Tomorrow's House

Solar Housing in 1940s America

DANIEL A. BARBER

In the tumultuous decade between 1939 and 1949, solar house heating was seen by many American architects, journal editors, and policymakers as a necessary component of the expansion into suburbia. As the technological and financial aspects of home ownership began to take on new implications for economic growth and social stability, design strategies of architectural modernism—including the expansive use of glass, the open plan and façade, and the flexible roof line—were seen as a means to construct a suburbia that was sensitive to emerging concerns over materials allocations, energy resource scarcity, and the economic challenges to postwar growth. Experimentation in passive solar house design came to be a prominent means for seeing suburbia as an opportunity for new kinds of building and new ways of living.

Solar housing was thus briefly a component of postwar energy and economic systems and was also an important site for envisioning the postwar future. In this period, the architectural profession was attempting to find a voice relevant to concerns beyond its traditional purview of design consultation. Faced with the intensity of materials and energy concerns amid wartime rationing—and with many architects either out of work or overseas fighting the war—discussions about the direction of the field came to be focused on research into policy imperatives related to infrastructure, energy, and economics. The conditions of postwar building were seen to be open to shaping by architects—not so much by the design and material concerns familiar to the profession but, rather, by how *design research* could indicate new directions for building. Prominent industry journals of the period—including *Arts and Architecture*, *Architectural Forum*, and *Pencil Points / Progressive Architecture*—began to focus on prefabricated building systems, new materials, and other innovations, while simultane-

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ously the *Ladies' Home Journal* and a host of other "shelter magazines" looked to these new design strategies as a means of framing the social and economic life of suburbia.[1] These journals, along with a series of exhibitions and publications at the Museum of Modern Art (MoMA) in New York City, demonstrate that modern architecture in general, and the design of the solar house in particular, was a means to explore multiple possibilities for technological modernity in the emerging suburbs, as architects, editors, and curators attempted to use their research and design skills to influence the contours of postwar living.

Until recently, narratives of architectural history have tended to eschew developments in technology and infrastructure in order to focus instead on the projects and biographies of prominent practitioners and those under their influence.[2] This is perhaps especially true of the midcentury period. The wartime and immediate postwar years have most often been addressed either by: tracing the influence of European masters who emigrated to the United States right before the war—especially Walter Gropius and Mies van der Rohe—and established influential practices and taught at prominent schools; or focusing on the importance of Frank Lloyd Wright.[3]

Although this article will integrate the activities of some lesser-known architects into the narrative, it will also follow recent analyses, inflected by the histories of technology and of the environment, that regard the war as a period of transformation in architectural practices and ideas.[4] Aspects of these narratives have focused on the importance of policy and technology for ushering in changes to the profession, and help to connect architecture to the historical literature on renewable energy strategies.[5] In the passive solar house of the 1940s, architecture became an important site for understanding the dynamics of postwar growth, the technologies that condi-

1. In 1945 the journal *Pencil Points* changed its name to *Progressive Architecture*.

2. Some examples of this historiographic trend include Anthony Denzer, *Gregory Ain*; Daniel P. Gregory, *Cliff May and the Modern Ranch*; Victoria Newhouse, *Wallace K. Harrison*; Meredtih L. Clausen, *Pietro Belluschi*; and Lisa German, *Harwell Hamilton Harris*.

3. On Gropius, see Jill Pearlman, *Inventing American Modernism*; the influence of Wright is discussed in Denzer and Gregory. The tendency to examine this generation through the lens of either European or Wrightian influence began in the period itself, most explicitly in James Ford and Katherine Morrow Ford, *Modern House in America*, and the expanded version by Morrow Ford and Creighton, *American House Today*.

4. See Harry Francis Mallgrave, *Modern Architectural Theory*, 326–27; Jean-Louis Cohen, *Architecture in Uniform*; Beatriz Colomina, *Domesticity at War*; Andrew Shanken, *194x*; and Greg Castillo, *Cold War on the Home Front*.

5. In the 1980s, as the solar interest of the '70s was fading, there was some interest in the earlier historical developments, though little specifically in the solar house: see Harvey Strum and Fred Strum, "American Solar Energy Policy," 135–54, and Harvey Strum, "The Association for Applied Solar Energy," 571–78. More recent discussions that have touched on these specific narratives include Frank N. Laird, *Solar Energy, Technology Policy, and Institutional Values*; and Adam W. Rome, *Bulldozer in the Countryside*.

tioned it, and the social patterns that ensued. At sophisticated levels of practice and analysis, what are broadly considered *environmental* concerns emerged in the period during and right after World War II through an interest in the possibilities of solar house design.

"The Case Study House Program"

In order to locate solar heating in this broader context of social and technological change, we begin by considering "one of the landmark chapters in post–World War II architecture"—and one of the most familiar episodes in the editorial promotion of midcentury architectural modernism—the Case Study House program.[6] Organized by the journal *Arts and Architecture* from 1945 to 1963, the program was a central arena for thinking about and experimenting with how to build in the postwar future. It strove to provide models—for the architect, for the homeowner, and for the developer—that would allow technological innovation to lead to transformations in the broader culture and to produce new ways of living.[7]

In a 1989 appreciation of the program, Esther McCoy, who had chronicled the Case Study Houses from the early 1950s, wrote the following:

> The most innovative of the early projects was Ralph Rapson's #4, of 1945, which he called a 'greenbelt house.' It describes well the yearnings of the mid-1940s. Rapson's rendering of the house showed a helicopter hovering over the flat roof, as if the owner was coming home to the suburbs from his day at the office. His wife is waving to him. Where is she? Hanging out diapers in the drying yard. Rapson's money was on the wrong machine.[8]

Here, it is already possible to find a trace of the contested social implications of technological innovation that played out in architectural visions of the postwar future[9] (fig. 1). While the clothes dryer soon replaced the clothesline as part of the postwar consumer boom in domestic appliances, Rapson's gamble on the helicopter registered a persistent hope that the industrial war machine would be repurposed for peacetime use.[10] More

6. Elizabeth A. T. Smith, "Introduction," 13. See also Reyner Banham, "Klarheit, Ehrlichkeit, Einfachkeit . . . and Wit Too!" 183–96; and Thomas S. Hines, *Architecture of the Sun*.

7. This basic engagement of technology, culture, and lifestyle change is developed in numerous essays in Annmarie Brennan, Beatriz Colomina, and Jeannie Kim, *Cold-war / Hothouses*. Despite the suggestive title, none of these essays address solar housing.

8. Esther McCoy, "Arts and Architecture Case Study Houses," 21.

9. Concern over the resource limits of the earth, and the relative costs and benefits of technological means to overcome them, are evident in two best-selling publications: Fairfield Osborn, *Our Plundered Planet*; and William Vogt, *Road to Survival*. See Thomas Robertson, "Total War and Total Environment," 336–64.

10. See Shanken, *194x*, 69.

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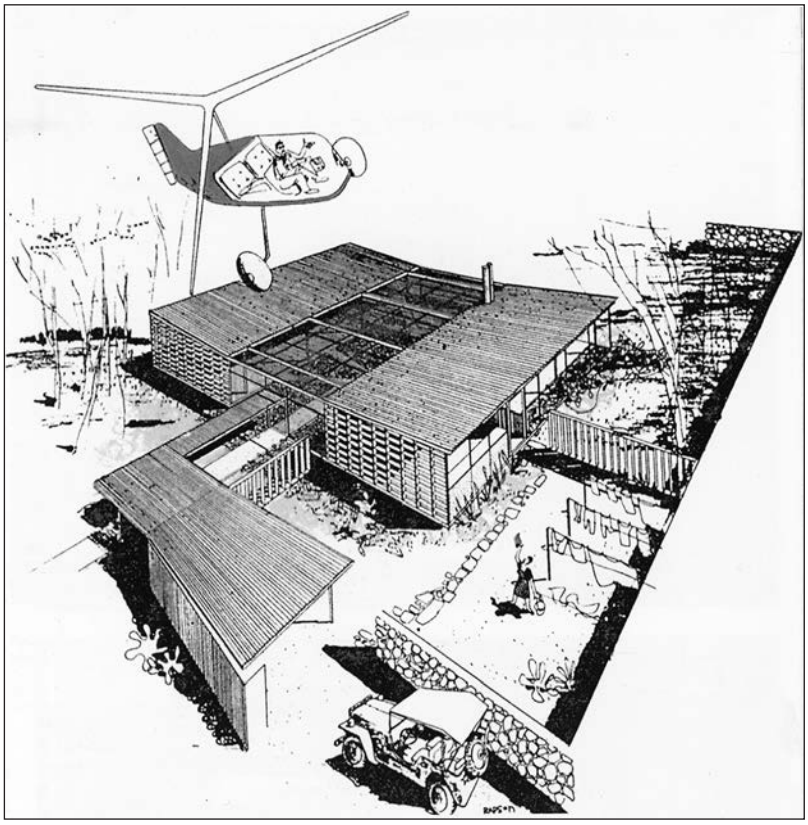

FIG. 1 Ralph Rapson, Case Study House #4—Greenbelt House (unbuilt). (Source: *Arts and Architecture* 62, no. 4 [April 1945]: 32–33. Reprinted with permission.)

than an indication of a youthful architect's poor capacity for prediction, the Greenbelt House drawing is symptomatic of the heated debates over energy infrastructure that preoccupied politicians, technologists, and architects during World War II.

Many of these debates were articulated in the context of the specific energy demands of suburbia as the site of a dispersed form of economic growth and the housing types and arrangements that could accompany it.[11] The architectural press had already begun to establish itself as an arena for discussion of these complicated issues. In the months before the publication of Rapson's house, numerous articles in *Arts and Architecture* placed the problem of housing directly at the nexus of energy availability and the prospects for economic expansion. For example, one author saw the possibility of energy scarcity as an impediment to the anticipated

11. Rome, *Bulldozer in the Countryside*, 39.

"housing boom in the post-war era," especially in the newly industrialized western areas of the country.[12] More generally, numerous authors decried the possibility of impending oil scarcity and the seeming inevitability that, as one article put it in May 1944, "we shall have to depend on oil fields as far away as Russia, Irak [*sic*], Iran, Egypt and Romania."[13]

These concerns in the architectural press developed amid the general turmoil instigated in December 1943 when the head of the U.S. Department of the Interior, Harold Ickes, who was also head of the Petroleum Administration for War, published an article entitled "We're Running out of Oil!" Ickes wrote presciently that "if there should be a World War III it would have to be fought with someone else's petroleum."[14] American postwar economic growth was predicated on industrial expansion, full employment for returning soldiers, and a dramatic increase of the housing stock, all of which required a reliable source of energy.[15] The economic and technological demands of developing a reliable energy source—oil, solar, or otherwise—were significant, and required not only the development of new industrial techniques but also, as Timothy Mitchell has recently pointed out, consistent demand. Mitchell identifies both "the rapid construction of lifestyles in the United States organized around the consumption of extraordinary quantities of energy" and "the new apparatus of peacetime 'national security'" as important tactics in the production of scarcity, and thus as justification for an array of corporate and governmental interventions in order to secure consistent energy availability.[16]

Concern over resource scarcity during the war had numerous design ramifications for the provision of energy and also for projections as to the availability of steel, iron, and other building materials. As the design and building industries anticipated returning to a period of growth—the first period of growth in housing construction since before the Depression—the house became a highly charged object implicated, on the one hand, in policies and principles relative to economic growth, imports and exports, and regional development and, on the other hand, in structuring the family unit and consolidating the productive power of consumption. The house, and then the solar house, was an important site not only for architectural debate and speculation but for the entanglement of design and policy and for thinking about the future in the immediate postwar period.

12. Rex Nicholson, "New Developments," 34–36. On the general impact of wartime industrialization on the Western states, see Gerald D. Nash, *The American West Transformed*; and James C. Williams, *Energy and the Making of Modern California*.

13. Jakob I. Zietlin, "Double Talk," 10.

14. Harold Ickes, "We're Running Out of Oil!" 38; see also Ickes's memoir *Fightin' Oil*.

15. See Chester Bowles, *Tomorrow without Fear*, 49; and Craufurd D. Goodwin, "Truman Administration," 5ff.

16. See Timothy Mitchell, *Carbon Democracy*, 41; see also George A. Gonzalez, *Urban Sprawl, Global Warming*.

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From the 1930s to the '50s, most houses in the U.S. were being heated with coal, oil, or natural gas. For many architects, the obvious solution to the threat of energy scarcity was to design houses to take advantage of passive solar energy. Technical aspects of solar house design were especially amenable both to modern design strategies and to the open lot conditions of the suburbs.

The basic principle of managing seasonal heat gain and loss through shading devices and south-facing windows had, of course, already been an element of house design for centuries.[17] A designed relationship to the sun had already been the subject of some interest in the modern architectural discourse of the 1930s, including research into the dynamics linking site orientation, the open plan, the roof overhang, and innovations in the thermal qualities of glass. One could view many prominent examples of interwar European modernism by virtue of a dual interest in the planimetric implications of solar orientation and technological innovation in glass production. In one iconic example, the *jardins suspendus* of Le Corbusier's Villa Savoye outside Paris (1928) were intended, as Le Corbusier wrote, to bring the "sun into the very heart of the house."[18] Mies van der Rohe's Villa Tugendhat (1928) in Brno, Czechoslovakia, had an all-glass southern façade that could be retracted into the basement, thereby opening up the living area to the large terrace. As one recent commentator has put it, in this house Mies used technology to "opportunistically take advantage of fine climate."[19]

A relationship to the sun was central to many of the innovations in housing design characteristic of interwar modernism.[20] In 1931, as an attempt to encourage cost-effective means of building in the English countryside, then in the throes of the Great Depression, the Royal Institute of British Architects (RIBA) sponsored and published an analysis of the radiation properties of the sun's seasonal path. The study introduced the term *insolation*—the absorption of solar radiation—into the architectural vocabulary.[21] Maxwell Fry's 1935 Sun House, in London, was planned according to the RIBA diagrams, as was Serge Chermayeff's House at Sussex of 1938, with a fully glazed south façade and precise roof overhangs for summer shading—perhaps the first entry in a proper history of the modern solar house[22] (fig. 2).

17. Ken Butti and John Perlin, *A Golden Thread*.

18. See Le Corbusier, *Precisions*, 132; Reyner Banham, *Architecture of a Well-Tempered Environment*.

19. Colin Porteous, *New Eco-Architecture*, 51.

20. For an in-depth discussion of this general trend, with a focus on German-speaking countries, see Paul Overy, *Light, Air and Openness*.

21. H. E. Beckett, "Orientation of Buildings," 61–65; P. J. Waldram, "Universal Diagrams," 50–55.

22. "House in Hampstead: Maxwell Fry, Architect"; "House Near Halland, Sussex: Serge Chermayeff, Architect." See also Porteous, *The New Eco-Architecture*, 37–42.

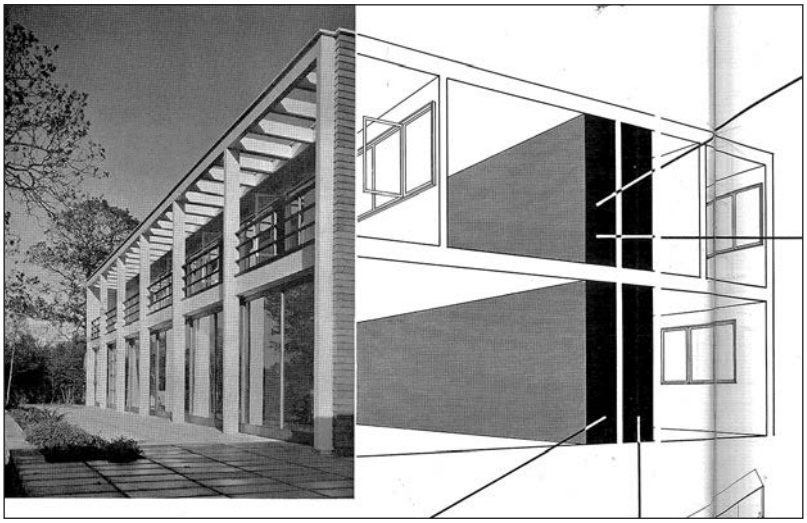

FIG. 2 Serge Chermayeff, House at Sussex. (Source: *Architectural Review* 85 [February 1939], 65. Reprinted with permission.)

The poor insulation of the all-glass façade at the House at Sussex, however, compromised its ability to effectively take advantage of solar radiation. Soon after a 1932 article in *Architectural Forum* presented the RIBA research to American architects, the Chicago architect George Fred Keck became interested in combining the design principles of maximizing solar *insolation* and the technological properties of multipaned glass that could maximize *insulation*, thereby retaining solar radiation for space heating purposes.[23]

These efforts were initiated through a decidedly nonsolar house—but one that nonetheless reflected the aspirations of the American architectural discourse of the period: Keck's House of Tomorrow, sponsored by the Libbey-Owens-Ford glass company and built for the Chicago "Century of Progress" World's Fair in 1933. The house, a dodecagonal structure filled with the latest in lighting technology, appliances, and air-conditioning, was completely glazed, floor-to-ceiling, on all twelve façades of the second and third floors. It was visited by thousands.[24] With an exposed glass façade, the house was unbearably hot in the summer, leading Keck to investigate design methods of solar shading. Similarly, the frigid interior of

23. Chermayeff came to the United States in 1936 and began to teach at the Institute of Design in Chicago. Keck was also teaching there, as was the young Ralph Rapson. See Robert Boyce, *Keck and Keck*, 9–12.

24. See Lisa D. Schrenk, *Building a Century of Progress*, 218; see also Narciso Menocal, *Keck and Keck*. Keck's Crystal House was built for the second year of the Century of Progress exhibition in 1934, with a prototype of Buckminster Fuller's Dymaxion Car parked in the glass-enclosed garage; see Thomas M. Slade, "'Crystal House' of 1934," 350–55.

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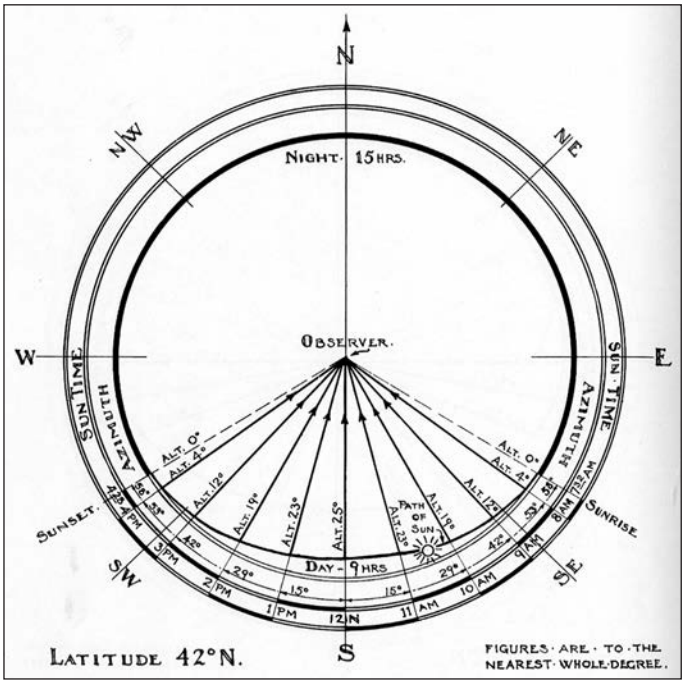

FIG. 3 Howard T. Fisher, "Solar Angles." (Source: "A Rapid Method for Determining Sunlight on Buildings," *Royal Institute of British Architects Journal*, December 1931.)

the house in the winter encouraged Libbey-Owens-Ford in its efforts to develop an insulating glass panel.

Around the same time, and also contemporary to the RIBA research of the early 1930s, the American planner Howard T. Fisher published the article "A Rapid Method for Determining Sunlight on Buildings" in *Architectural Record*[25] (fig. 3). The article was illustrated with diagrams of the sun's path and methods for predicting the precise length of shadows based on the solar-incidence research of turn-of-the-century American scientist Walter Atkinson.[26] Fisher also drew on the "rational site-planning" imperative discussed at the third International Conference of Modern Architecture (CIAM) held in Brussels in 1930 and developed in diagrams by Gropius and others.[27] In the *Architectural Record* article, the design implications of solar

25. Howard T. Fisher, "Rapid Method for Determining Sunlight," 445–54. Fisher's article was based on an article by Waclaw Turner-Szymanowski, "Rapid Method for Predicting the Distribution of Daylight."

26. Numerous writers also refer to Henry N. Wright's "Solar Radiation," written as a report for the Pierce Foundation and published, in part, in *Architectural Record* in 1936.

27. See Walter Gropius, "Houses, Walk-ups or High-Rise Apartment Blocks?" 119–

angles were presented to the American profession as parameters for a new approach to suburban design. For the 1932 speculative Chicago Housing Project, exhibited in the House of Tomorrow in 1933, Keck collaborated with Fisher's business partner Paul Schweiker and astronomers at the Adler Planetarium to develop a series of orientation and alignment diagrams based on the shadow studies Fisher presented, and included suggestions for how to conform their conclusions to both urban conditions and to the open lot of the single-family home in the American suburb.[28]

Still, as with the European examples discussed above, such exercises were concerned exclusively with solar *insolation*. It wasn't until technological refinements in plate glass manufacture produced a panel with significant insulating properties that the modern solar house was properly initiated. The development of an insulating glass panel was part of a broader attempt by Libbey-Owens-Ford to refine the manufacture of glass in order to expand its uses and marketability.[29] Research into an insulating panel at Libbey-Owens-Ford began right after the uncomfortable climatic experience of the House of Tomorrow became evident in 1933, as described above. The company's signature double-paned product called "Thermopane" was first tested in 1934 and went into production at the end of 1937. Thermopane consisted of "two panes of glass sandwiching an insulating area of dehydrated air, the whole affair to be permanently sealed around the edges at the factory" (fig. 4). Because the seal itself was quite delicate, most installations of Thermopane during the 1950s involved windows that were fixed in place.[30] For the glass industry, Thermopane had wide-ranging marketing implications, as it allowed for glass panels to be sold as auxiliary heating equipment.[31] For the architectural profession, the technolog-

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35; and CIAM, Rationelle Bebauungsweisen. A number of the relevant texts were translated into English through the New York Housing Study Guild (Lewis Mumford, Henry Wright, and Carol Arnovici) as *Abstract of Papers at the Third International Congress at Brussels of the International Committee for the Solution of the Problems of Modern Architecture* (New York, 1935). See Eric Mumford, *CIAM Discourse on Urbanism,* 59–65, 287n130.

28. George Fred Keck and Paul Schweiker, "Chicago Housing Project," 159–63.

29. Earl Aiken, "Glass in Future Building Construction," 230. Aiken was a marketing executive at Libbey-Owens-Ford. Libbey-Owens-Ford was central to the remarkable increase in plate-glass production since the turn of the century, growing from 93 million to 370 million square feet between 1880 and 1920; see Isenstadt, *Modern American House*, 149.

30. Maron J. Simon, *Your Solar House*, 11. Thermopane was an important product for Libbey-Owens-Ford into the 1960s. The Thermopane seal needed to be a hard seal to prevent leakage of air, but the metals that could provide a hard seal tended to shrink and expand with temperature variation. An alloy of aluminum, titanium, and copper allowed for a workable compromise. However, it was still physically delicate and not conducive to repeated opening. See Charles Haven, "Notes on Thermopane," in Libbey-Owens-Ford Collection, The Ward M. Canady Center for Special Collections, The University of Toledo Libraries. The developments are summarized in Simon, *Your Solar House*, 12.

31. Libbey-Owens-Ford, *Glass as an Architectural Medium*, n.p.

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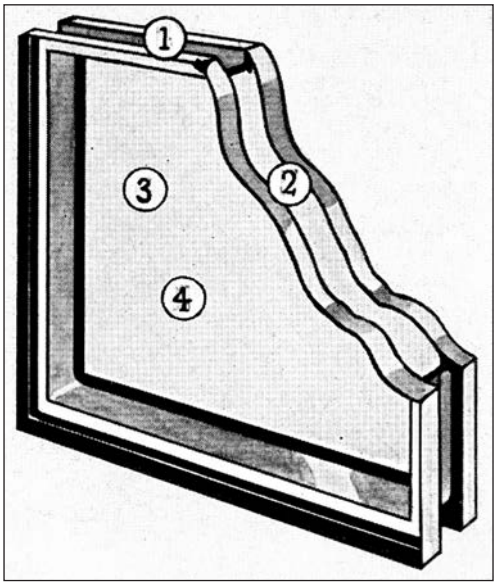

FIG. 4 Libbey-Owens-Ford Glass Company, close-up of "Thermopane." (Source: *Your Solar House*, 12. Libbey-Owens-Ford Collection, Ward M. Canady Center for Special Collections, University of Toledo Libraries, Toledo, Ohio. Reprinted with permission.)

ical refinement of insulating glass had direct impacts on design strategies, as a south-facing wall of windows became ubiquitous in midcentury residential design. This episode suggests how formal innovations in architecture developed in complex dialog with technological change.

Beginning with Keck's Sloan House in 1939, the full template for the solar house finally emerged (fig. 5). These long, narrow houses had a south-facing façade, almost fully glazed, on which all of the living spaces were placed. The delicacy of Thermopane meant that many of the glass panels were fixed in place, often alternating with operable windows or surrounded by ventilating panels. Keck's early experiments, following the RIBA and other analyses described above, also led to a precisely tuned design process of correlating roof projection to seasonal solar angles. This allowed for complete shading during the summer and the penetration of solar radiation deep into the interior during the winter (fig. 6). The dual maximization of insolation and insulation distinguished the modern solar house, as a glazed and insulated southern façade deployed the formal and material tropes of modern architecture toward alleviating mechanical heating loads.

An August 1942 article on Keck in *Architectural Forum*, called "A Portfolio of Modern Houses," documented a number of the solar houses

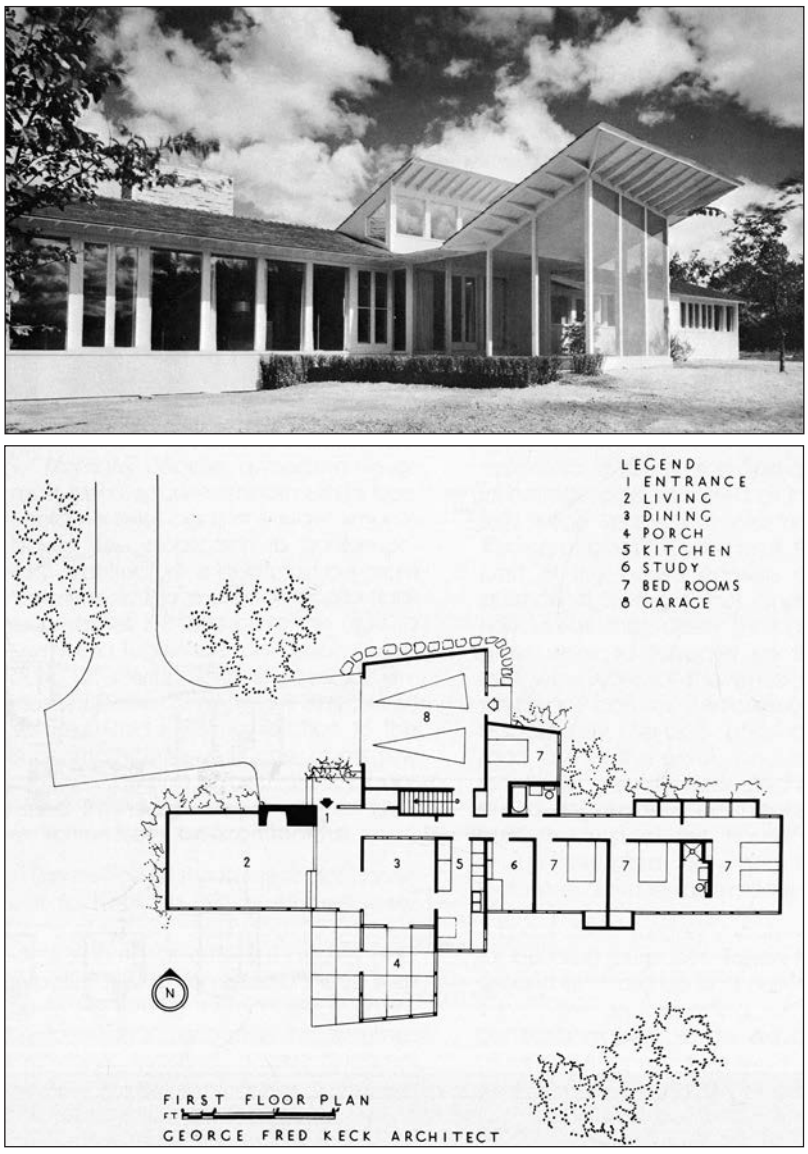

FIG. 5 George Fred Keck, Sloan House, outside Chicago, 1939. (Source: Libbey-Owens-Ford Collection, Ward M. Canady Center for Special Collections, University of Toledo Libraries, Toledo, Ohio. Reprinted with permission.)

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FIG. 6 George Fred Keck, Duncan House, Flossmoor, Illinois, 1941. Winter (top) and summer (bottom) photos of sun penetration into the living room. (Source: Libbey-Owens-Ford Collection, Ward M. Canady Center for Special Collections, University of Toledo Libraries, Toledo, Ohio. Reprinted with permission.)

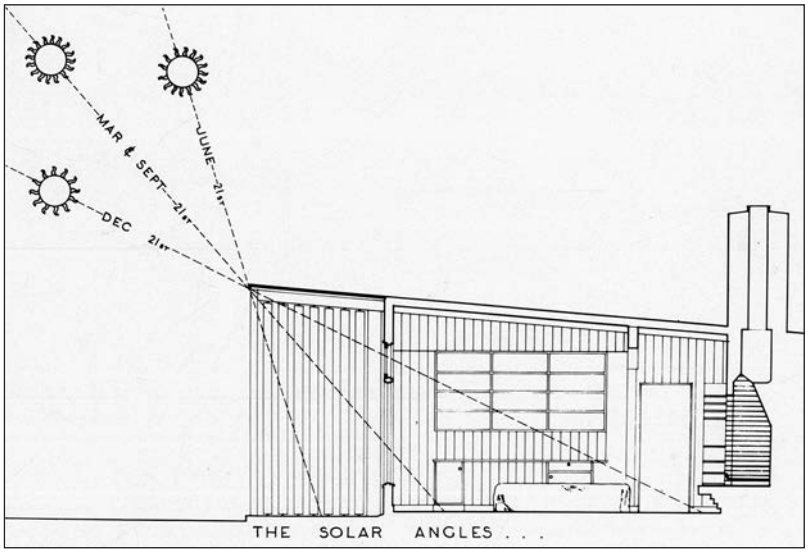

FIG. 6 (*Continued.*) Duncan House, diagram of solar angles.

he had built across the northern Midwest, all variations on the same basic template, during the years leading up to the U.S. entry into war. The Kellett House of 1939 was one of the most elaborate, with the fully glazed south façade forming an arc in response to both the path of the sun and the lakeshore on which it sat. At one end of the arc, a dramatic double-height living space brought daylight into the living areas of the slightly sunken ground floor and to the private areas on the second level. At the other end, a kitchen and dining area led to a porch looking onto the lake. Surrounded by glass on all sides, the large porch had a stone floor that absorbed solar radiation, warming the outdoor room for comfortable fall and spring use[32] (fig. 7).

The solar house was well received by both the popular and professional press. The Kellett House was also featured in a July 1942 article in *House Beautiful* called "What Houses Will Be Like After the War."[33] A September 1942 article in *Fortune*, "How to Heat Your House," demonstrated that numerous other architects were also pursuing solar design strategies, while a *Reader's Digest* article in December 1943 referred to Keck's 1941 Duncan House as "the most exciting architectural news in decades."[34] By 1945 the

32. "A Portfolio of Modern Houses: George Fred Keck, Architect," 67–82.

33. "What Houses Will Be Like after the War: George Fred Keck," 30, 72.

34. Ralph Wallace, "The Proven Merits of a Solar Home," 101–4. The article was originally published in the *Baltimore Sun*, 13 December 1943. See also "How to Heat Your House," *Fortune* (September 1942): 45–49. Wallace also discussed the persistent notion that the solar house was better for your health, a point argued by Keck's first solar client, Howard Sloan (see Sloan, "Insolation," 80).

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FIG. 7 George Fred Keck, Kellet House, Menasha, Wisconsin, 1941. (Source: *Architectural Forum*, September 1942. Photograph by Hedrich-Blessing Photography, Negative HB-06585-S. Reprinted courtesy of the Chicago History Museum.)

solar house was seen, as *Architectural Forum* editors George Nelson and Henry Wright wrote in their book *Tomorrow's House: How to Plan Your Postwar House Now*, as "typical of the very best developments in modern house design."[35] And typical they were—with wide expanses of glass, radiant floor heating, experimental use of new materials, open plans with flexible room partitions, and careful site orientation, these houses were readily placed in the context of numerous contemporaneous experiments in residential design.[36] As the writers of *Tomorrow's House* declared, "from here on, anyone who plans a house without giving serious consideration to the operation of the solar house principle is missing a wonderful chance to get a better house, a more interesting house, and a house that is cheaper to run."[37]

This last point was paramount, as this largely professional discussion about design technique and material specification engaged with wider concerns over energy systems and economic growth. When the U.S. fully com-

35. George Nelson and Henry Wright, *Tomorrow's House*, 178–79.

36. Keck saw his houses as being in dialogue with Frank Lloyd Wright's Usonian Houses, built from the mid-1930s to the late '50s, and the two architects had numerous discussions on technical issues related to in-floor heating systems. See "Portfolio of Modern Houses," 79.

37. Nelson and Wright, *Tomorrow's House*, 178–79.

mitted to the war in late 1941, the price of heating oil increased dramatically. In September 1943 an *Architectural Forum* article titled "Does Modern Architecture Pay?" featured Keck's solar houses. Here the client of the Sloan House, a developer named Howard Sloan, boasted of his 60 percent savings in heating costs as an effective marketing tool for the subdivision of Solar Park that he had built with Keck at the end of 1942. As Sloan wrote in the *Architectural Forum* article, Solar Park "was born in trying times. Hitler was fast overrunning Europe, prospective customers were becoming jittery, prices were going up. In spite of these difficulties, solar houses . . . sold faster than we could build them."[38]

Sloan's comments connect the solar house to an array of wartime complications, among which concerns about energy were prominent. By the end of the war many of those concerned with building—architects, developers, and editors, of course, but also a broad public interested in how they might live after the war—worried that wartime oil rationing and materials restrictions were an indication of things to come. In a December 1945 article entitled "War and Our Vanishing Resources," Interior Secretary Ickes elaborated on his earlier article and warned that "the prodigal harvest of minerals that we have reaped to win this war has bankrupted some of our most vital mineral resources. We no longer deserve to be listed with Russia and the British Empire as one of the 'Have' nations of the world. We should be listed with the 'Have-nots' such as Germany and Japan."[39] The invocation of a "Have-not" status, reiterated in editorials and in Congress, generated much concern in the press, industry, and government.[40] Before the early 1950s, when the extent of oil reserves in the Middle East became widely understood, government reports and popular texts offered discouraging analyses of the resource and energy situation.[41] A general impression emerged among many policymakers, corporate actors, engineers, and architects that, as one prominent report put it in 1948, "this tiny period of earth's life, when we are consuming stored riches, is over."[42]

38. "Does Modern Architecture Pay?" 73.

39. See Ickes, "War and Our Vanishing Resources," 20; see also Alfred E. Eckes Jr., *The United States and the Global Struggle for Minerals*, 120.

40. The specter of "have-not" status had been invoked in August 1943 by the Republican senator from Massachusetts, Henry Cabot Lodge, in an editorial in the *New York Times*, insisting that all material and energy decisions meet domestic needs rather than those of the seemingly endless global war. See Lodge, "To Keep Us from Being a Have-Not Nation," A7.

41. Although knowledge of the extent of foreign oil reserves was not widely known, it was beginning to enter industry and government discussions, thanks, in part, to reports provided by Edward DeGolyer that estimated Middle East oil reserves at 25 billion barrels. As DeGolyer wrote in his preliminary report: "the center of gravity of world oil-production is shifting . . . to the Persian Gulf area." It was not yet clear how this oil would reach the U.S. market (DeGolyer, "Preliminary Report of the Technical Oil Mission," 919–23). See also Daniel Yergin, *The Prize*, 393; and David S. Painter, "Oil and the Marshall Plan," 359–83.

42. Eugene Ayres, "Major Sources of Energy," 109–44. For evidence of this wide-

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The technological disposition of the modern solar house was thus a potent symptom of a much broader concern over energy depletion. Consequently, the solar attributes described above became part of a new agenda for design research, in combination with other topics including prefabrication, flexible programming, and the use of new materials. The debate about solar design became a locus for proposals within the architectural discussion that intended to impact financing structures, insurance regimes, and the parameters of regional planning. Architects, editors, planners, curators, and others concerned with the relationship of design to these broader issues took on the postwar house as a site for the debate over possible futures. Such design strategies as solar house heating were seen to bring together a wide array of practices and policies and to mitigate the unpredictability of both geopolitical and geophysical forces, as tomorrow's house was becoming today's.

"What Is a House?"

The solar house is indicative of the broader speculative trends of American architectural practices during the war, concerned with both technological innovation and the challenge of suburban expansion, and allows for a return, briefly, to the Case Study House program.[43] When introducing the program in January 1945, *Arts and Architecture* editor John Entenza wrote: "That building is likely to begin again where it left off is something we frankly do not believe. Not only in very practical changes of materials and techniques but in the distribution and financing of these materials lie factors that are likely to expand considerably the definition of what we mean when we now say the word 'house.'"[44] During World War II, the entire system of house building—from its economic position to its political implications to its potential for technological innovation—was under analysis by architects and editors, and was seen not only as a means to influence policy but also as a way to impact the availability of energy and

spread anxiety in government, see Julius Krug et al., *National Resources and Foreign Aid*; and Harold J. Barnett, *Energy Uses and Supplies*. See also the technological discussion of energy forecasting at the 1948 "Symposium on New Sources of Energy" organized by the American Association for the Advancement of Science in M. King Hubbert, "Energy from Fossil Fuels," 46–51, and Farrington Daniels, "Solar Energy," 51–57; and from the United Nations Scientific Conference on the Conservation and Utilization of Resources in late 1949 (*Proceedings of the United Nations Scientific Conference on Conservation and Utilization of Resources*, vol. 1: *Plenary Meetings*).

43. This reading of the solar house suggests a more general emergence by which developments on the cultural sphere became tightly connected with policy imperatives; a transformation has been described by Michel Foucault as the process of "governmentalization"—not government per se, but a managerial disposition to the care of the population, coextensive with practices and principles in the cultural sphere. See Foucault, *Birth of Biopolitics*, 217–26.

44. "The Case Study House Program," 39.

materials and the general prospects for economic growth after the war.

It is important, in this context, to distinguish between the seeming inevitability of the suburban patterns of the postwar housing boom—which did not manifest until after the Housing Act of 1949, as will be noted below—and the visions of the postwar future proposed by planners, economists, and architects during and immediately after the war. That the war involved a massive technological, cultural, and infrastructural reconfiguration has been well documented.[45] Less studied is the fact that, at the time, this reconfiguration was seen to have the potential for many possible futures.[46] Much as with the general anxiety over energy, there was concern that the temporary restrictions on wartime building would become permanent, presenting challenges not only to ways of building but to economic expansion and national security.

On the one hand, some suburban patterns appear to have been embedded in wartime economic growth. This was especially true of population mobility. As the urban planner Catherine Bauer wrote in a 1943 article entitled "Cities in Flux," over 25 percent of the U.S. population (about 40 million people) were expected to move by the end of the war, often more than once.[47] From 1940 to 1943, most of this migration was from rural homesites to suburban housing—though much of it was multifamily apartment blocks, rapidly built to accommodate the need for increased production at wartime factories.[48] The growth of wartime factory production, furthermore, relied on a vastly expanded road network, the beginnings of an air transportation system, and new methods in the production of housing.

On the other hand, the acceleration of the prewar pattern of suburban expansion, especially as regards housing typologies, was seen as temporary. It was not clear, in the midst of the process, whether such growth would persist after the war, even as the need to find housing for returning veterans and their anticipated families—numbering some 16 million, more than 10 percent of the entire population—became increasingly urgent.[49] In the project of solar house heating and elsewhere, the important question for architects, planners, and policymakers was less how to consolidate emergent suburban patterns and more how innovations in home design could accommodate this period of flux and mitigate uncertainty—that is, how architectural technology could mediate the adaptation to new, and as yet undefined, living conditions.

45. On architectural terms, these reconfigurations are documented in the essays in Donald Albrecht, *World War II and the American Dream*.

46. See Arnold L. Silverman, "Defense and Deconcentration," 157–65; see also Robert A. Beauregard, *When America Became Suburban*, and Mark W. T. Harvey, "Taking the Postwar Seriously," 3–19.

47. Catherine Bauer, "Cities in Flux," 70.

48. Alan Rabinowitz, *Urban Economics and Land Use in America*, 129; see also Silverman, "Defense and Deconcentration," 155.

49. Robert C. Wood, "Rethinking the Suburbs," 75.

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Architectural journals and practitioners were closely monitoring these demographic and territorial shifts as well as the policy developments that were anticipated relative to them. When the National Housing Authority was founded in 1942, in large part to manage defense housing and anticipate future development patterns, the editors at *Architectural Forum* took note. They began to aggressively use the pages of the journal to discuss housing policy and to explore the design and technological innovations architects could bring to bear on these issues. The September 1942 issue exemplified the trend. Published less than a year after the U.S. fully committed to the war—and a month after *Forum*'s first feature article on Keck's solar houses—the issue contained an eighty-seven-page spread on "The New House 194x." It was an attempt to envision the possibilities for postwar living emergent from industrial, economic, and political transformations. Architects, as the editors made clear, were on the front lines: "It is everywhere recognized," the editors wrote, "that the end of the war will bring about vast changes in our everyday lives. These changes will affect habits of consumption and methods of production, and inevitably will be reflected in the physical form of the world in which we live—and which it is the business of designers to mold."[50]

In "The New House 194x," an uncertain future was both reflected in the speculative designs of architects and specifically taken as a theme for exploration. Ralph Rapson in collaboration with David Runnels proposed, for example, a "Fabric House," a light steel frame covered with a hybrid wall-roof element that operated as cladding, insulation, and water protection. The system could accommodate numerous design configurations and could also be changed by the user at will. "Since all walls and roof are fabric," Rapson and Runnels wrote, "with one-inch light metal telescopic pipe integrated with the [fabric] rolls, maximum freedom of planning results"[51] (fig. 8). They argued, "the post-war individual, long weary of wartime regulations and restrictions, will demand the freedom for which he fought . . . since every family has ever changing requirements, shelter must have one major characteristic—flexibility."[52]

If Rapson and Runnels's conflation of the flexible house with political liberation is overly simplistic, it is nonetheless symptomatic of a broader trend. In "The New House 194x," the trope of flexibility was everywhere. The simple title of "Flexible Space" headed entries from Skidmore, Owings, and Merrill (SOM) and also one by William W. Wurster. The SOM proposal included modular furniture and wall units to allow for changes to

50. "The New House 194x," 65. The editors included Ruth Goodhue, John Beinert, Doris Grumbach, George Nelson, and Henry Wright.

51. The quotation is taken from a later entry of the *Fabric House* into a competition organized by *California Arts and Architecture* (which became *Arts and Architecture* in February 1944), as it was reported on in "Forum"; see "'Designs for Postwar Living' Competition," 93.

52. "The New House 194x," 87.

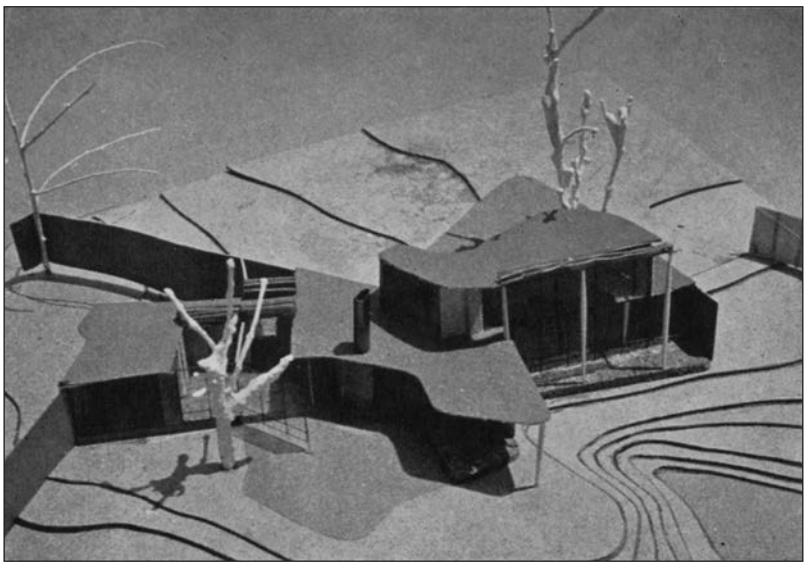

Fig. 8 Ralph Rapson and David Runnels, "A Fabric House." (Source: "The New House 194x," *Architectural Forum*, September 1942. Reprinted with permission.)

the home as the family grew or shrunk. John Porter Clark and Albert Frey showed their recent vacation house in Palm Springs as an example of manipulating "New Architectural Elements" in which the five components of the floor slab, wall unit, glass unit, roof unit, and composition could similarly accommodate changing needs and desires.[53]

Gardner Dailey and Joseph Esherick's "House DE-2, Magic Carpet Series" was perhaps the most potent example (fig. 9). The small house had four flexible living spaces separated by movable partitions, with a service core spanning the middle. Intended to be transportable by trailer, it included an identifying number on its roof, like an airplane or the license plate of a car, to allow for the family to maintain a bureaucratic and social identity in the midst of demographic and territorial flux. Dailey and Esherick also read these tropes back onto the question of energy: the mobile unit had a "mechanical nurse" that carried its own fuel and contained all the "equipment needed to supply the functions of the house's chemical and mechanical core."[54] The "nurse" could be switched out for a new model, using new means for energy generation, as technology improved. As the "House DE-2" suggests, the widespread wartime experience of transience led to a reevaluation of the importance of a settled domestic condition. This new way of living was seen as an opportunity for both architectural intervention and infrastructural transformation.

53. Ibid., 100–101, 118–19, 140–42.
54. Ibid., 114–15.

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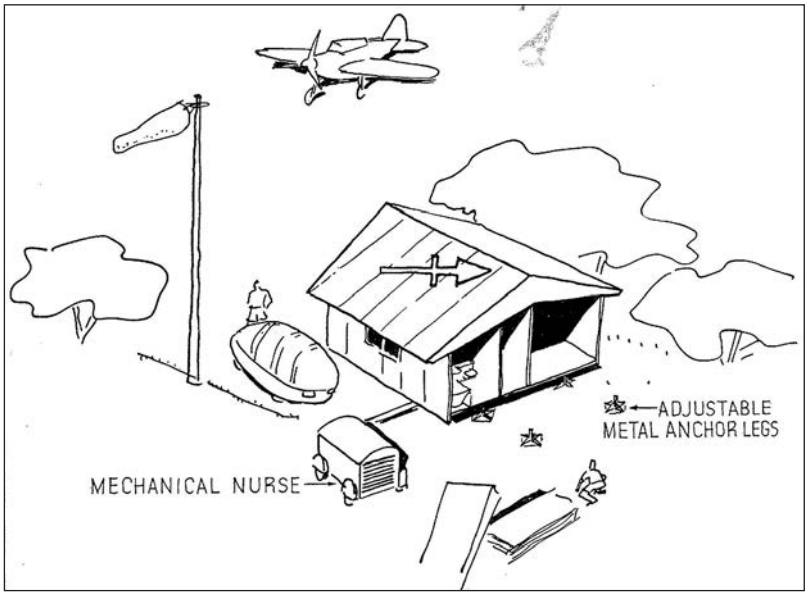

FIG. 9 Gardner Dailey and Joseph Esherick, "House DE-2," Magic Carpet series. (Source: "The New House 194x," *Architectural Forum*, September 1942.)

The July 1944 issue of *Arts and Architecture* further articulated the flexible imperative of postwar growth and its anticipated effects on the future, also with reference to the broader postwar organizational regime of energy provision. Entitled "What Is a House?," the eighteen-page article contained photo-collages and graphic design elements by Ray Eames and Herbert Matter to help explain the potentials and pitfalls of the "urgent housing problem" that was expected when the war ended.[55] Here, prefabrication techniques were foregrounded, though they were framed within the larger goal of "taking advantage of the best techniques of our highly industrialized civilization."[56] Discussion of the unprecedented scale of postwar housing needs was accompanied by images of recent technological innovations and peppered with quotes from architects, engineers, in-dustrialists, and politicians about the need to approach shelter provision from a rational, scientific perspective.

The centerpiece of "What Is a House?" was a process diagram in which the architect, described as "the student of human behavior . . . the scientist . . . the economist . . . [and] the industrial engineer," was the connecting element by which the postwar house would be organized according to a new set of inputs[57] (fig. 10). On one side: "an understanding of family be-havior,

55. "What Is a House?" 22.
56. Ibid., 23.
57. Ibid., 33.

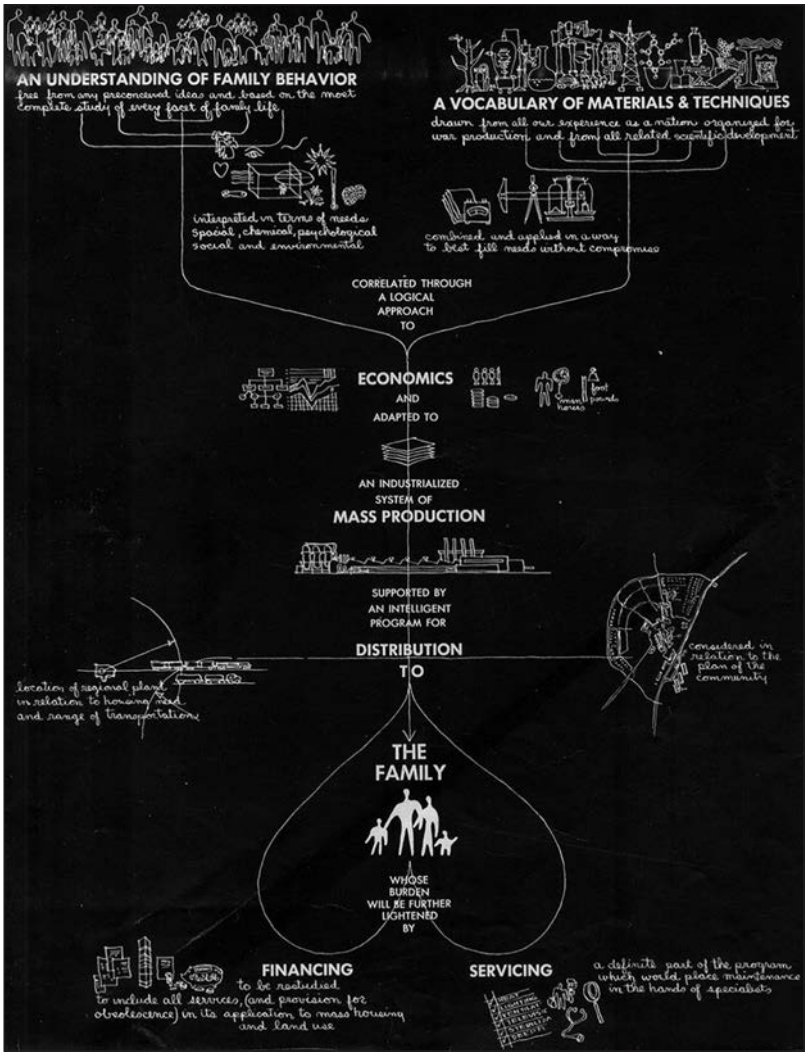

FIG. 10 Herbert Matter and Ray Eames, diagram. (Source: "What Is a House?" in *Arts and Architecture* 7 [July 1944], 31. Reprinted with permission.)

free from any preconceived ideas and based on the most complete study of every facet of family life . . . interpreted in terms of needs spatial, chemical, psychological, social, and environmental"; on the other: "a vocabulary of materials and techniques, drawn from all our experience as a nation organized for war production and from all related scientific development." These two factors were then, according to the diagram, "correlated through a logical approach to economics" and fed through a coordinated system of mass production and regional distribution. This deployment of an expanded field

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of architectural strategies focused on benefits to the family, drawn at the bottom of the diagram in an inverted heart, "whose burden will be further lightened" by rationalized financing and service systems.[58]

Seemingly intended as a direct response to the question "What Is a House?," the diagram indicated that the hoped-for postwar house would be both the center of social life and, perhaps more consequentially, the organizing principle of the postwar infrastructural network—of materials distribution, energy provision, and communication, of political support and economic security. Though the solar house was not addressed directly, the issue proposed that the war effort had produced ideal conditions for architectural interventions in the "modernization" of the housing industry, including issues of energy and economics.[59] Entenza and his colleagues at *Arts and Architecture* emphasized that this was an opportunity to redesign the process of housing financing and production, and thus to make quality housing available to everyone.[60] The architect was identified as a key figure in the negotiation of the economic, infrastructural, and industrial metabolism of the production system of the postwar house. If the entries to "194x" operated as a survey of adaptive strategies, "What Is a House?" was a more aggressive editorial push for architects to take a leading role in the anticipated transformations of postwar industrial development. In their attempt to both reveal and resolve wartime anxieties, these visions of the postwar house are symptomatic of the intensity of wartime demographic upheaval and also indicative of architectural ambitions to use the technological tools of modern architecture to transform geopolitical pressures into opportunities for designed lifestyle improvements.

"Tomorrow's Small House"

Although less articulate in their specifics than "194x" or "What Is a House?," a number of other articles, special issues, and competitions further placed the house in this charged context.[61] During and after the war, the economics and policy of housing became a topic of much public interest and speculation—in large part due to the issues traced above—and the

58. Ibid., 31.
59. Ibid., 23.
60. Creighton, Foreword to *Case Study Houses, 1945–1962*.
61. Revere Copper and Brass held a competition in 1942; *Arts and Architecture*'s "Design for Post-war Living" competition in 1943 has already been mentioned; Pittsburgh Plate Glass's "Design of a House for Cheerful Living" in 1945; the Plywood Corporation's competition of 1944, also published in *California Arts and Architecture*; *House and Garden*'s "Blueprints for Tomorrow," held in late 1944—and in which Ralph Rapson's "aggressively modern" Lopez House won first place. See Elizabeth A. T. Smith, "Chronology of Related Events," 240. The April 1945 issue of *Architectural Forum* called "House Omnibus" gave over the pages of "Forum" to the editors of *Better Homes and Gardens*, *McCall's*, *Ladies' Home Journal*, *House Beautiful*, *Parents Magazine*, *Woman's Home Companion*, and *Country Gentleman*.

solar house came to represent an alternative means for growth. While the industrialization of housing also led to the corporatization of developers, who saw it in their interest to influence building regulations and financing systems, a similarly proactive stance was taken by architects as well as by a number of editors and curators.[62] The editors and curators discussed in the final section of this essay identified opportunities in the early postwar period that, they hoped, would establish lasting mechanisms for influencing policymaking processes, especially concerning precise methods by which to construct suburbia.

The imperative of flexibility and the promise of solar heating, as well as the design and managerial regime summarized in "What Is a House?," were read directly onto the needs and desires of the prospective postwar homebuilder in a monthly feature in *Ladies' Home Journal* from January 1944 to August 1946. Richard Pratt, the architecture and gardens editor at the *Journal*, enlisted "outstanding architects . . . to design small but 'really adequate' houses which would dramatize the advantages of modern planning and building techniques."[63] Pratt not only commissioned designs but also hired a modeling firm to build detailed miniature versions of the houses, including "tiny bentwood chairs, workable four inch lawnmowers and real greenery"; he then photographed the models himself to produce a seductive vignette, a clear vision of a well coordinated future at one-inch scale.[64] From May to September of 1945, the models were shown at Museum of Modern Art in New York City in the exhibition *Tomorrow's Small House: Models and Plans*.

The *Ladies' Home Journal* already had a substantial record of supporting innovations in modern architecture. Edward Bok, the editor from 1889 to 1919, published a number of features on Frank Lloyd Wright starting in 1901. Throughout the 1910s and '20s, *Ladies' Home Journal* was well ahead of *Architectural Forum* and other design journals in celebrating Wright's "prairie style" as a significant development in American design.[65] In August 1942, Pratt initiated what would become the "Tomorrow's Small House" series, publishing "The First Victory House," which, though of a traditional design, established the premise of a quality, low-cost housing for the returning soldier and his family—two adults and two to four children, with an income between $2,000 and $3,000.[66] By 1944, he had collected designs

62. Ullman, *Suburban Economic Network*, 12.

63. Museum of Modern Art (Elizabeth Mock and Richard Pratt), *Tomorrow's Small House*, 5.

64. Ibid., 6.

65. See Gwendolyn Wright, *Building the Dream*, 172; and Robert Shoenauer, *6,000 Years of Housing*, 358.

66. These details are taken from an entry by Marcel Breuer that Pratt did not accept, in the Breuer archive at Syracuse University and viewable online at http://breuer.syr.edu/project.php?id=358. Pratt was best-known for articles on gardening techniques. See Pratt, *Ladies' Home Journal Book of Landscaping*; Richard Pratt and Dorothy Pratt, *Guide to Early American Homes*; and Pratt, *Houses, History, and People*.

from Marcel Breuer, William Wurster, Edward Durell Stone, and numerous others under the rubric of "Houses Planned for Peace"—some of these would remain unpublished while others were converted to the later series.[67] As Wurster recounts, Pratt insisted that these houses use off-site production techniques and that they be designed to take advantage of the technologies and materials "inherent in this age in which we live."[68]

The basic premise of the solar house, a "long, single story, precisely outlined rectangle, open to the south and closed to the north," was ubiquitous in Pratt's curated models.[69] Elizabeth Mock, the curator of architecture at MoMA who worked with Pratt on organizing the exhibition, wrote in the press release and in the accompanying catalog that, amid the array of new materials and innovations in construction:

> The most remarkable thing about the group as a whole is the quantity of glass, and it's there for better reasons than the personal whimsy of the architect. In almost every case the major rooms face south with great sheets of glass. The wide roof overhangs shade the interior in summer . . . but allow the sun to penetrate deep into the rooms in winter, when warmth is welcome. Heat loss is minimized by using triple sheets of glass . . . such houses have proven to be extraordinarily comfortable and economical, even in the extreme climate of Chicago.[70]

Such houses, Mock concluded, were destined to "emerge as the dominant post-war plan type," a point that was repeated almost verbatim in many of the press treatments of the exhibition.[71]

John Funk's house in the August 1945 issue of *Ladies' Home Journal* was one of the most straightforward representations of these new possibilities for suburban house design (fig. 11). It was a rectangular building with living room, kitchen, and master bedroom on the south façade, kids' rooms and services on the north, and a flat roof atop a band of clerestory windows. As built and photographed in the model, the house appeared light-filled and open to the spacious yard, with modern furniture both inside and out, and surrounded by trees to provide seasonal shading.[72] Other

67. See "The House Planned for Peace," 54; see also David Smiley, "Making the Modified Modern," 41–43.

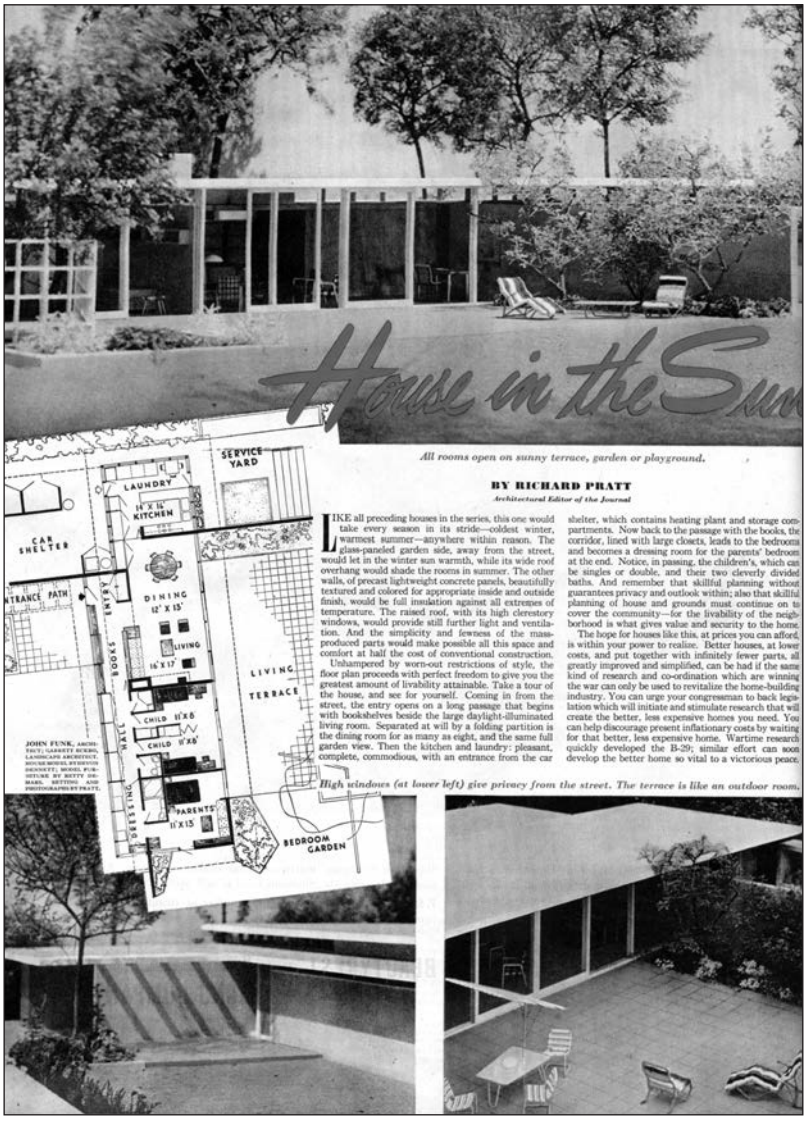
68. William Wurster on his discussion with Pratt, quoted in Greg Hise, "Building Design as Social Art," 156.

69. *Tomorrow's Small House*, 6.

70. Elizabeth Mock in the press release for *Tomorrow's Small House*, in archives of the Museum of Modern Art, registrar's folder for "Tomorrow's Small House: Models and Plans (Exhibition no. 289)." Mock went on to indicate that concerns over excessive glare in such houses were unfounded.

71. Ibid. For an example of the press coverage, see Mary Roche, "Museum Presents Small House Show," *New York Times*, 29 May 1945, A7.

72. Landscape architect Garrett Eckbo was consulted for a number of the "Tomorrow's Small House" models.


House in the Sun

All rooms open on sunny terrace, garden or playground.

BY RICHARD PRATT
Architectural Editor of the Journal

LIKE all preceding houses in the series, this one would take every season in its stride—coldest winter, warmest summer—anywhere within reason. The glass-paneled garden side, away from the street, would let in the winter sun warmth, while its wide roof overhang would shade the rooms in summer. The other walls, of precast lightweight concrete panels, beautifully textured and colored for appropriate inside and outside finish, would be full insulation against all extremes of temperature. The raised roof, with its high clerestory windows, would provide still further light and ventilation. And the simplicity and fewness of the mass-produced parts would make possible all this space and comfort at half the cost of conventional construction.

Unhampered by worn-out restrictions of style, the floor plan proceeds with perfect freedom to give you the greatest amount of livability attainable. Take a tour of the house, and see for yourself. Coming in from the street, the entry opens on a long passage that begins with bookshelves beside the large daylight-illuminated living room. Separated at will by a folding partition is the dining room for as many as eight, and the same full garden view. Then the kitchen and laundry: pleasant, complete, commodious, with an entrance from the car shelter, which contains heating plant and storage compartments. Now back to the passage with the books, the corridor, lined with large closets, leads to the bedrooms and becomes a dressing room for the parents' bedroom at the end. Notice, in passing, the children's, which can be singles or double, and their two cleverly divided baths. And remember that skillful planning without guarantees privacy and outlook within; also that skillful planning of house and grounds must continue on to cover the community—for the livability of the neighborhood is what gives value and security to the home.

The hope for houses like this, at prices you can afford, is within your power to realize. Better houses, at lower costs, and put together with infinitely fewer parts, all greatly improved and simplified, can be had if the same kind of research and co-ordination which are winning the war can only be used to revitalize the home-building industry. You can urge your congressman to back legislation which will initiate and stimulate research that will create the better, less expensive homes you need. You can help discourage present inflationary costs by waiting for that better, less expensive home. Wartime research quickly developed the B-29; similar effort can soon develop the better home so vital to a victorious peace.

High windows (at lower left) give privacy from the street. The terrace is like an outdoor room.

SERVICE YARD
LAUNDRY
9' X 11' KITCHEN
CAR SHELTER
ENTRANCE PATH
DINING 12' X 15'
LIVING 16' X 17'
BOOKS
HALL
LIVING TERRACE
CHILD 11'X8'
CHILD 11'X8'
DRESSING
PARENTS' 11'X15'
BEDROOM GARDEN
JOHN FUNK, ARCHITECT; GARRETT ECKBO, LANDSCAPE ARCHITECT; HOUSE MODEL BY DEVON DENNETT; MODEL FURNITURE BY BETTY DEMARS. SETTING AND PHOTOGRAPH BY PRATT.

FIG. 11 John Funk, "A House in the Sun." (Source: *Ladies' Home Journal* 62, no. 8 [August 1945]: 116. Reprinted with permission.)

models, such as the one designed by A. Lawrence Kocher for the November 1944 issue, emphasized the capacity for modular houses to expand and contract according to family needs. Keck's July 1944 contribution, "Water on the Roof," elaborated on the solar logic of his earlier de-signs by providing an insulating membrane of water on the roof for summer heat deflection. The house presented in the June 1945 issue, by "the world's most

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distinguished architect," Frank Lloyd Wright, was almost completely sheathed in glass, with thin wood columns elegantly supporting an extended roof overhang.[73]

Pratt's editorial commentary offered a sophisticated analysis of the multivalent complications that the postwar house, considered in the midst of wartime anxiety, had come to represent. The designed provision of solar heating was a central element in the placement of the house as a node in the interconnected network of energy, economy, and consumer desire now focused on realizing the possibilities of postwar living. Pratt emphasized that the technological and cultural transformations derived from the increased productivity of the war simply needed to be redeployed in order to coalesce a new built condition. As he wrote:

> Unless our American standard of living is an idle boast, every family should be able to have a really adequate house. . . . American resources can provide such a house . . . but they can do it only if industry, labor, finance, and Government all make up their minds to work together as never before.[74]

Pratt's focus, much like that of "What Is a House?," was on developing a new structure of home production, so that the building industry, architects, and home buyers would be ready once materials became available and war bonds began to return savings to the public.

Significantly, however, the architect is not on Pratt's list of collaborators. For him, the designer is an absent presence, almost magically resolving the anticipated "vast changes in our everyday lives" through the considered deployment of design and technology—as in the hopeful title above Philip Johnson's July 1945 house for the *Journal*, "As Simple as That." Instead, the architect's potential client—Pratt's reader—was the activated subject, now able to use their position as consumer to encourage new infrastructural conditions. As Pratt indicated, "This is where you come in . . . month by month, as peace approaches, we want to show new living places to you, so that you can make up your mind what's possible as a way of life for you . . . the more you like houses that are made this way, the sooner you will have them."[75]

Reports on the *Journal* houses were featured in both *Pencil Points* and in *Architectural Forum*'s "House Omnibus" issue of April 1945.[76] The well-illustrated report in *Pencil Points* was titled "Houses for the People." Be-

73. John Koch's house was published as "A House in the Sun," 116; A. Lawrence Kocher's as "Most House for the Least Money," 130; Frank Lloyd Wright's as "Opus 497," 138–39.

74. Pratt, "Every Family's Right," 134–35.

75. Ibid., 134.

76. See "House Omnibus." The issue also summarized contributions to thinking about the house in the popular magazines *McCall's*, *Woman's Home Companion*, *House Beautiful*, *Better Homes and Gardens,* and *Country Farmer*.

yond a laudatory analysis, it included an extensive interview with Pratt and a selection of letters that had been written to the *Journal* about the houses. A companion article entitled "Can America Afford New Houses?" saw the economic efficiencies of prefabrication and solar living promoted by Pratt's campaign as a convincing argument to completely rebuild the housing stock according to modern methods, and saw a modern suburbia as a reasonable solution to population growth and demographic upheaval in the years before the proliferation of low-cost developer housing was consolidated.[77]

Pratt's advocacy for a transformed housing industry, with the consumer in a determinant role, was even more marked in the exhibition at MoMA. In the MoMA gallery, the models were hung at eye level, encouraging the viewer to "imagine yourself five or six inches tall and walk about each house until you feel quite at home"; as the lede of the MoMA press release quipped, "Race of Lilliputian New Yorkers Invited to View Exhibition."[78] The exhibition was a "tremendous success," attracting to the museum its "largest audience in five years"; while this was, no doubt, in part due to the cessation of the war and a changed mood on the home front, it was also because the suburban house had come to represent prospects for an American homeland newly concerned with the promise of peace.[79] As a report on the exhibition by one of its docents indicated, "most of [the visitors] seem interested in a very personal sense. They . . . want a house of their own after the war and they visit the exhibition with an eye to seeing how these houses would fit with their own specific needs"[80] (fig. 12). Plans were made for the exhibition to travel to Baltimore, Buffalo, Minneapolis, and numerous other cities, although the *Ladies' Home Journal* eventually withdrew its support for this ambitious project after determining the models were too fragile to be shipped around the country at a reasonable cost. Large, back-lit transparencies of some of the *Journal* photographs of the models did go on a limited national tour.[81]

Mock, a staunch advocate of housing reform, shared Pratt's conviction that the consumer could be the driving force in determining the disposition of postwar living.[82] Though MoMA was initially not involved in com-

77. "Houses for the People," 59–66; "Can America Afford New Houses?" 66–69.

78. *Tomorrow's Small House*, 4.

79. Monroe Wheeler, director of exhibitions and publications at MoMA, to Bruce Gould, general editor of *Ladies' Home Journal*, 12 July 1945, in archives of the Museum of Modern Art, curatorial folder for "Tomorrow's Small House: Models and Plans (Exhibition no. 289)."

80. Roslyn Ittelson, "Report on the Reaction of the Public to the Exhibition of Small Houses at the Museum of Modern Art" (n.d.), in archives of the Museum of Modern Art, curatorial folder for "Tomorrow's Small House: Models and Plans (Exhibition no. 289)."

81. Letter from Richard Pratt to Elodie Courtier, MoMA director of circulating exhibitions, summarizing correspondence between Pratt and Bruce Gould, editor of *Ladies' Home Journal,* 8 June 1945, in archives of the Museum of Modern Art, curatorial folder for "Tomorrow's Small House: Models and Plans (Exhibition no. 289)."

82. Jenny Tobias, "Elizabeth Mock at the Museum of Modern Art, 1938–1946," un-

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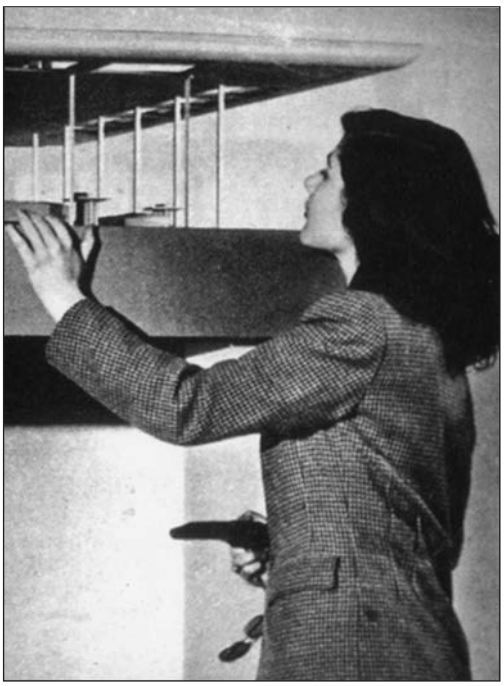

FIG. 12 Museum visitor looking at model of Frank Lloyd Wright's *Ladies' Home Journal* house at MoMA's *Tomorrow's Small House* exhibition, 1945. (Source: *New York Herald Tribune* [18 July 1945]. Image courtesy of MoMA Archives.)

missioning the designs or the models published by the *Ladies' Home Journal*, Mock became interested in how Pratt's development of single-family house models also had ramifications for larger-scale, suburban planning. She was especially interested in mediating the openness of the possibilities of solar orientation with the privacy of suburban living: the *Journal* spread for Johnson's plan cited above includes an offset image demonstrating that "the first lesson in good community planning" involved a "semiprivate loop drive that serves each cluster of houses, all of which face away onto a green and gardeny outlook."[83] The exhibition featured an even more developed model of the "semiprivate loop" as a collaboration between the *Jounal* and the museum (fig. 13). Designed by Vernon de Mars, Serge Chermayeff, and Susanne Wasson-Tucker and called "The House in Its Neighborhood," this model placed a number of the *Journal* houses in a series of rambling cul-de-sacs. They were intermingled with multifamily dwellings based on

published manuscript (2003), in archives of the Museum of Modern Art, curatorial folder for "Tomorrow's Small House: Models and Plans (Exhibition no. 289)." Much appreciation to Ms. Tobias for directing me to this work.

83. Pratt, "As Simple as That," 118.

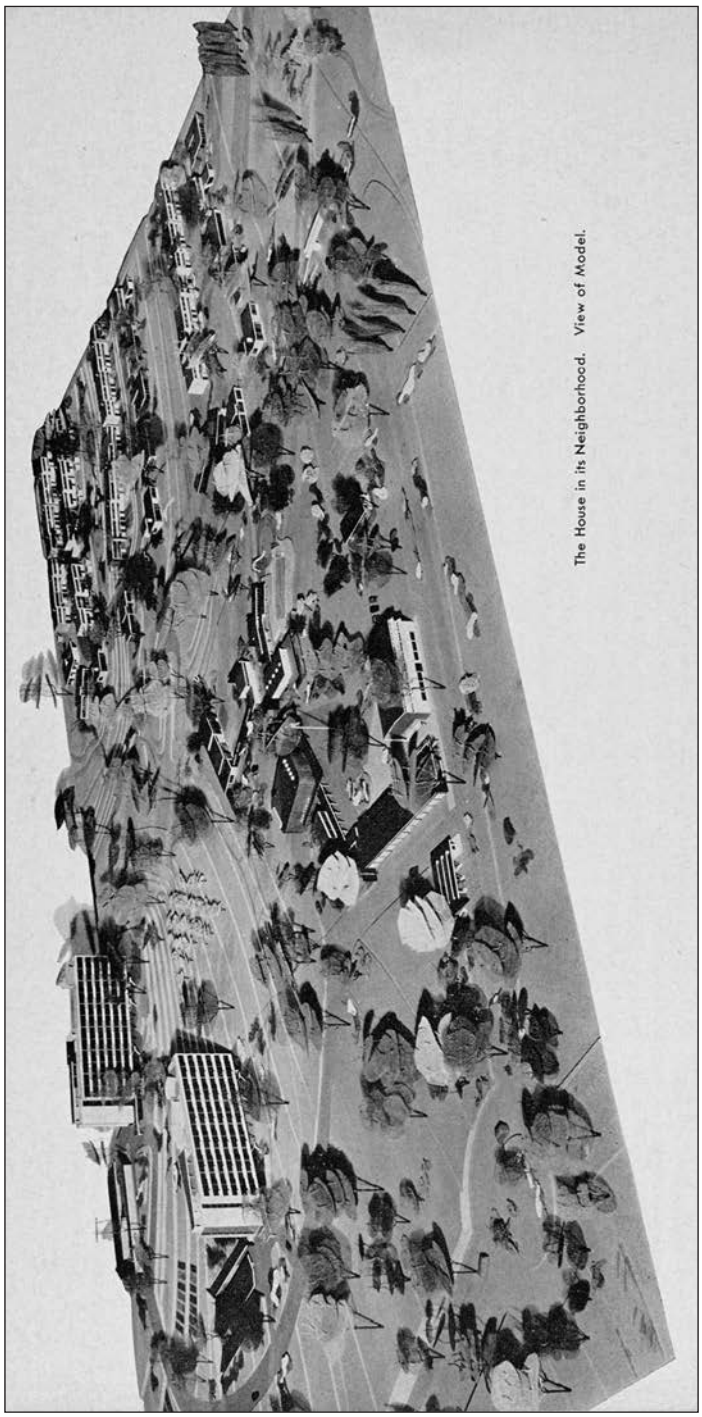

FIG. 13 Vernon de Mars, Serge Chermayeff, and Susanne Wasson-Tucker, "A House in the Neighborhood," from MoMA's *Tomorrow's Small House* exhibition, 1945. (Source: MoMA Archives. Reprinted with permission.)

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de Mars's design for the February 1945 issue of the *Journal*, and also with a number of "community buildings," including a restaurant and a swimming pool, designed by Chermayeff.[84] As Mock concluded the catalog description of the model, "would this be anything like your idea of a pleasant community?"

The "Tomorrow's Small House" catalog had begun as a much more ambitious project in its own right. Initially conceived by Mock as an "illustrated booklet of advice for the small home builder," it devolved into a regular issue of MoMA's monthly bulletin. The exhibition, however, served as a prelude to Mock's next project, entitled "If You Want to Build a House." As the title suggests, this second catalog realized the proposal for a home-builder's manual. The book, along with an accompanying exhibition of explanatory photographs, cartoons, and homeowners' checklists, traveled to fifty-one venues nationwide. It presented a "simple, informal analysis of problems in home planning, designing and construction," from "Choosing an Architect" to "The Possibilities of Maximum Light."[85] In this latter section, Mock used photographs from nine of the architects who had designed houses for the *Ladies' Home Journal* series. In *If You Want to Build a House*, the solar house, as should be expected by now, was everywhere, seemingly a necessary part of any attempt to house the expanding nation.[86]

Conclusion

Amid the broad range of architectural and planning issues raised, the solar capacities of the modern house, small or otherwise, remained an important aspect of the postwar discourse on suburban growth. The *New York Times* article covering the MoMA exhibition focused on the "typical solar house" and detailed the lighting mechanism the museum deployed on the model of Keck's house, with "one set of lights showing how the rooms are flooded with the high-riding winter sun, automatically alternat[ing] with another set indicating that the overhang keeps the sun out in summer."[87] This dramatization of the benefits of solar design helped to clarify its potential to many of the exhibition's visitors, and suggested the continued importance of energy efficiency to both the specialized professional and broad public discussions of home-building right after the war.[88]

84. *Tomorrow's Small House*, 19; see also Pratt, "Good Neighbors," 150–51, and Tobias, "Elizabeth Mock," 28ff.

85. Mock, *If You Want to Build a House*.

86. In addition to these editorial and curatorial interventions, glass manufacturers continued to emphasize the possibility of solar heating as an auxiliary system to furnace-based systems. Libbey-Owens-Ford led the charge, especially with its book *Your Solar House*, edited by Marion Simon and appearing in 1947.

87. "Museum Presents Small House Show: Modern Art's Display Offers 'Eye Appeal' as Well as 'How it Works' Stress."

88. Ittelson, "Report on the Reaction," n.p.

When suburban growth began to expand around 1948, however, the possibilities outlined in the pages of the *Ladies' Home Journal* and at the MoMA exhibition were not considered; or at least not as Pratt or Mock might have wanted. The Housing Act of 1949 *did* provide significant improvements in financing structures—reflecting, in general terms, many of the proposals in "What Is a House?"—and strengthened the G.I. Bill in this regard, but the act also imposed design and siting restrictions on mortgage approval that were heavily biased toward the integration of new domestic technologies into traditional designs.[89] Furthermore, the coordination and industrialization of the building industry took place, but according to a lowest common denominator of design and materials, with little opportunity for variation according to site orientation or the desires of the consumer—a condition best represented by the assembly-line production of Levittown.[90] Pratt and Mock's move to appeal to the consumer instead of to the architect was trumped by the developer, who paid attention to neither.

The solar house, amid these and other impediments, persisted as a symbol of possible alternative futures and was the subject of numerous technological experiments. At the Massachusetts Institute of Technology (MIT), engineers built a number of houses using solar energy for space heating by absorbing sunlight into insulated water channels, and using the heated water to temper air for introduction into a traditional heating system.[91] These systems were effective but expensive, and despite their appeal to policymakers and economists, they were never developed into marketable products.

A parallel attempt at scientific analysis of solar house heating was not encouraging. From 1944 to 1947 the refrigeration engineer F. W. Hutchinson, working through the Housing Research Laboratory at Purdue University, tested two houses built to be "thermally, structurally, and architecturally" identical; except, as Hutchinson wrote, "one has substantially greater window area than the other."[92] The houses' performance was compared over three heating seasons. Hutchinson's principal conclusion was that because of the comparatively poor insulation capacity of the double-glazed wall versus the masonry wall, the heating plant in the solar house

89. Wright, *Building the American Dream*. The Housing Act was also heavily biased toward the suburbs; although it made provisions for urban public housing, they were largely ignored until the 1960s.

90. Seemingly a model of efficient production and affordable housing provision, Levittown's infrastructural condition was seriously flawed. See Hayden, *Building Suburbia*, 139; and Rome, *Bulldozer in the Countryside*.

91. See Richard W. Hamilton, *Space Heating with Solar Energy*; see also Daniel A. Barber, "Experimental Dwellings."

92. See F. W. Hutchinson, "Solar House: Research and Analysis," 92, "The Solar House: A Full-Scale Experimental Study," 96–97, "The Solar House: A Research Progress Report," and finally "The Solar House: A Second Research Progress Report." The 1947 article in *Progressive Architecture* summarizes these earlier reports.

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had to be able to provide significantly more heat in the event of a sunless and cold winter day. "Irrespective of geographical location, or of any other factor," he wrote, "the use of large glass areas will necessarily require installation of a larger heating plant."[93] As oil started to become cheaper, the upfront costs necessitated by increased glazing contributed to developers' refutation of the solar house premise.

Despite this seeming denigration of potential economic benefits, interest in the solar house continued. In an international solar house competition in 1958, called "Living with the Sun" and organized by the Association for Applied Solar Energy (AFASE), the goal was to work toward a marketable solar heating system by building a demonstration house and attracting industry investment—here again maneuvering around the architect, and also the public and the developer, to appeal to the building industry and those corporations, such as Dow Chemical, Carrier, and others now firmly engaged in producing heating, ventilation, and air-conditioning systems.[94] The competition was won by Peter Lee, a student in the School of Architecture at the University of Minnesota, where Ralph Rapson had been dean since 1954. Lee's design was built, though due to cost-cutting its solar heating system never worked very well. Other houses, from South Africa to India to New Jersey, attempted similar strategies and harbored similar ambitions, with little success.

There is significant formal resonance between Peter Lee's plan for the AFASE competition and Rapson's Greenbelt House—as their basic planimetric move, for example, both used a shaded central court to separate public and private space. Both also had full glazing on almost every façade (fig. 14). Such formal affinities are less about architectural influence and more about the conflation of inputs into the design parameters of solar and modern housing. Numerous authors have proposed that the elaboration of modern themes in the postwar period developed a bifurcated model of housing—one side that deployed modern amenities in a traditional shell, and the other, which proposed that, as David Smiley has put it, "modern living could only occur in a modern house that *looked* modern." Both trends, still following Smiley, "shared special flexibility, built-in furnishings, indoor-outdoor living and, perhaps most importantly, the ideal of an infinite variety of personal patterns of living." A modernism emerged, Smiley concludes, "that formalized a separation of exterior appearances from interior performance."[95]

To a great extent, the modern solar house frustrated this distinction, as

93. Hutchinson, "Solar House," 91. Scientists at MIT and researchers at Libbey-Owens-Ford (who had partially sponsored Hutchinson's study) sought to dispute his claims, but to little effect.

94. John I. Yellott, *Living with the Sun: Competition*. The Association for Applied Solar Energy was the precursor to the International Solar Energy Society.

95. Smiley, "Modified Modern," 47.

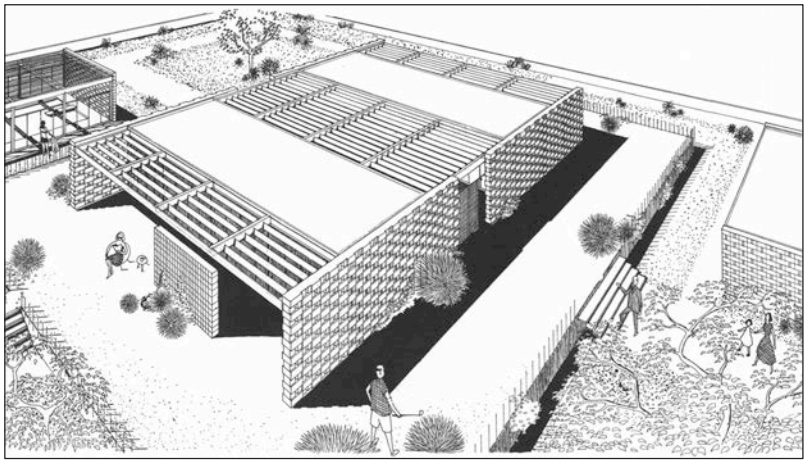

FIG. 14. Peter Lee, Association for Applied Solar Energy Solar House, Phoenix, 1957–59. (Image copyright International Solar Energy Society. Reprinted with permission.)

it relied on the formal principles of modernism to produce the cost-savings and lifestyle improvements it purported to offer. Though a modern house, such as Rapson's, did not have to be solar, a solar house, such as Lee's, *did* have to be modern. What is perhaps most significant is that the location of the modern solar house at the intersection of economic, political, and cultural issues resulted in the ubiquitous proliferation of the design tropes associated with it, as the panic of war transformed into the exultation of the postwar consumer boom. Numerous modern houses came to reflect a relative fidelity to the solar house principle—even when their generous use of glass did not reflect the material transformations embedded in the "vast changes in our everyday lives" predicted in "The New House 194x" and other publications of the period. The appellation "solar house" came to be used in relation to any modern house using glass, whether or not economic or fuel efficiency was explicitly claimed.[96]

Insofar as modern architecture can be seen as a formal approach to the possibilities of technological innovation, much of the promise of the solar house was the new relationship it offered between people and the places they live. The modern solar house is an artifact of a time when architecture was seen to have potential for a substantive impact on economic and polit-

96. In one example, in a 1949 story in the *New York Times* on Frank Lloyd Wright's planning of the Usonian compound in Pleasantville, the subtitle reads: "New Kind of Home Rising in the Suburbs: Solar Houses on Round Lots, Minus Attics, Cellars, Mark Big Westchester Project." In the article, the solar nature of the houses is not elaborated upon beyond the use of "large expanses of glass." See Merrill Folsom, "A New Cooperative Housing Development Underway in Westchester County."

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ical conditions and, in this case, to provide for a cultural expansion untethered to endless consumption. In the end, however, the solar house, as with modern house design more generally, came to be one style among many. As a wartime proposal for organizational innovation, the solar house provided a framework to look at the multifaceted dimensions of technological innovation across cultural, energy, and political spheres, and helped to identify a wide array of visions for how to live in a prosperous future—visions that architects, technologists, and their critics are struggling with once again today.

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