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Philips' Anatomical Model.

A Pictorial Representation of the Human Frame and its Organs.

WITH DESCRIPTIVE TEXT BY DR. SCHMIDT.

ENGLISH EDITION BY

WILLIAM S. FURNEAUX,

AUTHOR OF "ANIMAL PHYSIOLOGY," "THE OUTDOOR WORLD," ETC.

LONDON:

GEORGE PHILIP & SON, 32, FLEET STREET, E.C.;

LIVERPOOL: 45 TO 51, SOUTH CASTLE STREET.

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E. O. SCHMIDT (189?)

Eduard Oskar

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PREFACE.

EVERYONE who has undertaken the task of teaching young pupils the structure of the human frame and the arrangement of its organs has undoubtedly felt the insufficiency of ordinary diagrams and sketches; for it is impossible to give, by the use of such aids alone, a correct idea of the positions and relations of parts.

The use of plaster models enables us to surmount this difficulty, but even here we are at a disadvantage; for such models, being expensive, are to be handled by the teacher alone, with the result that very few are able to look into the structure closely at one time.

In this little work by Dr. Schmidt an admirable attempt has been made to give the readers a pictorial representation of the human body and its organs, such as may be examined and turned over by the youngest students; and, at the same time, to supply a simple description of its structure and functions.

In preparing an English edition of this useful book, I have made no substantial alterations in the translation, but have simply checked the references, made such changes in the order of the text and in the wording as seemed to me essential, and have introduced a Table of References to the anatomical model.

W. S. F.

CONTENTS.

THE SKELETON.

[See Plate II. of Model.]

The bony skeleton forms the rigid structure or framework upon which the human body is built up. The bones of which it consists may be divided into three groups: those of the **skull**, the **trunk**, and the **limbs**.

A. BONES OF THE SKULL.

The **skull** consists of twenty-two bones, which, with the exception of the lower jaw, fit closely into one another, forming a compact hollow case enclosing the brain and the organs of sense. Of these, eight form the **cranium** or **brain-case**, and the remaining fourteen belong to the **face**.

The bones of the cranium consist of flat plates, fitting one into the other by means of irregular, tooth-like edges.

The **cranium** consists of two pairs of bones—the **parietal** (7) and the **temporal** (5); and four others—the **occipital** (Plate V. 3), the **sphenoid** (Plate V. 4), the **frontal** (Plate II. 1), and the **ethmoid**. The under surfaces of the parietal and temporal may be seen in Plate V. (2 and 1). The ethmoid forms part of the inner walls of the eye-sockets (Plate II. 8).

The **face** consists of six pairs of bones—the **superior maxillary** or **upper jaw** (Plate II. 2), the **malar** or **cheek bones** (Plate II. 6), the bones of the **palate**, the **nasal bones** (Plate II. 4), the **lachrymal** or **tear bones**, which form part of the inner walls of the eye-sockets, and the **inferior turbinated** bones of the nasal cavity; and two others—the **vomer**, which divides the cavity of the nose into right and left portions, and the **inferior maxillary** or **lower jaw**, which forms movable joints with the temporal bones.

In the superior and inferior maxillary bones are fixed thirty-two teeth, each of which consists of a very hard substance called **dentine**, surrounding and protecting a very soft pulp.

The sixteen teeth of each jaw consist of four **incisors** or **cutting teeth**, two pointed **canines**, four **bicuspids** or **pre-molars**, each having two ridges, and six **molars** or **grinding teeth**, each with three or more roots.

B. BONES OF THE TRUNK.

The bones of the body or trunk consist of the **vertebræ**, the **breast-bone**, and the **ribs**.

The **vertebræ**, taken together, form the **back-bone**, **vertebral column**, or **spinal column** which is the principal support of the body. They may be divided as follows:—

1. Seven **cervical** or **neck vertebræ**, the topmost of which, called the **atlas**, supports the head. In Plate II. only the three lowest of these are visible (5*c*–7*c*), but in Plate V. the three upper may be seen (1*c*–3*c*).
2. Twelve **dorsal vertebræ** (Plate II. 1*d*–XII*d*). Most of these are hidden by the breast-bone.
3. Five **lumbar vertebræ** (Plate II. I*l*–V*l*).
4. The **sacrum** (*S*) and the **coccyx** (*C*).

On Plate II. are shown, between the vertebræ, what are known as the **intervertebral cartilages**, consisting of flat pads of gristle, which unite the bones, and give the spinal column its elasticity.

The **breast-bone** (*st*) is situated in the front portion of the trunk, opposite the spinal column, and its sides are united to the cartilaginous ends of the first seven ribs.

The **ribs** (1*r*–12*r*) are twelve pairs of bones connecting the spinal column with the breast-bone. For the sake of clearness, the back portions have been indicated only in the case of the first three pairs. Each rib consists of a curved bony portion, and a softer piece of cartilage connecting it with the breast-bone.

The cartilages of the upper seven pairs extend direct to the breast-bone, and these ribs are therefore called **true ribs.** The other five pairs are known as **false ribs.** The eighth, ninth, and tenth are each connected with the cartilage of the next above it; but the ends of the last two pairs (11*r* and 12*r*) are quite free.

C. BONES OF THE UPPER LIMBS.

These consist of four movable and connected parts: the **shoulder,** the **upper arm,** the **forearm,** and the **hand.**

The bones of the shoulder are the **collar-bone** (clavicle) and the **shoulder-blade** (scapula).

The collar-bone (*cl*) is a strong curved bone which forms the connection between the upper limbs and the trunk, passing from the shoulder-blade to the breast-bone.

The **shoulder-blade** (*sc*)—a flat, broad bone the shape of a triangle—is situated on the back surface of the chest, and is articulated on one side with the collar-bone, and on the other with the upper arm, by means of strong ligaments.

The upper arm or **humerus** (*h*) fits by means of its ball-shaped, thick upper end or head into a cavity in the shoulder-blade.

The interior of this cavity and the exterior of the ball-shaped head are covered with a thin layer of cartilage, and a membrane from which a slimy fluid is continually exuding. By means of this fluid the movements of the joint are greatly facilitated. This is the case with all the movable joints of the body. In addition to this they are also surrounded by fibrous bands known as **ligaments,** in order to lessen the risk of dislocation.

The lower end of the upper arm is also rounded, and forms the **elbow-joint** with the two bones of the forearm. These two bones are known as the radius (*r*) and the ulna (*u*), and their lower ends are articulated with the hand.

The bones of the hand may be divided into the **carpal bones** (*w*), consisting of eight small bones, arranged in two rows, and bound together by strong ligaments; the five **metacarpal bones** (*m*), passing through the palm of the hand; and the **finger bones,** of which the thumb has two and the other fingers three. The carpal bones, together with the lower ends of the bones of the forearm, form the wrist.

FIG. 1.—BONES OF THE LOWER LEG AND FOOT.

D. BONES OF THE LOWER LIMBS.

These include the bones of the **hip** (*H*), the **thigh** (*f*), the **calf,** and the **foot.**

The tops of the two hip-bones are connected behind with the **sacrum** (*S*), at the lower end

of which is the **coccyx** (*C*). These all form together a basin-like cavity, the **pelvis**, in which the organs of the abdomen are supported. There is a socket on the lower outside portion of each hip-bone, in which the upper rounded extremity of the thigh-bone moves.

The thigh-bone (*f*), which is very strong, has the upper part bent at an angle to the lower; and on this the rounded head, forming the joint, is situated.

The lower part terminates in two knobs (*kn*, Fig. 1), partially covered with gristle, with which the bones of the calf are articulated.

These bones are called the **tibia** or **shin-bone** (*t*) and the **fibula** or **splint-bone** (*f*), and form, with the thigh-bone, the **knee-joint**, which is protected in front by the little round **knee-cap** or **patella** (*pa*).

The lower ends of the shin-bone and the splint-bone form the joint to which the foot is attached.

The **foot** is composed of seven **tarsal bones**, five **metatarsal** or **instep bones** (*mf*), and the bones of the toes.

The largest of the tarsal bones projects backward and forms the **heel** (*ca*), and the top one (*ta*) forms the **ankle-joint** with the two calf-bones.

The big toe, like the thumb, has two bones; while the others have three each.

THE MUSCLES.

[See Plates III. and IV. of Model.]

The **muscles** are the active organs, by means of which the movements of the human body are effected. They form what is known as the **flesh.**

By means of the nerves, by which they are controlled, they may be contracted or relaxed.

Muscles consist of bundles of fibres, covered with a whitish skin or membrane. The ends of a muscle terminate in **tendons**, by means of which they are fastened to the bones.

As the muscles have a great deal of work to perform, they rapidly waste away; therefore they are particularly well provided with blood-vessels, by means of which the used-up particles are removed, and fresh nourishment supplied to make good the loss.

Most of the muscles are in the shape of spindles; but some, such as those on the breast, are broad and flat. They are mostly placed in layers, one on the top of another.

MUSCLES OF THE FACE AND HEAD.

The muscles of the face have two important functions to perform: viz., the formation of the different expressions of the face, such as those of laughter, crying, anger, joy, etc.; and the control of the movements of the mouth, eye-lids, nose, etc.

Those of special interest are:—

1. The **temporal muscle** (Plate III. 1), which lifts the lower jaw in the act of biting.
2. The muscle of the forehead (**occipito-frontalis**, Plate III. 2), by means of which the brow is contracted or wrinkled.
3. The **orbicularis muscle** (3), by which the eye-lids are closed.
4. The muscles which raise the upper lip and control the corners of the mouth (4)
5. The muscles which draw down the lower lip (5).

Of the neck muscles the most important are the **sterno-mastoid** (6), by which the head can be turned or nodded.

The muscles numbered 7 move the shoulder-blade, and are known as the trapezius muscles.

The **muscles of the breast** lie in three layers, one on top of another. Some are shown on Plate III., and others on Plate IV.

On Plate III. the **great pectoral** (9) forming the outer layer is visible. This is a large muscle, extending from the chest to the upper arm, and forming the front wall of the arm-pit. It is triangular in form, and is principally instrumental in bringing the arm to the side of the body. This may easily be seen by making the movement.

The second layer contains the **small pectoral muscle** (Plate IV. 1), which draws the shoulder down and lifts the ribs; also the **serratus magnus** (Plate IV. 2 and Plate III. 10). This latter muscle commences with eight or nine points on the upper eight or nine ribs; hence the term **serratus**, which means saw-like. It is fastened to the inner surface of the shoulder-blade, and causes that bone to be drawn forward.

The third layer of breast muscles consists of the **external** and **internal intercostals** (Plate IV. 3 and 4), which occupy the spaces between the ribs. The **external** (3) run obliquely downwards and forwards; and the **internal** downwards and backwards. Both sets of intercostal muscles assist in the movements of respiration; the external raising the ribs, and the internal depressing them.

MUSCLES OF THE SHOULDER.

The most important of these is the **deltoid muscle** (Plate III. 8), which is fastened to the upper arm and serves to raise it.

MUSCLES OF THE UPPER ARM.

In the front of the upper arm is situated the strong **biceps muscle**, which starts from the shoulder-blade at two points (Plate IV. 5), and is fastened to the radius of the forearm near the elbow-joint (Plate III. 13). It is very powerful in bending the arm, and is the muscle most commonly brought into activity during manual exercises. On Plate IV. 6 is shown another muscle that assists in bending the arm.

At the back of the upper arm the external muscles are the ones principally called into play; and of these the powerful **triceps muscle** may be readily felt in extending one's own arm.

MUSCLES OF THE FOREARM.

The muscles here are arranged in three layers, one over the other.

Those of the outer layer, visible in Plate III., and distinguished collectively by the number 14, turn the forearm inwards; and the tendons attached to them (Plate III. 15) help us to close the hand.

The second layer includes the muscle numbered 7 on Plate IV. The fleshy substance of this muscle divides into four spindle-shaped portions, each of which terminates in a tendon. The four tendons pass under the ring-like ligament of the wrist (Plate III. *H* and Plate IV. *H*), into the hollow of the hand, and then up the four fingers, which they help to bend.

The thumb has its own particular bender. The thumb and little finger have also special muscles to themselves.

MUSCLES OF THE ABDOMEN.

The muscular covering of the abdomen or belly is formed of both long and broad muscles.

The long muscles are situated towards the front, and the broad ones over the sides and back.

The long straight muscles (**recti abdominis**) of the abdomen may be seen in Plate IV.

(11 *a*), cut across. They are surrounded by a strong fibrous membrane, the back portion of which may be seen in Plate IV. (11), where its curved lower extremity is plainly shown. The front portion, with its sinewy oblique stripes, is shown in Plate III. (12).

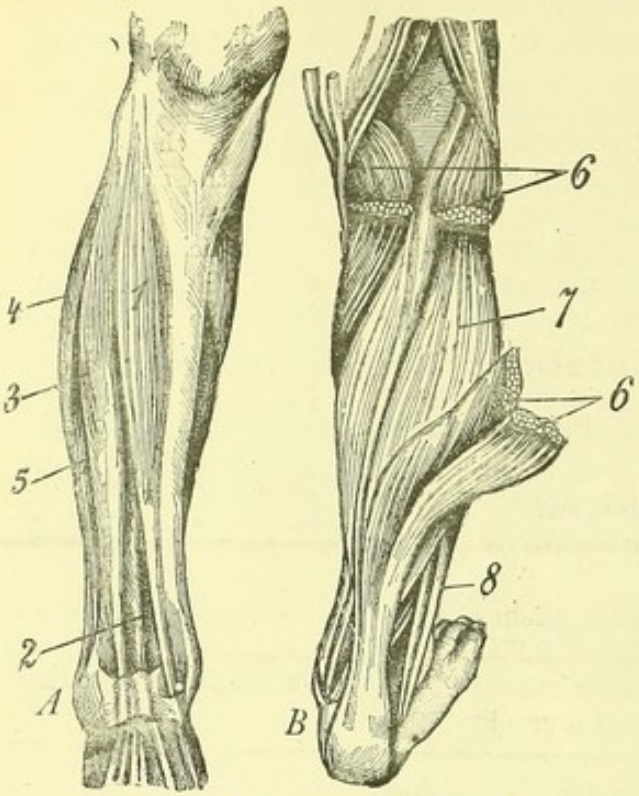


FIG. 2.—THE MUSCLES OF THE LEG.

A.—From the front.
B.—From behind.

The broad muscles are the **external oblique** (Plate III. 11), the upper portion of which fills the spaces between the teeth of the **serratus magnus** (Plate III. 10); the **internal oblique**, which lies beneath it; and, still deeper, the **transverse muscle** (Plate IV. 10).

MUSCLES OF THE THIGH.

The muscles numbered 16 on Plate III. serve partly to turn the leg inwards, and partly to stretch it out. The muscles which extend or straighten the leg are joined together at the knee-cap by a strong tendon. The deeper muscles, shown on Plate IV. (9), serve to draw the thighs together.

MUSCLES OF THE LEG.

The accompanying diagrams show the principal of these. In Fig. 2 A we see the muscle that covers the front of the shin-bone, and raises the foot (1), the long tendon that lifts the great toe (2), the tendon that moves the other four toes (3), and the long and short calf muscles (4 and 5), which move the foot.

In Fig. 2 B the calf muscles of the back of the leg are shown. The outer layer is formed by the powerful double muscle (6) which raises the heel. This is cut across and moved aside in order to show the long (7) and short (8) muscles, the front surfaces of which have already been noticed in Fig. 2 A.

THE HEART AND BLOOD-VESSELS.

[SEE PLATES I. AND V. OF MODEL.]

THE heart (*H*) is situated in the front of the chest, between the lungs, and is surrounded by a membranous pouch-like skin.

The wall of the heart is formed of powerful muscles, which contract and relax at regular intervals.

The interior is divided by a partition into two cavities, right and left, which have no direct means of communication with each other.

Each half is again divided into two chambers: one, a small one, called the **auricle**; and the other, a larger one, called the **ventricle**.

On Plate V. two sections of the heart are shown in order to display the interior; and there you will see the four cavities indicated as follows:—

Right auricle = *RA*.
Right ventricle = *RV*.
Left auricle = *LA*.
Left ventricle = *LV*.

The auricles overlap the ventricles externally, and are named from their resemblance to an ear. The one on the right side is shown clearly on Plate I. (*RA*).

The activity of the heart may be gathered from the fact that in one minute it alternately contracts and expands about sixty times.

When it expands, blood flows into it; and when it contracts, this blood is expelled again.

From the left ventricle the blood is forced into the main artery of the body, known as the **aorta** (*A*).

This artery splits into three smaller ones: one, on the right, called the **innominate**; and two on the left, called respectively the **left subclavian** (*As*) and the **left carotid** (*c*) arteries.

The innominate artery is partly hidden on the plates, but it divides into two vessels, called the **right subclavian** (*As*) and the **right carotid** (*c*).

Each of the carotid arteries divides into an outer and an inner branch.

The subclavian artery is continued on to the armpit, where it is known as the **axillary artery** (*Aa*); and then on to the upper arm, where it is called the **brachial artery** (*BA*).

It branches into two portions at the elbow. One branch follows the radius, and is termed the **radial artery** (*Ar*); the other follows the ulna, and is called the **ulnar artery** (*Au*). They both unite again in the palm of the hand, forming the **palmar arch** (*Arc*), from which the arteries of the fingers start.

Returning to the aorta (*A*), we find that, after sending off arteries to the lungs, it passes down the thorax or chest, along the spinal column (see Plate V.), through a perforation in the **diaphragm** (Plate I.), and then through the abdomen.

In its descent it gives off branches to the **kidneys** (Plate I. *Ra*) and other organs; and, in the lower part of the abdomen, divides into two branches—the **iliac arteries** (*Ai*).

These branches again divide into two vessels, one of which—the **internal iliac artery** (*Ii*)—supplies the organs of the pelvis; and the other—the **external iliac** (*Ie*)—conveys blood to the lower limbs.

All these arteries, coloured red on the plates, are filled with bright red blood, which spurts out with considerable force when the vessels are severed.

They all divide into smaller and smaller vessels, till at last they give rise to minute **capillaries**, which are to be found in every part of the body, with the exception of a few structures, such as cartilage, the nails, and the hair, which are bloodless.

It is through the thin walls of these microscopic vessels that nutritious particles are passed from the blood to build up the tissues, and that the waste materials of the tissues are collected up for removal.

The blood from the capillaries, which has changed in them to a dark bluish colour, is now collected up by **veins**. The smallest of these are formed by the union of capillaries, but they again and again unite as they approach the heart, forming larger and larger veins, till at last two great veins—the **vena cava superior** (*VS*) and the **vena cava inferior** (*VI*)—convey the whole of the blood into the right auricle, whence it passes at once into the right ventricle.

Thus we have seen that the blood which was forced out of the left ventricle into the arteries passes through the capillaries of all parts of the body, and returns by the veins to the right auricle. This circulation is called the **systemic circulation.**

But what becomes of this dark blood, rendered useless for the further nourishment of the system, when brought back to the heart by the veins?

It is forced from the right ventricle through the **pulmonary artery** (*Ap*) into the lungs (Plate V. 24). There these arteries divide and subdivide into smaller and smaller branches (Plate V.), which at last give rise to capillaries, just as we observed in the case of the aorta.

These capillary vessels penetrate into every part of the lungs, and surround the little air-cells at the terminations of the breathing tubes.

Both the capillaries and the air-cells have exceedingly thin walls, through which the blood

gives up carbonic acid gas—the product of the decomposition of the tissues—and takes in exchange oxygen from the air breathed in.

The blood, thus restored to a bright red colour, and rendered once more serviceable for its work in the tissues, issues from the capillaries of the lungs, and enters small veins, which unite to form the large **pulmonary veins** that lead into the left auricle.

This secondary circulation from the right ventricle, and through the vessels of the lungs to the left auricle, is called the **pulmonary circulation.**

On Plate V. may be seen the trunk of the aorta (*A*) leading from the **left ventricle** (*LV*), the junction of the **vena cava superior** (*VS*) with the **right auricle** (*RA*), the commencement of the **pulmonary artery** (*Ap*) at the **right ventricle** (*RV*), and the junction of the **pulmonary veins** (*Vp*) with the **left auricle** (*LA*).

Finally, we must mention the valves of the heart, of which the **tricuspid** is situated between the right auricle and right ventricle, and the **bicuspid** or **mitral** between the left auricle and left ventricle (Plate V.).

They both serve to prevent the blood from passing from ventricle to auricle, but offer no obstruction to its passage in the opposite direction.

There are also valves at the commencement of each of the two great arteries—the **aorta** and the **pulmonary artery.** These are called the **semilunar valves**, and serve to prevent the blood from passing back into the ventricles at the times when the walls of these cavities of the heart are relaxed.

THE INTERNAL ORGANS.

[See Plate V. of Model.]

The body consists of two great cavities—the **chest** and the **abdomen**; and these contain the heart, which has already been described, and the organs of respiration and digestion.

THE CHEST.

We have already seen that the renovation of the blood is carried on in the lungs by the air we breathe.

This air enters the body by means of the nose and mouth, and then reaches the **larynx** or **voice-box** (20), which is connected with the tongue by the **hyoid bone** (19). Thence it passes downwards through the **windpipe** (22) into the lungs.

The larynx is composed chiefly of cartilage, and contains the two **vocal ligaments**, which, when one is speaking, are stretched and brought close together, so that the air passing between sets them in rapid vibration.

When one is breathing quietly, the vocal ligaments are relaxed and farther apart, and allow the air a free passage.

When food or drink is being swallowed, the larynx is covered for the moment by a lid called the **epiglottis**, so as to prevent any of it entering the windpipe.

The **windpipe** or **trachea** (22) consists of a series of rings of cartilage, and is covered inside with a tender velvety skin called the **mucous membrane.**

The windpipe and larynx are partially covered by the **thyroid gland** (21), the enlargement of which is sometimes the cause of croup.

The windpipe divides into two branches in the upper part of the chest. These are called the **bronchi** (23), and they subdivide in the lungs, forming smaller air-passages **(bronchial tubes)**, which at last terminate in the air-cells already mentioned.

Between the smaller divisions of the windpipe pass the branches of the pulmonary arteries and veins.

The **lungs** (24) consist chiefly of air-vessels and blood-vessels closely interwoven with each other. They are two in number—called the right and the left—and are surrounded by a membrane (the **pleura**), which also lines the chest.

The right lung consists of three lobes, and the left of two. Both are shown cut through in Plate V., in order that the arrangement of their vessels may be seen.

When drawing in a breath, the ribs with their muscles are raised, and the diaphragm is at the same time depressed. Thus the chest is enlarged to make room for the inspired air.

When exhaling the air, the opposite movements are produced, and the chest returns to its former dimensions.

A healthy person breathes about sixteen times in a minute.

THE ABDOMEN.

The chest is separated from the abdomen by the diaphragm (18). This is a strong dome-shaped partition, starting at the sides below the ribs, and composed partly of muscle and partly of tendon.

The **œsophagus** or **gullet** (Plate V. 6), the **aorta**, and the **inferior vena cava**, all pass through perforations in the diaphragm.

On Plate V. the diaphragm is cut through the middle from right to left, in order to show the front and the back surfaces.

DIGESTION.

The body must repair the material that it uses up. This it does by the absorption of nutritious substances from the digested foods.

The chief food substances are albumen, fat, sugar, starch, and certain mineral salts.

All food substances must undergo such a change that they are rendered capable of absorption into the blood. The processes by which this is effected are together called **digestion.**

The food is first reduced to small pieces by the teeth, and mixed with the **saliva** that exudes from the **salivary glands** of the mouth. Thus it is formed into a soft pulpy mass, which is easily swallowed, and at the same time the saliva commences to turn the starchy particles into a kind of sugar.

It then passes through the **pharynx** (5) and **œsophagus** (6) into the **stomach** (7).

The **œsophagus** is a fleshy tube, running along the front of the spinal column, and through the diaphragm, as already described.

The **stomach**, which is shown cut through longitudinally in Plate V., is situated just below the diaphragm, somewhat to the left side of the body, and consists of muscular walls, lined with a smooth mucous membrane that is richly supplied with blood.

The **mucous membrane** contains countless small glands, which secrete the **gastric fluid**. It also absorbs much of the fluid constituents of the food, conducting them at once into the blood.

The **gastric fluid** acts principally on the albuminous matter, reducing it gradually to a fluid state.

The albuminous substances thus changed, together with the other constituents of the food which have not yet been acted on, are kept in constant motion by the alternate contraction and expansion of the muscular fibres of the stomach; and, after a period varying from two to six hours, the whole of the contents are passed through the outlet called the **pylorus**, into the **small intestine**—a fleshy tube, about sixty feet long, covered with a thin skin called the **peritoneum**, and lined with mucous membrane.

The first portion of the small intestine is shaped like a horse-shoe, and is called the **duodenum** (8). It receives two very important digestive fluids—the **pancreatic fluid** from the **pancreas** through the **pancreatic duct**, and the **bile** from the **liver** through the **biliary duct.**

The **liver** (17) is a large reddish-brown organ of two lobes, situated just under the right side

of the diaphragm, partly covering the stomach. It prepares from the blood a brownish-yellow bitter substance called the **bile**, which is stored in the **gall-bladder** (17 *g*, shown on the back of the liver in Plate V.) when not required for immediate use. But while digestion is going on it mingles with the contents of the duodenum, where it aids especially in the digestion of fat.

The **pancreas** (15) is situated behind the stomach, between the duodenum and the **spleen** (16). The fluid secreted by it acts in the same way as the saliva on starchy foods, and it also assists in the digestion of albuminous substances and fat.

The **spleen** is a dark brown gland, engaged in the building up of the blood.

The mucous membrane of the small intestine secretes a fluid which acts on foods much in the same way as the bile and the gastric fluid, and also envelops the undigested substances that remain, so that it is readily urged onward by the serpentine contractions of the muscular fibres in the walls of the tube.

The term **chyle** is commonly given to the contents of the small intestine.

The inner surface of the small intestine is covered with a number of little projections called **villi**, which give the mucous membrane a velvety appearance. Each villus contains a little absorbent vessel called a **lacteal**, which absorbs a milky fluid from the chyle.

The lacteals unite in the walls of the intestine, forming a system of vessels known as the **lymphatics**; and these unite with one another, forming still larger vessels, all of which at last convey their contents into a great tube which passes into the chest, and discharges the milky fluid into the left subclavian vein. In this way the chyle reaches the blood.

From the small intestine the remainder of the chyle, now considerably reduced in nourishing properties, passes into the **large intestine**, where the rest of the nutritious matter is absorbed.

The large intestine consists of the **ascending colon** (11), the **transverse colon** (12), and the **descending colon** (13). At the point where the small intestine passes into the large there is a blind pouch-like tube called the **cæcum** (10), to which is attached the worm-like **vermiform appendage.**

A valve is also situated at this junction, and the use of this is to prevent the chyle from returning after having once left the small intestine. In Plate V. the cæcum is shown in section in order to expose this valve.

At the lower end of the descending colon the large intestine forms an S-shaped curve called the **sigmoid flexure** (14), which leads into the **rectum**—the last portion of the intestines.

In the back of the abdomen lie the two **kidneys** (26), one on each side of the spinal column. These are complicated glandular organs (see the sections on Plate V.) which separate many of the used-up particles from the blood, and the waste material thus collected is conveyed in the form of urine through the **ureters** (27) into the **bladder** (28).

THE BRAIN AND NERVES.

NEARLY all parts of the human body are penetrated by **nerves**. These are delicate whitish threads, of varying thickness, which for the most part divide like the branches of a tree, and at length terminate in very fine ends that are sensitive to impressions from without.

The nerves are divided into three groups:—

1. **Nerves of the senses**—those which receive and convey impressions of light, sound, smell, and taste to the brain.
2. **Nerves of sensation**—those which receive and convey impressions of feeling, originating either from without or within the body, to the brain.
3. **Motor nerves**—these all proceed from the brain, and transmit the commands of the will to the muscles of all parts, causing them to move.

Motor nerves and nerves of sensation often run side by side, and are so much alike that it is impossible to distinguish between them.

The brain is the great nerve centre to which all sensory impressions are transmitted, and from which the commands to the muscles proceed.

The brain (Fig. 3) is surrounded by three membranes, and is contained in the skull. It consists of two principal divisions—the **greater brain** (*a*) and the **lesser brain** (*b*); the former being situated in the front and upper part of the cranium, and the latter in the back and lower part.

Each of these is further divided into a right and a left half by a deep fissure; and the upper surface of the greater brain is formed into numerous folds or convolutions with depressions between them.

Twelve pairs of nerves proceed from the under surface of the brain, and these lead respectively to the nose, eye, ear, other parts of the head, and the trunk; but the greater number of nerves pass through the cavity of the occipital bone, and down the tubular cavity formed by the spinal column, all running together as the **spinal cord** (*d*).

Between each pair of vertebræ two nerves branch off from this cord, one from each side, and run to corresponding parts of the body.

Every portion of the body has its own system of nerves—the arm, the neck, the loins, etc., each possessing one or more.

The spinal cord, like the brain, is surrounded by three membranes. Its upper portion, called the **medulla oblongata** (*c*), which penetrates the cavity of the brain, sends four pairs of nerves to certain muscles and to several of the important internal organs.

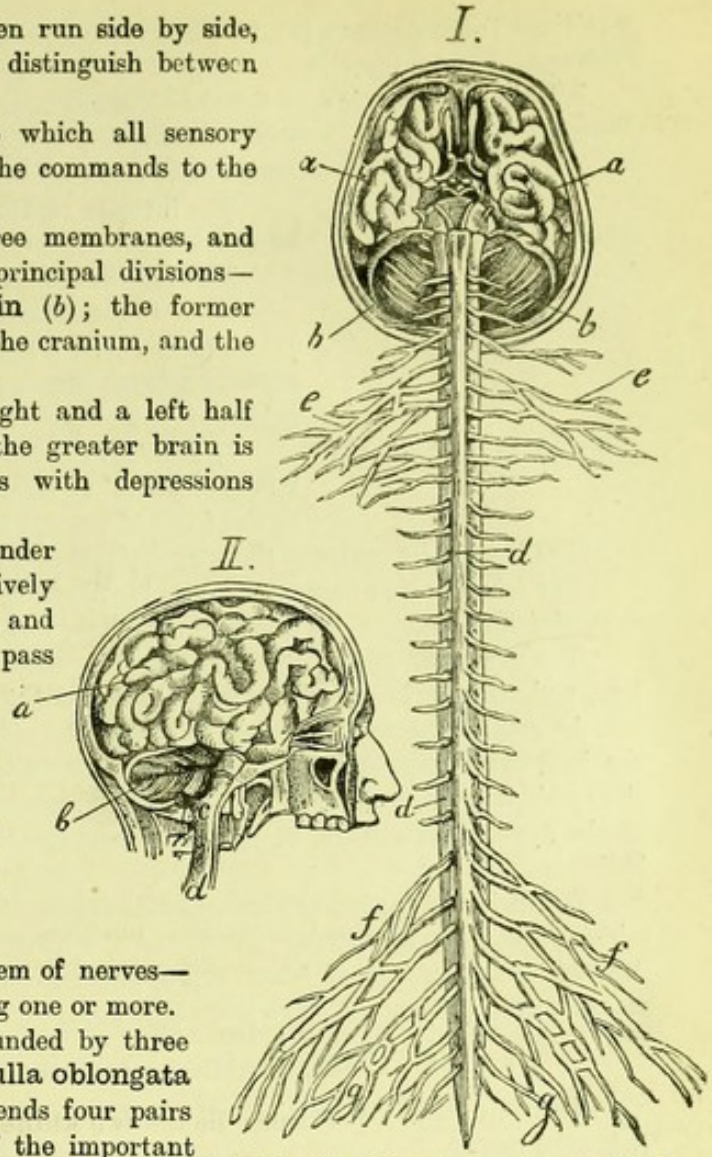


FIG. 3.—THE BRAIN AND SPINAL CORD.

ORGANS OF SENSE.

THE EYE.

THE **eye** is well protected in the bony eye-socket, which is so well lined with fat that all its movements are rendered perfectly easy.

These movements are produced by six muscles, which are fastened round the eye-ball, and any irregularity in their action causes what is known as squinting.

The **eye-lids** protect the front portion of the eye; the **eye-lashes** tend to prevent dust from falling on it; and the eye-brows prevent the perspiration from running into the eye from the forehead.

The **eye-ball** (Fig. 4) is nearly spherical in shape, and is formed of several different coats, lying one within the other.

The strongest of these coats is the outer one, called the **sclerotic coat** (a_1), which gives form and firmness to the ball. It is opaque, and shuts out all light from the sides; but continuous with

it in front is the **cornea** (*a*), which is clear and transparent, and more convex than the rest of the surface.

Within the sclerotic coat lies the **choroid coat** (*e*), in which the blood-vessels of the eye-ball are distributed; and within this is the **retina** (*f*), an expansion of the **optic nerve** (*d*), which connects the eye-ball with the brain.

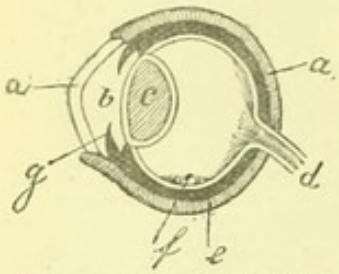


FIG. 4.—SECTION OF THE EYE.

The interior of the eye is divided by the **crystalline lens** (*c*) into two cavities, a small one in front and a larger one behind.

The lens is a semi-solid and perfectly transparent body, which is capable of slight alterations in form.

The space in front of it is filled with a watery fluid known as the **aqueous humour**, and that behind it with a transparent semi-solid substance called the **vitreous humour**.

In front of the lens there is a circular perforated screen called the **iris** (*g*); and it is this that gives the colour, generally blue or brown, to the front of the eye-ball.

The hole in its centre is the **pupil** (*b*), through which light is admitted to the interior.

The iris contains numerous muscular fibres, by means of which the size of the pupil is enlarged or diminished according as a smaller or larger amount of light strikes the eye.

The rays that pass into the eye are so refracted by the cornea, aqueous humour, crystalline lens, and vitreous humour, that small images of the objects we look at are formed on the retina

In connection with the eye we must also mention the **lachrymal** or **tear system**, which serves to keep the eye-ball moist, and, with the aid of the movements of the eye-lids, is always, as it were, cleaning the eye-ball.

It consists of the **lachrymal glands** (Plate IV. 14), which prepare the **lachrymal fluid**, and the **lachrymal canals** (15), by means of which the fluid passes into the **nasal ducts** (17), and thence into the nose.

THE EAR.

The **ear** consists of the **external, middle,** and **internal ears.**

The **external ear** comprises a cartilaginous **pinna** or wing (Fig. 5, *a*), and the **auditory canal** (*b*) leading into the middle ear. The pinna serves to collect sound-waves and reflect them into the canal; and the canal secretes the substance known as ear-wax.

Between the external and middle ears is a membranous skin called the **drum of the ear** (*c*), and this forms a complete separation between the two parts.

The **middle ear** or **tympanum** is full of air, and communicates with the pharynx by means of a semi-cartilaginous, semi-bony tube called the **Eustachian tube.** On the other side is the internal ear or **labyrinth,** shut off from the middle ear by two membranous skins, called respectively the **fenestra rotunda** and the **fenestra ovalis.**

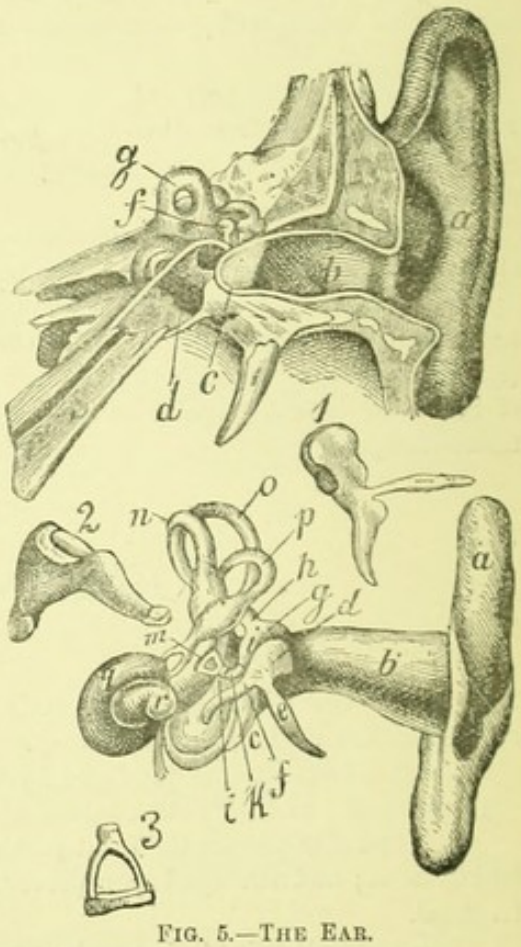


FIG. 5.—THE EAR.

In connection with the latter there are three small bones, called respectively the **hammer** (Fig. 5, 1), the **anvil** (2), and the **stirrup** (3), which fit into one another.

When sound strikes the drum of the ear, the latter is set vibrating; and as the handle of the hammer is attached to the drum, the motion is communicated to this bone, and thence to the other bones, till it reaches the membrane of the fenestra ovalis.

The internal ear or labyrinth is situated inside the temporal bone. It consists of three parts—the **vestibule**, the **semicircular canals** (*n*, *o*, and *p*), and the **cochlea** (*q r*). It is completely filled with a fluid called the **perilymph**.

Within the labyrinth the ends of the auditory nerve spread out into numerous delicate fibres, which communicate with the membranes of the cochlea and semicircular canals. These fibres convey the sound-vibrations to the brain.

THE ORGAN OF SMELL.

This is of a much simpler construction than either the eye or the ear.

The upper part of the sides of the nose and the upper part of the partition between the nasal cavities are covered with a mucous membrane, in which the filaments of the **olfactory nerve** terminate. Thus only this portion of the nose assists in producing the sensation of smell. The lower portion is supplied with other nerves, which, when irritated, give rise to other sensations such as that which occasions sneezing.

TASTE.

The sensation of taste is located in the tongue and palate. Just as the nose can receive olfactory impressions only from gases, so the organ of taste is affected only by fluids. Thus, if you place a little salt on the tongue, it cannot be tasted until it commences to dissolve.

The tongue consists of a number of muscles; and besides being the organ of taste, assists in mastication and swallowing, and is an important organ of speech.

The nerves which convey the impressions of taste arise in the base of the brain, and their delicate branches terminate in small wart-like prominences, which may easily be seen on the upper surface of one's own tongue.

TOUCH.

The sensation of **touch** is spread over the whole body. It really consists of three separate sensations: one by which we can determine the solidity, shape, roughness, and other properties of the surface of a body; another by which we can estimate weight; and a third enables us to distinguish between different temperatures.

These sensations are due to the nerves which proceed from the brain and spinal cord, and penetrate into every portion of the skin.

The greater the number of nerve fibres in a certain area of skin, the more delicate is its sensitiveness. It is for this reason that the tongue, the lobes of the ear, and the lips are far more sensitive than the skin of the back or upper arm.

TABLE OF REFERENCES.

PLATE I.—HEART AND BLOOD-VESSELS.

H Heart (see also Plate V.).
RA Right auricle.
LA Left auricle.
RV Right ventricle.
LV Left ventricle.
A Aorta.
As Subclavian arteries.
c Carotid arteries.
Aa Axillary arteries.
BA Brachial arteries.
Ar Radial arteries.
Au Ulnar arteries.
Arc Palmar arch.
Ra Renal artery.
Ai Iliac arteries.
Ii Internal iliac arteries.
Ie External iliac arteries.
Ap Pulmonary artery.
VS Vena cava superior.
VI Vena cava inferior.
Hv Hepatic veins.
Rv Renal vein.
Vi Iliac veins.
Vs Subclavian veins.
Vj Jugular veins.

PLATE II.—THE SKELETON.

1. Frontal bone.
2. Superior maxillary.
3. Inferior maxillary.
4. Nasal bone.
5. Temporal bone.
6. Malar or cheek bone.
7. Parietal bone.
8. Eye-sockets (orbits).

5*c*. Fifth cervical vertebra.
7*c*. Seventh cervical vertebra.
1*d* First dorsal vertebra.
XII*d* Twelfth dorsal vertebra.
1*l* First lumbar vertebra.
V*l* Fifth lumbar vertebra.
S Sacrum.
C Coccyx.
H Hip-bone.
f Femur or thigh-bone.
cf Head of femur.
cl Clavicle or collar-bone.
sc Scapula or shoulder-blade.
h Humerus.
r Radius.
u Ulna.
w Wrist or carpal bones.
m Metacarpal bones.
1*r* First rib.
12*r* Twelfth rib.
st Breast-bone.

PLATE III.—SUPERFICIAL MUSCLES.

1. Temporal muscles.
2. Occipito-frontalis muscles.
3. Orbicularis muscles.
4. Levator labii muscles.
5. Depressor labii muscles.
6. Sterno-mastoid muscles.
7. Trapezius muscles.
8. Deltoid muscles.
9. Great pectoral muscles.
10. Serratus magnus.
11. External oblique muscles.
12. Recti abdominis.
13. Biceps muscles.
14. Muscles which turn the fore-arm inwards.
15. Tendons.

H. Ligament of the wrist.
16. Muscles which move the leg.

PLATE IV.—DEEPER MUSCLES AND THE EYE.

1. Lesser pectoral muscles.
2. Serratus magnus.
3. External intercostal muscles.
4. Internal intercostal muscles.
5. Upper portion of biceps muscle.
6. Brachialis anticus muscle.
7. Flexor profundus digitorum muscle.

H. Ligament of the wrist.
8. Adductor pollicis muscle.
9. Muscles of the thigh.
10. Transverse muscle of abdomen.
11. Internal membrane of the recti abdominis muscles.

11*a*. Recti abdominis muscles.
12. Upper eye-lid.
13. Lower eye-lid.
14. Lachrymal gland.
15. Lachrymal canals.
16. } Nasal ducts.
17. }

PLATE V.—THE VISCERA, ETC.

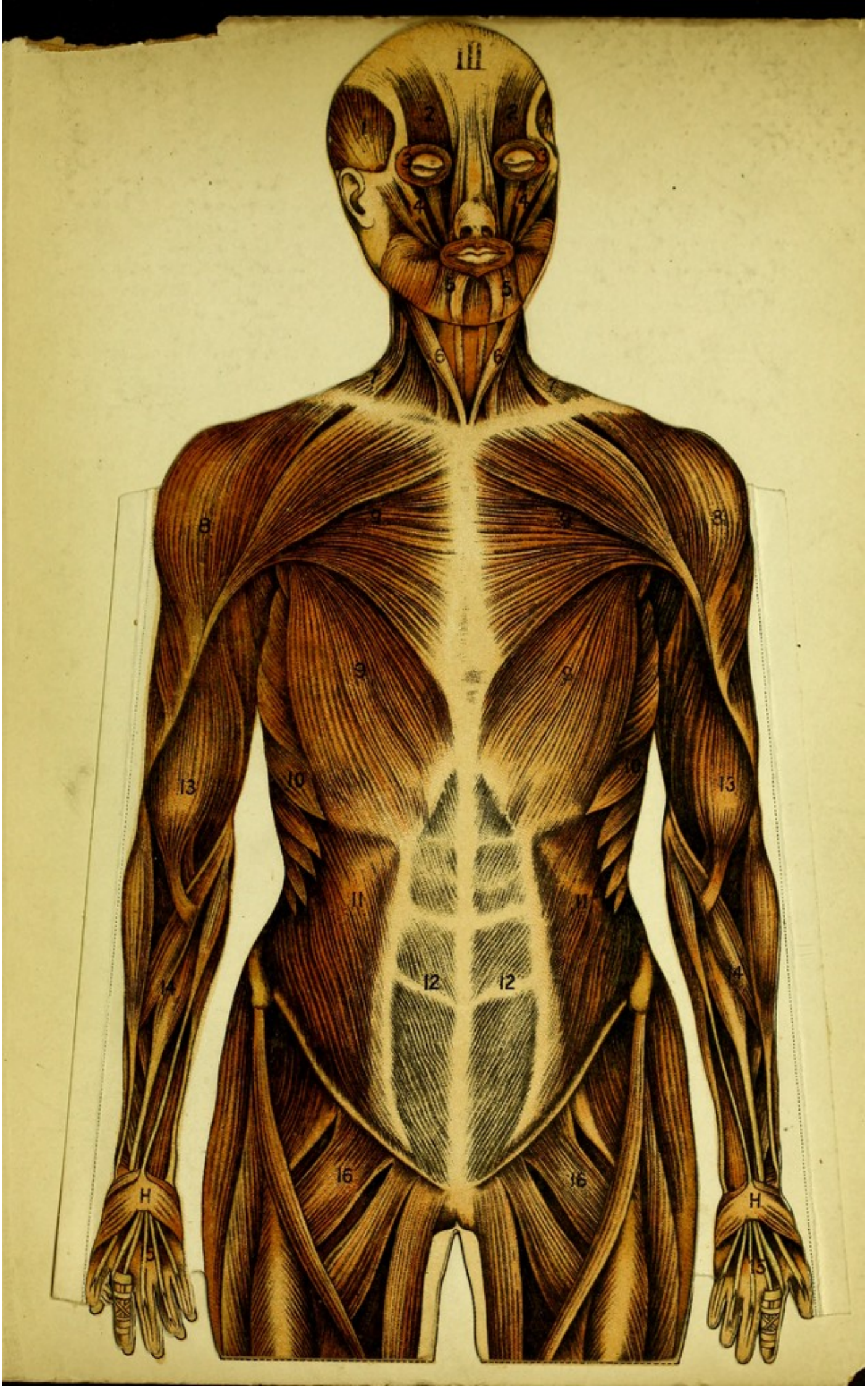
1. Temporal bones.
2. Parietal bones.
3. Occipital bone.
4. Sphenoid bone.
5. Pharynx.
6. Œsophagus.
7. Stomach.
8. Duodenum.
9. Small intestine.
10. Cæcum.
11. Ascending colon.
12. Transverse colon.
13. Descending colon.
14. Sigmoid flexure.

14*a*. Rectum.
15. Pancreas.
16. Spleen.
17. Liver.

17*g*. Gall-bladder.
18. Diaphragm.
19. Hyoid bone.
20. Larynx.
21. Thyroid gland.
22. Trachea.
23. Bronchi.
24. Lungs.
25. Heart (see reference to Plate I.).

Vp. Pulmonary veins.
26. Kidneys.
27. Ureters.
28. Bladder.

1*c*. First cervical vertebra.
3*c*. Third cervical vertebra.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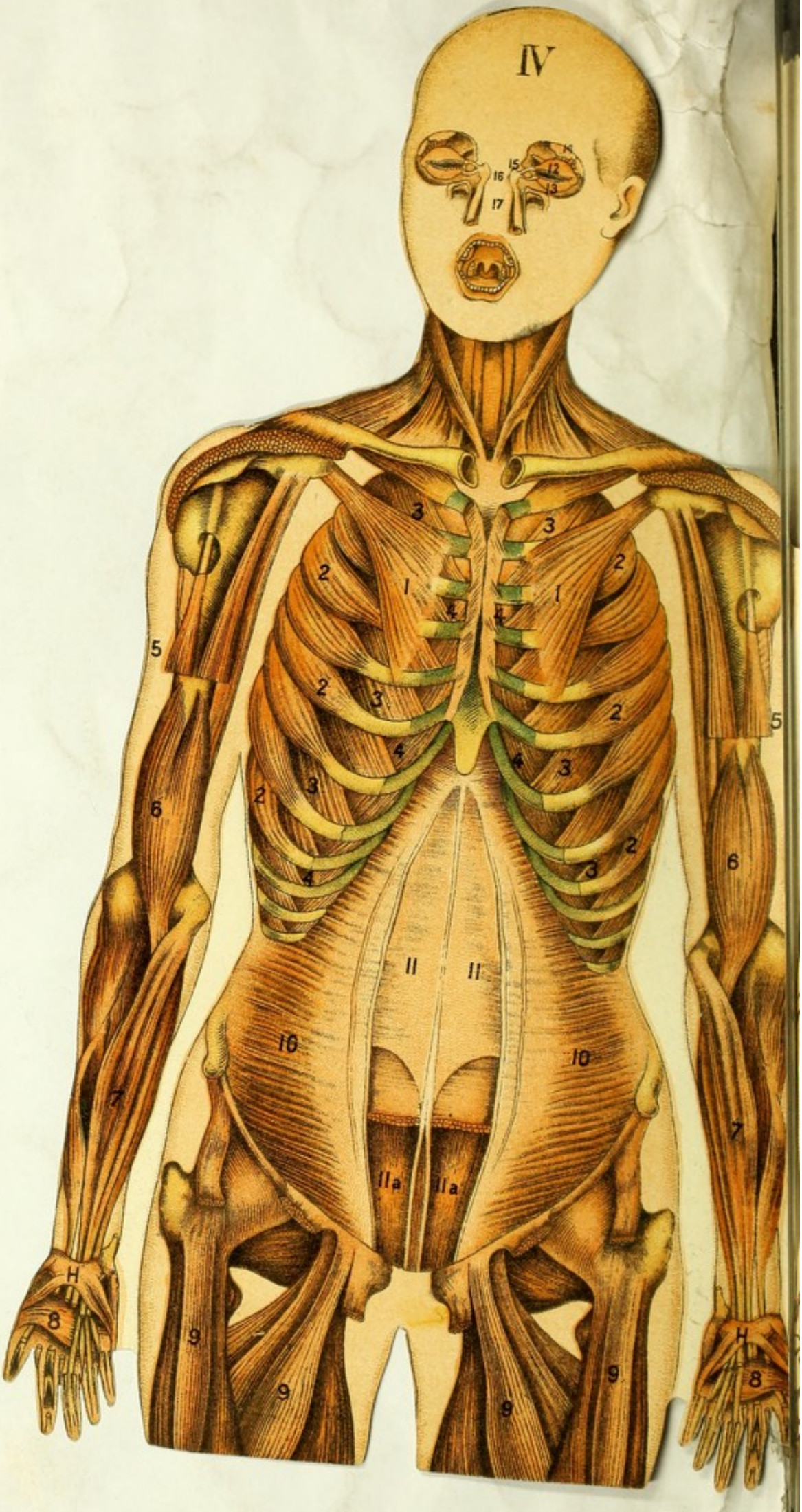
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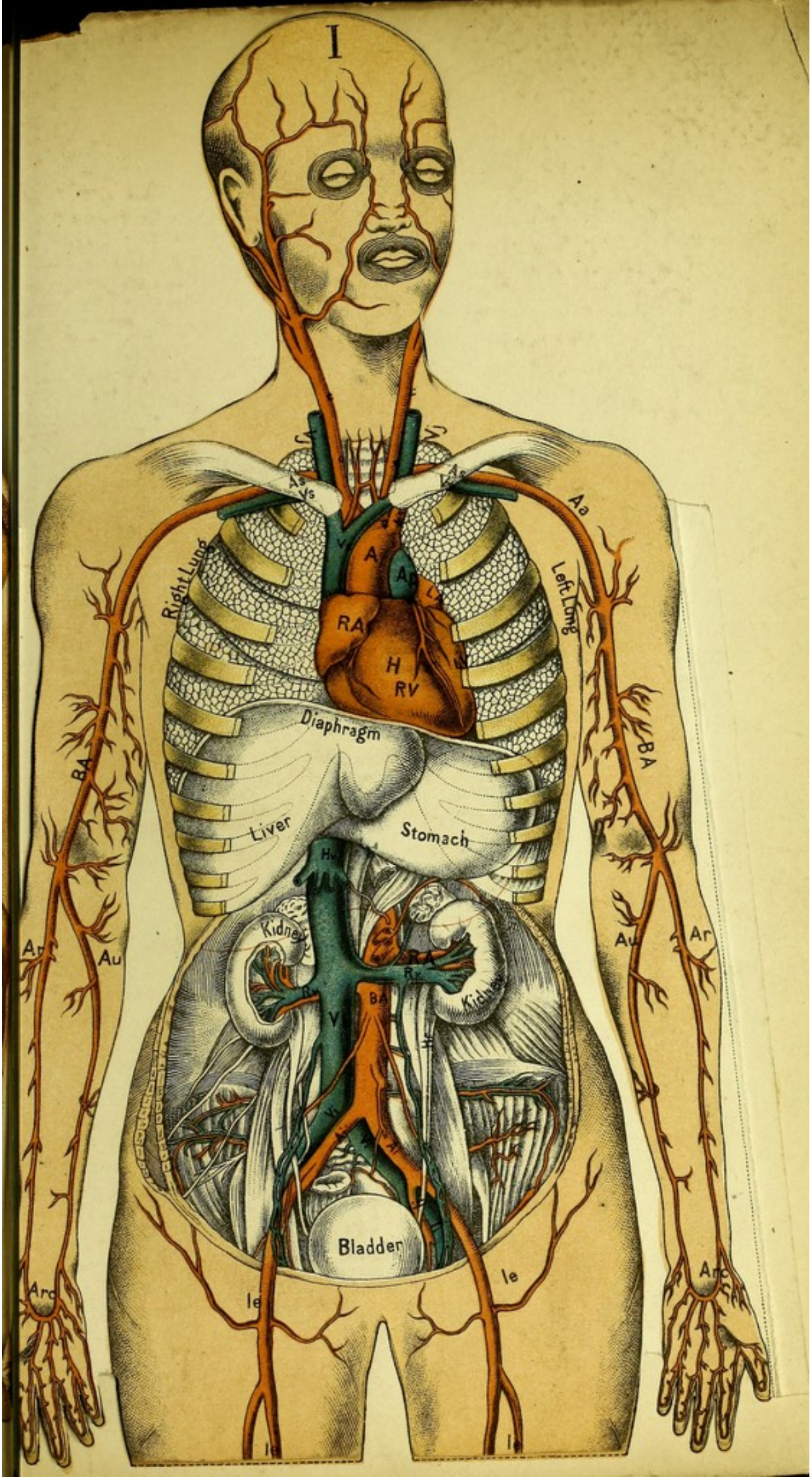
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Left Lung
Aa
RA
H
RV
Diaphragm
BA
Liver
Stomach
Kidney
Kidney
Bladder
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