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ENHANCEMENT IN SPORT – THE EMERGENCE OF GENE-DOPING

Mark S. Frankel

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While many of the grand accomplishments by extraordinary athletes at the 2008 Olympics took our breath away, there are still those holding their breaths, hoping that the dazzling array of performances in Beijing are not subsequently tainted by allegations and findings of illicit doping. In the days and weeks ahead, Olympic officials will be conducting further tests on samples from athletes collected during the sporting events for any evidence of doping.

During the Olympics there was significant increase in the amount of testing by anti-doping labs in Beijing. The International Olympic Committee conducted between 4,000-5,000 tests, 1000 more tests than were conducted in the 2004 Games in Athens and the most in Olympic history [1]. But even as officials test for traditional methods of enhancement—drugs, growth hormone, etc.—scientific developments in genetics are raising more challenges.

Genetics as Treatment

New forms of medicine are emerging based on the use of genetic material to ameliorate human disease. They rely on methods that introduce foreign genes into cells and tissues to repair or replace defective functions due to genetic errors. These kinds of genetic approaches to therapy have begun to demonstrate life-saving results. For instance, children suffering from lethal forms of genetic immune deficiencies have had their immune defects corrected by the introduction of normal forms of several genes into their blood cells. Many of them have lived normal childhood lives for as long as seven-to-eight years since the treatment. However, to underscore the experimental and potentially dangerous nature of the technology, several of the children have developed leukemia as a direct result of their treatment, and one of them has died [2].

The demonstration that it is possible to modify disease traits by introducing foreign genes into the body raises the possibility that similar methods will eventually be equally effective in altering "normal" human traits that some may wish to enhance. Today, we are bombarded by messages that reinforce the notion that enhancement via drugs, dietary supplements, and cosmetic surgery is readily accessible for personal self-improvement. For many, enhancements via the science of genetics will be seen as a logical extension of what is commonplace today.

Gene Doping

In modern times, the enhancements of choice among athletes have been the familiar drug-based techniques, such as of steroids and growth hormones, and the widespread use of erythropoietin in endurance sports such as cycling. Now the world of sport has become increasingly concerned about methods that introduce genes designed not to treat disease, but to enhance athletic performance. These concerns are justified in the world of sport, where competitive pressures, medical injuries, financial incentives such as huge salaries and lucrative endorsement deals, national pride, and public adulation coalesce to create the "perfect storm" for performance enhancement.

One recent example from the laboratory has made the prospect of gene doping increasingly likely. In July, researchers at the Salk Institute in San Diego reported that they had used two drugs to alter energy metabolism and the pattern of muscle fibers in mice. This had the effect of enabling the mice to run faster and longer than normal. Recognizing the implications of their research for competitive sport, the scientists approached sports officials with their findings, asking them to collaborate on developing a test that would be able to detect the drugs [3].

Responding to Gene Doping

Although there is no evidence that gene doping has been used by athletes, the World Anti-Doping Agency (WADA), established in 1999 to detect and reduce doping, plans to be pro-active. It has invested in a new approach that would focus on "the effects of gene doping at the genetic level, at the proteomic level, and possibly at the metabolic level"[4]. This emphasis on the "effects" of gene doping, rather than focusing on the identification of substances that are the "cause" of such effects, will circumvent athletes' attempts to evade detection by current tests by using methods like limiting the amount taken, regulating the timing of intake, or substituting their own urine with that of others. The seriousness of this issue to WADA is reflected in its allocation of one-quarter of its $25

(**Frankel** continued from page 1)

million research budget on the science of gene doping, including its detection [5].

The challenges posed to WADA and other sports organizations concerned about gene doping are exacerbated by a technology much more ubiquitous than the knowledge and techniques of genetic enhancement. The Internet, combined with commercial interests, creates a powerful marketing tool for promotion and distribution. No effort to keep doping out of sports is likely to be fully successful if it ignores the influence of the marketplace.

Persons differ, cognitively and emotionally, in the way they perceive marketing messages and in the way they are affected. Some are more vulnerable or gullible than others. As others have noted, "athletes feel excessive pressure to win, and particularly when extrinsic rewards are at stake, they may resort to questionable behaviours in an attempt to ensure victory" [6]. Among those "questionable behaviours" are "[S]ubstances that improve performance, or are even perceived to improve performance, [which] are widely used by athletes….The 'just say no' approach to advising the athlete about these supplements will continue to fail because there is such a potent marketing influence to take these supplements and such a powerful drive in athletes to find a competitive advantage"[7].

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The Internet is the world's largest and most ubiquitous marketplace, which, unencumbered by geographical boundaries, facilitates the dissemination of information and goods for both legitimate and illicit uses. It can directly communicate with consumers in the privacy of their homes. It offers new ways to market and sell products that circumvent scientific peer review and, in some cases, escape regulatory oversight. Anyone can set up a website, and companies promote themselves to broad audiences in order to create new markets for products. "While commercial websites are…biased, and unreliable by rigorous scientific standards, they are a principal source of information for many athletes, and should be monitored when looking for evidence of developing trends in doping" [8].

WADA's St Petersburg Declaration

It was out of concern for the possibility of gene doping that WADA hosted a Gene-Doping Symposium in June 2008 in St. Petersburg, Russia. More than 60 representatives from 16 countries attended. They included experts in gene transfer, scientists from the field of anti-doping, WADA's Gene Doping Panel members, representatives from sports and regulatory authorities, policy analysts, and ethicists. Over two days there were eight presentations on topics including the state of the science, ethical issues, the commercial and policy dimensions of gene doping in sport, and the legal framework within which laws and regulations could combat the use of gene doping in competitive sport. (The full program is posted at http://www.wada-ama.org/en/dynamic.ch2?pageCategory.id=794.)

At the end of the symposium, the participants agreed to a series of findings and recommendations on several aspects of gene doping, many of which were incorporated into the St. Petersburg Declaration (http://www.wada-ama.org/rtecontent/document/2008_StPetersburg_Declaration.pdf) adopted by the attendees.

Letters to the Editor: The editors welcome comments from our readers. We reserve the right to edit and abridge the letter as space permits. Please address all correspondence to the deputy editor.

Among the findings were the following:

- The potential risks of gene doping are inconsistent with ethical norms of human research and medical practice.
- Significant progress has been made in identifying molecular targets suitable for developing gene doping detection.
- The commercialization of genetic science and the worldwide market are affecting the…accessibility by sport figures to materials and methods of potential use in gene doping.
- It is important for WADA to have a clear view of the regulatory framework that would best serve the interest of sport and be an active participant in the societal discussion of these issues.

Among the recommendations were the following:

- The WADA research program should continue to be the central component of …developing improved detection methods for doping in sport…and there should be increasing emphasis on expanding such research to additional academic, private and commercial institutions.
- Encourage research on ethics and gene doping.
- Promote knowledge in the sport community about misconceptions and potential dangers associated with gene doping.
- Increase awareness within the sport community about marketing and communications strategies employed to promote the use of genetic technologies in sport.
- Anti-doping organizations should be prepared to provide objective and reliable information to athletes, trainers and physicians to enable them to assess critically the claims made on the Internet and elsewhere regarding the "power of genetics" to enhance athletic performance.
- Promote the development of regulatory mechanisms for the prevention of misuse of genetic technologies.

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(**Frankel** continued from page 2)

The battle against gene-doping in sport will take place in an arena of competing interests. On the one hand, there is much to gain for the public good by funding and nurturing research on genetic technologies for medical uses. On the other hand, there are strong forces—economic, national pride, and personal fame—at work to push those same technologies in the direction of performance enhancement, giving some athletes an edge over their competitors. The battle will undoubtedly persist, and the stakes will become higher for individual athletes and those supporting them as well as for those committed to an ethic of sport that promotes a level playing field. At the center of this clash is science, and those who do it, the institutions that support it, and those who study it as an important social endeavor. The relationship between science and sport, while not new, is one that merits much more public dialogue and expert assessment than has been the case up to now. In addition to whatever we might learn about this particular relationship, there is also the promise of learning a great deal about the values and policies that should guide future use of genetic enhancement in all walks of life.

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Commentary

SCIENTISTS AT RISK

Deborah Runkle
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If you are a scientist who conducts research that uses animals, and especially if you live in California, you are at risk of phone, e-mail, or even physical attack. For the past several years, extremists in the animal rights community have targeted industries that use animals in research or testing, as well as academic research institutions. For example, the Universities of Minnesota (twice) and Iowa and Louisiana State University (twice) have seen laboratories trashed, animals "liberated," and years of data destroyed, with close to $3 million in combined damages. Following these attacks, faculty and staff have been the subjects of serious harassment. The children of a University of Minnesota psychiatrist who uses monkeys to study cocaine addiction were taunted at their school, and University of Iowa researchers received over 400 unsolicited magazine subscriptions.

As research institutions have upgraded security, making it difficult for animal rights terrorists, the extremists have, over the past two years, put the bull's eye squarely on individual scientists, their families, and their homes. Nowhere is this truer than in California, a leading indicator in trends good and bad. Some examples:

- In August 2006, an explosive device intended for the home of Lynn Fairbanks, a professor in the department of psychiatry and biobehavioral sciences at UCLA who studies primate behavior, was accidentally placed at the home of a 70-year-old neighbor. Although the device failed to go off, FBI investigators said that it was powerful enough to kill someone if successfully ignited.
- In June 2007, another failed incendiary device was placed next to a car belonging to Arthur Rosenbaum, UCLA's chief of pediatric opthamology, who conducts vision research on primates.
- In October 2007, the home of Edythe London was vandalized when a window was broken and a garden hose was inserted, causing major flood damage. Dr. London, who studies nicotine and methamphetamine dependence using primates, was bold enough to write an op-ed in the *Los Angeles Times* explaining the rationale for her research. Four months later, her home was attacked again, this time with an incendiary device. Fortunately, Dr. London was not at home, but her house was again damaged.
- Twenty-four UC Berkeley researchers and seven staff members have been victims of harassment this year, 13 of them more than once. For example, extremists have paid "home visits" in front of scientists' houses in the middle of the night with bullhorns, chanting "animal killer" and three cars have been vandalized.

The most dangerous incident– to date – took place in August 2008 at UC Santa Cruz, when firebombs were ignited at the house of one researcher and the car of another. This time they worked. The car was destroyed, and Dr. David Feldheim, a molecular biologist, was forced to escape his smoke-filled house with his wife and two young children. The attacks should not have come as a surprise, because a "Wanted" flier was found at a local coffee shop listing the names, addresses, and photographs of 13

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Santa Cruz researchers, including Dr. Feldheim. These attacks were considered so outrageous that, at last, the nonviolent animal rights community spoke up, with the Humane Society of the United States offering a $2500 reward for information leading to the arrest of the criminals and the People for the Ethical Treatment of Animals announcing on their website that they disapproved of violence directed against all animals, including humans.

At least two scientists have stopped conducting studies on animals, one forsaking research altogether. In August 2006, UCLA neurobiologist Dario Ringach posted a message on the internet, saying "I quit," and begging the extremists to stop threatening his family. Many of the scientist/victims were conducting their research with taxpayer-funded federal grants, and all of their research was approved by Institutional Animal Care and Use Committees, which oversee research with animals to promote high standards.

"Credit" for most of these attacks comes from the Animal Liberation Front (ALF), a loosely knit group of individuals who share a common goal – the end of all animal research – but operate independently. ALF spokesman, Dr. Jerry Vlasak, a trauma surgeon who claims no advance knowledge of ALF activities, testified before a Senate committee in 2005 that it would be "morally justifiable" to kill scientists to get them to stop their research with animals.

What can be done? Although several scientific societies (including AAAS) and the National Institutes of Health have issued strong statements condemning this violence, the most effective response will come through law enforcement. Recently, California enacted a law intended to strengthen the hand of law enforcement officials. More importantly, in 2006 Congress passed the Animal Enterprise Terrorism Act, which gives the Department of Justice new tools, in the form of heavy fines and lengthy prison sentences, to pursue and prosecute individuals attacking researchers or their institutions. But a prosecutorial tool is only effective if you can identify and arrest the perpetrators, which neither local nor federal law enforcement officials have been successful at in California. That is, not successful yet, but each attack leaves new clues, and the scientific community and its supporters can hope that if a few of these terrorists are sentenced to years in a federal prison, it will have a chilling effect on their confederates.

In the News

AMERICANS AGREE – SCIENCE EDUCATION IS SUFFERING

Chicago's Museum of Science and Industry recently commissioned a survey by Harris Interactive to gauge Americans' opinions about the state of science education. If half of a solution is recognizing there is a problem, then we are well on our way to solving the current science education crisis. Overwhelming majorities of American adults agreed that although science is important, our youth are failing to learn it, let alone love it. Ninety-six percent of participants believed the U.S. must be a leading country in science education, but only twelve percent gave current science education an "A" grade. Their concerns about our youth may reflect their own science insecurities, since only four percent of respondents could name a living scientist, and a meager twenty-six percent claimed a solid understanding of science.

American adults clearly grasp the potential ramifications of poor science education. Sixty-five percent believe that the United States will not be a global science leader in the next twenty years, a position that seventy percent think we have already lost. However, the same adults also appear to understand that hard work and earnest investment will pay off. Over ninety-percent agreed that increasing hands-on classroom exercises, improving teacher training, and expanding parental involvement are all vital steps toward advancing youth science learning. Furthermore, eighty-seven percent favored increased science education funding, and eighty-one percent advocated for a minimum of an hour of science in the classroom.

Aside from failing to compete globally in research and development, the next generation will suffer in other ways, too. A recent *USA Today* article featuring Donald Kennedy, former editor-in-chief of *Science*, highlighted the failure to understand basic scientific method that accompanies a poor general understanding of science. People become vulnerable if they cannot identify biased or even fabricated studies or claims. Discussions about crucial policy issues will exclude the majority of Americans if they do not have the tools to understand and analyze the scientific bases of such issues as alternative energies or genetically modified crops.

A summary of the survey results can be found here: http://www.harrisinteractive.com/NEWS/newsletters/clientnews/2008_ChicagoMuseum.pdf

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NEW NIH WEB TUTORIAL ON FINANCIAL CONFLICT OF INTEREST

On August 15, 2008, NIH's Office of Extramural Research announced the launch of an online tutorial to educate institutional officials about Financial Conflict of Interest (FCOI) requirements. The content focuses in particular on reviewing the requirements detailed in Title 42 Code of Federal Regulations (CFR) Part 50 Subpart F and Title 45 CFR Part 94. Its three main modules are Definitions, Q&A, and Overview of Responsibilities.

The Definitions module serves as a glossary of terms. It focuses on identifying the major role players, and also clarifies terms like "significant financial interest" and "investigator." The Q&A section answers three frequently asked questions regarding the intent, importance, and extent of FCOI regulation. Overview of Responsibilities, which is the bulk of the tutorial, examines the roles of the three central stakeholders: the NIH, the institution, and the investigator. Responsibilities for the institution include details about maintaining proper records, establishing

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appropriate mechanisms for enforcement, and providing adequate information to NIH. Regarding the investigator's role, the tutorial again emphasizes exactly what defines "significant financial "interest" and addresses more specific questions about which kinds of interests must be disclosed.

The site can be viewed either as a pdf file or in a more interactive format that requires Adobe Flash Player. The tutorial is not a replacement for individual institutions' training programs, but rather an additional tool to aid in ensuring compliance with NIH policy.

The tutorial can be found here: http://grants.nih.gov/grants/policy/coi/index.htm.

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CONCERNS OVER PRIVACY OF GENETIC DATABASES: BIG MESS OR BIG FUSS?

A new scientific finding will—at least for the time being—hamper numerous collaborative efforts. A report from researchers at Translational Genomics Research Institute and University of California, Los Angeles published in the August 2008 issue of *PLoS Genetics* [1] describes a new statistical method for identifying one individual's genetic code within a mixture pooled from 1000 or more individuals.This new method is especially useful in the field of forensics, where current techniques become unreliable when the proportion of the genetic material of interest falls below 10% of the total mixture being sampled.

However, fears that this technique could be used to single out participants in genome-wide association studies (GWAS) led the National Institutes of Health (NIH), the Broad Institute and the Welcome Trust in the UK to remove their previously available databases from public access [2,3]. Previously, these entities posted online the pooled genetic contents of GWAS participants, in efforts to encourage open-source use for identification of illnesses and other genetic studies. David Craig, senior author of the *PLoS Genetics* article, acknowledges that the withdrawals are "very pre-emptive," [4] and "…could hamper data sharing, which has facilitated so many discoveries." [3]

In an attempt to balance the right of participants to the privacy they were promised and the benefits of future research made possible by the data sharing, NIH has issued a modified data access policy for GWAS information. [5] The new policy will make controlled access data available to investigators from scientific institutions. Investigators will be required to submit Data Access Requests packages that are subject to approval by the NIH Data Access Committees. A major concern from the scientific community not directly addressed by the modified policy is how quickly requests will be answered.

NIH also released a fact sheet stating "the NIH is unaware that [the new identification method] has been used to compromise any information within NIH GWAS datasets." [6] The fact sheet also points out that a number of technical difficulties must be overcome before the sensitive information can be accessed.

In order to identify an individual within a pool, the software algorithm developed by Craig and his colleagues must analyze between 10,000 to 50,000 bits of genetic information in the form of single nucleotide polymorphisms (SNPs). The software compares SNPs from the individual in question with SNPs from a pool of individuals, available, for

Accordingly, in order for an individual's identity to be revealed, an inquisitor must first obtain the individual's genetic code. In the majority of instances, this would entail acquiring a tissue sample from the individual, extracting the genetic material, amplifying and identifying tens of thousands of SNPs within a laboratory, and ultimately employing the software designed by Craig's team. In short, identifying an individual's SNPs within a pool is not an easy task, and requires a high degree of technical know-how.

If someone is going to go through all this trouble to acquire one's SNPs, then taking part in research that posts pooled genetic data online could be a risky endeavor. While an individual's right to privacy is not to be taken lightly, it is worthwhile to point out that the threat posed to one's privacy is quite low, when the long and technical path to individual identification is considered.

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STEM CELL REGULATIONS ABOUND

Within weeks of each other, two sets of guidelines regarding stem cell research were released. On August 26, the International Society for Stem Cell Research (ISSCR) released its Guidelines for the Clinical Translation of Stem Cell for public comment (period ending on Oct 1). Additionally, on September 5,

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the Human Embryonic Stem Cell Research Advisory Committee, convened by the National Research Council and the Institute of Medicine of the National Academies, released its 2008 Amendments to the National Academies' Guidelines for Human Embryonic Stem Cell Research, in response to feedback from the medical research community.

The ISSCR Guidelines seek to "highlight the scientific, clinical, regulatory, ethical, and social issues that should be addressed so that basic stem cell research is responsibly translated into appropriate clinical applications for treating patients." These guidelines are divided into the stages stem cell research undergoes: cell processing and manufacture, pre-clinical studies, and clinical research. Additionally, the concepts of unproven commercial stem cell "therapies," medical innovation procedures and social justice were addressed.

The ISSCR Guidelines stress that since cell-based products present novel challenges, research should be conducted with "scrupulous, expert, and independent review and oversight, to ensure as much as possible the quality and safety of the cells." However, due to the large variability involved in stem cell research, including their source, differentiation potential, intended use, persistence in the patient, and the manner in which they are integrated into the human body, distinct principles should be established for each variant.

The ISSCR Guidelines state that the main requirements of clinical research include, "regulatory oversight, peer review by an expert panel independent of the investigators and sponsors, fair subject selection, informed consent, and patient monitoring."

The Academies' Amendments seek to clarify ambiguous passages, as well as adding sections to address the new discovery that enables scientists to reprogram somatic cells to pluripotency. While the original 2005 Academies' Guidelines focused on human embryonic stem cells, the 2008 revisions seek to expand their recommendations to other types of stems cells. Thus, a whole new section was added, "Recommendations for Research Use of Non-Embryo-Derived Human Pluripotent Stem cells (hPS Cells)." This section states that hPS cells, which are adult cells transformed into a stem-cell-like state, are covered by existing IRB regulations, and therefore do not fall under the authority of an Embryonic Stem Cell Research Oversight Committee (ESCRO). Section Seven additionally lays out procedures to be followed to undergo testing within animals, and specifies that "No animal into which hPS cells have been introduced such that they could contribute to the germline should be allowed to breed."

However, the report reinforces that, even in light of new developments, all avenues of stem cell research should be allowed. Thus, research on embryonic stem cells is still needed: "It is far from clear at this point which cell types will prove to be the most useful for regenerative medicine, and it is likely that each will have some utility."

Additionally, the phrase "direct expenses" in regard to reimbursing women donating oocytes was clarified: "Direct expenses may include costs associated with travel, housing, child care, medical care, health insurance, and actual lost wages." This was in response to concern that women may be paid to donate blastocysts for research.

The other two main revisions involved specifying the necessary procedures to follow when reporting research and obtaining approval from ESCRO committees, and detailing the responsibilities of institutions in registering and auditing the stem cell research occurring under their jurisdiction.

For more information:
ISSCR Guidelines:
http://www.isscr.org/clinical_trans/ISSCR_DraftGuidelines_082608.pdf

2008 National Academies Amendments:
http://www.nap.edu/catalog.php?record_id=12260

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In the Societies

THE TRIALS OF RELIABLE SCIENTIFIC LITERATURE

In July, the International Council for Science (ICSU) Committee on Freedom and Responsibility in the conduct of Science (CFRS) published a "Statement on publication practices and indices and the role of peer review in research assessment." CFRS is apprehensive that current processes used by scientific institutions, as well as the use of publication metrics, are weakening the integrity of the scientific literature.

Often methods of making career appointments and awarding grants are based upon the number of one's publications. Such emphasis on a publication record can lead to duplicate publications, inflated results, or even, in very extreme cases, the presentation of false data. Moreover, the increased number of unreviewed or non-expert reviewed archives increases the probability of poor quality or misleading literature.

CFRS emphasizes the necessity of a proper peer review process to ensure the publication of high quality scientific work. Additionally, CFRS advises that quantitative measures, or metrics, should be used sparingly as a complement and not a replacement for the peer review process. Such numerical values can be easily manipulated or misinterpreted. For example, citation numbers are higher in cases of review articles than primary papers, and in instances where a paper is heavily rebutted.

A related publication, the "Citation Statistics report," produced by the International Mathematical Union, scrutinized the use of citation numbers within scientific evaluations, and similarly concluded, "While having a single number to judge quality is indeed simple, it can lead to a shallow understanding of something as complicated as research. Numbers are not inherently superior to sound judgments."

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In light of these concerns, CFRS urges that "rather than learning to survive in a 'publish or perish' culture, young scientists should be encouraged and supported to produce high quality scientific communications that make a real contribution to scientific progress."

IMU report: http://www.mathunion.org/fileadmin/IMU/Report/CitationStatistics.pdf

ICSU statement: http://www.icsu.org/Gestion/img/ICSU_DOC_DOWNLOAD/2095_DD_FILE_CFRS_Statement_Publication_Practices.pdf

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Resources

BIOETHICS BRIEFING BOOK

The Hastings Center has released *From Birth to Death and Bench to Clinic: The Hastings Center Bioethics Briefing Book for Journalists, Policymakers, and Campaigns*, which covers timely bioethics concerns, such as abortion, health care reform, human and sports enhancement, organ transplantation, personalized medicine, medical error, and stem cells. For more information, visit: http://www.thehastingscenter.org/Publications/BriefingBook/Default.aspx.

PRACTIONER TRAINING ON THE SOCIAL AND ETHICAL DIMENSIONS OF NANOTECHNOLOGY

The Center for Nanotechnology in Society at Arizona State University (http://cns.asu.edu/) and the National Nanotechnology Infrastructure Network (http://www.nnin.org/) have developed training modules for practitioners on the social and ethical issues of nanotechnology. The Center for Nanotechnology in Society and the Center for Integrated Nanotechnologies (http://cint.lanl.gov/) are offering a practitioner training program addressing nanotechnology and public policy, environment, health and safety, ethical and social implications, and social science research.

AAAS-NATIONAL ACADEMIES COMPILATION OF RESOURCES ON SCIENTIFIC MISCONDUCT AND RESEARCH INTEGRITY

AAAS, in collaboration with the National Academies, has developed a website on research integrity and scientific misconduct for students, researchers, administrators, and policymakers. The website brings together a comprehensive set of educational resources, such as upcoming events, recent literature, web and media resources, policies, codes and guidelines, and international tools. Visit: http://www.aaas.org/spp/sfrl/projects/research_integrity/scientific_integrity/

FOR THE LOVE OF MONEY

A Review *The Price of Truth* (224 pages), Oxford University Press, 2007.

By David Resnik, J.D., Ph.D. NIEHS, NIH

David Resnik provides a well-structured account that underscores money's trenchant effects on the pursuit of quality science. Not only does he provide tangible examples of how financial incentives have tainted scientific research, Resnik also dissects the meaning of "truth" and suggests the best means to maintain it within science. He notes that although science is known to provide hard facts, there are forces that influence institutions and human beings capable of hiding, delaying, and skewing the truth in order to secure economic benefits. Yet, Resnik contends that just as institutions and scientists are susceptible to succumb to both private and public money's influence, they are also just as adept to minimize their effects.

The first half of the book details the ethical principles that govern behavior in science, such as honesty, objectivity, openness, and freedom, and it lays out the epistemological principles that shape what scientists believe to be true or false, such as testability, empirical support, precision, and novelty. Resnik devotes an entire chapter to the scientific norm of objectivity, expanding his discussion to diverse notions of truth from the vantage points of John Locke, David Hume, Immanuel Kant, William James, and Thomas Kuhn, just to name a few. This discussion provides a foundation underlying the norms that maintain truth in science, as well as "food for thought" on whether truth can ever stand independent from the human mind and its influences and biases.

The next half of the book adheres closer to the book's central aim, specifying how money can tamper with scientific norms. Resnik does so by cleverly investigating money's role on science at each step of the scientific method. For example, he describes how the power of money can hand-pick and direct the first step of research – problem selection. Private industry, which contributes two-thirds of R&D in the United States, favors projects that will potentially garner the most financial return and devotes less to the sole pursuit of knowledge. Another stage touched by financial incentive is experimental design, where researchers can choose the research methods that lean toward producing desired outcomes. Resnik continues to uncover money's grasp at other stages of research like subject recruitment, data collection and interpretation, authorship, publication, and peer review and replication. With greater depth he focuses on individual and institutional conflicts of interest (COI). Succeeding chapters investigate how intellectual property (IP) can create bias, and how public funds have affected academic researchers, who are pressured to publish and procure grants in order to obtain job security.

Throughout the book and with his set of recommendations in the final chapter, Resnik presents substantive ideas for curtailing the perverse effects of money in science. Key recommendations include: suggested situations when individuals and institutions should disclose, manage, and prohibit COIs; an appropriate balance between sharing a public good and protecting individual rights in IP law and policy; and significant bolstering of education, training, and mentoring on research ethics for scientists and students. Resnik does a noteworthy job of highlighting the problems society faces in reaping the benefits from science beyond economic gain, and champions the need for scientists to honor truth over money.

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(**Resources** continued on page 8)

(**Resources** continued from page 7)

Announcements

Call for Papers - The Fifth Biennial ORI Research Conference on Research Integrity will be held in New York on May 15-17, 2009. The Conference provides a forum for scholars to discuss crucial research questions, explore different research methods, and share research results, with the ultimate goal of furthering research integrity and detering research misconduct. Abstracts are due October 31, 2008. Visit: http://ori.hhs.gov/conferences/upcoming_conf.shtml

Call for Papers – The Research Group Integrity of Governance at VU University in Amsterdam is hosting, *'Governing Good and Governing well': The First Global Dialogue on Ethical and Effective Governance* on May 28-30, 2009 in The Netherlands. Abstracts are due November 1, 2008. Visit: http://english.fsw.vu.nl/firstglobaldialogue

Call for Papers – The BIOS Centre for the Study of Bioscience, Biomedicine, Biotechnology and Society will host *The Politics of the Life Sciences in an "Age of Biological Control"* at the London School of Economics and Political Science on September 16-18, 2009. Abstracts are due December 1, 2008. Visit: http://www.lse.ac.uk/collections/BIOS/events/Vitalpolitics3.htm

Call for Papers - *Science & Technology in Society: An International, Interdisciplinary, Graduate Student Conference* provides a venue for graduate students from Science & Technology Policy, Science & Technology Studies and related fields to present their research. Email abstracts to abstract@stglobal.org by December 19, 2008. Visit: http://www.stglobal.org

Conference – The Fifteenth Session of the International Bioethics Committee (IBC) will be held at UNESCO Headquarters in Paris on October 28-29, 2008 and will be followed by the Joint Session of the IBC and the Intergovernmental Bioethics Committee (IGBC) on October 30. The meetings will discuss the principle of social responsibility and health as set forth in the UNESCO Universal Declaration on Bioethics and Human Rights (2005) and the issue of human cloning and international governance. Visit: www.unesco.org/bioethics

Conference – The Neuroethics Society is holding its first annual meeting on November 13-14, 2008 at AAAS Headquarters in Washington, DC. Topics discussed will include: pediatric neuropsychiatry, deep brain stimulation & functional neurosurgery, the business of neuroscience, and neuroscience & national security. Visit: http://web.memberclicks.com/mc/page.do?sitePageId=33808&orgId=ns

Conference – On November 17-19, 2008 PRIMR will host *Advancing Ethical Research Conference: Balancing the Needs of Human Subjects and Science* in Orlando, Florida. Two hundred sessions offer strategies for many stakeholders in human subjects research. Visit: http://www.primr.org/Conferences.aspx?id=4831

Conference– The Third International Applied Ethics Conference in Sapporo, Japan will take place on November 21-23, 2008. Topics discussed will include: Meta-Normative Ethics, Bio/Medical Ethics, Engineering Ethics, Ethics of Science and Technology, Information Ethics, Environmental Ethics, Business Ethics, and International/Global Ethics. Visit: http://ethics.let.hokudai.ac.jp/en/new.html

Conference – A conference on December 10-11, 2008, hosted by the Tilburg Institute for Law, Technology, and Society (TILT), will address the available knowledge on and policy approaches to regulating new technologies. The conference will take place at Tilburg University, Netherlands. Visit: http://www.tilburguniversity.nl/faculties/law/research/tilt/conference/

Fellowships – The Center for Human Values at Princeton University invites applications from all disciplines for the Laurance S. Rockefeller Visiting Fellowships for the 2009-10 academic year. Deadline is November 10, 2008. Each year a fellow is selected to explicitly examine values in ethics, aesthetics, religion, or another evaluative discipline. Visit: http://www.princeton.edu/~uchv/VPDT.html

Fellowship – The Stockdale Center for Ethical Leadership and the Carnegie Council on Ethics and International Affairs invites applications for its annual Resident Fellowship in Ethics and Leadership. The fellowship seeks to strengthen public understanding of the ethics of war and peace, ethics and the military profession, and the relationship of ethics and leadership development. Deadline for applications is February 1, 2009. Send to Dr. George R. Lucas, Jr., 112 Cooper Road, Annapolis, MD 21402-5022; Fax 410-293-6081; grlucas@usna.edu

New Media – Public Ethics Radio, an online audio broadcast that features scholars and thinkers engaged with ethics in the public life, was launched in August 2008. Visit: http://www.cceia.org/resources/audio/data/000216

Workshop – The Association for Practical and Professional Ethics and UNL's Robert J. Kutak Center for Teaching & Study of Applied Ethics are hosting a workshop on *Promoting Ethics in Research* on October 18, 2008 at the University of Nebraska, Lincoln. Visit: http://www.indiana.edu/~appe/rcrec_workshop.html

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