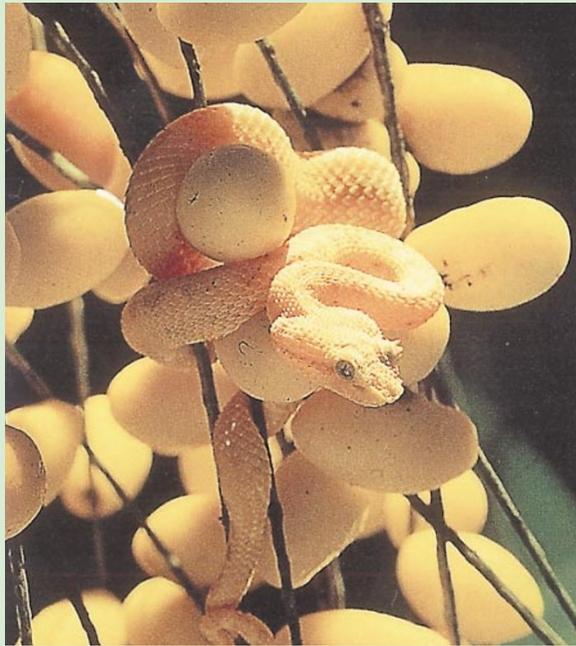


Reptiles of the republic

The republic of Costa Rica is home to almost 400 known species of amphibian and reptile. In *The Amphibians and Reptiles of Costa Rica: A Herpetofauna Between Two Continents, Between Two Seas* (University of Chicago Press, £75), Jay M. Savage provides an in-depth guide to the biology of each species, with details of their anatomy, behaviour, systematics and distribution, as well as an identification guide. The book also contains many splendid photographs by Michael and Patricia Fogden, including this striking image of the snake *Bothriechis schlegelii*.



colour, or monomorphic hearts. So why are evolutionary psychologists so insistent that we all have monomorphic minds? One possible answer is to avoid the charge of racism.

Those people, whoever they may be, who actually believe that all minds are blank slates are off the hook with respect to being called racists; after all, blank is blank. But evolutionary psychologists insist that genes play an important role in making us what we are, and it is possible that these genes cluster. Some subgroup of human beings might have more of the 'good' genes than other subgroups. As a result, a charge of racism might have some justification. But if all the variation that occurs among people is only surface variation, then evolutionary psychologists are also off the hook: we all have fundamentally the same mind. Those evolutionary biologists who think that both genes and traits are distributed in highly complex ways can also avoid being termed racists, but their argument is a good deal more complex.

Much of this discussion presupposes that in order to have the same rights, we must all be fundamentally the same. Pinker argues that, at a very fundamental level, all human beings are the same. Hence, we all have the same rights. But he also quotes Ernst Mayr as arguing for a much more sophisticated position: that equality does not require identity. Why can't we all have the same rights even if in many ways we are essentially different? That is the question.

I oppose the blank-slate view of human minds as strongly as Pinker does. I just do not think that it is as widespread as he does. I also think, contrary to Pinker, that a belief in the existence of something properly

termed 'human nature' is very widespread. The trouble is that these 'natures' are highly variable, as indeed they must be if they are to evolve. They are innate but neither fixed nor universal. In *The Blank Slate*, Pinker presents an overarching view of the world in a way that quite a few readers will find seductive. The preceding objections aside, I find myself in basic agreement with Pinker's world-view. That I can accept so much of what he has to say while rejecting one of the positions that he takes to be fundamental implies that possibly this position is not really so fundamental. ■

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Dog-days at the data factory

Pavlov's Physiology Factory: Experiment, Interpretation, Laboratory Enterprise

by Daniel P. Todes
Johns Hopkins University Press: 2002.
 512 pp. \$58

Steve Sturdy

Ivan Pavlov is remembered chiefly for his work on the conditioned reflex, one of the fundamental concepts of modern physiological psychology. But when in 1904 he became the first physiologist to receive a Nobel prize, he had barely started to investigate conditioning. Rather, the prize was awarded in recognition of his ground-

breaking research into the nervous integration and control of digestive secretion. It is this earlier work that Daniel Todes examines in *Pavlov's Physiology Factory*.

Pavlov's rise to international eminence effectively began in 1891, when he was appointed head of the physiology division of the sumptuous new Institute of Experimental Medicine in St Petersburg, Russia. Physiology at that time was in transition from being a field of largely individual endeavour to one of increasingly collaborative effort. Pavlov stands out for the sheer degree of managerial control that he exerted over the work conducted in his laboratory. In part this was due to the nature of his workforce. Most of his co-workers were medical students spending a brief sojourn in the laboratory en route to a career in medical practice. By specifying the topics they addressed and the precise methods they used, Pavlov ensured that their efforts were channelled to produce meaningful data for his own research programme.

But Pavlov's organizational innovations were also inspired by developments elsewhere in Russian society. His enthusiasm for laboratory science was part of a more general commitment to social modernization, which idealized the factory system as the most effective means of harnessing the productive capacity of workers. The managerial regime that he imposed on his laboratory was a self-conscious adaptation of this ideal for the purpose of producing scientific knowledge. And as in the factory, technology played an important role in determining the activities of semi-skilled workers.

Pavlov's investigations revolved around several surgically modified but otherwise healthy dogs — 'chronic' as opposed to 'acute' vivisections — in which a succession of researchers could observe the passage of food and the flow of secretions through the digestive tract. It was the development of these "dog technologies", as Todes calls them, as much as Pavlov's intellectual supervision, that made possible the continuous production not just of physiological facts and theories, but also of such commercially successful therapeutic commodities as natural gastric juice.

Literary products such as theses and publications also issued from Pavlov's lab, and he maintained strict control over all of them. Final responsibility for the theoretical elaboration of experimental data remained firmly in Pavlov's hands. Here, too, he found inspiration in the ideal of the factory, although this time of a metaphorical kind. He saw the alimentary system as a complex chemical factory in which the work of the various digestive organs was regulated by nervous reflexes to ensure the most efficient digestion of different foodstuffs.

Todes makes clear how Pavlov's scientific conclusions were shaped by such presuppo-



Production line: for his early work on digestion, Ivan Pavlov collected dogs' gastric secretions.

sitions. Pavlov was acutely aware that his results often varied widely, not just from one animal to another but within the space of a single experiment, in response to a host of often unidentifiable disturbances in the experimental system. Indeed, his later work on conditioned reflexes grew out of his efforts to characterize the role of "psychic" phenomena in producing such perturbations. But it was precisely this variability that enabled Pavlov to select those data that best confirmed his supposition that digestive processes were purposively and selectively regulated, and to explain away any results that contravened the supposition. Pavlov's wishful thinking eventually became apparent, however, particularly when the demonstration by W. M. Bayliss and E. H. Starling of the humoral control of pancreatic secretion raised doubts about his claim to have identified more selective forms of nervous regulation.

Such revelations did not deter the Nobel committee, however, who by that time were considering Pavlov for the prize in physiology or medicine. Initially, his supporters on the committee had cited the theoretical significance of his conclusions as sufficient grounds for awarding him the prize. But as the validity of those conclusions began to be challenged, they instead invoked Pavlov's methodological innovations and his demonstration of the promise of concerted laboratory research for the pursuit of medical knowledge. Pavlov's elevation to the pantheon of Nobel laureates thus rested, in the final analysis, as much on the way that he made manifest the new values and aspirations of collective scientific endeavour as on any specific contribution to scientific knowledge.

Pavlov's achievements are in no way diminished by such scrutiny. On the contrary, by revealing the technical, intellectual, managerial and literary skills that led to the

success of Pavlov's endeavour, Todes broadens our appreciation of the far-reaching contribution that Pavlov made to the development of modern science. Todes has achieved an impressive feat of scholarship, combining meticulous research with analytical clarity, which does full justice to his compelling subject. ■

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A stroll with the moulds

Mr. Bloomfield's Orchard: The Mysterious World of Mushrooms, Molds, and Mycologists

by Nicholas P. Money
Oxford University Press: 2002. 224 pp. \$26

Elio Schaechter

Countless stories can be told about any large group of living things, and fungi are no exception. Fungi are quite familiar to us: we enlist their help in making bread, wine and beer, and are vexed by the disease that they cause in humans, animals and plants. We know them as unicellular yeasts, filamentous moulds and complex-looking mushrooms. Less widely appreciated is their most important pursuit: they are the essential decomposers of vegetable matter. Quite simply, life on Earth would not be possible without the recycling activity of fungi.

Fungi have a wide repertoire of life cycles, a large variety of shapes and structures, and a strong propensity to interact with other organisms in manners benevolent and otherwise. Quite a few of the stories about each of these properties can be found in



Red and green: fungi such as the scarlet elf cup aid nutrient cycling by breaking down vegetation.

Mr. Bloomfield's Orchard. The main topics are the life cycle of moulds and water moulds (oomycetes), aspects of fungal biomechanics, and fungal parasitism of plants and humans.

Nicholas Money gives considerable attention to subjects in his own research area, such as cytoplasmic turgor and the electrical and mechanical properties of hyphae. These lead to some lively examples: stinkhorns that make geodesic domes (*Clathrus*), hyphal filaments that can pierce bullet-proof vests (let alone human skin), spores that trap air bubbles for buoyancy, and moulds that quarry rocks. He also describes in some detail the ingenious strategies for spore dispersal in mushrooms, plant pathogenic moulds and water moulds, and helpfully explains stories that tend to be quite intricate. For instance, the life cycle of certain rust-causing fungi includes four kinds of spore, two separate plant hosts, and three acts of plant penetration.

The contributions and quirks of several notable mycologists also get a mention. In the early 1900s, Reginald Buller did much to explain how fungi, especially mushrooms, disperse their spores. It is now believed that the mechanism involves the formation of a droplet at the base of the spore. By a mechanism that involves changes in surface tension, this 'Buller's drop' helps to catapult the spore away from its native gill with astounding acceleration. Buller, an Englishman transplanted to Winnipeg in Canada, had a distinctive personality. Needing to be dark-adapted to make his observations, Buller used horse blinkers to keep out the light as he walked through the sunshine from his hotel to the university. Money also portrays another colourful mycologist, Curtis Gates Lloyd, who circumvented the risks of peer review by publishing his own journals.

Books on fungi written for the non-specialist are few in number. Pre-eminent in this genre is E. C. Large's *Advance of the Fungi* (Jonathan Cape, 1940). In this much-revered book, Large focused on plant pathogens and described their activities in a lively and informative style that infused the reader with enthusiasm for the subject. Money's book follows this tradition. His writing is accommodating and personal, with occasional chummy asides. He makes no bones about his enthusiasm for the fancy shapes and forms of moulds. He says of yeast: "Only a biochemist can be satisfied with such dull architecture when the grandeur of other fungi can surpass the Palace of Versailles."

Whether one agrees with this view or not, one can enjoy the book for the choice of topics and the clarity of the writing. It can be recommended to all nature lovers, regardless of background, who want to know more about fungi. ■

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