

Preface

We can probably say that any field of knowledge is concerned with anthropology, dealing with some general or specific aspects of the biology or of the culture of humankind. Similarly, we can also say that any field of knowledge is about brain, the brain itself being the central director organizing the information of such a perspective. This is why human sciences and brain sciences have always had blurred and debated boundaries. On the one hand, we have the “hard fields” commonly recognized to be essential in neuroscience, nowadays mostly focused on molecular and cellular levels. At the same time, plenty of disciplines orbit around this conventional core, mixing and integrating heterogeneous dynamics. We are used to organizing things (including science) using separate “boxes” and labels, and we feel uncomfortable with such a scarcely defined topic. However, the difficulties in organizing a defined structure for the study of the human brain are implicit within the nature of the subject. The image of a core of fields is an illusory picture generated from our reductionist tendency, a need to handle single small pieces like, in this case, cells and molecules. The human brain is about everything, and its study suffers from a circular and tautological indetermination principle, in which the observer and the observed are the same entity. Although we may be partially aware of the bias this can induce, we totally ignore the actual effects of such circularity. In recent decades, many holistic approaches have attempted to escape these reductionist excesses, integrating different sources of information, large-scale perspectives, and multidisciplinary programs. Although results are probably still preliminary, the effort is valuable and necessary. An example is the field of neuroanthropology, which considers the integration between brain and environment by evaluating the relationship between biology and culture, and attempting to disentangle the dichotomy between organic and superorganic components of the mind. In an evolutionary context, another example is given by cognitive archaeology that interprets the cultural evidence of the archaeological record through the cognitive evidence of the current neuropsychological fields. It is undeniable that the multidisciplinary integration between anthropology, medicine, neuroscience, and social sciences will be a major key in future discoveries in human brain biology and evolution. Theories and advances in extended mind and embodiment will be probably decisive to change paradigms, possibly leading to epistemological shifts and new levels of interpretation.

While this new attempt to integrate knowledge is supporting some recent pioneering perspectives, technology is supplying a parallel and necessary methodological enhancement. In the last decade, digital tools in anatomy and morphometrics allowed to rediscover topics and issues left apart more than 50 years ago. Thanks to biomedical imaging, virtual modeling, and computed statistics, anatomy has become again a central issue in biology and evolution. Methods in anthropology and paleontology have been particularly empowered by these new toolkits, and “morphometrics” represents nowadays a specialized professional field.

One of the disciplines which have benefited most from the technical improvement of digital morphometrics is paleoneurology. In its early times, it mainly concerned the study of the cranial capacity and brain volume, its variations and differences among extinct and living hominoids, and the allometric study of the encephalization processes. The physical molding of the endocranial cavity and the production of endocranial casts also supported inferences on sulcal patterns and brain morphology. Nonetheless, paleontological study of the brain anatomy has been hampered for a long-time due to the elusive nature of its main target, namely providing inferences on brain structure from bone remains. Apart from the intrinsic limits of the field, methodological problems associated with the reconstruction of the brain form have represented a relevant limiting factor. The contribution of digital anatomy in this sense has been decisive, promoting in the last decade a new age of paleoneurological studies. As always, influent technical advances are difficult to control in their earliest stages of application, and caution is recommended to avoid excesses based on an improper use of the methodological power. Nevertheless, the crucial contribution of these tools in paleoneurology and evolutionary neuroanatomy has been essential.

In October 2012, an international symposium on *Human Paleoneurology* was organized at the National Research Center for Human Evolution in Burgos, Spain. The conferences, supported by the Instituto Tomás Pascual, were aimed at connecting people working on different aspects of brain evolution. The works presented during the conference were conveniently reorganized and extended, before being collected in this book. In the introduction Ralph Holloway, a pioneer in paleoneurology, offers a critical review of the main challenges still constraining the field. The chapter by Laura Reyes and Chet Sherwood introduce current topics in evolutionary neuroanatomy. Philipp Gunz presents major technical advances and digital tools. Emiliano Bruner discusses functional craniology, supplying a general review of the state of the art in paleoneurology. Simon Neubauer analyzes brain size and brain shape changes during hominid evolution, introducing issues associated with allometry and heterochrony. Natalie Uomini adds a behavioral component, including laterality, asymmetries, and language. Dietrich Stout and Erin Hecht integrate neurobiological and archaeological evidence, reviewing the current analytical methods in brain imaging. Fred Coolidge, Tom Wynn, Lee Overmann, and Jim Hicks discuss topics in cognition and archaeology, ranging from sleep to working memory. Finally, a collection of images displays endocasts

of representative fossil and living hominoids, digitally reconstructed by José Manuel de la Cuétara.

This volume is a synthesis of many current perspectives aimed at integrating studies in brain evolution, connecting anthropology with neurosciences. The target is to provide a general view of the present topics, methods, limits, and problems, encountered by those who decide to approach paleoneurology in the age of multidisciplinary, digital anatomy, and computed morphometrics.

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