PHYSICAL GEOGRAPHY

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Contents

Summary

This article provides a historical overview of the evolution of physical geography from classical Greece, through Chinese and Islamic scholars, to European and North American research. Ten main fields of study in contemporary physical geography are defined. Five fields are systematic, and emphasize one of the natural spheres: geomorphology (lithosphere), climatology (atmosphere), hydrology (hydrosphere), biogeography (biosphere), and soil geography (pedosphere). Five fields are integrative and provide linkages between two or more spheres, including in all cases the anthroposphere: coastal systems, mountain ecology, natural hazards, landscape ecology, and biogeochemical cycles. Past environmental changes are evidenced from a wide variety of data sources and contemporary global environmental change includes consideration of tectonic movements, volcanism, atmospheric and oceanic circulation, energy budgets, mass budgets, snow and ice changes, land use and land cover changes,

and biomass energy changes. A final section on applied physical geography demonstrates that all the fields of physical geography, whether systematic or integrative, have important practical applications.

1. Historical Background

1.1. Chinese, Islamic, and Classical Greek and Roman Scholarship

Of the five types of Chinese geography recognized by Needham and Wang, three bear on physical geography:

- Hydrographic books and coastal descriptions (fifth century B.C.E. onwards)
- Local topographies or gazetteers (fourth century C.E. onwards)
- Geographical encyclopedias (fourth century C.E. onwards)

In addition, the Chinese cartographic tradition, culminating in Chu Ssu-Pen's map of China (1311–1320) was significantly ahead of European work at that time.

Islamic geographical writing was influenced by the requirement that all faithful Moslems had to make a pilgrimage to Mecca at least once in their lives. Hence the production of detailed travel guides. Al-Idrisi (1099–1180) completed a descriptive geography in 1154 that described the towns and territories of the planisphere, the nature of agriculture and settlements, and the extent of its seas, mountains, and plains. Ibn Khaldun (1332–1406) is a more substantial scholar, whose contribution to historical geography was major, but the physical geography that he wrote was largely derived from Al-Idrisi.

In early Greek writing, there were two physical geographic traditions:

1. A topographic tradition, concerned with describing Earth.
2. A mathematical and astronomical tradition, concerned with measuring Earth.

Homer's *Iliad* and *Odyssey* (ninth century B.C.E.) are widely considered to be among the earliest surviving geographical works, in the sense that they provide detailed descriptions of the people and places visited. In this sense, they can also be viewed as the earliest evidences of an emergent physical geography. In the third century B.C.E., Eratosthenes made the first accurate measurement of the globe and has been described as the "parent of scientific geography."

The contributions of Strabo and Ptolemy, writing respectively in the first and second centuries C.E., can be considered to have had the most direct influence on the future shape of European geography. Strabo's 17-volume *Geography* contains extensive topographical description of the known world and emphasized what Ptolemy subsequently called chorography. Ptolemy, who was by contrast an astronomer, emphasized that geography was concerned with the whole earth and that therefore the mathematical sciences are central to geography.

1.2. Translation of Ptolemy's Geography into Latin, and the Age of Discovery

The translation of Ptolemy's *Geography* into Latin in 1410 was a milestone, as has been suggested, not least because he had devised a system of geographical coordinates by which any point on the surface of the earth could be identified. "The new availability of

this work, together with the use of the compass since the eleventh century, and the idea that the ocean was not so much a barrier to movement but rather a waterway, stimulated a group of Florentine humanists to take seriously the possibility of westward exploration."

There is much debate about the precise role of Prince Henry the Navigator (Dom Henrique, 1394–1460), but it is certain that the ruling dynasty of Portugal had a major influence on Europeans setting their sights on horizons overseas. Not only did this lead to recalculating the size of the earth and improved cartography, a profoundly new understanding emerged of the variety of physical environments globally.

1.3. The General and Special Geographies of Varenius

The *Geographia Generalis* of Bernhard Varenius (1622–1650) divides geography into general and special geography, a direct echo of Ptolemy's distinction between geography and chorography. He emphasized the importance of geography as a science and therefore focused on general geography to the neglect of special geography. He divided general geography into three parts:

1. Absolute general geography, concerned with the body of Earth
2. Relative general geography, concerning effects of celestial phenomena on Earth
3. Comparative general geography, concerning comparison of different places on Earth

This book has been described as the first response by a geographer to the new empirical and rationalist science of Bacon, Galileo, and Descartes.

1.4. Seventeenth-Century Scientific Revolution, Eighteenth-Century Natural Theology and Natural History

Whereas older accounts of the scientific revolution emphasized the physical sciences, it is now clear that the natural sciences were also being transformed. An interesting comparison has been drawn between von Gesner's *Historia Animalium* from the mid-sixteenth century and Johnston's *Natural History* of 1650. In the former, natural history specimens were described not only in terms of habits and characteristics but also in relation to proverbs, myths, and hieroglyphs; in the latter, observable characteristics alone are described. Such a revolution in thinking made scientific classification systems possible and travel and discovery became paramount to the emergent physical geography. The role of natural theology is perhaps less obvious. In the Protestant, and particularly in the eighteenth-century Scottish tradition, there was a perceived need to maintain links between moral philosophy and natural science. This meant that the motivation for good science was the interpretation of the mind and purposes of God. A necessary corollary was the need for accurate and detailed description of lands, seas, plants, and animals. Sacred Theories of the Earth, such as that of Burnet (1681–1689) rapidly evolved into Natural Histories, such as that of Buffon (1749).

1.5. The Role of Immanuel Kant (1724–1804)

Immanuel Kant delivered lectures on physical geography at the University of Konigsberg for 40 years, from 1756 to 1796. His *Physical Geography*, the first full-

length book to carry this title, was published in 1802. Kant argued that there are three ways of looking at the earth:

1. A mathematical way concerning its form,
2. Political doctrine concerned with people, and
3. Physical geography, concerning the natural conditions of the earth

He also argued that physical geography was the foundation of history as well as of all other possible geographies. In this sense, his physical geography was a forerunner of the environmental determinist position that emerged so strongly over a century later.

1.6. Emergence of "That European Science"

It has been argued that geography is essentially a European science, that the combination of improved position fixing with measurements of height both above and below sea level, allied to the expansion of European expeditionary activity, were the main contributory factors in the emergence of modern geography. Specifically, 1769, the year Captain Cook first entered the Pacific Ocean, has been identified as the birth of geography as a recognizable European science. The contribution of the Forsters, Johann Reinhold and his son Georg, to the development of that science has also been highlighted. The scientists on Cook's voyages brought a new realism to observation and description and a concern with measurement; a systematic approach to knowledge that employed the newly developed Linnaean classification and the comparative method to find common explanations for apparently disparate phenomena. The essential ingredients of this science were "a recognition of the immensity of time, the importance of space and scale and a recognition of humanity's capacity to interpret and to modify their environment."

1.7. The Role of Alexander von Humboldt (1769–1859)

Many field-oriented physical geographers recognize Alexander Von Humboldt as the founder and systematizer of the field of physical geography. They find Kant too philosophical and the European science too expeditionary in its emphasis. The challenge of the collection and organization of information on the natural world on land was much greater than that faced by the maritime explorers at sea. For example, on their expedition to South America, von Humboldt and the French botanist Bonpland collected over 60 000 specimens of 6000 plant species of which 3000 were new to science. Beyond this activity, however, von Humboldt was a great organizer of knowledge. It was von Humboldt who first mapped areas of equal temperature, enclosing them within isotherms, and developed the first map of world temperature distribution. He provided the first transects across mountain ranges and the changes in climate and vegetation zonation that went with them. Towards the end of his life, von Humboldt drew together his experiences and his philosophy in the 5-volume *Cosmos*, sub-titled "A sketch of a physical description of the universe." Von Humboldt insisted on the importance of the interlinkages between each of the physical environmental spheres and the sphere of human society.

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Biographical Sketch

Olav Slaymaker is professor in the Department of Geography of the University of British Columbia (UBC), Vancouver, Canada. He completed a B.A. (Honours) in Geography at King's College, Cambridge, in 1961 and won a Frank Knox Fellowship to Harvard University, where he completed an A.M. degree in geological sciences in 1963. After working six months as research assistant to Dr. Luna Leopold, Chief Hydrologist of the Water Resources Division of the U.S. Geological Survey in Washington, D.C., Professor Slaymaker returned to Cambridge University to commence a Ph.D. in geography. While pursuing his doctorate, he taught geography at the University College of Wales at Aberystwyth, and served as a member of the executive committee of the British Geomorphological Research Group. In 1968, Professor Slaymaker joined UBC as an assistant professor of geography. In 1978/1979, he was president of UBC's Faculty Association. He served as head of the Department of Geography from 1982 to 1991. From 1984 to 1987, Professor Slaymaker was an elected member of UBC's Board of Governors. He was Associate Vice-President, Research, from 1991 to 1995.

Professor Slaymaker's major research interests are the geomorphology and hydrology of mountain regions, especially the Canadian Cordillera, the effects of land use on the sustainability of mountain environments, and the implications of society-environment interrelationships for our understanding of future scenarios of development in mountain regions. In 1990, Professor Slaymaker was chair of the Sustainable Development Initiative Committee, which conceptualized the Sustainable Development Research Initiative at UBC. He was acting director of this institute from 1991 to 1992.

In 1997, in Bologna, Italy, Professor Slaymaker was elected president of the International Association of Geomorphologists. Since 1997, he has chaired the Academic Steering Committee of the Liu Centre for the Study of Global Issues at UBC. He has been a visiting professor at the Universities of Canterbury (New Zealand), Southern Illinois (USA), and Oslo (Norway). He has received the following awards and distinctions: Killam Senior Research Fellow; Erskine Fellow; NSERC International Collaborative Research Fellow; Certificate of Merit, Japanese Geomorphological Union; Fellow of Norwegian Academy of Science and Letters; NATO Advanced Studies Institute Lecturer; and Award for Service to the Profession, Canadian Association of Geographers.

In addition to serving on numerous committees at UBC, Professor Slaymaker has been and continues to be active in many professional organizations including:

- American Geophysical Union (1966–1992);
- British Geomorphological Research Group (1964-);
- Canadian Association of Geographers (1968-); Vice-President (1990–1991); President (1991–1992);
- Canadian Geophysical Union (1992-);
- Canadian Geoscience Council (1979–1995); Executive Committee (1993–1995);
- International Association of Geomorphologists (Treasurer, 1989–1993); Senior Vice-President (1993–1997); President (1997-);
- International Development Research Centre, Board Member (1994-);
- International Geographical Union (1964-); Commission Secretary (1976–1980); Commission Chair (1980–1984); Coopted Executive Member (1996-);
- Liu Centre for the Study of Global Issues (2000-);
- Royal Canadian Geographical Society, Fellow (1993-);
- Social Science Federation of Canada, Board Member (1992–1996);
- Society for the Advancement of Excellence in Education, Chair (1996–1999).

During his career, he has authored, co-authored or edited 95 scientific papers and 16 books.