# In Memoriam

## William Warntz, 1922–1988

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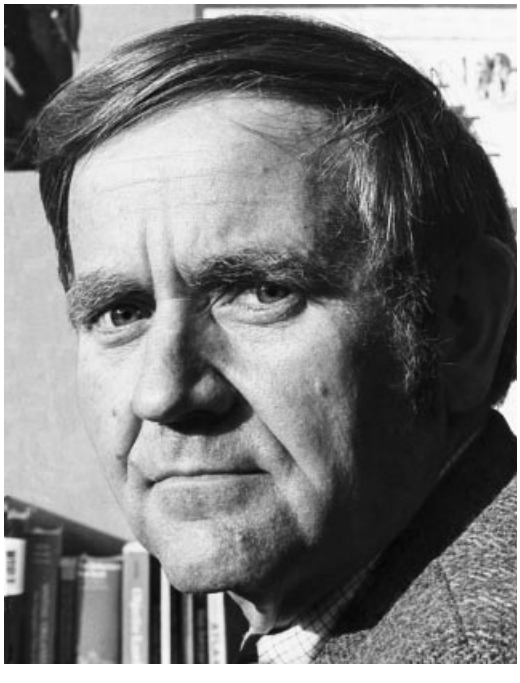
William Warntz was a pioneer in mathematical approaches to spatial analysis. He attempted to bridge the divide between mathematics and the spatial representation of phenomena, leading to significant contributions in theoretical geography. An untiring advocate of the systems view of geography, he sought to identify principles of spatial organization that were common to phenomena in both physical and human geography. He saw geography as a general science of locations, with descriptive geography describing locations, regional geography classifying them, and theoretical geography predicting them. Mathematics was the key to Bill's early contributions. Indeed, before most geographers were aware that it was occurring, he had already published some of the classic papers of the quantitative revolution. He also was an avid scholar on the history of geographic thought and devoted the later part of his career to identifying the origins of spatial analysis, including archival studies on the possible contributions of Sir Isaac Newton to the development of geography (1989).



### Origins of a Spatial Scientist

William Warntz was born on October 10,1922, in Berwick, Pennsylvania, in a coal mining area, eighty miles up-river from Harrisburg, on the Susquehanna. His father, Sterling Adrian Warntz, was a superintendent in a local industry that manufactured railway passenger cars, and his mother, Lilian Grey Warntz, was a teacher. Bill spent much of his boyhood playing baseball, practicing on the trombone, and reading, passions that he nurtured throughout his life. At the dinner table, he would entertain his two sisters, brother, and parents, asking question after question about geography and history, or posing geometrical puzzles for solution.

Education in liberal arts at Berwick School (1936–1940) prepared him for undergraduate work in economics. His education was interrupted, however, by six years in the U.S. Army Air Force (1943–1948). In 1943, he entered the Aviation Cadet College Training Detachment at Albion College in Michigan, where he soloed in a Piper Cub and played on the football team. This was followed in 1943–1944 by a series of Air Force flight and navigation schools that took him across the country, studying cartography, meteorology, and radio. Service as a navigator with the heavy bombardment group in England earned him the Purple Heart, three battle stars, and several other

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decorations. Injured in a crash landing of a B-24 that limped back to England after incurring damage from enemy fire, Warntz was stationed in Cambridge for recuperation. This allowed frequent visits to Cambridge University, where his fascination with the papers of Sir Isaac Newton took his mind off the war and encouraged his pursuit of educational goals.

Following the war, in 1946, Warntz was assigned to the Newfoundland Base Command for duty in sea search-and-rescue missions. Events in Newfoundland had lifelong personal and professional significance for him. In 1947 he met and married A. Minerva Mosdell in Saint John's. Soulmates in their love of music, art, and history, they had two children, Christopher and Pamela. Interest in things geographical were heightened by a fortuitous discovery of a book by John Q. Stewart in the base library at Gander. In what appeared to be a strange deviation from the principal theme of *Coasts Waves and Weather*, Stewart (1945) applied Newton's gravitational concept to studying geographical patterns of population. This insight set the stage for a lifelong friendship, mentorship, and collaboration with Stewart, who was at Princeton.

Warntz completed the B.S. in 1949, the A.M. in 1951, and the Ph.D. in 1955, all three degrees in economics from the University of Pennsylvania. Before the Ph.D., his curiosity for geographical questions arose independently of much formal contact with geography. Recognizing this, he interrupted the Master's program in economics (a minor in geography) to take part in McGill University's 1950 summer course in geography at Stanstead, Quebec. Discussions there, with Kenneth Hare, Trevor Lloyd, Dudley Stamp, Edward Ullman, and others stimulated questions about the history of geography.

Although his Ph.D. was in economics, his thesis advisor was Lester E. Klimm, an economic and military geographer, who became President of the Association of American Geographers in 1958. Warntz's thesis on *The Geography of Price* involved thousands of calculations to derive population potential fields, all with a mechanical adding machine.

## An Engagement with Geography: AGS and Princeton, 1956–1966

Warntz's first academic position was as an instructor/assistant professor in Geography and Economics at the University of Pennsylvania (1949–1956). It was his appointment as research associate and administrative assistant to the Director (Charles B. Hitchcock) of the American Geographical Society in New York (1956–66), however, that opened the engagement between the broader community of geographers and his imaginative mind. Among his published accomplishments while at AGS were *Geography Now and Then* (1964), an insightful documentation of the changing geography curricula in American colleges from colonial days to the 1950s, and two innovative books—*Toward a Geography of Price* (1959), an extension of his dissertation, and *Macrogeography and Income Fronts* (1965). These books draw seemingly disparate interdisciplinary connections (meteorology, economics, and geography) and skillfully combine cartography with mathematical constructs. The latter book explains and predicts with uncanny accuracy the geographical patterns of U.S. population and wealth through the last decade of this century.

A less well-known achievement while at AGS was a 200-hour spare-time construction of a three-dimensional map showing population potential of the U.S.—a special AGS exhibit on "New York: An International City" for the 1964–1965 New York World's Fair (AGS 1964). With patience and precision, he hammered more than 3,000 nails (one for each county) onto a board measuring $2 \times 3.25$ feet, in preparation for a sculptor to cover with plaster. This outreach to the public with geography was common in Warntz's career. He wrote articles for local newspapers, spoke before local geography societies, prepared television seminars on an "Introduction to Geography" (22 hours for WCAU in Philadelphia in 1964) and on "Geography, Concepts and Applications" (13 hours for WHDH in Boston in 1968), and assisted local school boards and teachers with geography curricula.

During his time with AGS, Warntz lived with his family in Princeton, New Jersey. In 1957, he joined Stewart's Social Physics Project as a research associate in the Department of Astro-Physical Sciences at Princeton. He was a frequent visiting lecturer in Geography at Hunter College and at Rutgers University, and in Regional Science at the University of Pennsylvania. In addition, he supervised two Ph.D. dissertations at Columbia University (David Neft in Statistics and Michael Woldenberg in Geography). The daily commutes by train between New York and

Princeton were opportunities for reflection and reading, and also time for drafting *Geographers and What They Do* (1964), an introduction to the discipline for school-age readers.

Jointly, Stewart and Warntz pioneered research on the population potential of the U.S. and on general concepts of what Warntz described as macrogeography. Their extensions of the gravity model continue to serve the practical needs of marketing researchers. This collaboration with Stewart, the opportunities to take part in the development of the regional science discipline, and the experiences with the American Geographical Society were, for Warntz, possibly the most enjoyable period of his career. He commented frequently about the joy of working with, and his great respect for, his AGS associates—Charlie Hitchcock, Wilma Fairchild, David Lowenthal, and Mait Miller.

## The Harvard Years, 1966–1971

In 1966 Warntz became professor of Theoretical Geography and Regional Planning in Harvard University's Graduate School of Design (GSD) and joined the research team in the Laboratory for Computer Graphics. The Lab was set up by Howard T. Fisher, the originator of SYMAP, one of the first general computer-mapping programs, with support from the Ford Foundation. Warntz's appointment was intended to provide strong intellectual grounding for the uses of SYMAP. He covered most of his salary with funding that he brought with him from New York—an Office of Naval Research grant for work on "Geography and the Properties of Surfaces." Warntz helped to define the lab's mission by appending the phrase "and Spatial Analysis." He was appointed Director of LCG&SA in 1968. Though not disposed to programming computers, his leadership there influenced some of the major developments in computerized cartography. With significant support from the National Science Foundation and from the Office of Naval Research, Warntz attracted a range of young mathematicians, geographers, and planners who held in common a certain fascination for things spatial. His courses (Regional Resources Planning, and Theory of the Region) were springboards for student research. He set them loose on a host of theoretical problems centered on the Sandwich Theorem, Thiessen polygons, minimum-path algorithms, topologies of surfaces, map projections, and morphologies of branching systems. Many of his younger associates and students at Harvard are now major contributors to developments in geographic information systems (GIS) (for example, Roger Dangermond).

Located in the basement of Memorial Hall, in an area once occupied by B. F. Skinner's behavioral-science pigeon coop, the Laboratory for Computer Graphics and Spatial Analysis became a center of innovation. Students had ready access to his cardboard boxes, piled deep with the latest papers from Brian Berry, Leslie Curry, Michael Dacey, Bill Bunge, Peter Gould, Walter Isard, Gunnar Olsson, and Waldo Tobler, among others. Serendipitous insights flowed from frequent, informal and, usually, enthusiastic rap sessions, punctuated by occasional musical jams, with Bill on the tuba, Lance Benson on dulcimer, Geoffrey Dutton on concertina, and Mike Woldenberg on guitar.

Warntz introduced and edited the important *Harvard Papers in Theoretical Geography* (1966–1971). He and his colleagues published imaginative work in this series, including lengthy monographs on map projections, and applications of topological theorems and field quantity theory. His trinity of "Geography, Geometry, and Graphics" attained its most pronounced developments while at Harvard. True to his historical interests, he drew inspiration from early Egyptian and Greek scholars, searching for precedents of spatial order. *The Harvard Papers in Theoretical Geography* highlight research on the properties of surfaces, including topological relations, minimum cost paths, spatial hierarchies, and map projections. *Breakthroughs in Geography* (1971a, with Peter Wolff) provides a readable and popular focus on these develpments, with related excerpts from the writings of Ptolemy, Halley, Galton, von Thünen, Horton and other contributors to the integration of geography, geometry, and graphics.

Warntz thoroughly enjoyed his time with students at Harvard, but the politics of campus life in the charged atomosphere of the late sixties had its toll. He attempted to rekindle geography within the university curricula, but with no positive outcome. In 1968 he was requested by Franklin Ford, Dean of the Faculty of Arts and Sciences, to form an ad hoc committee to review the position of geography in the curriculum for possible recommendations to the Committee on Educational Policy.

With prospects of establishing geography as a full-status academic unit within Harvard College,

Warntz anchored the intellectual foundations of this initiative to the research underway in LCG&SA. He envisioned a strong focus on theoretical geography as a science of locations, and sought financial support from the National Science Foundation and from the Carnegie Corporation of New York. These carefully argued bids were not successful, but a more serious obstacle was the changing state of Ford's health and his resignation as Dean. This altered the dynamic, but even more damaging was emerging turmoil in the financial and intellectual health of the Graduate School of Design. Events quickly overshadowed the prospects for a geography program; they even threatened sustained support for LCG&SA—what under the circumstances may have been seen as an expensive luxury, and the significance of which to both geography and science was not yet fully appreciated. This was not so much an academic war over geography, as Smith (1987) described the elimination of geography at Harvard in 1948. It was a war within GSD, with prospects for geography's renewed presence diminished as a result.

Even though he held the position of a full professor and had achieved significant success as a teacher and researcher, Warntz's appointments at Harvard were contractual, and, as noted earlier, he funded much of his salary from research grants. With increasingly discouraging prospects for tenure status and little hope for introducing a geography program, and before completing the third of his three-year contracts, Warntz resigned his position at Harvard in June 1971. Nonetheless, his dream of geography at Harvard persisted, and, even long after his departure, he continued to petition Ford's successor, John T. Dunlop, and President Derek C. Bok to bring the matter of geography before the Committee on Educational Policy.

## Life in a Real Geography Department: Western Ontario, 1971–1988

Warntz accepted an invitation to chair the Department of Geography at the University of Western Ontario in 1971, a position he held to 1976. Western's Geography Department was large by North American standards. It had more than twenty-five full-time faculty, up to sixty graduate students in residence, and between two hundred to three hundred undergraduates majoring in geography. He expected to find a community of nearly four hundred aficionados of theoretical geography. Indeed, an indisputable champion of theoretical geography, William Bunge, was a visiting professor in the first year of Warntz's tenure at Western. Allen Philbrick, noted for his work on areal functional organization and for creation of original map projections, provided a critical but sympathetic comrade for Warntz. And a number of young geographers with interest in spatial analysis were beginning their academic careers at Western (e.g., Michael Goodchild, Donald Janelle, Terence R. Smith, and Roger White), offering Warntz an obliging audience for expansive thinking. But, as with most departments across North America, theoretical geography and spatial analysis shared ground at Western with other important disciplinary viewpoints. A diverse range of faculty interests paralleled the discipline's eclectic reality. To Warntz, this was symptomatic of a lack of disciplinary focus and offered a rationale for invoking a systems perspective—spatial systems theory.

As is true for most academics, Warntz achieved partial success in reaching his ideal, but mostly through students attracted to his research and academic style, particularly his Ph.D. advisees William J. Coffey and James A. Pooler. At Western, Warntz taught undergraduate courses on the Geography of the U.S., Maps—Their Makers and Their Uses, Intermediate Theoretical Geography, and the required Honors Seminar on Geographical Thought. At the graduate level, courses on Spatial Concepts and Spatial Analysis and on Macrogeographic Systems and Environmental Quality, were central to the programs of many students.

Hallmarks of academic life at Western, however, were Warntz's frequent research seminars on his latest findings. Presentations usually lasted for two hours, at least, and always attracted more students and faculty than the room could hold. With reams of overhead transparencies, dry wit, and total command of his subject, Warntz explored themes on cartographic solutions to problems in location theory, cultural literacy and the knowledge of place names, innovative and peaceful spaces, multidimensional scaling of geography's ivory tower, and others. His famous "peaks, pits, passes and pales, course lines and ridge lines, hills, and dales" approach to analyzing topographical surfaces was not only applied to the socioeconomic terrain of the U.S., Canada, and

the world, but was also used to explore properties of physical landscapes and meteorological pressure patterns. Not surprisingly, Warntz reigned supreme in the Department's annual Christmas Orals (geographical trivia quiz)—dreaming up geographical questions that stumped most and drawing on a wealth of knowledge for quick responses to the most obscure questions that his colleagues and students could imagine. It didn't seem fair.

In moving to London, Ontario, Bill and Minerva kept "Wendling," their lovely home in Andover, Massachusetts. It became a holiday refuge from the mounting responsibilities of a department chair in periods of growing economic uncertainty, and a place to pursue his writing. Asked where he lived, he described his "weighted mean residential location" as Syracuse, New York, approximately midway between London and Andover. Wendling was also a vantage point on continuing developments at Harvard, and, following 1983, it gave him a base to participate as a Research Scholar in Harvard's Center for Population Studies, where he was investigating population patterns in rural Europe in the thirteenth to eighteenth centuries.

At Western, Warntz developed the Macrogeographic Systems Research Workshop, devoted to studying the growth of the North American economic system and global patterns in physical geography. This workshop was also the springboard for further developments in spatial analysis and computer cartography. Through the affiliation and initiatives of Michael Goodchild, David Mark, and many students, the workshop was transformed from its exclusive focus on macrogeography into a major contributor to the foundations of GIS. Macrogeography remained a dominant theme in Warntz's work through 1978, culminating with his presentation of "Canada: Its Geographical Unity and Diversity" to the prestigious Royal Society of Canada. Afterwards, the history of geography and its contemporary role in society marked the foci of his research. He enjoyed spending summers and sabbaticals at Cambridge University, researching the geographical contributions of Isaac Newton and Bernhard Varenius. His last published paper, based largely on archival work at Cambridge, appeared following his death. This paper shows his capacity to shed light on contemporary themes in geography through studies of the past. "Newton, the Newtonians, and the *Geographia Generalis Varenii*" (1989) is only a fragment of his intended project, but ranks as a significant contribution to the history of geographic thought. In preparing for this project, he learned Latin in order to translate Newton's editions of Varenius.

## Retrospective

Bill Warntz received many honors: President of the International Regional Science Association (1965–1966), Fellow of the American Association for the Advancement of Science, Fellow of the American Geographical Society, Fellow of the Explorers Club of New York City, Life Associate of Clare Hall (Cambridge University), and Fellow of the Royal Society of Canada. Unpublished books, research analyses, and correspondence are in the Warntz Collection of the Regional Science Archives at Cornell University. A book-length manuscript, "Distances in the Man-made Environment," completed in 1971, follows the geometric tradition of spatial analysis. Another unpublished book, finished in his final weeks at the hospital (with Jane Forsythe), "Place Names, Probabilities, and Priorities," attempts to position geographical literacy in a broad intellectual framework. These manuscripts join yet another unpublished book—"Geography: The Innocent Science." Jointly authored with William Bunge in the 1960s, this work explores the primitive mathematical and geometrical base of physical and human phenomena. Warntz had saved much work for publication after retirement but died on 29 May 1988, less than six weeks before retirement. Work in progress included original documentation on the geographical spread of printing and the origins of universities in Europe, urban and rural population distributions in Europe in 1200–1700 A.D., a series of essays on geographical puzzles and paradoxes, a philosophical history of ideas on the shape of the earth, and studies on the contemporary role of universities in North America.

A *festschrift* from associates and students (Coffey 1988) marks Warntz's intellectual influence on discourse in Geography. He had a knack for unleashing the creativity of students; he regarded them as colleagues and delighted in exchanges on almost any subject. For those of us who knew and worked closely with Warntz, he had a formidable intellectual presence. He was noted for his quick mind and for his ability to call upon an astounding range of theory and facts, but was also warm and generous.

Though Warntz's lasting contributions are in scholarship, friends recall his accomplishments as a gifted musician and as a fierce competitor in squash and tennis. Other diversions included an encyclopedic knowledge of baseball and an insatiable addiction to geographical puzzles, paradoxes, and algorithms. He read widely in astronomy, cartography, mathematics, the history of exploration, and the history of education. He combined a sense of history and social structure with insights from mathematics, economics, and meteorology to produce tantalizing research about geographical patterns. His curiosity and enthusiasm opened the minds of many students and colleagues. Classroom and conversation queries, such as, "How wide is the Pacific Ocean from Panama City to Shanghai?" marked a constant engagement with ideas and challenges to anyone who ever spent more than a few minutes with him. The rigor of a specialist and the breadth of a generalist mark William Warntz as one of geography's outstanding personalities in the twentieth century.

Warntz's views on the discipline were seen as unusual in the early days of the quantitative revolution. He departed from the established dogmas on geography but pursued his curiosity-driven questions in search of underlying truths that might unite an approach to human and physical phenomena. Although his papers appeared regularly in the prestigious *Geographical Review*, Warntz was seen by many as separated from the discipline's mainstream—educated in economics, never holding an academic post in a major geography department until the last third of his career, and never maintaining active membership in geography's professional and scholarly associations. His loyalty was to geography and to a life of the mind; he found his intellectual home in the realm of regional science, systems theory, computer graphics, and mathematical topology. The interdisciplinary nature of his work won respect among mathematicians, physicists, and economists. Within geography, spatial analysts and economic geographers identified most readily with his approach, and current-day geographical information scientists appreciate his important role in meshing theory with often elegant empirical demonstrations and in mentoring some of today's leaders in GIS.

By the 1970s, Warntz's work was often cited for its excesses of analogy between human and physical systems, and he was frequently cast as the archetypal scientific positivist. This shift in philosophical grounding for geography was recognized by Warntz and may account, in part, for the reorientation of research objectives in the latter part of his career, and for the many unpublished manuscripts found buried in boxes of computer output, notes, and correspondence. As he turned towards new intellectual challenges regarding the history of the discipline before the nineteenth century, and to questions about contemporary education in geography, he never lost sight of his roots in spatial analysis, puzzles, music, and baseball.

## Acknowledgments

This memorial essay is derived from the insights of William Warntz's close associates and friends. I borrowed freely from correspondence and other materials that are now found in the Warntz Collection of the Regional Science Archives, Department of Manuscripts and University Archives, Cornell University, Ithaca, NY 14853. Special appreciation is extended to Patricia Chalk, William Coffey, Geoffrey Dutton, Judy Bowley, Michael Goodchild, David Mark, Waldo Tobler, and Michael Woldenberg. Warntz's sister, Maxine Smeltzer of Concord, New Hampshire, provided details on his early childhood interests. I hold full responsibility for lateness in the appearance of this essay, approved by the Council of the Association of American Geographers in November 1988.

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