production and the extent and pattern of flowering. Genes that confer male sterility are of particular value to the breeder, and account for about 8% of applications.

Although much of the controversy surrounding genetically modified crops concerns herbicide tolerance, only 7% of applications relate directly to this trait. These include genes encoding glutathione *S*-transferase IIIc, acetolactate synthase, lycopene cyclase and a protein conferring glyphosate resistance. The complexity of gene function is well illustrated by the acetyl-CoA carboxylase gene, which confers herbicide tolerance in monocotyledons but is claimed primarily for regulating oil content.

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1. Nuffield Council on Bioethics *Genetically Modified Crops: Ethical and Social Issues* (NCOB, London, 1999).

Papers should spell out authors' roles

Sir — When scientific papers with multiple authors are published, an indication should be given of the contribution that each author has made to the research. *Nature* recently published a paper by more than 20 authors. We can only guess what the contribution of author No.17 might have been, but it might be important to let the reader know about that, not least for the benefit of author No.17 himself. We propose the following system, which would take up minimal space in the journal.

All authors should be listed again at the end of the paper with a short statement about their contributions (Table 1). No matter if the author is the first or the seventeenth, they will be able to show their part in the work, which might be helpful for their future careers, especially in the case of younger scientists[1]. This system will be informative for readers and also for potential employers, who need to assess the work of scientists they might employ.

This statement of authorship would also strengthen scientific teams, because it would become more difficult for someone to usurp rewards not belonging to him[2]. Possible resentment about positioning within the list of authors would be reduced, because each author would be given full credit according to their personal contribution. The scientific community would benefit — better research would emerge from teams that cooperated rather than behaving like packs of wolves. And other scientists would find it easier to contact the right person to ask about a specialized area of the research.

Table 1 **Personal contributions to papers**

Author 1	Head of project, project design, coordination, initial idea
Author 2	General realization
Author 3	Reviewing
Author 4	Immunohistochemistry
Author 5	Electron microscopy

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1. Tarnow, E. *Nature* **398,** 657 (1999).
2. Schiermeier, Q. *Nature* **397,** 640–641 (1999).

Scientists must bridge the communication gap

Sir — Lewis Wolpert is characteristically thought-provoking in his Commentary "Is science dangerous?"[1]. But he misses the point.

Wolpert informs us that scientists have "specialized knowledge of how the world works that is not easily accessible to others". In fact, scientists show us an aspect of how the world can be considered to work. This is related to a particular way of thinking that has sufficient common principles to allow for a community of thought and discussion. The great power of this method is its predictive capacity and its potential for application in everything from space rockets to genetically modified crops.

But the scientific method does not, as Wolpert believes, "tell us how the world is". What gives scientists their special voice and power is not the 'truth' of their theories, but the application of these theories in technology.

Power is dangerous and therefore so, potentially, is science. Not because, as Wolpert scornfully suggests, our stupid culture is afraid of knowledge, but because scientists do not seem to be able to understand non-scientists. The understanding of scientists is limited to their particular approach to life. Or, to parody Wolpert, non-scientists have unspecialized knowledge of how the world works that is not available to scientists. Often the attempts of scientists to communicate to non-scientists only reinforce the divide: those who are interested in science enjoy the popularization; those who are not, do not.

Science, therefore, is dangerous because it is out of contact with much of its user base and, from some perspectives, is close to a tyranny. For too long scientists have patronized the non-scientific majority, and carried on with little concern for their reservations. The high-handed "It is essential to recognize" of Wolpert's article belongs in the past. Scientists are boxing themselves into a corner by their inability to see that other people have a legitimate right not to see the world scientifically, and by their poor social skills. In science it is a virtue to be somewhere between forceful, condescending and arrogant. When communicating science, it is a disaster.

From 'mad cow disease' to genetically modified food, scientists have been failing to convince. No longer able to understand the language and aspirations of their fellow humans, they are moving from the position of curious outgroup to vulnerable minority. Science is useful, and the world it reveals is amazing. But Wolpert and the rest of us must understand that scientists can no longer dictate to the world. It is essential to realize.

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Sir — Wolpert's Commentary[1] seems quite naive. Take the key point of the supposedly 'neutral' knowledge provided by science. Wolpert says: "It is essential to recognize that reliable scientific knowledge has no moral or ethical value. Science tells us how the world is." From this, all the rest of the article's argument follows — we can't discuss reality, we can only accept it.

This crucial idea is in itself dangerous. It should be obvious that all knowledge has been acquired and is therefore a mix of 'reality' and our own way of understanding — the glasses with which we observe, and distort, reality. These 'glasses' include reductionism (see ref. 2 for simple examples in biology), and the necessity of building stable entities that can resist controversies ('black boxes'[3,4]) and rapidly circulate within scientific networks[3].

To use a crude analogy, science summarizes reality as much as a football score sums up two hours of emotions, missed opportunities and referee's mistakes. Any fan knows that the score does not exhaust the game, it only allows us to build a league table. Similarly, science chooses to extract from reality those features that allow it to build theories, and this demands high technology and a specific social organization.

The knowledge provided by science stems from the way the world is, but also from the way science has chosen to deal with it. Science is interwoven with technology, and the argument that 'science is pure, only its (technological) applications can be bad' might not be convincing for much longer in these distrustful times.

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3. Latour, B. *Science in Action* (Harvard Univ. Press, 1988).
4. Jensen, P. *Am. J. Phys.* (submitted).