Self-Organization in the Evolution of Speech

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To Cécile and Arthur

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Preface

The extraordinary capacities of the human brain have fascinated me for a long time. It is without doubt the most complex system we know. Reading the works of the founding fathers of artificial intelligence (von Neumann, Turing, Minsky among others) made me aware that computers could be a crucial instrument in our quest to understand the brain. These machines have the potential to play the same role for the cognitive sciences as particle accelerators play in physics: they make it possible to re-create in a controlled environment simpler versions of the brain, while keeping to an interesting level of complexity. The use of the computer, a calculating machine, to simulate and study natural phenomena is not new: Pascal used his little calculator to simulate the behaviour of mathematical series, Lorenz used the first computers to study the behaviour of climatic models, Fermi to study the interactions between magnetized particles, Turing to imagine how processes of morphogenesis could be self-organized, von Neumann to study self-replication.

Later, my meeting with Luc Steels, who invited me to work in his research team, made me realize that there is one subject whose study could show itself particularly useful for understanding cognition, namely language, and especially the origins of language. In addition, after several years, research into the origins of language underwent spectacular development and mobilized the energies of researchers from very different scientific cultures: linguists, biologists, philosophers, anthropologists, ethnologists, primatologists, neuroscientists, and researchers in artificial intelligence.

It was therefore quite natural for me to undertake research in this area, obviously with the idea that using a computer would be the touchstone. Just as quickly, I chose to focus on studying the origin of speech, the physical supporting medium of language, which seemed to me an ideal compromise between complexity and generality. By way of example, Jakobson's work in phonetics in the first half of the twentieth century established the bases of structuralism which were, and still are, highly influential in all domains of Western thought.

This book is a synthesis of the results of these years of research. It is bound together by the concept of self-organization, a property by which complex systems spontaneously generate organized structures, and by the role which self-organization could have played in the evolution of speech. From a theoretical point of view, it participates in the revolution in the sciences of complexity which took place in the second half of the twentieth century, and which has already made possible the reconceptualizing of whole sections of the physical and biological sciences. An example of this is the new understanding of the architectural and social structures of insect societies. My aim is to contribute to this momentum, showing how the concept of self-organization makes possible a better understanding of a fundamental phenomenon of human culture, the origin of speech. In this book, however, the reader will not find a definitive answer to this question. We are still a long way from resolving it. The book tries, rather, to explore and structure the space of hypotheses, and to develop conceptions and intuitions about the complex dynamics of speech. In short, it should be read as a tool for thinking about the origin of speech, which I hope will find a place in the construction of theories about the origin of language.

I thank Luc Steels for welcoming me into his team at the Sony Computer Science Laboratory in Paris, as well as for the confidence and support which he has extended to me in this research work. His visionary papers on the origin of language are among the main sources of inspiration for my work. I also thank Frédéric Kaplan for stimulating discussions which enabled me to explore many aspects of my work, as well as for his critical commentary on the text. I have learned a lot from him on how to present my ideas. Thanks to Nicole Bastien for the time she took to reread this text and the articles which preceded it. I am also grateful to Michael Studdert-Kennedy, Bart de Boer, Louis Goldstein, and Jim Hurford, who helped with the elaboration of my arguments by the constructive rejoinders they made on careful reading of my work. The encouragements, kindness, and open-mindedness of Michael Studdert-Kennedy have been a precious help. I am indebted to Jim Hurford for his editorial work, which improved the quality of the text, as well as for his faithful and precise translation, and to John Davey for his amiable comportment. Finally, I give special thanks to my wife, Cécile, for the energy she gives me each day, and which has motivated me during the writing of this book.

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