SCIENCE, STEM CELLS, AND FRAUD

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The world of science was stunned, and the hopes of many people dashed, when Professor Hwang Woo Suk of Seoul National University was recently found guilty of massive scientific fraud. Until January 2006 he was considered one of the world's leading experts in cloning and stem cell research. Yet he was found by his own university to have fabricated all of the cell lines he claimed, in articles published in *Science* in 2004 and 2005, to have derived from cloned human embryos.

By the time he was exposed, Hwang had been given the title of leading scientist in Korea by his government. A postage stamp had been issued in his honour, showing a paralysed man leaping out of a wheelchair to embrace his lady love. Schoolchildren read specially produced stories of the indefatigable scientist who supposedly worked 365 days a year for the sake of saving humanity from disease and disability. When I spoke on the ethical wrongness of human embryonic stem cell research at a major conference in San Francisco in 2005, I overheard scientists – professors of high repute and excited graduate students alike – speaking in awed tones of the incredible technical skill that Hwang and his team were thought to have displayed. He told *Nature Medicine* that his dexterity was a cultural inheritance: "This work can be done much better in Oriental hands. We can pick up very slippery corn or rice with steel chopsticks."[1]

[1] Quote reported by *Wired News* at http://www.wired.com/news/medtech/0,1286,67599,00.html (accessed 19 Feb. 06).

The story of Hwang's disgrace is now well known, and so I will not go over any more details.[2] What will concern me in this article is the question of scientific fraud itself, and what it means for science's relation to society. Should the Hwang case be brushed aside, as some commentators have done, as a terrible incident but one that should not stop the onward rush of scientific progress?[3] Or is there a deeper malaise at the heart of contemporary science that needs to be addressed?

Let me begin with an evidently true assertion: the majority of scientists are not, as far as any one knows, cheats or fraudsters. No survey of the evidence has ever shown that they are. Over the years I have spoken to many scientists in diverse fields, all of whom have been people of professional integrity. Excellent, honest science is being done every day in universities all over the world, my own included. I discussed the Hwang case at length with a young American PhD student researching adult stem cells: she and, as she added, her colleagues, were appalled by the disgrace he had brought upon their profession. Having said this, however, I still believe there are serious systemic problems in much contemporary science. Perhaps even more disturbingly, some of the blame for this lies less with scientists themselves than with society at large.

Consider some of the evidence. In 2002, the famed Lawrence Berkeley National Laboratory in California had to fire physicist Victor Ninov, when it was discovered he was behind a fraud relating to their 1999 announcement that they had made the heaviest atomic elements so far synthesized. The

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[2] For Seoul National University's report on Hwang's fraud, see http://www.snu.ac.kr:6060/sc_sne_b/news/1196178_3497.html (accessed 19 Feb. 06).
[3] See for example the attitude of *Newsweek*, as reported and quoted by Wesley Smith in his article 'Wooed: The Media Hypes a Fraud', at http://www.nationalreview.com/smithw/smith200601170903.asp (accessed 19 Feb. 06).

original article, published in the leading journal *Physical Review Letters*, was retracted in 2001. Again, Jan Hendrik Schön, a physicist at Bell Laboratories in New Jersey, was fired in 2002 for having falsified data at least sixteen times between 1998 and 2001. He had been regarded as a star researcher in electronics, had published eighty papers in two years, and was hailed as a future Nobel Prize winner.

More generally, in a recent survey of 3,247 scientists, more than *one third* confessed to academic misconduct in the past three years – from falsification or plagiarism (1.5%), to failing to present data that contradicted their previous research (6%), to overlooking the use by others of flawed data (12.5%), and, perhaps most ominously, changing the design, methodology, or results of a study in response to pressure from a funding source (15.5%). The social scientists who carried out the study warned that overemphasis on high-profile cases was causing many more minor examples of misconduct to be ignored. They said the range of misconduct found was "striking in its breadth and prevalence."[4] In correspondence with *Nature*, a physicist working in industry claimed that some of the reported misbehaviour was standard practice in the private sector, and often not even considered ethically suspect![5]

The Office of Research Integrity, set up by the US government to investigate and monitor academic misconduct in public health research, claims that between 1992 and 2001 reports of academic misconduct in general have steadily increased, though fortunately actual findings of misconduct have remained small. 76% of the top 25 National Institutes of Health-funded

[4] See the report in *Nature* 435 (9 June 2005): 737, summarised at 718.
[5] *Nature* 436 (4 August 2005): 626.

institutions made research misconduct findings during the period.[6] To take another example, the Think Twice Global Vaccine Institute maintains a public dossier of correspondence concerning fraud in relation to vaccine research, a particularly sensitive area.[7]

Unfortunately, very few major studies are conducted into the prevalence of scientific fraud, making it hard to know exactly how serious the problem is. Two important books catalogue numerous cases: William Broad and Nicholas Wade's ground-breaking 1982 study *Betrayers of the Truth: Fraud and Deceit in the Halls of Science*; [8] and, more recently, *The Great Betrayal: Fraud in Science*, by Horace Judson.[9] They demonstrate that scientific misconduct goes back a long way. Isaac Newton manipulated data to make them look more impressive.[10] In the mid-1860s the famous anatomist and evolutionist Ernst Haeckel, in his eagerness to defend evolution, fabricated pictures of human and animal embryos in order to 'show' that they shared primitive evolutionary similarities.[11] John Dalton, the celebrated 19th century chemist, almost certainly committed fraud.[12] Sigmund Freud is now notorious for making up his evidence.[13] In more recent times, IQ researcher Sir Cyril Burt carried out fraud,[14] as did Australian gynecologist William McBride (who became famous for discovering the genuine link between

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[6] 'New Institutional Research Misconduct Activity: 1992-2001', at http://ori.dhhs.gov/documents/NewInstitutionalResearchMisconductActivity.pdf (accessed 19 Feb. 06).
[7] See www.thinktwice.com/fraud.htm (accessed 19 Feb. 06).
[8] (New York: Simon and Schuster, 1982). In it they claimed that one third of all pesticides then on the market had been approved on the basis of falsified safety tests.
[9] (Orlando: Harcourt, Inc., 2004).
[10] Broad and Wade: 27-9.
[11] See M. K. Richardson et al., 'Haeckel, Embryos, and Evolution,' *Science* 280 (1998): 983-6.
[12] Broad and Wade: 29.
[13] Judson: 83-90.
[14] Broad and Wade: 203-11; Judson: 90-6.

thalidomide and birth defects).[15] Further cases could be mentioned, but I have cited enough to show that scientific fraud is, to put it mildly, something of an occupational hazard in the profession. What can we learn from it as far as both the practice of science and public policy are concerned?

A central fact concerns the standing and reputation of scientists in our contemporary, post-religious era. Like it or not, the figure of the priest in clerical garb has been replaced in the public imagination by the white-coated scientist. Figures such as Lord Robert Winston and Professor Richard Dawkins regularly appear on our television screens, pontificating (I use the word advisedly) on anything from religion to politics to anthropology to biology to public policy. Whether they are actually qualified to do so or not, they are more than happy to dispense their wisdom to the masses on whatever takes their fancy; and when it comes to their pronouncements on the scientific issues of the day, their word is received almost as Holy Writ.

Moreover, the media itself, already complicit in the secular deification of individual scientists, are always ready to report the latest findings from the lab, whether or not they have already been published or even peer reviewed. Once the work is in print, though, it has received the secular *imprimatur* and is recorded as eternal truth. The BBC regularly reports the headline news from the medical journal *The Lancet* much as preachers of old captured public attention for their Sunday sermons. By generating false or unwarranted hopes that the latest cure for cancer is just around the corner, or that the final truth about the origin of the universe has been uncovered, or that the secret of life is a mystery no more, the media deliberately and recklessly give science and

[15] See the summary of the case in Brian Martin, 'Fraud and Australian Academics', *Thought and Action* 5 (1989): 95-102. An unedited version of the article is at http://www.uow.edu.au/arts/sts/bmartin/pubs/89ta.html (accessed 20 Feb. 06).

scientists a reputation as the ultimate repository of truth which far outstrips anything the profession is capable of achieving.

We must add to this the pressure under which scientists operate, especially in the life sciences, from the public and private bodies that are their funding lifeline. Typical is the remark by Oh Il-Hwan, a geneticist at South Korea's Catholic Medical Center, on the case of erstwhile 'top scientist in Korea', Hwang Woo-Suk: "I understand what drove Hwang into this state. The pressure to achieve something was enormous."[16] It wasn't just the media that created this pressure. The Korean government had poured millions into Hwang's laboratory, and they expected results. Billions of dollars flow into laboratories and research institutes from governments and corporations. Both are, of course, motivated by the simple desire to improve the welfare of mankind. But for governments, the national prestige associated with being at the leading edge of discovery is also a strong inducement to direct and indirect pressure on scientists to come up with the goods. At the time of the Hwang affair, the British media were quick to report that the University of Newcastle in England was now by default the world's leading centre for research into developing human embryonic stem cell lines: pride sometimes comes *after* a fall.

For the corporations that pour millions into their own research efforts the lure is, quite simply, the massive profits that will accrue from the development of the latest drug or patentable technology. Never mind the almost weekly reports of drugs' being withdrawn because of their danger or inefficacy: the sales prior to withdrawal will often be huge, and if there is no

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[16] *The Times*, 24 December 2005, at http://www.timesonline.co.uk/article/0,,25689-1958528_2,00.html (accessed 20 Feb. 06).

withdrawal the wealth can be as good as it gets in the private sector. (Witness the stock market valuations of the major pharmaceutical companies, and even of those that have no actual product, only hopes and dreams.) Once again, the pressure to toe the funder's line – even if it may mean 'fudging' data, as the euphemism goes – can be enormous.

The problem is especially acute in the life sciences because it is here that humanity can be directly benefited. When a physicist gets it right no lives are saved, and when he falsifies data no one dies as a result; there is only disgrace. But when a biologist, epidemiologist, geneticist, or drug researcher makes a genuine discovery, our lives and our health can benefit immediately; yet when he fiddles the lab books, people may die. The risks and rewards can cause that little voice inside the researcher's head to say: 'What's a decimal point here or there? After all, the overall results are clear enough. Surely the anomaly is just minor experimental error. The result really should look like *this*, since that's how it came out the first couple of times. If people don't get access to this drug as soon as possible, lives will needlessly be lost.' And so on. Soon he might end up convincing himself not only that the 'anomalies' in the data are of no significance, but that he has a positive moral *duty* to publish forthwith. What would his government funding body/chief executive think if he were found to be sitting on a potential discovery maybe for *years* because the evidence did not, in our imperfect world, conform *exactly* to prior expectations?

When frauds are exposed, scientists and their media defenders are quick to declaim the success of science's 'self-correcting' mechanisms. After all, the fraud was outed, wasn't it? The much-vaunted peer review process is efficient in nearly all cases at weeding out fishy science. And when the guilty

party is revealed, his career is over. It is, so they claim, the very detestation of the profession for the fakers in its midst, and its rigorous self-monitoring of scientific practice, that keep science as clean as one could hope for.

There may be a grain of truth in this, but not a lot more. For a start, the peer review process often fails comprehensively to weed out fakery before it appears in print. Hwang's articles went through the peer review process of the one of the world's two leading scientific journals. Schön, as already mentioned, had published *scores* of peer-reviewed papers before he was outed. Many more cases can be cited. The journal *Science* has *itself* admitted the flaws in its process, echoing the sentiments of many periodicals that the backlog of submissions, the difficulty of finding enough referees (themselves academics under pressure to do their own publishing), let alone sufficient specialists to give proper scrutiny to articles that demand high expertise, and the general pressure to turn articles around quickly, mean that shortcuts will commonly be taken. Moreover, an inherent limitation of peer review is that reviewers cannot be expected to replicate the experiments on which a submission is based. They simply have to take the author on trust that when he says he got result X, he really did get it; or that when he says he has a photograph of Y, the picture is genuine. Sometimes anomalies in an article will create suspicions in a reviewer's mind, and he will ask to look at the raw data behind the article, the precise methodology, and so on. But this is and has to be the exception rather than the rule, and will itself only improve detection marginally.

Furthermore, the fact is that scientific fraudsters are only on some occasions exposed – at least openly – by their peers. Sometimes exposure is the result of the dogged persistence of a reporter in the media when they hear

rumours of misconduct, as happened in the Hwang case and the McBride case. Usually there will be some academic help along the way, of course, but this sort of haphazard way of getting to the truth hardly recommends itself as the standard form of policing, important and useful though it may be. The available literature on the topic tells a sad tale of colleagues put under pressure to keep their mouths shut for fear of bringing their university or company into disrepute. Younger researchers – those who work under a particular scientist – are often the ones closest to the evidence and so best in a position to expose malpractice. And they are precisely the ones whose careers can suffer the most – if not be destroyed – by speaking up against their boss. This sort of pressure, seemingly endemic to a profession with a rigid hierarchy and precise career path, is hardly compatible with an open, free atmosphere of self-discipline and self-regulation.

It is of no avail for scientists to step back from the crown of authority they often happily embrace, claiming in modesty that science is fallible, that no one should expect it to proceed inexorably towards the truth anyway, that scientists are mere mortals like the rest of us, and so on. For true though that all is, it does not sit well with the aura of certainty that scientists have, albeit implicitly as well as overtly, courted in the media and before the organizations that hand out their supply of funds. Most scientists, I imagine, realize this and shrink from the very idea of being catapulted into the spotlight. But far too many are only too happy to bask in all the attention, hence giving an impression of invulnerability that belies the truth of how the profession of science operates and what it can achieve.

In consequence of the serious and growing problem of fraud in science, I find myself – surprisingly – siding with the philosopher Paul Feyerabend,

who called for a "separation of science and state",[17] though my reasons are different to his and my recommendations less extreme. He called for a separation because he did not think there *was* such a thing as scientific method, and hence that science was no more nor less a path to the truth than any other cultural tradition, all of which should have equal rights and privileges in society. His irrationalism has often been pointed out, and I have nothing to do with it.

I do, however, share his concern with the many failures of science – the politics, the biases, the uncertainty, the fraud, and the countless cases in which science just gets it plain wrong and continues to do so. By 'separation of science and state' I do not mean that science should be relegated in the public mind to just one more way of finding out about the world. Good science should continue to be applauded and appropriately rewarded. But there does, in the current climate, have to be a radical curtailment of public funding subject to a root-and-branch reform of the profession. For a start, the relative lack of data on fraud must be filled. Governments should create commissions of inquiry dedicated to gathering statistics on the incidence of scientific misconduct. Secondly, the media have a responsibility to cease elevating scientists into a kind of secular priesthood. For its part, people need to be more sceptical and critically minded in the way they receive scientific pronouncements. Thirdly, detection rates must be improved and the penalties made stricter and more comprehensive. There are too many cases of guilty scientists being allowed to move from country to country, or university to university, or even to continue for long periods with their research undisturbed before anybody takes any action. Current methods of uncovering

[17] P. Feyerabend, *Against Method* (London: Verso, 1975).

malpractice are far too haphazard and unreliable. Fourthly, science as a whole should follow the lead of physics, where most articles are published freely online before they appear in peer-reviewed journals. This is especially important for any discipline that touches on human health and well being. I believe this can be done without compromising the legitimate protection of intellectual property and sensitive information. Fifthly, the climate within universities must change, so that potential whistle-blowers are not deterred from speaking out by intimidation, pressure, and threats to their future careers. Such behaviour must itself be a matter for disciplinary action.

Finally – and here I am going on a slight tangent, though the issue is important and adds to the problems already mentioned – there must be a rethinking of the use of state funds for research that many taxpayers find morally objectionable. Human embryonic stem cell research is a case in point. Note that one of the examples of Hwang's misconduct – the one that began the ball rolling that led to his downfall – was his coercion of women, including his own junior colleagues, into allowing him to 'harvest' their eggs for his cloning research. (He had originally claimed that all eggs were freely donated. It was *this*, rather than any potential fraud, that led to the initial worries expressed by Hwang's co-author and colleague from the University of Pittsburgh, Dr Gerald Schatten.) But this is not the only area in which many people have ethical qualms about such research. Many – myself included – seriously object to the very idea of cloning human beings for experimentation or any other purpose. Why should a taxpayer with moral objections be forced contribute to such research? He or she is free not to buy shares in a company that carries out objectionable research, but when it comes to government funding no opt-out is possible. This, among other reasons, supports the case

for the hypothecation of tax, so that taxpayers do not have to contribute to state funding of practices and institutions to which they have serious moral objections.

Many scientists are worried that the Hwang case, and those like it, tarnish the reputation of every researcher, honest or not. One would hope (perhaps optimistically) that people had enough common sense to realize that not every scientist should be tarred with the same brush. In any case, what is more important is that the institution of science, and its relationship with the state, be subjected to scrutiny of a kind it has not experienced before. Private research corporations can and should be strictly regulated so as to minimize the risk of malpractice. But private funding of science should not be prohibited in a free society where making a profit is not a crime in itself. Nor should the state have no role whatsoever in the advancement of science for the benefit of its citizens. Until science as a whole cleans up its act, however, the state's function should far more be one of monitor than of milch cow.

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