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On the Nature of Organs and Organ Systems – A Chapter in the History and Philosophy of Biology

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Contrasting definitions of organs based either on function or on strictly morphological criteria are the legacy of a tradition starting with Aristotle. This floating characterization of organs in terms of both form and function extends also to organ systems. The first section of this review outlines the notions of organ and body part as defined, explicitly or implicitly, in representative works of nineteenth century's comparative morphology. The lack of a clear distinction between the two notions led to problems in Owen's approach to the comparative method (definition of homolog vs. nature of the vertebrate archetype) and to a paradoxical formulation, by Anton Dohrn, of the principle of functional change. Starting from the second half of the twentieth century, with the extensive use of morphological data in phylogenetic analyses, both terms – organ and body part – have been often set aside, to leave room for a comparison between variously characterized attributes (character states) of the taxa to be compared. Throughout the last two centuries, there have been also efforts to characterize organs or body parts in terms of the underlying developmental dynamics, both in the context of classical descriptive embryology and according to models suggested by developmental genetics. Functionally defined organ are occasionally co-extensive with morphologically defined body parts, nevertheless a clear distinction between the former and the latter is a necessary prerequisite to a study of their evolution: this issue is discussed here on the example of the evolution of hermaphroditism and gonad structure and function.

Keywords: organ, body part, organ system, Dohrn, Owen, hermaphroditism, homology, evolutionary morphology

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INTRODUCTION

Five years ago, in a paper published in a medical journal, Coffey and O'Leary (2016) proposed that the mesentery is an organ of the human body and, as such, should be added to the traditional list of human organs, as item No. 79. In a timely review of that article, Neumann (2017) remarked that "no two anatomists are likely to compile identical lists of the organs of the human body," largely because of the vague current notions of organ, "commonly defined in medical dictionaries as a (somewhat independent) part of the body that performs a (vital or special) function."

Despite an admittedly high level of indeterminacy, this tentative definition of organ as a body part with a well-defined function reveals two important features that have accompanied the usage of the term since classical antiquity: on the one side, individual organs *are parts of the body*; on the other, individual organs *perform distinct functions*. Sensible (or poorly informative, according to personal preferences) as it may appear, this twofold identity of organs opens a series of questions. First, are there body parts that are not organs? Yes, there are, for example body regions such as head,