



## LETTERS

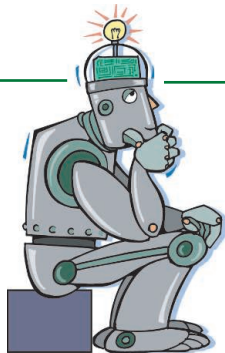
edited by Jennifer Sills

### Robot Inventors: Patently Impossible?

AS TWO PATENT ATTORNEYS AND A TECHNICAL adviser at a long-established Philadelphia intellectual property law firm, we read R. D. King *et al.*'s Report about robotic inventors ("The automation of science," 3 April, p. 85) with interest. We wonder whether the products invented by robots will ultimately become free to the public without the possibility for patent protection.

American patent law (35 U.S.C. Section 102) says that a "person shall be entitled to a patent unless..." (emphasis added). That preamble to section 102 limits the ability to patent to a person; machines are presumably excluded. This conclusion is reinforced by section 101, which limits the invention to the discoverer: "Whoever invents... may obtain a patent..." Section 101 uses "whoever," not "whatever." Thus, a person using a robot that invents something may face some serious statutory impediments to patent protection.

The situation is compounded by Section 102(f), which states that one cannot obtain a patent if "he did not himself invent the subject matter sought to be patented." Thus, Section 102(f) prevents



one from obtaining valid patent protection if he gets the idea in question—even in private—from another source.

Some existing U.S. patent practice offers hope. Existing DNA/amino acid sequencing machines provide inventors with information that inventors later patent, of course. Another case in point involves high-throughput compound screening to identify promising compounds for pharmaceutical, agricultural, and other purposes. However, there are differences: Such machines are automated and not capable of cognition, and humans provide and select the inputs and analyze the data. Unlike these examples, the robots discussed in King *et al.*'s article seem to have an independent ability to generate and verify hypotheses, perhaps leading in patent parlance to independent "invention" by the robot, not the human.

Europe may differ. Article 58 of the European Patent Convention states that a "European patent application may be filed by any natural or legal person, or any body equivalent to a legal person by virtue of the law governing it." This language seems to provide some wiggle room for the possibility of a robot being an inventor in Europe.

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### Painless Deprivation

IN THEIR PERSPECTIVE ("PAINS AND PLEASURES of social life," 13 February, p. 890), M. D. Lieberman and N. I. Eisenberger argue that for every type of deprivation, there is an associated pain, and that the more deprived one is, the more pleasurable fulfilling the need will be. This harkens back to need-reduction theo-

ries of reinforcement, along the lines of Hull (1). However, there are numerous counterexamples [as Mazur (2) points out].

For example, rats need thiamine, but despite the fact that foods containing the nutrient would constitute "the salve that will take the pain away and satisfy the underlying need," rats cannot detect thiamine in food, and so do not seek it out. Similarly, humans need oxygen, but carbon monoxide poisoning does not generate a pain. People instead fall asleep and die.

It is unclear whether a distinction between wants and needs (as the argument is sometimes framed) has implications for the basic argument made by Lieberman and Eisenberger regarding the representation of pleasure and pain in the brain, but it is certainly a distinction that should not be ignored.

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### Shared Ownership of Biological Resources

THE POLICY FORUM "COULD ACCESS REQUIREMENTS stifle your research?" (S. Jinnah and S. Jungcort, 23 January, p. 464) should be viewed in the wider context of the Convention on Biological Diversity (CBD), which recognizes the sovereign rights of the nation states over their biological resources and undermines the concept of biological resources as a common heritage of mankind. National legislation in many countries restricts access to biological resources. Such parochial restrictive measures are gradually becoming ubiqui-

### Letters to the Editor

Letters (~300 words) discuss material published in *Science* in the previous 3 months or issues of general interest. They can be submitted through the Web ([www.submit2science.org](http://www.submit2science.org)) or by regular mail (1200 New York Ave., NW, Washington, DC 20005, USA). Letters are not acknowledged upon receipt, nor are authors generally consulted before publication. Whether published in full or in part, letters are subject to editing for clarity and space.

tous, imperiling not only academic research but even global food security.

Cultivated plants have originated in different regions of the globe. The nations of the world are connected in a complex network of plant genetic interdependence. With extreme dependence on imported genetic materials, no country can afford to isolate itself, or to be isolated, from access to plant germplasm in other regions. Given that genetic resources are truly renewable, their use in a given system does not reduce options elsewhere. Thus, it is imperative that genetic resources be treated as a common heritage to serve the best interest of humanity. The International Treaty on Plant Genetic Resources for Food and Agriculture represents an appropriate step in this direction.

National legislations regulating access to biological resources often do not differentiate between academic and commercial research because their boundaries are vaguely defined. Even if the Ad Hoc Open-Ended Working Group on Access and Benefit-Sharing (ABS WG) resolves to exempt academic research from restrictions, the nation states would continue with the restrictive regimes. Current negotiations within the framework of the CBD on access and benefit sharing do not address the issues created by nationalization of genetic resources. Hence, a dialogue should be initiated in the next Conference of the

Parties (COP) of the CBD to correct the historic aberration of nationalization and to treat biological diversity as a common heritage of mankind. **PRIYADARSANAN DHARMA RAJAN<sup>1</sup>\* AND PRATHAPAN DIVAKARAN<sup>2</sup>**

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## Biological Invasions: Benefits versus Risks

A COMPREHENSIVE ASSESSMENT OF BIOLOGICAL INVASIONS (“Will threat of biological invasions unite the European Union?” P. E. Hulme *et al.*, Policy Forum, 3 April, p. 40) requires a quantification of the benefits provided to humans by the introduced species as well as their negative impacts. Potential benefits include aquaculture (1), sport fishing (2), forestry (3), horticulture (3), and game hunting (4). Human needs for food explain 51% of alien fish introductions worldwide (2). In 2006, European aquaculture production was reported to be \$8.65 billion (1), and most invasive aquatic alien species introduced in Europe are currently

part of European aquaculture’s portfolio (2, 5). The economic value of many exotic species provides a strong incentive to their further introduction, despite the potential ecological risks (2). Acknowledging this paradox is central to developing a unified approach to biological invasion (2).

Hulme *et al.* also fail to recognize that species blacklisted in one area may be Red Listed (6) (i.e., considered as conservation priorities) in another (7). Invasion of new territory by such species could constitute assisted species relocation, a positive outcome in conservation terms (8).

Considering all impacts of species introductions as negative is counterproductive and ignores their benefits to the European economy (1). Policy advisers should not ignore risks of biological invasions, but they should also examine their potential impacts on a wide range of ecosystem services. Neither should they seek to limit trade by citing the precautionary principle as a surrogate for our scientific ignorance.

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## Response

OUR POLICY FORUM AIMED TO HIGHLIGHT several challenges to implementing a pan-European Invasive Species Strategy, one of which is how best to prioritize invasive species for blacklisting. Among many potential criteria used to blacklist species (1), we would argue against making an allowance for species conservation status in the native territory or the potential economic value in the introduced region. If a species is perceived as a pest where introduced, it will often be blacklisted, regardless of its conservation status in its native range. Two of our examples of native European species that are invasive elsewhere in Europe are either Red Listed (2) or classified as nationally threatened (3), but this has not stemmed eradication attempts in the places where they are considered invasive.

### TECHNICAL COMMENT ABSTRACTS

#### COMMENT ON “Functional Traits and Niche-Based Tree Community Assembly in an Amazonian Forest”

Jeffrey K. Lake and Annette Ostling

Kraft *et al.* (Reports, 24 October 2008, p. 580) used a variety of metrics describing the distribution of functional traits within a tropical forest community to demonstrate simultaneous environmental filtering and niche differentiation. We discuss how these results could have arisen from sampling design and statistical assumptions, suggesting alternative approaches that could better resolve these questions.

Full text at [www.sciencemag.org/cgi/content/full/324/5930/1015c](http://www.sciencemag.org/cgi/content/full/324/5930/1015c)

#### RESPONSE TO COMMENT ON “Functional Traits and Niche-Based Tree Community Assembly in an Amazonian Forest”

Nathan J. B. Kraft and David D. Ackerly

Lake and Ostling address several issues that they suggest could influence our analyses of tropical forest community assembly. Some of the issues have already been considered, whereas others appear to arise from misunderstandings. We offer clarification of our analyses and additional discussion of our results.

Full text at [www.sciencemag.org/cgi/content/full/324/5930/1015d](http://www.sciencemag.org/cgi/content/full/324/5930/1015d)

It is well known that many alien species have been introduced deliberately to Europe for economic benefit (4), and we have addressed elsewhere how policy-makers could address and manage these risks (5). In our assessment of the impacts of alien species on European ecosystems, we emphasize how difficult it is to balance the environmental costs and economic benefits of species introductions (6). Major aquaculture species such as the crayfish *Procambarus clarkii* and Pacific cupped oyster *Crassostrea gigas* threaten endemic species through predation, competition, and/or the spread of diseases, and these two specific examples are widely recognized as some of the worst invasive species in the region (7); however, assessing these impacts in terms of comparable monetary costs is difficult (8). Furthermore, economic benefits are often gained by one sector of society while the costs are borne by the wider public. The history of biological invasions in Europe has too many examples of shortsighted decisions targeting perceived economic gains that have resulted in much larger (and often irreversible) costs to society (4, 7). Thus, such

“balance sheet” decision-making promoted by Gozlan and Newton, rather than a precautionary approach, is not only naïve but potentially dangerous.

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## NASA Must Be Held to Account

THE NEWS FOCUS STORY BY A. LAWLER (“Trouble on the final frontier,” 3 April, p. 34) describes the history of NASA’s over-budget and behind-schedule projects over the years. Despite the protests of the various science teams that they are doing their best to develop sound budgets and schedules, the fact remains that they have not been able to make credible estimates, sometimes missing the mark by huge amounts. And yet, NASA management continues to accept the estimates. As long as there is no accountability for the science teams and NASA management—in the form of canceled programs and bars to future contracts and grants—and as long as Congress continues to view NASA as a jobs program instead of an investment of taxpayer dollars in the advancement of sound science, we should expect more of the same. Projects will be forecast as affordable, only to balloon out of control. Then more money will be poured in and no one will be held to account.

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