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SCIENCE WRITING SAMPLES
200-word summaries, for a scientifically literate audience, of reports in the literature

Human behavior
Punishers don't win

If we take unselfish cooperation with others to be a biological trait at least partly subject to evolution; and if we see evolution in economic terms, where individual fitness is analogous to profit or loss in a high-stakes marketplace; then some of the mathematical techniques developed by economists could be useful in modeling the evolution of social behavior. According to some recent theories in this rapidly developing field, if prosocial individuals are willing to incur a personal cost to punish antisocial behavior, prosocial behavior will be encouraged, possibly improving average fitness for the whole group. Dreber et al. tested this hypothesis with human subjects playing a modified repeated prisoner's dilemma. In this game, "cooperating" meant spending 10 cents to have one's counterpart paid 20 cents; a "defector" made 10 cents, while costing the other 10 cents; and to "punish" was to pay 10 cents to have another player docked 40 cents. Compared to a control group who could only cooperate or defect, the punishment option did foster increased cooperation; however, the benefit was offset by the costs of punishment, resulting in lower payoffs on average.

Dreber A et al. 2008. Winners don't punish. *Nature* 452:348-351. [abstract]

Cell biology
Clues to unblocking a cholesterol blocker

Low-density lipoprotein (LDL) transports cholesterol from the liver to other tissues, including the heart. LDL receptors (LDLRs) on the surface of cells throughout the human body, but especially in the liver, capture LDL and sequester it within the cell, removing it from the bloodstream. Proprotein convertase subtilisin/kexin type 9 (PCSK9) can also attach to the LDLR. Though PSCK9 binds to a different part of the LDLR, it still blocks the endocytosis of LDL. Thus, excess PCSK9 in the liver leads indirectly to excess cholesterol in the blood. Because of its health implications, this interaction has been extensively studied. Systematic manipulation of the proteins involved, through recombinant DNA techniques, has revealed much about the conditions that promote or inhibit PSCK9 activity. Now Kwon et al. have significantly advanced this field of research by deciphering the precise molecular geometry whereby PSCK9 binds to the LDLR. This reveals important clues to exactly why the PSCK9 keeps LDL out. A few more such clues may lead to the possibility of a systematic search for specific blocking agents that would interfere with PSCK9's interference and let the LDLRs do their helpful work.

Kwon HJ et al. 2008. Molecular basis for LDL receptor recognition by PCSK9. *PNAS* 105:1820-1825. [abstract]

Cell biology

An intimate portrait of a powerful gatekeeper

Eukaryotic cells, characterized by a nucleus and other complex internal structures, are believed to have evolved from the simpler prokaryotes about 2 billion years ago. The nucleus in each eukaryote is usually perforated by hundreds to many thousands of pores. An intricate assembly of 456 proteins of 30 different types, the nuclear pore complex (NPC), fills and stabilizes each pore like a grommet. Smaller molecules, such as water, move through easily in both directions; for protein and RNA molecules, the NPC functions as a gatekeeper, allowing only certain types across the bilayer nuclear membrane while excluding others. Electron micrographs of this important structure have shown little more than a lumpy ring. Now, after 8 years of work, an interdisciplinary team of 12 researchers has produced a computer model of the NPC with all 456 proteins positioned and oriented to better than 10 nm resolution – not the atomic level, but good enough to reveal intimate details of its structure. The internal framework or "scaffold" of the NPC is found to be made of 11 proteins, of just 2 fold types, repeated in 16 symmetrical "spokes." This surprisingly simple pattern is similar to that of the vesicle-coating complexes of prokaryotes, which implies a shared (very ancient) evolutionary origin and perhaps an analogous assembly process.

Alber F et al. 2007. The molecular architecture of the nuclear pore complex. *Nature* 450:695-701. [abstract]

Geochemistry

The subtle knife: mass-independent fractionation in mercury

Mercury (Hg) is extremely toxic to humans. Much remains to be learned about how Hg and its compounds enter the environment – that is, the food chain – and are transformed or eliminated by natural processes. The mass-dependent fractionation (MDF) of elemental isotopes can be used as a tracer for certain biochemical processes. In the tissues of fish, for example, Hg isotopic weight is proportional to Hg tissue concentration, implying that MDF occurs in bioaccumulation and excretion. Now, Bergquist and Blum show experimentally that of mercury's seven stable isotopes, two exhibit mass-*independent* fractionation (MIF). The effect is seen during photochemical reduction of ionic mercury (Hg^{+2}) and monomethyl-mercury (MeHg) in solution, an important process in nature. MIF is a subtle effect – not completely understood, and previously observed without ambiguity only in oxygen and sulfur. Its discovery in Hg will be important to the many scientists and engineers trying to quantify, track, and mitigate this widespread poison.

Bergquist B, Blum JD. 2007. Mass-dependent and -independent fractionation of Hg isotopes by photoreduction in aquatic systems. *Science* 318:417-420. [abstract]

Evolution

Brothers in arms: two Darwinian puzzles may help solve each other

A strictly Darwinian explanation for the evolution of altruism – helping others at some cost to oneself – is not obvious. How can altruistic individuals leave proportionately more descendants than the free riders to whom they are, by definition, ceding some of their fitness? Perhaps even more difficult to explain is the surprising popularity of war, in which people willingly sacrifice their lives – and, implicitly, the lives of all their potential descendants – for the supposed benefit of their community, as against other communities. Choi and Bowles present a game-theoretic model supporting the hypothesis that altruistic and war-like behavior are more evolutionarily robust in combination than either is by itself. In an agent-based simulation designed to represent the conditions likely to have governed the lives of humans before the last ice age, groups with substantial numbers willing to engage in conflict with outsiders outcompeted other groups. It remains to be seen whether this model can acquire empirical support.

Choi J, Bowles S. 2007. The coevolution of parochial altruism and war. *Science* 318:636-640. [abstract]

Materials science

It takes mussels to stick to Teflon

The study of materials at the molecular scale has brought, as a side effect, new appreciation of the extreme sophistication of "Nature's nanotech." For example, the common mussel can hold fast to practically any material, including polytetrafluoroethelene. Lee et al. describe a new, "mussel-inspired" process for the deposition of very thin films on organic and inorganic surfaces. Hypothesizing that the adhesiveness of *Mytilus edulis* foot protein 5 results from a combination of catechol and amine groups, the group identified a much simpler molecule with both properties: 22-atom dopamine. Remarkably, simple immersion in an aqueous solution of dopamine resulted in the slow (30 nm in 6 hours) but spontaneous and highly uniform deposition of polymerized dopamine on all kinds of surfaces, from noble metals to ceramics to commercial plastics. The polydopamine layer was similarly versatile as a substrate for secondary coatings, including metals and biopolymers.

Lee H, Dellatore SM, Miller WM, Messersmith PB. 2007. Mussel-inspired surface chemistry for multifunctional coatings. *Science* 318:426-430. [abstract]