European Science Foundation Policy Briefing

Good scientific practice in research and scholarship

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The European Science Foundation acts as a catalyst for the development of science by bringing together leading scientists and funding agencies to debate, plan and implement pan-European initiatives.

Foreword

At a time when the need to build trust between science and society is becoming ever more important, it is vital that the conduct of science itself is based on the highest ethical considerations and that misconduct within science itself can be identified and dealt with in an open and transparent manner. Several cases of misconduct have been reported over recent years from across the World. This does not mean that there is an epidemic of such cases but each one destroys trust both in the science system itself and between scientists. Most agencies concerned with science have taken action to deal with these problems and develop best practice. The ESF statement which follows and the report on which it is based reflects the very large amount of work which has already been undertaken by our Member Organisations. Although we may have overlooked some activities, nevertheless, I trust that this report will help in the ongoing actions necessary to develop and further improve good research practice across Europe. This report is not the end of such efforts. Further developments in the way in which science is conducted are inevitable in a rapidly changing world and there will always be a need to update and refine our approaches and this calls for ongoing action. ESF hopes that this may be carried out in close partnership with other European organisations representing institutions such as academies of sciences and the universities. Finally, I should re-iterate that the public must have confidence in the conduct of science. We in ESF and our Member Organisations are determined that only the highest standards should prevail.

Enric Banda
ESF Secretary General

ESF statement

Good scientific practice in research and scholarship is essential for the integrity of science. It sets internationally valid benchmarks for quality assurance, which enable replication and further studies by other scientists. And it provides safeguards against scientific dishonesty and fraud. Good practice, thus, nurtures trust within the scientific community and between science and society, both of which are necessary for scientific advance.

Several European Science Foundation (ESF) Member Organisations and some individual research institutions and universities have already published guidelines, or codes, for good scientific practice across the full range of the natural and social sciences, engineering and the humanities. However, to be fully effective, such codes have to be more widely adopted by European universities and research institutions, observed by all researchers and scholars and monitored for compliance. Both institutional and individual commitment are prerequisites.

Procedures for investigating allegations of scientific misconduct complement codes of good scientific practice. Such investigations are commonly carried out at local (institutional) level, with guidance and oversight by national bodies. Some countries, however, prefer to carry out investigations at national level.

To achieve full compliance, and thus demonstrate effective self-regulation, the various players – national academies and research funding agencies, universities and research institutions employing scientists and the scientists themselves, each has distinctive advisory, managerial or regulatory responsibilities.

ESF, with its two sets of stakeholders firstly, (its membership drawn from funding agencies, national research organisations and academies of sciences and letters and, secondly, the research community at large) is uniquely placed to play a significant role in promoting the highest levels of scientific integrity and better self-regulation across Europe. At a strategic level, there is a need for more commonality in codes of good scientific practice, in the effective managing and monitoring of those standards and in developing transparent procedures for investigating allegations of scientific misconduct. Pan-European progress in these areas would improve quality assurance, strengthen the self-regulation of science and help reinforce public trust in science. Therefore, ESF believes that the following conclusions and recommendations set out a basis for further action at European level on this important topic:

1. **Both the globalisation of science, with its extensive inter-organisational and international collaborations, and current public concerns about self-regulation underline the need to extend and harmonise codes of good scientific practice and procedures for investigating allegations of scientific fraud.**

2. **European scientific institutions are responding, though somewhat unevenly, to these pressures and are addressing the moral issues of scientific ethics and integrity and the more practical matters associated with self-regulation.**

3. **With its extensive membership in 23 countries, the ESF is uniquely placed to play a pan-European role in promoting common approaches amongst its Member Organisations for managing and regulating good scientific practice.**

4. **The current debate about a *European Research Area* introduces a favourable political dimension and creates a window of opportunity for action.**

5. **At a strategic level, there are several possible initiatives which need to be taken, at a European level, to strengthen approaches to scientific integrity and good scientific practice across Europe. Some of those listed below are purely advisory; others require a more active intervention.**

ESF commits itself:

- **to support and promote vigorously the concepts and principles of good scientific practice in research and scholarship; and**

- **to promote the principle that the selection of scientists by academic institutions should be transparent, based primarily on criteria of scientific quality, creativity and promise, without discrimination on grounds of sex, race, political opinions or cultural backgrounds.**

ESF considers that a number of other actions are necessary. In taking action, it is vital that the approach is inclusive and sensitive to what has already been achieved by many of the ESF Member Organisations and other European organisations and by relevant international developments carried out by International Council of Scientific Unions (ICSU) and other similar bodies. Real progress will require linkages with these initiatives. And it is important that the goal of harmonising policies and procedures on the basis of best practice should be achieved without compromising the principle of subsidiarity in matters of executive action.

Therefore it is recommended that:

- **ESF Member Organisations that are national academies should draw up national codes of good scientific practice in research and scholarship, where these do not yet exist; and**

- **ESF Member Organisations that are national academies should initiate discussions on the most appropriate national approach to procedures for investigating allegations of scientific misconduct (where this has not yet been done), whether by means of an independent national body (as in Denmark), formal procedures in each university and research institution, or by other means.**

- **ESF Member Organisations that are research-funding agencies should consider ways of making an institution's eligibility to apply for research grants conditional on that institution having adequate policies for good scientific practice and procedures for investigating scientific misconduct.**

- **ESF Member Organisations that employ scientists should act as responsible employers with clear, fair and robust guidelines for good scientific practice, coupled with effective and transparent management procedures for implementing these guidelines and for investigating allegations of scientific misconduct.**

Finally, it is important to consider whether there is a need for any pan-European structures to reinforce national arrangements, for example, by maintaining a college of eminent scientists who might serve on local or national committees investigating scientific misconduct, or by setting up an Ombudsman system to provide a third party for counselling "whistleblowers" in the scientific community. Consideration of such issues will need to involve not only ESF and its Member Organisations but also other relevant European organisations, including those representing the universities.

Introduction

The nature of research and scholarship

1. Scientific research and scholarship are diverse and multifaceted activities embracing a wide range of intellectual and practical endeavours. These include theoretical studies, experimental work and surveys, as well as the verification, further analysis and extension of earlier work. The objective is always to extend human knowledge and our understanding of the physical, biological and social worlds.

2. Progress in science depends on trust. Scientists must have confidence in the results of other scientists. Also, society has to trust the honesty and motives of scientists and the integrity of their results. Much of the current disillusionment with science in Europe is due to a loss of public trust.

3. To regain and retain public trust, it is vital that the ethics and integrity of science are beyond question. Good practices in the design, conduct, interpretation and reporting of scientific research and scholarship are the gatekeepers of integrity. They are the prerequisites of mutual trust within the global scientific community and of greater trust between scientists and the public. Where there is a climate of trust, the results of science are more likely to be accepted, exploited or applied, for the benefit of humankind.

Self-regulation

4. Science has had a tradition of informal self-regulation to ensure that the highest professional standards of integrity are maintained. Over the past 20 years several trends in the increasingly complex world of science, however, have strained the traditional, low-key approach to self-regulation.

5. Greater competition between scientists for scarce research and scholarship funds and the emphasis on publications as measures of performance have put pressures on scientists to produce results quickly, in turn creating temptations to short-cut proper procedures. Senior researchers and scholars sometimes have insufficient time to involve themselves personally in the day-to-day conduct of the various investigations they may be directing. The greater weight that some public funding agencies attach to the utilitarian value of science, too, has sharpened the focus on outputs, as well as challenging traditional academic values of freedom of thought and action.

6. The ethical issues always inherent in social science and clinical research, where people are the subjects, and increasingly posed by advances in biomedical and biotechnological research, have added to the problem. In today's more inclusive society, these issues are now widely held to be too important, at best, to be left to informal and private debate within the scientific community, or, at worst, neglected by scientists. Last, but not least, self-regulation has been damaged by several well-publicised allegations and some proven cases of scientific misconduct and fraud.

7. All this has turned a spotlight on issues of scientific integrity and professional standards, and put pressure on the scientific community to strengthen the process of self-regulation and make it more visible.

Principles of scientific integrity

8. Scientific integrity is at the heart of the trust on which scientific communication and collaboration depend. Scientific integrity demands that those engaging in research and scholarship should at all times, and without exception, adhere to the following basic principles:

- highest professional standards in designing and conducting investigations
- a critical, open-minded approach in conducting research and scholarship and in analysing data
- frankness and fairness with regard to the contributions of partners, competitors, and predecessors

- absolute honesty at all stages in scientific enquiry, in particular, avoiding:
  - any form of fraud, such as fabricating or falsifying data or records;
  - piracy or plagiarism;
  - sabotaging the work, records or protocols of other scientists;
  - breach of confidence as a reviewer or supervisor, and
  - complicity in such actions by fellow scientists.

To retain professional and public trust, it is vital that all scientists accept personal responsibility to uphold these fundamental values.

Good scientific practice

9. Good scientific practice embraces all the procedures and practices that are necessary for planning, conducting and reporting research and scholarship within a framework of scientific integrity. By providing a common currency, good practice facilitates the vital, external processes of peer review, verification and repeatability. This enables other scientists to judge the validity of new contributions to knowledge and understanding. Standard methodologies for collecting and interpreting information also reduce the individual bias that might be introduced, perhaps unwittingly, by a scientist's personal background and values. And the audit trail created by good scientific practice provides quality assurance and a valuable buttress against scientific misconduct and fraud.

10. To be effective, good scientific practices have to be made explicit in written guidance or codes. There also have to be managerial procedures for implementing them and monitoring processes to ensure compliance. European universities and research institutions are increasingly introducing these measures.

11. The main components of good scientific practice are described in paras. 18-50, along with brief accounts of the present position in selected countries.

Scientific misconduct

12. Allegations of scientific misconduct and fraud first attracted major public and political attention in the USA, where there were several well-publicised cases in the 1980s. Some of these cases led to litigation. Although a few prominent cases may have attracted disproportionate publicity, it was difficult to deny the conclusion that self-regulation of science, based on traditional approaches to instilling values of scientific integrity, was not sufficiently meeting heightened public and political expectations.

13. In response, the US National Academies of Science established a Panel on Scientific Responsibility and the Conduct of Research to review scientific misconduct. In 1992-3 the Panel published a defining two-volume report *Responsible Science: Ensuring the Integrity of the Research Process.*[i] Volume II contains guidelines for good research practice and for handling allegations of scientific misconduct.

Ethical and responsible science

14. The moral dimensions of the sciences and the ethical and social responsibilities of scientists are themselves the subject of academic study and debate. These topics are developed, for example, in two collections of essays published under the patronage of the Confederation of Swiss Scientific Academies [ii] [iii] and

books and articles by authorities such as Professor John Ziman FRS.[iv] There is now an international peer-reviewed journal, founded in 1995, devoted to ethical issues of direct concern to scientists and engineers.[1] These studies, however, go beyond the scope of current review.

15. The growing concern about the ethics of science is also reflected in the creation of high-level fora by the International Council of Scientific Unions (ICSU) [2] and by UNESCO,[3] by the agenda of the joint ICSU/UNESCO World Conference on Science in Budapest in 1999, and more recently by a working group report on the Misuse of Science, presented to the 50th Pugwash Conference in Cambridge, UK in August 2000.

The present position

16. Generally speaking, the global scientific community is responding positively, though too slowly in the opinion of some scientists, to the concerns and expectations of society. Questions of scientific integrity, high professional standards and public trust are high on scientists' agendas. Several national, European and international bodies [4] have taken initiatives designed to raise awareness of the ethical dimension of science, to encourage good scientific practice, and to set procedures for investigating allegations of scientific misconduct. All this is helping to strengthen the processes of self-regulation.

17. However, one senses a lack of unanimity in the European scientific community, at both institutional and individual levels, on the extent to which new measures are needed and on the pace of their introduction. There is a clear opportunity for the ESF to exercise leadership by co-ordinating further developments in the European arena.

Good scientific practice

Introduction

18. In the late 1980s, biomedical research witnessed some of the first initiatives in codifying good scientific practice and establishing procedures for dealing with misconduct. By mid-2000 a good deal of progress has been achieved by individual European research organisations. Several of the more significant developments are summarised below.

19. In the mid-1990s the UK Medical Research Council (MRC) produced a series of reports on the ethics of biomedical and clinical research, on good scientific practice and on procedures for inquiring into allegations of scientific misconduct. The MRC has recently published updated guidelines on good scientific practice that could serve as a general model for biomedical research.[v] Other UK research councils have now produced their own guidelines of good scientific practice.[vi]

20. Stimulated by a well-publicised case of scientific misconduct in Germany – the Herrmann/Brach affair, the Deutsche Forschungsgemeinschaft (DFG) in Germany appointed an international Commission, *Selbstkontrolle in der Wissenschaft,* to:

- explore causes of dishonesty in the science system
- discuss preventative measures
- examine the existing mechanisms of professional self-regulation in science.

21. The Commission presented a comprehensive report in late-1997 with an analysis of the issues along with 16 recommendations covering principles and operation of good scientific practice as well as procedures for investigating allegations of scientific misconduct.[vii] These recommendations would provide an excellent basis for developing a set of common European standards.

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[1] *Science and Engineering Ethics*.

[2] The Standing Committee on Responsibility and Ethics in Science (SCRES; created in 1996).

[3] World Commission on the Ethics of Scientific Knowledge and Technology (created in 1998).

[4] For example the Comité d'éthique pour les sciences (Comets) of the Centre National de Recherche Scientifique (CNRS) in France; the All European Academies (ALLEA) and the European Union in Europe; the ICSU and UNESCO internationally.

22. By mid-2000, 13 German universities had finalised their rules on good scientific practice, in line with the Commission's recommendations, and work was in progress in another 17 universities.

23. In France, a Working Group on scientific integrity recommended in 1998 that the Institut National de la Santé et de la Recherche Médicale (INSERM) should actively promote good laboratory practice in its units, building on existing legal requirements for clinical research. The Working Group also recommended that the organisation should have formal principles and procedures for dealing with allegations of scientific fraud.

24. The INSERM Working Group noted that, to be most effective, good laboratory practices and procedures for investigating allegations of fraud require some harmonisation between the various universities and research organisations in France, especially when research was being undertaken collaboratively. Looking wider, the Working Group envisaged that the ESF might seek to harmonise ethical codes and good practices at a pan-European level.

25. On handling allegations of serious misconduct, the Working Group argued that there should be a degree of independence (from INSERM) amongst the investigating experts and suggested that, longer term, the ESF should create a college of scientists who could serve as independent experts, on a case-by-case basis, in investigations of scientific fraud allegations anywhere in Europe.

26. In accord with the Working Group recommendation, INSERM has now produced a comprehensive code of good practice in conducting biomedical research. It is in an attractive format suitable for distribution to all its researchers.[viii]

Scope of codes of good scientific practice

27. Though the details will vary to meet the requirements of particular disciplines and national circumstances, guidelines for good scientific practice should cover the following key areas, which are elaborated in the following paragraphs:

- designing and conducting research and scholarship, including documenting and analysing the data or findings
- accumulating, storing or archiving data
- publishing the results of research and scholarship
- protecting intellectual property (IP)
- training, development and mentoring of young scientists
- appointing academics and other researchers.

28. Several codes of good practice have been built around a core of legislative requirements for health and safety in the workplace, the use of human beings and animals in research, environmental protection, data protection and individual privacy.

Design and methodologies

29. All research should be designed so that it has a clear objective, either answering a valid scientific question or, in scholarship, adding to the understanding of an event, individual, concept or phenomenon. The design of the study must be robust, the procedures proposed technically feasible and the intended methods of analysis appropriate.

30. Protocols and plans should, therefore, be written in clear and unambiguous terms. They should include specific details of the aim, materials, methods, time schedules and analytical approaches to be used. Unambiguous and fully documented protocols are not only necessary for those conducting the research, but also for those who may wish to assess or replicate the work at a later date. It is essential that all

participants in the research accept responsibility for these crucial initial steps.

31. Throughout the conduct of research all participants must keep clear and accurate records on a daily basis of the procedures followed and the results obtained. Particular attention should be paid to the completeness, integrity and security of these records. Those conducting the research should authenticate their findings by signing the records at the end of each day's work. These records must be kept securely in paper or electronic format. The aim is to provide a continuous and verifiable record of good scientific practice.

32. Research in the humanities and social sciences often involves interactions with people. In these circumstances, private citizens have a right to be protected against unethical interference in their personal lives. The Swedish Council for Research in the Humanities and Social Sciences has published a code of ethical principles[ix], which sets our four key requirements for such research, as follow:

- to inform individuals about all aspects of the proposed research
- to secure their voluntary agreement to participate – the principle of 'informed consent'
- to handle and store personal information under conditions of the highest possible confidentiality
- to use such information exclusively for the purposes of the research.

33. The balance between protecting the individual and allowing genuine researchers to access data is, however, a delicate one. Guidelines should be sufficiently flexible to allow legitimate replication and even secondary analyses of valuable (and costly) data sets to address new, and quite possibly unforeseen, research questions. Such an approach actually reduces the need for new data collection and social surveys – a point that has been acknowledged by data protection commissioners.

34. The UK Economic and Social Research Council (ESRC) has produced a draft policy statement and guidelines for the social science community designed to maximise the benefit of social data to the community while protecting the interests of the data subjects.[x]

35. The French Institut de Recherche pour le Développement (IRD) has recently initiated a debate [5] on a professional code specifically for development research. It is seeking to determine whether there are special factors concerning scientific conduct in co-operation-based research for development, bearing in mind the vulnerability of partner countries in terms of their political, social and cultural characteristics, as well as their human and material resources.

Data accumulation, handling and storage

36. Data are produced at all stages in experimental research and in scholarship. Data sets are an important resource, which enable later verification of scientific interpretation and conclusions. They may also be the starting point for further studies. It is vital, therefore, that all primary and secondary data are stored in a secure and accessible form.

37. Institutions must pay particular attention to documenting and archiving original research and scholarship data. Several codes of good practice recommend a minimum period of 10 years, longer in the case of especially significant or sensitive data. National or regional discipline-based archives should be considered where there are practical or other problems in storing data at the institution where the research was conducted.

[5] At http://www.ird.fr/fr/inst/ird/debat/en_remarq.shtml

Publishing the results of research and scholarship

38. Publication in a peer-reviewed journal or as a scholarly book is an important stage in the scientific process, marking the point when data, theories, interpretations and paradigms formally enter the public domain. The right to authorship of publications derives solely from a creative contribution to the work in question. In the case of joint authors, each should have made a significant contribution to the creative or analytical process and each has to accept shared responsibility for the content of the resulting article or book. The practice of honorary, or "ghost", authorships is inconsistent with these principles and with good scientific practice.

39. Authorship brings further responsibilities. In particular, authors need to provide accounts of the materials and methods and of any analytical and statistical techniques they used in sufficient detail to enable the reader to judge the validity of the approaches adopted and, if so desired, to replicate the analysis. Authors must also be honest and frank in referring to earlier work, acknowledging the intellectual contributions of other scientists and declaring any potential conflicts of interest.

40. Scientific journals, too, have responsibilities. They should make it clear in their guidelines that they are committed to best international publishing practice. Generally accepted rules have been drawn up and the majority of high quality publications adhere to them. In particular, reviewers and members of editorial boards should be required to declare actual or potential conflicts of interest. Moreover, the membership of such boards and the names of those who serve as expert referees should be published on a regular basis. Many publishers have also issued clear guidelines for authors.

41. Many in the scientific community share their ideas and data freely with colleagues as their thinking proceeds - through discussion, correspondence or at scientific meetings. Any subsequent exploitation of information gained through these informal contacts, without the direct involvement or the explicit approval of the originator of the ideas, amounts to infringement of the proprietary rights of the scientist concerned.

Protection of IP

42. Research workers have a duty to ensure that intellectual property arising from their work is properly safeguarded. This requires them to keep thorough, accurate and contemporaneous records of the steps leading to their discovery. It is important they understand that their records may have to stand up to legal challenge. It is also vital that they avoid public disclosure before patent protection is achieved. Laws on disclosure vary significantly between Europe and the USA.

43. Scientists have a further duty to ensure, insofar as is possible, that their research and scholarship should be developed for the benefit of the community. This may involve assigning or licensing the IP to industry or commerce if a product needs to be developed and marketed.

Training, development and mentoring of young scientists

44. The training and development of young researchers is an important responsibility of all those in science. These activities should not be limited to providing the technical skills necessary to enable them to conduct their research and become independent investigators. Training must also inculcate the core ethical standards and norms of science, as well as principles of best scientific practice.

45. In the past, young scientists have learned these values and norms informally, by working alongside

senior scientists and by mentoring. Such approaches were supplemented by occasional publications that offered general advice; for instance Sir Peter Medawar's book *Advice to a Young Scientist.* [xi]

46. With the pressures of today's world, greater formality is needed to help young scientists understand the importance of scientific integrity and to adopt good scientific practices as early as possible in their careers. Some universities now routinely provide short courses on these issues for their graduate students. In 1989 the US National Academy of Science published a booklet *On Being a Scientist: Responsible Conduct in Research,* which described the ethical foundations of scientific practice and some of the professional issues and dilemmas that scientists might encounter. It was addressed to junior research workers, and some 200,000 copies were distributed to graduate and undergraduate students.

47. An expanded second edition was published in 1995, jointly by the National Academy of Sciences, the Institute of Medicine and the National Academy of Engineering.[xii] Although it is written for American readers, the principles and values it describes are universally valid. The booklet could be of value throughout Europe.

48. On the question of mentorship, the DFG Commission advised that it is good practice for graduate students to be associated with two experienced scientists in addition to their formal supervisor, one of whom should be chosen by the student. This arrangement would create a safety valve for mediating in any conflict situations, on scientific practice or other matters, which might arise.

Academic and other scientific appointments

49. Advances in science are the result of free, creative thinking by individual scientists. When recruiting to scientific posts, academic and related institutions should put a high premium on scientific excellence, creativity and potential as selection criteria.

50. Appointment procedures for scientific positions should be transparent, with the selection criteria clearly publicised in advance and adhered to during the selection process. The procedures should also be socially inclusive, aiming to address deficits of under-represented social groups. Under no circumstances should political or any other external influence be applied to press the appointment of particular candidates.

Managing good scientific practice

Introduction

51. Scientists have a moral duty to maintain the highest standards of integrity without the imposition of external controls and the threat of sanctions. Nevertheless, in today's world the sensitivity of the issues involved in scientific integrity underline the need for the scientific community to be seen to be regulating itself. Hence the importance of scientific institutions having formal and transparent procedures for managing and monitoring their policies of good scientific practice.

Responsibilities of institutions

52. It is primarily the responsibility of individual universities and research institutions to develop practical rules for good scientific practice for the scientists they employ. The need to establish clear and robust institutional policies is a central recommendation of most recent reviews of scientific integrity – for example, the DFG Commission.

53. Institutional policies for good research practice must incorporate and reinforce any existing civil legislation or codes of practice concerning, for example, the use of animals in scientific experimentation, human patients in biomedical research and the use of surveys in the social sciences.

54. The rules will affect individual scientists and it is important that universities and research institutions formulate their rules of good scientific practice in a democratic manner that involves their professional members of staff. Once agreed, these rules should be widely publicised [6] and made binding on all members of an institution, if necessary through terms and conditions of employment.

55. Universities and research institutions need to have appropriate management structures and procedures to implement their codes of good scientific practice, including mechanisms for:

- delegating responsibilities for direction, supervision, conflict resolution and quality assurance within their management structures, taking into account the size of each scientific unit
- maintaining an effective management audit trail to verify these procedures
- appointing mediators to whom scientists can turn in conflict situations, including cases of suspected scientific misconduct
- investigating allegations of scientific misconduct
- incorporating the principles and rules of good scientific practice into teaching curricula and the education of young scientists and scholars.

Responsibilities of research groups

56. Institutions should delegate to individual departments, research laboratories and groups the responsibility to adopt good scientific practice and to operate within institutional policy frameworks at all times. These operational groups must develop mechanisms, appropriate to their particular discipline and situation, for ensuring compliance with good practice. In particular, there need to be mechanisms for monitoring methodologies, data records and notebooks and checking the integrity of audit trails. Responsibility for compliance monitoring is best assigned to an experienced member of each research group.

57. At a more philosophical level, there is a responsibility on the heads of schools, departments and research groups and their senior colleagues to create a climate in their groups or units that encourages all to aspire to the highest professional standards in the conduct of their research and scholarship.

[6] A good, recent example of an institutional code is the *Code of Good Scientific Practice* (in the field of Health and Life Sciences) published jointly in July 2000 by the Universitat Pompeu Fabra and the Institut Municipal d'Investigació Mècida, Barcelona.

Responsibilities of individual scientists

58. Recently, there have been suggestions that the intrinsic moral responsibility of scientists to work with absolute integrity might be reinforced if students were to make pledges at their graduation, along the lines of the Hippocratic Oath in the case of medical graduates. Some professional bodies and institutions already do this for their members. The idea would be to extend the approach to the generality of scientists, irrespective of their discipline, at the time of graduation. The support and co-operation of universities would clearly be essential.

59. Such a proposal was discussed at the Budapest World Conference on Science in 1999 and is now being followed up in Europe and in the USA. Some members of the scientific community, however, strongly oppose the idea as impractical.

Leadership by national academies

60. National academies are well placed to provide leadership in the pursuit of scientific integrity and good practice. They are often the most appropriate independent body to establish and support a national committee for scientific ethics and to nominate independent experts to panels investigating cases of alleged scientific misconduct. Those academies that employ scientists have the added responsibility of formulating and managing their own guidelines and codes of practice.

The role of research funding agencies

61. Research funding agencies have a particular opportunity to demonstrate leadership in promoting high standards of scientific integrity. As a condition of their research grants they can oblige institutions and principal investigators to adhere to good scientific practice in the conduct of research and scholarship and to make the results and data collections available, for example by archiving. Some research funding agencies have already gone further. In the USA, as a precondition for accepting research grant applications, the National Science Foundation (NSF) and the National Institutes of Health (NIH) require all submitting universities and other research institutions not only to have in place rules for good scientific practice, but also procedures for handling allegations of scientific misconduct. The DFG Commission recommended a similar approach for Germany.

62. By the same token, funding agencies, research councils and foundations have a duty to set an example by the probity of their research appraisal processes. It is essential that their operating policies and practices be characterised by equity, integrity, confidentiality and transparency. Some have published guidelines.[7]

63. Confidentiality requires that all those who assess or administer applications for research funds should not pass privileged information to others and should take all necessary steps to ensure that it is stored securely. They must be required to treat the research proposals they review confidentially and to disclose any conflicts of interest. This extends to those who contribute to the review process by acting as external referees.

64. Considerations of openness or transparency require that the procedures used by research funding agencies should be published, including the criteria that peer reviewers will apply. The names of their advisory committees, as well as those who carry managerial and administrative responsibilities, should also be publicly available.

[7] For example, the Czech Academy of Sciences, the UK Medical Research Council, and the Swedish Research Council for Engineering Sciences.

The contributions of learned and professional societies

65. Learned and professional societies in science have traditionally prepared guidelines of professional standards for their members, particularly in areas with obvious ethical considerations. The DFG Commission encouraged scientific learned societies to be more active in this area.

Contract research

66. The guidance provided by codes of good scientific practice is equally applicable to contract research funded by commercial sponsors, governments or official agencies. Certain tensions do, however, arise from time to time when research projects are carried out under contract. These frequently relate to the ownership and exploitation of intellectual property and to publication arrangements, which should be clearly addressed and agreed before a contract is finalised.

67. Some government and commercial research customers now expect research organisations to have acquired formal accreditation, such as ISO 9000, as a measure of quality assurance, and may restrict their competitive tendering processes to accredited organisations.

A pan-European approach

68. In early 2000 the European Commission adopted a policy paper by the Commissioner for Research, Training and Development entitled *Towards a European research area*.[xiii] The paper was designed to stimulate a debate about the need for, and ways of achieving, a better overall framework for research in Europe.

69. On scientific ethics, *Towards a European research area* [8] argues that there should be stronger links between ethics committees established at national and European levels. The ethical criteria and rules adopted in national and in European research programmes should be compared with a view to alignment around common principles, while respecting differences in sensitivities and opinions between member states. The paper concludes that the process of spreading best practice would be enhanced if the various national committees included experts from other European countries.

70. Though primarily concerned with scientific ethics, these observations are equally relevant to the policies and management practices needed to achieve more uniform standards of good scientific practice across Europe.

[8] Section 7.2

Investigating allegations of scientific misconduct

Introduction

71. Major incidents of scientific dishonesty are uncommon, but they do cause considerable concern when they do occur. They not only call into question the data reported, but also undermine public confidence in science and the mutual trust between scientists. The Herrmann/Brach affair is still reverberating in Germany. And as recently as August 2000, a principal author had to retract a molecular biology paper already published in *Science*, after peer review, because a co-author had admitted altering gel records and other data.[xiv]

Formal procedures

72. The primary responsibility for establishing a procedure for investigating allegations of malpractice rests with each university and research institute where research is carried out. Preliminary enquiries should normally be carried out in that institution. It is also the responsibility of each institution to ensure that its entire staff are aware of what constitutes misconduct and that its investigating procedures are properly publicised.

73. Whatever the source of an allegation of scientific misconduct, it is essential to ensure that justice is done, and is seen to be done, to the complainant and to the accused. *Bona fide* complaints must be pursued with integrity, in confidence and without detriment to the complainant. Equally, staff who are the subject of such allegations are entitled to expect that their work will be regarded as honest unless proved to be otherwise, and that they will be protected against ill-founded, frivolous, mischievous or malicious allegations.

74. With these considerations in mind, the following general requirements, largely based on the recommendations of the DFG Commission, should be included in all procedures for investigating allegations of misconduct:

- a definition of categories of action that seriously deviate from good scientific practice and which are held to constitute scientific misconduct
- jurisdiction, rules of procedure (including rules for the burden of proof), and time limits for preliminary and substantive investigations designed to ascertain the facts
- the rights of the involved parties to be heard, and rules for the exclusion of conflicts of interest
- the confidentiality of investigations, though if there is conflict between the need for confidentiality and the need to seek the truth, the latter must prevail
- the range of available sanctions, which should be related to the seriousness of any proven misconduct
- the jurisdiction for determining sanctions.

Local and national investigations

75. In the USA, the two main public research-funding agencies, the NSF and the NIH, have established permanent offices to maintain the integrity of their science programmes - the NSF Office of Inspector General (OIG) and the NIH Office of Research Integrity (ORI). However, the primary responsibility for dealing with allegations of scientific misconduct rests with institutions. The federal bodies, OIG and ORI, are there to provide policy guidance and technical assistance to those institutions and to perform a review and oversight function. Since it was formed in 1992, ORI has logged more than 1,500 allegations of misconduct in public health and biomedical research. About 20% required a formal inquiry. Misconduct has been proved in about 100 cases – about 6% of the original allegations.

76. Apart from in Scandinavia, the European approach is also to investigate allegations locally – by the university or research institute where the alleged misconduct took place. In most countries this is done without the oversight of national bodies like the ORI in the USA. Several research bodies [9] have issued regulations for dealing with allegations of scientific misconduct in their research institutions.

77. The approach in Scandinavia is the main departure from the prevalent European practice of investigations being undertaken at institutional level. The Danish Medical Research Council founded the Danish Committee on Scientific Dishonesty in 1992, initially to investigate allegations of fraud in biomedical research. The Committee now works under the Danish Research Ministry and covers the full range of scientific disciplines. The Danes believe that centralising the investigation introduces an important independent element at the outset and overcomes any inhibitions that universities might have in investigating one of their own scientists.

78. Other Nordic countries have largely followed the Danish model of an independent committee of investigation, but they generally allow local institutions to conduct preliminary investigations. For example, the Research Council of Norway established a National Committee for the Evaluation of Dishonesty in Health Research in 1994. As well as investigating cases of alleged scientific dishonesty, the Committee promotes measures to prevent dishonesty in health research. To date the Committee has investigated nine cases.[xv]

79. In early 1999, a Parliamentary Commission in Sweden made wide ranging recommendations in a report *Good Practice in Research* designed to increase public oversight of the research system, including setting up a national commission to deal with cases of alleged scientific fraud.

Appeals

80. Natural justice requires that arbitration and appeal arrangements are available. Responsibility for establishing such a facility might be undertaken by national funding agencies and/or professional bodies. Arrangements for access to arbitration and appeal mechanisms must be available equally to employing authorities, complainants and those who have been the subject of allegations of misconduct.

Ombudsman

81. To address the dilemma facing scientists who have doubts about the conduct of other, possibly senior, scientists, the DFG Commission recommended the creation of a national Ombudsman (or a small committee). Its mandate should be to advise and assist scientists and scholars in questions of good scientific practice and its impairment through scientific dishonesty, and to give an annual public report on its work.

82. A mediating person or committee of this sort could become a trusted third party to whom scientists would turn with their problems. It would alleviate the isolation that potential "whistle blowers" experience and could provide wise counsel not available locally. The Ombudsman could take up matters judged to be of serious concern with the university or research institute in question. But he or she would not have a mandate to investigate alleged misconduct. In addition to its intrinsic benefits, setting up a mediating authority along these lines would send a clear message to the public and politicians that science is taking self-regulation seriously.

83. The DFG Ombudsman, in fact a three-person committee, has been active for a year or so and has made its first report to the DFG Senate.

[9] Including the Medical Research Council (UK) and, in Germany, the Max Planck Gesellschaft and the Herman von Helmholtz Gemeinschaft.

Bibliography

[i] *Responsible Science: Ensuring the Integrity of the Research Process*. Report of a Panel on Scientific Responsibility and the Conduct of Research. (Two volumes.) National Academy Press, Washington D C, USA. 1992 (Volume I) and 1993 (Volume II).

[ii] *Scientists and their responsibilities*. Eds. W Shea & B Sitter-Liver. Watson Publishing International. Canton, Maine, USA. 1989.

[iii] *The Responsible Scholar. Ethical considerations in the Humanities and Social Sciences.* Eds. G Berthould & B Sitter-Liver. Watson Publishing International. Canton, Maine, USA. 1996.

[iv] *Why must scientists become more ethically sensitive than they used to be?* J M Ziman FRS. Science, Vol. 282; p. 1813 [4 Dec] 1998.

[v] *Principles of Good Research Practice*. Medical Research Council (MRC). London. 1999.

[vi] *Safeguarding Good Scientific Practice*. Biotechnology and Biological Sciences Research Council (BBSRC). Swindon, UK. 1998.

[vii] *Recommendations of the Commission on Professional Self-Regulation in Science*. Deutsche Forschungsgemeinschaft (DFG). Wiley–VCH. 1997.

[viii] *Les bonnes pratiques de Laboratoire*. Institut national de la santé et de la recherche médicale (INSERM). Paris. 1999.

[ix] *Ethics*. Swedish Council for Research in the Humanities and Social Sciences. Stockholm. 1990.

[x] *Copyright and Confidentiality*. A report to the Economic and Social Research Council by Allen & Overy, London. 1998.

[xi] *Advice to a Young Scientist*. Sir Peter Medawar FRS. Harper & Row, New York, 1979.

[xii] *On Being a Scientist: Responsible Conduct in Research.* Second edition. National Academy Press, Washington D C, USA. 1995.

[xiii] *Towards a European research area*. P Busquin. Office for Official Publications of the European Union, Luxembourg. 2000.

[xiv] *Reflections on a Retraction*. Donald Kennedy. Science, Vol. 289; p. 1137 [18 Aug] 2000.

[xv] *Dishonesty in Health Research*. Report of the National Committee's work 1998. The Research Council of Norway. Oslo. 1998.

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