angles that could possibly explain what was in the mind of the builders of these ancient cities. Knowles stood in front of the lecture podium, deliberately placing his feet and facing the hall. He asked us to imagine that he was facing south at the center of a sundial or solar clock. With arms raised and pointing in opposite directions to left and right (due east and west), he said that on two days of the year, the vernal and autumnal equinoxes, "the sun rises here [waving his left hand] and sets here [waving the right hand], no matter where we are standing at any position in the northern hemisphere." He then stretched his arms back and explained that, depending on our exact latitude, this might be where the sun rises and sets in summer and then moving his arms forward, where it might rise and set in winter. He then explained how the altitude of the sun depends on latitude, tracing the arc of the sun with his arms as we might see it in winter (low in the sky) and in summer (high in the sky).

The lecture was in an auditorium with fixed seating. But more than half of the audience was placing their arms and hands in similar positions, as everyone relaxed, laughed, and at the same time, became familiar with the elemental lessons of solar geometry. They were finally able to "get it." A complex topic was made easy to visualize and to internalize as part our own physical awareness. With this introduction, Knowles went through a series of studies of sun angles and architecture, always relating it back to the first elemental exercise of seasonal and daily sun position that we were able to understand.

This is an example of the lucid and elegant way that Ralph Knowles has made generations of architectural students and practitioners aware of the secrets of the sun. He has helped us understand how solar geometry can make designs of our buildings and cities climate responsive, open to the sun when it is beneficial for people and plants and shaded when the sun is an unwelcome burden.

Ralph Knowles has made this contribution in a lifetime of research, writing and teaching. His method of teaching has been based principally in the design studio, where interaction with students and with the subject matter at hand is primary. In teaching architectural students about solar geometry, he devised a heliodon or "sun machine," essentially a lamp by which one can easily retrace and model the daily and seasonal passage of the sun. With this, he posed challenges for students: to design arrangements of buildings so that they shared equally in winter sun, or in another assignment, to design a building form and shading devices so that is exposed entirely to winter sun but shaded entirely in summer (no easy trick). Among the most challenging of the assignments was to ask students to design a series of increasingly dense housing arrangements such as one would find in a city like Los Angeles, applying "sun-rights" zoning (providing for equal sun exposure for all building sites). The students then were asked to calculate whether the number of units with equal sun rights would be higher or lower than what is currently permitted without sun rights zoning. The answer—of great significance in any city in the United States or elsewhere—is that applying sun-rights zoning does not restrict or limit the number of housing units on a site. The studies demonstrate that with sun-rights zoning an equal (and in some cases, increased) number of units could be placed on a site as allowed by current zoning, with the added benefit that every unit had equal access to winter sun. Without quite realizing it, the students who participated in the design studies taught by Knowles were also undertaking significant research, utilizing design to test the limits of a hypothesis (in this case concerning zoning and land-use formulations, policies, and laws).

As a career-long interest for over fifty years, Ralph Knowles has developed such studies of the sun and its implications for architecture and urban design. He was engaged in these studies and published his first books well before the 1970s OPEC oil