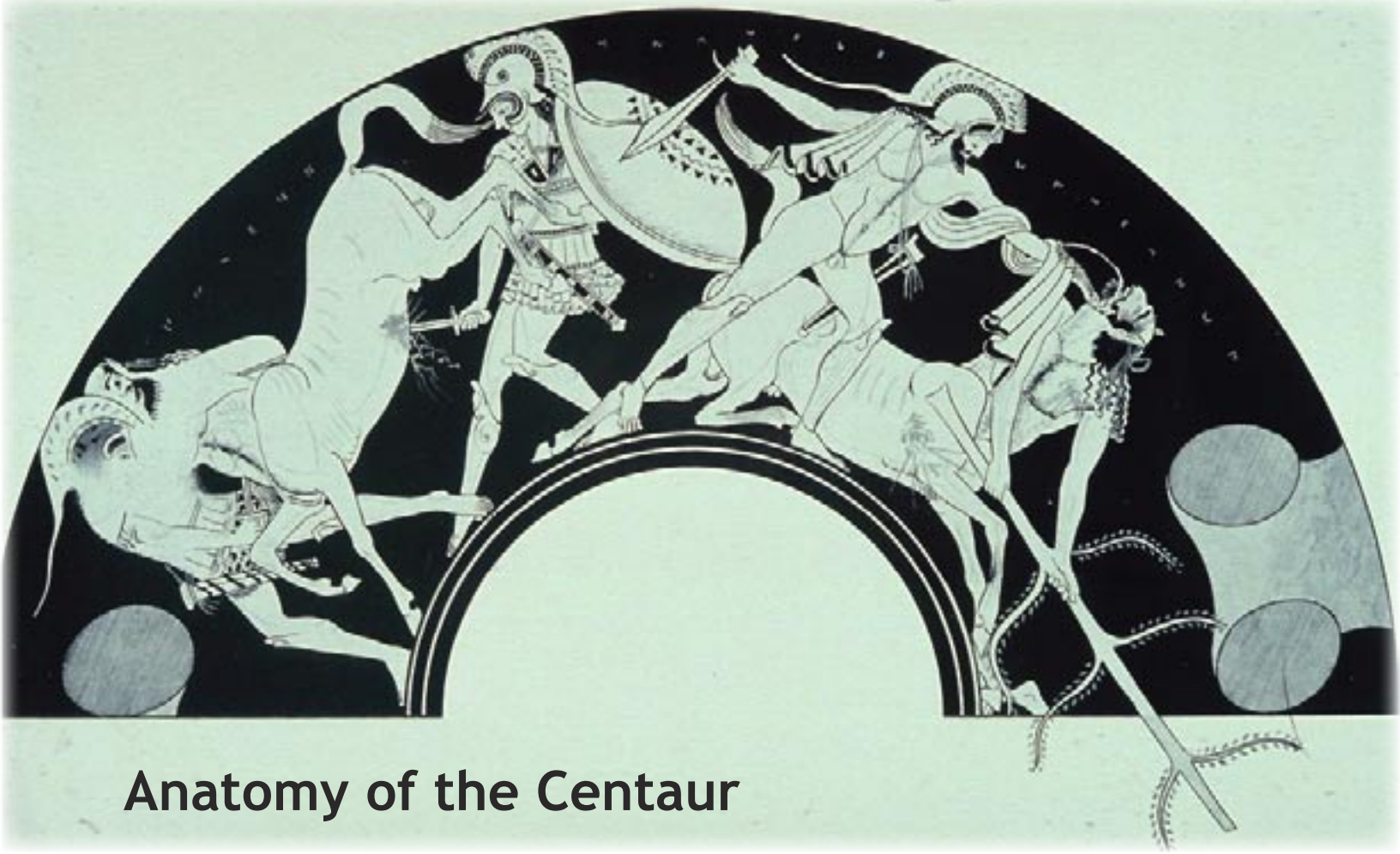

Anatomy of the Centaur

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Figure 1. Battle between Lapiths and Centaurs (Centauromachy) at the wedding of Perithoos with Hippodameia (Vase 5th century b. Chr.)

This study concerns itself with the systematics of Centaurean anatomical conditions. These are bound to be highly peculiar, combining, as they do, an animal trunk (the equine component) with a human trunk sans legs (the human component). (See Figure 8.)

A staple of Greek mythology, Centaurs have made many appearances throughout the centuries and even in our own time. They are represented by numerous sculptures and images in museums. True, when speaking of Centaurs, we have to rely on two- and three-dimensional models—here as many other instances in biology—because there has not yet been a sighting of a live specimen. However, the majority of extant graphic documents show a degree of verisimilitude and accuracy that makes them appear quite trustworthy, at least as regards the outward appearance of those beings.

Historical Background

As we know from the ancient Greeks, the Centaurs are the offspring of the ill-fated relationship of Ixion, the king of the Thessalian Lapithes, and a cloud with the features of Hera, the wife of Zeus. At the wedding of Perithoos, king of the Lapithes, the drunken Centaurs sought to ravish the Lapithes' wives. In the ensuing battle (the Centauromachy), they were driven from Thessalia to the Peloponnese. Quite understandably, Centaurs and Lapithes became mortal enemies on that day.

Materials

Since neither fossils nor living specimens of Centaurs have hitherto been discovered, the present study must be founded upon artistic renderings of its subject matter. These are abundant; collectively, they offer us a wealth of data.

The most ancient depictions of Centaurs may be found on Grecian vases (see Figure 1). Greece and Rome have provided us with impressive sculptures. Medieval sources, on the other hand, are primarily scriptorial. Artistic renderings of Centaurs soared at the onset of the Modern period. Judging by the number of sculptures extant, Centaurs must have enjoyed remarkable popularity in the Renaissance. They have also inspired sculptors of more recent times.

Methods

This is a foundational survey of the Centaurean body and its organs. We present no statistical analyses. The sizes of sets of specimens are widely heterogeneous and can by no means be considered evenly distributed as regards their characteristics.

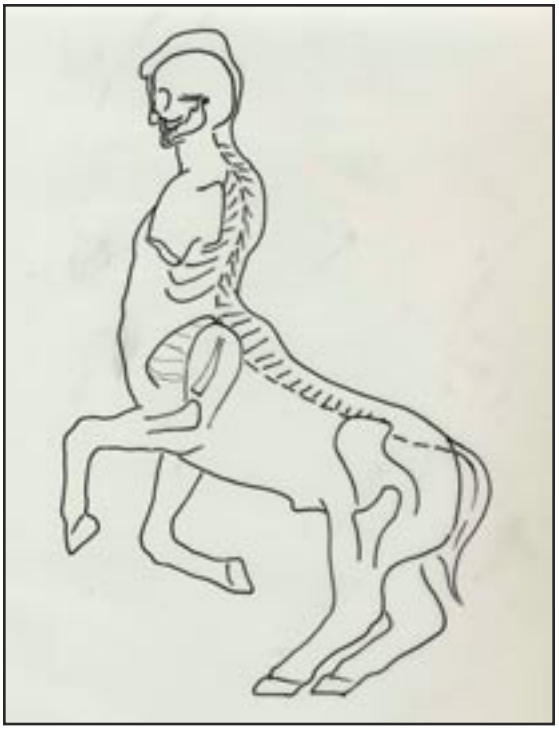

Figure 2. Hypothetical skeleton of Centaurs.

Nomenclature

The classic Centaur consists of two body parts, which meet at a right angle. The vertical or anterior part shows all the characteristics of the species *Homo*. For simplicity's sake, however, we will simply refer to it as Anterior (A). The horizontal part is the posterior one. In classic Centaurs, this quite obviously belongs to the species *Equus*. We will simply call it Posterior (P). For the purpose of the present study's phylogenetic considerations, and in order to improve legibility, species-related epithets will be attached to these terms. When describing and discussing classic Centaurs, therefore, the anterior part of the body will be referred to as Human Anterior (HA); the posterior part, as Equine Posterior (EP).

Two Parts

The anterior (HA) of the classic Centaur consists of a human element constituted by a head, a neck, a thorax with upper extremities, and an abdomen. The presence of a pelvis cannot be established with certainty. At any rate, the outward appearance indubitably and undeniably shows that HA—down to the umbilical region—possesses that human plasticity that is described in any modern anatomical atlas (e.g. Putz and Pabst, 2005). In contrast, EP consists of a near-complete horse's trunk with a tail and four extremities. Again, the plasticity of the trunk allows us to accept as standard the equine anatomy that is exhaustively documented in the relevant literature (e.g. König and Liebich, 1999).

Two Sexes

Owing to the far larger number of samples of male Centaurs, the present study will not be concerned with the anatomy of females, with the exception of a brief discussion of the external genital organs. The intensive analysis of female centaurs is a task we leave for future researchers.

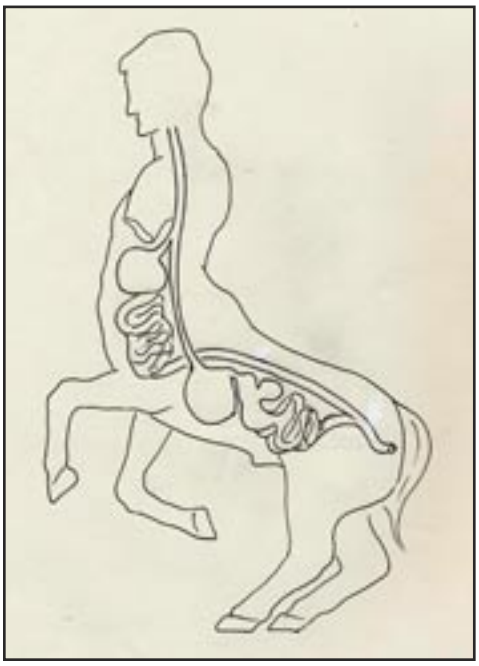

Figure 3. Hypothetical digestive apparatus of Centaurs.

Two Structural Principles

We take into account two different structural principles in the hypothetical anatomy of classic Centaurs. On the one hand, the Centaurean body contains simple systems, such as the locomotor and the nervous systems; on the other hand, there exist duplex systems, such as the digestive, respiratory, circulatory, and urogenital apparatuses (see Table 1).

Simple Systems: The Skeletal Locomotor Apparatus

The most problematic region, and the main focus of attention, is the junction of the two body components. It appears that EP provides a fully developed thorax complete with thoracic spine as the basis from which HA emerges. However, there is no way of ascertaining whether there also exists an equine cervical vertebra. As regards the scapula, we may safely assume that it serves a double purpose. Firstly, its functional orientation is toward the anterior extremity of EP. This suggests that the scapula may be suspended in a complex web of muscular loops and that it has to possess

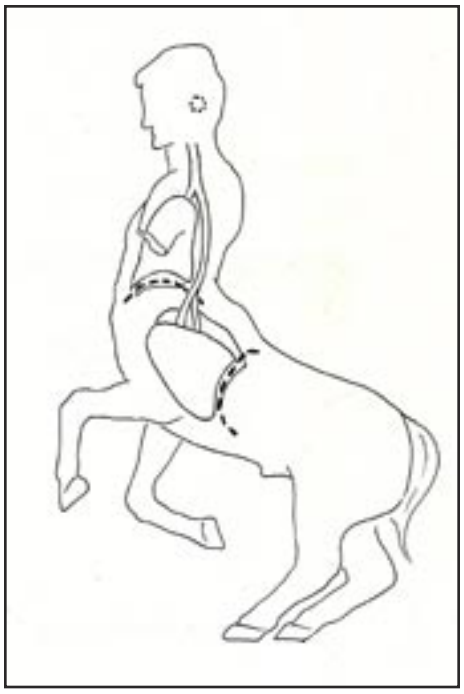

Figure 4. Hypothetical respiratory apparatus of Centaurs.

a certain dynamic mobility. Second, the scapula's spatial proximity to the pelvic region of HA assigns to it the task of supporting the weight of HA, which demands a relatively a higher stability.

Concerning the caudal end of HA, the humanoid systematic of the pelvic skeleton suggests a somewhat stronger connection of the pelvis with the spine. This peculiarity may be explained by the specific structure of the syndesmotic junction, which is a characteristic e.g. of the locomotor segments of the lumbar column and which is present in the interosseous talocalcanear ligament. There is also the possibility of an ilioscapular joint. However, a comparison of various Centaurs in various positions suggests—at least in the case of classic Centaurs—the presence of synosteosis and, therefore, of an ilioscapular bone (see Figure 2).

If we assume such a junctional bone, we have to conclude that the vertebral column of HA contains an indeterminable number of sacral segments above the fifth lumbar vertebra. This has to be the case because usually, in primates, *os coxae* is immediately connected segmentally with *os sacrum*. The connecting equine vertebra—depending on the length of the human portion of the sacral section—is either one of the lower cervical vertebrae or the uppermost thoracic vertebra. Apart from the very peculiar structure of this humano-sacro-equo-thoracic transition, the skeletal elements of both components seem to show the correct features appropriate to the respective species.

Simple Systems: The Muscular Locomotor Apparatus

The Centaurean corporal plasticity not only allows us to comprehend the structure of the skeletal elements; it also gives us an understanding of the muscular relief. Again, it seems certain that both HA and EP present themselves in a manner appropriate to the respective species as described in the relevant textbooks. Of course, certain problems arise in the transitional area. The caudal ventral muscles of HA emerge from both rectus muscles as well as from the lateral ventral muscles. The rectus muscles in particular are often visible in the shape of two pronouncedly modeled bulges beneath the skin. On the part of EP, the anterior termination of the musculature of the trunk is a large, symmetrical muscle shield, which is quite evidently constituted by the two major pectoral muscles. It cannot be ascertained whether there is a sternal muscle located between these muscles, as is commonly the case in the species *Equus*. At any rate, the Centaurean body seems to have formed a pectoral-abdominal muscle shield that is characterized by a fascinating interplay of differently oriented fibers. Specific developments of this kind are by no means uncommon, as is proven memorably by the rich array of variants in mammals (Romer and Parsons, 1978).

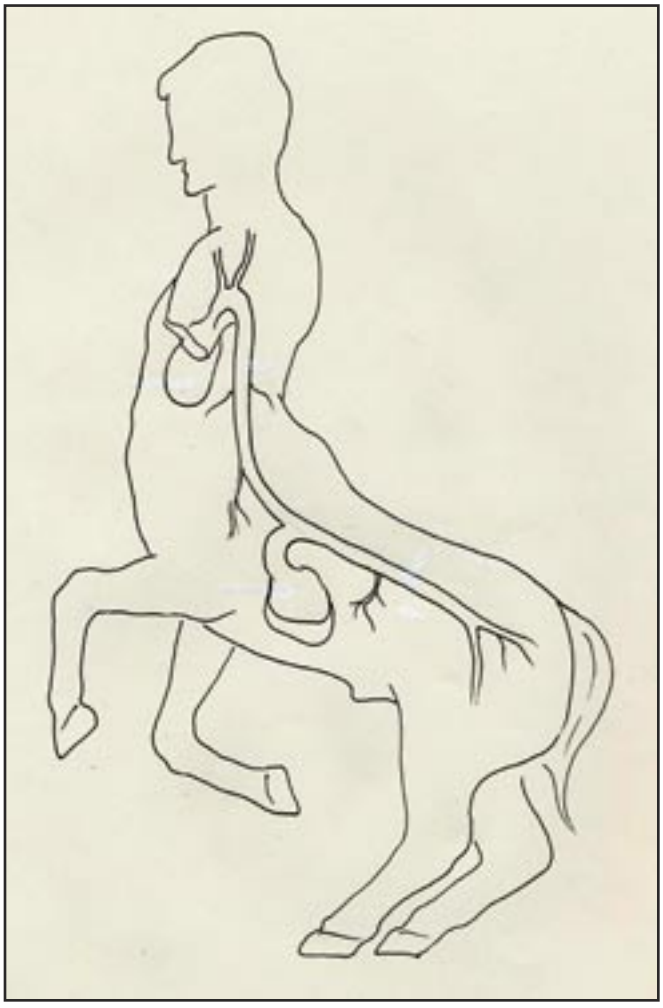

Figure 5. Hypothetical cariovascular apparatus of Centaurs.

Simple Systems: The Central Nervous System

The arrangement of the central nervous

system in classic Centaurs is comparably easy to interpret. Obviously, the head contains a cerebrum, connected to the medulla, which in turn is located in the vertebral canal. Certain intumescences of the medulla at the sites where nerve tracts link to the extremities are common in mammals. In Centaurs, this accounts for the presence of a humano-cervical intumescence as well as of an equo-lumbal intumescence. Since the anterior extremity (forehand) of EP presents itself as properly equine yet fulfilling increased static and dynamic demands owing to the larger mass of HA, which rests upon it, a somewhat extended lumbobrachial intumescence has to be assumed. The course and topography of the segmental nerves seem to be appropriate to the respective species. This rigid metamerism is not interrupted in the transitional area.

Surprisingly, the relative size of the Centaurean cranium is in fact disproportionate. In spite of its significantly increased peripheral distribution area, the brain volume is no larger than human average, or so the shape of the skull seems to suggest. Another question that must remain open is that of the allometric functioning of the cerebellum, which has to coordinate six instead of four extremities. It must be assumed that the proportions of the brain segments strongly diverge from the common human type.

Duplex Systems: The Digestive Tract and the Common Rectum

Since there is no evidence of HA's digressing from the forms of fully developed *Homo sapiens*, it has to be assumed that also the Centaurean digestive tract, at least up to the sigmoid colon, is developed in the same manner as in the human body proper. Besides, the iliac crest allows conclusion to the position of the vermiform appendix.

The transportation of food to the equine stomach poses another problem. At this point, we must forego the question of where the connection to the equine stomach branches off from the common esophagus. Owing to a certain lack of space in the area of the posterior mediastinum, we can assume that this embranchment occurs *after* the common esophagus has passed the human diaphragm, and slightly above the cardia, that is, away from the abdominal portion of HA. This branch

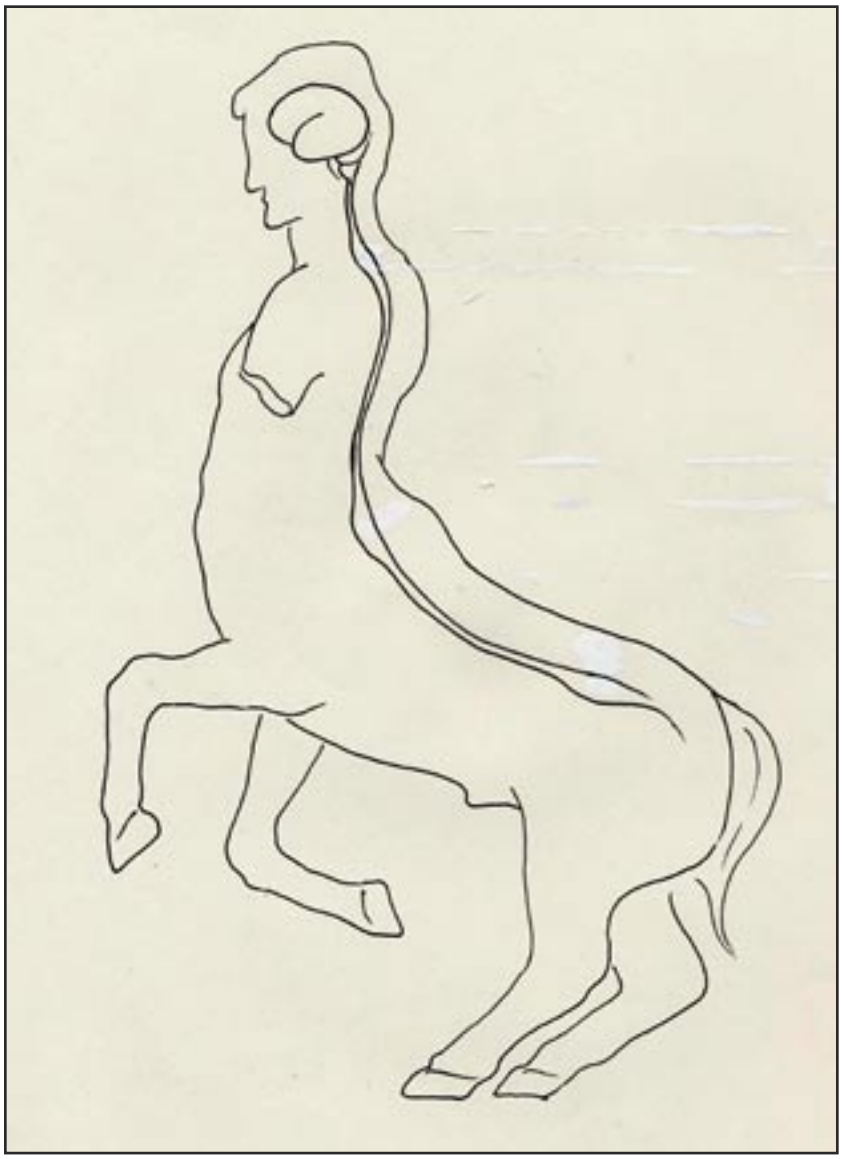

Figure 6. Hypothetical central nervous system of Centaurs.

of the esophagus passes the equine thorax in a generous arch that stretches to the equine stomach. The further formation of the specifically equine digestive tract appears to follow the textbook pattern. It ends in a common rectum. This is the term employed here for that section of the intestine that is joined by an elongated colon linking from HA.

It must be made quite clear, of course, that the gaster of EP, here called "equine stomach" for convenience's sake, can by no means be a regular horse's stomach. It is merely localized in the position of the equine gaster; however, its function has to be that of a regular human stomach, since the upper gastrointestinal tract, which supplies it with food, is clearly human. There is no hint in the relevant literature that Centaurs subsist on other than human food. The sources indicate, however, that Centaurs were rather fond of Greek wine. Precisely this uncontrolled predilection for alcohol was to play a fateful role in their conflict with the Lapithes (that is, the Centauromachy). Therefore, it is clear that the small intestine of EP follows the functional principle of its human counterpart and thus has to be significantly shorter than the equine small bowel, which is usually as long as 25 meters (80 feet). Likewise, the length of the cecum has to correspond to the usual length of the human cecum, which measures approximately 10 centimeters (4 inches).

Duplex Systems: The Respiratory Apparatus

As can be deduced from the external appearance, the respiratory apparatus is constructed in a manner similar to the gastrointestinal tract. There seems to exist a common trachea, with a bifurcation occurring at the height of the third or fourth thoracic vertebra of HA. The anterior pipe—"short trachea" for our purposes—corresponds to the human windpipe and ramifies into the various pulmonary bronchi. The primary pulmo (that of HA) is situated correctly in the two pleural cavities. The long trachea penetrates the human diaphragm, presumably in front of the esophagus yet behind the heart, and enters the equine thorax in an elegant curve. It ramifies into the secondary pulmo according to the well-known structural principle of the equine lung.

Further interesting issues are the extension of the pleural cavities, which are indispensable for the mechanics of breathing, and the synchronization of the two diaphragms. The interaction of the two tightly linked respiratory systems indubitably poses a tremendous challenge to the central nervous system.

Duplex Systems: The Circulatory System

The structure of the circulatory system is particularly interesting. We could assume the existence of two hearts that sustain circulation in their function as pressure and suction pumps. It would not be entirely illogical, however, to

suggest two separate circulatory systems, since the respective blood pressures of *Equus* and *Homo*, the original species, are considerably different. However, the two systems may have aligned in the course of phylogenesis.

Yet for simplicity's sake, let us assume a primary and a secondary heart. The cranial aorta emerges from the primary heart. Since HA does not need common iliac arteries, it has to be taken that the cranial aorta immediately joins the caudal aorta. This happens in the area of the aortic arch that emerges from the secondary heart. The further structuring of the caudal aorta follows the principle explained in the standard texts on veterinary anatomy (e.g. König and Liebich, 1999).

The question for the systematics of the transitional vessels remains entirely open. The subclavian artery presumably follows standard patterns; however, the position and function of the common carotid artery are highly problematic. For the present study, we prefer to assume that no equine carotids have been developed. The question of the existence of an equine vertebral artery is particularly stimulating.

The large body veins present no fundamental systematic problem, since they are generally known to be highly variable in form and position. It would be foundationally important, however, to establish the boundaries between the catchment areas of the human inferior vena cava and the equine superior vena cava, respectively.

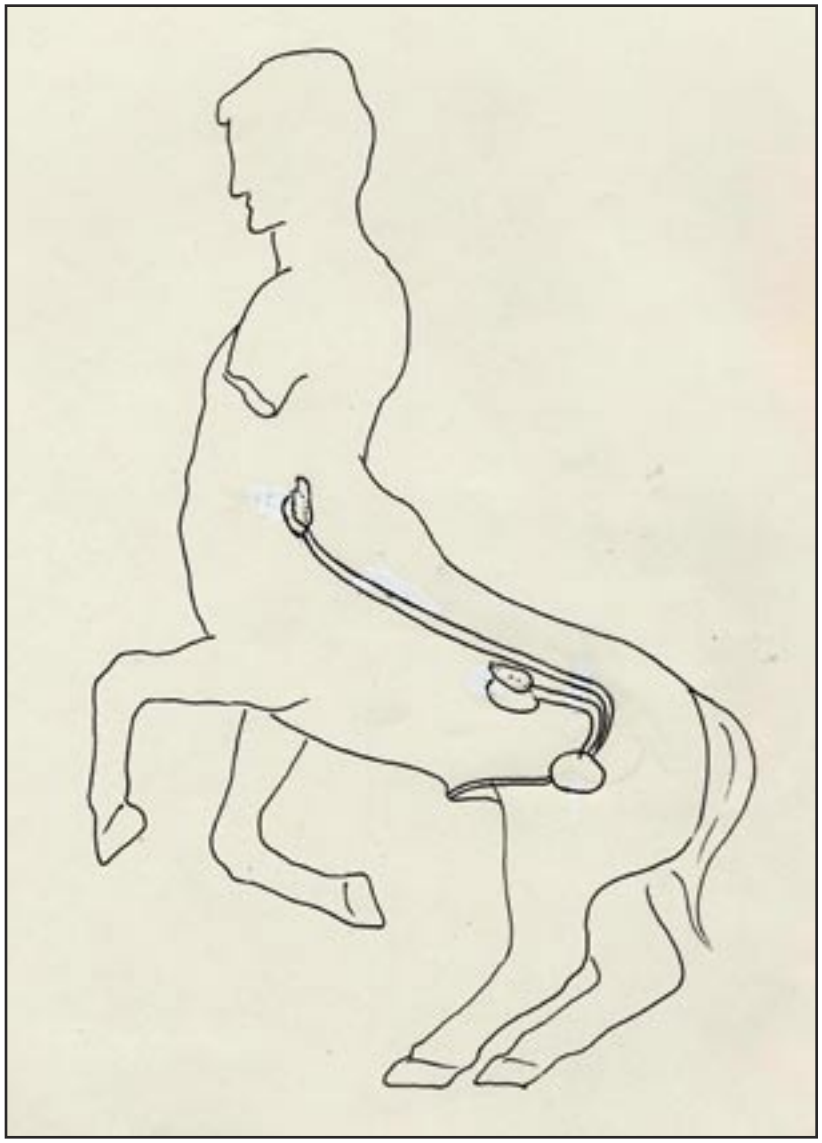

Figure 7. Hypothetical urogenital apparatus of Centaurs.

Duplex Systems: The Urogenital Apparatus

The structure of this part of the metabolic system appears unproblematic. Obviously we have to assume two (caudal) kidneys in HA. The long ureters connect these with the common urinary bladder through the retroperitoneum and the posterior mediastinum (or the retroperitoneum) of the equine thorax/abdominal cavity. The caudal kidneys of EP doubtlessly possess ureters, which we will call short ureters. These are linked to the posterior of the urinary bladder at the lateral posterior wall of the minor pelvis. Quite understandably, only a single urethra leads from the urinary bladder to the anterior abdominal wall. The penis is likewise developed according to equine anatomical standards. Somewhat surprisingly, if one considers possible reproductive techniques, even a painstaking scrutiny of the Centaurean body yields evidence of only one pair of reproductive glands.

The Cretan Variety

There seems to exist in Crete a very rare variety of Centaurs that are equipped with one pair of human legs instead of the equine forehand. This species, quite dissimilar to the regular Centaurean form, also possesses a full human genital apparatus, at least in male specimens. (Due to a scarcity of depictions, there may hardly be any statement made regarding the external genitals of female Centaurs, or Centauresses.) Relevant material is exceedingly scarce and sketchy.

Outlook

By way of summary, we may state that Centaurs and related life forms present a fascinating model for the study of foundational aspects of mammalian morphology and phylogenesis. With particular regard to the big number of questions left open by this study, it seems in order to demand—corresponding to the "Decade of the Brain," or to the "Decade of Degenerative Diseases" recently postulated by WHO—a new direction of research that paves the way to what might be described as the "Century of the Centaur."

Table 1

Hypothetical systematic anatomy of the Centaurs

Monosystemic Principles

Arranged Axially:	Central nervous system
	Sense organs
	Reproductive apparatus
Arranged Additively:	Locomotor apparatus
	Peripheral nervous system
Arranged Cumulatively:	Hormonal apparatus
	Immune apparatus

Disystemic Principles

Arranged Consecutively:	Cardiovascular apparatus
Arranged in Parallel:	Digestive apparatus
	Respiratory apparatus
	Urinary apparatus

Acknowledgement

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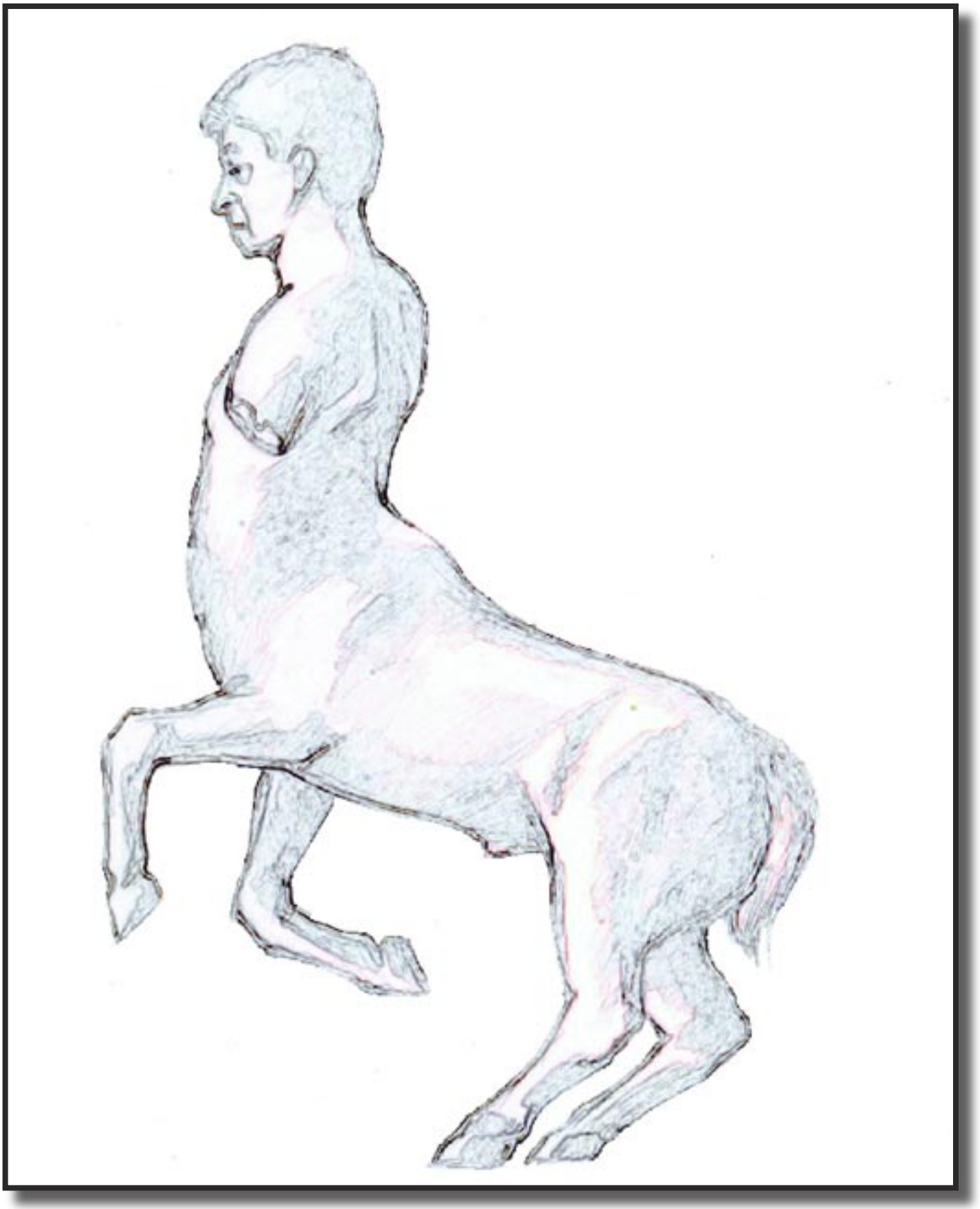

Figure 8. Idealised recent Centaur (in parts a portrait of the author).