

Deep Sea in Peril

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Source: BioScience, 58(2) : 172-173

Published By: American Institute of Biological Sciences

URL: <https://doi.org/10.1641/B580213>

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Solving the “Sapient Paradox”

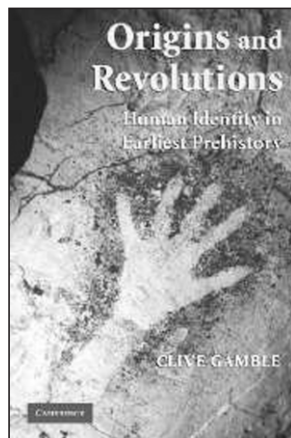
Origins and Revolutions: Human Identity in Earliest Prehistory. Clive Gamble. Cambridge University Press, New York, 2007. 364 pp., illus. \$27.99 (ISBN 9780521677493 paper).

The origin of humankind continues to be one of the most difficult and intriguing uncertainties in the field of science. Discoveries of fossils, notably in Africa, and the development of DNA studies situate the emergence of *Homo sapiens* in Africa more than 150,000 years ago, and the dispersal of our species out of Africa about 60,000 years ago. But when and how did the behaviors that we associate with modern humankind emerge? And in particular, if the genotype was established 60,000 years ago or earlier, why did it take the new behaviors that accompanied the sedentary revolution of some 10,000 years ago so long to develop?

These are some of the questions tackled by Clive Gamble, professor of geography—but primarily an archaeologist—at Royal Holloway University of London, in *Origins and Revolutions: Human Identity in Earliest Prehistory*. He is one of the most original of current specialists in the early human past, and the author of *Timewalkers: The Prehistory of Global Colonization* and of *The Palaeolithic Societies of Europe*. His new book is particularly refreshing because it is not just a review of the hard evidence (hominid fossils and stone tools) that forms the undeniable basis of our knowledge. Rather, it questions the assumptions and the preconceptions that inevitably color perceptions of our own early past. It introduces the fresh argument, sometimes called the “sapient paradox,” that some of the complex behaviors now associated with humans took a long time to develop even after the emergence in Africa of humans who were fully modern in the anatomical and genetic senses. This is difficult territory, because archaeologists have not reached consensus about when language

first arose or when self-consciousness developed.

Gamble first reviews the well-established concepts of the “Neolithic Revolution” (associated with the origin of farming) and the “Human Revolution,” involving the appearance of our own species with some of the behaviors (new lithic industries, bone and antler tools, new social relations) that can be detected in the archaeological record from that time. He makes an excellent case that the term “revolution” is not a helpful one, and that we should



find new ways of examining and discussing the underlying processes at work. He also critically examines the alleged significance of the origins of sedentism: that is, the first permanent village communities sustained by the new practice of agriculture. He accepts that this change was one of profound significance, even if it happened too gradually to be dubbed a revolution.

Gamble’s approach is to undertake a thorough examination of the notion of personal identity and of the material basis for identity, during what he terms the “long introduction” to modernity (up to 100,000 years ago). He then surveys the “common ground” (100,000 to 20,000 years ago) and the “short answer” (20,000 to 5000 years ago). Gamble begins his analysis with the human body, and moves to the instruments with which humans, using that body in

intelligent ways, have come to shape the world. Finally, he focuses on the containers—clothes, boats, houses—that humans have fabricated, allowing the creation of new social worlds. Throughout this analysis, he draws expertly on the evidence of the archaeological record, revisiting the archaeological sites—first in Africa, then in Europe and the Near East—that are most relevant to the story, as he traces it, from 3 million to 10,000 years ago.

Many parts of *Origins and Revolutions* make the reader think, and fresh thought is required when dealing with what is, as I said at the outset, a difficult topic. Yes, the evidence is still fairly sparse. But the main difficulty is trying to think in fresh ways about the human past and to structure a new vocabulary that progresses beyond the notions of earlier generations, with their ready-made “revolutions”.

Chapter 5, “The Accumulation and Enchainment of Identity,” is one of the most demanding. Gamble’s emphasis on “fragmentation” and social “enchainment”—the results of exchanging or transporting materials through space—may come as a surprise to some readers. Yet he develops ideas here that will prove influential, and that are essential if archaeology is to transcend the stones and the bones of the material record and grasp some of the underlying social realities. In the final chapter Gamble asks, “Did agriculture really change the world?” And the conclusion is that “agriculture, or more precisely sedentary communal living, really did change the world” (p. 209). But there is much more to it than that. Throughout the book, Gamble stresses the rather neglected field (in this context) of children, of how children are reared, and of what he calls the “childscape.” There are many insights offered here that will lead, productively, to developments in our thinking about human origins.

Origins and Revolutions, which is readable and satisfyingly documented,

suffers from one significant defect. In his treatment of early sedentism (and agriculture), Gamble restricts his study to the Near East (including Anatolia), which was indeed one of the earliest focal centers for sedentism and plant (and animal) domestication. But his generalizations would be more powerful if they had been applied to (and tested by) the evidence from other such centers, including those of China, Mesoamerica, and South America. Admittedly, it is a formidable task to become familiar with the “formative” periods before full agricultural life in each of those areas, but their omission denies the reader the opportunity to see Gamble’s persuasive ideas tested and exemplified again in those other early theaters of human development. Nonetheless, that omission does not detract from what Gamble has achieved in this thoughtful and refreshing book. This is a challenging and well-informed analysis by a leading scholar on the formation of early human identities and societies. It suggests promising paths for further study, and it will be read with profit by anyone who wants to understand how we have come to be as we are.

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doi:10.1641/B580212

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DEEP SEA IN PERIL

The Silent Deep: The Discovery, Ecology, and Conservation of the Deep Sea. Tony Koslow. University of Chicago Press, Chicago, 2007. 312 pp., illus. \$35.00 (ISBN 9780226451251 cloth).

The *Silent Deep* has been published at a critical time: the deep sea, which covers a vast part of our planet, is being gravely threatened by anthropogenic

impacts, ranging from rising temperatures and increasing concentrations of carbon dioxide and pollutants to the effects of trawling the bottom at ever-increasing depths to extract a diminishing supply of fish. Tony Koslow, a deep-sea ecologist, very effectively sounds the alarm, especially about uncontrolled benthic trawling in international waters, an issue that the public is little aware of.

The Silent Deep is an enjoyable, illustrated history of the exploration and scientific investigation of the deep ocean from the 19th century to the present, one that will appeal to lay people as well as to scientists. Koslow spent six years writing this comprehensive treatise, and I applaud his attention to detail. Especially noteworthy is his use of the primary research literature, along with more general treatises and government

Although it is easy to suppose that anthropogenic impacts on deep-sea systems are associated with continental margins, Koslow demonstrates that this is not always true.... [P]ollutants are disseminated on a global scale, and concentrations are amplified through oceanic food webs.

reports. Moreover, even though Koslow tackles many, sometimes confusing subjects, he makes them coherent for the general public, yet shows scientific caution in the overall synthesis.

The section on the impact of increasing levels of carbon dioxide on the ocean is particularly well orchestrated. Koslow describes the papers that first discussed the potential problems associated with fossil-fuel consumption and rising carbon-dioxide levels in the atmosphere, properly crediting Roger Revelle and Hans Suess for emphasizing these issues and the need for long-term monitoring. Although it is easy to suppose that anthropogenic impacts on deep-sea systems are associated with the continental margins, Koslow demonstrates that this is not always true. The atmospheric transport of chlorinated hydrocarbons and trace metals such as

mercury is a case in point. These pollutants are disseminated on a global scale, and concentrations are amplified through oceanic food webs. The consequences for deep-sea animals are as yet unstudied, but they may well be far from trivial.

Koslow also gives a good description of the controversy concerning the number of animal species in the deep sea and the number of species that remain undescribed, beginning with the seminal study of Fred Grassle and Nancy Maciolek, who sampled macrofauna in sediments along the New Jersey and Delaware continental margin. These investigators extrapolated the rate of occurrence of new species in successive transect samples (one per kilometer) to the world’s oceans below 1000 meters, arriving at a global estimate of 10 million new species in the deep sea. Their paper has been a galvanizing force in establishing initiatives to study biodiversity and document all species in the deep ocean worldwide, although some prominent researchers—Koslow included, he acknowledges—have criticized Grassle and Maciolek’s projections as being overestimates.

Unfortunately, Koslow only briefly discusses the technological advances that have led to breakthroughs in our knowledge of the deep sea, such as the bathysphere, the submersible *Alvin*, the use of finer-mesh sieves, and camera systems for detecting scavenging species around bait. A more thorough presentation might have made it apparent that many discoveries would not have been possible without these and other technological advances. Autonomous instrumentation untethered to a ship, for example, has been used extensively over the past 50 years for both short- and long-term studies in the deep sea.

Koslow does stress, however, the importance of long time-series measurements in the deep sea, and notes that such research is now conducted at only two sites worldwide. The planned installation of cabled observatories in the North Pacific, North Atlantic, and Mediterranean will allow a new approach to long-term monitoring. Many countries and the European Union

are financing these installations. An introduction to this frontier of deep-sea observation, which allows real-time data acquisition and control, would have provided the reader with insight into future long-term monitoring of the deep sea.

The only part of the book that I found laborious was chapter 11, which deals with ocean conservation and policy options. Here the author describes the myriad governing bodies involved with deep ocean issues, each of which is introduced, and subsequently discussed, by acronym. The resulting alphabet soup is unappealing. Had fewer agencies been described in detail, this section would have been far more readable, and the take-home message for the reader would have been much clearer.

Koslow's personal notes throughout the book establish his unique credibility in discussing deep-sea biology. His studies of the orange roughy provide good insight into the known natural history of this species and the subsequent decline of its extensive fishery. Koslow makes a concerted effort to relate earlier descriptive chapters to the sections dealing with fisheries management and with the critical international issues yet to be resolved.

Koslow describes the key discoveries in deep-sea biology that have led to our current, and still sketchy, knowledge. Considering how little of the ocean floor has been explored, we should not wonder why the deep ocean is still the most understudied expanse of the earth's surface. *The Silent Deep* illuminates the deep sea—both its wealth of biological diversity and its vulnerability to anthropogenic assaults—and persuasively argues for protection of this vast portion of the biosphere. I highly recommend this book to anyone interested in the deep ocean.

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doi:10.1641/B580213

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ANOTHER PERSPECTIVE ON YELLOWSTONE'S NORTHERN RANGE

Yellowstone's Destabilized Ecosystem: Elk Effects, Science, and Policy Conflict. Frederic H. Wagner. Oxford University Press, New York, 2006. 392 pp., illus. \$64.50 (ISBN 9780195148213 cloth).

Yellowstone National Park (YNP) and its complement of native wildlife populations and diverse habitats have long fascinated both scientists and the public. Park management goals and methods have changed since this first national park was established in 1872, and ecological understanding has also evolved. Notable among many park issues that have elicited controversy is the state of Yellowstone's elk population and the elks' critical winter habitat, the northern range. "Natural regulation policy" lies at the heart of many of the concerns about YNP, and is the focus of *Yellowstone's Destabilized Ecosystem*, by Frederic H. Wagner.

Wagner makes the key point that adaptive management requires a solid monitoring program and explicit criteria by which management can be evaluated.

Wagner, professor emeritus in the Department of Forest, Range, and Wildlife Sciences at Utah State University, offers analysis, synthesis, and a personal perspective on elk effects and the science and policy conflicts surrounding Yellowstone's northern range. Wagner has also created a broader outlet for research conducted by his former student, Charles Kay, whose dissertation (Kay 1990) is one of Wagner's key sources. Wagner argues, in part on the basis of Kay's work, that ungulates were relatively scarce before the park's establishment, and this premise underpins the entire book. Also underpinning the book is Wagner's contention

that science and policy have not been separated on the northern range, and that a "pernicious effect [of this lack of separation] is that policy implications color the objectivity of scientific inference." Considered broadly, the saga of the northern range elk is a fascinating example of the scientific process and how different authors evaluate evidence and reach different interpretations.

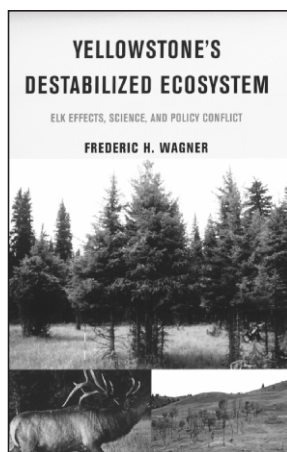
The book is organized into four major sections. Part 1 focuses on the history of the northern range dispute and provides a useful entrée for readers new to the subject. Wagner contends that the natural-regulation policy was adopted for political rather than scientific reasons. In this section, as in other places in the book, potential explanations for observed phenomena are correct but sometimes incomplete. For example, the movement of many elk (approximately 40 percent of the herd) out of the park in search of food during the winter of 1988–1989 is described as an exodus that established a tradition. Wagner mentions the extreme drought of 1988 as a catalyst for this change in movement, along with the return of a more severe winter, suggesting that forage depletion could be an important stimulus. However, the role of the 1988 fires, which burned about 34 percent of the northern range and 22 percent of the grasslands, in reducing the forage available at the outset of the 1988–1989 winter is not mentioned. Furthermore, the deep or dense snow associated with severe winters often makes the forage present on the range inaccessible to elk—thus, elk may move because they cannot get to the forage, rather than because they have depleted it. Finally, the Dome Mountain Wildlife Management area, to which many elk now migrate in winter, is managed to enhance winter forage for wildlife and may well have reinforced the initial migration. Thus, factors beyond those mentioned in the book may have played key roles.

The long-term population dynamics of the northern Yellowstone elk are the subject of part 2. Wagner presents an excellent summary of how the population has changed during the period for which census records exist (1923–2003).

For the prehistory period before YNP was established, Wagner relies on Kay's dissertation research. Kay (1990) inferred low elk population densities in pre-Columbian time and suggested that aboriginal hunting was an important control on elk populations. This notion certainly warrants consideration, but the prehistory size of the elk population has not been resolved in the scientific community, and even Wagner acknowledges the uncertainty of reconstructing the past. It is unfortunate that he considers differing views as "one-sided, negative arguments seeking to falsify Kay's hypothesis." Nonetheless, Wagner's estimate of the elk population from 1850 to the present is nicely illustrated in figure 5.1, which merges the prehistory population inferences with the census record. Wagner raises the important question of whether the elk population is now entering a new phase, given the exodus of elk during winters and the 1995 reintroduction of wolves, and underscores the critical need for well-designed monitoring to evaluate the ecological consequences of these patterns.

The effects of elk on ecosystem structure and function are the focus of part 3. The review of elk browsing in the context of aspen decline and the condition of sagebrush steppe is useful, although Wagner stresses his conclusion that "the weight of the evidence now points to low [elk] numbers in prehistory" as he interprets the vegetation record. Genetic analyses that bear on the frequency of establishment of aspen clones in the northern range were not mentioned (e.g., Tuskan et al. 1996). Interesting work by contributor Richard Kiegley on how the architecture of conifers may be altered under browsing pressure is also reviewed. The role of fire for the conifers is mentioned tangentially, but the slow reestablishment of Engelmann spruce stands burned in the 1988 fires may reflect the natural course of succession in this forest type rather than browsing by elk. The discussion of interactions among species that make up the ungulate guild is nicely presented. In keeping with his premise, Wagner asserts that the biomass of animals

wintering on the northern range in the 1880s was very likely no more than one-third of the biomass in the 1990s. Further, he suggests that herbivory pressure in the 1990s must have been around six times the pressure in 1872. The discussion of riparian systems reviews the multiple arguments regarding willow decline and includes a nice section on the riparian fauna. A chapter on erosion coauthored by Kiegley includes a careful reanalysis of experimental data that demonstrates increased runoff in the presence of grazing. Regarding bioenergetics, Wagner disputes results from previous published studies that suggest compensatory plant growth in response to grazing. A concise chapter on nitrogen biogeochemistry rounds out this third part of the book, which concludes with a synthesis of Wagner's primary conclusions about the ecology of the northern range.



The final part of the book addresses the general role of science in policy. Wagner asserts that YNP research since the 1970s has not provided an accurate and objective assessment of the northern range ecosystem. This part of the book is largely a critique of park science that mixes some worthwhile and valid points with others that are anecdotal and not widely held. Furthermore, the dark description of park oversight of science does not hold for many scientists who have conducted research in YNP and published widely in peer-reviewed journals. As a scientist who has conducted research in Yellowstone for nearly 20 years (with external funding),

I can assert from personal experience that the park staff has never attempted to direct our research, to influence the interpretation of our data, or to discount findings that differ from their a priori expectations. Although I do not discount the veracity of others' experiences, readers should be wary about their generality.

Examples of how different scientists can reach different conclusions are also found in these final chapters—for instance, Wagner's conclusion that aboriginal hunting was a key influence in Yellowstone during pre-Columbian times, and Boyce's (1998) inference that such effects are "essentially untestable and highly unlikely." Science must consider multiple interpretations, and scholarly disagreements can ultimately advance understanding. Wagner makes the key point that adaptive management requires a solid monitoring program and explicit criteria by which management can be evaluated. Some disputes regarding the northern range might have been resolved had a long-term, rigorous effort been in place; however, even the best of monitoring programs will be unable to resolve the question of what constitutes "natural."

In summary, Wagner's book includes new and informative analyses; an extensive, albeit not complete, synthesis of relevant literature; and strong personal opinion. His main thesis is nicely encapsulated in a concluding statement: "The subsequent [after 1967] laissez-faire implementation of natural regulation by the park has been contrary to...the goal of restoring and maintaining the natural state of the northern range" (p. 333). Scientists and managers who have followed the northern range controversies will want to read this book. Students interested in science-policy interactions would find it valuable to read Wagner's book along with other publications on the subject (e.g., Boyce 1998, National Research Council 2002) that have differing perspectives. Collectively, these would provide a useful example of the importance of ongoing dialogue within science and between science and policy.

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doi:10.1641/B580214

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