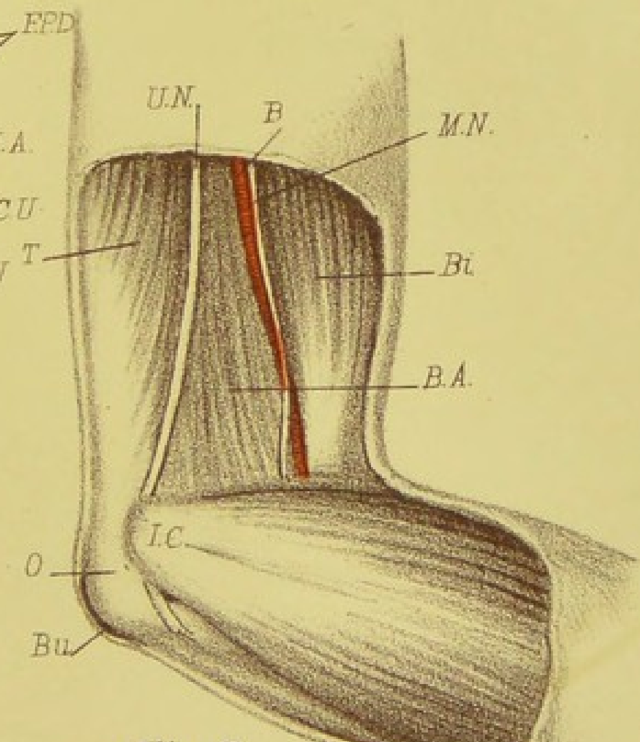

Fig. 3.

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PLATE VI.

FIG. 1. *Dissection of the Ulnar aspect of the Wrist.*—*U.* Ulna. *S.p.* Styloid process. *E.c.u.* Extensor carpi ulnaris. *F.c.u.* Flexor carpi ulnaris. *U.n.* Ulnar nerve. *U.a.* Ulnar artery. *F.p.d.* Flexor profundus digitorum. *C.* Cuneiform bone. *P.* Pisiform bone. *Uc.* Unciform bone. *A.m.d.* Abductor minimi digiti. *F.m.d.* Flexor minimi digiti.

FIG. 2. *Dissection of the Radial aspect of the Wrist.*—*E.c.r.l.* Extensor carpi radialis longior. *E.c.r.b.* Extensor carpi radialis brevior. *E.i.* Extensor indicis. *E.s.p.* Extensor secundi internodii pollicis. *R.a.* Radial artery, crossed by the radial nerve. *E.m.p.* Extensor metacarpi pollicis. *E.p.p.* Extensor primi internodii pollicis. *P.L.* Posterior annular ligament. This figure illustrates the anatomy of the parts in the radial incision in excision of the wrist-joint.

FIGS. 3 and 4.—These figures—*antero-posterior sections of the Elbow-joint*—illustrate the relations of the *olecranon* and *coronoid* processes of the ulna to the *humerus* in flexion and extension. *H.* Humerus. *U.* Ulna. *B.* Biceps. *B.a.* Brachialis anticus. *Tri.* Triceps.

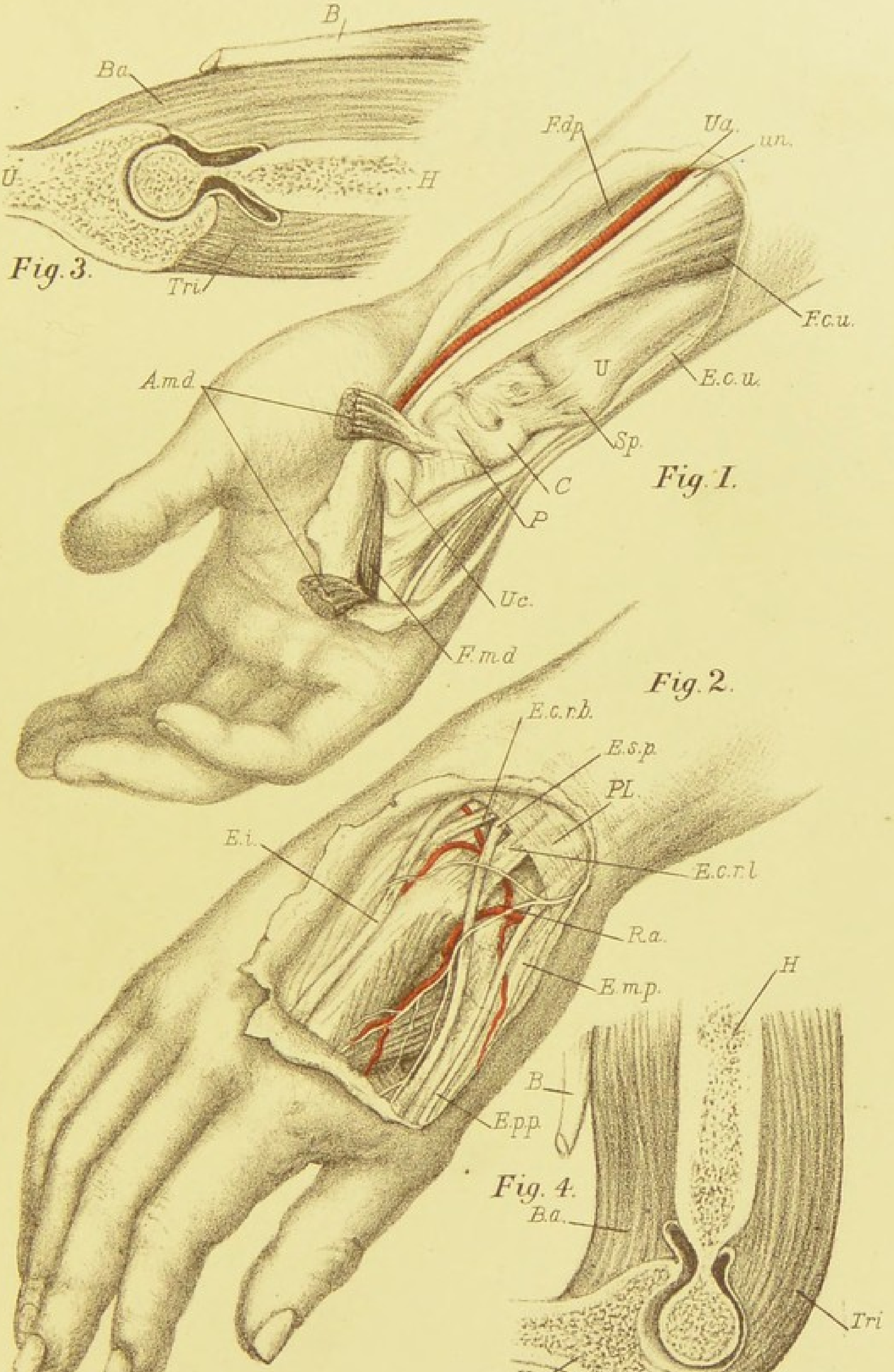

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PLATE VII.

FIG. 1.—*Superficial Dissection of the Palm of the Hand,* intended to show the situation of the principal blood-vessels. The superficial palmar arch is shown giving off the digital arteries, which bifurcate at the clefts of the fingers, and are continued forwards along the sides of the fingers (shown as a dotted line in the middle finger) to the finger tips.—*U.A.* Ulnar artery. *S.V.* Superficial volar branch of radial. *Ab.p.* Abductor pollicis. *F.P.* Flexor pollicis. *A.D.* Adductor pollicis. *Ab.m.* Abductor minimi digiti. *Fl.m.* Flexor minimi digiti. *F.* Flexor tendon. *L.* Lumbrical.

FIG. 2.—*Transverse section of the Forearm* immediately above the styloid process of the radius.—*R.* Radius. *U.* Ulna. *S.* Supinator longus. *E.M.P.* Extensor metacarpi pollicis. *E.P.P.* Extensor primi internodii pollicis. *E.C.R.L.* Extensor carpi radialis longior. *E.C.R.B.* Extensor carpi radialis brevior. *E.S.P.* Extensor secundi internodii pollicis. *In.* Extensor indicis. *E.D.* Extensor digitorum. *E.M.D.* Extensor minimi digiti. *E.C.U.* Extensor carpi ulnaris. *U.A.* Ulnar artery. *U.N.* Ulnar nerve. *F.C.U.* Flexor carpi ulnaris. *P.* Pronator quadratus. *F.P.* Flexor profundus digitorum. *F.S.* Flexor sublimis digitorum. *M.* Median nerve. *F.C.R.* Flexor carpi radialis. *F.L.P.* Flexor longus pollicis. *R.A.* Radial artery.

FIG. 3.—*Lateral section through the lower ends of the Radius and Ulna, the Carpal, and Metacarpal Bones.*—*R.* Radius. *U.* Ulna. *Sc.* Scaphoid. *S.* Semilunar. *C.* Cuneiform. *Un.* Unciform. *O.M.* Os magnum. *Td.* Trapezoid. *Tm.* Trapezium. The synovial cavities are indicated in shading.

FIG. 4. *Antero-posterior Section of Hand.*—The section was made to the radial side of the mesial plane of the middle finger. *R.* Radius. *S.* Semilunar. *O.M.* Os magnum. *M.* Metacarpal. *P.P.P.* Phalanges. *S.F.* Tendon of superficial flexor. *D.F.* Tendon of deep flexor. *S.S.* marks the close proximity of the flexor synovial sheath in the finger to the common flexor synovial sheath. *S.P.A.* Superficial palmar arch. *D.P.A.* Deep palmar arch. The figure is intended to show the danger of delay in opening a whitlow depending on suppuration in the synovial sheath on the front of the finger.

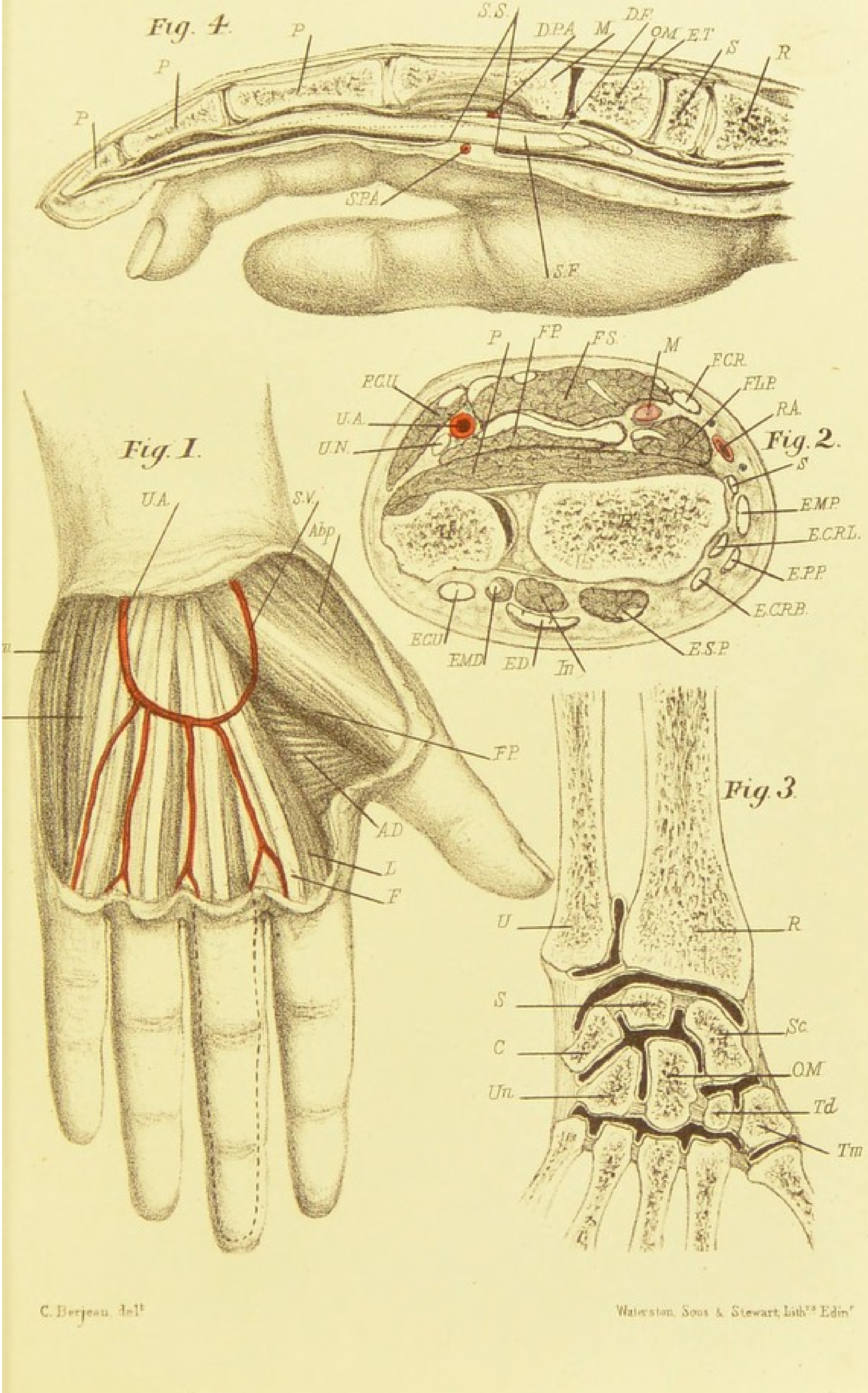

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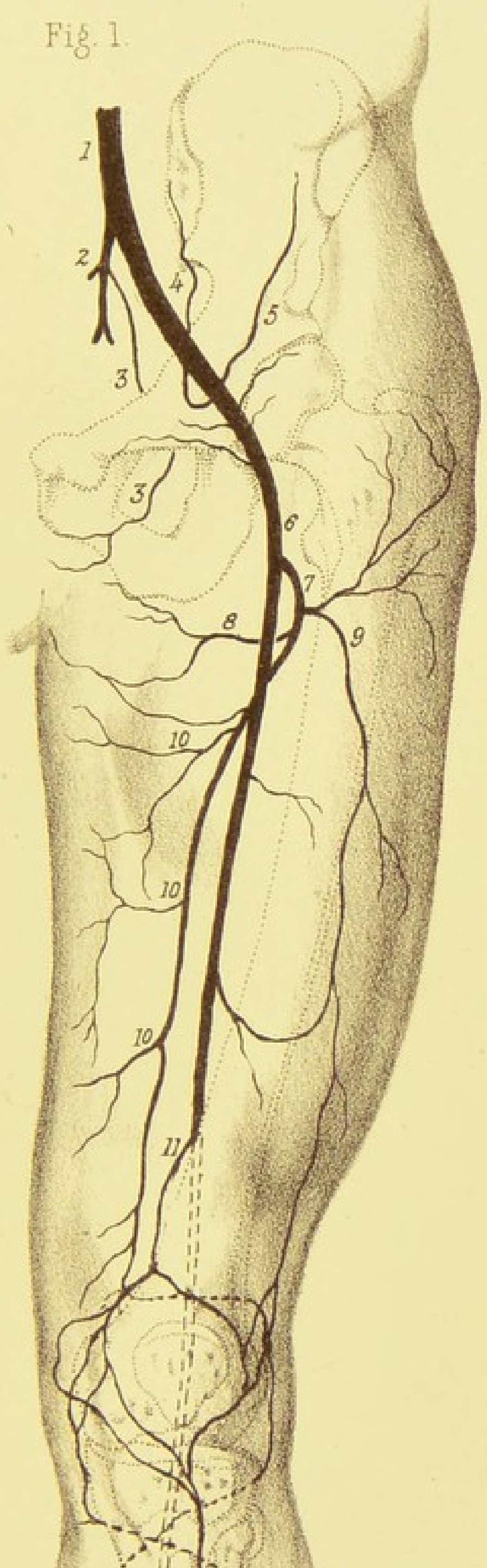
PLATE VIII.

Fig. 1.—*Anterior Aspect of Thigh.* Bones in faintly dotted lines. 1. Common iliac. 2. Internal iliac artery. 3. Obturator artery. 4. Deep epigastric branch of external iliac. 5. Deep circumflex ilii. 6. Common femoral. 7. Profunda femoris artery. 8. Internal circumflex. 9. External circumflex, which divides into ascending, transverse, and descending branches. 10. 10. 10. Perforating branches of profunda. 11. Anastomotica magna. 12. Recurrent branch of anterior tibial anastomosing with articular branches of popliteal artery.

Fig. 2.—*Anterior Aspect of Leg.* 1. Termination of common femoral. 2. Terminal branch of profunda femoris. 3. Descending branch of external circumflex. 4. Recurrent branch of (5) anterior tibial. 6. Dorsal artery of foot.

Fig. 1.



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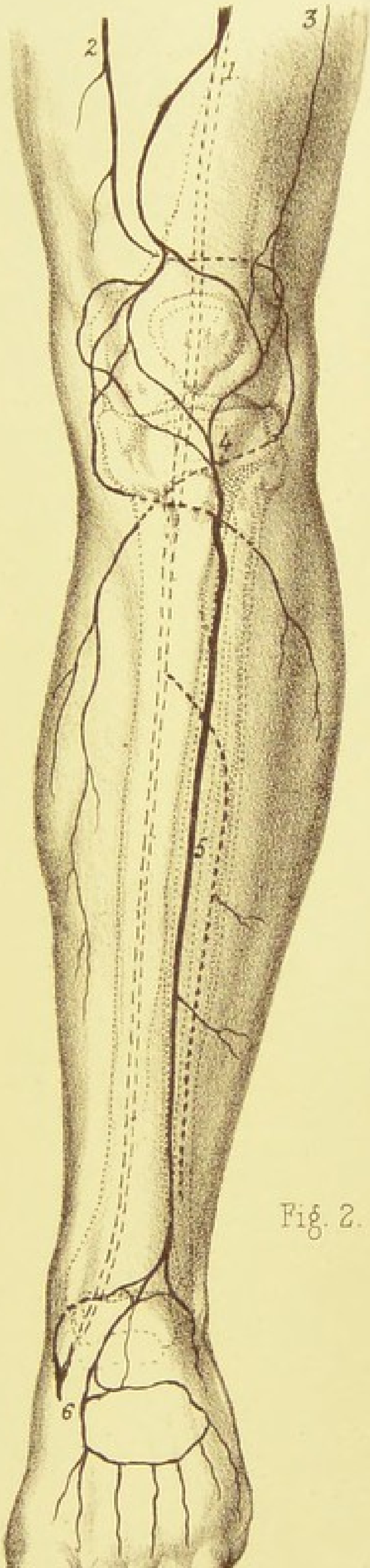

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PLATE IX.

FIG. 1.—*Dissection of Scarpa's Triangle.* *F.a.* Femoral artery. *F.v.* Femoral vein. *A.c.n.* Anterior crural nerve. *I.* Iliacus. *Pe.* Pectineus. *A.b.* Adductor brevis. *A.l.* Adductor longus. *S.* Sartorius.

FIG. 2.—*Dissection of Hunter's Canal.* The leg is rotated outwards. Skin and superficial fascia removed along with a portion of the sartorius muscle (*Sar.*) and its fascia. The canal is opened, exposing the femoral artery (*F.a.*), femoral vein (*F.v.*), and the long saphenous nerve (*L.s.n.*)

FIG. 3.—*Transverse section of the Thigh through Hunter's Canal.* Before making the section the limb was rotated outwards, and the knee bent. *F.* Femur. *R.f.* Rectus femoris. *C.* Crureus. *V.i.* Vastus internus. *V.e.* Vastus externus. *F.a.* Femoral artery. *Sar.* Sartorius. *L.s.v.* Long saphenous vein. *A.l.* Adductor longus. *G.* Gracilis. *A.m.* Adductor magnus. *S.m.* Semi-membranosus. *S.t.* Semi-tendinosus. *B.* Biceps. *P.f.a.* Profunda branch of femoral artery. *S.n.* Sciatic nerve. The femoral vein in Hunter's canal is double in this instance; as a general rule there is only a single vein. The long saphenous nerve is seen in the canal in front of the artery.

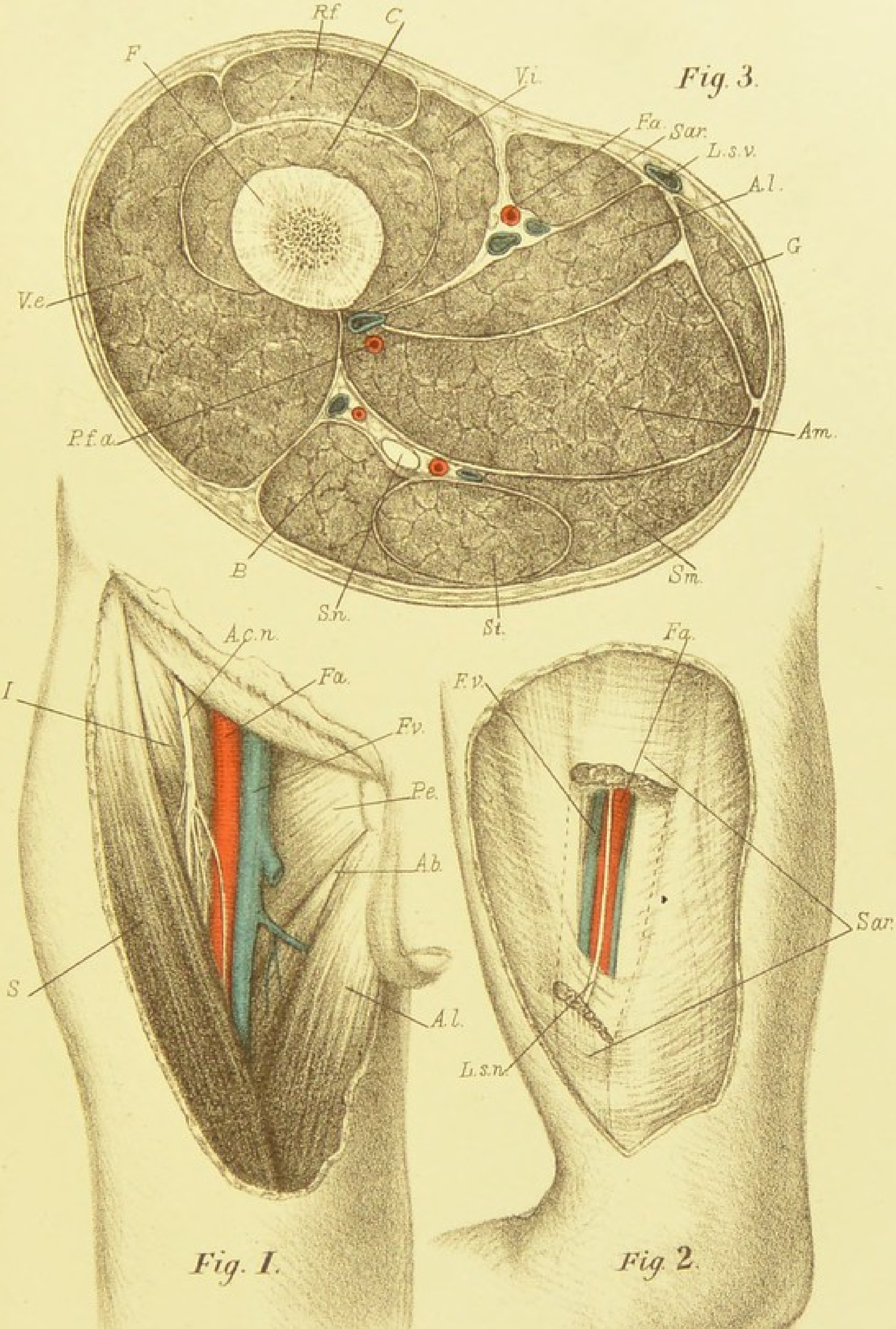

Fig. 3.

Fig. 1.

Fig. 2.

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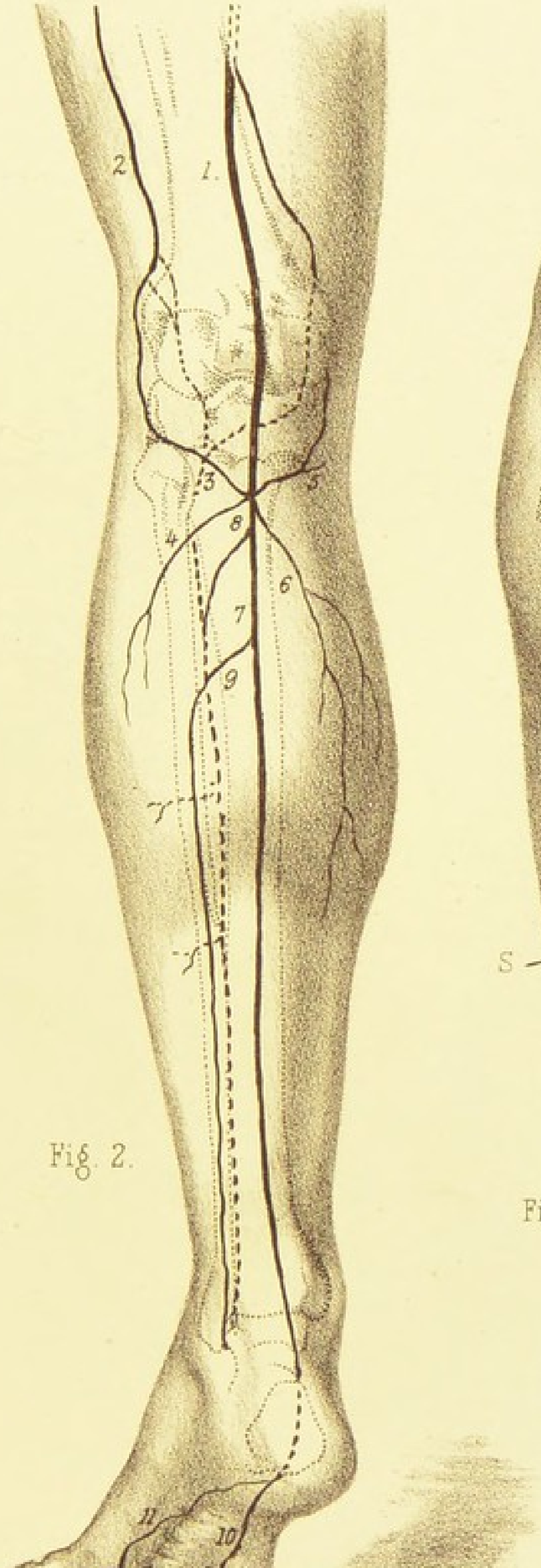
PLATE X.

Fig. 1.—*Posterior Aspect of Buttock and Thigh.* The bones are in faintly dotted lines. 1. Popliteal artery. 2 and 3. Superior articular branches. 4 and 5. Inferior articular branches. *S.* Great sciatic nerve.

Fig. 2.—*Posterior Aspect of Leg and Foot.* 1. Popliteal artery. 2. Descending branch of external circumflex. 3 and 5. Inferior articular branches of popliteal. 4 and 6. Sural branches of popliteal. 7. Posterior tibial artery. 8. Anterior tibial passing forwards between the bones, and continued onwards as a dotted line on the front of the leg. 9. Peroneal artery. 10. Internal plantar. 11. External plantar.



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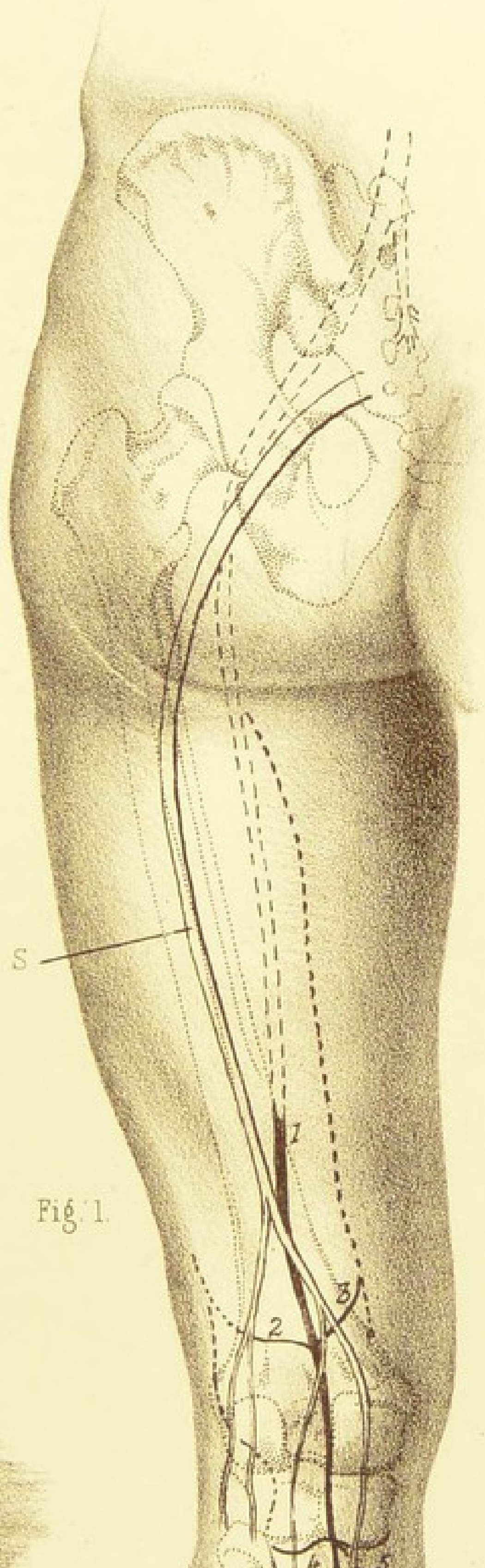

Fig. 1.

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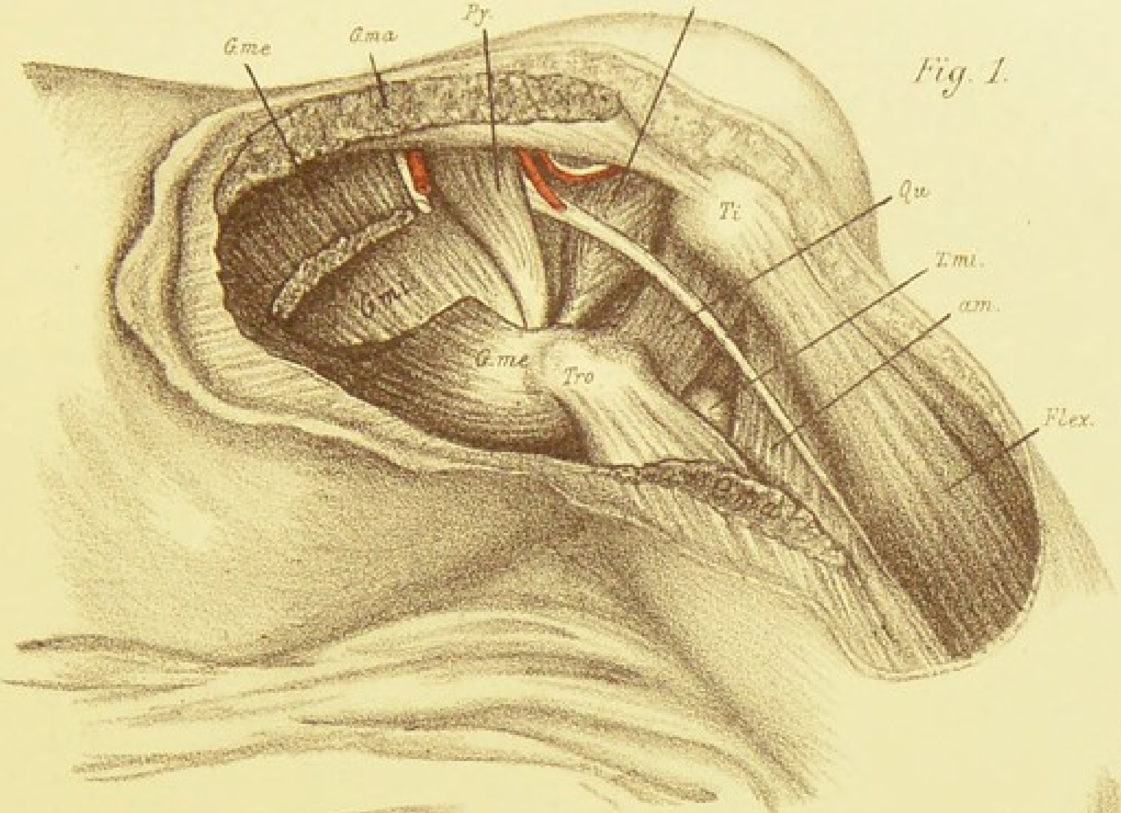
PLATE XI.

FIG. 1.—*Dissection of Buttock.* The subject is laid upon a table, the legs hanging over the end of the table. The skin, superficial and deep fascia, the gluteus maximus, and a portion of the gluteus medius, have been removed. *Tro.* Trochanter major. *T.i.* Tuber ischii. *G.ma.* Gluteus maximus. *G.me.* Gluteus medius. *G.mi.* Gluteus minimus. *Py.* Pyriformis. *O.i.* Obturator internus. Between the pyriformis and gluteus medius the gluteal vessels are seen; between the pyriformis and obturator internus the sciatic and pudic vessels and nerves are seen. *Qu.* Quadratus femoris. *T.mi.* Trochanter minor. *A.m.* Adductor magnus. *Flex.* Flexors of the leg.

FIG. 2.—*Region of Hip-Joint, anterior aspect.* The superficial structures having been removed, the femoral vessels and anterior crural nerve are cut across at the level of Poupart's ligament. The psoas and iliacus are then divided and turned down, exposing the anterior ligament of the joint. Portions of the sartorius, tensor fasciæ femoris, and rectus femoris, are also removed. *F.s.* Femoral sheath. *P.s.* Spine of pubis. *Pso. Il.* Psoas and iliacus with anterior crural nerve on their anterior aspect. *A.i.* Anterior inferior spinous process with origins of rectus. *Ant.S.* Anterior superior spinous process, with origin of sartorius. *T.f.f.* Tensor fasciæ femoris. *G.mi.* Gluteus minimus (anterior border). *G.me.* Gluteus medius (anterior border). *V.* Vastus externus. *S.* Sartorius. *R.* Rectus. *A.br.* Adductor brevis. *A.long.* Adductor longus. *P.il.* Psoas and iliacus turned down. *Pe.* Pectineus.

FIG 3.—*Region of Hip-Joint, posterior aspect.* The body was laid upon a high table and the limbs allowed to fall vertically over the end of the table. The left hip is drawn. The gluteus maximus (*G.ma*), portion of the gluteus medius (*G.me.*), and quadratus femoris (*Q.f.*), have been removed. *Tro.* Trochanter major. *Si.n.* Sciatic nerves. *Si.Vs.* Sciatic vessels. *Tub.Is.* Tuber ischii. *Flx.* Flexors. *Ad.m.* Adductor magnus. *Ps.* and *Il.* Psoas and iliacus. *O.e.* Obturator externus. *N.F.* Neck of femur covered by the posterior part of the capsular ligament. *O.i.* Obturator internus and gemelli. *Py.* Pyriformis. *G.mi.* Gluteus minimus. Anus in middle line to right of *Flx.*



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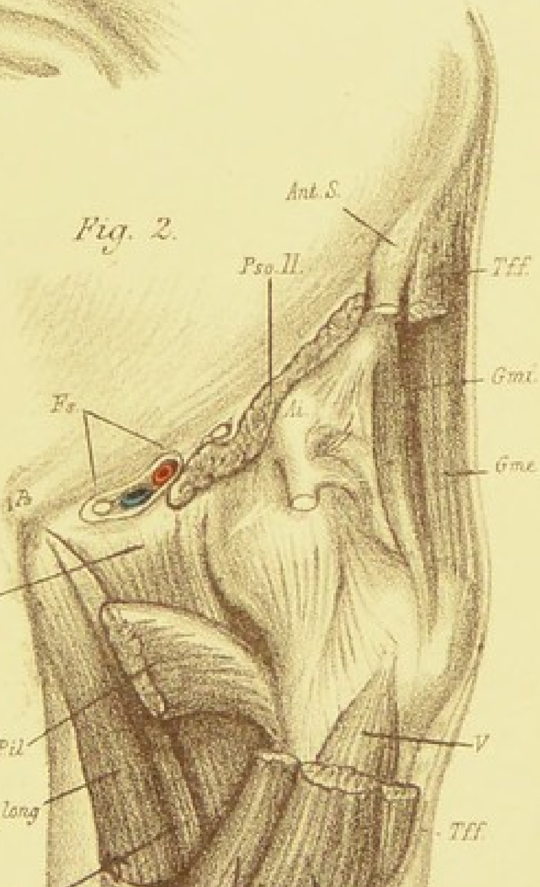

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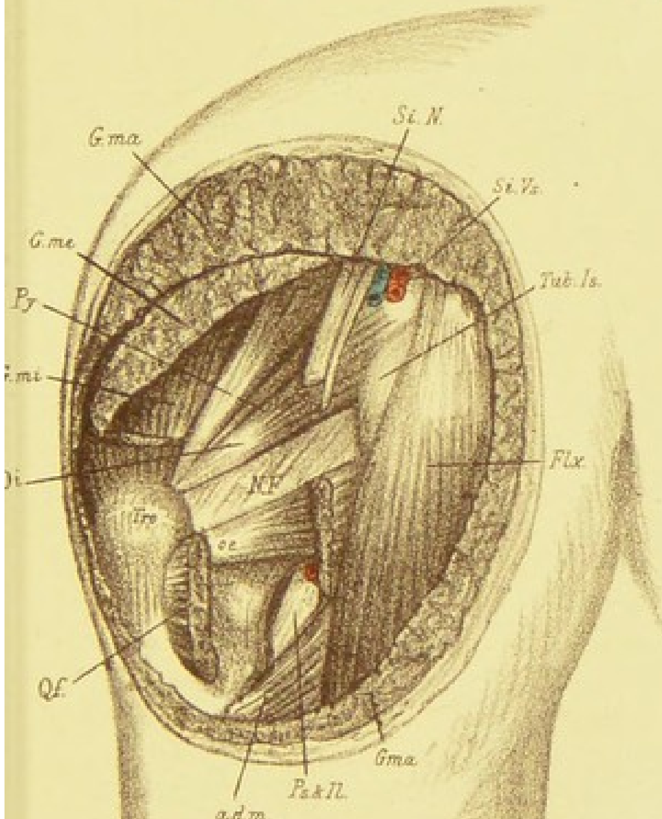

Fig. 3.

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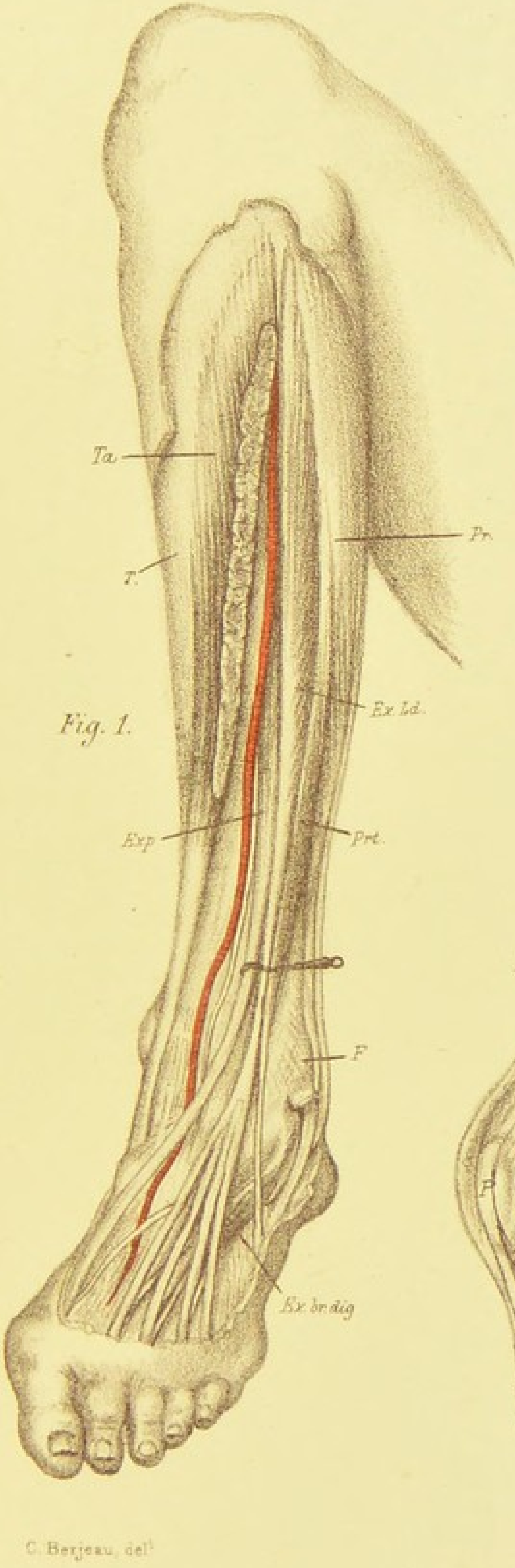
PLATE XII.

FIG. 1.—*Dissection of anterior aspect of Leg.* The skin, superficial and deep fascia, and the portion of the muscular belly of the tibialis anticus, which overlaps the anterior tibial artery, have been removed. The subject from which the drawing was made suffered from bunion. *T.* Tibia. *T.a.* Tibialis anticus. *Ex.p.* Extensor pollicis. *Ex.l.d.* Extensor longus digitorum. *Pr.t.* Peroneus tertius. The last three muscles have been drawn outwards in order to lay bare the anterior tibial artery and nerve. *Pr.* Peroneus longus and brevis. *F.* Fibula. *Ex.br.dig.* Extensor brevis digitorum.

FIG. 2.—*External aspect of Knee-Joint.* *F.* Head of the fibula. *Bi.* Biceps. *I.p.n.* Internal popliteal nerve. *E.p.n.* External popliteal nerve. *G.* Gastrocnemius.

FIG. 3.—*Internal aspect of Knee-Joint.* The sartorius, gracilis and semi-tendinosus, and the internal lateral ligament, have been removed. *I.c.* Internal condyle. *Ti.* Tibia. *P.* Patella. *S.* Sartorius. *G.* Gracilis. *S.t.* Semi-tendinosus. *Ad.mag.* Adductor magnus. *Gastr.* Gastrocnemius, inner head. *S.m.* Semi-membranosus. The superior internal articular branch of the popliteal artery is seen lying on the bone above the internal condyle.



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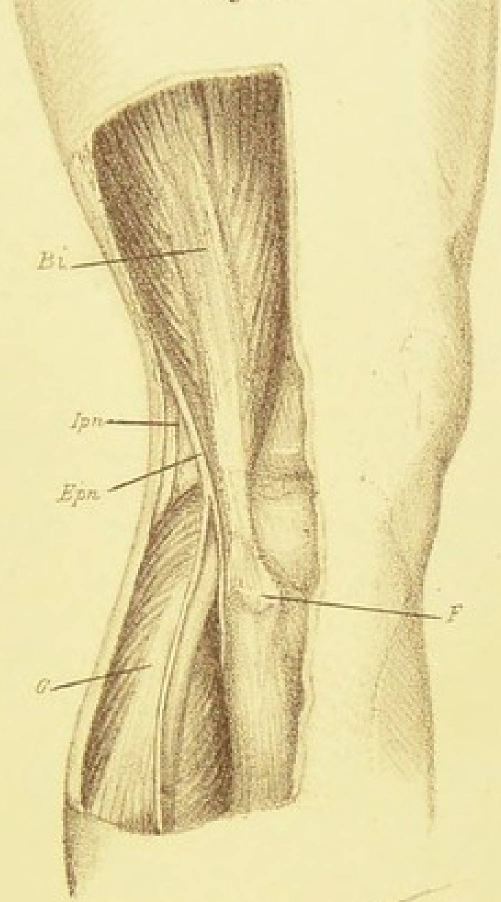


Fig. 2.

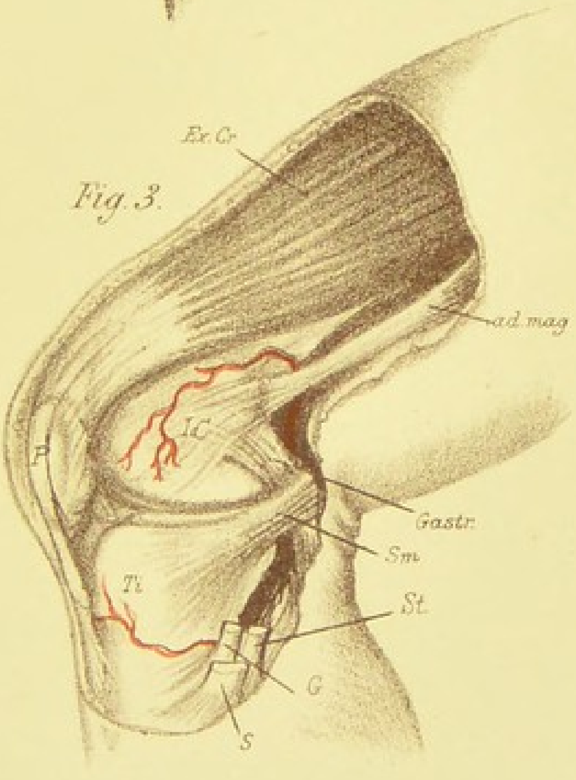


Fig. 3.

PLATE XIII.

Fig. 1.—*Dissection of Inner Ankle.*

T. Tibia. *T.p.* Tibialis posticus. *F.l.d.* Flexor longus digitorum. *P.t.a.* Posterior tibial artery. *F.* Flexor hallucis. The posterior tibial nerve is lying between the artery and the flexor hallucis. *T.ac.* Tendo Achillis. *P.* Plantaris. *O.c.* Os calcis. The plantar fascia and abductor hallucis are seen running forwards from the os calcis. The dense pad of skin and fat forming the heel is also seen.

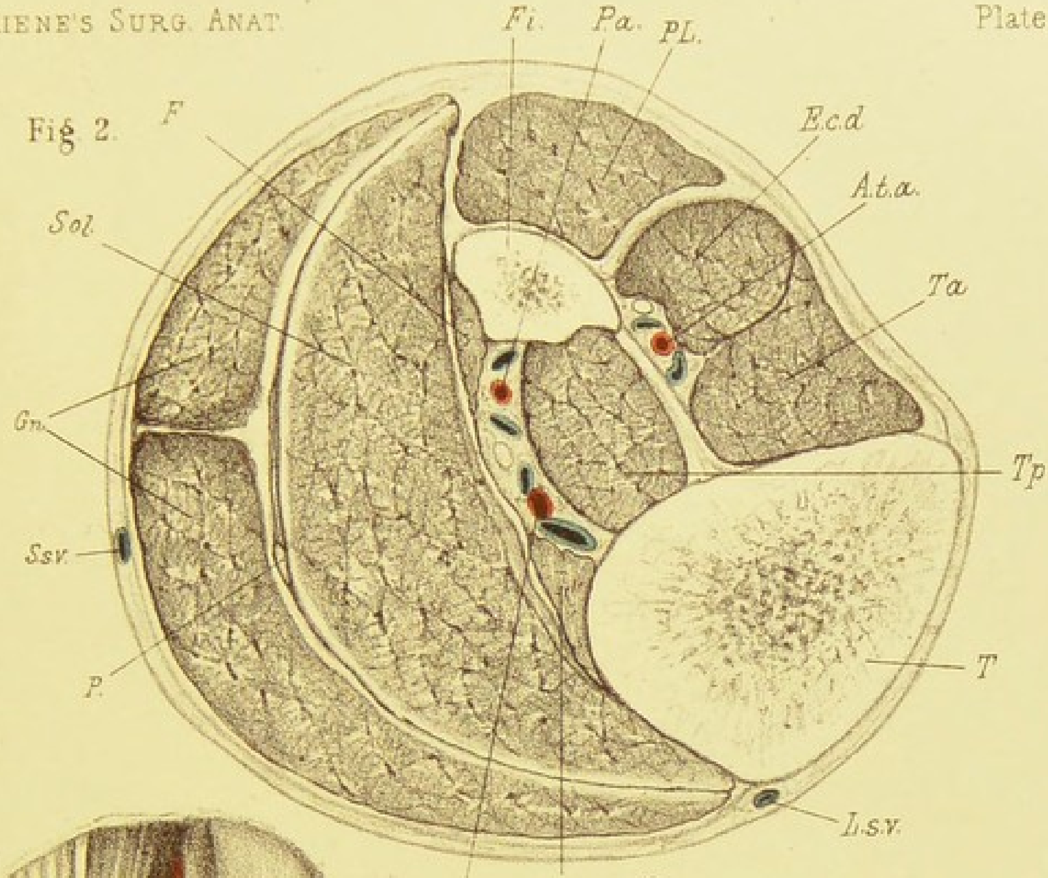
Fig. 2.—*Transverse Section of Leg at junction of Upper and Middle Thirds.*

T. Tibia. *Fi.* Fibula. *P.L.* Peroneus longus. *E.c.d.* Extensor communis digitorum. *A.t.a.* Anterior tibial artery, lying on the interosseous membrane. *T.a.* Tibialis anticus. *T.p.* Tibialis posticus. *F.d.* Flexor digitorum. *F.* Flexor hallucis. *P.t.a.* Posterior tibial artery. *P.a.* Peroneal artery. Posterior tibial nerve lying between these vessels. *Sol.* Soleus. *P.* Plantaris. *Gn.* Gastrocnemius. *S.s.v.* Short saphenous vein. *L.s.v.* Long saphenous vein.

Fig. 3.—*Transverse Section of Leg at junction of Middle and Lower Thirds.*

T. Tibia. *T.a.* Tibialis anticus. *A.t.a.* Anterior tibial artery. *E.p.* Extensor hallucis. *E.d.* Extensor digitorum. *Pr.* Peroneus longus and Peroneus brevis. The Peroneus brevis lies next the bone. *F.* Flexor hallucis. *P.* Plantaris. *G.s.* Gastrocnemius and soleus. *Per.A.* Peroneal artery. *P.t.a.* Posterior tibial artery. *T.p.* Tibialis posticus. *F.d.* Flexor digitorum.

Fig. 2.



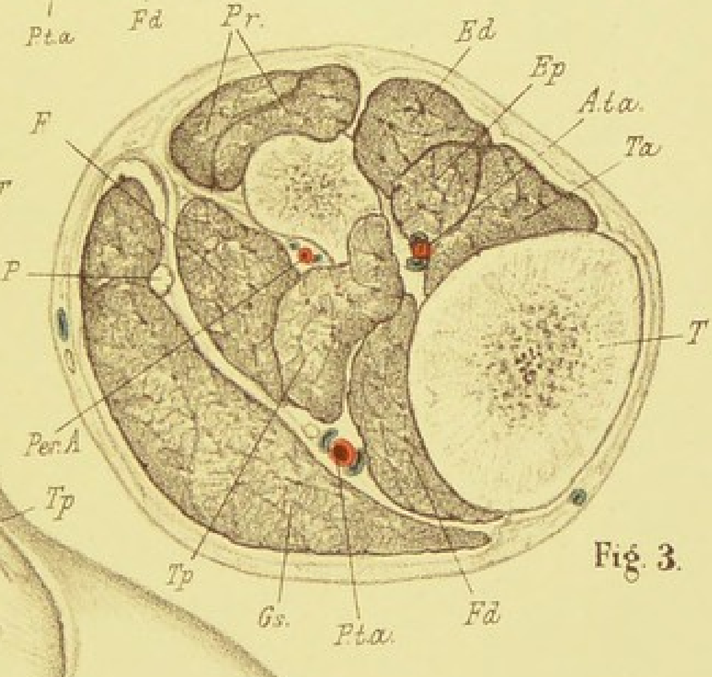


Fig. 3.

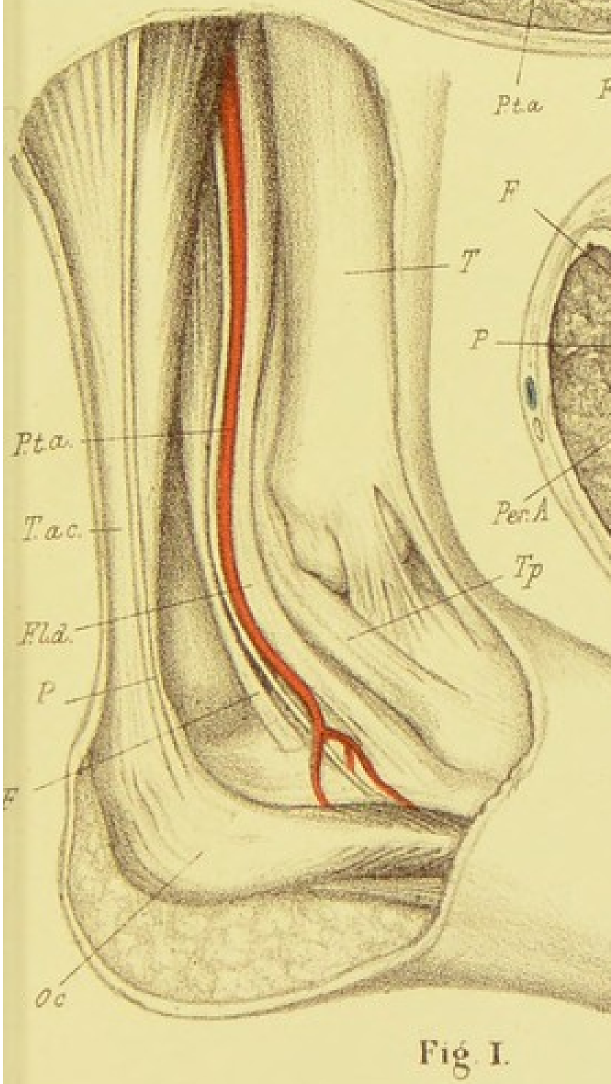


Fig. I.

PLATE XIV.

FIG. 1. *Antero-posterior mesial section of the left Knee-Joint.*—The internal condyle and inner half of femur, the inner half of the patella, and the inner half of the tibia, have been removed along with the soft parts. *Fe.* Femur. *T.* Tibia. *P.* Patella. *B.* Bursa patellæ. *S.t.* Semi-tendinous. *S.m.* Semi-membranosus. *A.* Popliteal artery. *V.* Popliteal vein. *N.* Internal popliteal nerve. *Gn.* Gastrocnemius. *Sol.* Soleus. *T.p.* Tibialis posticus. *Pop.* Popliteus. *P.c.l.* Posterior crucial ligament. After the section was made the cavity of the joint was slightly distended with horsehair; X marks the height of the synovial membrane mesially, X X the height of the membrane at its highest part on the external condyle. The patella is drawn in position, the extensor muscles relaxed. If these muscles are tense, the patella rises to a higher level.

FIG. 2. *Vertical lateral section of Ankle-Joint and Os calcis.*—The section is made through the tip of the external malleolus. *T.* Tibia. *Fi.* Fibula. *As.* Astragalus. *O.c.* Os calcis. *T.p.* Tibialis posticus. *F.d.* Flexor digitorum. *F.* Flexor hallucis. *P.b.* Peroneus brevis. *P.l.* Peroneus longus. *Ac.* Accessorius. *Abd.* Abductor hallucis. *F.b.d.* Flexor brevis digitorum. *A.m.d.* Abductor minimi digiti. *I.* Interosseous ligament. This section is in the same plane as the cut across the sole in Syme's amputation at the ankle-joint. The posterior tibial artery has divided into the external and internal plantar vessels at the point of section.

FIG. 3.—*Transverse section of the Leg* immediately above the ankle-joint. *T.* Tibia. *Fi.* Fibula. *T.a.* Tibialis anticus. *E.p.* Extensor pollicis. *E.d.* Extensor longus digitorum. *P.t.* Peroneus tertius. *A.t.a.* Anterior tibial artery. *P.l.* Peroneus longus. *P.b.* Peroneus brevis. *F.* Flexor hallucis. *T.ac.* Tendo Achillis. *P.* Plantaris. *P.t.a.* Posterior tibial artery. *P.t.n.* Posterior tibial nerve. *F.d.* Flexor digitorum. *T.p.* Tibialis posticus. This section is on the same plane as the transverse section of the bones in "Syme's" amputation. The inferior tibio-fibular joint is seen between the bones. In amputating for disease of the ankle the inferior tibio-fibular joint should be examined, and if diseased the gouge ought to be used to remove the diseased surface. The anterior peroneal artery is seen in front of the fibula. It is larger than usual in this drawing.

FIG. 4.—*Antero-posterior section of the Bones of the Foot,* illustrating the arch of the foot and the principal synovial membranes. *A.* Astragalus. *O.c.* Os calcis. *S.* Scaphoid. *I.c.* Internal cuneiform. *T.a.* Tendo Achillis. *I.* Interosseous ligament. *C.S.* Inferior calcaneo-scaphoid ligament. It will be observed how the plantar fascia and inferior calcaneo-scaphoid ligament act as tie-rods supporting the arch. Their relaxation is followed by flat-foot. The bursa between the tendo Achillis and os calcis is to be noted.

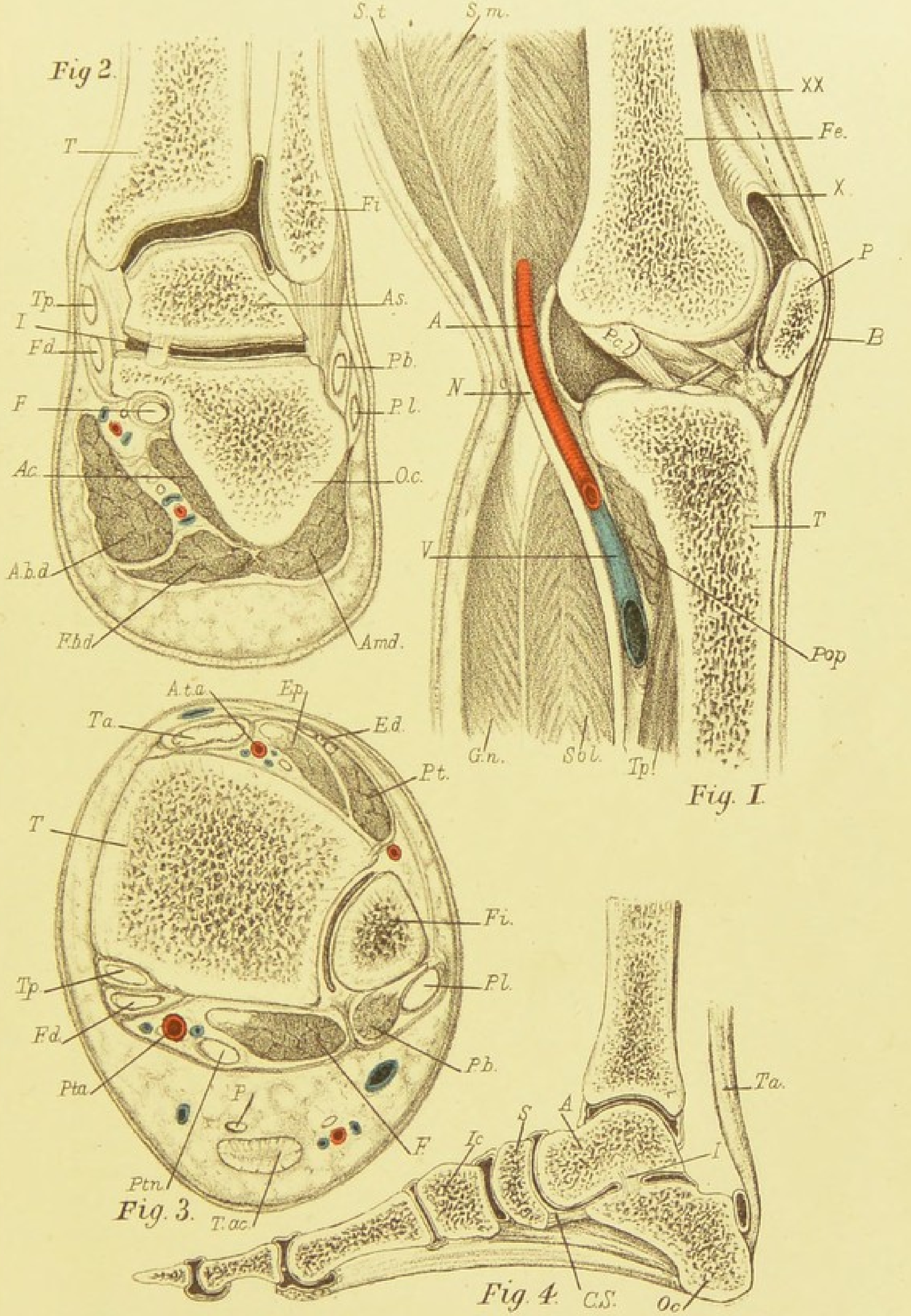


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PLATE XV.

Fig. 1. *Transverse section of the Pelvis.*—The specimen was taken from a young child. The observer is looking upwards. The plane of section is through the projecting points, which mark the junctions of the middle curved lines with the crests, and cuts the iliac bones posterior to the anterior superior spinous processes (see text, page 39). *C.C.* Caput cæcum. *S.I.* Small intestines. *S.F.* Sigmoid flexure. *R.* Rectum. *S.* Sacrum. *I.* Iliacus. *P.* Psoas. *G.* Gluteus. *E.S.* Erector spinæ. *L.E.I.* Left external iliac artery. *L.I.I.* Left internal iliac artery. *L.I.V.* Left common iliac vein. *U.* Ureter. *R.E.I.* Right external iliac artery. *R.I.I.* Right internal iliac artery. *R.I.V.* Right common iliac vein. The transversalis fascia is indicated by a blue line.

Fig. 2.—*Anterior aspect of Abdominal Wall.* Bones in faintly dotted lines. *A.* Aorta bifurcating at the level of the crest of the ilium into (*C.I.*) common iliac arteries. *E.I.* External iliac artery. *I.I.* Internal iliac artery. *P.* Poupart's ligament. *I.A.R.* Internal abdominal ring. *E.A.R.* External abdominal ring. The mesial line is faintly indicated; so also are the outer edges of the recti abdominis.

The diagram illustrates the relation of the blood-vessels and abdominal rings to the anterior abdominal wall.

Fig. I.

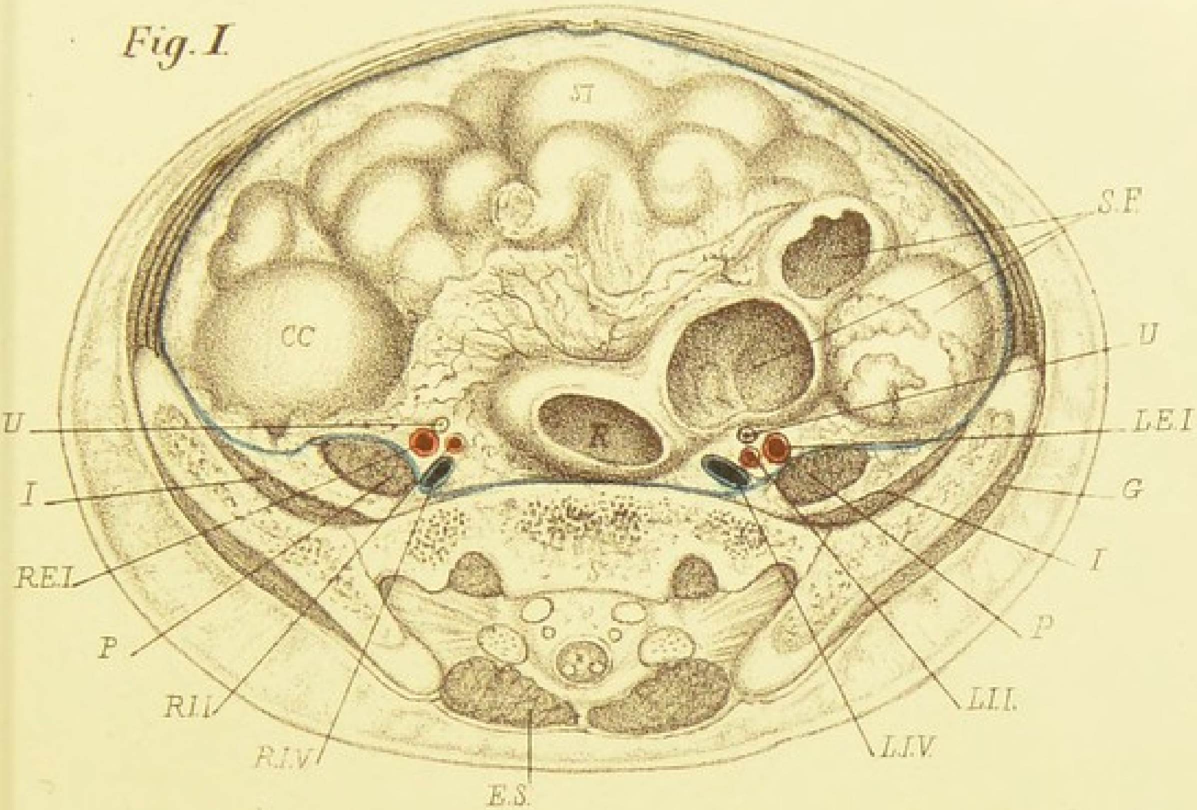

Fig. 2.

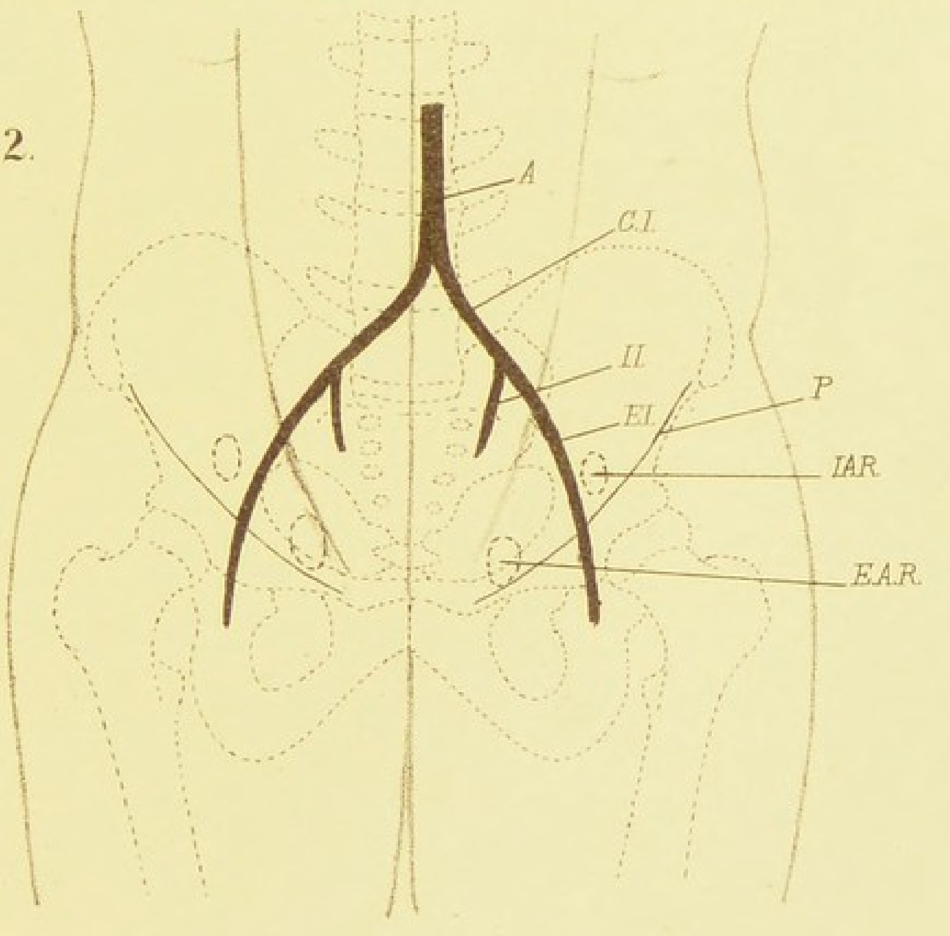

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PLATE XVI.

FIG. 1.—*Transverse Section of Lumbar Region,* midway between last rib and crest of ilium, looking downwards towards pelvis, illustrating the anatomy of the operation of Colotomy. *E.S.* Erector spinæ. *Q.l.* Quadratus lumborum. *L.* Latissimus dorsi. *E.o.* External oblique. *F.T.* Transversalis fascia (blue line). *D.c.* Descending colon. *Ps.* Psoas muscle. *A.* Aorta. *I.V.* Inferior vena cava.

FIG. 2.—*Dissection of the Left Lumbar Region,* illustrating operation of Colotomy. *C.il.* Crest of ilium. *L.d.* Latissimus dorsi. The dotted line, marked 1, represents the anterior edge of the Latissimus. *E.s.* Erector spinæ. The dotted line, marked 2, represents the anterior edge of the Erector spinæ. The dotted line, marked 3, represents the position of the anterior edge of the Quadratus lumborum. *I.o.* Internal oblique. *E.o.* External oblique.

FIG. 3.—*Dissection of the Anterior Abdominal Wall* in left hypochondriac region, illustrating operation of Gastrostomy. *R.a.* Rectus abdominis. *E.o.* External oblique. *I.o.* Internal oblique. *Tr.* Transversalis muscle. *T.f.* Transversalis fascia.

Fig I

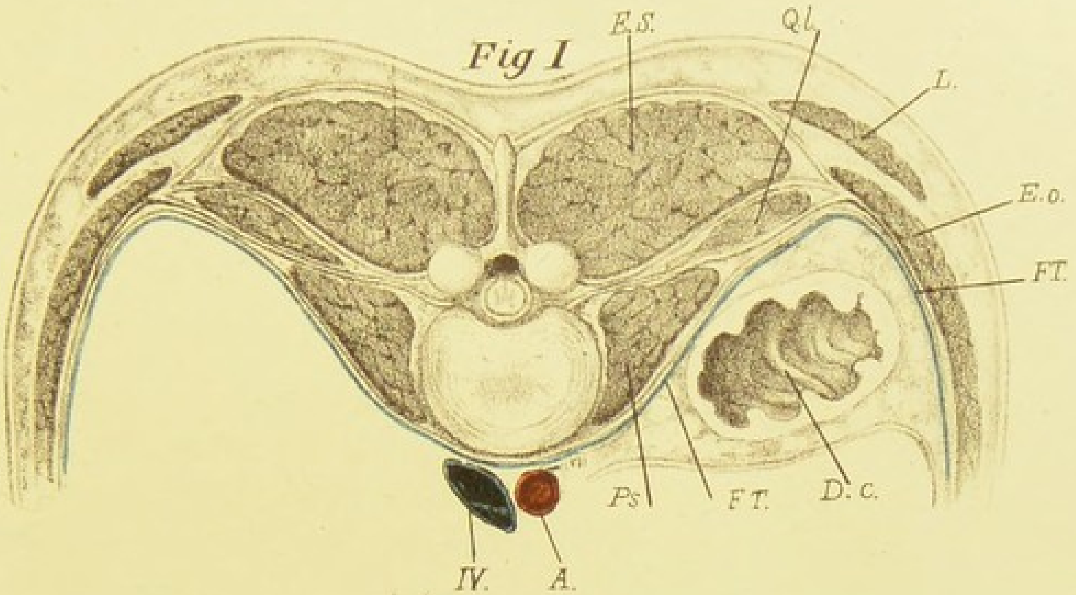

Fig. 3.

Fig. 2.

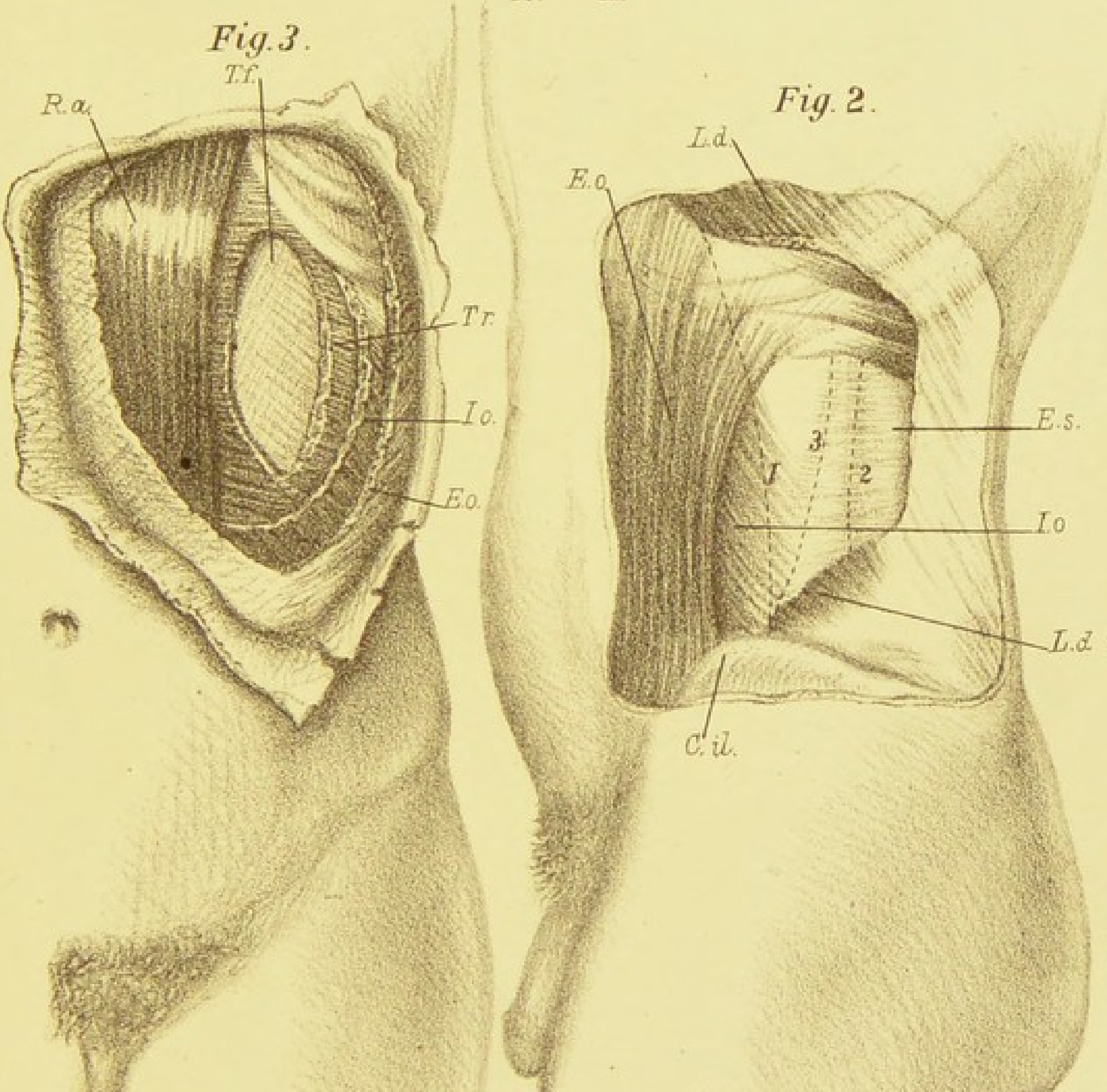

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PLATE XVII.

FIG. 1.—*External Anatomy of the Perineum.* The subject is tied in position for the operation of lithotomy. A staff is introduced into the bladder; the right hand of the assistant holding the staff, the left hand supporting the scrotum. *T.I.* Tuber ischii. The dotted line running forwards represents the position of the anterior edge of the ascending ramus of the ischium and descending ramus of the pubis. The dotted line running backwards to *C.* (coccyx) represents the position of the posterior edge of the gluteus maximus, which marks the fold of the nates. *B.* Bulb. *A.b.* Artery to the bulb.

FIG. 2.—*Superficial Dissection of the Perineum.* *T.is.* Tuber ischii. *G.mx.* Gluteus maximus. *C.* Coccyx. *L.a.* Levator ani. *Sph.* Sphincter ani. *P.* Obturator portion of the pelvic fascia. The perineal fascia is in position on the anterior portion of the perineum. The ischio-rectal fossa is dissected on the right side of the subject. The fat is left in position on the left side.

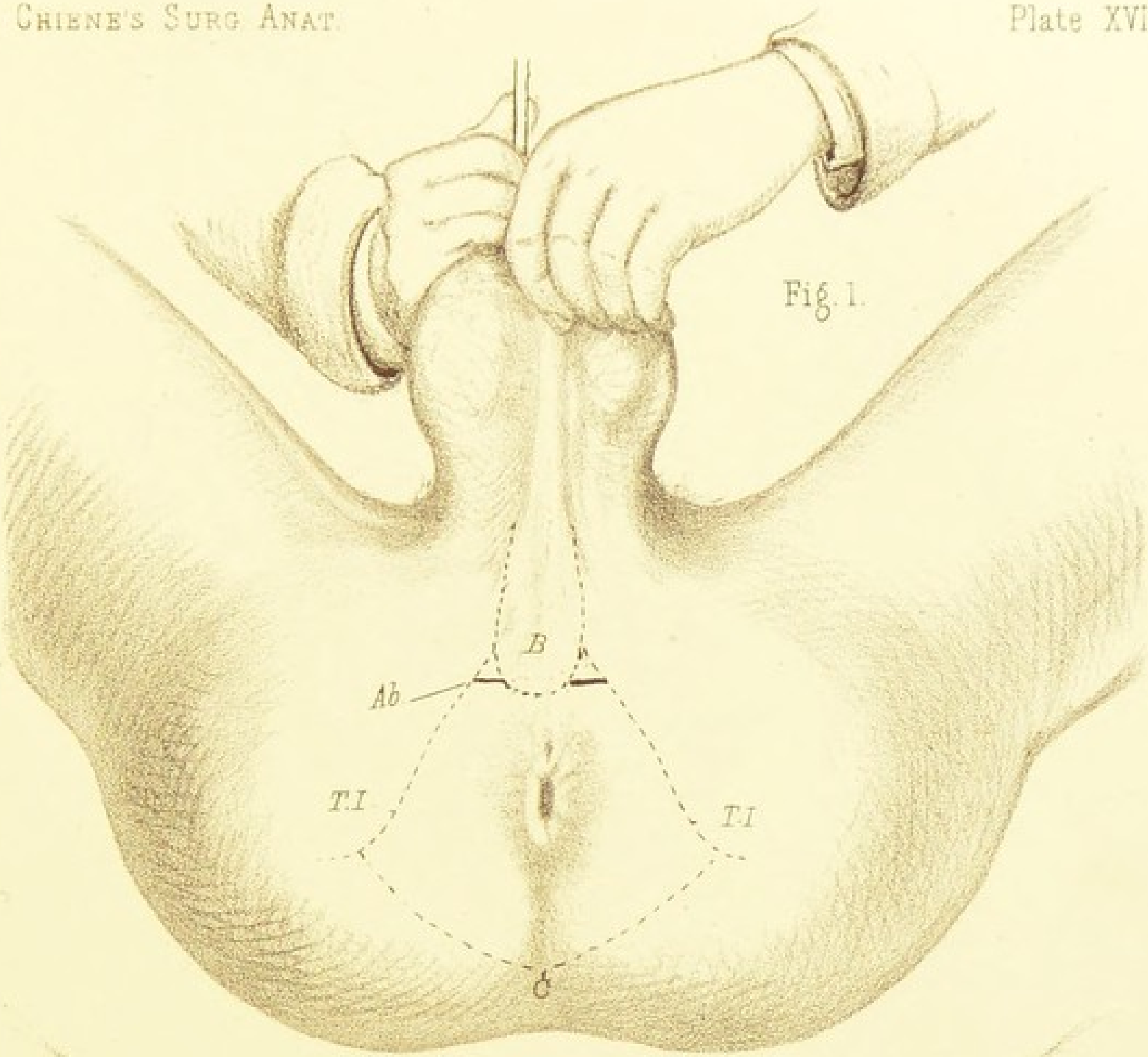


Fig. 1.

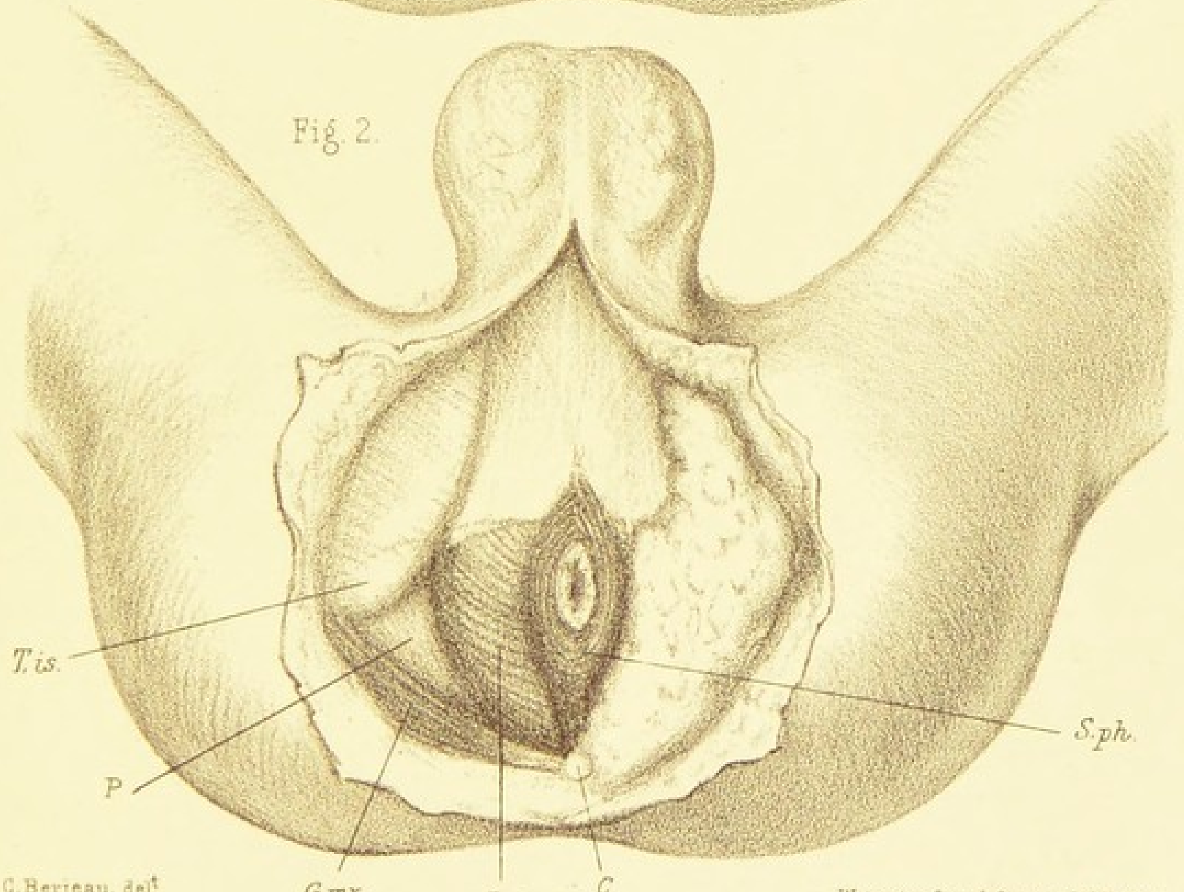


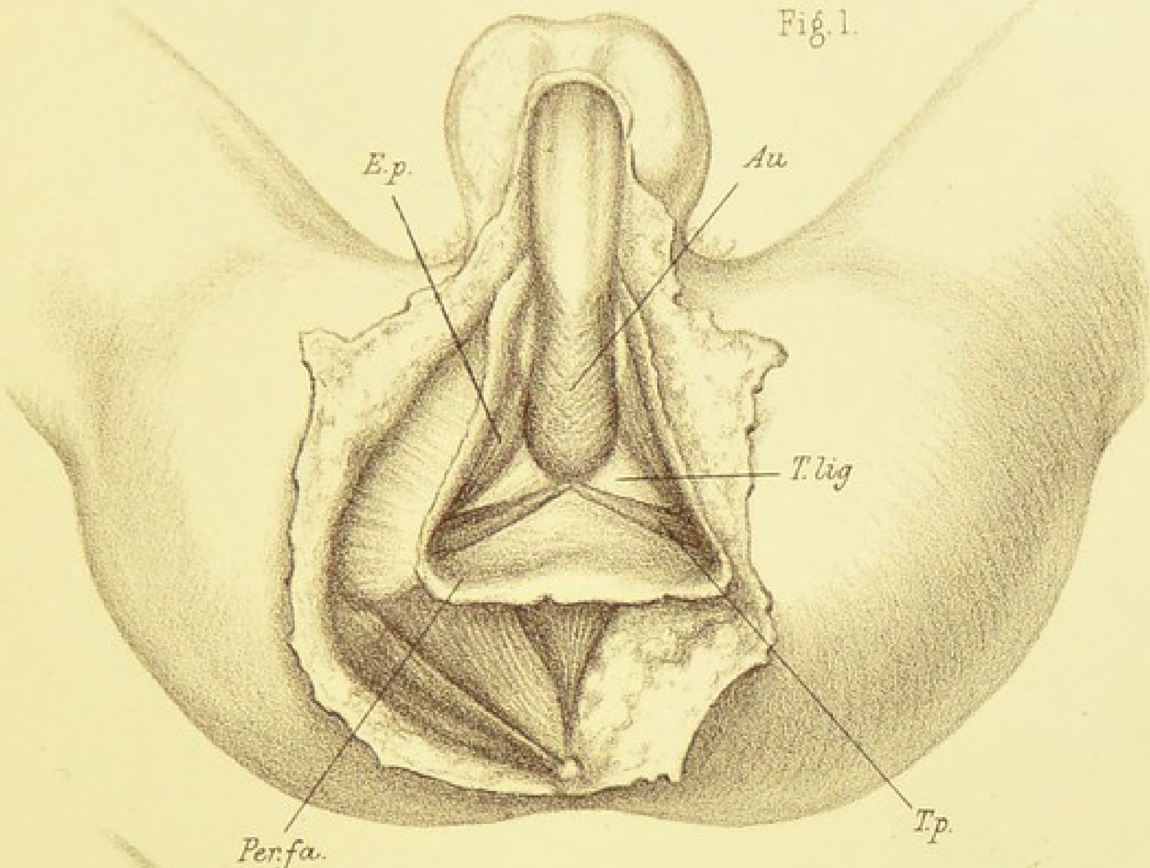
Fig. 2.

PLATE XVIII.

Fig. 1.—*Dissection of the Anterior or Urethral Division of the Perineum.* The perineal fascia (*Per.fa.*) is thrown downwards, and its connection with the base of the triangular ligament (*T.lig.*) is observed. The bulb of the urethra, covered by the accelerator urinæ (*A.u.*), is observed, on each side of which is seen the erector penis (*E.p.*) covering the crus penis. *T.p.* Transverse perineal muscle forming the base of a triangle, the sides of which are formed by the erector penis and accelerator urinæ muscles.

Fig. 2.—*Deep Dissection of the Perineum.* The sphincter ani is detached from the central point of the perineum, the levatores ani (*L.a.*) are divided, and the rectum (*R.*) is pulled downwards. The transverse perineal muscles, the bulb, accelerator urinæ muscle, erectores penis, and triangular ligament, are cut away. The corpus spongiosum penis (*C.s.p.*), on cross section, the corpora cavernosa penis (*C.p.*), and the membranous portion of the urethra (*M.*) are seen; the prostate gland (*P.*), and the vesiculæ seminales (*V.ss.*), covered by the pelvic fascia, are also exposed.

Fig. 1.



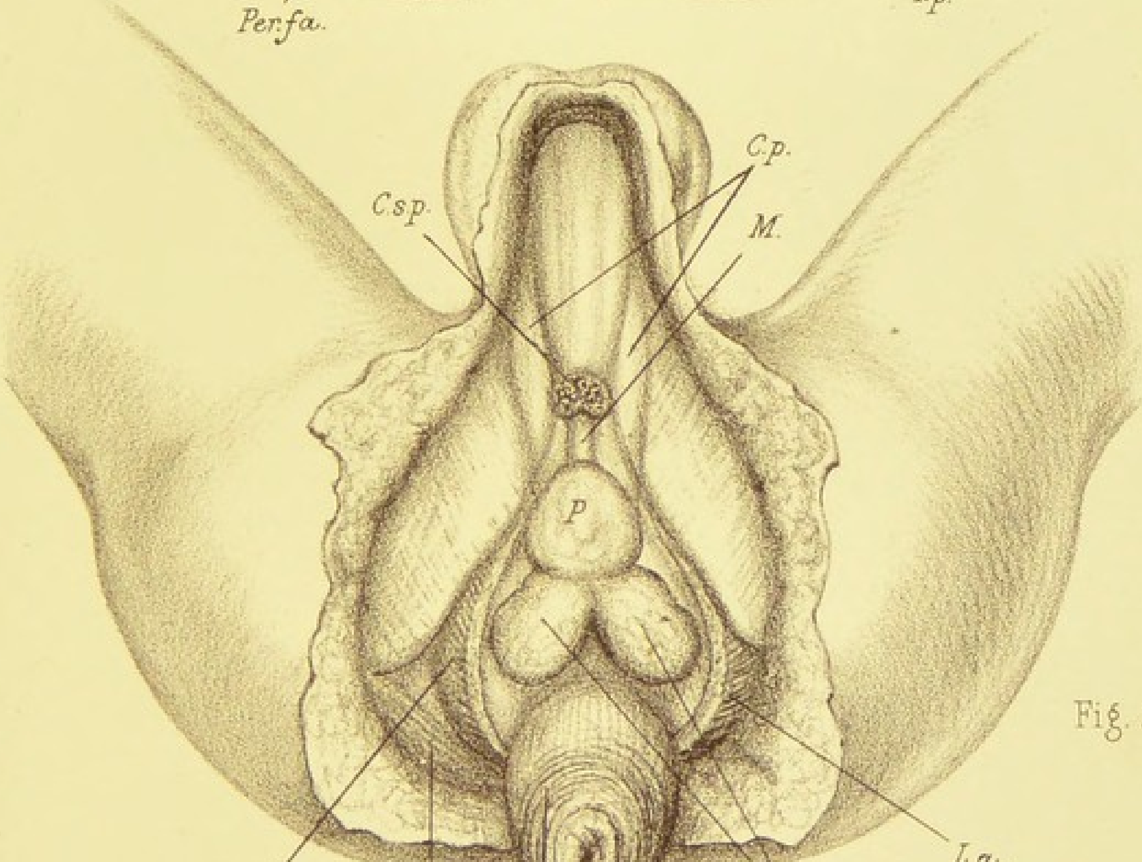


Fig. 2.

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PLATE XIX.

Fig. 1.—*Vertical Antero-posterior Section of Male Pelvis* (from a preparation by Mr. J. C. Ewart, University College, London). *R.* Rectum. *B.* Bladder, into which five ounces of fluid were injected before hardening. *P.C.* Peritoneal cavity. *S.P.* Symphysis pubis. *R.A.* Rectus abdominis. *P.* Prostate. *Bu.* Bulb. *T.* Testicle ; the different coverings of the testicle have been laid open in order to expose the gland. *A.* Anus. *S.* Sphincter ani.

Fig. 2.—*Vertical Antero-posterior Section of the Pelvis of a Female Child* (from a preparation by Mr. Ewart), to illustrate the abdominal situation of the bladder in children. *B.* Bladder. *O.* Ovary. *U.* Uterus. *V.* Vagina. *R.* Rectum. *S.P.* Symphysis pubis.

Fig. 3.—*Dissection of the Supra-pubic Region.* *R.S.* Rectal sheath. *R.* Rectus. *P.* Pyramidalis. *T.* Transversalis fascia ; if opened mesially, the extra-peritoneal fat is exposed.

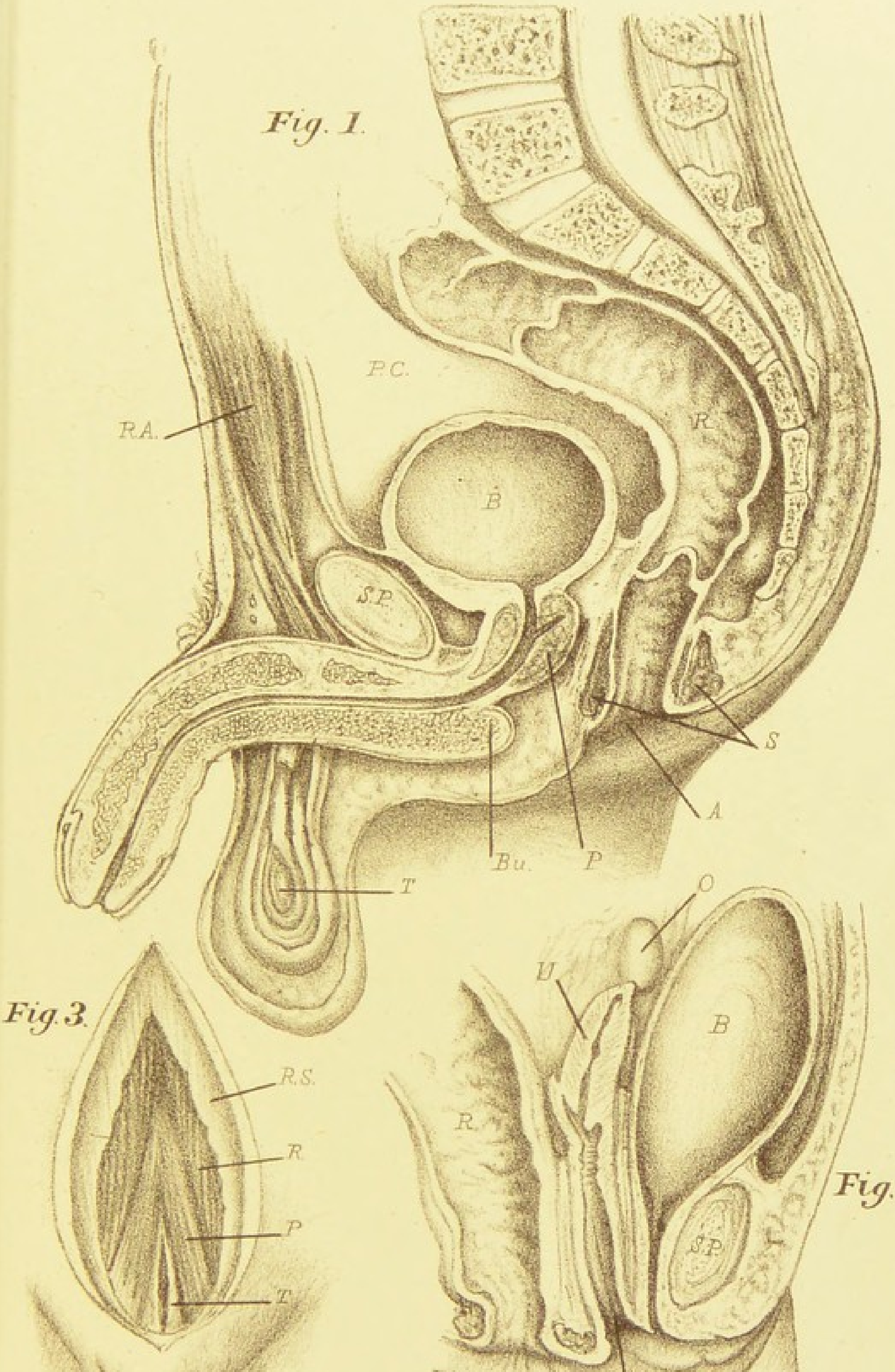

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PLATE XX.

FIG. 1.—*Drawing of the Floor of the Male Urethra* (from a preparation by Mr. Ewart). *B.* Bladder. *U.* Ureters. *T.* Trigone. The veru-montanum (*V.M.*) is seen on the floor of the prostatic portion of the urethra. *P.* Prostate. *M.* Membranous portion of urethra. *C.C.* Corpora cavernosa. *G.P.* Glans penis.

FIG. 2.—*Diagram illustrating the position of the Hand and the direction of the Catheter during the passage of that instrument.* *P.* Penis. *A.* First position of the instrument. *A.P.* Line of catheter until the point reaches the bulb. In the recumbent position of the body, with a rigid instrument in the canal, the spongy portion of the urethra is vertical; the point of the instrument is therefore to be directed downwards. This can be done with accuracy if the surgeon is looking along the instrument, as he can do when in line *A.P.* After the point has reached the bulb, the instrument is rotated through quarter of a circle to the middle line of the body (*B*). The hand is then raised from the abdomen, and sweeping through half a circle in the mesial plane of the body, the hand reaches the space between the thighs, the point of the instrument passing backwards and upwards into the bladder.

FIG. 3.—*Vertical Antero-posterior Section through an Enlarged Prostate Gland* (from a preparation in the author's museum). *B* Bladder, with thickened rugæ. *P.P.* Prostate. *V.S.* Seminal vesicle. *V.D.* Vas deferens.

Fig 2

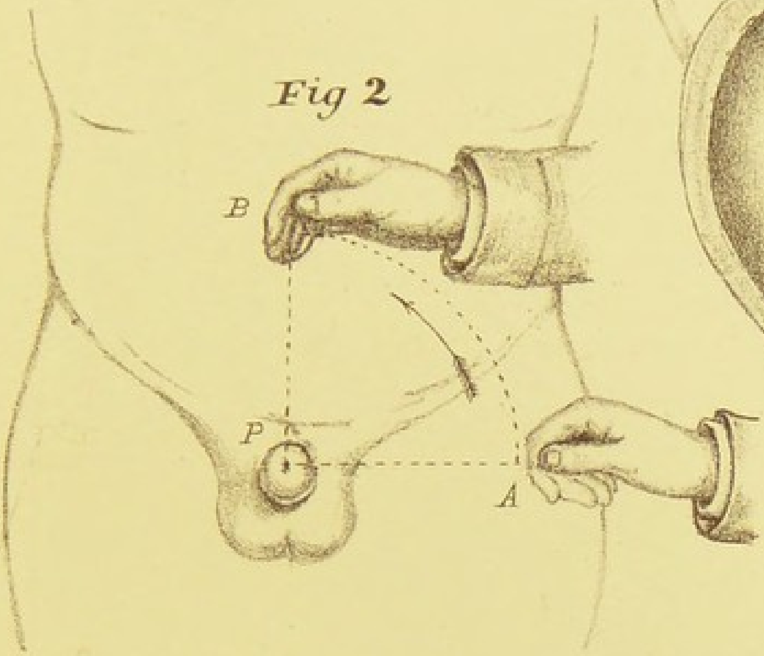

Fig. I.

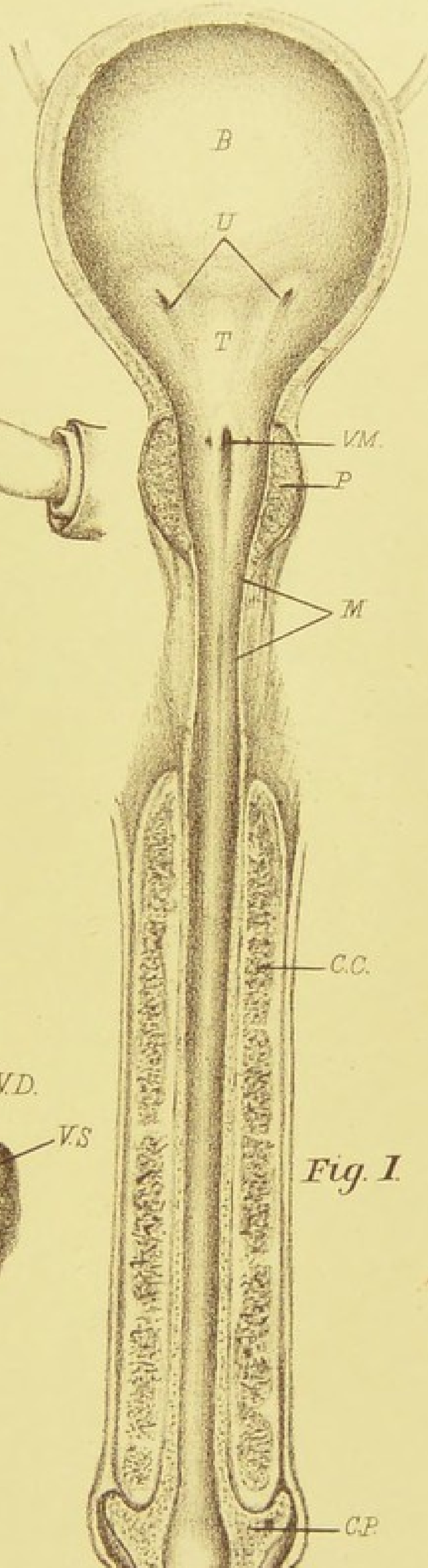

Fig. 3.

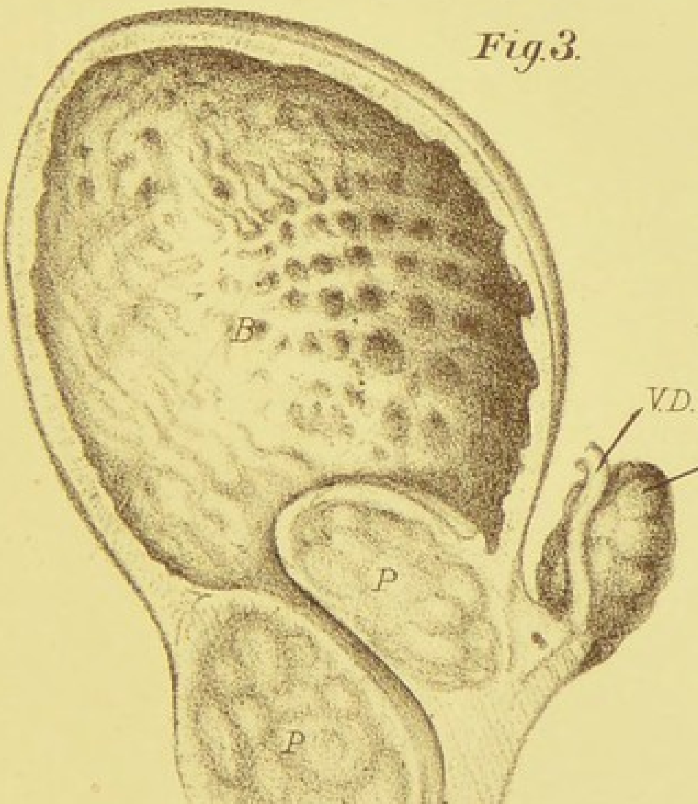

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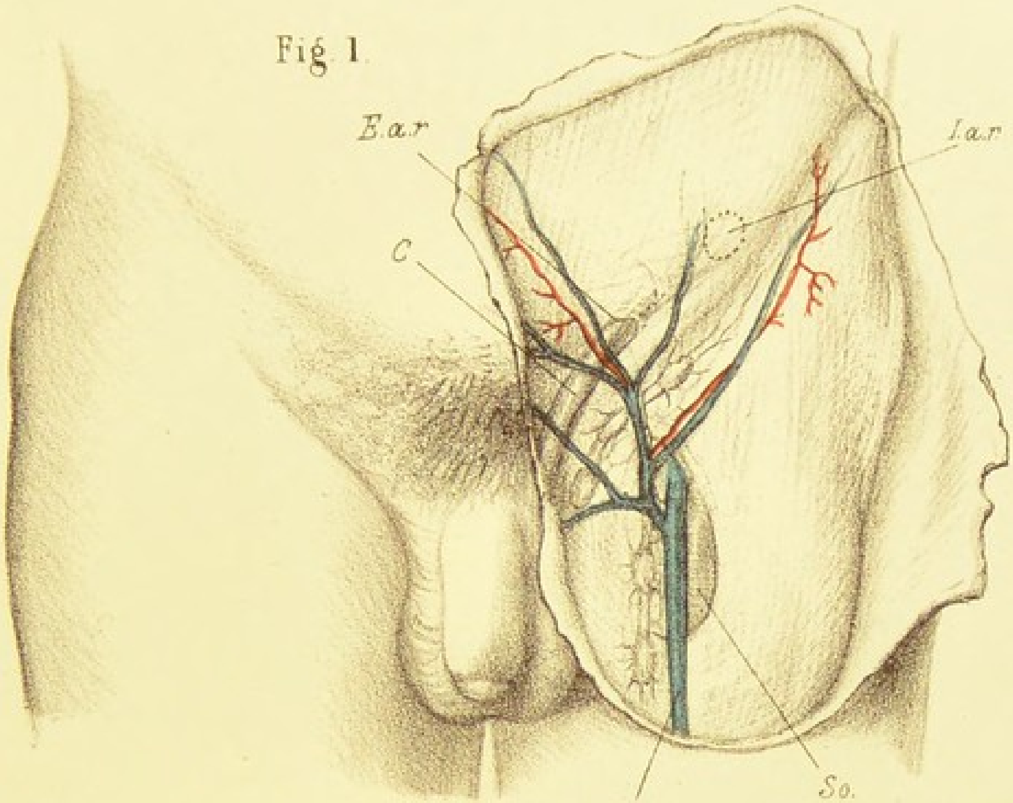
PLATE XXI.

Fig. 1.—*Superficial Dissection of the Groin.* The skin has been removed, and the blood-vessels and lymphatics dissected out. *E.a.r.* External abdominal ring. *I.a.r.* Position of internal abdominal ring. *C.* Cord. *S.o.* Saphenous opening. *S.v.* Saphenous vein.

Fig. 2.—*Dissection of the Inguinal Region.* The skin and superficial fascia have been removed. The external oblique (*E.o.*) is exposed, divided, and turned down. The cremaster muscle (*C.*) is seen covering the cord. The internal oblique muscle (*I.o. I.o.*) is, in its turn, divided and thrown outwards and inwards, exposing the transversalis muscle (*Tr.m.*) with its free lower border. Between this border and Poupart's ligament the transversalis fascia (*Tr.f.*) is seen. The cord is seen passing through the fascia, and receiving a covering from it called the infundibuliform fascia. The deep epigastric artery is indicated in dotted outline beneath the fascia transversalis, lying internal to the internal abdominal ring. The situations of the abdominal rings and saphenous opening are indicated on the opposite side in dotted outline.

Fig. 1.



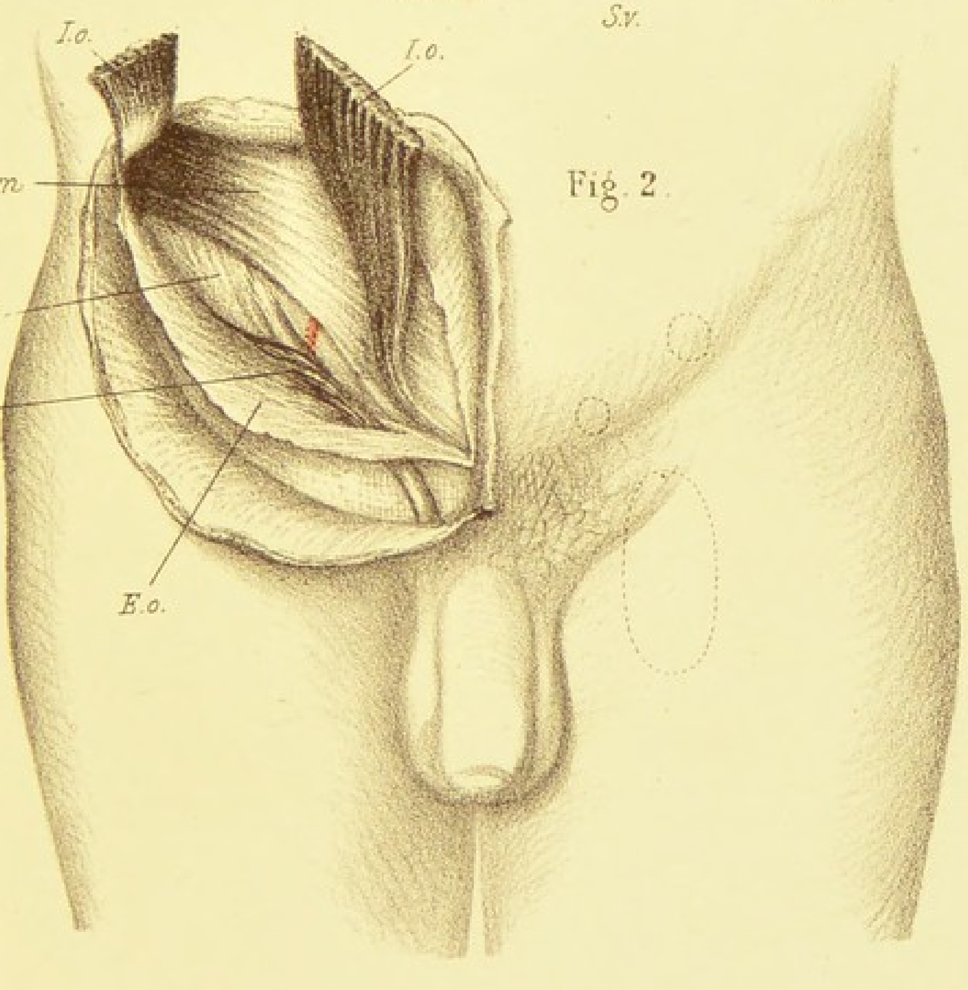


Fig. 2.

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PLATE XXII.

Fig. 1.—*Diagram of a Case of Triple Hernia.* (From a preparation in the author's museum.)

1. Oblique inguinal Hernia.
2. Testicle.
3. Direct inguinal Hernia.
4. Femoral Hernia.

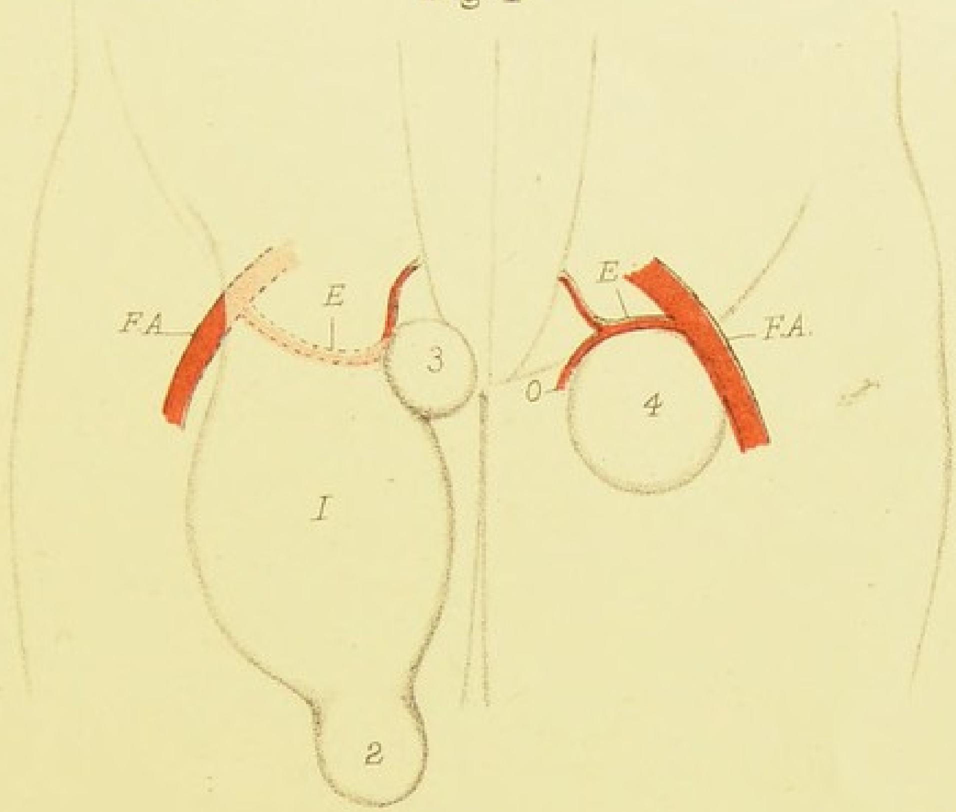
F.A. Femoral artery.

E. Epigastric artery, on the right side, winding round behind the neck of the sac of the oblique hernia, and appearing to the outer side of the direct hernia; on the left side giving off the obturator artery, which winds round the neck of the femoral hernia, and shows that care is necessary when dividing the constriction.

Fig. 2.—*Dissection of the Saphenous Opening and Femoral Sheath.* The skin and superficial fascia have been removed, along with the superficial blood-vessels and lymphatics. The outer edge of the saphenous opening is defined. The three compartments of the femoral sheath (*F.s.*) have been opened. *A.* The femoral artery. *V.* The femoral vein. *L.* The lymphatic gland lying in the crural canal. *S.* Saphenous vein.

Fig. 3.—*Drawing of a Case of Femoral Hernia* (from a preparation in the author's museum). The femoral hernia (*F.H.*) is seen lying internal to and overlapping the femoral vein. *S.* Saphenous vein.

Fig. I.



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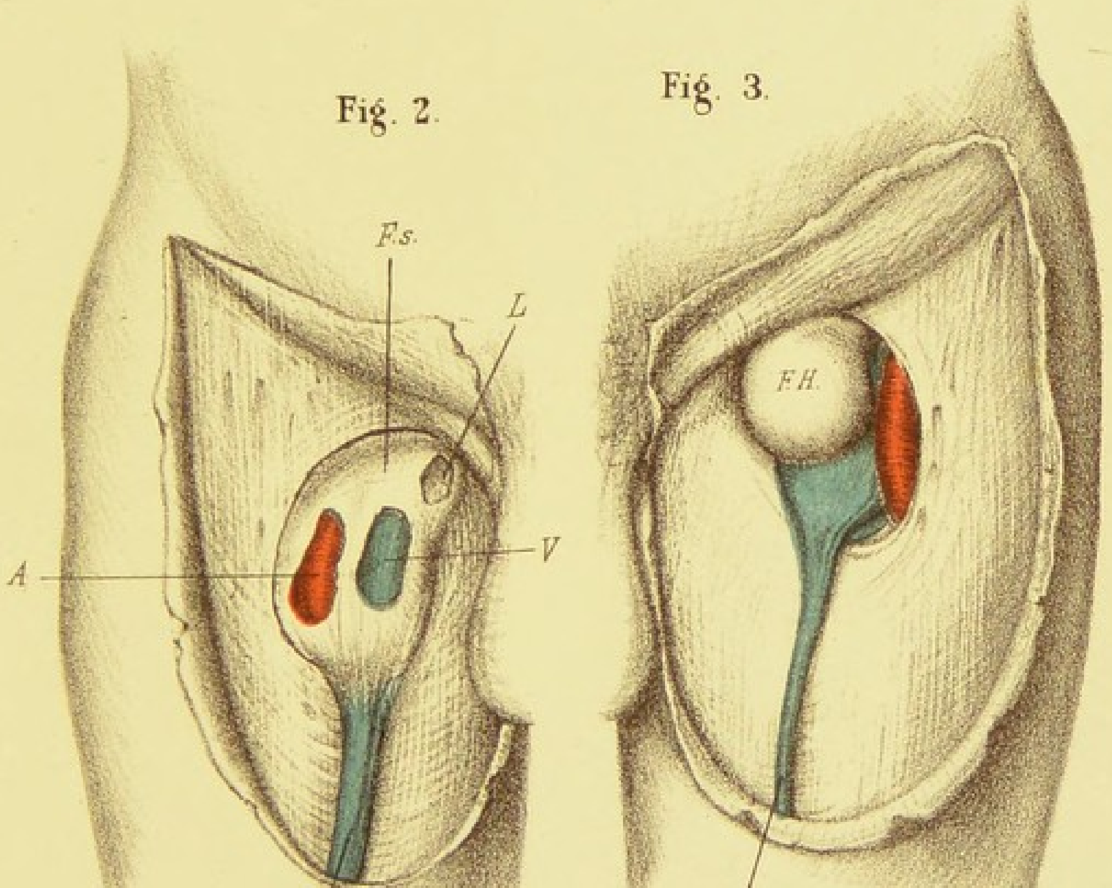

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PLATE XXIII.

FIG. 1.—*Drawing of a Case of Double Right Inguinal Hernia* (preparation in the Anatomical Museum, University of Edinburgh, *Edinburgh Medical Journal*, March 1869). The internal surface of the peritoneum is seen with the double opening, and the epigastric artery (*E.A.*) is indicated in dotted outline. The sacs are also in dotted outline. The internal or direct hernia (*I.H.*) was larger than the external or oblique hernia (*E.H.*) A portion of the direct hernia is seen below the level of the bone. *F.A.* Femoral artery. *F.V.* Femoral vein. *T.* Testicle. The tunica vaginalis testis was stuffed before the specimen was dried. *I.* Right os innominatum.

FIG. 2.—*Internal View of Anterior Abdominal Wall.* The saw was carried vertically through the acetabula. The parietal peritoneum and extra-peritoneal fat have been removed; also the transversalis fascia covering the left rectus abdominis. *R.* Rectus. *T.F.* Transversalis fascia. *P.L.* Poupart's ligament. *E.A.* Epigastric artery. *E.V.* Epigastric veins. *Il.* Iliacus. *F.A.* Femoral artery. *F.V.* Femoral vein. *A.* Acetabulum. *V.D.* Vas deferens. *C.C.* Crural canal. *G.L.* Gimbernat's ligament. *O.* Abnormal obturator artery in dotted outline. *O.F.* Obturator fascia.

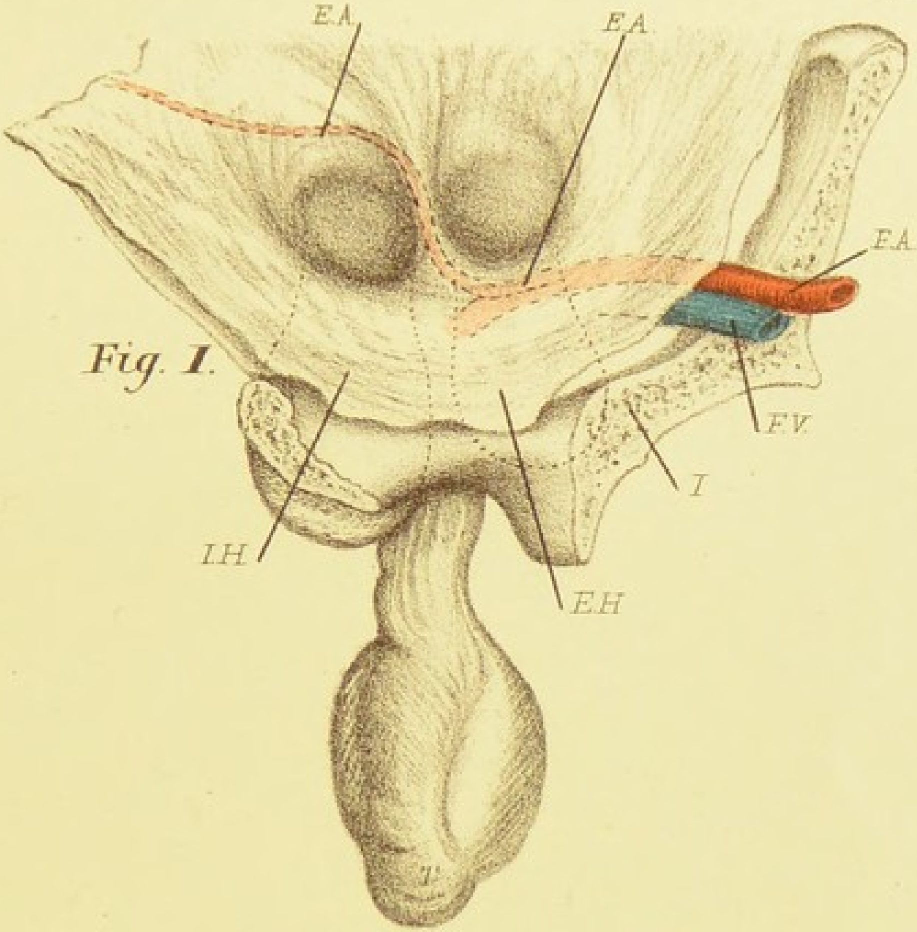

Fig. 1.

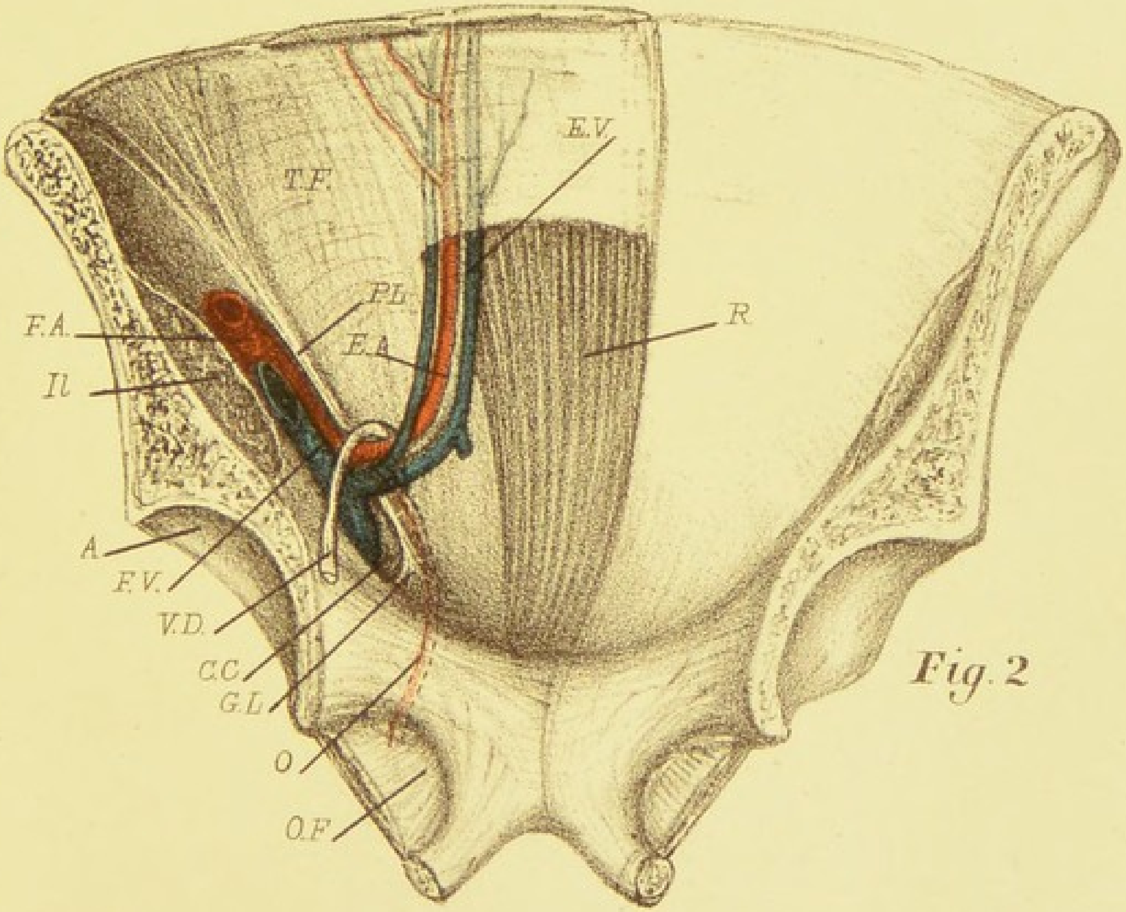

Fig. 2

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PLATE XXIV.

FIG. 1.—*Head and Neck, Bones and principal Blood-vessels indicated.* *E.C.* External carotid. *F.* Facial artery. *I.M.* Internal maxillary. *T.* Temporal. *M.* Middle meningeal. *Oc.* Occipital. *P.D.* Parotid duct. *M.p.* Mastoid process. 1, 2, 3. Three situations in which leeches may be applied in cases of intra-cranial congestion. 1. The external and internal jugular veins communicate in the substance of the parotid gland. 2. The mastoid foramen, which transmits a vein from the occipital vein to the lateral sinus. 3. The inner angle of the orbit, where the ophthalmic vein, from the cavernous sinus, anastomoses with the facial vein.

FIG. 2.—*Dissection of the Sub-maxillary and Parotid Regions.* The skin, superficial and deep fascia, have been removed. The facial nerve and the external jugular vein have also been cut away. The parotid gland has been partially removed, in order to expose the external carotid artery. *S.M.* Sterno-mastoid. *E.J.V.* External jugular vein. *D.G.* Digastric. *C.* External carotid. *I.J.V.* Internal jugular vein. *H.* Hypoglossal nerve. *F.* Facial vein. *H.B.* Hyoid bone. *S.H.* Stylo-hyoid. *H.G.* Hyoglossus. *M.G.* Sub-maxillary gland, drawn upwards. *M.* Masseter muscle. *P.* Parotid gland. *T.* Temporal artery. *T.F.* Transverse facial artery. The parotid duct is seen lying on the masseter muscle at a lower level than the transverse facial artery.

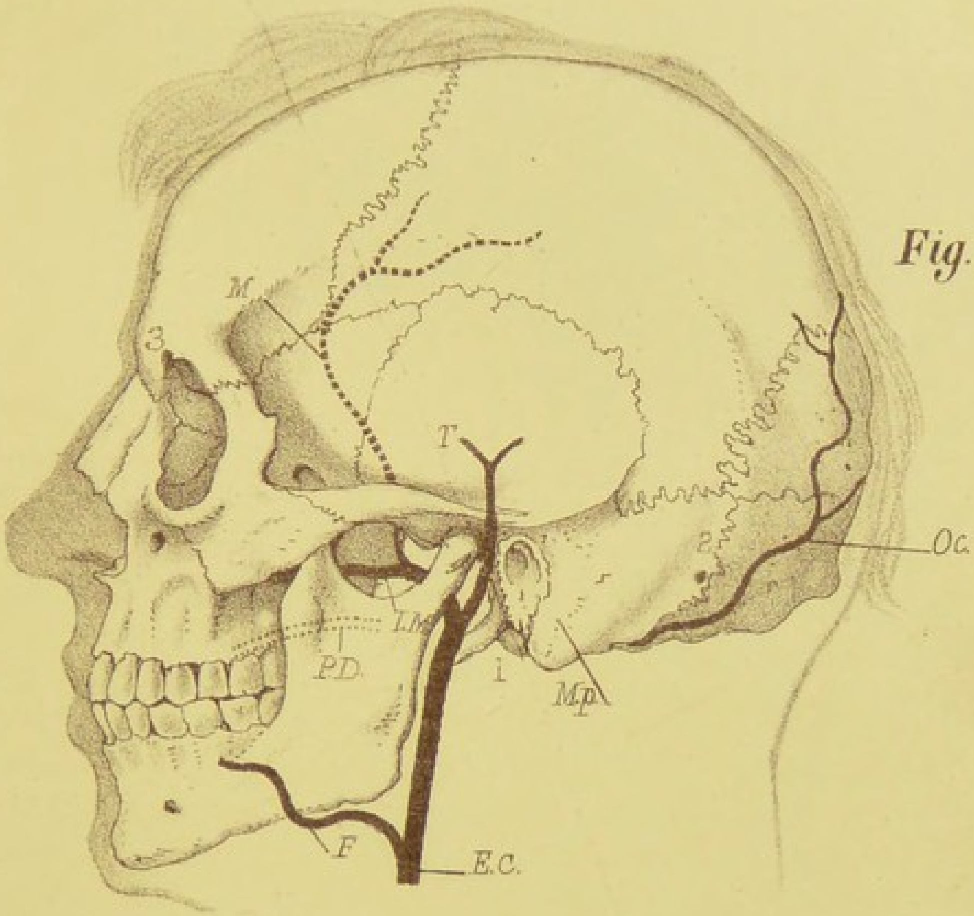

Fig. I.

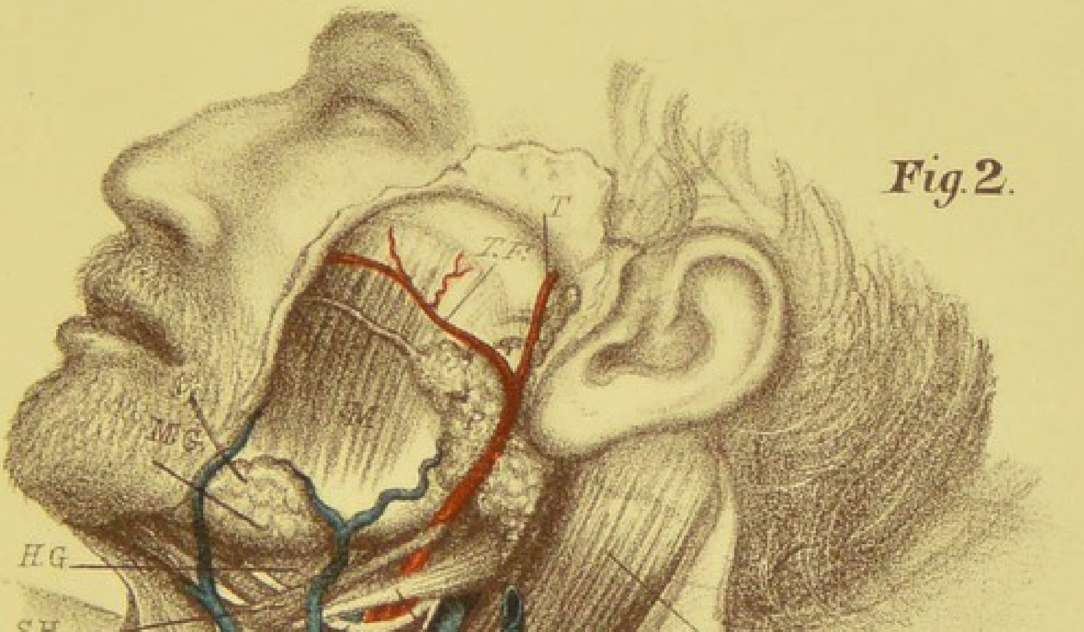

Fig. 2.

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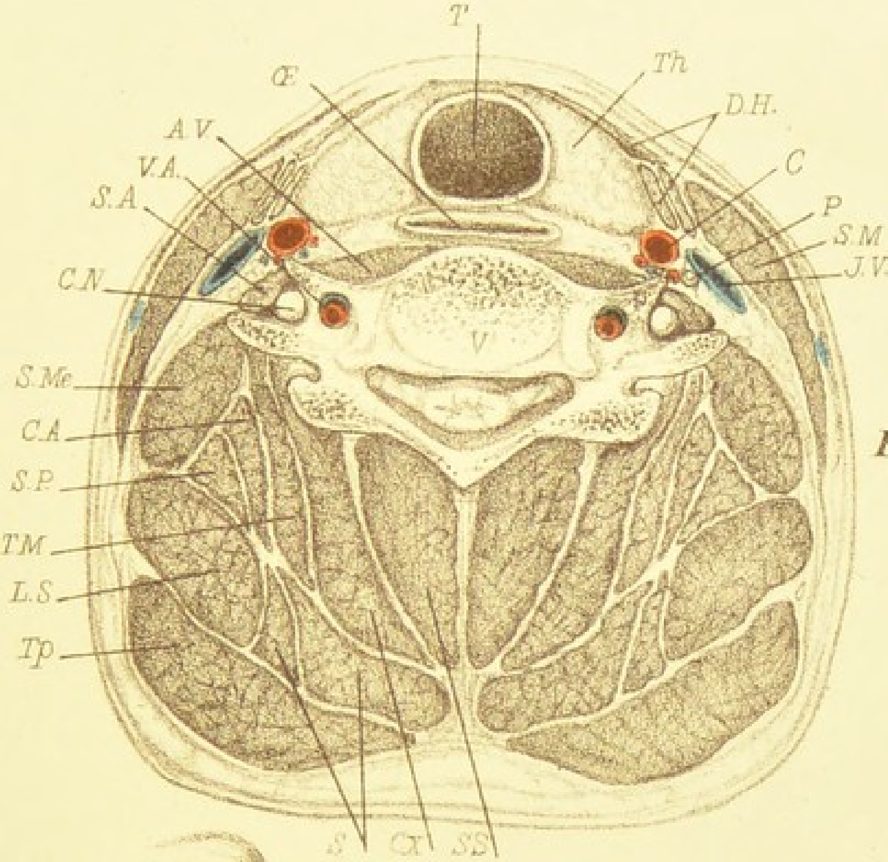
PLATE XXV.

FIG. 1.—*Lateral Aspect of the Neck.* The skin, superficial and deep fascia, have been removed; the sterno-mastoid (*S.M.*) and internal jugular vein (*J.V.*) drawn backwards, in order to expose the common carotid artery (*C.*) and descendens noni nerve. *S.H.* Sterno-hyoid. *O.H.* Omo-hyoid. *T.H.* Thyro-hyoid. An arterial branch of the superior thyroid is seen lying on the thyro-hyoid.

FIG. 2.—*Transverse Section of the Neck at the level of the Thyroid Isthmus.* *V.* Cervical vertebra. *T.* Trachea. *Th.* Thyroid gland. *D.H.* Depressors of the hyoid bone. *C.* Carotid artery. *J.V.* Internal jugular vein. *SM.* Sterno-mastoid. *P.* Vagus nerve. *Œ.* Œsophagus. *A.V.* Anterior vertebral muscles. *V.A.* Vertebral artery. *S.A.* Scalenus anticus. *C.N.* Cervical nerve. *S.me.* Scalenus medius. *C.A.* Cervicalis ascendens. *S.P.* Scalenus posticus. *T.M.* Trachelo-mastoid. *L.S.* Levator anguli scapulæ. *Tp.* Trapezius. *S.* Splenius. *Cx.* Complexus. *S.S.* Semi-spinalis.



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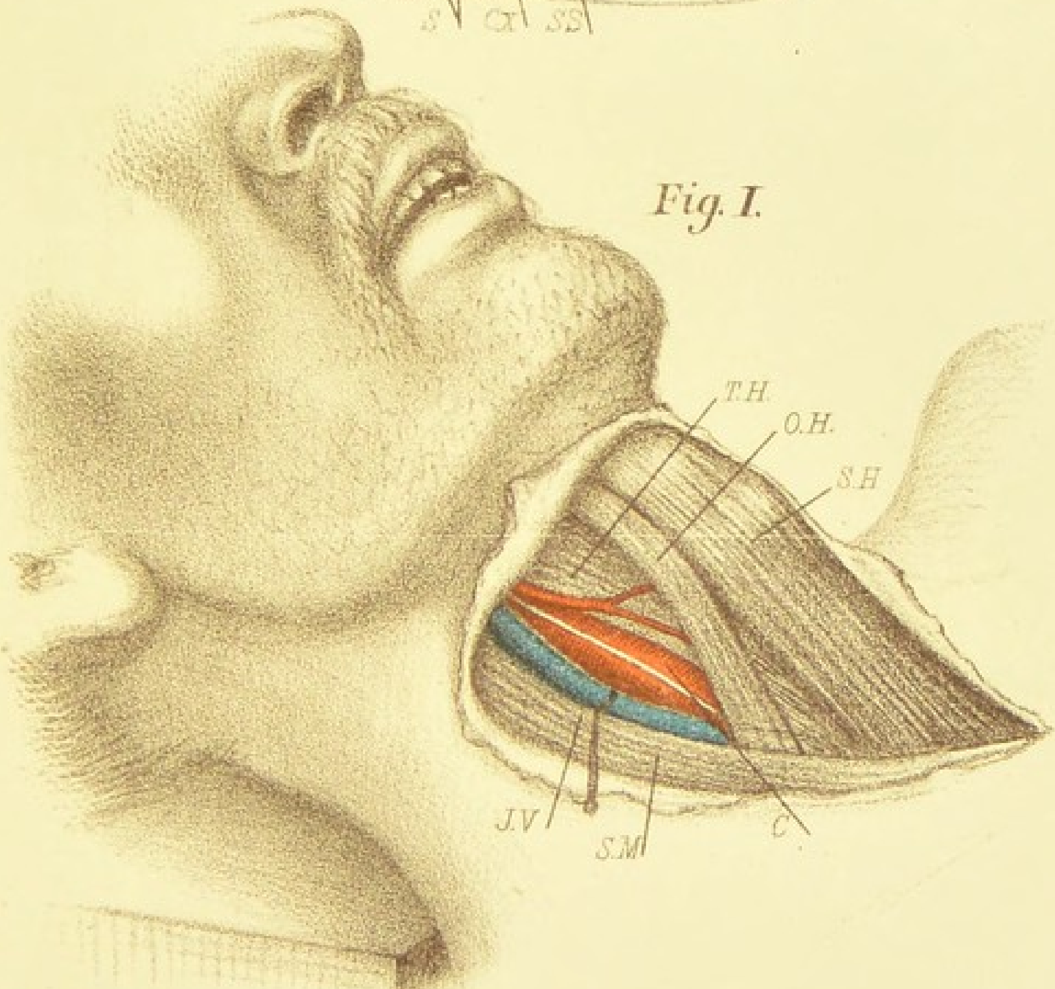

Fig. I.

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PLATE XXVI.

FIG. 1. *Transverse Section of the Face and Neck at the level of the angle of the lips.* *B.* Buccinator. *P.g.* Palato-glossus. *M.* Masseter. *I.G.* Inferior dental and gustatory nerves. *S.g.* Styloglossus. *Pt.in.* Internal pterygoid. *I.C.* Internal carotid artery. *S.H.* Stylo-hyoid. *E.C.* External carotid artery. *S.m.* Sterno-mastoid. *Dg.* Digastric. *I.o.* Inferior oblique. *T.m.* Trachelo-mastoid. *O.A.* Occipital artery. *S.* Splenius capitis. *Tr.* Trapezius. *C.* Complexus. *S.A.N.* Spinal accessory nerve. *J.V.* Internal jugular vein. *St.p.* Styloid process. *V.N.* Vagus nerve. *S.N.* Sympathetic nerve. *T.* Tonsil. *P.P.* Palato-pharyngeus. *U.* Uvula. *S.p.* Stylo-pharyngeus. *V.A.* Vertebral artery. *R.m.* Rectus capitis posticus major.

FIG. 2.—*Vertical Transverse Section of the Tongue, Lower Jaw, and Hyoid Bone.* *G.hg.* Genio-hyoglossus. *T.h.* Thyro-hyoid. *H.b.* Hyoid bone. *H.g.* Hyoglossus. *M.h.* Mylo-hyoid. *H.* Hypoglossal nerve. *L.* Lingual or Gustatory nerve. *L.a.* Lingual artery.

This drawing illustrates the position of the mylo-hyoid muscle; the submaxillary gland lying superficial to and beneath the mylo-hyoid; the facial artery piercing the superficial portion of the gland; the large nerves lying superficial to the hyoglossus; the lingual artery beneath the hyoglossus, between that muscle and the genio-hyoglossus.

Fig. 2.

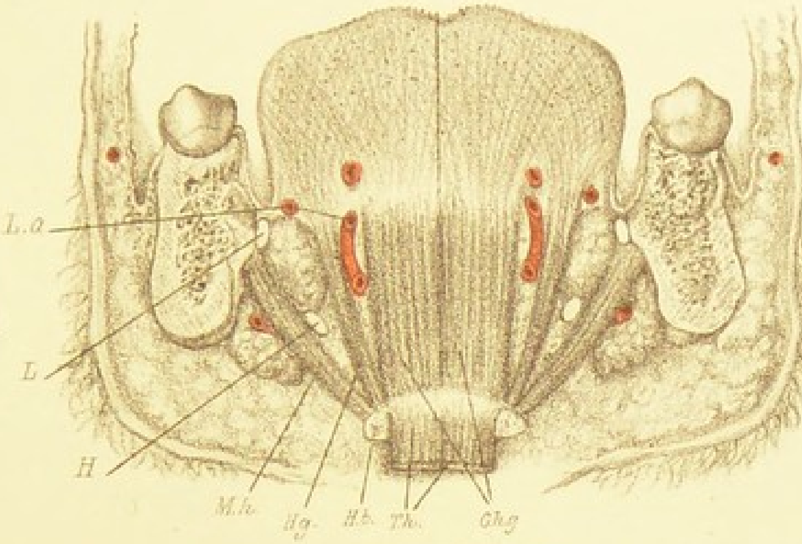

Fig. 1.

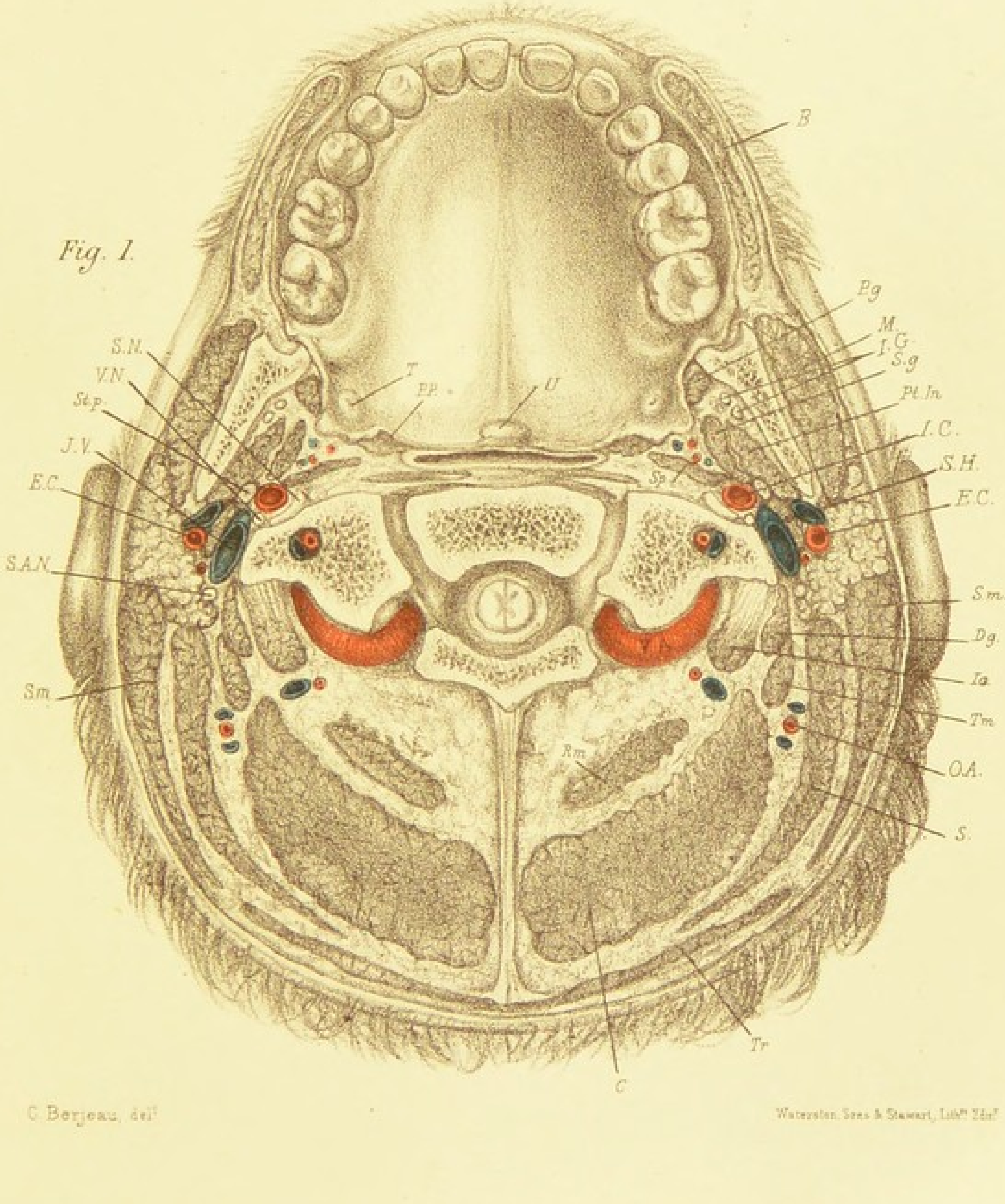

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PLATE XXVII.

Fig. 1.—*Dissection of the Posterior Triangle of the Neck.* The shoulder is depressed; skin, superficial and deep fascia removed.

S.M. Sterno-mastoid.

S.A. Scalenus anticus.

S. Subclavian artery.

N. Nervous cords of brachial plexus.

O.H. Omo-hyoid.

S.P. Scalenus posticus.

T.C.A. Transversalis colli artery.

E.J.V. External jugular vein.

Fig. 2.—*Dissection of the Root of the Neck on the right side.* The shoulders are depressed, and the head thrown back. The skin and fascia are removed. The sterno-mastoid, sterno-hyoid, and sterno-thyroid, cut away from their thoracic attachments. The inner third of the clavicle (*C.*), is also removed. *S.* Sternum. *R.I.V.* Right innominate vein. *In.* Innominate artery. *S.M.* Sterno-mastoid. *C.C.A.* Common carotid artery. *S.A.* Subclavian artery. *I.J.V.* Internal jugular vein. *P.N.* Pneumogastric nerve. *S.V.* Subclavian vein.

Fig. I

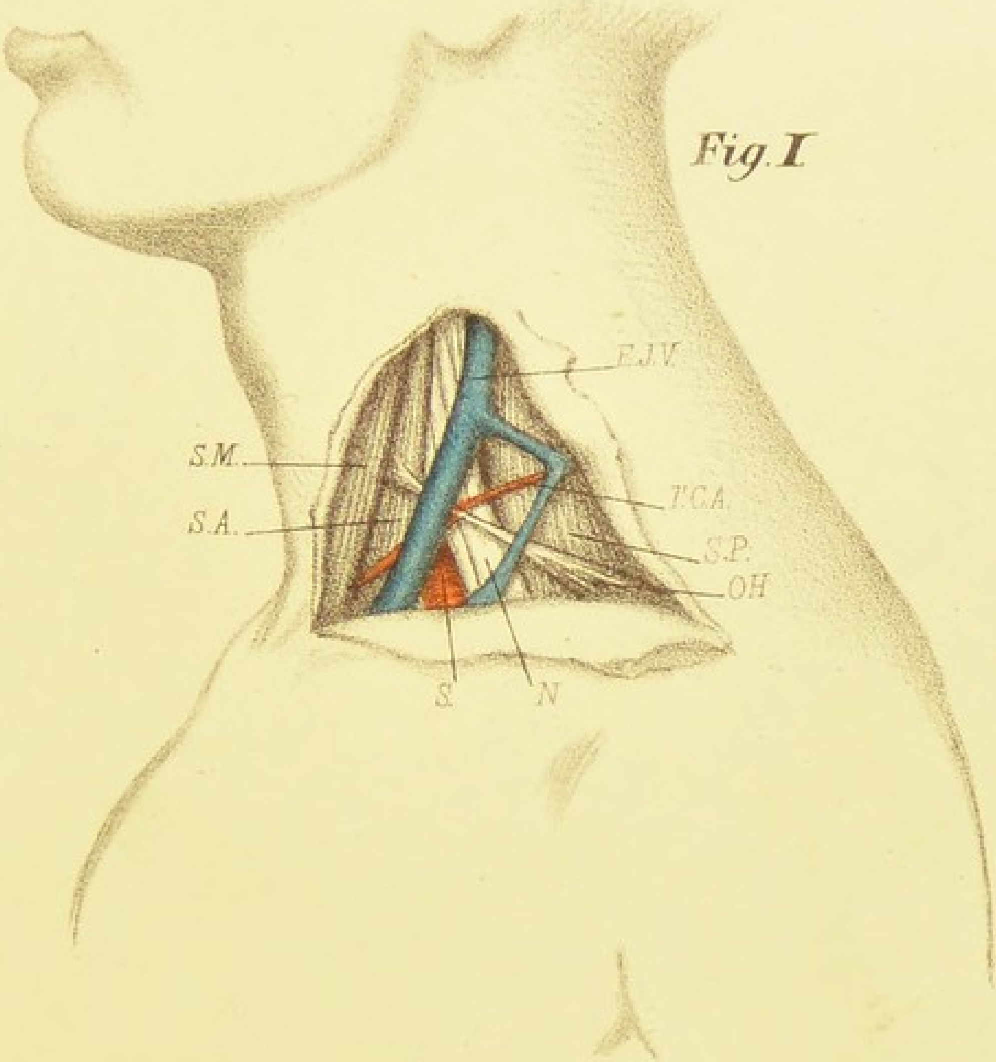

Fig. 2.

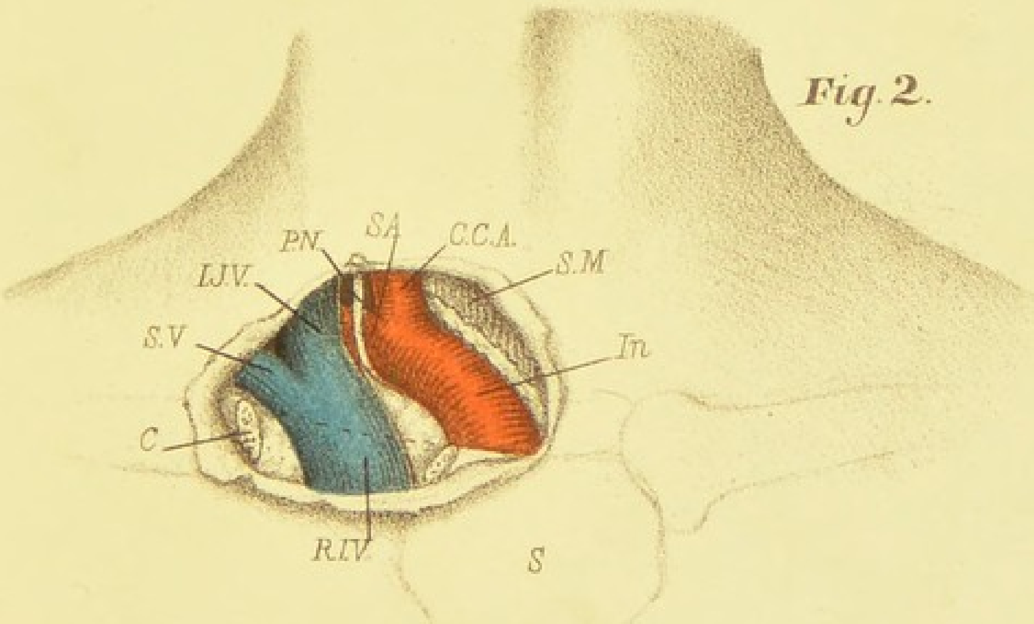

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PLATE XXVIII.

FIG. 1.—*External Anatomy of the Middle Line of the Neck.*

H. Hyoid bone.

T.C. Thyroid cartilage.

C. Cricoid.

I.T. Isthmus of the thyroid body.

Tr. Trachea.

FIG. 2.—*Dissection of the Middle Line of the Neck.* Skin, superficial and deep fascia removed; the depressors of the hyoid bone (*D.H.*) drawn aside.

T.H.M. Thyro-hyoid membrane.

T.C. Thyroid cartilage.

C.T.M. Crico-thyroid membrane, across which the small crico-thyroid artery runs.

C.T. Crico-thyroid muscle.

T.I. Isthmus of the thyroid body.

I.A. Innominate artery, which is here seen unusually high above the manubrium sterni.

T. Trachea, with deep thyroid veins running downwards to join the right innominate vein.

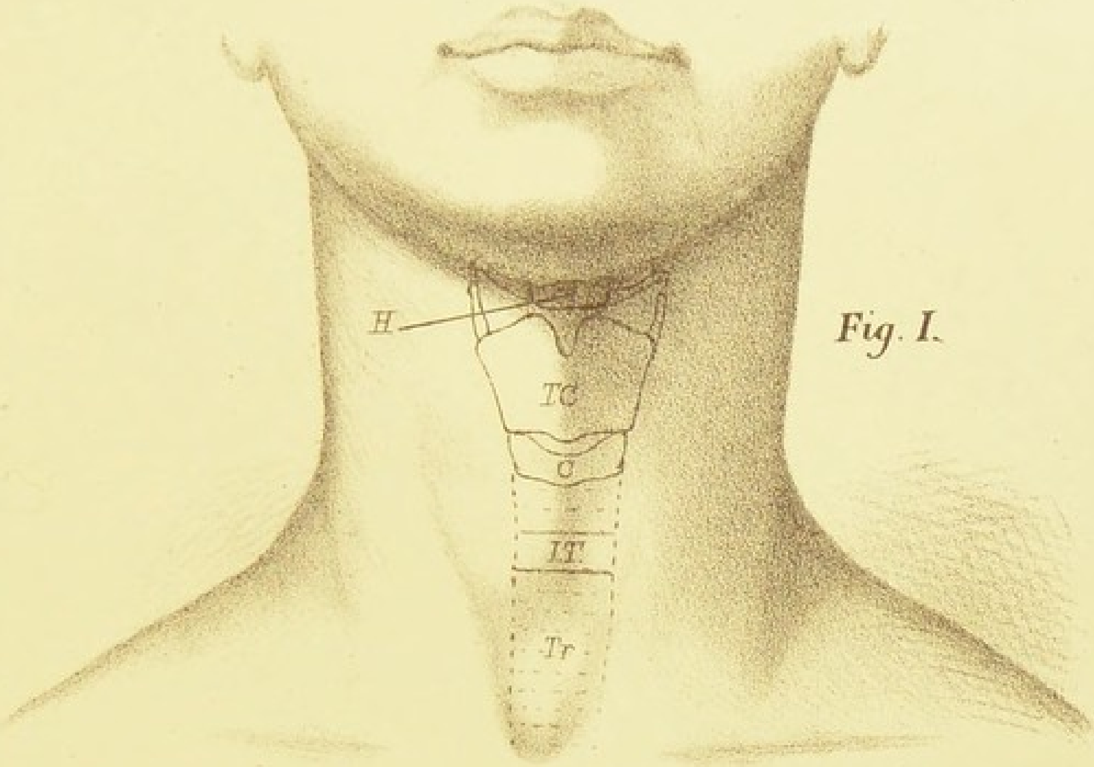

Fig. I.

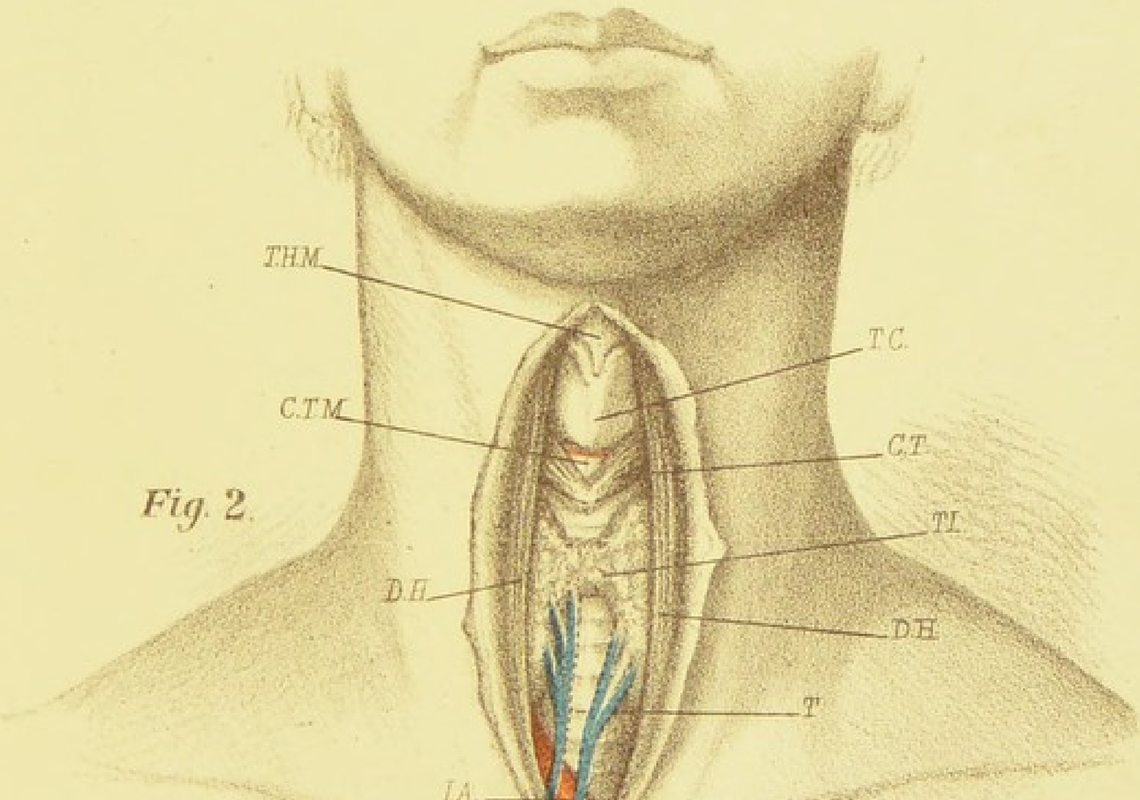

Fig. 2.

PLATE XXIX.

Mesial antero-posterior Section of the Head and Neck, and upper part of Thorax. The subject was a female child about two years old. After being injected with Mr. Stirling's preservative fluid, the arteries were injected with lard, and the body hardened in spirit. The section was made with a long amputating knife. *P.* Pharynx. *E.t.* Eustachian tube. *I.D.* First dorsal vertebra. *Thy.* Thyroid cartilage. *Cr.* Cricoid cartilage. *I.Thy.* Isthmus of the thyroid body. *D.h.* Depressors of the hyoid bone. *I.a.* Innominate artery. *L.I.v.* Left innominate vein. *A.* Aorta. *T.* Thymus. *L.* Left lung. *R.A.* Right auricle. *L.A.* Left auricle. *R.P.A.* Right pulmonary artery. *Œ.* Œsophagus. *D.a.* Descending aorta. *F.c.* Falx cerebri.

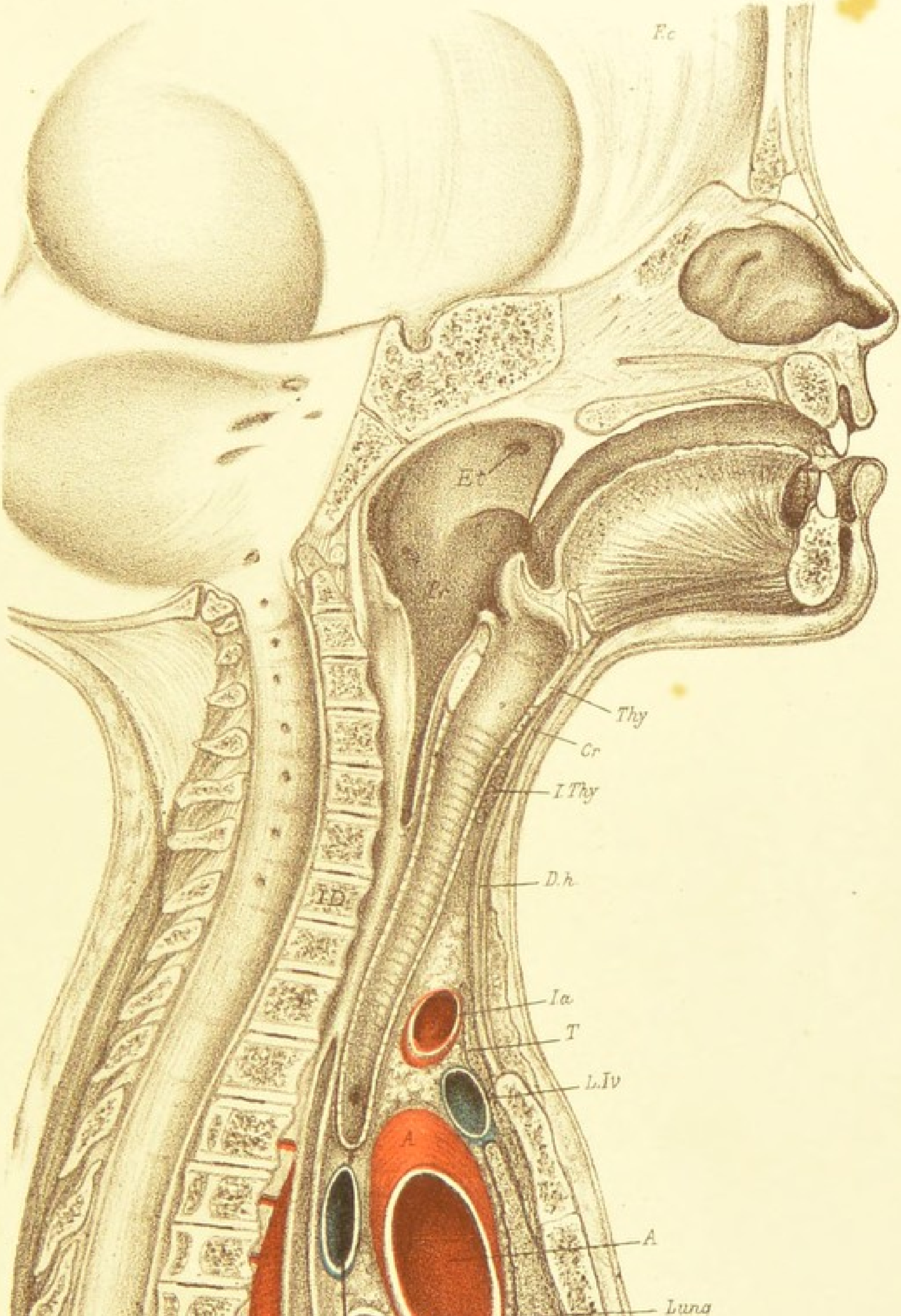

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PLATE XXX.

FIG. 1.—*Diagram of the principal Cervical, Cranial, Thoracic, and Scapular Anastomoses.* 1. Arch of aorta. 2. Innominate. 3. Right subclavian. 4. Vertebral. 5. Inferior thyroid. 6. Transversalis colli. 7. Suprascapular. 8. Superior intercostal. 9. Deep cervical. 10. Intercostal. 11. Internal mammary. 12. Axillary. 13. Thoracic branches of axillary. 14. Common carotid. 15. Internal carotid. 16. External carotid. 17. Superior thyroid. 18. Lingual. 19. Facial. 20. Temporal. 21. Occipital. 22. Princeps cervicis. 23. Posterior scapular. 24. Subscapular. 25. Dorsalis scapulæ.

FIG. 2.—*Diagram of the Anastomoses of Shoulder, Upper Arm, and Elbow.* 1. Axillary. 2. Thoracic axis. 3. Subscapular. 4. Anterior circumflex. 5. Posterior circumflex. 6. Brachial. 7. Superior profunda. 8. Inferior profunda. 9. Anastomotic. 10. Common interosseous. 11. Radial. 12. Ulnar. 13. Anterior interosseous. 14. Posterior interosseous. 15. Interosseous recurrent. 16. Radial recurrent. 17. Anterior ulnar recurrent. 18. Posterior ulnar recurrent.

FIG. 3.—*Diagram of the Anastomoses of Carpus and Hand, antero-posterior mesial section.* 1. Superficial palmar arch. 2. Deep palmar arch. 3. Anterior carpal arch. 4. Posterior carpal arch. 5. Anterior interosseous. 6. Posterior interosseous. 7. Digital arteries. This diagram illustrates the inutility of ligaturing the radial and ulnar arteries for wounds of the palm. The interosseous arteries communicate with the carpal arches, which in their turn send branches forward to the deep arch.

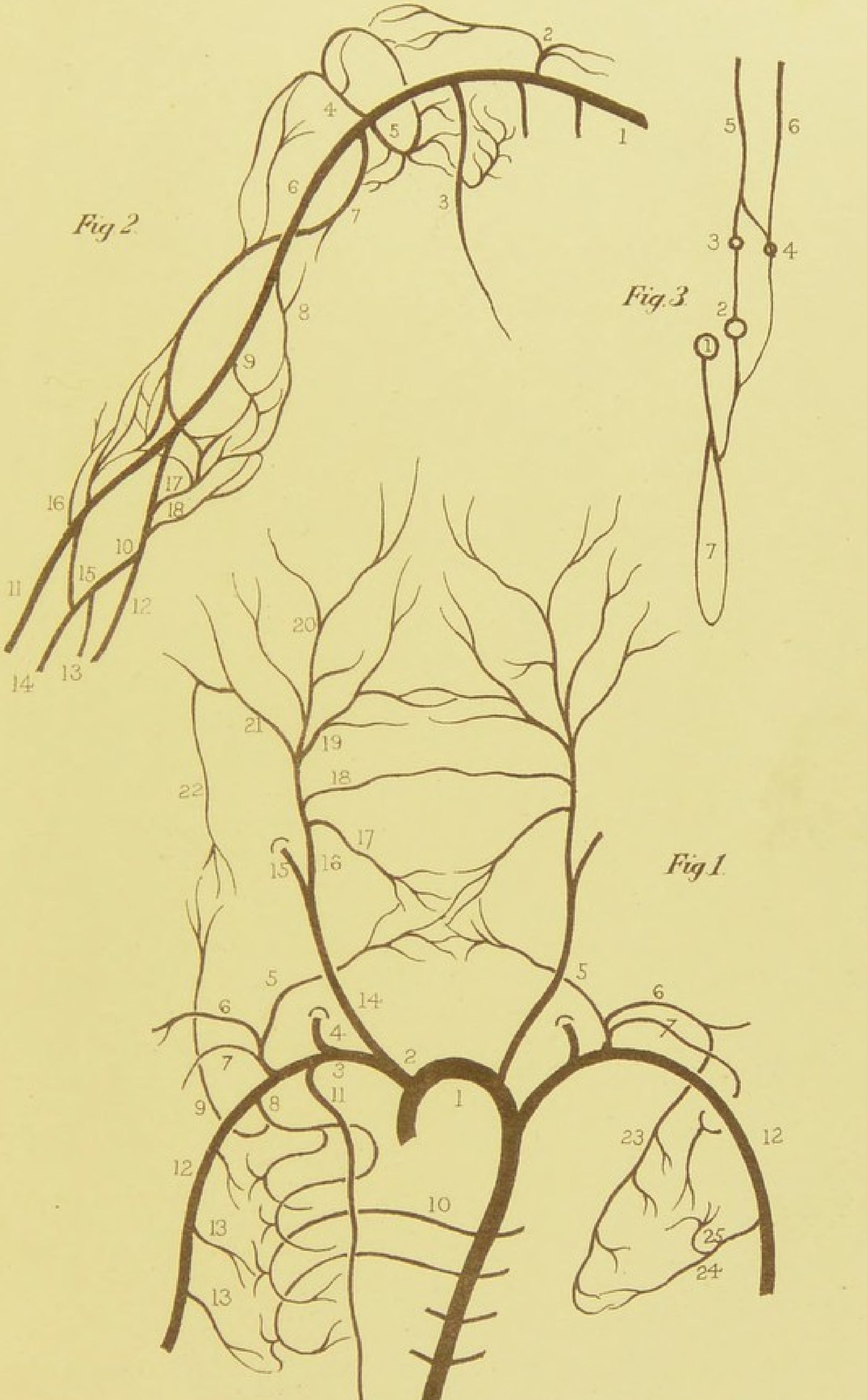

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PLATE XXXI.

FIG. 1.—*Diagram of the Abdominal, Pelvic, and Femoral Anastomoses.* 1. Abdominal aorta. 2. Superior mesenteric. 3. Colica media. 4. Colica dextra. 5. Inferior mesenteric. 6. Colica sinistra. 7. Sigmoid branches. 8. Common iliac. 9. Sacra media. 10. Lumbar. 11. Deep epigastric. 12. Ilio-lumbar. 13. Internal iliac. 14. Lateral sacral. 15. Superior hæmorrhoidal. 16. Pudic. 17. Ischiatic. 18. Obturator. 19. Gluteal. 20. Deep circumflex ilii. 21. Common femoral. 22. Deep femoral. 23. Descending branch of external circumflex. 24. Ascending branch. 25. Internal circumflex.

FIG. 2.—*Diagram of Anastomoses in Femoral Region.* 1. Common femoral. 2. Profunda femoris. 3. External circumflex. 4. Descending branch. 5. Internal circumflex. 6. 6. 6. Perforating branches. 7. Anastomotica magna. 8. Popliteal. 9. External superior articular. 10. Internal superior articular. 11. External inferior articular. 12. Internal inferior articular. 13. Posterior tibial. 14. Anterior tibial. 15. Peroneal. 16. Recurrent branch of anterior tibial.

FIG. 3.—*Diagram of Parietal Abdominal Anastomoses.* 1. Abdominal aorta. 2. Internal mammary. 3. Musculo-phrenic. 4. Phrenic. 5. Supra-renal. 6. Renal. 7. Lumbar. 8. Common iliac. 9. Deep epigastric. 10. Ilio-lumbar. 11. Deep circumflex ilii. 12. Obturator. 13. Internal iliac. 14. External iliac.

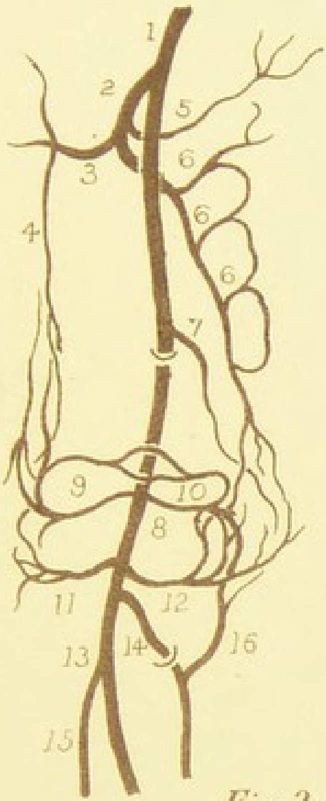

Fig. 2

Fig 1

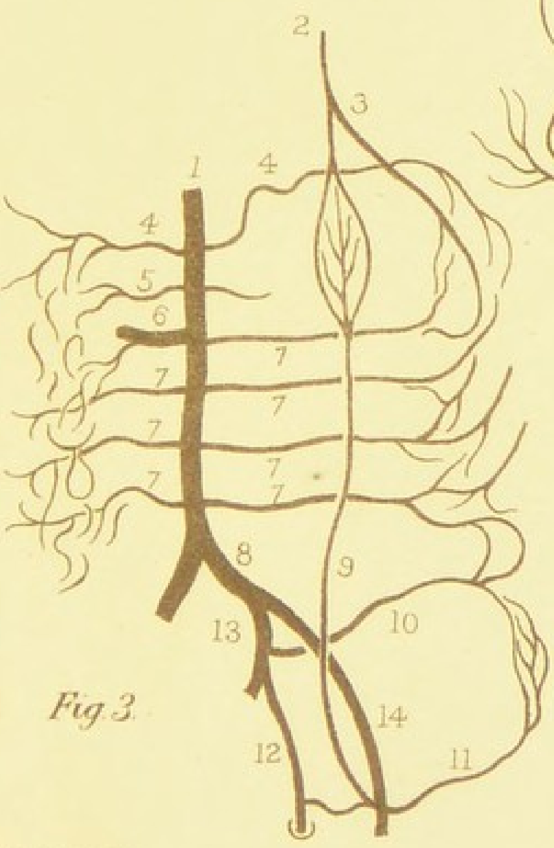

Fig. 3.