Chapter 3

Ethical Issues of Concern in the United States Department of Agriculture-Agricultural Research Service

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ABSTRACT

Widely publicized occurrences and allegations of fraud and plagiarism in scientific publications have eroded public confidence in the integrity of scientists. They have caused scientists to question the wisdom of our traditional reliance on the honor system and the self-correcting nature of the process. Concerns about such misconduct have also raised questions about the ethical climate in our scientific institutions and how to improve it. One important way institutions establish and maintain their ethical climate is through their publication policies. Although allegations or instances of scientific misconduct in the Agricultural Research Service (ARS) have been few, it is currently reviewing its ethical climate and procedures for dealing with scientific misconduct, reflecting science and society's general concern. In ARS, classification (rank, promotion, and demotion) and annual performance appraisals of research scientists are based largely on accomplishments documented in scientific publications. There is a pervasive trend among scientists both within and outside ARS toward summarizing achievement in terms of numbers of papers published. It is easier to count publications than to objectively assess their quality and impact. Procedures used to assess quality and impact of publications rely heavily on formal peer review of publications during the classification process. Therefore, continued reinforcement is required to keep the focus on quality and impact during review. Manuscripts reporting original research are also peer reviewed within ARS before they are approved by ARS for submission to journals. The ARS is developing a Code of Scientific Ethics to emphasize ethical responsibilities and aspirations relevant to its activities. Procedures for dealing with allegations and instances of data falsification and plagiarism are under review and an ARS directive formally defining the procedures is being developed. It is anticipated that both the code of ethics and the directive for dealing with misconduct in science will be officially adopted by ARS in 1992.

SOCIETY'S IMAGE OF SCIENTISTS

Being a scientist is not what it used to be. Gone is the luxury of working in obscurity over a lifetime to pursue a narrowly focused interest while communicating with only a handful of respected colleagues. This was the nineteenth century image of science many of us grew up with. The public's views of what scientists are and do, and how we do it, and how long it takes to do what we do, are often shaped by Hollywood images. They too often see scientists portrayed in the act of defeating alien technology in 2 h or less with just the right gadgets, that coincidentally happen to be lying around the lab.

In their excellent publication *On Being a Scientist*, the National Academy of Sciences' Committee on the Conduct of Science (Committee on the Conduct of Science, NAS, 1989) describes how complicated the role of science has become in modern society. Science operates in a highly visible public arena, addresses and reshapes many fundamental social issues, and spends large amounts of

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public money. It is a prime agent in providing the technology that has begun in less than three generations to reshape the very face of the planet upon which we live. "Yet," to quote the committee, "scientific knowledge emerges from a process that is intensely human, a process marked by its full share of human virtues and limitations." Because of the potency of science as a catalyst for change, and because of society's growing uncertainty whether the sum of progress wrought by science has been entirely good for mankind, science itself and individual scientists have increasingly become the focus of public scrutiny. Unfortunately, attempts to understand what motivates a highly skilled scientist to commit fraud have given only ambiguous and clouded insight (Anonymous, 1989; Roman, 1988).

RANGE OF CONCERNS AND ALLEGATIONS

Several recent controversies have elevated the concern of scientists, administrators, legislators, and publishers about ethical issues and misconduct in science. Prominent among these controversies have been alleged cases of data fabrication (Broad and Wade, 1982; Kohn, 1988; Klotz, 1986; Norman, 1988; McBride, 1974; Sun, 1989; Culliton, 1983; Anderson, 1988; Boffey, 1987), and proactive intervention by journal editors to discredit research that they had already consented to publish (Davenas et al., 1988; Sun, 1989; Benveniste, 1988a, b; Maddox, 1988; Maddox et al., 1988; Pool, 1988). These are examples of atypically extreme ethical "questions" involving elements of the scientific community.

What frequently has emerged from this initially narrow focus is an appreciation of the need to ensure an ethical climate in its broadest sense. As institutions responsible for science deal with the problem of misconduct, ethics questions are soon recognized to be highly stratified. The problem of individual scientists publishing false or plagiarized data is only one stratum when viewed in the fullest scope of scientific activity. In addition to the highly visible issue of integrity in reporting science, ethics questions arise at other levels of scientific activity. At a minimum these ethical concerns involve the maintenance of integrity in proposing, funding, administering, conducting, and evaluating science ... in addition to the highly visible issue of integrity in reporting science. In the most general sense, any activity that has the potential of bringing credit or money to oneself, one's friends, or one's favored ideas or programs (or conversely, of withholding credit or money from competitors, enemies, or opposing ideas or programs) carries a potential incentive for ethics violations or misconduct.

Indeed, conflict of interest has been recognized as the Medusa of science ethics, a Gorgon for which there is no immediate Perseus. Conflict of interest can take many different forms, manifest itself with varying degrees of intensity, and carry a range of consequences from the trivial to the cataclysmic. Program sponsorship or constituency served has been quantitatively shown to influence data interpretation in the medical and ecological sciences (Chalmers et al., 1990; Smith, 1988). At a personal level, conflict of interest can influence writing or review of grant proposals, manuscripts, or reports for reasons ranging from ego protection to programmatic or personal gain (Spector, 1990; Cassidy, 1990; Reisner, 1986; McGourty, 1989; Mervis, 1990; Koshland, 1990).

Ethical controversies from within Federal scientific agencies involving various aspects of the scientific process have received wide publicity in recent years. The Challenger explosion and Hubble telescope failure have prompted questions regarding the pressures of politics and public relations on implementation of scientific decisions. The Atomic Energy Commission and Nuclear Regulatory Commission have come under intense criticism for problems at reactor sites and weapons facilities. Federal science funding is under increasing scrutiny as competent but small research entities seek fair treatment in the arena of grant review and funding (Norman, 1990) in a system that cannot be totally freed from influence networks. The U.S. Geological Survey (USGS) was the focus of U.S. Senate hearings that questioned USGS policies that suppressed scientific dissent and favored technical interpretations that conformed to a particular political point of view (Marshall, 1989). Within the United States Department of Agriculture (USDA) a politically sensitive human nutrition study was altered without the authors' consent in 1986 by politically appointed USDA officials prior to publication (Marshall, 1990a). The National Academy of Sciences was sued for plagiarism in the 10th edition of the nutritional guide *Recommended Daily Allowances* (Marshall, 1990b). The agronomic and animal sciences have been criticized for promoting a system of agriculture from the 1950s through the 1970s that has accelerated soil loss and introduced millions of tons of hazardous substances into the environment and food chain. Our worst critics argue (rightly or wrongly) that this has been the result of a large-scale lapse of ethical judgement, resulting from the corruption of public institutions and scientists by the outside funding of research by chemical companies.

Questions of ethics, by definition, involve personal value judgments that are often only arguably right or wrong, depending on the social context in which they are evaluated. Unlike the Ten Commandments of Judeo-Christian tradition, which strictly forbid or require specific behavior, a code of ethics, at best, identifies ambiguous considerations, and offers guideposts outside of the specific context in which decisions are being made.

An important aspect of ethical decisions that frequently differs from simpler legal decisions lies in the immediacy of impact. Ethical decisions may not result in noticeable consequences for a long time or they may have more impact on individuals removed from the decision than those immediately involved with it. There may be an accretion of consequences with the passage of time or, as the result affects locations, individuals, or institutions stepwise removed from immediate impact of the ethical decision. Thus, ethical decisions frequently involve a

degree of speculation about consequences, rather than defining a framework of absolute right and wrong.

Another consideration involves institutional or organizational decision making and policy making that can provide substantial anonymity (and amnesty) to those who collectively make these judgments. Their decisions and policies can have profound impacts on the lives and careers of individuals, or even other institutions and organizations. They can also create "climates" that are capable of either enhancing or impairing the ethical framework of the individuals within their domain. Pragmatism takes on a larger dimension in such institutional and anonymous decision-making environments. Because the product of most scientific institutions is published research, and because their reward systems are generally tied to publication, it is important to understand the range of ethical issues important to the institutional conduct and publication of science.

APPROACHES TO RESOLUTION—GENERAL

The Congressional concern about the potential for ethical violations and fraud in Federally funded science has produced a tide of ethics bolstering measures in science institutes nationwide. This has been most clearly manifest in the requirement by the National Institutes of Health (NIH) for grantees to demonstrate the existence of an effective mechanism for dealing with misconduct in science (Dep. of Health and Human Services, 1989). Congress and NIH have been particularly concerned about preventing publication of fabricated or plagiarized data. The urgency of dealing with misconduct in science has taken a quantum leap with recent application of the False Claims Act of 1863 (amended in 1986) to cases of scientific fraud (Palca, 1990). This statute provides financial incentives to whistleblowers who provide information used to prosecute institutions that have made fraudulent use of Federal funds. Within the scientific community much of our anxiety has emanated from a concern for the integrity of the scientific literature (Stewart and Feder, 1987). Universities, private foundations, and other Federal agencies have responded to these concerns and requirements by establishing or revamping policies and protocols to ensure the integrity of published research.

Some have suggested that a well-tuned peer review system could prevent or minimize scientific fraud, plagiarism, and other egregious forms of scientific misconduct. Refereed publication, as we know it today, has been in place for less than 100 yr (Burnham, 1990, 1992). It finds its earliest roots in the dissemination and evaluation of scholarly letters. Daniel J. Boorstin's book *The Discoverers* (1983) provided some insight into one of the earliest concepts of the peer review system in the Royal Academy. Sir Isaac Newton, a celebrated churchman as well as the world's most renowned contemporary scientist, was president of the academy. He notoriously rode roughshod over the careers, reputations, and creations of his colleagues in his personal quest for awards of "Priority." From these earliest beginnings the peer review system has struggled with conflict of interest. In modern journals editorial power is usually less concentrated, and the fate of a given manuscript is less capricious. It is generally recognized, however, that no peer-review process is perfect.

Certainly internal institutional peer review by close associates prior to journal submission has the greatest potential to detect fraudulent papers through a review regimen. Most agree, however, that no form of peer review can be made infallible, especially if it is to deal efficiently with the numbers of submissions faced by today's scientific institutions and journals. The system relies on trust and honor. Our best hope as a scientific community lies in removing unreasonable publication pressure by emphasizing research quality over quantity, limiting temptation by requiring rigorous internal review, institutionalizing measures to deal with misconduct, and continually fostering a climate of ethical sensitivity among individual scientists (Sigma Xi, 1986; Committee on the Conduct of Science, 1989). Fortunately, there are at least limited data that would suggest that the literature, in time, heals itself. In recent citation analyses of fraudulent work (Garfield, 1990; Garfield and Welljams-Doraf, 1990; Kronick, 1990) about 40% of the citations of fraudulent literature were self citations, and citation rate fell off by one-third once a published work was identified as illegitimate. Furthermore as citation indices become thoroughly automated and cross-referenced to include errata, retractions, disavowals, and related editorial caveats, future use of discredited data will diminish even more.

Nonetheless, ethics training should be an integral part of science education at the graduate level. An individual's application of ethics cannot be significantly altered by a last minute short course on the topic (Levin, 1990). Science depends upon a continued growth of an individual's ethical awareness both as a maturing and learning adult, and specifically within our profession through the course of our graduate study (Iammarino et al., 1989). This growth may involve some specific classroom consideration of ethics, but in greater part it involves emulation of mentor and role-model behavior, attitudes, and application of ethics in day-to-day professional activities (Committee on the Conduct of Science, 1989). At best, however, it must still be recognized that the will to act within an ethical framework rests with the individual. To quote the Sigma Xi handbook *Honor in Science* (1986):

> Certainly, neither codes of behavior nor statements of principles can prevent unethical behavior. They may even be endorsed enthusiastically by individuals who ignore them in practice, if only because many people are capable of rationalizing their own actions as justifiable exceptions . . . But such statements of principle need not be useless, either.

APPROACHES TO RESOLUTION—AGRICULTURAL RESEARCH SERVICE

The Agricultural Research Service (ARS) has taken a number of positive steps to enhance its ethical climate. Many of these steps relate directly or indirectly to the publication process. At the direction of Dr. R.D. Plowman, Administrator of the ARS, a committee of scientists and administrators was convened in September 1989 to heighten ARS sensitivity to the issue of integrity in science, to recommend policies to minimize the potential occurrence of misconduct, and to deal with cases of misconduct in the event they occur. Some ARS policies that impact upon ethical concerns are described below. In the context of this symposium, particular emphasis was placed on the ethical implications for the publication of ARS research.

Identifying an Ethical Paradigm

As Federal employees, ARS scientists are required to adhere to the "Code of Ethics for Government Service" as specified under the authority of Public Law 96-303. This code was passed unanimously by the U.S. Congress on 27 June 1980, and signed into law by the President on 3 July 1980 (Appendix 3-1). The opening statement of this code stipulates that "Any person in government service should: [uphold] loyalty to the highest moral principles . . ." This code was supplemented on 17 Oct. 1990 by President Bush with the signing of Executive Order 12731 (Appendix 3-2), "Principles of Ethical Conduct for Government Officers and Employees." This executive order particularly addresses conflicts of interest from which Federal employees might benefit financially. Furthermore, all Federal employees receive a semiannual reminder on ethics and conduct, usually accompanied by one or both of these codes with instructions on how to initiate investigation of alleged misconduct covered by these codes.

In addition to these general codes, the ARS Committee on Misconduct in Science has drafted a specific code of ethics relating to ARS scientists and their mission. The current draft of the code is presented below. Statements 1 to 6 apply directly to the publication process, as noted by bold passages.

DRAFT CODE OF SCIENTIFIC ETHICS OF THE U.S. DEPARTMENT OF AGRICULTURE-AGRICULTURAL RESEARCH SERVICE

As civil servants, all ARS employees must adhere to the Code of Ethics for Government Service as established in Public Law 96-303. Scientific personnel in ARS also share special ethical responsibilities that derive from their professional skills and roles in the service of science, agriculture, the environment, and the public. These additional ethical responsibilities include, but are not limited to the following:

1. Pursue new knowledge and disseminate it freely and widely for the betterment of mankind, and **make no impediment to the advancement of science by others.**
2. **Be honest and objective in all scientific** or managerial **discussions and decisions concerning** the U.S. Department of Agriculture, Agricultural Research Service, and **science and agriculture at large.**
3. **Ensure the validity and integrity of all proposed or accomplished research, the accuracy and precision of collected data, and the maintenance of original data to allow review after dissemination.**
4. **Present research findings fully and objectively, even if they conflict with personal interests or the interests of those supporting the research.**
5. **Provide encouragement, assistance, and constructive criticism to juniors, peers, or established scientists in your field as warranted, and foster an environment that emphasizes research and publication quality but allows for conflicting scientific interpretations.**
6. **Recognize the enabling role of antecedent science and the contributions of others to your work, and accept no unwarranted benefit from the accomplishments of others.**
7. Seek the training required to maintain or improve professional skills. Provide mentorship and encourage training and development for others.
8. Plan and conduct research in a manner that ensures human safety, protection and humane treatment of human and animal subjects, and that avoids unnecessary degradation or contamination of research resources and the environment.
9. Promote the mission of the USDA to ensure the supply of food, fiber, shelter, and other produce of the biosphere through responsible husbandry of the soil, air, water, and biological and aesthetic resources of the earth. At the same time encourage ecosystem sustainability and the health and hygiene of the biosphere and its inhabitants.

Contending with Scientific Misconduct

The second product of the Committee will be a draft ARS directive dealing with misconduct in science. The draft directive, which will not be finalized until revision following review by the Office of General Counsel, Office of the Inspector General, and the Office of Personnel, provides for appointment by the administrator of ARS of a standing Committee on Ethics in Science and investigative panels. The Committee on Ethics in Science is envisioned to have umbrella responsibility to make recommendations to the administrator of ARS that will foster the principles embodied in the proposed Code of Scientific Ethics. It would also recommend when allegations of scientific misconduct warrant investigation and recommend panel members for appointment by the Administrator to investigate the allegations.

The draft directive would establish step-by-step protocols to follow in dealing with allegations of scientific misconduct. An important consideration in the development of the draft directive has been to properly protect all parties in an investigation of misconduct, so that regardless of outcome the smallest possible consequences on the mission of science, integrity of data, and careers and productivity of innocent parties could be preserved. The draft document draws heavily on protocols established at NIH and universities as models. The draft directive would further recognize the need to identify and, if appropriate, punish frivolous accusations of misconduct, such accusations being, in themselves, a form of misconduct. Where necessary the directive would also provide for active measures to restore the reputation and credibility of the wrongfully accused.

EXISTING AGRICULTURAL RESEARCH SERVICE POLICIES

Manuscript Review and Approval

Certain policies and practices related to ethics and publishing have been in effect in ARS for many years. One example is the requirement for internal review and administrative approval of scientific publications prior to journal submission (ARS Directive 152.1). As noted earlier, no system of review is likely to be *totally* effective in *detecting* scientific misconduct. Internal review is likely, however, to serve as at least a *partial deterrent* and has some potential to avoid ethical conflicts related to author credit within a research group. Internal review certainly improves manuscript quality. Internal peer review also affords the opportunity to detect potentially fatal (in terms of manuscript acceptance) flaws in the analysis or reporting of the work.

This policy, in effect for the approximately 2500 ARS research scientists, requires a minimum of three reviews of every manuscript to be submitted as the first publication of definitive data in a peer-reviewed journal. The reviews must come from " ... two or more peers from outside the authors' research units, selected with the assistance of the Research Leader (RL) or other supervisor. At least one peer must be in a location other than that of the author(s), and the author(s) are strongly encouraged to get a review by a scientist who is not employed by ARS." Upon requesting administrative permission to submit the revised manuscript to a journal, these peer reviews must be accompanied by statements of rebuttal to or compliance with the reviewer's comments. The choice of reviewers and adequacy of revision are evaluated by the scientist's RL and area director before the scientist is permitted to submit the paper to a journal. Similar policies are widely practiced by other research institutions. In a survey of state experiment stations (Sojka et al., 1992), 22 of 44 states responding replied that peer review and administrative approval were required by the college or experiment station prior to journal submission.

The question of who should be included as an author on scientific publications is itself an important if sometimes ambiguous ethical question. The ARS has had specific policies in place regarding authorship since at least 1979 (ARS Directive 152.2). These guidelines for crediting authorship of scientific and technical publication specify that "Regardless of grade, classification, or title, if an individual has made a meaningful and effective contribution to the planning, implementation, analysis, or preparation of a research project, then that individual should be considered as a potential author or co-author." The directive provides specific guidelines that constitute criteria for authorship. In general these criteria delineate involvement in essential elements of the scientific creative process as a prerequisite to authorship, and exclude authorship for what are generally described as " ... a routine service function ... rote application as standard procedure ... or a mechanical compilation of data." In instances where it is not clear if an individual who participated in a phase of the work warrants authorship, that individual can be assigned responsibility for defending the manuscript during the internal peer review. Successful defense under critical review provides additional evidence that authorship is warranted.

Classification of Research Scientist Positions, Promotion, and Demotion

Peer review is also the centerpiece of ARS research scientist career advancement, via the "Research Position Evaluation System," or RPES (ARS Directive 431.3). The processes of research scientist position classification and annual performance evaluation are often the sources of some confusion and misunderstanding among Federal research scientists. This stems from the fact that both processes involve assessment of "the person in the job," and both proceed simultaneously on a continuing basis. The aspect of position classification based on performance of the person in the job is implemented through the RPES. The aspect of individual performance is implemented through a system of annual performance appraisals (described in greater detail below). The RPES evaluates long-term productivity, whereas the annual performance appraisal evaluates productivity during the past year but does not recognize a scientist's proven track record.

Research scientist positions in the Federal government are classified via criteria in the U.S. Office of Personnel Management (USOPM) Research Grade Evaluation Guide (RGEG). Centered on the RGEG, ARS has developed a comprehensive approach to classifying the wide variety of research scientist positions within the agency. This approach is designated the "Research Position Evaluation System" or RPES. The RGEG and the RPES find a strong parallel in most universities in their tenure and promotion committees and faculty handbooks. The Federal government "promotes" its research scientists by

having them demonstrate that they have positively impacted their research positions to such an extent that the positions meet higher RGEG grade-level criteria.

In ARS, however, no scientist is tenured for life. An ARS scientist can be reduced in grade through action of the RPES, or even separated from service for poor performance by failing to meet annual performance goals appropriate to the research position for which the scientist was hired. Each ARS research scientist position must be re-evaluated every 3 to 5 yr, depending on grade level. This philosophy of recurring evaluation by peers provides a strong motivation for ARS scientists to remain productive and to publish. It also demands, however, that interpretation of a scientist's performance focuses on the impact of his/her scientific contributions rather than on the thickness of his/her resume. Evaluating impact is often difficult. It is necessary, however, in order to keep the focus on the quality of a scientist's contributions rather than the quantity of a scientist's publications. Such a focus tends to diminish the motivation to publish trivial research or seek the least publishable unit. Ideally, it also lessens the temptation to commit scientific fraud, to plagiarize, or "fudge" in order to lengthen a scientist's list of publications.

The RPES system has been under continual scrutiny, review, and revision since its implementation in 1958. Yet the RGEG itself has not required substantial change since 1960, attesting to its quality. The most recent (1986) revision of ARS Directive 431.3 identified a number of other important issues (besides recognizing impact) that are currently affecting the RPES. Since technology itself, and the framework of government-mandated research are constantly evolving, the RPES (as implemented through peer evaluation panels) must constantly be alert to subtle or newly emerging issues relevant to the assessment of a research scientist's contribution.

Some of the various issues the RPES has recently begun addressing include: (i) the need to devise evaluation criteria for technology transfer, particularly in the new climate of patent development and industry interactive research, both of which can limit or delay publication; (ii) the need to adequately reward the administrative role of the RL in ARS; (iii) the need for appropriate criteria to evaluate the impact of accomplishments, such as computer modeling, which often are not delivered through traditional publication outlets, and may not lend themselves to such techniques as citation analysis; (iv) the need to adequately credit special assignments, long-term or high-risk research, or research categories that have come to be called maintenance research . . . that are often routine but absolutely vital to the overall continuance of agricultural research as a whole.

Annual Performance Appraisals

The performance of research personnel in ARS is evaluated on an annual basis through the development and implementation of annual performance plans. The concept of the annual performance plan is an outgrowth of implementation of the Civil Service Reform Act of 1978 and is documented in ARS Directive 418.3. The annual performance plan is a contract between supervisor and scientist to identify appropriate performance goals for each year. Ideally, these goals are codified and customized for each scientist and agreed upon in writing in an annually updated document that itemizes "specific" goals for the year. Achievement of annual performance plan goals are the basis of performance ratings, annual bonuses, and awards as determined through the performance management and recognition system or PMRS (ARS Directive 468.6). The annual performance plan is also the primary management tool in place for dealing with unacceptable performance by scientists. It provides for remedial activity by poor performers through performance improvement plans (PIP). Ultimately the annual performance appraisal can also result in separation from service as a result of a scientist's failure to meet performance goals or improvement goals mandated by PIP. Specific appeals and grievance policies are also established (ARS Directives 463.2 and 463.4).

For research scientists the main focus of the annual performance plan is on conceiving, conducting, and reporting research. The annual goal setting and the focus of the annual performance plan on publication numbers have caused concern amongst many ARS research scientists. This argument suggests that the plans would do better to emphasize impact and quality, and that annual number counting creates undue pressure in an occupation where timed creative production is often unreasonable.

Coping with Ethical Controversy

The ARS must also deal with other ambiguous ethical questions that have societal and political implications. Tobacco (*Nicotiana tobacum*) production research is an example of a program that poses ethical questions because the industry it supports has both positive and negative impacts. On the one hand, ARS has the Congressionally mandated responsibility to conduct research to support the farmers and others whose livelihood depends on the tobacco industry. On the other hand are the health problems associated with tobacco use. On the positive side is the unique value of the tobacco plant as a tool for basic research in genetic engineering, plant pathology, etc., that will ultimately be applicable across the spectrum of plant sciences. This results in an ongoing debate about the wisdom and ethics of using public resources for tobacco research. These concerns cause some individuals to avoid or decline employment in tobacco research. In some instances these individual decisions may be primarily for ethical reasons. Others may decide on the basis of enlightened self interest and doubts about long-term prospects for research tied to an industry increasingly condemned for its contribution to a public health problem.

The care and welfare of animals used in research is an ethical issue of concern in society at large, as well as in the scientific community. The ARS policy assures that all vertebrate animals used in ARS research are treated humanely and in compliance with the Federal Animal Welfare Act, the NIH Guide for the Care and Use of Laboratory Animals, and the USDA Guide for the Care and Use of Agricultural Animals in Agricultural Research and Teaching. The ARS policy for animal care and use includes requirements for: facilities, daily care provided to each animal, appropriate training and health programs for all employees who work with animals, an attending veterinarian, and an Institutional Animal Care and Use Committee at all ARS locations that use vertebrate animals.

Institutional Animal Care and Use Committees include scientists, the attending veterinarian, an individual not otherwise affiliated with the institution, and an individual who is not a scientist (e.g., ethicist, clergy, attorney, or business person). The committee reviews in advance and approves or disapproves all protocols for experiments involving animals. Their review is to assure compliance with ARS policy and that the animals are not subject to unnecessary pain or suffering. They may suggest or require alternative experimental procedures that will improve the welfare of the animals to be used in specific experiments. They conduct annual reviews of animal facilities and activities at the location, notify scientists and administrators of deficiencies and advise on opportunities for improved animal care. They investigate any allegation of animal abuse or failure to comply with ARS policy, and maintain records of the above activities.

Numerous other issues pose equally if not more controversial ethical conundrums. These include research affecting or involved with animal welfare, fetal tissue, and toxic substances. If an employee requests reassignment based on his or her individual ethical concerns, ARS policy is to consider such requests and make appropriate reassignments if feasible. On the other hand, ARS is legally and ethically accountable to conduct Congressionally mandated research, and must act in accordance with that responsibility.

CONCLUSIONS

The issues cited throughout this paper are subtly interwoven into the overall publication ethos of scientists. The peer-review and editing process does not exist in a vacuum. It exists inside the scientific paradigm, affected by and affecting these issues. The process has intellectual, moral, institutional, and human dimensions, none of which can reasonably be removed, and all of which deserve legitimate consideration in dealing with this issue.

The perception that publication number is an appropriate measure of scientific productivity exists, in varying degrees among scientists in ARS and other research organizations. To the extent that it exists, it fosters the attitude that it is numbers rather than quality that count. This attitude can be a factor that serves to erode ethical sensitivity and may increase the temptation toward misconduct. It may also encourage research approaches most likely to yield the greatest numbers of publications. Alternative (longer-term or higher-risk—from a publication standpoint) approaches are sometimes more likely to solve problems. Although no further formal revisions of ARS Directive 431.3 are likely to be adopted in the near term, the ARS Committee on Misconduct has discouraged focusing on the tallying of numbers of publications as a measure of a scientist's achievement and impact. Our institutions and organizations must reinforce the emphasis on quality and impact when evaluating a scientist's publication record. These recommendations are not new (Branscomb, 1985; Jackson and Prados, 1983).

As our government and institutions attempt to come to grips with application of ethical standards and prosecution of fraud, great danger exists that the solutions posed by well-meaning nonscientists may be worse than the problem. As noted by Robert Rosenzweig (1989) there is a tendency for Congressional oversight to oversimplify issues and gravitate toward unrealistic solutions. In posing what he felt was the proper governmental role in these matters Rosenzweig stated:

> Beyond those useful and supportive stances, the government must periodically assure itself that public monies spent for research are being used responsibly and effectively. The primary duty to ensure that is the case rests with the agencies that administer the funds. The overarching responsibility lies in Congress and can be exercised when necessary through periodic oversight hearings. There is good reason to believe that this distribution of responsibilities among universities, the administering agencies, and Congress has worked well in this instance, too. At least it deserves a chance.

The efforts to promote high ethical standards in ARS have been in this vein, namely to shoulder the fundamental responsibility for high standards within the agency's own administrative prerogative. This elevation of ethical sensitivity across the entire profession of science must occur in order to maintain credibility with the public, who finance science. The shouldering of this responsibility will ultimately ensure the vigor and purity of the scientific literature, and avoid what Candace Pert described as "a crime far worse than fraud" in policing of scientific misconduct (Pert, 1990). Quoting from her editorial:

> ... there is a much greater threat to the quest for truth than the one-in-a-million scientist who fabricates data. Because the overwhelming majority of outright deceptions—or even honest but incorrect interpretations—is quickly revealed, the community of scientists is never led astray for long by scientific fraud ... Truly invidious—and a far greater danger to scientific enterprise—is the prevailing closed-minded stodginess prompted by suspicions of fraud that now inhibits the acceptance of the new, unexpected discoveries that make for real scientific progress ... it is more important to publish the slightly uncomfortable study than to publish the solid-to-the-point-of-being-boring work. Fraud is an infinitely smaller danger to scientific

> progress than is the suppression of the quest for novel, invigorating truth ... When new and important work never sees the light of day and innovators are eliminated from the system before their contribution can penetrate it—this is a real crime!

Although it is possible to criticize Pert's outlook as too forgiving and overly optimistic, the sole alternative (random audit) to increased professionalism and institutional responsibility may be unthinkably Draconian by comparison. Drummond Rennie, western editor of the Journal of the American Medical Association, has suggested that scientific journals conduct random audits of papers, as what has been termed a pre-emptive strike against bureaucracy (Culliton, 1988). He maintained that such audits "would be scholarly and would not demand the setting up of a large federal bureaucracy." The resources and energy that have recently been expended investigating well-founded (and subsequently well-publicized) suspicions of fraud, and the public spectacles that have usually resulted, belie the likelihood that random audits would proceed so primly.

There would be many pitfalls, not the least of which includes the question of data interpretation. Who would have both the qualifications and the time to participate in credible random scientific audits? Who will peer review the assessments and interpretations of those who presume to audit? Who will pay for the audits? Will journals retract articles that auditors have retrospectively labeled as fraudulent? Will "random audits" of publicly financed research be public information? Who will pay the legal expenses and damage claims if auditors are sued by auditees accused of fraud?

Scientific productivity thrives best in a climate of intellectual freedom and diversity. Such a nurturing environment could easily be eroded by excessively heavy-handed monitoring that treats all professional scientists with the same level of distrust deserved only by transgressors. Close control at the institutional, organizational, and professional levels is and should be the first line of defense against scientific misconduct. Our scientific institutions are already rigorously financially accountable for research funds. There is no evidence that, in all but the rarest of circumstances, that immediate supervisors, research leaders, department heads, cooperators, concerned colleagues, and in-house reviewers do not provide ample checks and balances on potential misconduct through the proper exercise of professionalism.

The ARS accepts no complacency with regard to scientific misconduct. It has long maintained administrative and structural protocols to provide a healthy ethical climate in every aspect of its research activities. Its attention to these issues is undeviating. The recent endeavors described in this paper underscore its ongoing commitment to safeguard the integrity of the scientific activity under its stewardship.

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APPENDIX 3-1

Code of Ethics for Government Service†

Any person in government service should:

Put loyalty to the highest moral principles and to country above loyalty to persons, party, or Government department.

Uphold the Constitution, laws, and regulations of the United States and of all governments therein and never be a party to their evasion.

Give a full day's labor for a full day's pay; giving earnest effort and best thought to the performance of duties.

Seek to find and employ more efficient and economical ways of getting tasks accomplished.

Never discriminate unfairly by the dispensing of special favors or privileges to anyone, whether for remuneration or not; and never accept, for himself or herself or for family members, favors or benefits under circumstances which might be construed by reasonable persons as influencing the performance of governmental duties.

Make no private promises of any kind binding upon the duties of office, since Government employee has no private word which can be binding on public duty.

Engage in no business with the Government, either directly or indirectly, which is inconsistent with the conscientious performance of governmental duties.

Never use any information gained confidentially in the performance of governmental duties as a means of making private profit.

Expose corruption wherever discovered.

Uphold these principles, ever conscious that public office is a public trust.

†Authority of Public Law 96-303, unanimously passed by the U.S. Congress on 27 June 1980, and signed by the President on 3 July 1980.

APPENDIX 3-2

Principles of Ethical Conduct for Government Officers and Employees

Section 101. Principles of Ethical Conduct. To ensure that every citizen can have complete confidence in the integrity of the Federal Government, each Federal employee shall respect and adhere to the fundamental principles of ethical service as implemented in regulations promulgated under sections 201 and 301 of this order:

(a) Public service is a public trust, requiring employees to place loyalty to the Constitution, the laws, and ethical principles above private gain.

(b) Employees shall not hold financial interests that conflict with the conscientious performance of duty.

(c) Employees shall not engage in financial transactions using nonpublic Government information or allow the improper use of such information to further any private interest.

(d) An employee shall not, except pursuant to such reasonable exceptions as are provided by regulation, solicit or accept any gift or other item of monetary value from any person or entity seeking official action from, doing business with, or conducting activities regulated by the employee's agency, or whose interests may be substantially affected by the performance or nonperformance of the employee's duties.

(e) Employees shall put forth honest effort in the performance of their duties.

(f) Employees shall make no unauthorized commitments or promises of any kind purporting to bind the Government.

(g) Employees shall not use public office for private gain.

(h) Employees shall act impartially and not give preferential treatment to any private organization or individual.

(i) Employees shall protect and conserve Federal property and shall not use it for other than authorized activities.

(j) Employees shall not engage in outside employment or activities, including seeking or negotiating for employment, that conflict with official Government duties and responsibilities.

(k) Employees shall disclose waste, fraud, abuse, and corruption to appropriate authorities.

(l) Employees shall satisfy in good faith their obligations as citizens, including all just financial obligations, especially those—such as Federal, State, or local taxes—that are imposed by law.

(m) Employees shall adhere to all laws and regulations that provide equal opportunity for all Americans regardless of race, color, religion, sex, national origin, age, or handicap.

(n) Employees shall endeavor to avoid any actions creating the appearance that they are violating the law or the ethical standards promulgated pursuant to this order.

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