

Figure 23
Structure supporting neck and head. Drawing by Leonardo da Vinci (Corpus of the anatomical studies, Royal Library Windsor, K/P 179v).

bone under the joint of the great toe of the foot, because if the tendon to which this sesamoid bone is joined were without the sesamoid, it would receive damage from the friction made under so great a weight.”

Elsewhere, the action of the muscles is compared to the “wedge,” while the terms “lever” and “counter-lever” are frequently used to explain the motion of the upper and lower limbs.

Other characteristic features show that the model of the “elements of mechanics” is at work in the illustration of the organic machine. Leonardo in fact individually examines many of the devices of the human body. One typical example is the drawings of single teeth (fig. 24), from whose mechanical action he derives the respective forms and functions; another is in the graphic catalogue of a group

of contrivances of the organic machine: the nerve, sinew, artery, muscle, each of which is associated with a precise function.

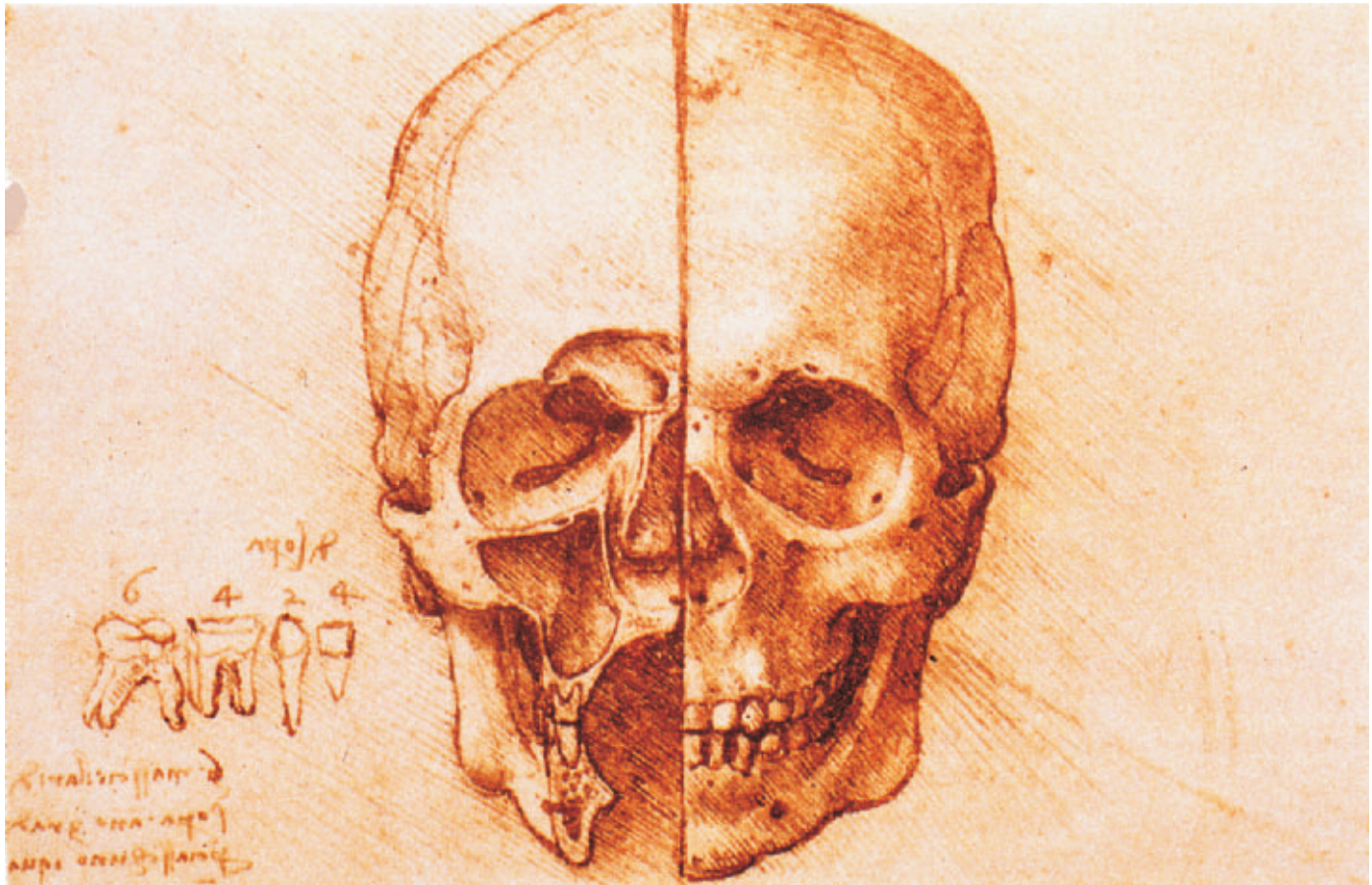
And lastly, he frequently refers to the geometrical schematisation of the organs to underline the mechanical laws that preside over their functioning, as in the demonstration of the action of the intercostal muscles in breathing or in the subjection of the motion of the jaw to the laws of the lever, where the related text displays the characteristic conciseness of the proportions of mechanics: “that tooth which is more distant from the center of the movement has less power in its bite.”

It must be emphasised that we are dealing once again with unprecedented methods of analysis and manipulation: no one had ever before conceived such a daring project of decomposition and recomposition of the human figure.

The complexity of the organic machine pushes Leonardo to constantly refine his drawing technique. The number of views in continuous rotation (fig. 25) increases, the exploded views (fig. 26) are frequently used, as are the penetrations of the structures in transparency, showing the surface with only a few essential lines and exploiting – as one can see in the extraordinary drawing of the lungs in transparency (fig. 27) – his capacity to convey outline and depth by straight and curved hatching.

Leonardo also faces the problem of global visualisation of the information contained in the anatomical data. He at first considers that three views are sufficient to show the limbs. Being unsatisfied with the results obtained, he later uses four views. At this juncture, he discovers that eight views are necessary to fully portray each member. These are accurate indicators of his growing consciousness of the extreme complexity of a project to illustrate the organic machine, as it theoretically presents infinite points of view.

In addition, the human body also has significant variants at the level of structural strata, from the skeletal support out to the skin. This imposes the production of sets of drawings of successive strata of the dissected organs starting from the skin and ending with the bone, or, vice versa, putting the strata back together from the bare bone up to the skin. We have a stupendous example of this technique in the series of drawings of the hand (fig. 28) and the torso.



In order to underline the analogies between organic and artificial machines Leonardo adopts graphic conventions that distance him from realistic representation. “If you want to demonstrate clearly the thin muscles you have to use rows of threads. Thus you will be able to represent them one upon the other as Nature has placed them [...]. And having given such knowledge you will draw alongside this the true size, shape and position of each muscle. But remember to make the threads that denote the muscles in the very same position as the central lines of each muscle.”

This means recognition not so much of the impossibility of faithful illustration of the fine muscular structure, but rather the inadequacy of such an effort when proposing to show the functional relations of the muscles and tendons or the mechanics of the articulations. In order to achieve this goal, the drawing must turn to simplification and schematisation, working from the presupposed analogy between organic and artificial machines. Thus the muscular masses have to be replaced by threads which indi-

cate the lines of force of their operation, as in mechanical models (like that of the lower limb (fig. 29), which Leonardo will actually build, using copper threads to outline the mechanical action of the muscles).

We are faced with a graphic solution which is extraordinarily innovative. Once again, it does not derive from a dilation of observation, but appears rather as a transfiguration of reality through drawing, in order to visualise the direct and necessary connection between observed evidence and intrinsic causes.

It is this ambiguous level of reality that Leonardo once suggestively defined as “*infra l’anatomia e il vivo*” (“between anatomy and life”). That is, an intermediary situation between the cadaver (which may be dissected, but is dead) and a “live” organic being (in which it is not possible to examine the transformations produced at the level of fine structure by various motions). Leonardo contrasts the impotence of the naked eye to the capacity of drawing to construct that which we would today call a “virtual” reality, in which the information culled from dissection as well as from simulation of functional mod-

Figure 24
Front view of the skull with details of the teeth. Drawing by Leonardo da Vinci (Corpus of the anatomical studies, Royal Library Windsor, K/P 42v).