GM crops, without such strong-arm tactics from either side. They need the kind of clear, authoritative information that she provides so that they can make up their own minds in a logical and dispassionate manner.

I recently had a long conversation with President Museveni of Uganda. He asked many thoughtful and penetrating questions about GM technologies. After our talk I sent him a copy of *Genes for Africa*. I know it will have given him many of the answers he is seeking.

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A knotty story

Knots: Mathematics with a Twist
by Alexei Sossinsky, transl. Giselle Weiss
Harvard University Press: 2003. 160 pp. $24.95, £16.50, E24.95

Andrzej Stasiak

Not surprisingly, knot theory is a complicated business. For instance, the common knots encountered in daily life are not even considered to be knots by mathematicians. A tied shoelace is not knotted, in mathematical terms, because it can be untied by a continuous deformation. But the situation changes completely if the two loose ends of a shoelace or a piece of rope are permanently joined together. Now, even if the newly spliced rope forms a simple circle, a mathematician would immediately recognize it as a knot, albeit a trivial one, as it is no longer possible to untie it with a continuous deformation; this would require cutting the rope. It is these mathematicians' knots — closed curves in three-dimensional space — that are the subject of Alexei Sossinsky's *Knots*, which was first published in French in 1999 and is now available in English.

Sossinsky, a professor of mathematics at the University of Moscow and a knot theorist, gives equal attention to both the historical and the theoretical aspects of his subject. He begins in the 1860s with Lord Kelvin's supposition that atoms are formed of closed vortices of ether, and that what set apart the atoms of different elements was the different ways in which those vortices were knotted. Kelvin's idea won its share of followers and launched scientific interest in the theory of knots, resulting in a systematic classification of various knot types. As it turned out, however, atoms are not knotted (at least not in the simple form imagined by Kelvin), and physicists relegated interest in the subject to mathematicians who might be less concerned with its utility and applications.

In recent years, however, there has been an intriguing convergence, as the mathematics of knots and the intricacies of quantum physics have become, well, knotted together. Sossinsky's final chapter is placed in the near future (2004), as this may be the time when a worthy successor to Kelvin demonstrates a deep connection between knots and elementary particles.

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It's knot unusual: like other knots recognized by mathematicians, the trefoil knot is a closed loop.

Sossinsky concentrates on the central problem in knot theory: how to tell whether two closed curves in space are topologically identical. The first step in the identification process is to assess whether the two knots can be twisted, bent, shrunk or stretched — all continuous deformations — into an identical form. If they can, the two knots are topologically identical. The catch is that even if you cannot make one knot into the same form as the other, it still doesn't mean that they are not the same type of knot — perhaps you have simply failed to come up with the appropriate sequence of topological deformations. To solve the problem, knot theorists have invented various mathematical tools that can distinguish different knot types irrespective of their actual three-dimensional shapes.

As Sossinsky describes it, the most intriguing tool is based on the discovery that knots that can be converted into one another by a simple set of surgical operations (cutting and pasting) are related to each other in a specific mathematical way, regardless of their actual shape and topology. For the reader, it is at first strange and puzzling to see equations that use projections of these surgically related knots as graphical symbols. Still, with Sossinsky's help and with a little work, you will be able to write and solve these same equations for other sets of knots. This experience alone, if you're willing to put in the effort, makes the book worth reading.

As a biologist, I was pleased to see that Sossinsky compares surgical operations at knot crossings to the action of DNA topoisomerases — enzymes that change the topology of DNA molecules in living cells. Indeed, passing the overlying segment through an underlying one (and vice versa) corresponds precisely to a reaction mediated by DNA topoisomerases. However, Sossinsky is wrong to assert that a topoisomerase can eliminate an individual crossing; this requires another enzyme, a resolvase, which mediates the process of site-specific recombination. Sossinsky could have avoided this and other mistakes by consulting a biologist while writing about DNA.

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What's blue and sticky?

The toes of the Tokay gecko, shown above, are worth a closer look because they can adhere to the smoothest surfaces. But this isn't the only neat feat that reptiles can perform. It is well known that chameleons can change colour for camouflage, and many lizards can pull off the handy trick of growing a new tail if their old one is, well, pulled off. For a more comprehensive, and beautifully illustrated, look at reptiles, see *The New Encyclopedia of Reptiles and Amphibians* (Oxford University Press, £25), edited by Tim Halliday and Kraig Adler.