URBAN STUDIES

Connecting Paradigms

Michael Szell

Science is an endeavor of artful simplification, of discovering general principles. Fruit flies, for example, look very different from humans, but the two species share 75% of disease-causing genes. Thus, we can study fruit flies to learn about our own weaknesses under the common framework of genetics. Similarly, the unifying principles of allometry allow us to make sense of most forms of life on Earth, where a cat is just a blown-up mouse and a human is just a blown-up cat. Multiply an animal's size by x, and its heart rate, lifetime, and other features will increase in proportion to specific powers of x. This is the case because the physical rules that govern the formation of circulatory systems hold everywhere. Turning to social phenomena, can we find universal processes underlying them?

The New Science of Cities

by Michael Batty
MIT Press, Cambridge, MA, 2013. 518 pp. $45, £31.95.
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Let us take a big leap and consider cities: Perhaps something similar to biology's allometric rules would allow a megacity as complicated as New York to be better understood by looking at what goes on in a small village. Is New York just a blown-up version of Venice? Universal principles that govern urban shapes and growth processes independent of particular history or geography could support a "grand unified theory of cities." What would it take to discover them?

The New Science of Cities presents a herculean attempt to bring together widely fragmented approaches to making sense of human social organization with the goal of eventually establishing a consolidated "science of cities" able to answer our questions. Michael Batty bases his argument on the interplay among space, dynamics, and relations. He holds that "to understand place, we must understand flows, and to understand flows we must understand networks." Batty (a geographer at University College London) also stresses two other principles: an intrinsic order of scale determines a city's form and function, and a science of cities should not merely observe but also predict. The book draws on the work of urbanists, economists, mathematicians, and physicists as well as almost five decades of his own contributions to urban studies.

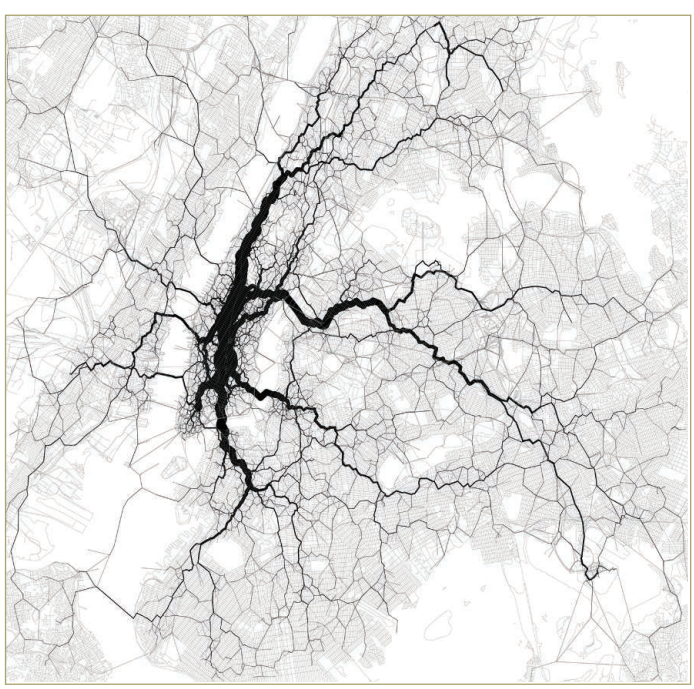
Batty's approach rests on a physicalist philosophy: He focuses on what can be immediately observed. In a treatise that eventually becomes technical, he simplifies cities as "sets of actions, interactions, and transactions." The book develops a toolbox of mathematical models—well applicable to "big data" that are being increasingly collected about cities—from a mesmerizing potpourri of paradigms. Its foundational part takes us on a fascinating historical journey through these perspectives, from urban economics and transportation to fractal geometry, dynamical systems, and network science. All these aspects can be embedded in complexity theory, the most likely candidate to provide the consistent philosophy for achieving the author's ambitious goal.

The foundations for modern urban studies were laid in the 19th century, with the first analytical, economic approaches and the concept of agglomeration. The closer we live together, the more opportunities of trade we find, creating economies of scale. Today, extensive empirical evidence supports an urban allometry that convincingly shows cities are humanity's socioeconomic reactors, in which citizens produce, consume, and interact more as the city increases in size. These interactions can be explained mechanistically using Newtonian metaphors of cities as entities that exert gravitational-like forces on populations. Such gravity models are used in various social sciences and have recently experienced a boom in the study of human mobility through mobile phone data.

Powerful metaphors populate the histories of urban studies and planning. For a long time, the prevailing line of thinking saw the city as a machine, a model in which a "controller steered the city cybernetically toward a future desired state." Now we know better, realizing that cities are complex systems meandering through a space of configurations, like biological organisms evolving in a Darwinian fitness landscape. Such systems exhibit hallmark features of nonlinear dynamics far from equilibrium. Small interventions can have massive, counterintuitive consequences, making cities almost impossible to control. In a field where planning is essential, this discovery is devastating. It means that monumental top-down plans, which dominated most of 20th-century city planning, are a recipe for failure.

The book provides some better options. Parsimonious bottom-up models and agent-based simulations unveil basic mechanisms of competition and growth. Cutting-edge visualizations facilitate the exploration and the interpretation of empirical and synthetic data. Through a synthesis of the descriptive and the normative and a combination of quantitative modeling with qualitative theories of social exchange and collective action, the author shows how to model urban design to improve the decision processes of authorities and policy-makers.

Batty stresses that the set of approaches he tackles is a first step and by no means exclusive: "it would be presumptuous to think of this effort as the only science of cities, for the city and its planning admits many viewpoints." He concludes that an



Urban complexity. Human flows (mapped by Eric Fischer using geotagged tweets) illustrate the organic structure of New York City.

CREDIT: ERIC FISCHER/USING DATA FROM THE TWITTER STREAMING API; BASE MAP DATA © OPENSTREETMAP CONTRIBUTORS

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integrated, "nicely packaged," and immediately applicable science of cities might never be reached. Nevertheless, *The New Science of Cities* succeeds in clearing a way. It illustrates convincingly the particular promise of mathematical modeling and complexity theory for designing sustainable urban futures.

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ENVIRONMENT AND HEALTH

Fighting Urban Scourges

Frederick R. Davis

Flies, bedbugs, cockroaches, and rats—ugh. What an ignominious group of animals. Each in its own way proved a bane of city life in the 20th-century United States. Collectively and individually, they carry disease, spoil pantries, and threaten the general well-being of urban residents, particularly the poor and especially people in public housing. How can cities fight these pests? Who is responsible: the federal government or the municipality? the community or the family? Where does agency lie in an urban ecology that pits resident against pests? Dawn Day Biehler examines these sorts of questions in her fascinating *Pests in the City*.

In laying out her history of urban ecology, Biehler (a geographer at the University of Maryland, Baltimore County) develops the notion of "ecologies of social injustice." In case after case, she reveals how wealthier urban residents drew on domestic help to combat pests while impoverished minorities, especially African Americans, remained vulnerable to the incessant onslaught of those unwanted co-inhabitants of our cities.

Lest the reader forget that pestiferous species possess agency, Biehler reveals this independence through a series of vignettes, set off from the main narration by italics. Without anthropomorphizing, Biehler captures the needs and wants of flies, rats, bedbugs, and cockroaches. These sections illustrate the biology and ecology of pests, and they remind readers that context is what characterizes an organism as a pest.

Given the ignominy of these pests, city planners and public health officials have waged truly epic battles with them. Such struggles often amounted to arms races as public officers and individuals launched one chemical after another against a never-ending onslaught. Biehler follows these fights against pests from private homes to public housing.

A family responsibility. In this 1916 drawing, most of the flies come from trash in the yard.

During the Progressive Era, the status of the house fly (*Musca domestica*) shifted from harmless companion to disease vector. Leland Howard, chief of the Bureau of Entomology at the U.S. Department of Agriculture, tried to change the common name to typhoid fly to transform popular perceptions of the fly. Biehler argues that Howard, along with representatives of the progressive Hull House in Chicago and advocates in the District of Columbia, saw homes as part of an urban ecology and called for government to clean up each of the cities, respectively. Yet, she notes, modernization of homes, citizens, and sanitation failed to effectively control flies in the cities. Such control was achieved only following the transformation of urban transportation systems when electrified streetcars and automobiles replaced horsepower.

Pests such as bedbugs (*Cimex lectularius*) did not respect social class—at least not during the early growth of American cities. Biehler demonstrates, however, that in time domestic help enabled wealthier city residents to control bedbugs through cleaning and attacking them with hot water and kerosene. Metal bedframes and cleaning appliances also helped the well to do in their battle with bedbugs. Not so the impoverished, who could not afford the time, help, or new technologies. Could a powerful insecticide tip the balance in this story of ecological injustice? Yes and no, Biehler argues. Hydrocyanic acid (HCN) substantially curbed bedbug infestations while subjecting residents to the risks of accidental exposure (including death, as illustrated by several tragic cases). Before Rachel Carson revealed its deleterious environmental effects, DDT provided a safer alternative to HCN. Yet, that popular insecticide carried risks of its own and once again shifted the burden of bedbug control to the residents (even in public housing).

Control of German cockroaches (*Blattella germanica*) followed a path similar to that of bedbugs (HCN to DDT). But, according to Biehler, it was disinvestment in cities in the aftermath of the federal Housing Act of 1949 that kept public housing budgets low and fostered the conditions wherein roaches (and mice and rats) thrived. Such conditions probably fostered development of ecological resistance to a new insecticide, chlordane, as the offspring of cockroaches that survived DDT also exhibited resistance to chlordane.

Like other pests, Norway rats (*Rattus norvegicus*) exploited the interstices between public policy and private residences. In Baltimore and Chicago, municipal rat control extended as far as alleys and other public spaces. This placed much of the domestic space off limits to exterminators, leaving residents vulnerable to infestation and responsible for control measures that they could not necessarily afford. Biehler shows that some proponents of urban rat control advocated chemical solutions, with all the risks associated with them, while others argued for ecological strategies on the grand scale, which failed to engage citizens. Populations of rats rebounded in the spaces between these strategies.

Pests in the City demonstrates that wonderful studies can emerge from extremely mundane origins. Throughout much of the 20th century, flies, bedbugs, cockroaches, and rats exploited niches within urban ecologies of the United States. Their continued presence challenged authorities and citizens alike. In her meticulous and thoughtful analysis of urban environmental injustice, Biehler deftly illustrates how these pests continue to undermine aspirations for modern and healthy living conditions for all.

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Pests in the City
Flies, Bedbugs, Cockroaches, and Rats

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