elected by other members — which is, of course, a recipe for perpetuating such bias. But some of the academy's 31 discipline-based sections have adopted proactive schemes for identifying promising female candidates, and a set of nominating groups established in 2003 helps more women and younger candidates enter the mix of potential members. The Royal Society in London has also made efforts in the past five years to increase the number of women in its ranks.

Such measures are to be applauded, but they don't seem to be working as well as they might. Options for a more direct assault on the issue are problematic, however. Setting up any kind of quota system, for example, would trigger a cascade of difficulties, starting with the possibly diminished status of women elected as part of a quota.

A slightly higher cap on the number of members admitted each year might better reflect the growing size and academic diversity of the scientific community, and open up the pipeline a little for deserving candidates of both sexes. But it would do little to address the gender imbalance.

Perhaps the best thing the academy can do is find ways to get suitably qualified women on the ballot in each of its sections. Such a change may, for instance, require a stipulation that nominees from diverse backgrounds will at least appear on the ballot.

Academy members at all levels should also take a more prominent and public role in promoting initiatives that will secure fair treatment for women scientists. All too often, discussions about advancing women or minorities in science spring from the same people — usually the women or minorities themselves. Some leaders do get involved, but it is up to them all to recognize that broadening diversity is more than just a feelgood effort, something to chalk up as a good deed done in the name of equality and then be forgotten.

A new initiative in US physics is to be applauded for taking steps in this direction. On 6–8 May, the chairs of 50 physics departments, plus 15 senior managers from national laboratories, met in College Park, Maryland, to discuss how to double the number of women in physics by 2022. The fact that a number of high-level researchers attended is cause for optimism. It remains to be seen how this effort will develop over time, but other fields would do well to consider similar moves.

Women in the United States have been told for decades that they need to enter science at the bottom in order to make their way to the top. But this situation has been going on for too long. Those already in the scientific élite must take it upon themselves to bring about genuine gender equity. ■

Under the microscope

The use of 'black box' techniques carries risks.

The apparatus list for a modern biology experiment is a far cry from the trusty pipette and centrifuge. A sophisticated and costly fluorescence microscope for exposing intricate cellular structures is often essential. So too are suites of software for bioinformatics and image analysis, a machine for sorting cells, and sophisticated computer models.

Mastering just one of these techniques can be a full-time job, yet a researcher may need several of them to gather data for a paper. Many biologists lack a detailed grasp of how the increasingly sophisticated techniques that they are using actually work (see page 138). As a result, they sometimes risk making innocent but nonetheless substantial errors.

Part of the problem can be attributed to the different approaches towards scientific equipment associated with different disciplines. Physicists, for example, have a long tradition of building their own equipment, and are often fascinated by its mechanics. Biologists' fascination is primarily with the mechanics of nature and, for many, the machines themselves are simply tools — complicated 'black boxes' that produce the results they need. It doesn't help that the tools biologists are using may have been designed by physicists, and that the two groups tend to use different jargon.

There are plenty of exceptions to this pattern. Some leaders in biological imaging, for example, have backgrounds in engineering and custom-build their own apparatus. But more typically, when life-science laboratories invest in an expensive new microscope, for example, only the first generation of users are properly trained in its use. As that knowledge is passed from person to person it can become dated or even distorted — and when the resident expert leaves, the knowledge often leaves with them. In the same vein, researchers may trustingly plug their data into a computer program for bioinformatics or image processing, without really understanding what the software is doing.

Ignorance of these black boxes can get researchers into trouble. Take the situation of Geoffrey Chang, a protein crystallographer at the Scripps Research Institute who didn't know that the software he was using to determine protein structures contained an error. He subsequently had to retract five papers because of the oversight (see *Science* **314,** 1875; 2006). More commonly, ignorance of the machinery creates minor setbacks, such as hours spent trying to repeat an imaging experiment when the initial report was actually the result of shoddy microscopy.

Individual researchers cannot be expected to know the minutiae of every instrument or technique they use, but a basic grasp of the principles and operation should be a professional requirement. In the case of microscopy, biologists should try to attend courses that provide a basic knowledge of optics, as well as some hands-on experience, to provide a foundation for operating the instrument.

Equally, researchers should admit to themselves what they do not know and seek out the missing expertise. The collaboration of specialists, either from within the same institution or outside, should be sought early during experimental design and, where appropriate, acknowledged in the resulting paper's author list.

For young scientists, the aversion of some of their colleagues to an intimate knowledge of instruments and techniques presents an opportunity. There is a fascination in being immersed in the mechanisms of microscopes, or in mastering the statistics behind sequence searches. People who can ask fundamental questions in biology and have mastered a sophisticated technique will never be short of a job. It really pays to know your apparatus inside out. ■