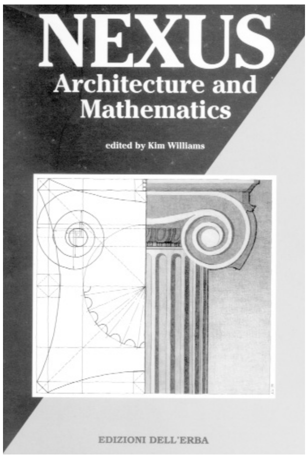

Kim Williams
Nexus: Architecture and Mathematics
Edizioni Dell'Erba, Fucecchio, Florence, 1996
205 pp., 138 b&w illustrations, $30.00 US.

Reviewed by Leonard K. Eaton

Of the holding of conferences on the condition of architecture, there is no end. One of the most interesting took place in Fucecchio (province of Florence) 9-12 June 1996. In this small but attractive town there gathered a number of individuals, architects, mathematicians and others, to study the conjunction (or nexus) of their disciplines. Some of these people were mature scholars who have already made substantial contributions. Others were graduate students or young designers/mathematicians at the beginning of their careers. All produced provocative papers, brought together by Kim Williams, convener of the conference, in the excellent volume under review. Interest in the relationship of architecture and mathematics began many centuries ago, and most of the essays reprinted here are historical in nature. The variety of mathematics with which they deal is quite astonishing: geometrical forms and constructions, proportions, modular systems, minimum surfaces, number theory and symbolism, dimensional manipulation, fractals, and symmetry. It is clear that there has been much fruitful interaction between the disciplines. Two of the papers first appeared in *The Mathematical Intelligencer*, while other material was published in *The Scientific American* and *The Journal of the Society of Architectural Historians.* Kim Williams, the editor, has performed a real service by bringing these essays together. For the convenience of our readers we will divide the papers into those proceeding from the architectural side and those deriving from the mathematical side.

On the architectural side, John Claggett's "Transformation at Geometry and the Central European Baroque Church" is typical. Claggett is a young architect who has become fascinated by the complex order of churches designed by Balthazar Neumann, the Dietzenhofer brothers, and various other architects during the seventeenth and eighteenth centuries. He believes that, in order to explain the organization of these buildings, a transformational geometry of rotation, reflection, translation and dilatation is necessary. Given the development of mathematics during this period, the argument is quite plausible. It is good to know that Claggett is engaged in further research on this field. Donald J. Watts and Carol M. Watts are faculty members in the Department of Architecture at Kansas State University. For almost a decade they have been studying urban house types in ancient Rome at Pompeii and Herculaneum. These studies have demonstrated that two simple geometric systems based on the square underlie the design of the Roman house at all scales. “These geometric systems,” they write, “explain the proportional relationships which are found in the overall shape of the site and its organization and subdivision, the relationship of volumes of space, and of planes such as walls and floors throughout the house” (p. 169). The Sacred Cut and the root-two or *ad quadratum* would have been a simple method of insuring proportional relationships among the parts of a house without the need to perform mathematical calculations. Measurements confirm their hypothesis. Not content with excavation and ancient mathematical theory, the Watts’ built themselves a “New American Prairie House” in 1988 using these historic geometric systems. While the diagrams showing the derivation of the design are very fine, the single published photograph is somewhat disappointing. In this paper one wishes for additional illustration. And of course, this domus has tough competition in the wonderful “Prairie Houses” of Frank Lloyd Wright, which also featured a strong geometry.

Among the contributions from the mathematicians, the essay by Jay Kappraff on “Musical Proportions at the Basis of Systems of Architectural Proportion both Ancient and Modern” is particularly impressive. Professor Kappraff, who teaches in the Department of Mathematics at the New Jersey Institute of Technology, first analyzes the musical proportions of Alberti, who, in fact, derived his system from Plato. He then proceeds to the integer series’ of Fibonacci and Pell and convincingly demonstrates that the Pell series was the basis of the Roman system of architectural proportion. The same computational properties occur in the Sacred Cut of Tons Brunés and the modulor of Le Corbusier. Kappraff accepts the findings of Kim Williams that Michelangelo integrated the Roman system of proportion, based on the irrational root-2 ratio, with the commensurable ratios of the musical scale in the Medici Chapel at Florence. Her measurements are convincing. Finally Kappraff takes up the system of modular coordination invented by Ezra Ehrenkrantz a few years ago. This system incorporates aspects of the mathematics of Alberti and Palladio along with the additive properties of the Fibonacci series. To this writer, the ideas of Ehrenkrantz seem superior to those of Le Corbusier. Almost equally impressive is “The Universality of the Symmetry Concept” by Istvàn and Magdolna Hargittai of Budapest. Their article, which includes material from several previous publications, is broad in scope and provocative in its suggestions from the continuing study of symmetry operations in architecture and in the exact sciences. The Hargittais find varieties of symmetry in the Blue Mosque at Istanbul, the Eiffel Tower, and in Buckminster Fuller’s Geodesic Dome at the Montreal Expo. This last edifice inspired certain chemists who saw that the structure of a newly discovered substance could be the truncated icosahedron. This molecule was appropriately called “buckminsterfullerene” and is characterized by six axes of five-fold rotation. The discoverers received a Nobel prize in 1996. Thus did the work of a great architect-engineer enter the world of one of the most exact sciences. And, the Hargittais rightly note, the fundamental conservation laws of physics are related to symmetry; this concept has opened up a whole new way of thinking for scientists.

So much for a brief look at the substantive content of this short but important book. The real significance of Nexus is that it points a way out of the morass into which architectural theory has descended in this century. Striving desperately to be up to date, theoretically-minded architects have dragged all sorts of strange figures into their discourse. Among these are the Nazi philosopher Ernst Heidegger, who, unhappily, wrote a characteristically foggy piece on "What it is to dwell" and the English neo-conservative Sir Karl Popper, whose chief claim to fame is his distaste for Hegel. Almost every other discipline one can think of has been invigorated by an infusion of mathematics and quantification. Biology, for so long consumed only with taxonomy, is at last achieving the kind of quantitative approach envisaged by D'Arcy Thompson in 1915 in *On Growth and Form*. It is impossible to conceive of modern economics or political science without reference to their mathematical aspects. The proceedings of this conference show that architecture and mathematics have always been closely linked. Indeed, as Mario Salvadori put it in his opening address, "...if mathematics had not been invented, architects would have had to invent it themselves" (p. 32). This reviewer believes that it is time for our theoreticians of architecture to throw the rubbish into the dustbin where it belongs and for contemporary architectural theory to receive new life from hearty infusion of mathematics. The conference and the publication of these papers, may well be a landmark. Let us hope for more such gatherings in the years to come.