counts depends on having specific selectable markers. Antibiotic resistance genes are generally unacceptable for environmental release but the *E. coli lacZ/Y* genes, which lend themselves to easy visual detection, are shown by D.J. Drahoš *et al.* to provide a useful alternative. The most sensitive method of detection is probably to probe for a DNA sequence specific to the target organism after amplification of that sequence in the sample under test by the polymerase chain reaction. This does not, however, give a quantitative measure of abundance prior to amplification.

The promise of human benefit emerges most clearly in the articles on the development of new vaccines. A.A. Lindberg deals with vaccines against oral and enteric pathogenic bacteria, and E. Paoletti and his associates with the use of fowlpox virus vectors to vaccinate non-avian species. In one of the round-table discussions, E. Wedman reports vaccination of calves against Sinbis virus (not, in fact, a pathogen) with a recombinant between Sinbis and vaccinia.

There is nothing on the use of vaccinia virus as a vector for the expression of genes encoding immunogenic proteins of pathogens, except for a full documentation of the unhappy affair of the rabies vaccine trial, carried out on cattle in Argentina. The perfectly respectable sponsors of the trial had failed to obtain clearance from the local authorities, and incurred universal denunciation. Clearly, innovators in this area need to have both a proper regard for safety and acute political sensitivity. Live vaccines produced by genetic engineering, though likely to be safer than the old vaccines obtained by attenuation of pathogenic viruses and brought into use on a trial-and-error basis, will doubtless have to satisfy far more stringent safety criteria before being accepted.

Those seeking controversy will be disappointed in this volume. Although there is preoccupation with containment, nobody puts forward any scenario of disaster should containment fail. There are a number of rather coy references to 'perceived' risks, but the perceivers do not appear to have been present at the symposium. Although many of the public expressions of concern have undoubtedly been irrational or perhaps (as in the furore about the ice-minus bacteria) merely symbolic, it is difficult to take efficient precautions if one does not have some idea of what one is guarding against. No doubt the scientists present did have their own perceptions of hazard, or lack of it. It would have made for a better-balanced symposium had these been more explicitly discussed. □

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Notes from the quantum field

Kate Metropolis & Chris Quigg

Beamtimes and Lifetimes: The World of High Energy Physicists. By Sharon Traweek. Harvard University Press: 1988. Pp. 187. \$20, £15.95.

IF A coprophagous coleopteran stopped to reflect, its life would no doubt seem a noble quest. Nevertheless, the attention lavished upon the dung beetle by a Serious Entomologist would be flattering in the extreme, applauding — by reason of the entomologist's devoted interest — this scarab's life work. So it is with high-energy physicists and anthropologists: the life of the mind, the quest for nature's secrets, is suffused with its own divinity. But surely, to be taken seriously by serious persons must be the sincerest form of flattery. Sharon Traweek is a Serious Anthropologist and our colleagues must needs be flattered by her fascination with their habits and tribal customs.

The community Professor Traweek has chosen to study, that of experimental high-energy physicists, seems apt for classical anthropological analysis. The group has a shared past, anticipates a shared future, has rites for initiating new members and is able to distinguish itself from other communities. The population is divided into highly ordered, long-lasting associations: the handful of high-energy accelerator laboratories comprise several groups, each executing an experiment in its own style. A group consists of 50 to a few hundred physicists from different institutions, with varying backgrounds, specialities and levels of experience — graduate students, postdoctoral fellows, professors, laboratory staff members — who build a detector to gather data on subatomic particles and then analyse the information to construct a more complete picture of the Universe. Subgroups, sometimes individuals, are responsible for different parts of the hardware, software and analysis. Although people occasionally move between experiments and laboratories, the collaboration may last for a decade or more. The society is highly ordered, rich in mythology and customs; and, because there are communities of experimental high-energy physicists around the world, it offers anthropologists the opportunity to distinguish behaviour patterns endemic in the profession from expressions of national or ethnic traits.

Particle physics has well-known personalities — clowns, tyrants, thoughtful moralists, egomaniacs, wizards — about whom many people are curious. Are they typical? How do they interact? What order underlies a group in which the

list of workers on a single experiment may fill an entire page of a journal? An analysis that revealed the strengths and weaknesses of a particular approach to large collaborations could be interesting, amusing and even cautionary for scientists in fields beginning to collectivize. Indeed, Traweek comes upon provocative questions: What are the norms of behaviour within the community? How are actions and motives analysed? Why do people who see each other day in, day out recount different versions of history?

Scientific inquiry requires that researchers play Devil's Advocate until they can convince themselves that their data are complete and can be trusted. Unlike the physicists she studies, Traweek evinces no scepticism towards her data and fails to convince us that she has gathered anything more than an idiosyncratic sample. *Beamtimes and Lifetimes* reads less like a mature analysis than like a collection of undigested field notes recording observations at SLAC, the Stanford Linear Accelerator Center in the United States, and KEK, the national high-energy physics laboratory in Japan.

Traweek consistently uses the experience or opinions of a few individuals to draw broad conclusions about the entire community. If these illustrations were used to vitalize an observation or conclusion, they would be useful. Without a convincing richness of supporting data, however, her inductions have a foundation of quicksand. Further, her decision not to identify her subjects means that they become interchangeable: one group leader, one laboratory director is presented as indistinguishable from another. Yet in fact these people have quite different personal and scientific styles. She does not make a plausible case for not differentiating them, so the reader can only conclude that her powers of observation are not equal to her task.

This judgement is reinforced by Traweek's methodology. Reporting a discussion of how wives of high-energy physicists supported their husbands' work, she writes, "The older wife of a laboratory director interjected that she thought the way to avoid distracting the husband from his important work was to pursue one's own interests seriously. By their glances at each other I gathered that the younger women disagreed". A moment's reflection provides a number of alternative interpretations: interest in each other's reaction to an unfamiliar point of view, exasperation over hearing this position put forth for the millionth time by someone in a situation different from theirs, and so forth.

A recurring theme for Traweek is gender bias and sexism in the education, the rites of passage and the practice of experimental high-energy physics — a subject that should not be trivialized. If

particle physics is a male culture (although saying so doesn't make it so), it is important to understand how it came to be that way and why it remains true. Traweek's summation is as cogent as the evidence that Beatles records, played backwards, contain messages of devil worship:

The language used by physicists about and around detectors is genital: the imagery of the names SPEAR, SLAC, and PEP is clear, as is the reference to the "beam" as "up" or "down." One must see the magnets at LASS to appreciate the labial associations in the detector's name, Large Aperture Solenoid Spectrometer. Ironically, the denial of human agency in the construction of science coexists with the imaging of scientists as male and nature as female. Detectors are the site of their coupling: standing on the massive, throbbing body of the eighty-two-inch bubble chamber at SLAC while watching the accelerated particles from the beam collide twice a second with superheated hydrogen molecules made this clear to me.

The plethora of facts that Traweek has got wrong does nothing to encourage faith in her inductions. Descriptions of scientific apparatus, events and phenomena, intended to confer verisimilitude, are

grossly inaccurate. Her judgements are no more convincing: the statement that the food at SLAC is "rather good, for a cafeteria" will come as a shock to anyone who has eaten there.

The neglect of the reasons that inspire people to join and remain in this community is a crippling omission. Particle physics is not a closed or isolated society in which membership is determined by happenstance. Because the only motive Traweek recognizes is career advancement, her narrative is oblivious to the excitement, the exhilaration of doing physics. Nowhere do we see people driven by curiosity, intoxicated with the creation and understanding of new experience.

Beamtimes and Lifetimes is not a complete or reliable guide to the community of particle physicists. Let it be taken nevertheless as an invitation to particle physicists to re-examine their values, institutions and assumptions about each other and about the rest of the world. □

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inundation. Like Lamarck, they believed that these animals had simply changed their form in a gradually changing world. As a result, Corsi is able to show that Lamarck's famous *Philosophie Zoologique* (1809) was less an insular pioneering work than a running dialogue with his contemporaries.

Given this context, Lamarck's science makes sense. Of course there were in-

Life transformed

Adrian Desmond

The Age of Lamarck: Evolutionary Theories in France 1790–1830. By Pietro Corsi. Translated by Jonathan Mandelbaum. University of California Press: 1988. Pp. 360. \$42.

AT THE entrance to the Jardin des Plantes, opposite the Seine, stands an imposing statue of Lamarck, the "Founder of the Doctrine of Evolution". And in relief, at the back, is a touching scene depicting a lonely, dejected Lamarck being consoled by his sister. This image, of an isolated trailblazing figure, is surely one of the most enduring in the history of biology.

Now Pietro Corsi, in his stunning study of Parisian science after the Revolution, shatters this myth. He questions the long-standing assumption that Lamarck was a prophetic genius, striding alone, out of time and place. The truth was very different; so much so that Corsi actually talks of an 'evolutionary culture', of which Lamarck was but a part. And in investigating this culture, he has given us the most compelling account yet of French transmutationism between 1800 and 1830.

Historians have been quick to deny Lamarck an audience. But Corsi argues that the eighteenth-century buffonian tradition — with its grand, unifying view of nature and attempt to look at life through time — still had a populist appeal, even after the Revolution. And it was to the buffonians (most by then outside acad-

emia) that Lamarck spoke — to the marginal men appalled by the increasing specialization of science. They deplored Cuvier's attempt to subordinate natural history to a descriptive, analytical comparative anatomy. There were still plenty of these outsiders in 1800, criticizing Cuvier for failing to investigate the larger laws of nature. It was against this cultural background that Lamarck's own ambitiously theoretical works, with their rival approaches to *biologie* (his word), were formulated.

Lamarck started out as a botanist, chemist and conchologist, and he was appointed the professor of insects and worms at the Muséum d'Histoire Naturelle in 1793. Before 1800 he remained a staunch anti-transformist, adamant too that life and inorganic matter were separated by a chasm. Then suddenly in 1800 he switched tracks. His subsequent evolutionary views have always been difficult to interpret (if easy to parody). Corsi explains the origin and real meaning of Lamarck's ideas by tracing their development in detail through the critical period 1800–1802. By this means he is also able to show that, far from accepting spontaneous generation first, as historians had thought, Lamarck only warmed to it after shifting to evolution.

The fact that Lamarck rarely quoted or cited fellow authors has led to the belief that he was acting alone. But again Corsi introduces us to numerous other dissident intellectuals at loggerheads with the powerful Cuvier. Many rejected Cuvier's claim that some fossil animals were extinct, perhaps killed off by a marine

consistencies. Lamarck had inordinate trouble squaring his progressing animal series with his non-progressionist geology; but, by the 1820s, a new generation had cast aside his old framework and mated evolution to a directionalist Earth history, which provided the environmental motor. There was also a good deal of frustration with the man himself: Lamarck exasperated even sympathizers with his pig-headedness, and they were less and less inclined to come to his aid. Even so, as Corsi says, he was never totally deserted by his friends, any more than he was completely ignored by his enemies, the way the old histories implied.

The Age of Lamarck was first published in Italy in 1983, and this translation (excellent in itself) has been well worth waiting for. Corsi makes Lamarck a man of his time, and that is no mean feat. For historians the result is a treat. But for Lamarck — pilloried and parodied for two centuries — it is long overdue justice. □

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REASONS

Still thinking — Lamarck's statue at the entrance to the Jardin des Plantes in Paris.