

A number of authors see a more central role for modelling in geographic inquiry and suggest that many of the criticisms are misplaced. Haines-Young emphasizes that it is through modelling that our understanding of the world can be evaluated critically and questions the view that we should reject modelling and the scientific method because of the shortcomings of quantitative modelling. Macmillan dismisses the idea that modelling is incapable of producing explanations, of dealing with real systems, or of examining historical processes. According to him, quantitative theorizing and modelling have a central place in geography. In a thought-provoking article, Bennett suggests that the post-welfarist environment into which we are moving provides a crucial role for modelling in public policy formulation. Finally, developments in computing technology and Geographic Information Systems, discussed by Rhind, promise to allow modellers to address larger and more complex questions. These and other contributions do much to dispel the notion that modelling is a technique of the past.

Even the most optimistic authors, however, voice concerns about possible setbacks to modelling if certain trends continue. Bennett, Batty, and Beaumont caution that the importance if not the survival of geography will depend upon the ability of our models to contribute to policy debates rather than the development of theories of narrow interest to academicians. Openshaw feels that this purpose will be best served by placing the future emphasis on strictly inductive, data driven models rather than "massively theoretical" models of the past. Cox, however, displays the opposite concern, that data driven models will lead to excessive empiricism that will ultimately "limit imagination and creativity."

One of the inherent problems in a book as wide in scope as *Remodelling Geography* is that it is difficult for all the papers here to appeal to any one audience; rather, different parts of it will be of interest to different groups. At least three such audiences can be envisaged: physical geographers interested in a focused, substantive discussion of modelling in the areas of geomorphology, climatology, and island biogeography; geogra-

phers working in the areas of computer modelling and spatial statistics; and geographers interested in the ongoing philosophical and critical debates in the discipline. The organization of the book, however, could have been made more helpful to these groups. While the current division of articles into sections such as physical, human, applied, and so on has logic, there are frequently abrupt thematic transitions from one chapter to another within a particular section. For example, a specialized discussion of models in geomorphology by Thornes is followed in the same section by a summary of and response to criticisms of the scientific method (Haines-Young). The organization also detracts somewhat from the book's objectives. The chapters by Macmillan and Wilson, for example, presented in Part II, summarize and respond to the various criticisms of modelling that are not presented until Part V.

Notwithstanding the last point, Macmillan must be credited with a superb job of editing. Authors refer to one another's chapters, making *Remodelling Geography* a remarkably well-knitted effort. Macmillan's afterword ably synthesizes the themes presented in the book and takes *Remodelling Geography* a step beyond most conference volumes. Particular mention must be made of the contributions such as those by Bennett and Macmillan where model-builders respond to the critics. In summary, this book is a valuable contribution to the ongoing debates on the future of modelling and geographic inquiry.

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*Behind the Silicon Curtain: The Seduction of Work in a Lonely Era.* By Dennis Hayes. Montreal: Black Rose Books, Ltd., 1990.

During the 1980s, high technology industry captured the collective imagination of economic geographers, regional scientists, urban planners, and public policy makers. Countless books and articles were written on the form and function of high technology

industry and regions. There grew up an entire literature devoted to the location of high technology firms and the formation of high technology complexes. More than any other place or region, Silicon Valley—with its fast-growing electronics start-ups, world class universities, entrepreneurial culture, and abundant finance capital—became the focal point of this burgeoning literature. Silicon Valley was portrayed as nothing less than a “high-tech miracle”—characterized by fast growth, an abundance of small innovative businesses, and the reappearance of tightly agglomerated spatial structure. Some went so far as to argue that Silicon Valley should serve as a model for less fortunate regions, touting the development of the “next Silicon Valleys.” Silicon Valley was heralded as a paradigmatic example of the “flexible specialization” model of development (e.g., network communities of small firms) that would form the basis for a new age of industry and a much improved way of life distinguished by artisan-like working conditions, high levels of trust, and “yeoman democracy.”

Dennis Hayes’ important new book on Silicon Valley, *Behind the Silicon Curtain*, provides a much needed counterpoint to this celebratory view. Hayes provides an insider’s account of Silicon Valley. His book is based upon first-hand research and observation, for the author is of the very factories he writes about. Hayes lays bare the harsh reality of the high technology labor process, providing riveting descriptions based upon his own experiences. In his mesmerizing tales of life inside Silicon Valley’s factories, communities, and cultural milieu, Hayes unveils a dark side of Silicon Valley and of high technology America that seldom surfaces in the literature. This book offers a gripping, revisionist perspective that is of great importance to all those concerned about high technology industry, industrial competitiveness, the new economic geography of North America, and the future of technology, industrial, and economic development policy.

Hayes grounds his analysis of Silicon Valley at the point of production. From his initial focus on production, he works outward to capital flows, labor mobility, the relation-

ships between firms, urban form, consumption, and lifestyle patterns—in this way placing his analysis of consumption and social reproduction on the strong footing of material production. He is thus able to avoid so many of the pitfalls of the geography literature that disconnects spatial structure, location, interfirm linkages, and the organization of the division of labor from the underlying realities of the production process.

Existing accounts of Silicon Valley describe a high technology workforce of well paid professionals engaged for the most part in exciting scientific and technological endeavors. Hayes takes the reader inside the brutally degrading labor process of Silicon Valley’s high technology firms and, in doing so, permanently explodes such myths. Where the theorists of flexibility see Silicon Valley through the lenses of cooperation, trust, and mutual obligation, Hayes finds a labor where profit, exploitation, and inhuman working conditions are the rule. Consider the semiconductor “clean rooms,” where, according to Hayes, workers are “packaged” to protect the product:

In cramped locker rooms, the women [workers] enjoy their last chatter before the crescendo. They snap on vinyl surgeon’s gloves and don white and pale-blue dacron: hoods, jump suits, veils and booties. As they shroud themselves in nearly identical bunny suits the workers, or rather the images they present to one another, shed their distinctness. They walk through a narrow vestibule with a grey sticky mat on the floor. Abruptly the crescendo begins its deafening ascent; they barely hear the stripping sound of the mat cleansing their soles. Along the vestibule walls, crooked plastic tentacle stumps pour a continuous fusillade of air at them, removing dust flecks and lint from the dacron. The roar submerges normal conversational tones—all but shouts and sharp sounds. Passing through the vestibule to the clean room . . . the workers take up their positions . . . From ceiling to floor, the forced air . . . blows dust particles larger than quarter widths of human hair. This protects the even smaller circuitry that blots the

wafers. But the air flow merges acoustically with the dull whir of the processing equipment. The consequence of this merger is a cacophonous, low boom—a crescendo that peaks but never falls off.

... Their mouths gagged and faces veiled ... phrases are muffled, expressions half-hidden. ... Like deep-sea divers, the workers use hand gestures, or like oil-riggers they shout above the din. ... [T]he crescendo encourages a feeling of isolation, of removal from the world (pp. 63-64).

Or ponder for a moment Hayes' equally vivid description of a factory where he once made deliveries:

Inside one of the shops—a dirt floor quonset hut in Santa Clara—were Hispanic workers in rubber boots, gloves and aprons, and without respirator masks. They moved up and down jerry-built platforms which gave access to the vats. Some of the vats boiled; others untouched by the fires yielded the smoke of chemical reaction. The first time I delivered there, the workers regarded me suspiciously. They may have taken my tie, twill slacks, and sunglasses for the accoutrements of La Migra [U.S. immigration agents] travelling incognito. Then after my pickups and deliveries became commonplace, their suspicion gave way to silent, grinning salutations. Into the vats the workers dipped the unfinished alloy chassis panels, nuts, and screws I would drop off. ... The foul metallic odors made me want to hold my breath. The twirling bulb-shaped fans on the roof provided little ventilation. After I stopped making deliveries there, someone in a position to know confirmed my suspicions: most of the metal shop employees were undocumented workers. I wondered how much they were daunted by their "alien" status from speaking out against the fumes (p. 54).

Hayes provides vital insights into the labor market for high technology workers, documenting the emergence of a labor force of "mass transients" who experience low pay and insecure employment and move constantly from job to job in search of work. Such highly irregular working condi-

tions, in combination with the mixed ethnic identities and fragmented communities of high technology workers, make it virtually impossible for this labor force to forge the bonds of class solidarity that might help to improve their conditions. As Hayes points out, unions are virtually nonexistent in Silicon Valley. This is not because workers do not want them; rather, the unions have failed even to try to organize Silicon Valley's workforce. Hayes suggests that this lack of union effort is the result less of oversight than of discrimination, contrasting Silicon Valley's immigrant, minority, and women-dominated workforce with the labor movement's traditional ethnic, white, male constituency.

Where many commentators see Silicon Valley's "clean industry" as the answer to the smoke-belching pollution of heavy industry, Hayes finds its invisible pollutants to be just as deadly. Workers on the production line are exposed to debilitating and at times fatal concentrations of arsenic, hydrofluoric and hydrochloric acids, trichloroethane (TCA), methylene chloride, chloroform, and carbon tetrachloride. Exposure to these chemicals can cause disorders that range from chronic headaches, short term memory loss, and heightened susceptibility and an inability to fight off colds and flu to menstrual problems, reproductive disorders, and spontaneous abortions. Some lead to a form of "chemical hyper-sensitivity" in which exposure to even small amounts of normally safe chemicals such as hair spray, perfume, laundry bleach, hand soap, and even tap water can cause violent allergic reactions. According to Hayes, the most extreme form of this condition, which is on the rise in Silicon Valley, renders the body's T-cells dysfunctional, creating what some doctors refer to as "chemically-induced AIDS."

Toxic pollutants are not limited to the workplace but affect the community at large as they seep out into the atmosphere and water supply. Hayes, who has worked closely with noted environmental scientists, is on perhaps his strongest ground when he documents the serious chemical contamination of Silicon Valley. He points out, for example, how pregnant women who drank tap water in Silicon Valley had significantly

higher rates of miscarriages and birth defects than those who did not.

A major point made by geographic theorists is that Silicon Valley comprises an organic outcropping of local businesses—a self-forming and self-reproducing agglomeration. Hayes explodes this myth too. His account illustrates that Silicon Valley is merely the latest geographic outpost for capital accumulation on a global scale—a place where industrialists and financiers from the United States, Japan, Korea, Taiwan, Saudi Arabia, Bahrain, Britain, Holland, France, and Germany reap huge profits by investing in new technologies and industries. Silicon Valley firms spread their reach far beyond the confines of the local industrial district, establishing a far flung international network of Third World branch plants to extract ever greater volumes of surplus value from low-wage labor.

Geographers and urban theorists have long been concerned with the relationship between work and home life. Hayes suggests that in Silicon Valley, work has come to overwhelm all facets of life. The condition is especially acute among Silicon Valley's professional and technical labor force for whom work has become the sole source of identification and self-worth. Hayes unravels the connection between this obsession with work and the breakdown of the family as a unit of social reproduction. He notes the extraordinarily high divorce rates in Silicon Valley, citing a 1986 survey that found that nearly half of Silicon Valley fathers said that their jobs, not their families, were of primary importance to them. He points out that Silicon Valley professionals are choosing to remain single because of work—a malady that psychiatrists refer to as "Silicon Syndrome." In this pressure-cooker environment, professional workers find it impossible to unwind or relax; the favored forms of rest and relaxation simply create, rather than relieve, pressure. As Hayes puts it: "With the compulsiveness—and with many of the symptoms—of a drug habit, Silicon Valley imbues its free time with the fury and excess of work" (p. 136). Hayes goes on to document the fitness mania and exercise abuse as well as drug and alcohol problems that comprise main sources of

recreation in Silicon Valley. The extent of social erosion in Silicon Valley is registered in the following indicators: nearly three-quarters of the working population victims of substance abuse, half in therapy, and the highest divorce rate in the nation.

For Hayes, all of this stems from the extraordinary demands placed upon Silicon Valley's high technology professionals—the tremendous pressure to produce and extremely long work weeks needed to turn their knowledge into saleable commodities. The result is a devastating sociopsychological cycle that contributes to greater alienation and estrangement. According to Hayes: "Work is a port in the storm of life's uncertainties, because no matter how harrowing, work offers meaning . . . and, for some, an escape from loneliness" (p. 136). In Hayes' view, Silicon Valley is a "brave new world" of alienation, anomie, and atomization—where social connection and family life are sacrificed for total dedication to work and the hyperaccelerated development of the forces of production.

Suburbanization and the decline of the urban center are topics well known to geographers, regional scientists, and urban planners. Hayes calls attention to the obvious problems of traffic congestion and escalating housing costs. He forces us to think critically about the housing developments, shopping malls, and affluent suburban way of life that define the landscape of high technology locales like Silicon Valley. The absence of a town center or urban core means that shopping malls become the focal point of life outside of work. In this environment, material consumption becomes not only a release but a virtual substitute for meaningful human relationships. From Hayes' perspective, the suburban landscape and settlement patterns of Silicon Valley contribute directly to its crisis of social reproduction:

The bill has come in for the homogeneous isolation of the ranch style subdivision, the condominium theme park, and the landscaped apartment complex. Hotly pursued for safety and seclusion, these housing arrangements secure a slight reduction in street crime . . . but drug dependencies, divorces and time

spent alone all rise alarmingly in Silicon Valley, suggesting a lonely and unwholesome collective existence (pp. 145-6).

For those who are historians in practice or at heart, this book contains an added bonus: an exceptionally cogent and well-written introduction by Drexel University historian David Noble, which provides the historical context for Hayes' analyses. Noble, the author of two very important books on corporate innovation, *America by Design* and *Forces of Production*, draws a compelling comparison between the late twentieth century fascination with Silicon Valley and the view of the textile producing community of Lowell, Massachusetts a century and half earlier. As with Silicon Valley, the original image of Lowell centered on industrial progress, material abundance, and social harmony, but in time the true reality of Lowell was unmasked: subsistence wages, long working hours, and horrid working conditions—its “satanic mills.” Silicon Valley is a modern day Lowell with its own high technology version of those “satanic mills.”

Still, *Behind the Silicon Curtain* is not without flaws. With overwhelming enthusiasm for his topic, Hayes sometimes flies by subjects, failing to devote enough attention to the details or to elaborate a point sufficiently. But these are minor flaws in a book that forces a major rethinking of the most basic assumptions of high technology industry and society.

This is more than an important new book—it is absolutely must reading for scholars, students, policy-makers, and all those who are concerned with our technological and industrial future. Dennis Hayes has peered into the future, and his book shows that the costs of this version of progress may be much more than most of us bargained for.

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*Mass Production.* By Richard Florida and Martin Kenney. New York: Basic Books, 1990.

Here is another of those books by professional scholars in which the business world is apostrophized in more or less plain English spiced up with much rather self-conscious vernacular idiom. What we have in this instance is, in the best traditions of the genre, a sweeping but intellectually non-threatening inquiry into the deterioration of American manufacturing performance, with several hints on how to resolve it.

*The Breakthrough Illusion* is an unswerving exposé of what Florida and Kenney allege is the central weakness of modern U.S. industry (particularly high technology industry): its fixation on spectacular forms of technological innovation at the expense of attention to detailed developmental work and the sort of fine-tuning of manufacturing processes that alone can ensure steady improvements in output quality and competitiveness. In short, U.S. industry is congenitally preoccupied with technological “breakthrough” and, to its detriment, relatively weak in providing “follow-through” services. In just over 200 acerbic pages, the authors develop an argument that pulls back the tarnished tinsel from the technological achievements of the American economy to reveal the underlying structural infirmities of the system. Japanese industrialists, they aver, succeed precisely where Americans fail. More ominously, the Japanese are moving steadily toward a state of affairs that incorporates the best of both worlds. To their proven aptitude for follow-through, they are now adding a significant breakthrough capability.

The argument is intriguing, and its main substance no doubt helps in part to account for the remarkable ability of Japanese firms to dominate sector after sector in their progressive ascent to economic mastery of world markets. Florida and Kenney cite a long list of variables that, they claim, are responsible for the declining prowess of American industry. The bill of particulars ranges across a gamut of social and economic factors from the Cold War to corporate raiding, all of them contributing in one

*The Breakthrough Illusion: Corporate America's Failure to Move from Innovation to*