BOOKS: PSYCHOLOGY

Reason Now and Then

Peter M. Todd

Shakespeare's Hamlet declared that reason, the godlike attribute that separates us from beasts, should not "fust in us unused." As the millennium draws to a close, Donald B. Calne worries that there is an increasing tendency instead to "let it fust," with people blaming science for the planet's woes and searching elsewhere for spiritual solace. Calne, professor of neurology at the University of British Columbia, sides with Shakespeare. In *Within Reason*, he sets out to show the many uses to which reason can be put, from Hamlet's time- (and evolution-) honored goal of maintaining one's social status to our modern dispassionate exploration of reason's own limits.

Within Reason
Rationality and Human Behavior
by Donald B. Calne

Pantheon, New York, 1999. 345 pp. $26, C$39. ISBN 0-375-40351-5

In Calne's view, reason is the optimal means for achieving ends, by building logical arguments out of four components: induction, deduction, observation, and parsimony. He sees reason as a highly versatile biological tool that is able to help us reach our goals, but one unable to determine what those goals are and, hence, how it will be used. After presenting this main message in the introductory chapter, Calne marshals evidence that reason so defined is employed in nearly every corner of human endeavor. Reason's direct role in science and technology, and its more indirect uses in creating systems of government and commerce and in waging war, are easy to document. But in addition, Calne concludes that reason is central to designing the structure of the institutions best suited to disseminate the enhanced emotional states of religion—itself a rationally constructed response to human needs—to people in particular social and cultural contexts. Similarly, he describes reason as vital in determining the content and method of art. Calne makes these points by drawing on and extensively quoting from a wide range of sources, from art critics and dictators to William James and E. O. Wilson.

By arguing that rational thinking is rampant in human affairs (especially in domains often claimed to be beyond the scope of reason), Calne strives to convince us that reason is (or can be) a good thing. Against the rising voices of mysticism, growing anti-science movements, and general millennial irrationality, he argues that reason should be applied as widely as possible. This is a laudable goal, though to readers of *Science* it may seem a sermon for the converted. Calne's purpose might best be served if his book were surreptitiously shelved in the "mind and spirit" section to catch and convince those who otherwise would never pick up a scientific volume. (Later chapters on the rudiments of neuroscience, brain evolution, and animal cognition seem unnecessary for Calne's main pragmatic points.)

Despite noting on his final page that "the purely rational human being...is a fictional character," Calne consistently presents reason as a powerful and pure tool that we can successfully wield to reach whatever lofty or tainted ends we choose—a "gun for hire," in Herbert Simon's words. Such a view, however, overlooks the past three decades of research on judgment and decision making that has led to vigorous debate over whether we even know how to load this gun, let alone where to point it. Calne acknowledges the considerable past work on irrationality, but concludes only that it shows how emotion can derail logical thinking. Psychologists and economists, particularly in the "heuristics and biases" research program (*1*) have argued that the problem runs much deeper: People are often—and all too easily—misled into illogical reasoning by flawed and biased cognitive shortcuts that undermine all four components of Calne's definition. For instance, people's erroneous deduction strategies were demonstrated by failures to process even simple if-then propositions, and faulty observation was shown through tendencies to search for confirming rather than disconfirming evidence.

More recently, proponents of ecological rationality (*2*) and evolutionary psychology (*3*) have countered that people use appropriate reasoning shortcuts that are well-adapted to the structure of information in their problem environments; although we can be misled, we generally reason very well in meaningful contexts. For instance, thinking within a social domain framework enables people to accurately process social exchange problems presented as if-then conditionals. Further, when applied to typically structured environments in which many important events are rare, searching for confirming evidence to test hypotheses can actually be the best approach. All these lines of research agree that humans are not good general-purpose reasoners, unerringly blasting all problems with a single logical bazooka. But in contrast to Calne's monolithic-reason view, the ecological and evolutionary perspectives, to which he seems particularly sympathetic, assert that we draw upon a quiver of special-purpose reasoning arrows that are fit to the challenges at hand.

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Unreasonable art. The church rejected Caravaggio's portrayal of St. Matthew as an elderly, poor working man because it found the image unacceptable, given its desire to deepen Christian thought and devotion.

Calne mentions the "domain-specific Darwinian algorithms" sought by evolutionary psychologists, seeing them as an intermediate stop on the evolutionary path to full, domain-general learning and logical reasoning. But any specific evolutionary path should leave traces that limit an adaptation's generality. In particular, as the above example of social conditional deduction indicates, an evolutionary perspective predicts that

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BROWSINGS

Archipelago: The Islands of Indonesia. From the Nineteenth-Century Discoveries of Alfred Russel Wallace to the Fate of Forests and Reefs in the Twenty-First Century. *Gavan Daws and Marty Fujita.* University of California Press, Berkeley, CA, 1999. 271 pp. $45, £27.50. ISBN 0-520-21576-1.

Eight years of travel and observation in the Malay Archipelago led Wallace to his independent development of the theory of evolution by natural selection. Daws and Fujita use their account of Wallace's explorations to frame a dicussion of the exploitation of the islands' rich biodiversity and current attempts to conserve it. Their text is accompanied by striking photographs of the regions' landscapes and life forms, such as the colorful pitcher plant from Borneo shown here.

cognitive mechanisms will reflect the specific functions for which they were originally selected. Recent studies have supported this expectation with evidence that when we apply reason to evolutionarily novel domains, our thinking is often shaped by specific evolved mechanisms drafted for the new purpose (akin to the process of exaptation discussed by Stephen Jay Gould and others). The domains that Calne covers in depth provide examples: different religious beliefs about the behavior of spirits and gods follow from our folk psychology of humans and animals (*4*); the production and dissemination of art follows reasoning matched to the domain of courtship and mate attraction (*5*); and moral indignation toward deviant social behaviors appears as an extension of food-related disgust (*6*). Thus to understand what forms of thinking fall within reason, and how best to apply these to modern problems, we must be cognizant of the specific past domains whose evolutionary traces suggest themselves for present use.

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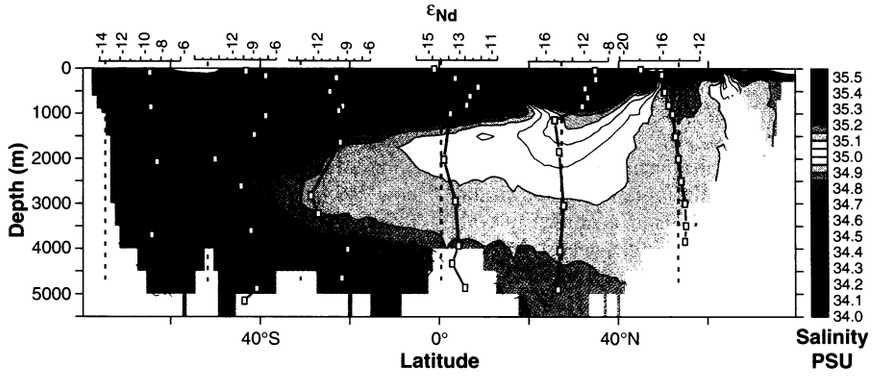
PERSPECTIVES: PALEOCEANOGRAPHY

Tracing Past Ocean Circulation?

Friedhelm von Blanckenburg

Interest in global ocean circulation has increased since coupled ocean-atmosphere models have suggested that the current mode of circulation is fragile. Natural changes have occurred in the past, for example, in conjunction with glaciations, but the models suggest that ocean circulation may also be heavily perturbed by anthropogenic greenhouse emissions, with dramatic consequences for global climate. However, to understand how ocean circulation and climate may change in the future, we must first understand how the system operated in the past, without man's influence. New isotopic tracers are now helping to elucidate past ocean circulation patterns, but controversies remain regarding the relative influence of ocean circulation and weathering on the isotopic signals.

Analyses of the salinity and temperature of water masses are used by oceanographers to reconstruct the present-day ocean circulation. For example, the salt content of Atlantic seawater differs depending on where the water originated (see the figure on this page). To determine the distribution of former water masses, paleoceanographers rely on isotopic measurements of marine sediments, which reflect the distinct isotope composition of the water masses from which they formed. For the past 20 years, the stable isotope ratios of carbon have been used as a tracer for labeling present-day water masses (*1*). They are also preserved in the shells of marine organisms, but the carbon isotope ratios in planktonic foraminifera, for example, are modified from those of the water masses in which they live by temperature (*1*), the availability of nutrients (*1*), and carbonate (*2*). Similarly, Cd/Ca elemental ratios in foraminifera are prone to thermodynamic effects (*3*). In addition, information from ^{14}C is limited by its short half-life of 5700 years (*1*). Therefore, there is demand for a supplementary set of tracers.



Two different water mass tracers. Present-day salinity distribution, integrated over the western Atlantic Ocean. A long tongue of water with high salinity (NADW, marked in yellow) carries about 18 x 10^6 m^3 of water per second southward. This is compensated for by two water masses flowing north with lower salinities [Antarctic Bottom Water (AABW), in green, and Antarctic Intermediated Water (AAIW), in blue]. Superimposed are measured sections of the isotopic composition of Nd dissolved in seawater, presented as ε_{Nd} ($^{143}Nd/^{144}Nd$ normalized and presented in parts of 10^4) (*14*, *15*). ε_{Nd} in NADW is dominated by Nd originating from the old continents surrounding the North Atlantic and has a uniform value of −13.5. This value is outlined by the dashed red line in each section. Water at 60°S has an ε_{Nd} of −9, because it is derived from erosion of much younger mountain belts. PSU, practical salinity units.

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