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978-0-521-42871-2 - Mechanics of Pre-industrial Technology: An Introduction to the Mechanics of Ancient and Traditional Material Culture

Brian Cotterell and Johan Kamminga

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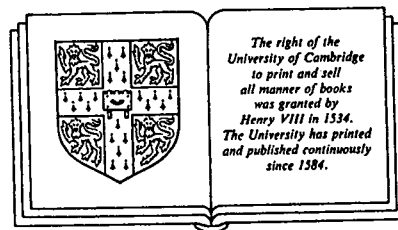
Mechanics of pre-industrial technology

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PREFACE

This book is about the material culture of ancient and non-industrial societies. The topics covered range from the fragments of siliceous stone that are the earliest known hominid artifacts to the development of watermills and other artifacts up to the Industrial Age. Our case studies are selected from as wide a range of societies as possible to try to avoid the Eurocentric bias that can be seen in some histories of technology. We consider not only archaeological artifacts but also ethnographic and historical evidence from traditional hunter-gatherers and other non-Industrial peoples such as, for example, the Australian Aborigines, the Polynesians and the Ottoman Turks. Some ethnographic artifacts can be of great value in reconstructing or inferring the properties and performances of archaeological ones. We encompass all modern artifacts used in non-Industrial societies under the label 'traditional'. Many of our examples of hunter-gatherer artifacts are from the material culture of the Australian Aborigines. Our bias is partly because we are most familiar with the traditional material culture of our own country, but it is also because the Aborigines comprised the world's largest population of hunter-gatherers in modern times and therefore much research has been done on their material culture.

The idea of a book about mechanics of early and traditional technology occurred to us during an archaeological conference on stone tools that was held in Vancouver some years ago. We gave a joint paper about the mechanics of stone flaking, a topic that drew on our two areas of special interest: engineering fracture mechanics and prehistoric stone technology. While the audience of archaeologists appreciated what we were saying most of the delegates did not know sufficient mechanics theory to understand how we had arrived at our conclusions; nor was there much comprehension of mechanics terminology. This general lack of familiarity with mechanics theory is not surprising. The structure of college and university education does not particularly encourage students in archaeology or anthropology, or in the humanities in general, to study the sciences. While the study of artifacts is a fundamental part of archaeology and cultural anthropology, the study of how they perform mechanically has a patchy history. Franz Boas was the first

anthropologist to write a general account of the mechanics and performance of traditional artifacts, in the introduction to a general book on anthropology (Boas 1938:238–81). However in recent decades there have been few general accounts of mechanics in material culture studies, though there have been many that deal with specific applications, a large number of which we refer to in this book. Mechanics serves anthropology not only in providing an understanding of artifacts and technological processes but in its applications to problems in biological evolution as well – as shown in recent biomechanical studies of the hominid face and cranial architecture (e.g. Demes 1982; Russell 1985).

This book is not a history of technology, nor one of mechanical science, though in our presentation of mechanical principles we have taken a partly historical approach. Mechanics forms the basis of many branches of science, including engineering, and is necessary in the development of much new material culture – be it a component for an artificial hip or a new transport system. In this book we present the interdisciplinary study of the mechanics of material culture. Interdisciplinary studies involving mechanics are not new. For example biomechanics is now a firmly established interdisciplinary field and mechatronics, the study of both the mechanical and electronic aspects of robots, is a fast expanding field.

This book, which illustrates the applications of mechanics in archaeology, should also serve a wider readership in disciplines such as cultural anthropology, engineering, history, and physics. Because our book embodies the first contemporary review of the field we introduce basic mechanical concepts in the earlier chapters and bring in other mechanics in later chapters as they become relevant to the various analyses. Because a number of our readers do not have a grounding in advanced mathematics we have kept our calculations reasonably elementary so that they should be understandable to anyone who has completed secondary school mathematics. Those of our readers who are uncomfortable with equations can still grasp the essentials of the mechanical concepts we present. The mathematical details of the mechanics of any artifact or technological process can be passed over lightly without losing continuity in reading the text.

In developing our style we were influenced by Lloyd Taylor's book, *Physics, the pioneer science*. We also much admired the lucid style of J. E. Gordon's two books, *The new science of strong materials* and *Structures*, which we found valuable sources of information. We would have found it difficult to begin the mechanical studies of the wide range of artifacts without the two monumental works: *A history of technology* edited by Charles Singer and colleagues, and *Science and civilisation in China* written by Joseph Needham and his co-authors.

For permission to publish photographs and drawings we thank the following individuals and institutions: Fig. 1.2, Carnegie Museum of Natural History (photo by Rudyerd Boulton); Fig. 2.7 and 2.8, Vatican Museums and Art Galleries; Fig. 2.10, Wilkinson Sword Group Australia Ltd., Melbourne; Fig. 5.2, Paul Popper Ltd., Photographic Agency, London (photo by Paul Popper); Fig. 5.14, The British School at Rome, Exhibition Road, London; Fig. 6.2, F. P. Dickson; Fig. 7.6, Bibliographisches Institut and F. A. Brockhaus (copyright Associated Press); Fig. 7.12, Dr Felix Hess, Rijksuniversiteit te Groningen; Fig. 8.3, National Museum, Copenhagen; Fig. 9.7, John Coates and CUP; Fig. 9.17, University Museum of National Antiquities, Oslo; Fig. 10.10, Jennifer Steel Photography, North Sydney.

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