

**QUAIN'S ELEMENTS OF  
ANATOMY. IN THREE  
VOLUMES. VOL I. -  
PART I. EMBRYOLOGY**

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**EDWARD ALBERT SCHÄFER & GEORGE DANCE THANE**

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QUAIN'S  
ELEMENTS OF ANATOMY

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EMBRYOLOGY

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# ELEMENTS OF ANATOMY.

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## INTRODUCTION.

ANATOMY, in its most extended sense, is the science which deals with the structure of organized bodies. It is divided into departments according to its subjects; such as Human Anatomy; Comparative Anatomy, or the study of the structure of different animals; and Vegetable Anatomy, comprehending the structure of plants.

On examining the structure of an organized body, we find that it is made up of members or *organs*, by means of which its functions are executed, such as the root stem and leaves of a plant, and the heart, brain, stomach and limbs of an animal; and farther, that these organs are themselves made up of certain constituent materials named *tissues* or *textures*, such as the cellular, woody, and vascular tissues of the vegetable, or the osseous, muscular, connective, vascular, nervous, and other tissues, which form the animal organs.

Most of the tissues occur in more than one organ, and some of them indeed, as the connective and vascular, in nearly all, so that a multitude of organs, and these greatly diversified, are constructed out of a small number of constituent tissues; and parts of the body, differing widely in form, construction, and uses, may agree in the nature of their component materials. Again, as the same tissue possesses the same essential characters in whatever organ or region it is found, it is obvious that the structure and properties of each tissue may be made the subject of investigation apart from the organs into whose formation it enters.

The foregoing considerations have led to the subdivision of anatomy into two branches, the one of which, under the name "General Anatomy," or "Histology," treats of the minute structure of the component tissues of the body; the other, named "Special or Descriptive Anatomy," treats of its several organs, members, and regions, describing the outward form and internal structure of the parts, their relative situation and mutual connection, and the successive conditions which they present in the progress of their formation or development.

To the description of the origin and formation of organs in the embryo, a special chapter is devoted in this work, under the name Embryology.

The study of anatomy may be viewed in two different aspects; viz., the physiological and the morphological. In the former, anatomy supplies the materials relating to structure from which an explanation is sought of the uses or functions of organs by the physiologist; and for this purpose the study of histology is of particular service. In its morphological aspect, anatomy investigates and combines the facts relating to the structure and relations of organs, from which may be deduced general principles as to the construction of the human body or that of



animals. In the determination of these general principles, or laws of morphology, it is necessary to combine the knowledge of the anatomy and development of animals with that of man.

#### PLAN OF ORGANIZATION.

**Vertebrate type.**—The general plan of construction of the human body agrees closely with that which prevails in a certain number of animals, viz., mammals, birds, reptiles, amphibia, and fishes, and is known as the vertebrate type of organization. The main feature of that type, and that from which its name is derived, belongs to the internal skeleton, and consists in the existence of a median longitudinal column, which extends through the whole trunk, and is composed in the fully developed state of a series of bones termed *vertebrae*. This *vertebral column* is formed in the early embryo around a simple rod-like structure, the primitive skeletal axis, which is called the *notochord*, and which in most vertebrate animals disappears to a greater or less extent in the course of development. The more solid portions of the vertebrae immediately surrounding the notochord are known as the *bodies* or *centra* (figs. 2 and 3), and constitute a pillar around which the other parts are grouped with a certain regularity of structure. At one extremity of this pillar is situated the *head*, showing in almost all the animals formed upon this type a greater development of its constituent parts; and at the other the *tail* in which an opposite character or that of diminution prevails; while on the sides of the main part or *trunk*, there project, in relation with some of the vertebral elements, two pairs of symmetrical *limbs*.

The head and trunk contain the organs or viscera most important to life, such as the alimentary canal and the great central organs of the vascular and nervous systems, while the limbs, from which such principal organs are absent, are very variable and differ widely in the degree of their development among the various animals formed upon the vertebrate type. In man and the higher animals the trunk is divisible into neck, chest, abdomen, and pelvis.

The vertebrate form of skeleton is invariably accompanied by a determinate and conformable disposition of the other most important organs of the body, viz. :—*firstly*, the existence on the dorsal aspect of the vertebral axis of an elongated cavity or canal which contains the brain and spinal cord, or central organs of the nervous system; and *secondly*, the existence on the ventral aspect of the vertebral axis of a larger cavity, the visceral cavity, body cavity or *coelom*, in which are contained the principal viscera connected with nutrition and reproduction, such as the alimentary canal, the heart and lungs, the great blood-vessels, and the urinary and generative organs.

The general disposition of the parts of the body and of the more important viscera in their relation to the vertebral axis are shown in the accompanying diagrams of the external form and longitudinal and transverse sections of the human embryo at an early period of its existence.

**Segmentation of the body.**—The vertebrate type of organisation in the repetition of similar structural elements in a longitudinal series, has a segmented character, especially in the axial portion of the body, and this segmentation affects more or less, not merely the skeletal parts of its structure, but also, to some extent, its other component organs.

A segmented plan of construction is by no means restricted to vertebrate animals, but exists in several other classes of the animal kingdom, as is most conspicuously seen in the Arthropoda, such as insects and crustacea, and in the Annelida or worms. These animals, however, although showing a serial repetition of parts of like structure, are not considered to belong to the vertebrate type of organization.

In the human embryo, as in that of all vertebrate animals, the segmentation is most marked in the muscular system, the nervous and osseous systems becoming for the most part correspondingly marked off: in the adult the osseous and nervous systems retain in great measure the segmentation which has thus been produced, although in the muscular system it has

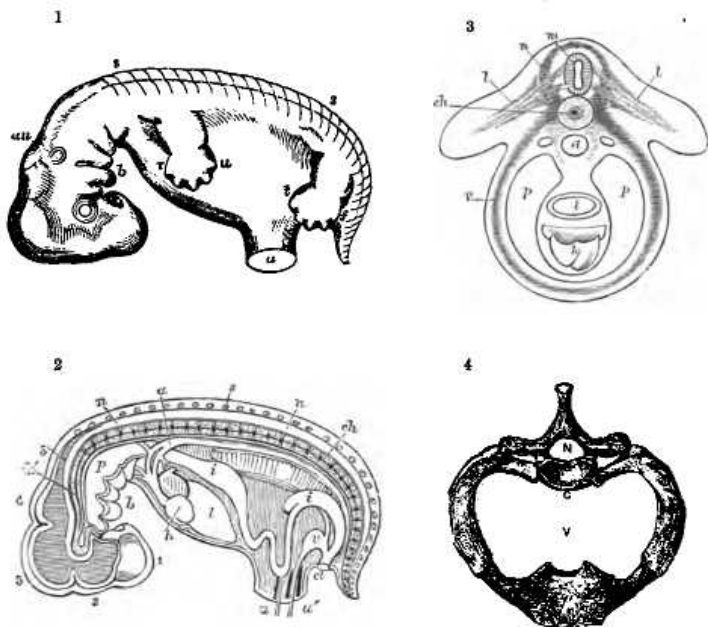


Fig. 1.—DIAGRAM OF AN EARLY HUMAN EMBRYO. (Allen Thomson.)

*s, s*, indications of the vertebral divisions along the line of the back; *r, u*, upper limb; *t, f*, lower limb; *u*, umbilical cord. In the cranial part the divisions of the brain are indicated, together with the eye, and *au*, the auditory vesicle; near *b*, the visceral arches and clefts of the head, forming *inter alia* the rudiments of the upper and lower jaws.

Fig. 2.—SEMI-DIAGRAMMATIC VIEW OF A LONGITUDINAL SECTION OF THE EMBRYO REPRESENTED IN FIGURE 1; SHOWING THE RELATIONS OF THE PRINCIPAL SYSTEMS AND ORGANS. (Allen Thomson.)

1, 2, 3, 4, 5, primary divisions of the brain in the cranial part of the neural canal; *n, n*, spinal cord in the vertebral part of the canal; *s*, spinous process of one of the vertebrae; *ch*, chorda dorsalis running through the axis of the vertebral centra; *ch'*, the same extending into the base of the cranium; *a*, dorsal aorta; *p, p*, pharyngeal cavity; *i, i*, alimentary canal; *h*, ventricular part of the heart, with which the arterial bulb is seen joining the aorta by arches; *b*, visceral arches of head; *l, l*, liver; *w*, Wolffian body; *r*, urinary vesicle or allantois, joining the intestine in the cloaca, *cl*; *u, u'*, umbilicus.

Fig. 3.—TRANSVERSE SECTION (DIAGRAMMATIC) OF THE TRUNK OF THE EMBRYO THROUGH THE UPPER LIMBS. (Allen Thomson.)

*m*, spinal cord; *n*, neural or dorsal arch, including bone, muscle, skin, roots of the nerves, &c.; *ch*, chorda dorsalis, surrounded by the vertebral body or centrum; *v*, ventral or visceral arch, or wall of the body; *p, p*, body cavity; *i*, alimentary canal; *h*, heart; *l, l*, the rudimentary limbs.

Fig. 4.—FIRST DORSAL VERTEBRA WITH THE FIRST RIB AND UPPER PART OF THE STERNUM, SEEN FROM ABOVE.  $\frac{1}{2}$ .

*C*, centrum; *N*, neural cavity; *V*, cavity of the chest, visceral cavity.

become greatly obscured. To the original segments in the embryo the terms *protovertebrae*, *mesoblastic somites* or *myotomes* have been applied; those segments or metameres which are traceable in the adult are often spoken of as *vertebral segments*. In the limbs, although there is strong reason for believing that they have originated as outgrowths of certain segments of the trunk, the repetition of such vertebral elements, and their primitive connection, are greatly obscured.

**Homology.**—A certain agreement in structure, situation and connection of parts or organs constitutes what is called *homology*, and this term is generally employed to indicate the morphological identity of representative parts in different animals, which may be considered to have its cause in community of origin (*homogeny*, Lankester), while the anatomical correspondence of parts which are repeated in the same animal may be more exactly distinguished as *serial homology* (*homodynamy*, Gegenbaur). Thus the arm-bone or humerus of a man is homologous (homogenetic) with the upper bone of the fore limb of a quadruped, or of the wing of a bird, while it is at the same time serially homologous (homodynamic) with the thigh bone of man himself, or any other vertebrate animal. It has farther been found convenient to express by the word *analogy* that kind of resemblance among the organs of animals which depends upon similarity of function, and although it may be accompanied by considerable agreement in structure, yet is not rendered complete by anatomical relation and connection: for example, the gills of a fish, of a crab, and of a mussel, serving the same function, are analogous organs, but in no sense homologous, as all morphological correspondence, or genetic relation, is wanting between them. Thus also, the upper limb of a man, the fore limb of a quadruped, the wing of a bird, and the pectoral fin of a fish are homologous but not analogous structures, the wing of a bat and the wing of a bird are both homologous and analogous, while the last is analogous to but not homologous with the wing of an insect.

**Symmetry of form.**—A remarkable regularity of form pervades the organization of certain parts of the body, especially the whole of the limbs, the head and neck, and the framework, at least, and external walls of the trunk of the body. Thus, if we conceive the body to be divided equally by a plane which passes from its dorsal to its ventral aspect (*median plane*), the two halves, in so far as regards the parts previously mentioned, correspond almost exactly with each other, excepting by their lateral transposition,—and the human body thus shows in a marked manner the character of *bilateral symmetry*. There is, however, a departure from this symmetrical form in the developed condition of certain of the internal organs, such as the alimentary canal from the stomach downwards, the heart and first part of the great blood-vessels, the liver, spleen, and some other viscera.

**Descriptive terms.**—In the description of parts so numerous, so various in form, and so complex in their connections as those composing the human body, there is difficulty in finding terms which shall indicate with sufficient precision their actual position and their relation to the rest of the organism. This difficulty is farther increased by the exceptional erect attitude in which the trunk of the human body is placed as compared with the horizontal position in animals. Hence, a number of terms have long been in use in human anatomy which are understood in a technical or restricted sense. For example, the *median plane*, already referred to, being that by which the body might be divided into right and left lateral halves, and the *middle* or *median line* being that in which the median plane meets the surface of the body, the words *internal* and *external* are used to denote relative nearness to and distance from this plane on either side, and may be replaced by *mesial* and *lateral*. The terms *sagittal*, *frontal*, and *coronal*, are also used in indication of direction within the body: *sagittal* denoting a dorso-ventral direction in or parallel to the median plane, *frontal* or *coronal* a transverse direction perpendicular to that