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On scientific freedom and responsibility

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1. Dedication

In dedicating this article to John T. Edsall, I focus on his positions and contributions in defining Scientific Freedom and Responsibility. I apologize for presuming to predict his possible responses to various agonizing problems facing the scientific community today. Although Edsall wrote about and justified secrecy in science during World War II, I venture to guess that, as we contend with a new and different international crisis in the War on Terrorism, he would vigorously oppose some of the policies now being considered by government agencies. Thus, it may be of value to revisit some of his past statements and place them in the context of 2002.

My involvement with Professor John Edsall began in the 1940s when I became a part time graduate student in the Department of Physical Chemistry at the Harvard Medical School, and I had visions of doing research for the Ph.D. under his supervision. Unfortunately, that goal had to be abandoned because of my obligations as a technician to help in the research of Wendell Stanley and Max Lauffer at the Rockefeller Institute for Medical Research in Princeton, New Jersey. As a result of the requirements for research on viruses and the development of vaccines during World War II, my periodic visits to Boston and Cambridge to pursue graduate studies were interrupted. Subsequently, I served in the Navy and ultimately completed my graduate education at Princeton University. In the ensuing 55 years, I have had frequent contact with John Edsall as he became my friend, mentor and role model. Indeed he and his wife, Margaret, lived in our home one summer while he was teaching Biochemistry in Berkeley and I was teaching at the Marine Biology Laboratory in Woods Hole, Massachusetts. My positions on many of the issues described herein have been greatly influenced by extensive discussions with him and by his writings.

2. Introduction

Among distinguished scientists, John T. Edsall is virtually unique in having so many illustrious careers. Moreover, many of his prominent contributions in diverse areas were concurrent. His pioneering research on the physical chemistry of proteins was not abandoned while he was inspiring and guiding many young students and post-doctoral fellows as their beloved mentor. With all that activity, he still found time to be an outstanding and innovative editor, historian and statesman whose incisive critiques on different issues proved definitive in the formulation of national science policy. It was John Edsall, through speeches, articles, and as an influential member of various committees, who helped to define and link the issues of Scientific Freedom and Responsibility. As a

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leading spokesman for the position that scientific freedom is indispensable and cannot be compromised, John Edsall also played a major role in educating his contemporaries and their followers that there was a concomitant responsibility which so many tended to neglect.

Edsall's seminal paper [1] in *Science* in 1975 described most of the issues relevant to freedom in science and the concomitant responsibilities that are still with us today. Although John Edsall was the sole author of the published paper, he points out in his typical, modest way that the contents were an abbreviated version of a lengthy report of the American Association for the Advancement of Science (AAAS) Committee on Scientific Freedom and Responsibility. The headings of some of the various sections are particularly relevant today: 'Should there be Forbidden Areas in Basic Research?'; 'Restrictions on Needed Research: Fetal Research as an Example'; 'The Conflict between Science and Secrecy'; 'Conflicts Involving Scientific Freedom and Responsibility'; and 'Professional Societies as Protectors of the Public Interest'. The contents of these sections, in terms of today's climate and the potential impact of proposed government policies on the scientific community, demonstrate vividly that John Edsall was far ahead of his time. It is noteworthy that the March 22, 2002 issue of *Science* contains a 'Letter of appreciation' from the Committee on Scientific Freedom and Responsibility of the AAAS citing John Edsall's important role in the establishment of that Committee in 1976. As pointed out in that Letter,

> Edsall's many articulate statements over almost a half a century of the rights and responsibilities of scientists have greatly focused these issues nationally and internationally.

3. Two aspects of scientific responsibility

In a later article [2], published in 1981, John Edsall wrote about the independence of scientists, issues of public policy, and whistle-blowing in a way which defined his philosophy of the responsibilities of scientists:

> There are two major kinds of scientific responsibility. There is the pattern of responsible behavior that is associated with basic research and the communication of the results. And there are the problems that arise when scientists deal with issues involving social responsibility—such matters as the control of nuclear and other weapons, the uses and hazards of toxic chemicals and radioactive materials, the choice among various modes of producing or conserving energy or the criteria for deciding whether to dam a river or let it flow freely. These are very different problems from those involved in basic research; the decisions reached involve value judgments. They are, and indeed should and must be, political decisions. Nevertheless, applied scientific knowledge is an important element in the making of such decisions.

Edsall recognized that the problems of responsible behavior in these societal issues were much more complex than those faced by scientists in their research. Throughout his career, he faced many controversial problems, analyzed the pros and cons, and took stands in modest statements of principles that were well honed by years of experience and careful thought. John Edsall rarely missed a struggle over some application of science to the formulation of public policy. No matter how controversial the issue and polarizing the arguments, he participated in clear, respectful terms weighing in on the position he considered more valid. Though bold in his positions and statements on social issues, he never appeared combative. As a consequence, his calm, reasoned presentations were disarming and those of the opposite persuasion on the matter under debate did not consider him contentious. Accordingly he was remarkably effective.

4. Secrecy in science

In the context of the War on Terrorism, the scientific community is now being confronted with rumors that the National Institutes of Health is considering the support of classified research. We also read that discussions in the Department of Defense include the possibility of imposing criminal sanctions against individuals who publish results of unclassified studies involving basic research. These potential actions are described in numerous, diverse articles, such as 'Biologists Apprehensive over US Moves to Censor Information Flow', 'Pentagon Considers Tighter Controls on Academic Research', 'Bush Administration may Bar some International Students from 'Sensitive' Academic Fields', and 'Security Fears put Scientists under

Scrutiny'. In view of the widespread clamor for the need for some secrecy in science, it behooves us to look at some words in the John Edsall article of 1975:

> We believe that, with rare exceptions, data that provide a significant advance in fundamental science should not be kept secret except in a major war situation, as with the atomic bomb in World War II. Even in such cases, information should remain classified only for a limited and specified time; it should then be released automatically, unless a strong case can be made for withholding a particular piece of information for a further limited time. We should look at claims of 'national security' with a very critical eye; such claims, as we have good reason to know from recent experience, often serve to cover up government ineptitude or corruption.

This 1975 statement by John Edsall, acting as spokesperson for the AAAS Committee on Scientific Freedom and Responsibility is a remarkable testament. It is particularly relevant now as government officials consider imposing restrictions on the dissemination of the results of scientific investigations on the grounds that such information may be harmful to the United States in the War on Terrorism. In that article, Edsall quotes from a 1965 report of the AAAS Committee on Science in the Promotion of Human Welfare [3] which is worth repeating:

> Free dissemination of information and open discussion is an essential part of the scientific process. Each separate study of nature yields an approximate result and inevitably contains some errors and omissions. Science gets at the truth by a continuous process of self-examination which remedies omissions and corrects errors. This process requires free disclosure of results, general dissemination of findings, interpretations, conclusions, and widespread verification and criticism of results and conclusions.

Despite repeated statements on the culture of science, the importance of openness in the communication of findings, and the gains from the peer review of scientific publications, we are now witnessing proposals that 'security demands secrecy'. In his 1998 book entitled '*Secrecy*' [4], former Senator Daniel Patrick Moynihan wrote:

> Secrecy is a form of government regulation. Americans are familiar with the tendency to over regulate in other areas. What is different with secrecy is that the public cannot know the extent or the content of regulation.

His biting prose continues:

> It remains a hidden, enormous metasticizing mass within government itself.

Those advocating secrecy in science frequently lose sight of the difference between the creation of knowledge and the use of that knowledge. The creation of knowledge brings with it the responsibility to dispense that knowledge through the normal methods of publication in peer reviewed scientific journals. In advocating restrictions on publishing, for example, they overlook the obvious, that science is worthless unless the findings are communicated to others. They also underestimate how quickly others uncover classified research either by 'independent discovery or by clandestine disclosure'. In that regard Moynihan cites a report in 1970 of a special task force convened by the Defense Science Board. In its most telling passage, the task force wrote:

> … more might be gained than lost if the United States were to adopt unilaterally, if necessary, a policy of complete openness in all areas of information.

During World War II and for some time following the cessation of hostilities, scientists in American institutions of higher learning were deeply involved in widespread secret (or classified) research. Many universities and research institutions, which traditionally fostered the free exchange of ideas and information, were subjected to curbs from government that seemed necessary and were readily accepted. Much of the time, we did not know what was being studied in a neighboring laboratory. The requirements for secrecy and the safeguards to impose it had a large impact on the culture and ambience of universities, and it was recognized after the war that such research and the attendant restrictions were antithetical to the openness essential in institutions of higher learning.

Now, the problem has been expanded because of additional restrictions impeding and limiting the freedom to pursue avenues of research aimed at understanding natural phenomena and improving the quality of life. This 'new secrecy' differs from the secrecy during and after World War II that pre-

vented, not the actual research, but rather the discussion and release of findings derived from that research. Today, we are faced increasingly with impediments to openness in scientific investigations and the communication of results; but more importantly there are restrictions on certain types of research. These limitations stem not only from actions of government but also from arrangements between industrial organizations and universities, as well as the activities of the investigators themselves.

All of these limitations are detrimental to our universities and to the progress of scientific inquiry. In turn, our security is harmed. That loss in security is not because of too much communication. On the contrary, it is the absence of communicating, criticizing, and revising scientific reports that hinders the pursuit of knowledge. In the words of Nobel Laureate, Peter Medawar, 'He who shuts his door keeps out more than he lets out'. It is 'the shutting of laboratory doors' that is now being considered by the Department of Defense and other government agencies in the name of 'Security'. Proposals now being debated, such as deleting experimental details from papers on the construction of mutant forms of organisms, are more likely to deter crucial scientific advances than to provide 'road maps' for terrorists. Many of the restrictions being considered may have an effect opposite to that desired. Instead, the policies should be based on the principle that 'Maintaining the free flow of scientific data enhances national security'.

5. Cloning

As John Edsall approached his 100th birthday, he had not been a participant in the vigorous and sometimes acrimonious debate over cloning. But there can be no doubt that he would have been expressing his carefully researched views on this subject had he been only 10 years younger. It is worth examining his position on an earlier conflict involving science and ethical principles. In his 1975 paper, Edsall included a section entitled 'Should there be Forbidden Areas in Basic Research?' While recognizing that 'no subject should be declared off limits', Edsall pointed out that there are 'clear limitations on some kinds of research involving human beings, and indeed animals'. But then he went on to consider some restrictions and focused on fetal research. His words are very clear:

> In some important instances we believe that current restrictions on research have gone too far. Thus, the National Research Act of 1974 has, at least temporarily, banned research on any 'living' human fetus, either before or after induced abortion, except in the very unlikely event that the experiment is intended to save the life of that particular fetus. We strongly oppose such restrictions. Research on the human fetus, over the past two decades has yielded major benefits for human health.

The folly of the proposed limitation in scientific research has been amply demonstrated by the remarkable benefits in human health resulting from research on fetuses. Few would argue today that fetal research should be restricted. Rather, it should be intensified. The same can and must be said about research on the human embryo. Nuclear transplantation or therapeutic cloning and research on human embryonic stem cells must not be identified and confused, deliberately or inadvertently, as reproductive cloning aimed at producing human beings.

It is inconceivable to me that a slighter younger John Edsall would be silent over the debate now raging in the United Sates Senate regarding a bill that has already been passed by the House of Representatives. According to that bill, research into DNA replacement therapies—so called 'therapeutic cloning' and the importation from abroad of the products of such research would be unlawful. In arguing forcefully against this legislation, former Congressman John E. Porter highlighted the danger by stressing that:

> A scientist who conducted somatic cell nuclear transfer research or an individual who went overseas to pursue therapies that might be developed from such research to address diabetes or Parkinson's disease would be subject to fines and imprisonment.

This proposal by the federal government to criminalize scientific inquiry is both abhorrent and indefensible. The Senate bill under consideration entitled 'Human Cloning and Prohibition Act of

2002' is poorly conceived in that, in their effort to ban cloning of human beings, some legislators propose banning nuclear transplantation research which has so much potential. In this public debate, those favoring widespread bans are confusing efforts to create knowledge, through ethically valid research, with the unsafe and arguably unethical use of that knowledge. The latter could be banned for a fixed period of time through appropriate legislation without limiting research that clearly is not aimed at cloning human beings by techniques that today are unsafe. Any legislation must have a 'sunset clause' to designate its applicability for a stated period, because the remarkable progress of science coupled with evolving ethical principles is likely to render such laws invalid in the future. In the debate over research on fetuses, John Edsall cogently stressed the opinion that legal prohibitions affecting social policies should be of limited duration. We witnessed a similar issue in the controversy over in vitro fertilization when opponents wanted to ban such practices without consideration of the views of individuals and changing ethical standards. A persuasive case for a 'sunset clause' for a ban on human cloning was made in a recent editorial [5] by Donald Kennedy who described the following scenario:

> Even for reproductive cloning, the moral horizon may not be as clear as it now seems. Imagine in the future there is a childless woman with an infertile dying husband, whom she loves deeply. Imagine also that the technology for cloning by nuclear transfer is perfected and is without risk. Should a law passed now forbid her to have a child cloned from one of her husband's cells in the distant future? The question is not whether that is something most people would want to do. The question, rather, is whether society ought to prevent it a priori by making it a criminal offense.

That editorial, with the intriguing title 'Legislate in Haste, Repent at Leisure', provides an excellent perspective of the starts and stops in social action and it illustrates John Edsall's often repeated message about the link between the responsibilities of scientists and freedom in research.

6. Culture of universities

In his 1981 article in *Science* with the title 'Two Aspects of Scientific Responsibility' [2], John Edsall dealt separately with the issues of responsibility of scientists in their research and teaching, on the one hand, and their responsibility as informed citizens dealing with matters of public policy, on the other. Now, more than 20 years later, it is worth examining some of his thoughts and concerns in relation to the changing culture of universities. He wrote:

> The pursuit of knowledge in basic science is inevitably full of rivalry and competition, especially in fields that are most active, but it usually proceeds in an atmosphere in which there is a great deal of free communication of ideas and active discussion. When obvious major practical results begin to appear, a trend toward secretiveness usually sets in. The most dramatic example is the effect on physicists of the discovery of nuclear fission and the secrecy that followed. More than one distinguished physicist recalled nostalgically the intellectual freedom of exchange in physics in the years before 1939. A somewhat similar change appears to be taking place among the molecular biologists today, as the techniques of gene cloning hold forth the promise of manufacturing substances of great biological importance, cheaply and on a large scale. Some of my younger colleagues have told me that they find scientific meetings less interesting than they were about 5 or 6 years before and that too many people, they say, were clearly holding back information, presumably with an eye to applying for patents on new processes. There have even been charges that some authors of reports are deliberating failing to cite relevant work of others in hopes of claiming a patent on some new biological process or product.

Edsall then goes on to lament the competitive atmosphere and the fact that some scientists seem to succumb to it in ways which clearly violated his ethical code. He quotes with approval from a letter in the 1980s written by Joshua Lederberg to Gaylord Nelson, a former Senator from Wisconsin:

> The possibility of profit—especially when other funding is so tight—will be a distorting influence on open communication and on the pursuit of basic scholarship.

That section of Edsall's paper dealing with competitiveness and responsibilities as scientists ended with:

> The traditional patterns of scientific reporting and communication may be in danger of undergoing significant erosion. As a believer in the classical tradition of operation in basic science, I hope that the erosion may be halted.

Unfortunately, Edsall's expressions of hope seem to have fallen on deaf ears, and the culture of our universities has moved further from what he experienced as a productive scientist and teacher. Imagine his reaction to the following offer from a prominent scientist at a non-profit institution who offered to provide some highly desired material on condition:

> that recipients [1] not share the material or by-products with anyone else, [2] notify the providing institution 60 days in advance of publication, and [3] yield the providers first rights on any improvement of the vector or products made with it.

Although some scientists signed this unconscionable agreement, many others were outraged and vociferous in denouncing such an 'offer to share'. Some institutions, through their technology transfer offices, objected to the conditions. But, suppose the university or research institution was seeking industrial support. Would there be institutionally imposed limitations on the dissemination of results of scientific investigations? Doubtless, John Edsall would have been horrified at this proposal from Company X to collaborate with Institution Y based on the following restrictions:

> Company X would provide Institution Y 'general funding' for research of its choice in return for an exclusive worldwide license to all Institution Y inventions related to medical or manufacturing products, excluding existing research agreements with third parties. …Company X would be allowed to review invention disclosures stemming from federally funded research at Institute Y before the disclosures are filed with the government.

When this contemplated agreement became public, it was met by an outcry in Congress leading to its demise. Problems inherent in the collaboration between the for-profit companies and universities are increasing. Unfortunately, there are too many egregious examples of clinical studies where the findings and publication of conclusions were either suppressed or delayed interminably while disputes were being resolved. In several of the disputes, litigation was invoked when individual scientists defied the restrictions on release of information they considered essential to the well being of patients. Instead of supporting the protesting scientists in several of these encounters, the institutions terminated their employment.

Much of the change in the culture of universities which John Edsall lamented is attributable to the enactment in 1980 of the Bayh–Dole Act [6] which was aimed at promoting the economic development of the products of federally funded research at non-profit institutions. For many years, NIH-sponsored research had led to an outpouring of exciting scientific results which were all in the public domain through publication in scientific journals. There appeared to be little incentive for commercial development of the new products or technologies. As pointed out by Garret Hardin [7] in his seminal article, 'The Tragedy of the Commons', the great discoveries were available to all, but no one benefited. In response to this apparent dilemma, Congress passed the Bayh–Dole Act encouraging universities to patent and profit from discoveries made through research supported by federal funds. This act has been remarkably effective in leading to the commercialization of advances in biomedical science. But it has had some unintended consequences, which clearly have troubled John Edsall and others who are concerned about the openness of our universities. Considerations about intellectual property, and material transfer agreements are predominant in the ambience of universities and medical schools, in particular. Gone are the days when a simple telephone call from an investigator at one institution requesting a 'plasmid' from a colleague at another laboratory led to a prompt response along with the receipt of the desired material. Now, more often than not, the response to the scientist requesting the material is 'Contact your university technology transfer office and have someone in that office get in touch with the corresponding office in our institution so that they can agree on a material transfer agreement'. Unfortunately, sharing material today is much less frequent than in the past and, when it occurs, there are stringent restrictions on the use of such material.

It is clear that impediments to the free exchange of materials, ideas and results are attributable to each of the constituencies involved in the research enterprise. Some scientists increasingly are not sharing the products of their research. For John

Edsall, this is an abdication of their responsibilities as scientists. To make matters worse, they are aided and abetted in this withholding by the universities in which they work. The hoped for goal of institutions to develop revenues from the research of graduate students, post-doctoral associates and faculty members is contributing to the barriers which defy openness. Interactions between academic institutions and industry almost inevitably led to the imposition of additional curbs on the intellectual exchange so necessary for the pursuit of knowledge. Superimposed upon these restraints are those emanating from government as a result of divergent and often conflicting political forces. There is no doubt that the grant programs of the National Science Foundation, the National Institutes of Health and other government agencies have led to much more research in universities, thereby affecting the culture of these institutions. Similarly, the Bayh–Dole Act is now having a major impact in leading to less openness and more secrecy. It is no surprise that the merging of academia and industry have introduced serious problems affecting the balance between openness and secrecy since their goals and functions are so disparate. The resulting conflicts must be addressed. It appears to many in academia, government and industry that the Bayh–Dole Act must be reexamined with the goal of reversing the commercialization or privatization of universities. How far back the pendulum must swing toward regaining the openness of the past without sacrificing the gains from commercialization of the products of research is a major dilemma. The success in biomedical research derived, for example, from the determination of the detailed structure of the human genome has brought this problem into focus. It has also raised the issue of patents and whether existing policies are actually leading to results opposite to those intended.

7. Whistleblowing

Throughout his writings, John Edsall has referred to the constructive role of whistleblowers and the intermingling of freedom and responsibility. His descriptions of some significant cases involving the application of science and technology in the development of public policy showed the benefits of whistleblowing. Often, the charges of whistleblowers have resulted in either a reversal of policies or a modification in their implementation. In controversial societal problems, as he pointed out, there are often fundamental differences of view. Although he was generally supportive of the whistleblower, he was well aware of the difficulty in being an ‘objective and impartial’ judge. He stressed that ‘the passion for getting at the truth should be the dominant passion for scientific workers when they are trying to act as responsible scientists’. While recognizing that ‘this may sometimes appear to be an unattainable goal’, John Edsall considered it ‘worth striving for’. As a result, he wrote about the criteria and procedures for the resolution of conflicts.

Edsall also devoted considerable thought to the role of whistleblowers in the investigation of ‘fraud’ or ‘misconduct’ in basic science. He wrote extensively on this subject. In 1988 he testified before the Subcommittee on Oversight and Investigations of the Committee on Energy and Commerce of the House of Representatives in their investigation of Fraud in NIH Grant Programs. His testimony, entitled ‘Some Thoughts on Scientific Fraud and Misconduct’, described some of his own experiences over a 10-year period as the Editor of the *Journal of Biological Chemistry* when he became aware of three published papers that were shown later to contain falsified or fabricated data. Based on that experience and his knowledge of other cases, Edsall almost instinctively was supportive of whistleblowers and was generally sympathetic to them because of the hazards they faced in making allegations. In that 1988 testimony [8] before the Committee of Congress, Edsall wrote:

> If a young scientist believed that he or she has witnessed a case of fraud, and comes to ask me about reporting it to the authorities, I would warn him or her emphatically about the dangers of doing so. If the potential whistleblower decided nevertheless to proceed, I would admire and greatly respect the person and the decision, but I would have serious anxiety about the future of that individual, as the system operates today.

Subsequently, Edsall wrote extensively [9] about that testimony, his support of Margot O’Toole who

was a whistleblower in the so-called Baltimore case, and his concerns about the hearings before the Committee of Congress. He recognized the controversial nature of the issues and the hearing before Congress with the words:

> I had been involved in controversies before, and had relished the involvement; I clearly understood the issues involved and knew unequivocally which side I was on.

That firm position was in support of the whistleblowers implicated in several of the cases under investigation. He was clear in indicating that he reached no conclusion as to the question whether 'fraud' was involved in the research being questioned by O'Toole. Indeed, in a letter to the Chairman of the Committee, Edsall expressed his concern that none of the authors of the paper under dispute 'were invited to attend the hearings, or given the opportunity to testify or answer questions'.

As stated forcefully in his 1994 paper, Edsall was troubled even more by the printed transcript of the 1988 hearings of that Committee of Congress labeled in large letters at the top of its cover page with the heading '*Fraud in NIH Grant Programs'*. He then went on to indicate that one of the cases discussed in the hearings had been thoroughly investigated and fraud was clearly established. However, as he emphasized pointedly, there had not yet been a resolution of the allegations made by O'Toole because the investigation had not been completed. Moreover, as Edsall understood O'Toole's testimony at that time, there was no charge of fraud. Rather it dealt with 'a question of error in the published findings, and of unwillingness to admit error on the part of Dr Imanishi-Kari'. Some years later, in 1996, after a lengthy investigation, the Research Integrity Adjudications Panel of the Department of Health and Human Services concluded:

> …the Office of Research Integrity (ORI) did not prove its charges of scientific misconduct by Imanishi-Kari by a preponderance of the evidence. The Panel recommends that no debarment be imposed and determines that no other administrative actions should be taken.

After more than a decade of charges and countercharges, this tragic episode, replete with incompetent investigations by a government agency and unwarranted leaks of confidential information to the press, was finally brought to a conclusion with the vindication of Imanishi-Kari. In the interim, of course, there was unfortunate damage to the reputations and positions of the involved scientists and considerable research was temporarily halted. As in others cases involving whistleblowers, John Edsall was steadfast in his support of O'Toole and the others who were whistleblowers in this particular case. Although he was firm in the conviction that errors in the literature must be corrected, he reached no conclusion about the validity of the allegations that there had been scientific misconduct.

8. Professional societies and codes of ethics

Throughout his writings, John Edsall stressed the role of professional societies in protecting the public interest. On various occasions, he referred to codes of ethics and their potential value in educating members of professional societies about the linkage between scientific freedom and responsibility. Although he supported the view that professional societies 'should fight for the rights of its members', he emphasized the need for them to act also on behalf of the public interest. As a leading member of the American Society of Biological Chemists, Edsall helped to initiate a protest over the actions of the US Public Health Service (PHS) in 1954 in denying grants to investigators because of unproven, adverse information in their security files [10]. That protest followed by actions of the National Academy of Sciences had a large impact leading to a reversal of the PHS policy with the restoration of grants to some of those whose grants had been terminated. The vigor of Edsall's position on this 'blackballing' of scientists because of presumed political activities was illustrated by his public condemnation of that practice and the announcement that he personally would not accept 'research support from the US Public Health Service as long as these practices continued'.

As notorious cases of research 'fraud' became public in the 1980s, congressional investigations and oversight of the activities of federally funded scientists became commonplace. This oversight

was accompanied by the establishment of the Office of Scientific Integrity, followed by the Office of Scientific Integrity Review, and finally the Office of Research Integrity. To an unfortunate extent, there was a return to the misguided policies of earlier years through the actions of the Public Health Service (PHS) in establishing its ALERT, which listed names of scientists under investigation for misconduct in science even before detailed investigations commenced. In response to the outcry from the scientific community, the PHS changed its policy to the listing of only those scientists against whom a finding of guilt had been reached.

Meanwhile, the word 'fraud' was replaced by 'scientific misconduct' causing individual scientists and professional societies to become active in taking positions on definitions of misconduct in science and appropriate mechanisms for adjudicating allegations of misconduct. Of particular concern in the definition of misconduct was the inclusion of the phrase, 'other practices that seriously deviate from those that are commonly accepted within the scientific community for proposing, conducting or reporting research'. There were no quarrels with a definition stipulating 'fabrication, falsification and plagiarism' as so egregious as to warrant government action leading potentially to sanctions as severe as debarment from federal support. The vagueness of the clause, 'other practices that seriously deviate', caused major protests by many professional societies including, in particular, the American Society for Biochemistry and Molecular Biology (ASBMB) and the Federation of American Societies for Experimental Biology (FASEB). After years of struggle and reports from numerous committees, a government wide definition based on fabrication, falsification and plagiarism has been adopted. Also, universities have been assigned primary responsibility for responding to allegations and investigating them. Procedures have been developed aimed at protecting the whistleblower as well as the accused. There are provisions for government oversight as well.

During this period of adversarial relations between the scientific community and government agencies, some professional societies have developed codes of ethics aimed at delineating the responsibilities of the member scientists. As John Edsall had pointed out, some of the existing codes of ethics dealt with applied science or engineering and seemed more applicable to industrial settings. Based on his experience as an editor who had to cope with several fraudulent papers over a 10-year period, he was very aware of the difficulties that professional societies would encounter in 'policing' misconduct. Nonetheless, he continually emphasized that professional societies had a responsibility in educating and inspiring their members toward achieving high ethical standards. In recognition of that responsibility and in response to the increasing government 'intervention' over misconduct in science, the ASBMB (formerly the American Society of Biological Chemists of which John Edsall was President in 1957) adopted a Code of Ethics in 1998. Although John Edsall had no role in its formulation, his frequently expressed views about the responsibilities of scientists in their research and positions on issues of public policy are readily apparent in the code. The ASBMB recognized that, in order to earn the trust of the public and the scientific community, its members would be expected to fulfill certain obligations described in the Code of Ethics in the following terms:

In fulfilling *obligations to the public*, it is *expected* that:

- investigators will promote and follow practices that enhance the public interest or well-being;
- investigators will use funds appropriately in the pursuit of their research;
- investigators will follow government and institutional requirements regulating research such as those ensuring the welfare of human subjects, the comfort and humane treatment of animal subjects and the protection of the environment;
- investigators will report research findings resulting from public funding in a full, open, and timely fashion to the scientific community; and
- investigators will share unique propagative materials developed through publicly-funded research with other scientists in a reasonable fashion.

In fulfilling *obligations to other investigators*, it is *expected* that:

- investigators will have actually carried out experiments as reported;
- investigators will represent their best understanding of their work in their descriptions and analyses of it;
- investigators will accurately describe methods used in experiments;
- investigators will not report the work of others as if it were their own;
- investigators, in their publications, will adequately summarize previous relevant work;
- investigators acting as reviewers will treat submitted manuscripts and grant applications confidentially and avoid inappropriate use; and
- investigators will disclose financial and other interests that might present a conflict-of-interest in their various activities such as reporting research results, serving as reviewers and mentoring students.

In fulfilling *obligations to trainees*, it is *expected* that:

- investigators serving as mentors will provide training and experience to advance the trainees' scientific skills and knowledge of ethical research practices;
- investigators will provide appropriate help in advancing the careers of the trainees;
- investigators will recognize research contributions of the trainees appropriately;
- investigators will encourage and support the publication of results of trainees' research in a timely fashion without undisclosed limitations; and
- investigators will create and maintain a working environment that encourages cultural diversity.

How much influence this code of ethics will have on biochemists and molecular biologists is, of course, not known. Almost certainly, John Edsall would support its purpose as a tool for educating and inspiring young scientists. It is likely also that he would recognize that implementation of the code through investigation of allegations and imposition of sanctions when guilt is established would be exceedingly difficult for professional societies. Moreover, the only sanction that could be imposed by a professional society is termination of membership, and such a remedy would be grossly inadequate for proven instances of fabrication, falsification and plagiarism. The present operating system for dealing with federally funded grantees, imperfect as it is, still seems the best mechanism for responding to allegations of misconduct in science. It provides protection for both the accused and the whistleblower.

9. Concluding remarks

The counsel of John T. Edsall in all aspects of scientific freedom and responsibility has been invaluable for approximately 50 years. No matter what the issue and regardless of the protagonists, he invariably provided an incisive analysis and carefully crafted statements that were remarkably effective. As a role model he had few peers. Today, in the backdrop of 'Security' in the 'War on Terrorism', the scientific community is faced with new restrictions which threaten the openness indispensable to institutions of higher learning. Some universities are considering accepting government funds for 'classified' research, even though there are government laboratories where such research could be conducted. Limitations are being proposed on access to data and results. Some journals are being urged to delete material from scientific papers that are considered as 'road maps' for terrorists. Federal support of certain types of research has been curtailed because of ideology. Many of those advocating these restrictions do not understand that the culture of science holds secrecy as antithetical to the conduct of research. The wisdom of John Edsall is sorely needed in convincing government officials and the public that openness in science actually enhances security.

It is an almost unbelievable paradox that the phenomenal success in biomedical research in the past 50 years has led to unanticipated pitfalls and conflicts that restrict the free pursuit of science. We are witnessing science, politics, greed and ethics colliding. Some crystallographers, and scientists in other areas, are not making available all of the data needed to support their publications and to permit others to use that information for further advances.

Although many leading journals recently have changed their policies and now require authors to make all of the information available at the time of publication, other journals still publish scientific papers without the requisite data being accessible in public data banks. It is ironic that the journal, *Science*, which is published by a professional society (AAAS), permitted only limited downloading of the sequence of the human genome obtained by a for-profit company, whereas a commercial journal, *Nature*, published the paper from the publicly funded effort which provided the complete sequence freely. It is reasonable and acceptable for a company that used its own funds for research to want to profit from that investment. What is not acceptable, and almost certainly would not have been tolerated by John Edsall, as the distinguished Editor of the *Journal of Biological Chemistry*, is for a journal to publish a paper on science without requiring all the necessary information to be made available to reviewers and readers. Unfortunately, a similar 'deal' has been made again by the Editor of *Science* in publishing a paper on the rice genome sequence without all of the data being accessible. The acrimony over this issue is likely to fade into insignificance compared to that looming over the patenting of genes. How one can support policies permitting the patenting of expressed sequence tags (ESTs), without identification of the encoded proteins, is difficult to fathom. Certainly, requirements for patents need reexamination. All of the participants in the research enterprise—scientists, editors, professional societies, universities, industry and government—will be needed in efforts to avoid collisions between greed and ethics along with those between science and politics. The writings of John Edsall provide some guidance for avoiding many of these conflicts.

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