

The good, the bad, and the ugly

Misconduct in science appears to be on the increase in some disciplines, but its prevalence is unknown and how best to deal with it is unclear.

MASSIVE GROWTH AND HIGH-LEVEL achievements in the scientific research enterprise, together with their conspicuous publication in reputable peer-reviewed journals, are a source of pride around the world. We have tacitly assumed that misdemeanours on the part of researchers are not only negligibly few but even self-correcting. The reality, however, may be more disturbing.

Nobody denies the embarrassment of the occasional Piltown skull and the multifarious frauds perpetrated by the likes of Sir Cyril Burt, or of expensively researched and approved drugs that sometimes had disastrous side effects. All of these took many years to be exposed, but, it is argued in defence of the science system, exposed eventually they were. After all, research results are designed to be reproducible (at least in the 'harder' sciences), and checks and balances are in place at the lab bench and, in the public domain, through the quality-control screening procedures of the main research journals. These procedures are so well established and robustly supported that over a million papers appear each year in some twenty thousand journals in the multi-billion dollar scientific publishing industry.

In recent times, however, various professional bodies have expressed concern about a perceived rise in misconduct in science. Increasingly sensitive to ways in which scientific practice might be and is abused, they have taken deliberate steps to address these issues in policy documents and guidelines.¹ Watchdogs to supervise the biomedical professions have been set up; in the United States a commission on research integrity was convened in the mid-1990s; national academies are busying themselves with codes of conduct. Even the relatively sheltered and sober world of physics has been so rocked by scandal that the Institute of Physics in the U.K. played host to a two-day meeting in London in October to discuss misconduct in its backyard, and the role that journals can play in dealing with it.² What follows is an outline of some of the issues raised as the meeting attempted to define and quantify the problem.

Why the concern?

Bad behaviour undermines the public trust in scientists and may corrupt the scientific record. It can divert resources from legitimate investigations. In some fields of science the misdemeanours may be 'victimless' (nobody is likely to die because a fossil bone was misidentified or

wrongly dated out of negligence). They are viewed in a more serious light if a drug is prescribed, or disease symptoms misdiagnosed, on the basis of fraudulent data.

So what constitutes misconduct in science and does it matter? The U.S. Commission on Research Integrity gives the following definition:

Research misconduct is significant misbehavior that improperly appropriates the intellectual property or contributions of others, that intentionally impedes the progress of research, or that risks corrupting the scientific record or compromising the integrity of scientific practices. Such behaviors are unethical and unacceptable in proposing, conducting, or reporting research, or in reviewing the proposals or research reports of others.

Although anecdotes and specific cases abound, we have no idea of the scale of the problem in its various manifestations. (A few examples appear in the box on the opposite page.) Some physicists consider that it affects 'not more than 1%' of papers in their field, but that is just a guess. By broad consent, it is perceived to be much more common in the biomedical sciences, as illustrated at the London meeting by Richard Smith, editor of the *British Medical Journal*.³ This could be due to long-established conflicts of interest with sponsorship by pharmaceutical companies of drugs trials; and also to the difficulty of replicating some experiments on human subjects.⁴ To believe that misconduct happens less often among professional scientists than, say, politicians or big business may be wishful thinking. 'Why wouldn't it happen? It happens in all other human activities,' observes Smith. 'You can get away with it. The system works on trust.'

Journals do not as a rule publicize their experiences of misconduct, whether by authors, reviewers or even editors; they may not even be aware of malpractice where it arises. Nor are they much given to discussing these experiences with other journals. In South Africa, such constructive interaction might have been possible in the days of the now defunct Bureau for Scientific Publications, but seems hardly ever to have happened, perhaps because there was (and is) virtually no culture of collaboration among journal editors in this country.

It is understandable that the problem of misconduct appears to be growing. The pressure to publish is felt from an early age in the careers of academics everywhere (although, paradoxically, the majority of published papers are scarcely

cited and not widely read). Financial inducements to publish can be large and irresistible. In China, for instance, some authors are rewarded in U.S. dollars for papers accepted by foreign journals. In South Africa, the generous government subsidy paid to academic institutions for articles published by their staff in 'accredited' journals is soon to increase by a factor of more than 3. Foreign students in the United States raise their chances of obtaining a residence visa with a decent publication record. Journals, too, compete with one another ('they are fishing in the same pool for the best papers' in fashionable subjects) and may be seduced by extravagant claims made in the manuscripts they are sent.

The march of electronic publishing is believed to compound the problem, mainly because quality control can be more lax than for the print journals, even though the new technology makes it easier to compare electronically posted articles and look for repetition.⁵

What constitutes misconduct

By common consent, a taxonomy of misconduct by authors in the publication of research results includes misleading authorship, undisclosed conflicts of interest, redundant publication, plagiarism, fabrication of data, selective exclusion of data, and breaches of ethical codes. In addition, there are various ways in which reviewers of manuscripts, and editors, can behave improperly. Apart from different kinds of misconduct, the scale of offences varies, from minor errors of judgement to outright fraud.

There is no universally agreed definition of authorship. A recurring problem seems that of 'guest authorship', where — perhaps to lend 'status' to the submission — the list of co-authors includes names of people who were never involved in preparing the paper.⁶ Such inclusion may add to a researcher's publication record but, as one speaker pointed out, agreeing to act as a co-author of a paper should be like 'signing a cheque' in terms of accountability and responsibility.

Citation, too, can cause dispute. The convention once was to cite the original source of an idea or a result; today it is more likely that the latest publications in the field will be cited instead. Redundancy — believed to be a problem in at least one fifth of papers in medical journals — occurs where two or more papers share essentially the same scientific material without full cross reference (for example, in cases where authors camouflage the repetition by omitting reference to work they have published elsewhere, especially in a foreign journal).

Undisclosed conflict of interest takes many forms. Although some journals now require authors to declare that they

have no competing financial interests, nonfinancial influences — institutional, political and even religious — are also potentially dangerous.

Researchers and journals in the developing world have their particular problems, it was said. Top journals are perceived to be prejudiced against third world authors, who have the 'wrong' addresses. Conversely, third world authors have been known to steal from leading journals and publish the material at home undetected — especially in India, Japan and China, where local editors are relatively remote from the main publication centres — or to recycle in a national journal what they have already published abroad. Such meretricious behaviour persists where the author's institution or funding source (which, at intervals, should monitor the publication record of members of staff or grant-holders) is prepared to overlook redundant and flawed papers.

Reviewers of manuscripts play a crucial role — which tends not to be properly acknowledged and is hard to assess — and all editors know that the review process is far from perfect. Anecdotes abound of reviewers who have stolen privileged information from a manuscript for their own ends, but few cases are recorded of disciplinary action being taken. Referees can be conservative in discouraging the publication of really novel ideas, especially those that would upset the status quo, and some famous papers are known to have been rejected by the journals to which they were originally submitted.

What needs to be done

One school of thought considers that, in practice, misconduct scarcely matters: the science system is self-correcting, and miscreants eventually get found out and receive their come-uppance. But do they, and what forms of disciplinary action are likely to encourage good behaviour?

There is at present no generally agreed penalty system and hardly any 'case law'. Punishment for bad behaviour often depends on the status of the perpetrator. Deviant senior professors may be less likely to be reprimanded than junior researchers; project leaders attracting generous research funding may enjoy greater protection than new postdocs.

In passing judgement, one needs to distinguish between the blatantly dishonest and the negligent, the crazy, and the merely delusional. One also needs to know whom to blame for what. Should a research supervisor be disciplined, for instance, if the member of his or her team publishes incorrect or fraudulent results? Should an institution take responsibility for the scientific misconduct of its staff?

Institutions — academic departments, funding agencies, national academies, employers, journals — have the power

Misconduct in science: Individual and collective behaviour

Most contributions to the scientific literature consist of relatively minor but reliable additions, steadily building on research that has gone before. At times, however, the progress of science has been seriously distorted by the actions of individuals in the context of large-scale interests.¹

Chauvinistic fervour, for instance, can help to fuel ideas that are consistently rejected by scientists outside their country of origin. The woeful influence of Trofim Denisovitch Lysenko on biology in the Soviet Union under Stalin is an extreme case of massive scientific corruption countenanced by political patronage. René Blondlot and N-rays, in the first three decades of the twentieth century, received much support in France, as did Jacques Benveniste more recently with his claims of physiological activity of certain cells in vanishingly small concentrations.

Another extreme case of the perverting effect of nationalism was the ascendancy of ideological quasi-science in Germany, especially the racial theories of Nazi anthropologists, which paralleled the rise of Hitler. An associated consequence was that Jewish scientists, notably physicists and mathematicians, were stripped of their university positions in Germany and many sought refuge

in the United States and Britain — to the military advantage of both countries during the Second World War.

The search for a scientific 'holy grail' can also perpetrate questionable behaviour. In the case of cold fusion, for example, which held out the hope of cheap energy and used headline-grabbing media announcements that bypassed normal scientific publishing procedures, support continues to this day — from a small number of scientists, laboratories, and funding bodies — for non-replicable results.²

Finally, eminence itself is not without danger. In Britain, influential psychologists Sir Cyril Burt and Hans Eysenck published fraudulent papers under their own names in journals they had founded and edited. Other powerful individuals, such as Lord Kelvin in the matter of the age of the Earth in the nineteenth century, have exercised great sway by practising 'academic birth control' in suppressing the publication of ideas that conflicted with their own.

1. See Gratz W. (2000). *The Undergrowth of Science: Delusion, self-deception and human frailty*. Oxford University Press.
2. Although cold fusion is largely rejected by mainstream science, the U.S. Navy continues to fund research on the subject (*New Scientist* 177, 36; 2003).

and the potential to impose, or at least to recommend, disciplinary action against those who bring science into disrepute.⁷ They can draw up codes of conduct (following existing models), actively teach and reward good practice, investigate cases of alleged misconduct and, in serious cases, publicize the action taken. Funders can withdraw support from delinquent researchers for a time; dishonest members of staff can be stripped of awards, prizes and fellowships, or even fired,⁸ journals can make a point of publishing retractions.⁶

For institutions to take determined action, however, they need to resist the temptation to sell out to short-term vested interests — of powerful individuals, for instance, or influence-wielding funders. They need to acknowledge the potential problem of misconduct, to apologize for mistakes, and to accept responsibility. They need, in short, not just to speak but also to act as custodians of scientific integrity.

Notes and references

1. One such body is the Committee on Publication Ethics (COPE), founded in 1997 by British medical editors, to address breaches of research and publication ethics, and to find practical ways of dealing with the issues. Guidelines on good publication practice, and COPE reports on cases of misconduct, are available at <http://www.publicationethics.org.uk>
A source of information on the ethical implications of advances in biological and medical research is the Nuffield Council on Bioethics (<http://www.nuffieldbioethics.org>). The American Physical Society has prepared a statement on

policies for handling allegations of research misconduct, and the American Chemical Society has issued Ethical Guidelines for Publications. The Online Ethics Center for Engineering & Science at Case Western University has extensive documentary holdings of relevance here.

2. A workshop on Scientific Misconduct and the Role of Physics Journals in its Investigation and Prevention was held under the auspices of the International Union of Pure and Applied Physics at the Institute of Physics, London, on 13 and 14 October. The intended outcome of the workshop is a document that summarizes the responsibilities of the various players, endorsement of the document by the IUPAP Working Group on Communication in Physics, and ultimately by the IUPAP Council (see <http://www.iupap.org>).
Two recent cases of fraud by physicists concern the extensive falsification of data by Jan Hendrik Schön, while a doctoral student in Germany and later at Bell Labs in the United States (see *Nature* 419, 419–421; 2002) and the claimed discovery of element 118 by scientists in California (see *Nature* 418, 261; 2002).
3. Dr Smith's workshop address and other presentations on medical publishing practices can be found on the *British Medical Journal's* website (<http://www.bmj.com>) under 'talks'.
4. In other fields, such as economics and sociology, for example, experiments are not always repeatable.
5. A study of duplicate publications in selective medical journals using an electronic search tool is reported by S.M. Mojon-Azzi *et al.* (*Nature* 421, 209; 2003).
6. The *New England Journal of Medicine* retracted a paper earlier this year because it claimed several authors who knew little or nothing about it (*Nature* 421, 775; 2003).
7. The workshop opposed the establishment of an 'Interpol' for the purpose, however, recognizing also that whistleblowers run the risk of being sued for defamation.
8. Earlier this year, the vice-chancellor of a university in north India was sacked for plagiarism. For details of this and other cases consult http://www.geocities.com/physics_plagiarism