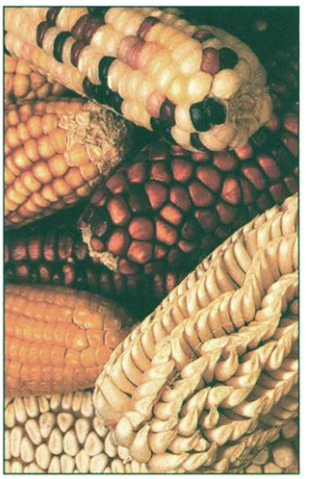
Commercial Nature of Corn Germ Plasm

I APPLAUD DANIEL CHARLES' NEWS FOCUS article on the debates over who controls the international crop germ plasms (the gene and seed banks from which new crop lines are developed) and the efforts to enhance free exchange of germ plasm ("Seeds of discontent," 26 Oct., p. 772). As a public plant breeder when the international Convention on Biological Diversity entered into force in 1993, which provided the right to nations to control the export of their genetic resources, I expected that I would be required to charge royalties on my cultivars (something that I had not done) to meet the potential requirements of returning money to countries where the parental germ plasms I used were discovered. Many U.S. crops (e.g., wheat, barley, oats, and soybeans) are introduced, and all of our parental germ plasms are derived from or are plant introductions. It is a relief to know this concern is being addressed.

However, care should be taken when using corn as the example for germ plasm exchange in agricultural crops. The issues Charles addresses are of concern to those dealing with public-sector genetic resources. The approach governing the exchange of genetic resources in corn is different because elite corn germ plasms are predominantly developed in the private sector (*1*) and corn is commonly sold as a hybrid. To give an example of the uniqueness of the commercial presence in corn, the total number of cereal crop breeders in the United States in 1994, the last scientific census for this field (*2*), was 893. Of these, 599 (67%) were in corn breeding (dent, popcorn, or sweet corn), 130 (15%) in wheat breeding, 55 (6%) in sorghum breeding, 42 (5%) in rice breeding, 32 (4%) in barley breeding, and lesser numbers in other cereal crops such as oats, rye, and wild rice. In wheat, 59% of the breeders were in the public sector and 41% were in the private sector. In corn, 93% of the breeders were in the private sector and 7% were in the public sector.



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In addition, corn is often sold as a hybrid, and the hybrid and its parental inbred lines have great commercial value. Therefore, for fear of theft of the parental inbred lines, many lines are covered by the strictest forms of intellectual property rights (e.g., patents). In contrast, for other crops such as wheat that are sold predominantly as inbred lines, theft is much less of a concern and less restrictive forms of intellectual property rights are used (e.g., the Plant Variety Protection Act). Simply, inbred lines are much easier to identify in the marketplace, and the seed has lower commercial value because it is easier to produce and farmers can save their seed.

This difference in commercial approaches between hybrid and inbred crops affects the extent of germ plasm exchange. In corn, because the inbred lines are valuable and most were privately developed, there is little exchange of elite inbred lines, whereas in wheat and many other agricultural crops, there is considerable exchange of both genes and elite genotypes (inbred lines) with relatively simple agreements (*3*). Germ plasm exchange in many crops is greater between developed and de-

veloping countries than in corn because breeders in these crops are routinely putting elite lines into public collections and these elite lines are exchanged for traditional crop varieties to the benefit of all.

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References and Notes

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2. K. J. Frey, *National Plant Breeding Study-1. Human and Financial Fesources Devoted to Plant Breeding Research and Development in the United States in 1994, Special Report 98* (Iowa Agriculture and Home Economics Experiment Station, Iowa State Univ., Ames, IA, 1996).
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The Broad Reach of Helminthology

HOW DOES MEDICAL HELMINTHOLOGY FACE the new millennium? That is the question D. G. Colley, P. T. LoVerde, and L. Savioli raise in their Policy Forum "Medical helminthology in the 21st century" (24 Aug., p. 1437). Aside from advancing the general field of parasitology, those studying helminths during the last century made great contributions to many other branches of the medical sciences, most notably, immunology and pathology. With the "worst of times" scenario that now exists for helminth research, as pointed out by Colley and co-authors, we should emphasize there are a variety of novel research areas that could be fruitful for those trained in fields other than helminthology. In addition, helminth infections present good model systems for studying numerous nonhelminth diseases, such as those with inflammatory, allergic, and chronic granulomatous components.

Scientists in disparate disciplines, from both the academic and private sector alike, should be encouraged to look more closely at what the field of helminthology has to offer. Many years ago, the National Institutes of Health had the foresight to organize repositories of helminth life cycle stages (for those in schistosomiasis and filariasis research) and make them freely available to interested investigators. This was a major step in helping investigators branch into research areas they otherwise would have been unwilling to pursue because of the labor-intensive demands of these life cycles.

It is a given that studying helminth infections holds the promise of reducing the human suffering in countries where these infections are widespread. It is equally likely that recruiting and supporting scientists from many disciplines to study these parasites can lead to significant scientific contributions far outweighing the direct public health benefits to those afflicted with these worm burdens.

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CORRECTIONS AND CLARIFICATIONS

TECHNICAL COMMENTS: "Inverse modeling of atmospheric carbon dioxide fluxes" (12 Oct. 2001, the full text is available at www.sciencemag.org/cgi/content/full/294/5541/259a). The affiliation address for Philippe Peylin was incorrect. It is Laboratoire de Biogeochimie Isotopique, CNRS-UPMC-INRA, 4 Place Jussieu, 75252 Paris, France. Also, the following acknowledgement was inadvertently omitted: "The authors thank D. Baker for helpful discussions on the tradeoff between aggregation error and estimation error, and for the depiction of it given in Fig. 1."