The strength of *Pricing Carbon* is also its weakness. The authors are so keen on the empirical focus that they largely eschew judgement, even as to whether the system has been a success. Nonetheless, the book is suffused with the sentiment that establishing a credible cap and price on CO_2 emissions on a grand scale is a triumph of policy, one that is still a world first after more than five years. I agree that it is a huge feat. The EU got many crucial things right: the basic market design; the focus on well-monitored, sizeable point-source emissions; and the sequential phases that have allowed the system to develop and improve.

The world's greatest experiment in carbon pricing is not out of the woods yet. Although the system will continue, with major design features agreed up to 2020, countries are still embroiled in battles over how to allocate allowances. The current modest carbon price will not support new low-carbon investments, and the establishment of tougher rules could risk driving established industries to non-EU countries. Hopes that other regions will develop similar schemes, laying the basis for a more coherent global response to emissions, are currently taking a battering. The EU regards its emissions scheme as the flagship, but there is little sign of an international fleet. Even so, for those who want to learn the real lessons of the EU ETS experience, there is no better source than *Pricing Carbon*. ∎

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Predicting human activity

Bursts: The Hidden Pattern Behind Everything We Do
by Albert-László Barabási
Dutton: 2010. 310 pp. $26.95

We usually assume that we do things for a reason, whether we are obeying the dictates of the unconscious, rational self-interest or our genetic predisposition. Yet such determinism cannot predict the diverse range of human behaviour. We are left to suspect that our actions may be no more patterned than coin-tossing.

In *Bursts*, physicist Albert-László Barabási explains how this notion of randomness has been undermined by recent research, including his own. We conduct our affairs in bursts, he says: for example, sending out several e-mails in a short space of time and then none for hours, or pottering around our neighbourhood and then travelling 1,000 miles. Barabási explains that we organize tasks in bursts because we prioritize them, attending to each on a timescale that is appropriate to its urgency.

Even our everyday wrist movements, when monitored with accelerometers, show bursts of motion that are interspersed with periods of repose. As a team at the University of Tokyo has found, the distribution of these bursts differs for people who are clinically depressed, suggesting that such statistics might offer a diagnostic tool.

The book is replete with human stories that animate what might otherwise seem a dry account of statistical patterns. Barabási describes Albert Einstein unwittingly stalling the career of fellow physicist Theodor Kaluza by taking two years to reply to a letter, and the US-based artist Hasan Elahi being questioned by the FBI because of his 'suspicious' travel patterns. After his interview, Elahi set up a public website to record his movements as an art project. It revealed that Elahi's globetrotting was genuinely anomalous. An algorithm developed by Barabási was able to forecast the move-
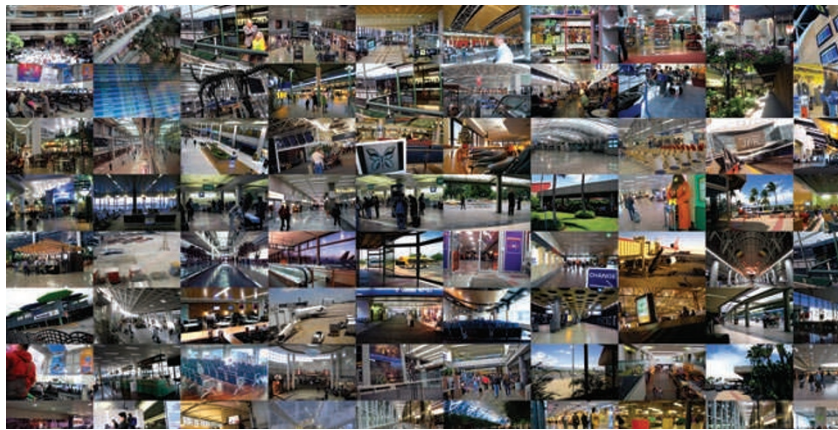
Artist Hasan Elahi now charts his random travel patterns after US authorities questioned them.

ments of anonymous individuals by combining information about their locations, as revealed by mobile-phone use, with their personal pattern of 'bursty' movements between locations. It was more than 80% accurate for everyone except Elahi, whose movements were unique in that they were truly random.

Barabási's success in predicting human mobility patterns from mobile-phone data leads to his plausible, if ominous, suggestion that individuals could be constantly tracked using such techniques coupled with widespread surveillance technologies. Yet his assertion that the prediction of most things we do at the individual level "is growing increasingly feasible" is not persuasive. Our predictability, to the extent that our choices and movements form a pattern, relies more on extrapolation of past behaviour — as exploited by web-based 'recommender systems' that draw on our purchase or browsing history — than on burst characteristics. Similar to avalanches and earthquakes, bursts have statistical orderliness but remain unpredictable as individual events.

The underlying origin of 'burstiness' is unknown. These intense periods of activity are not a by-product of advanced cognition because they apply beyond human behaviour — to the different foraging patterns of animals, the transcriptional activity of genes, and evolutionary speciation, for example. But Barabási cannot say whether their ubiquity stems from the same cause or whether bursts are merely a statistical signature, like power laws or fractals, that many different mechanisms can generate.

Barabási punctuates his exposition with the tale of the 1514 peasant revolt in Hungary, led by his compatriot György Székely. This story supposedly illustrates the difficulty of predicting human affairs, but one could make that point using most episodes in history, and the link to bursts is tenuous. I was happy to indulge him in this digression; others might not, but I encourage them to try, because *Bursts* reveals Barabási to be both an inventive, interdisciplinary scientist and a talented communicator. ∎

Philip Ball is a writer based in London and the author of *Critical Mass: How One Thing Leads to Another*. His latest book is *The Music Instinct*.

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