BOOKS: BEHAVIOR

Still Stimulating After All These Years

Steven Pinker

Why do we shrug? Why do dogs wag their tails? Why do we scowl when angry and pout when sad rather than the other way around? What is the difference between guilt and shame? Darwin's *The Expression of the Emotions in Man and Animals* would be an extraordinary book even if it had only answered these and scores of similar questions about the emotions in 1872. But *Expression* also proved that the human mind, not just the body, is a product of evolution. It showed, during the heyday of scientific racism, that the races of mankind are fundamentally similar. It anticipated virtually every 20th-century behavioral science: child development, psychopathology, ethnography, ethology, cognitive science, and neurophysiology. It was the first scientific work to rely on photography. And it laid in obscurity for over a century.

The Expression of the Emotions in Man and Animals
by Charles Darwin
Third edition, with Introduction, Afterword and Commentaries
by Paul Ekman
Oxford University Press, New York, and HarperCollins, London, 1998. 509 pp. $30, ISBN 0-19-511271-7. £16.99, ISBN 0-00-255866-1.

The psychologist Paul Ekman has now edited a "definitive" edition. It includes revisions and material that Darwin had intended for a second edition that he did not live to see because the publisher refused to go back to press until all the copies of the first edition had sold (some things don't change). Ekman has also added commentary before, after, and within the text, and has reproduced original versions of photographs that had been altered or misprinted in the first edition.

Darwin explained the expressions with three principles. The first is "serviceable habits." Animals configure their faces and bodies in certain postures for practical reasons—for example, baring their teeth before biting, widening their eyes for a panoramic view when danger is sensed, or flattening their ears to protect them in a fight. These preparatory movements then become habits that are carried out in diluted form even when the action is suppressed. Finally, the habits are passed on to the offspring (yes, Darwin was a Lamarckian). Thus we bare our teeth when angry and look like headlight-stricken deer when afraid.

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The second principle is "antithesis." When an animal has a disposition opposite to one that triggers a certain posture, the disposition will produce the physically opposite posture. For example, a hostile dog stiffens its body, retracts its lips, raises its head and shoulders, and holds its tail erect and rigid, all in preparation for attack. An affectionate dog does not have to prepare for action, but it assumes a characteristic posture that is part-for-part the opposite of the attack pose: it crouches, wriggles, slackens its ears and lips, and wags a limp tail. Similarly, an assertive or defiant man stiffens his neck, squares his shoulders, lowers his brows, and clenches his fists with knuckles forward. What does a man do when he is resigned or impotent? He slackens his neck, raises his shoulders and brows, and opens his hands with palms outward—that is, he shrugs.

The third principle is "the direct action of the excited nervous system": a flow of nervous energy to the skin and muscles. Darwin thought that it explained why a child jumps for joy, the damned are said to gnash their teeth, a flogged sailor bites a bullet, a music-lover shivers, and "a vulgar man scratches his head when perplexed in mind; ... as if he experienced a slightly uncomfortable bodily sensation, namely, the itching of his head, to which he is particularly liable, and which he thus relieves" (p. 37).

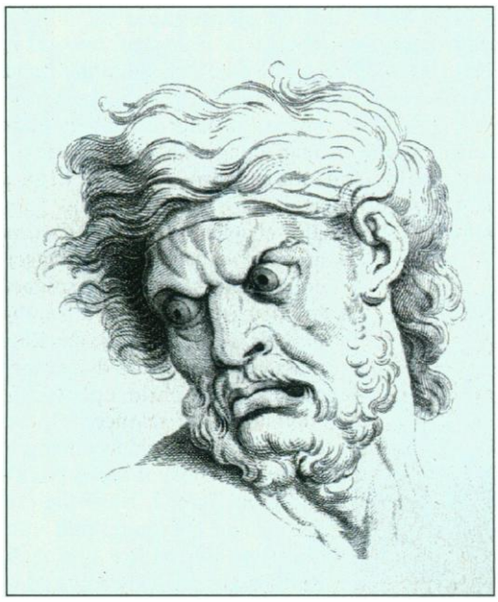
Strangely absent is anything having to do with natural selection. Darwin occasionally argued for the adaptive value of the original habits, as when he noted that species that fight with their teeth are also the species that flatten their ears (he could not have anticipated what Mike Tyson did to Evander Holyfield). But he rarely considered the expressions themselves to be useful as signals intended for a perceiver. Why was Darwin so non-Darwinian in one of his most important works?

One explanation, based on recent arguments by Stephen Jay Gould, is that Darwin was a committed "pluralist" who never put excessive stock in natural selection but wisely invoked a panoply of evolutionary forces. But an observer as acute as Darwin surely must have noticed that the expressions are conspicuous, keenly attended to, and often consequential (as when the proverbial smell of fear emboldens an adversary). Moreover, Darwin's "pluralistic" embrace of Lamarckism was hardly an example of reasonable eclecticism; it was perhaps his biggest scientific blunder.

Ekman recounts a more plausible explanation. One can only understand someone by knowing who he is arguing against, and Darwin was fighting on two fronts. He had to explain adaptations to satisfy his fellow biologists, but at the same time he made much of pointless vestigial features in humans to combat the creationists, who argued that design had to come from a designer. Darwin was particularly annoyed by his contemporary Charles Bell, who claimed that human facial expressions were God's way of allowing us to convey moral sentiments. Darwin retorted: If God had really designed humans, why would he have installed features that are useless to us but similar to features that are useful to animals? When we sneer in contempt, we raise a corner of the lip as if to unsheath a daggerlike canine tooth, though our canines have shrunk into line with the rest of our teeth. When we get goosebumps, our hair stands erect, just as other terrified mammals erect their hair to look bigger, but our sparse body hair is unnoticeable.

There is a second reason why *Expression* neglects the function of the emotions and their display. Darwin was famously handicapped by living in the century before scientists had elucidated the mechanisms of heredity. He was also born too soon to enjoy another great discovery of this century: the understanding of information. We now take it for granted that the brain is an information processor confronted with problems such as regulating the body through feedback, detecting signals in noise, recognizing complex patterns, making decisions under uncertainty, executing strategies against rational antagonists, and discriminating honest from deceptive signals. But these are insights of the middle of this century. Darwin's nervous system is the Victorian hydraulic contraption of psychic energy flowing through channels, and it is the only idea in *Expression* that feels antiquated.

Today we interpret ritualized "habits" not as a Lamarckian inheritance but as signals of threat, appeasement, and requests or offers of aid. "Antithesis" is not an effect of mechanical pushes and pulls but a design for signals that are impossible for a receiver to confuse. (I suspect the principle could be profitably applied to cycles in fashions or hairstyles, as each generation strives not to be confused with the un-hip previous one.) And the "direct action of the



WELLCOME INSTITUTE FOR THE HISTORY OF MEDICINE

Man in a state of anger. The studies of expression by Charles Le Brun were engraved and widely reprinted in the 18th century. (From Deanna Petherbridge and Ludmilla Jordanova's *The Quick and the Dead: Artists and Anatomy*, published by the Hayward Gallery and the University of California Press, 1997.)

nervous system" may be a combination of the preparation of the body for fight or flight, and the use of visible signs of those involuntary reactions as guarantees to skeptical perceivers that our threats and promises are not bluffs and double-crosses.

Expression is a captivating book. From questionnaires Darwin had furnished to missionaries and explorers, he reports that many of our familiar expressions are also found among "Hindoos, Kafirs, Negroes, wild Malays, Esquimaux, New Zealanders, Abyssinians, the Dyaks of Borneo, and Indians of North America," which led him to the strikingly modern conclusion that "the several races [are] descended from a single parent-stock, which must have been almost completely human in structure, and to a large extent in mind, before the period at which the races diverged from each other" (p. 355). The universality of these expressions—and the appearance of many of them in infants, animals, and the congenitally blind—also convinced Darwin that these attributes are innate. He enriched his arguments with hundreds of insightful observations (many with the pathos and humor of great literature), as when he describes the terror of a man being led to his execution, the comical dejection of his dog as soon as it sensed that a walk was coming to an end, and the movement of the eyeballs of nursing infants that "gives to them an absurd appearance of ecstatic delight." Equally riveting are the macabre photographs of an institutionalized man literally shocked into exaggerated expressions by electrodes placed on his face.

The "bonus tracks" (including a fascinating essay by Phillip Prodger on the dawn of scientific photography) are excellent. Ekman explains why the book went unnoticed for most of this century—largely because of behaviorism, which outlawed discussion of mental states, and a prevailing dogma that denied the existence of human nature. He reviews recent literature on topics Darwin discussed, much of it from his own groundbreaking research, which he places in historical context. These insertions of contemporary commentary might be seen as marring the "definitive" version of a classic, but I found them quite appropriate. Ekman is a fitting heir of the Darwin of *Expression*, having catalogued the major facial expressions, documented their anatomy and physiology, and shown their universality across cultures in the teeth of fierce opposition (in Ekman's case, from relativist anthropologists such as Margaret Mead). Indeed, Ekman's additions pay the book the ultimate compliment. This edition has the feel not of a lovingly restored museum piece but of a seminal work that needed only minor updating. It is as fresh and provocative today as it was 125 years ago.

BOOKS: HISTORY

Focusing Cell Biology

Peter Satir

In the years after World War II, the biological sciences experienced a dramatic explosion. Increasing governmental support and new methodologies created entirely new fields of inquiry—molecular biology, cell biology, and biophysics—with their attendant institutions—new scientific societies and new journals. This was the time of Watson and Crick's DNA double helix, tobacco mosaic virus and bacteriophage, polio virus and the Salk vaccine. We found that lipids self assemble into membranes, that proteins self assemble into structures as complex as ribosomes, and that cells have fine structure in their cytoplasm. These dramatic achievements contributed to the optimistic belief that we would come to understand critical medical problems rationally, in terms of molecular processes within the cells.

Picture Control
The Electron Microscope and the Transformation of Biology in America, 1940–1960
by Nicolas Rasmussen

Stanford University Press, Stanford, CA, 1997. 356 pp. $55. ISBN 0-8047-28372.

In *Picture Control*, Nicolas Rasmussen explores the impact of one of the most productive of the new technologies, electron microscopy, on the biological sciences. By recounting the history of electron microscopy, particularly as practiced in the United States and Canada, he explores a more general question: how a new technology becomes established in, and useful for, science. The title is apt, for electron microscopy produced pictures with a resolution that had never been seen before. With this new view of the cell, we had to learn to see what was in the picture, and how to interpret what we saw. As every electron microscopist knows, those who control these factors, control the field.

The history Rasmussen relates is a fascinating one. Because the cast of characters was small, the roots of our present understanding are readily exposed. From about 1940 to the end of the 1950s, electron microscopes were expensive, hard to come by, and hard to use effectively with biologic materials. Only a few major centers developed where practitioners flourished: the University of Pennsylvania, the Rockefeller Institute for Medical Research, the Karolinska Institute, MIT, and Berkeley. Each of these groups was headed by one or a few individuals, whose philosophy and skills shaped their laboratories. Shaping the new field were Stuart Mudd at Penn, who used the microscope to study bacterial structure; Keith R. Porter and George E. Palade, the founders of cell biology (whose laboratory at Rockefeller I joined in 1956); Fritiof Sjöstrand, their European counterpart; Francis Schmitt at MIT, a founder of biophysics; and Robley Williams and Wendell Stanley, molecular virologists who built programs at Michigan and Berkeley. These researchers were responsible for the novel images and advances with the microscope, and for picture control in parts of the emerging fields.

The story Rasmussen tells begins in 1938, when Vladimir Zworykin, then head of electronics research at RCA and later famous in the United States as the "father of television," convinced his company to build an electron microscope in Camden, New Jersey, for possible commercial production. By 1940, Zworykin had recruited James Hillier from Toronto to build the workable model B, and Stuart Mudd, head of medical microbiology at

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