elements of a "supermap" representing in the same symbolic space adult schematizations, the several childhood schematizations arising in development, and the mapping tasks that researchers create as they try to get people to "externalize" their cognitive maps.

Two chapters round out the group of developmental chapters that talk to one another. Roger Hart reviews findings from his longitudinal study of the ways in which children experience and know a New England town. Hart argues that the miniature studies that make up the bulk of the research literature must be supplemented by studies of how children know the real world around them. His work as presented here makes this obvious.

Seymour Wapner, Bernard Kaplan, and Robert Ciottone of Clark University try in 30 pages both to set forth a radically different framework for the understanding of human development, Genetic-Dramatism, and to review the findings of a series of studies in which people in transition—freshmen entering college, American children beginning an extended visit to Holland, elderly people moving into an old-age home—represent themselves in the context of the places and spaces around them. The chapter is clumsy because too many messages are crowded into it, but it may be useful in outlining a change in a well-known research program.

Clark University has been a creative center for the work represented in this volume. Much early work on cognitive mapping grew out of a kind of developmental psychology established by the late Heinz Werner at Clark, the comparative-developmental approach, whose theoretical influence stands second only to that of Piagetian genetic epistemology in Geneva. A weakness of the Clark theorizing has been that it has never had a data base that was adapted to it and suitable for the elaboration of the position. Piaget invented his own research tradition—first the "clinical method," then the "revised clinical method"—providing a comfortable ground on which his theory could be explored and elaborated. Werner and some of his collaborators were aficionados of experimental psychological work. They produced many interesting findings and many findings that were consistent with their theoretical position, but they did not seem able to produce a synergy between their theory and their data. This chapter may signal the development of theory and a data base in communication with one another.

Finally, the volume contains a chapter by Irwin Altman and Mary Gauvain outlining a "cross-cultural and dialectic" analysis of homes. Dwellings embody mythological and dramaturgical statements about the dilemmas and oppositions that have to be reconciled in human existence. A chapter by Walsh, Krauss, and Regnier presents data from a study under way dealing with how a sample of aged people in Los Angeles understand and use the urban terrain around them.

There are nine substantive chapters in the book—six of them good chapters that together make up a connected symposium on the development of spatial representation, one of them a useful review of male-female differences in spatial ability, two of them a little at loose ends in relation to the others. The editors have embedded these nine substantive chapters in five chapters of commentary. There are an overall introduction, a commentary chapter after each set of three substantive chapters, and finally an overall review. Some excellent people wrote those commentary chapters. But the five chapters seem to offer more reflection and commentary than a volume of nine substantive chapters needs or wants, particularly when a number of the substantive chapters achieve a rather high plane of scholarship and sophisticated discussion.

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The Importation of a Science

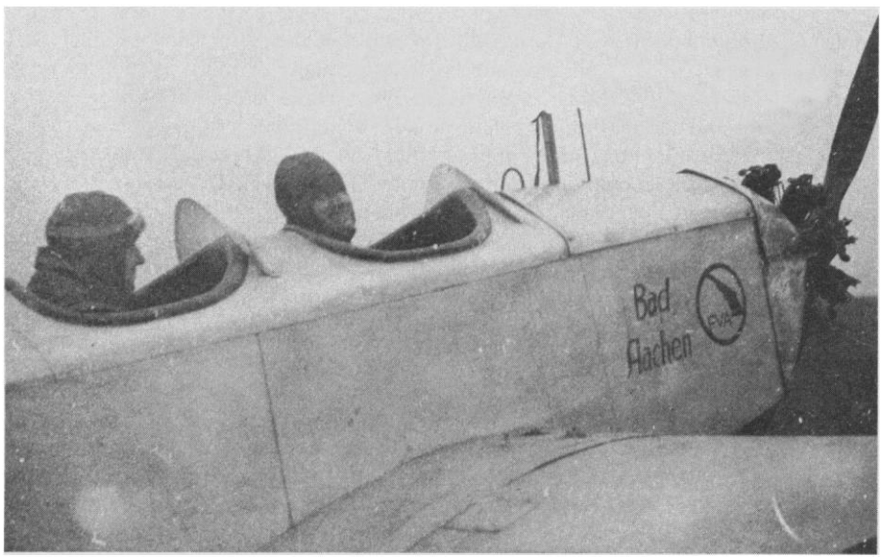
Bringing Aerodynamics to America. PAUL A. HANLE. MIT Press, Cambridge, Mass., 1982. xvi, 184 pp., illus. $20.

For reasons that are still only partly understood, the invention of the airplane by the Wright Brothers in 1903 did not foster the study of aeronautics as an exact science in this country. Rather, Germany, followed by France and England, took the lead in establishing the science of flight as an academic discipline. Aeronautical research and development at Göttingen University, in particular, stressed theoretical and experimental research, whereas the solution of similar scientific problems on this side of the Atlantic emphasized empirical methods.

America's second-class standing in aeronautics led Daniel Guggenheim, in 1926, to set up a $2,500,000 fund that was used to establish seven aeronautical schools in the United States, including one at the California Institute of Technology. The success of Pasadena's program depended critically on Robert Millikan's ability to lure Theodore von Kármán, Göttingen Ph.D., class of '08, away from his post as head of the Aerodynamics Institute at the Technical University of Aachen. By the mid-1920's, the accomplished physicist, aerodynamicist, and applied mathematician had built up an aeronautics establishment second only in importance to Ludwig Prandtl's at Göttingen. Then came von Kármán's association with Caltech, a watershed in the history of American aviation, Hanle argues, because the Hungarian-born scientist brought with him "the organization and personality of Göttingen-style applied science."

As the title suggests, this book is primarily about the transmission of theoretical aerodynamics, the hallmark of Göttingen's aeronautical curriculum, from the Old World to the New. Writing with the fervor of a true believer, Hanle traces German aeronautics, particularly theoretical aerodynamics, from the mathematician Felix Klein's success in creating a school of applied mechanics and mathematics at Göttingen to Theodore von Kármán's first visit to the United States in 1926, under the auspices of the Daniel Guggenheim Fund for the Promotion of Aeronautics, and concludes that von Kármán's appointment figured prominently in Millikan's plan to turn Caltech into another Göttingen. This is an interesting idea, although Hanle doesn't cite any primary source material to support his claim. Millikan believed that the modern world was basically a scientific invention, that science was the mainspring of the 20th century, and that America's future rested on promoting pure science and its applications. Caltech, in Millikan's view, existed to provide America's scientific leadership. If Göttingen did indeed provide the inspiration, so surely did Zurich's Eidgenössische Technische Hochschule, Pisa's Scuola Normale, and Paris's Ecole Polytechnique also.

Hanle is on much surer ground when he writes about the Klein-Prandtl-von Kármán alliance in Germany. He gives a good account of Ludwig Prandtl's role in reforming the technical education of engineers, following his Göttingen appointment in 1904. Prandtl's scientific contributions to aerodynamics are underlined, starting with his pioneering work on the flow of fluids around a body, which emphasized the need to study the region near the object's surface ("the boundary



Theodore von Kármán (forward seat) and Anthony Fokker, 1921. From *Bringing Aerodynamics to America*; courtesy of the Archives, California Institute of Technology.

layer"), through his theory of induced drag in 1910, work that radically altered the wing design of airplanes in the '20's. This chapter and the succeeding one, in which Hanle analyzes von Kármán's celebrated paper on the stability of vortex patterns that form behind stationary bodies in flowing fluids ("Kármán vortex street"), point up just how much the mathematization of American aeronautics owed to the flowering of fluid mechanics in Germany.

By his own account, politics, not science, brought von Kármán to America. He disliked not only the growing German militarism but the increasing number of anti-Semitic incidents in Aachen. Drawing upon several unpublished letters in the von Kármán papers, Hanle concludes that von Kármán's personal encounter with anti-Semitism in 1922 left him ripe for Millikan's offer in 1929.

The episode involved von Kármán's physicist friend and scientific collaborator Max Born and the mathematician Richard Courant. They had proposed von Kármán as Prandtl's successor, following rumors that Prandtl might leave Göttingen for Munich. Their suggestion came to nothing, because neither man was willing, in Born's words, "to fight it out for you against the enemies of Israel." The correspondence is arresting not simply because it paints a realistic picture of German academic politics in the pre-Hitler period but because at the personal level von Kármán's distinguished colleagues seem like very ordinary human beings.

What Hanle has to say could have been said in fewer words in a scholarly journal. Some of his chapters, particularly those dealing with American aeronautics before and after von Kármán, repeat information readily available in John Rae's *Climb to Greatness* and in von Kármán's semiautobiography, *The Wind and Beyond.*

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