

Renaissance Resonates with “Algebra” of Novelty

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THIS SUMMER, EXTERNAL FACULTY MEMBER JOHN
PADGETT HOSTS A WORKING GROUP ON STATE AND
MARKET FORMATION AT SFI

A FEW YEARS AGO IN SANTA FE, the ghosts of Donatello, Masaccio, and Brunelleschi came out to dance, but not at the city's open-air opera. It was 3 a.m., an appropriate hour for poltergeists of the Renaissance pioneers of sculpture, painting, and architecture. It occurred in a darkened adobe house on Gonzales Street where a chemist lay reading a scholarly paper under a lamp. He was plowing through a treatise by University of Chicago political scientist John Padgett on the upheavals in 15th century Florentine society when it dawned on him that the sudden flowering of the Renaissance resembled the abrupt physical transitions of many chemical reactions. He was mesmerized.

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Ambrogio Lorenzetti.
Effects of the Good Government
in the City. 1338-39.
Palazzo Pubblico, Siena, Italy

“I couldn’t put it down,” said the chemist, Walter Fontana. “There was a kind of natural resonance in Padgett’s analysis of Florentine society leading up to the Renaissance with how the first self-maintaining, self-reproducing cell must arise, or how any new paradigm of organization comes into existence.”

The next day, as planned earlier, an excited but fatigued Fontana described Padgett’s research to a group of SFI scientists, including Padgett himself. SFI pioneered this kind of interdisciplinary cross-fertilization 14 years ago and now is famous for it. The Institute’s inclusion of Padgett’s work reflects its effort to explore complex adaptive systems like biological evolution or the behavior of securities markets from unusual vantage points.

Padgett’s ongoing research and his discussions with Fontana and others emboldened him. For example, he argued in a paper published this year in the journal *Theory and Society* that Florence “can be considered the birthplace of mercantile capitalism.” He argues that novel uses of money, art, science, and politics created a new social alchemy in Florence in much the same way that a tetrahedral carbon atom takes on different properties depending on the elements it covalently binds to, and the links those elements make with other atoms, and so on.

“Walter and I, independently of each other, happen to place a great deal of causal weight on the ‘algebras’ of interactions leading very frequently to unintended institutional and personal novelties,” says Padgett. He officially credits Fontana and other Institute scientists in his scholarly papers on the rise of the elite Medici family in 15th century Florence.

Padgett’s research conclusions are based on ingenious interpretation of voluminous data. He has spent months in Florence poring over archived records of marriages, dowries, and other public transactions. These led him to conclude that at the birth of the Renaissance, the Florentine families that dominated banking, wool manufacturing, and other areas of commerce maintained their status and power through an elaborate system of political patronage and strategic inter-marriages. Padgett’s analysis of 38 prominent Florentine family trees and the marriages of 298 families of lesser renown revealed an abrupt shift at the start of the Renaissance. He maintains that the shift, combined with other factors, eroded the political influence of elite Florentine families. At the same time, the previously excluded middle class united behind one family—the Medici. Coincidentally, vital accoutrements of modern business—double-entry bookkeeping, marine insurance, partnerships with branches, holding companies, bills-of-exchange, and international banking—were invented in north-

ern Italy about the same time and quickly spread.

Completing the “phase transition,” a term borrowed from chemistry to describe the abrupt molecular change from solid to liquid, or liquid to gas, was the emergence of humanism, a new ethic that viewed the individual as important. The arts and sciences were valued as inherently worthwhile in their own right. Creativity was unleashed. The inventive power of Brunelleschi’s “modern” urban architecture was one of many examples of public art and architecture that physically affirmed the transition.

During visits to Santa Fe Institute conferences, Padgett recognized a harmony between his analysis of 15th century Florence and Fontana’s molecules reacting in solution. Fontana, a research professor in residence at SFI and an associate professor of theoretical chemistry at the University of Vienna, describes Padgett as an “intuition pump.” When Padgett and Fontana discuss each other’s research, creative ideas come forth like ripe fruit from the garden of the Badia at Fiesole.

“One of the unifying themes of interest to economists, physicists, biologists, and immunologists at the Institute is understanding the origin of novelty,” says Fontana. “John Padgett brings an important social science perspective on the mechanics of novelty that escapes our formalization.” For example, although the laws of physics don’t change, the world churns with novelty. Padgett and his colleagues find evidence that change of social rules themselves gives rise to novel social and political structures.

Padgett is himself a product of the collisions of politics, civil rights, and foreign policy in 1960s America. He grew up in Waldorf, Maryland, at that time a rural tobacco and crabbing community of 2,000 residents. When he played baseball as a child, Waldorf Little League was still segregated. Padgett’s own family tree has Catholic and Protestant branches and English, French, and Irish roots. He was valedictorian and president of his senior class of 50 at Ryken High School, a male-only parochial school.

His life embodied the nation’s uneasy search for a new social order and political equality after the tumultuous 1960s. Like many of his high school classmates, he aspired to engineering. During summers while studying engineering at Princeton University he helped build the sonar systems for Poseidon submarines at the Norfolk Naval Shipyard. But later he was tear-gassed at Fort Dix, New Jersey, while protesting the war in Vietnam. “I got an electrical engineering degree, but I lost the faith,” he says, grinning and leaning back in his university-issue office chair.



Domenico Lenzi. The grainmerchant. Italy, 14th c.

Biblioteca Laurenziana, Florence, Italy

Padgett gravitated to political engineering. He was deeply influenced by what some might call the messiness of politics while working as a policy aide to Trenton, New Jersey, Mayor Art Holland in the mid-1970s. Holland, himself a former Jesuit priest, wanted to reform taxes that favored the rich. The mayor also wanted to erase zoning rules that effectively kept minority families out of white enclaves. He was impressed with Padgett's mathematical and analytical skills and solicited his help. But Padgett soon realized that no matter how well reasoned his proposed reforms appeared on paper, the mayor used a different calculus. Votes mattered. The opinions of political pals and the political debts owed them mattered. The mayor listened to Trenton's minority leaders. "After I would give a presentation to one of these groups, and invariably a Romanian lady would pinch my cheek and say, 'Such a nice boy,' I got a deep sense that social engineering is not how cities work."

The increasingly pragmatic Padgett realized that the real world was rarely reducible to conventional social or mathematical analysis. "When it came down to taking action, the mayor had all kinds of other constraints," Padgett says. "I couldn't put it into a computer and crunch it." Nobody could. "This had a big impact on me." He left Trenton for graduate school. After studying federal budgetary processes and earning a Ph.D. in political science from the University of Michigan, Padgett began to formally dissect interpersonal relationships and networks. "I do social network analysis," he says. Those networks include political, economic, and personal connections that extend from the neighborhood to the state and even influence how individuals create their own sense of identity. "How do crises reshape each network and how do they fit together over time?" he asks rhetorically. With that, he pencils a rough answer: It is a series of one-inch arrows arranged in rows, stacked on top of one another. The position of each arrow, the direction that it points, and which arrows it points to is a metaphoric representation of his analysis. Leading up to the Renaissance, the arrows are synchronous. They behave as if they were a perfectly choreographed school of fish. A downward pointing arrow could represent the tactic of one high-ranking family's policy of marrying "down" its daughters (to sons of lower-ranking families), thereby preserving social harmony. This intermarriage logic was common in Medieval Florence. But

the Renaissance coincided with an abrupt change in the intermarriage conventions. The marriage arrows no longer point in the same directions. They swivel, become more chaotic, and lose cohesion. The school of fish scatters.

Padgett's arrows take increasingly complicated flights in the 15th century. And many of them point to and from the Medici family. "The Medici were like FDR (President Franklin Delano Roosevelt): They made alliances across trades and classes and across the city," he says. "The Renaissance was a particularly potent historical time for such novel institutional and personal inventions. I am trying to understand what actually happened in late Medieval marriage, economic, and political networks that induced such creative effects."

Padgett's analysis may change the way historians think about the forces that underlie new social and political systems. It also gives biologists another way to imagine how evolution, in a general sense, may operate to give rise to new species. How might his notions about the generation of novelty affect everyday life? Nobody knows. However, in theory, catalysts for change might be more thoughtfully designed; or useful institutions might be made to flourish with specific legal, social, or legislative changes.

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Anonymous.
Festival in the Piazza della Signoria, Florence.

