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The oceanography of Cuchlaine A.M. King

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Abstract
C.A.M. King, the noted British coastal geomorphologist, authored two books in a three-year period. *Beaches and Coasts* in 1959 was a major contribution to coastal geomorphology, whereas *Oceanography for Geographers* represents King's attempt to show the importance of the oceans to all of geography. Their approaches and pedagogy differ, but their lessons remain relevant today.

Keywords
C.A.M. King, coastal geomorphology, oceanography

Introduction

The early history of oceanography, what may be called the exploratory phase, included geographers along with members of many other of the sciences. William Morris Davis, in his Presidential Address at the founding of the Association of American Geographers (AAG) in 1904, specifically included geographers working in oceanography in his call to "bring together a large majority of the investigating geographers of the United States – indeed, of North America" (Davis, 1905: 85). In addition to mapping and charting coastlines, geographers were involved in many aspects of the description of the oceans as both a physiographic and biologic construct (Greene, 1993). Table 1 from Greene (1993) neatly summarizes these associations.

Geographers and oceanographers worked alongside meteorologists during the Second World War to solve many practical problems, such as constraints on amphibious landings and improved weather and wave forecasting (Bascom, 1988; Kennedy, 2013). After the war, oceanography was perceived as "big science" with correspondingly large funding mainly because of the efforts of the US Navy and major oceanographic institutions, such as Scripps and Woods Hole (Rainger, 2000). As a result, the theoretical development of physical oceanography became more closely aligned with meteorology. Geologists tended to dominate the expanded exploration and mapping of the seafloor,

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Table 1. Geography and oceanography in the early 20th century (adapted from Greene, 1993).

Geography	Oceanography
Explorations	Voyages
Geomorphology	Geography of ocean basins
Natural history	Marine biology and fisheries research
Cartography	Hydrography
Soils	Physical properties of seawater
Grand theory of landforms	Grand theory of tides and circulation

culminating with the paradigm-changing theory of plate tectonics (Menard, 1986). Physical geographers turned their efforts to the land–sea interface, embracing coastal geomorphology. In 1970, the AAG formed the Marine Geography Committee, the forerunner of the current Coastal and Marine Specialty Group (Psuty et al., 2003).

Cuchlaine Audrey Muriel (C.A.M.) King (Figure 1) is an exemplar of a post-war marine geographer. King was born in Cambridge in 1922 and graduated with a bachelor's degree in geography from Cambridge in 1943. At graduation, she joined the Women's Royal Naval Service and was posted to airfields in Wales and Northern Ireland to assist in weather forecasting. She earned her doctorate, also in geography, at Cambridge in 1949, researching sand beaches under the direction of William Williams. Another influence on her academic research was William Vaughan Lewis and his studies of waves on beaches, along with glacial erosion. As an undergraduate, King mastered topographic surveying, a skill that she used effectively in her field studies. King joined the Geography Department at the University of Nottingham in 1951, where she remained until her retirement in 1982. She was an active field researcher while at Nottingham, studying beaches, coasts, and glaciers throughout the world.

King was noted for her work in the male-dominated field and was the first female scientist

Figure 1. C.A.M. King was a pioneer and advocate for women conducting field research. Photograph by permission of John Wiley and Sons from Whalley (2020).

granted permission by the Canadian Government to conduct fieldwork on Baffin Island. In 1961 she was a founding member of the British Geomorphological Research Group, later the British Society for Geomorphology (BSG). She was awarded the Linton Prize from the BSG in 1981, a fitting recognition of her contributions in both research and student mentoring (Whalley, 2020). King was an early proponent of the quantitative revolution in geography and authored numerous textbooks on physical and quantitative geography. Following an active retirement, King died at her home in Wensleydale, North Yorkshire, UK in December 2019.

The focus of this article is two of King's books. One of these books is well known, whereas the other is not. Both deal with aspects of oceanography and geography and provide a glimpse of King's ability to operate in both domains.

The texts

Beaches and Coasts, published in 1959 and reprinted in 1961 and 1966, is King's best-known work. It represents a synthesis of research on coastal issues, especially those associated with the morphology of the beach. In 12 chapters (Table 2), King first introduces the main factors affecting the beach: waves, wind, tides, and beach material. The heart of the book is the chapters dealing with

Table 2. Chapter titles in *Beaches and Coasts* (King, 1959).

Chapter title	No. of text pages
The main factors on which the character of the beach depends	36
Methods of research	17
Waves	67
Movement of material on the beach	58
Beach profiles – experimental results and surveying techniques	28
The effect of wind	20
Classifications of beaches and coasts	20
Constructive wave action and coastal accretion	32
Destructive wave action and coastal erosion	42
Beach gradient and beach profiles	35
Historical data on coastal change	10
Coastal types and their development – the marine cycle	22

Table 3. Chapter titles in *Oceanography for Geographers* (King, 1962).

Chapter title	No. of text pages
The origin and structure of the ocean basins and their water	32
The geomorphology of the ocean floor	43
The water of the oceans	26
The circulation of the oceans	42
The tide	39
Waves	37
Sediment in the oceans	31
Some aspects of life in the oceans	40
The geographical significance of the oceans	15

the transport of beach materials, beach profiles, and the constructive and destructive action of waves. A final set of chapters addresses the geomorphology and classification of shorelines. The book adopts a systems approach and represents an early example of the use of quantitative techniques. Considerable space is devoted to the quantitative aspects of waves: their generation, propagation, and interaction with the coast. The Methods chapter includes a discussion of both experimental and field techniques. King makes good use of her experience in topographic surveying in her discussion of beach profiling.

Oceanography for Geographers, published in 1962, allows King to fill in more of the science of the oceans than was presented in *Beaches and Coasts.* In nine chapters (Table 3), King covers much of the material found in the introductory oceanography textbooks of today. The treatment is mostly non-quantitative, relying on description and illustrations to convey more complex principles. The two chapters on tides and waves are the most quantitative, with clear illustrations and nomograms substituting for complex mathematics. Although the book is directed toward geographers and does not present its material in depth, the numerous references at the end of each chapter provide a guide to more in-depth study for the interested reader. King uses the final chapter to tie together aspects of oceanography and geography. The seven sections (Table 4) highlight some of the ways the oceans influence human life on Earth: climate, which manifests its impact through the interaction of the ocean and atmosphere; fisheries; changes in sea-level; and use of ocean transport for bulk cargos. It represents King's attempt to push back against the developing physical–human dichotomy in the discipline (James, 1967).

Importance of the texts

These books represent a response to one of the major challenges of mid-20th century physical geography. The quantitative revolution allowed physical geographers to focus on physical process studies, but human agency could not be excluded and yet maintain a true geographical perspective of the human–land tradition of geography (Marcus, 1979). Coastal geomorphologists like King studied the processes driving shoreline equilibrium that led them to an enhanced study of the coastal ocean and its waves, tides, and currents

Table 4. Section headings in Chapter 9 of King (1962): The geographical significance of the oceans.

Introduction
The interaction of the oceans and atmosphere
Coastal change as influenced by marine forces
The oceans in exploration and transport
The strategic role of the oceans
The oceans as a source of food
International co-operation in the oceans
Conclusion
References
Glossary

(Gregory, 2000). By contrast, episodic events, such as coastal flooding, showed the importance of understanding the oceans for the population affected either directly or indirectly by what occurs along the coast (Barnes and King, 1953).

Beaches and Coasts is a process-oriented physical study, whereas *Oceanography for Geographers* provides supplemental material for understanding coastal processes. However, King goes beyond physical processes to show geographers the importance of the oceans to both physical and human geographers. Most of her sections in Chapter 9 of *Oceanography for Geographers* (Table 4) are separate chapters in today's introductory oceanography texts and her discussion of the role of the oceans in global climate change is especially prescient. Although *Oceanography for Geographers* has been supplanted by the many excellent introductory oceanography texts now available, it does represent one of the first attempts to combine both the physical and human aspects of the world ocean. *Beaches and Coasts* continues as a classic in coastal geomorphology. References to it and King's work continue to appear in more recent coastal geomorphology texts and it lists as number 118 in sales on the Amazon.com geomorphology list.

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