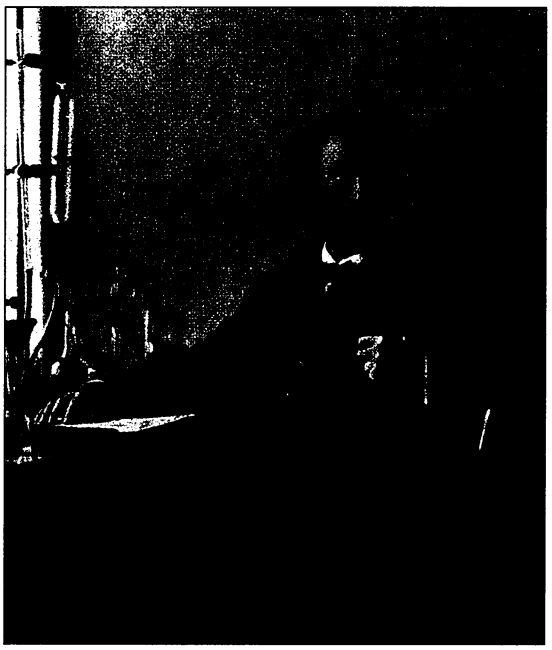
A Nobel Prize for Sustainability, Perhaps?

THE HUNDREDTH ANNIVERSARY OF THE creation of the Nobel Prizes provides an excellent opportunity for some reflection. Alfred Nobel's goals, as specified in his will and testament (*1*), were obvious: He wished to reward those who make major scientific or social contributions to the well-being of humanity as a whole, and the five prizes he stipulated in his will reflect a certain balance between science (physics, chemistry, and physiology or medicine) and society (literature and peace). A sixth Nobel Prize, officially known as the Bank of Sweden Prize in Economic Sciences in Memory of Alfred Nobel, was established in 1968 to commemorate the 300th anniversary of the founding of the Bank of Sweden.

There has been debate, even among eminent economists, whether a prize in economics really fits in with Nobel's own views (*2*, *3*). It is fascinating to speculate what prizes Nobel would have created had he been writing his will today. For the domain of "science," his philosophy still leads to physics, chemistry, and physiology or medicine, although possibly with an emphasis on new aspects (biotechnology) or, the addition of new disciplines such as computer science. For the domain of "society," it is our view that modern topics such as environmental management and social development—or to widen the definition, sustainability—could well supplement literature and peace as subjects befitting Nobel's views.

What could be the nature of a Nobel Prize for Sustainability? One option would be to add another prize in addition to that for economics. Or the prize for economics could be transformed into a Nobel Prize for Sustainability, because the three mainstays of the concept of sustainability are the environment, economics, and social development. A variation of this idea would be to award alternating prizes for economics, the environment, and social development.

The first option, adding a new prize, seems least likely to be realized. When the Nobel Foundation Board created the prize for economics, it decided to accept no further prizes (*3*). Thus, transforming the prize for economics is a more realistic option, all the more so because economists already questioned in the early 1980s whether enough outstanding economists could be found for an annual prize (*3*).



The dream of Nobel, inventor of dynamite, was "to be of service to mankind" (*1*). (Painting by Emil Osterman, undated.)

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Who could be eligible for a sustainability prize? Two categories of people come to mind. The prize could be awarded to persons who have made major scientific contributions to the field of sustainability research (including environmental science, economics, and social development). This would not seem to be the most obvious choice, however, because together with the potential paucity of eligible economists, environmental science lacks the necessary international status as a discipline. Furthermore, environmental researchers are already eligible for the physics and chemistry prizes.

An alternative, which we favor, would be to award the prize, in the manner of the Nobel Peace Prize, to persons, institutions, or projects that have made great contributions to the promotion of sustainability in society; for instance, in terms of environmental protection. These could include candidates such as Brundtland, Greenpeace, or the Club of Rome.

Although other types of prizes are already being awarded to people who have distinguished themselves in various aspects of sustainability such as environmental protection, these prizes are not nearly so prestigious as a Nobel Prize. Creation of a Nobel Prize for Sustainability would provide a high political and media profile for the discipline annually, and thus a powerful impetus for humankind.

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References and Notes

1. Norwegian Nobel Committee, *Alfred Nobel, Biography* [online] (2001). Available at http://www.nobel.no/eng_com_will1.html
2. R. A. Wirtz, *Region* **3** (no. 13), 7 (1999). Available at http://woodrow.mpls.frb.fed.us/pubs/region/99-09/nobel.html
3. B. Lemmel, *The Nobel Foundation: A Century of Growth and Change* [online], V. Kayfetz, transl., The Nobel Foundation, Stockholm, Sweden, June 2000 [updated 17 April 2001]. Available at http://www.nobel.se/nobel/nobel-foundation/history/lemmel/index.html. Nobel Laureate Douglass North (1993) admitted that the supply of serious candidates might have become exhausted after the first 15 years when he said, "There is some question whether [the Academy] ought to be giving [the Prize] out every year....I don't think there are any big, outstanding individuals left" (*2*).

Candidate Number 1: Instant Runoff Voting

STEVEN J. BRAMS AND DUDLEY R. Herschbach are right about the defects in the plurality voting system used in most U.S. elections (Editorial, "The science of elections," 25 May, p. 1449). But, on both theoretical and practical grounds, they are wrong to tout approval voting (AV) over instant runoff voting (IRV).

Used for decades in Australia and Ireland and considered in 13 U.S. state legislatures this year, IRV allows voters to rank candidates in order of preference. A voter's best strategy is to sincerely rank the candidates. If no candidate gets a majority of first preferences, candidates at the bottom

are sequentially dropped. Each ballot cast for those eliminated candidates is added to the totals of the next choice indicated on that ballot, until a candidate achieves a majority (*1*). IRV duplicates a series of traditional runoffs, but without the need for additional elections that cost taxpayers and candidates more money and often lead to falloffs in voter participation.

In contrast, AV is a binary system, where the voter can indicate only "yes" or "no" for each candidate. But voters rarely have binary views about a range of candidates. Assume a voter sees Z as most favored, Y as less favored, and X as unacceptable. By voting for "acceptable" candidates Y and Z, the voter could cause Z to lose. But by voting only for Z, the voter makes it easier for X (the unacceptable candidate) to win (*2*). The voter will be torn between voting defensively against X or strategically for Z, because voting for a second choice counts against your first choice.

Approval voting has another important flaw. Political behavior has much to do with what is rewarded by the election system, and AV would exacerbate one of the worst aspects of U.S. campaigns: avoidance of substantive policy debate. Because a candidate could lose despite being the first choice of an absolute majority of the electorate (*3*), smart candidates would avoid controversial issues that alienate any significant number of voters. Smiling and using policy-empty themes like "I care" will not clarify the choices leaders must make. Those rewarded by AV could be characterized as "inoffensive" more than "centrist."

IRV strikes a better balance. It rewards candidates who stand out on policy enough to gain first-choice support, yet encourages coalition-building and fewer personal attacks, as candidates seek to be the second choice of other candidates' supporters.

These arguments help explain why IRV is used and proposed far more often than AV, and why next year Alaska and San Francisco will hold ballot measures to implement IRV for their major elections (see www.fairvote.org/irv for details). IRV is the right system for the United States' high-stakes elections with a single winner.

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References and Notes

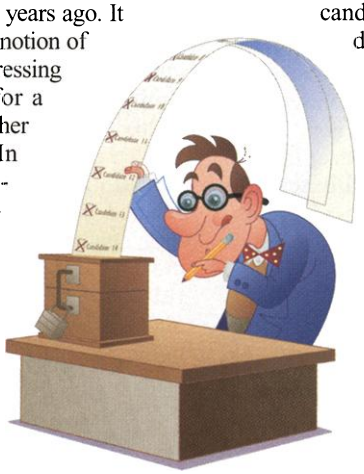
1. Ireland's 1990 presidential race provides an example of how IRV works. In the first round, Brian Lenihan won 44% of first choices, Mary Robinson won 38%, and Austin Currie won 17%. After Currie's elimination, Robinson had clear majority support, winning 53% to 47% in the second round of counting. Without IRV, Currie would have been a "spoiler" and handed the presidency to Lenihan.
2. Imagine an AV election with 100 voters. After 98 ballots are counted, the results give 55 approval votes to candidate Z, 60 votes to candidate Y, and 61 votes to candidate X. The two remaining ballots were cast by those voters who really liked Z and intensely dislike X. If they knew these results in advance, they would want to block candidate X by casting votes for both candidates Y and Z. Now suppose the results instead gave 60 approval votes to candidate Z, 61 to Y, and 55 to X. The final two voters in this case would want to elect candidate Z by not voting for Y. But only in imaginary elections can we know the results in advance. Without that advance information, supporters of candidate Z are in a quandary—as, in fact, are most remaining voters. IRV's alleged mathematical deficiencies, on the other hand, have almost no strategic impact, because they depend on voters making complex calculations with advance knowledge of election results.
3. Here is how AV can allow a candidate with strong majority support to lose in an election with 100 voters. In a plurality election, candidate A is the favorite choice of 65 voters, candidate B is preferred by 25, and candidate C is the top choice of only 10. Candidate A is the unambiguous winner, and C is a distant third. Under AV, however, many voters might pick C as a weak, but tolerable, alternative. The final count might give 70 approval votes to A, 35 votes to B, and 75 votes to C. Candidate C would win.

Response

IRV IS A SPECIAL CASE OF A VOTING SYSTEM proposed by Thomas Hare of England (and others) 150 years ago. It sounds attractive, but when compared with AV, it has several singularly unappealing features, including the following.

First, IRV may hurt centrists, especially when challenged from both the left and right. Even when there are only three candidates, it is not uncommon that the centrist comes in third, which means that he or she loses under IRV. In contrast, AV tends to help such candidates, because they draw approval from their opponents' supporters on both the left and right, who want to avoid at all costs helping the candidate on the opposite side of the political spectrum.

Second, IRV has the perverse property of nonmonotonicity, which means that raising a candidate in one's ranking can cause him or her to lose. This can occur because of the way in which candidates are sequentially dropped and their votes transferred to those who remain in the race. This property was discovered only about 30 years ago. It is antithetical to the very notion of democracy, in which expressing a stronger preference for a candidate should help rather than hurt that person. In contrast, expressing approval for additional candidates under AV can never hurt them, and generally helps them.



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Third, IRV is very complex. Even mathematicians have not fully understood it, as evidenced by misstatements they have made about the Hare system. It is noteworthy that the American Mathematical Society, after long debate, abandoned the Hare system for AV. In fact, none of the eight professional societies that has adopted AV over the last 15 years has reconsidered its decision and chosen a different voting system.

It is true that AV is a binary system, but not with respect to where voters draw the line between acceptable and unacceptable candidates. Thus, if there are five candidates, a voter might reasonably approve of one, two, three, or four of the five candidates. With AV, the voter decides who is worthy of approval, whereas IRV forces voters to make a strict ranking, which might be asking too much for those who do not know a great deal about the candidates but do know who is basically acceptable and who is not.

In addition, AV might not always elect the first choice of a majority of voters. But that result, surprisingly, is sometimes desirable. For example, if 50 voters rank three candidates XYZ (in that order) and 49 voters rank them YZX, AV will elect Y if the 50 XYZ voters approve of both X and Y, and the 49 YZX voters approve of either Y or both Y and Z. Is not Y the better social choice, compared with X, the IRV winner, who is considered the worst choice by nearly half the voters?

Ritchie and co-authors make one false claim. A sincere ranking under IRV is not always optimal—a voter can sometimes ensure the election of a preferred candidate by not being sincere. The scenarios they discuss in their references 2 and 3 to discredit AV also have difficulties, the chief one being that they are not descriptive of general situations that the theorems given in (*1*) provide. The scientific analysis of voting systems calls for the specification of conditions under which different outcomes can occur, which in the case of IRV means understanding when raising a candidate in one's ranking hurts rather than helps that candidate, or when ranking candidates sincerely is not optimal. Their work has not provided such conditions.

We think Ritchie *et al.*'s claim that AV would force all candidates toward a lowest common-denominator position of blandness is erroneous. In a detailed study of the 1980 presidential election, which had a significant third-party candidate (John Anderson), Peter Fishburn and one of us (Brams) showed that Ronald Reagan would have won under AV, on the basis of both election and poll data (*1*). We strongly doubt that AV would have compromised Reagan's decidedly strong convictions or his campaign behavior—or affected the outcome. Indeed, trying to be everything to everybody is likely to make a candidate not even minimally acceptable to many voters and, therefore, is not a smart campaign strategy under AV.

Ritchie *et al.* point to the serious interest in IRV. We would point to the failure of the Hare system to stand the test of time. It was adopted in several large U.S. cities, including New York, about 50 years ago, but the last city still using the system in the United States is Cambridge, Massachusetts.

Serious analysis of AV began only about 20 years ago. Since then, AV has gained many adherents inside and outside the scientific community. Both its compelling theoretical properties and its simplicity commend it for practical use,

which cannot be said for IRV, especially in those jurisdictions that do not already have electronic voting equipment that would permit voters to rank candidates.

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1. S. J. Brams, P. C. Fishburn, *Approval Voting* (Birkhäuser, Boston, 1983).

Candidate Number 2: Proxy Representation

IN DISCUSSIONS CONCERNING THE METHOD of elections to legislatures, the principal competitor to plurality elections in single-seat constituencies has, for a long time, been proportional representation. This has met objections, most of which are well known to those who have interested themselves in this subject. There are others, notably approval voting (AV), which is advocated in the Editorial by S. J. Brams and D. R. Herschbach ("The science of elections," 25 May, p. 1449). Another, which probably has been proposed by others, is proxy representation (PxR). This system meets many of the objections to proportional representation, has interesting similarities to AV, and produces a legislature even more precisely proportional than either of these or the current method (*1*). Its practicality is grounded in technology only available within the past 40 years.

With the PxR method, constituencies would elect several representatives, each having a voting strength in the legislature precisely equal to his "mandate," that being defined as the number of voters who have indicated acceptance of that representative in a preferential balloting. PxR gives to each voter, even more surely than AV, an acceptable representative. The voter, by the ballot cast, directly empowers the chosen candidate with exactly one additional vote on every issue before the legislature.

Representatives stand for people, not districts, and with PxR, representatives are empowered in a secret ballot to cast votes only on behalf of voters who have given them their proxy. The drawing of lines between constituencies would become considerably less important, and among the minor advantages would be the saving of the expense of primary and special elections. The result would also be a more direct democracy.

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References and Notes
1. Because the full analysis is too long for this letter, it has been made available at www.math.wisc.edu/~beck/proxy.html

SciTecPac Was Science's First Watchdog

CONTRARY TO THE OPENING SENTENCE OF the News of the Week article "Group raises hackles as well as funds" by A. Lawler (7 Sept., p. 1747), Republican Representative Vernon Ehlers of Michigan has not "created the first political action committee (PAC) to support proresearch candidates for Congress." The first science-based political action committee in Washington, DC, was founded in 1981 by former Congressional Fellows from the American Association for the Advancement of Science (publisher of *Science*), the American Chemical Society, and other scientific organizations. I was its co-founder and first chair.

> "...the scientific community fails in its responsibility to support political candidates who have an interest in science."

The name of that organization was SciTecPac. Unlike the present PAC, however, it was nonpartisan and counted a number of senators, congressmen, corporate leaders, and leaders of scientific societies as advisory board members. Its task was to develop a grassroots lobby in support of science and science education.

According to the article, Neal Lane, former head of the National Science Foundation, observes that "[T]he science community needs to be much more involved in the political process"—the same belief that prompted the founding of SciTecPac more than 20 years ago. I continue to agree strongly that the scientific community fails in its responsibility to support political candidates who have an interest in science. It is sad that we have made so little progress despite all the clarion calls for more involvement.

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Letters to the Editor

Letters (~300 words) discuss material published in *Science* in the previous 6 months or issues of general interest. They can be submitted by e-mail (science_letters@aaas.org), the Web (www.letter2science.org), or 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.

CORRECTIONS AND CLARIFICATIONS

REPORTS: "Late Holocene climate and cultural changes in the southwestern United States" by V. J. Polyak and Y. Asmeron (5 Oct., p. 148). In reference 13, the URL for the supplementary material was incorrect. The correct URL is www.sciencemag.org/cgi/content/full/294/5540/148/DC1.

NEWS: "The quandary of quantum information" by C. Seife (special issue on Computers and Science, 14 Sept., p. 2026). The article reports that Peter Shor worked at Lucent Technologies' Bell Labs in Murray Hill, New Jersey, when he discovered the prime factorization algorithm for a quantum computer in 1994. Shor was indeed working at Bell Labs in Murray Hill, but in 1994 it was owned by AT&T. Shor now works at AT&T Labs–Research in Florham Park, New Jersey. He has never been employed by Lucent Technologies.

NEWS OF THE WEEK: "Painting a picture of genome evolution" by J. Couzin (14 Sept., p. 1969). It was stated that the two bacteria, *Rickettsia conorii* and *R. prowazekii*, have 1.3- and 1.1-billion-base-pair genomes, respectively. The word "billion" is in error. The bacteria have 1.3- and 1.1-million-base-pair genomes, respectively.

LETTERS: "Chiral selection when stirred, not shaken," response by J. M. Ribó J. Crusats, F. Saguès, J. Claret, R. Rubires (24 Aug., p. 1435). The last sentence of the figure caption, written by *Science*, was misleading as to what the evidence from the research by Ribó and colleagues indicates. The sentence should have read, "These aggregates [of porphyrin molecules] then assemble into supramolecular chiral structures, oriented according to the vortex motion." There is no evidence of helicity of the supramolecular structures, nor conclusive evidence of the sign relation between absolute chirality and vortex direction, as suggested by the original sentence.