A previous letter favorable to the prospects of planting transgenic maize in Mexico, its land of origin, draws further discussion: "[T]he genetic and ecological risks of introducing transgenic crops into the centers of origin of agronomic crops are largely unknown....The effects may prove, in most cases, of little consequence, but we should not find out by default or accident." Meeting future electricity demands cannot ignore the environmental consequences of the method of production: "Any successful energy policy needs to preserve current resources that meet environmental goals as well as plan for future technologies." And the social and economic conditions scientists in Nazi Germany faced are discussed.

Transgenic Crops: A Cautionary Tale

In their letter (25 Feb., p. 1399), J. P. R. Martínez-Soriano and D. S. Leal-Klevezas say that there "should be no need for concern" that the introduction of transgenic maize varieties in Mexico may pose a risk to landraces or wild relatives of maize in its ancestral home. However, it would be a mistake to dismiss such concerns given the limited state of our current knowledge. Indeed, what little evidence is available seems worrisome.

Martínez-Soriano and Leal-Klevezas mention that there is only one wild relative of maize, annual teosinte, but there are several subspecies of teosinte (which is conspecific with maize itself) as well as a perennial teosinte, a separate species endemic to Jalisco, Mexico. Other less closely related species are found throughout Mexico and Central America. The possibility of gene flow from the teosintes to maize is well established and has been deliberately induced by Mexican farmers. The possibility of gene flow and introgression (incorporation of genes) from maize to teosintes is less studied, but the work of J. Doebley and M. Goodman and of B. Benz *et al.* confirm this possibility (*1*). Reviews on the issue (*2*) also make it clear that reciprocal gene flow between maize and the teosintes is possible. Thus, the available evidence does not support the authors' comment that "transgenes cannot be established in a natural population of teosinte." The concern expressed by some scientists that such gene flow could create aggressive strains of weeds cannot be dismissed on the basis of the reasoning presented in their letter.

Martínez-Soriano and Leal-Klevezas also say, "Any transgene transferred inadvertently to native maizes can be removed from the progeny by selecting against the incorporated trait." But "gene" and "trait" are not synonymous; selection by farmers for a trait is not 100% efficient in eliminating a gene from a breeding population.

Although perhaps technologically feasible, there is no practical way for farmers or breeders to select out genes for Bt or glyphosate resistance, for example, given the scale at which landraces are grown in Mexico. Furthermore, maize farmers actively increase infraspecific diversity by interplanting varieties to generate hybrids (*3*). Any transgenic trait that is introduced can therefore be expected to diffuse into other maize races—especially if the trait is dominant. Martínez-Soriano and Leal-Klevezas say that transgenic maize is opposed because people think maize is "genetically fragile." However, the issue is not fragility, but the irreversible insertion of a new trait that may become common in Mexican maize landraces or wild relatives.

We believe that the genetic and ecological risks of introducing transgenic crops into the centers of origin of agronomic crops are largely unknown. We must not get beyond the science. The effects may prove, in most cases, of little consequence, but we should not find out by default or accident. Regulatory decisions involving the introduction of transgenic plants should be based on thorough scientific research, which in the case of maize, at least, has not yet been conducted.

Ronald Nigh, Centro de Investigaciones y Estudios Superiores en Antropología Social del Sureste, Carretera a S. Juan Chamula Km 3.5, San Cristóbal de Las Casas, Chiapas 28247, Mexico. E-mail: Danamex@internet.com.mx; **Charles Benbrook**, Benbrook Consulting Services, 5085 Upper Pack River Road, Sandpoint, ID 83864, USA; **Stephen Brush**, Human and Community Development, University of California, Davis, CA 95616, USA; **Luis Garcia-Barrios**, Division de Sistemas de Produccion Alternativos, El Colegio de la Frontera Sur, Carretera Panamericana y Periferico Sur s/n, San Cristóbal las Casas, Chiapas 29290, Mexico; **Rafael Ortega-Paczka**, Direccion de Centros Regionales, Universidad Autonoma Chapingo, Km. 38.5 Carretera Mexico-Texcoco, Chapingo, Estado de Mexico 56230, Mexico; **Hugo R. Perales**, Departamento de Agroecología, El Colegio de la Frontera Sur, Carretera Panamericana y Periferico Sur s/n, San Cristóbal las Casas, Chiapas 29290, Mexico

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Martínez-Soriano and Leal-Klevezas say in their letter, "transgenes cannot be established in a natural population of teosintes. Any teosinte recipient of maize pollen is at risk of transmitting to its progeny the trait of not being able to release its seeds." They add that gene transfer is more likely to occur from (wild) teosinte to (cultivated) maize rather than vice versa. However, the only alleles less likely to move from transgenic maize to teosinte are those linked to cob disarticulation loci. Other alleles will flow with no fitness reduction. Moreover, the amount of pollen released from cultivated fields relative to the amount of wild pollen would suggest that the direction of gene flow is more likely to occur from cultivars to the wild plants (*1*).

Indeed, this seems to be the most frequent cross direction, as demonstrated in the cases of Indian red rice (*1*) and white-flowered lupines in Western Australia, to name just two examples. Such a process is bound to occur where and when wild progenitors grow adjacent to cultivated types. The general nature of the phenomenon would suggest that, before irreversible decisions are taken regarding transgenic maize, it would be wise to consider similar situations from other crops in other areas.

In Israel and other Mediterranean countries, barley and Johnson grass grow wild. The six-row trait of cultivated barley has introgressed more than once into spontaneous forms and is maintained in many populations (*1*). Johnson grass without rhyzomes developed spontaneously after introgression of the pertinent genes from sorghum in Israel. If such morphological alleles could move into wild and weedy forms, what could prevent the introgression of a glyphosate resistance allele from (hypothetical) transgenic sorghum into Johnson grass, thereby eliminating the only economic means for its control? By the same token, if cultivated wheat or barley engineered with herbicide resistance is to be cultivated throughout the Mediterranean basin, the inevitable introgression will soon follow.

Transgenic crops are here to stay, but it is

imperative to ensure that such crops are grown only outside the range of their wild progenitors. Otherwise, the most valuable gene pools for future food supplies will be at risk.

Shahal Abbo
Baruch Rubin
The Hebrew University of Jerusalem, Rehovot 76100, Israel

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Electricity Supply

Philip H. Abelson in his Editorial "Future supplies of electricity" (*Science*'s Compass, 11 Feb., p. 971) makes important points about next-generation sources of electricity, but a few points about the current state of affairs should be made. There are substantial electricity resources in the forms of nuclear power and hydroelectric generation that produce no carbon dioxide (CO_2) or air pollution. In fact, nuclear power plants in the United States have increased their output over the last several years such that this increase alone constitutes the largest industrial contribution to reduced CO_2 emissions.

The non–fossil fuel power sources are, however, in jeopardy. The demands for electric utilities to increase short-term profits in a deregulated electricity market and the failure of the federal government to make progress on accepting spent nuclear fuel from commercial reactors are pressuring nuclear plant owners to sell or shut down their facilities. There are even plans to dismantle some hydroelectric dams in the name of environmental restoration. Today, the fuel of choice for replacing the electricity supplies that would be lost is natural gas. Although better than coal or oil, it is still a fossil fuel that generates CO_2.

It will be of little use to develop new energy sources for the long-term when we cannot maintain existing sources that generate no CO_2 or pollutants. Any successful energy policy needs to preserve current resources that meet environmental goals as well as plan for future technologies.

Alan E. Waltar
Department of Nuclear Engineering, Texas A&M University, College Station, TX 77843–3133, USA. E-mail: waltar@trinity.tamu.edu

Clinical Research

Alan M. Sugar raises a number of important issues in his letter (3 Mar., p. 1593) in which he comments on our Policy Forum "Oversight mechanisms for clinical research" (*Science*'s Compass, 28 Jan., p. 595). He discusses the undue emphasis on documentation rather than on protection of participants in clinical studies, citing the attention paid to the informed consent form rather than the education of the study participant. He also points out the unique roles institutional review boards have in protecting the public rather than representing the institution, and the potential conflicts faced by clinical investigators who also practice medicine. We agree with Sugar's concerns and reiterate a key point of our Policy Forum that there is a need for a national debate among representatives of all relevant constituencies concerning human subject protection regulations and the development of an understandable and relatively simple set of regulations that work and are focused on the rights of the participant while recognizing the importance of clinical research to our nation's health. Such regulations must be flexible in responding to changing environments. The continued concerns of the public, the press, and political leaders on clinical trials further emphasize the need for human subject protection regulations to be revisited soon in a comprehensive fashion.

Ralph Snyderman
Duke University Medical Center, Durham, NC 27710, USA. E-mail: snyde001@mc.duke.edu