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# Integrity in Science: A Continuous Concern*

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At present research organisations, universities and academies are placing scientific integrity in the spotlight. And rightly so, as I hope to illustrate in this paper. Scientific integrity should and must be a continuous concern to all of us!

This applies notably to academies of sciences and humanities. Besides their task of *promoting* science by means of lectures, discussions and the exchange of people and ideas, and conducting of high-quality *research* in their own institutions or through research programmes under their auspices, academies also have an important *advisory* role to play. Issues bearing on ethical and social questions as they relate to scientific research occupy a special place in the domain of this advisory task.

This is not to say that the advisory role is limited to problems related to integrity. The following may serve as a guideline: The advisory task of an academy could have bearing on the following four types of problems:

- advice based on quality evaluations (of people, institutes or programmes),
- advice pertaining to questions of science policy (areas that need stimulus, the balance of natural sciences and the humanities, the fundamental-applied research balance etc.),
- advice in respect of political decisions to which scientific knowledge could make a contribution (global change, epidemics, crime, immigration),
- advice with regard to social/ethical issues that are linked to or generated by scientific research.

Within this fourth category of ethical problems in science we get to deal with what I have previously denoted (Drenth, 2002) as internal and external ethical problems. The *external* category of problems refers to questions such as:

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- What justifies the choice of the research topic? Is it worth knowing what we investigate?
- Is scientific research truly sufficiently independent (of clients, interested parties, sponsors)?
- How far does the researcher's responsibility extend in respect of what is being done with his results?
- Is there a need for 'no go' or 'go slow' decisions in certain cases on the ground of ethical objections to implications or consequences of insights generated by the research? One thinks of stem cell research, xenotransplantation, research into dangerous viruses, nuclear fusion or fission etc.

*Internal* social/ethical problems in science all refer to undesirable or unacceptable behaviour by scientists. The following are relevant:
- negligent behaviour in regard of human or animal research subjects,
- careless or inaccurate communication with the general public and the media,
- disregard of the rules of good practice when publishing, quoting and evaluating research, and
- violation of the norms of scientific integrity.

The next part of this paper shall concentrate on this type of internal unethical behaviour - the violation of scientific norms of integrity.

## Trust

Trust is the most important pillar on which science rests. Colleagues should be able to rely on the honesty of a researcher; honesty in describing the phenomena (s)he observes, in reporting how these have been analysed and interpreted, and in proper referring to other publications in the field. This applies also - and perhaps more so – to society in general. Users and interested parties (clients, patients, businesses, and social institutions) are far less able to verify the correctness and the quality of the conclusions and insights that the researcher presents than fellow researchers. If other scientists and the public at large can no longer give this trust, this would sooner or later mean the end of the usefulness and relevance of science.

How does science currently fare in respect of trust? On answering this question we encounter a curious paradox: On the one hand there is much - to the point of irresponsible - trust in science. Do dangers lurk through damage done to the ozone layer, depletion of fossil energy, reduction of the biodiversity, illnesses as a result of smoking, drinking, unsafe sex...? Science will no doubt present a solution, is often the carelessness incurring, but misplaced optimistic thought.

On the other hand, we also encounter an increasing scepticism. This manifests itself in the increasing interest that various pseudo-scientific theories, such as astrology, psychokinetics, neurolinguistic programming and telepathy enjoy, as well as in the growing popularity of unscientific, sometimes occult, practices such as reincarnation therapy, homeopathy, laying on of hands and hypnosis. Alarmingly, paranormal observations of UFOs, aliens and extra-terrestrials, corn circle makers and voices of the dead, too, are taken seriously by many. Even *anti*-scientific sounds are only too often heard from newspapers and other media, with scientific researchers being depicted as sly Mephistos or Frankensteins who eagerly and disrespectfully tinker with the secrets of life through their cloning or genetic manipulation.

How can one explain this growing scepticism and anti-science attitude? Firstly we could point to science's changing *social position*. Science has also encountered the currently applicable and justifiable need for public justification. Through this disclosure, inadequacies come to light - vulnerability being the price to be paid for transparency. Furthermore, society does not always sufficiently appreciate that science is an *evolving* process in which improvements of insights, adjustments of previous conclusions, and a continuous specification of contingencies are part of normal practice. Statements and conclusions of researchers can thus often be contradictory. Thirdly, in the empirical sciences, scientific assertions very often have a *probabilistic* character. This probability is either ontic (much random variation in the object), or epistemic (too many gaps in our knowledge, measures that are too unreliable). Society, however, wants certitude and does not know how to handle probability statements that are mistaken for doubt or ignorance.

Let us concede, however, that the negative attitude in respect of science has also been prompted by honest concern and even fear. Over the years a good deal of the power to be derived from knowledge has been transferred from an omniscient God to the scientists and scholars.

But have they proved capable of using this power in a responsible way? The blessings of scientific research are, of course, manifold. But do we not perceive, at best unintentional, dangerous consequences of scientific research? Nature, peace, the sharing of affluence, health, privacy..., have they all really done well in the current explosion of scientific knowledge?

But not to a small extent this anti-scientific movement can also be blamed on the scientific researchers themselves. They do not handle the media well, are vague or arrogant, don't sufficiently differentiate between personal opinions and scientific results, are careless in respect of animal experiments, or with human research subjects, cite incorrectly, argue about the sequence of authors' names.... or, most harmful of all, violate the norms of scientific integrity. More and more cases of fraud, swindling and plagiarism seem to be making headlines these days. The harm that each of these cases does to science cannot easily be overestimated.

## Scientific misconduct

Hard data on the occurrence of scientific misconduct are rare and also difficult to get hold of. Not only are researchers and their managers reluctant to hang their dirty laundry in public, but also is the line between bad or sloppy research and true misconduct not always clearly drawn, as we shall see below. Utter discretion is furthermore required; a scientific reputation is quickly harmed - harm that is very difficult to undo and that often proves to be 'fatal'.

And yet, as mentioned, an increasing number of unacceptable cases have recently been reported in the press: in my country there were the cases of a neurologist who fabricated data for an experiment that was paid for per case, of a psychologist who use dreams of text from an American colleague's work without citing him, of a biochemist who went to the press with insufficiently tested hypotheses on the treatment of Aids patients, of an environmental researcher who was forced to adjust certain for the sponsor disagreeable conclusions. Prior to this, authors such as Van Kolfschooten (1993), and Hulspas and Nienhuys (1997) had already unmasked a substantial number of cheats and swindlers. In one of his columns, the Dutch oncologist Borst speculated that while "out and out fraud' does not occur very frequently,

*tampering* with data does. He compared this with lower back pain - it is there but difficult to prove.

Inevitably, cases of scientific fraud have also been revealed in other countries and, it would seem, lately in growing numbers. Thus:

- last year Nature and Science comprehensively covered the infamous case of the fraud of a group of cancer researchers at the Max Delbrück Centre for Molecular Medicine in Berlin,
- two year ago (13-9-01) Nature examined a number of shocking cases of the theft of ideas by journal reviewers,
- the Times Higher Education Supplement (27-04-01) revealed that at least 19 review articles published in the highly esteemed 'New England Journal of Medicine' had been written by researchers who had secret financial links to the pharmaceutical companies that had brought the examined medicines on the market,
- at a recent conference of the Office of Research Integrity (ORI), a unit within the American government's Department of Health and Human Services, a number of case studies were presented, including the dramatic case of the Research Triangle Institute in North Carolina, where there had been a veritable 'epidemic of falsification'; employees simply fabricated whole batches of data,
- last year we were startled by two cases of fraud in very highly esteemed institutes: in the Lawrence Berkeley National Laboratory in California data had been concocted to reveal the discovery of a new element (element 118), and in the famous Bell Labs a similar case of data fabrication was reported to have occurred (the Schönland scandal, see Physics World, June 2002),
- Denmark is involved in a conflict involving the environmental researcher, statistician Lomborg, who seems to approach, and some would say cross, the permitted margin of the selective use of data in his book 'the Sceptical Environmentalist' (Nature 16-01-03),
- recently Nobel Prize winner Rolf Zinkernagel's Institute of Experimental Immunology at the University of Zürich was accused of the manipulation of data (Nature 20-02-03),
- the New England Journal of Medicine withdrew a submitted article, since a number of the co-authors were unaware that 'their' article had been submitted, and

- a few years ago this same journal described how the pharmaceutical industry lobby applied undue pressure on researchers who were intending to publish data that it found unwelcome (Deyo et al., 1997).

The above is a selection from the generally known cases of scientific misconduct, but, as Borst indicated, the fear that unnoticed far more fiddling with research data occurs, does not, unfortunately, seem unfounded.

Apart from that, it should be pointed out that scientific misconduct is a *universal* phenomenon that has *always* occurred. Descartes was accused of plagiarising Snellius and Beekman, and Darwin of 'borrowing' ideas from his fellow countryman Wallace. Even Einstein was accused by the mathematician Hilbert of stealing his ideas on the theory of relativity (an accusation that has, incidentally, been recently disproved by the Max Planck Institute in Berlin). Pons and Fleischman claimed success with the so-called cold fusion, which could never be confirmed, and Cyril Burt concocted his high correlation between twins' intelligence test scores to support his heredity hypothesis. Sometimes it was just a matter of stubbornness: Pauling defended vitamin C's ability to heal cancer despite all empirical evidence to the contrary, the Russian Fedjakin kept believing in his polywater and the Frenchman Blondot in his N-radiation.

## The nature of scientific misconduct

Thus far we have more or less lumped all forms of violation of scientific integrity together. In truth, however, we cannot tar them all with the same brush. What exactly do we mean when we talk about scientific misconduct? Anyhow we can distinguish the following three categories (see also Drenth, 1999):

First of all, *fraud*: This includes the fabrication of data, the falsification of data, the 'trimming' of the data (rounding off favourably, omitting undesirable data), and the selective use of data. In short, fraud implies tampering with data or with the presentation of data.

In the second place, *deceit*: This pertains to the deliberate violation of the rules of the methodically sound analysis and processing of data. For example, the suggestion that empirical data are available, when this

is not true, gross negligence in sampling, deliberately chosen improper but 'favourable' analysis techniques, and the deliberately incorrect or selective rendition of others' research results or conclusions. With deceit a colleague or reader is therefore explicitly lead up the garden path.

Thirdly, infringement of *intellectual property rights*: The best known example is plagiarism - the deliberate presentation of others' ideas, findings, research results or texts without acknowledgement or reference, as if they were those of the author him- or herself. But there are also other forms: the pinching of ideas from a doctoral student or colleague, claiming to be the sole author of research to which others had contributed, and a journal editor or reviewer claiming the thoughts or ideas originating from a reviewed (and rejected) article.

Two observations should be made at this point:

- Not all violations are equally serious. There is variation in the seriousness of misconduct both between and within the mentioned categories. The fabrication of data is more serious than 'rounding off' or making use of a too small sample. Plagiarising substantial pieces of text is more reprehensible than pinching an idea from a conversation between colleagues.
- Secondly, the border between unacceptable and (still somewhat) acceptable behaviour is not always easy to indicate. Where do you draw the line between verification on a too small sample and the illustration of an argument with 'case' data? Where lies the boundary between plagiarism and careless citation? Was an incorrect, but 'favourable' statistical technique truly chosen deliberately? Is it scientific fraud or a different methodology or even paradigm?

## Causes

To answer the question of what causes or fuels this corruption of science, three types of causal factors come to mind: Firstly the *pressure* from powerful persons or institutions that resist honest scientific analysis, because they are ill disposed towards or even strongly opposed to the results thereof. Historical examples vary from the Roman Catholic pressure on Gallileo to revise his heliocentric

conclusion to fundamentalist Christian and Muslim opposition to the theory of evolution.

Secondly, *economic* and *financial* motives. Economic interests in research into new medicines, technological innovation or patent-directed research can be substantial and can exert such unwarranted pressure. Here too recent history offers a series of striking examples, varying from the thalidomide tragedy to the subversive activities of medical researchers in the service of the tobacco industry, and from the Chernobyl disaster to the exploded NASA explorer. At this point it is perhaps appropriate to utter a word of warning in respect of contract research to universities and research institutes that are subsidised by the government. Research within universities and large institutes is increasingly dependent on contracts with industry, the government or interest groups. In principle this needn't be wrong. It is quite possible for contract research to be independent and unbiased and to be executed strictly according to scientific rules. But there is most certainly the danger of a tendency to curry favour with the client (even if merely to secure a continuation of the research). The English expression 'he who pays the piper calls the tune' is apt indeed. In their book '*De onwelkome boodschap*' [The unwelcome message] Köbben and Tromp (1999) reveal through a host of examples that this danger is far from unfounded.

Thirdly, the researcher's own *ambition* may not be omitted; an ambition fed by vanity, the desire for fame and recognition, and the prospect of personal gain. In itself scientific ambition is not reprehensible. Neither are tenacity and strong belief in one's own views or hypotheses. Without such motivations probably no important discoveries would be made nor Nobel prizes awarded. But here we refer to a dysfunctional craving for scientific fame that leads to behaviour that crosses the limits of what is admissible.

## Prevalence and prevention

As previous stated, there is not much to say about the frequency with which scientific misconduct occurs. Hard data on this subject are almost non-existent. We have also indicated that it is a universal phenomenon of all time. Yet, it is not unlikely that misconduct is on the increase. First of all for statistical reasons. The enormous increase in

the number of researchers will also inevitably lead to an increase in the absolute number of misconduct cases and the resultant negative press reports. But there is more: (especially young) researchers are under mounting pressure to achieve, to record results, to deliver output, to have articles published and to be cited. Tenure appointments, membership of research schools, research fellowships of academies or national research organisations, subsidies and grants, promotions and professorships - for all these desirable aspirations one needs research results and publications, preferably spectacular ones. Add to this the above-mentioned (real or perceived) pressure from sponsors of contract research and it will be clear that a dangerous climate in which scientists are tempted to engage in unacceptable behaviour arises.

Then the second word in the title of this section: prevention. Various procedures and rules are being devised in our country and others to cope with the dangers of scientific misconduct, as well as to develop proper procedures when such misconduct is suspected. Protocols, ombudsmen, confidants, science courts of arbitration and appeal, and various kinds of sanctions are suggested, all of which are very noteworthy and useful. But of the essence is the development of a matured scientific conscience and a basic sense of responsibility of the researcher him- or herself. This is of vital importance. And the development and nurturing of these values and responsibilities, rather than the fear of sanctions or the risk of being caught, will enable science to fight and prevent misconduct and fraudulent activities.

## The Academy's role

Finally, what role could an Academy of Sciences play in this? Above it was mentioned that this problem most certainly concerns the academy in its advisory role. In a modest survey among the European academies, all ALLEA members, almost common consent was expressed with an academy's vigilant, informing and often even judiciary responsibility. Also a recommendation of the European Science Foundation (2000) envisages an important task for academies in the formulation of national codes of good scientific practice and in the initiating of discussions on the most suitable national approach to this problem.

Obviously a good few things are already occurring which have been implemented or initiated by academies. The American National

Academy of Science has published a superior brochure 'On being a scientist' (NAS, 1989, 1995 2nd edition), the KNAW (Heilbron et al. 2000) in the Netherlands produced a booklet a few years ago that not only described the rules of good practice, but also presented a number of real or imagined (but realistic) cases of ethically unacceptable behaviour or ethical dilemmas, to be used as discussion material for the training of researchers. Many European academies have developed or published a Code of Science, or function as an advisory board or science court in ethical cases.

Yet some co-ordination within Europe would be useful without this meaning that uniform rules and procedures need to be developed for all European countries. With this purpose ALLEA has adapted a recommendation by the Royal Netherlands Academy of Arts and Sciences ('Notitie wetenschappelijke integriteit'), translated it into English and offered this 'Memorandum on Scientific Integrity' for the perusal of all ALLEA's member academies. This Memorandum urges the founding of a National Committee for Scientific Integrity (NCSI) that can serve as an advisory board or science court of appeal in those cases of violation of scientific integrity where the settlement by the (primarily responsible) management of the institute or university is found to be unacceptable to one of the relevant parties. In the Netherlands such a body (LOWI) has been founded by the Royal Academy in close consultation with the National Science Foundation (NWO) and the Association of Universities (VSNU). We keenly await its first activities. It is not ALLEA's intention to have this formula exactly copied by other European countries, but by offering this model it aims to stimulate the discussion on the most desirable approach, to stipulate a possible helpful role of Academies of Science, and, if possible, to co-ordinate a European approach to the phenomenon of scientific misconduct that can be so injurious for science.

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