Ethical standards in astronomy

Decadal Survey

State of the Profession Position Paper

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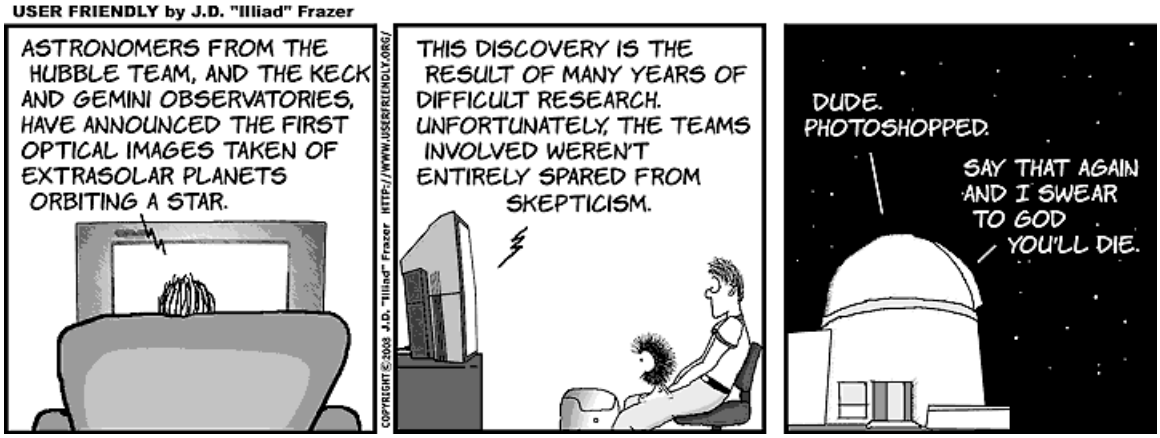

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Cover Art: Cartoon indicating that the integrity of all professional astronomers and astronomy as a scientific discipline depends on the responsible analysis and dissemination of primary data. Though photoshopping an astronomical observation, or "fabrication" in general, may seem unprecedented, evidence shows that modern scientists have been doing it for decades, and research misconduct receives wide public attention, when caught. It is telling that cases of fabrication are typically discovered by junior colleagues and/or science writers, rather than senior scientists or institutional entities. Arguably the professional penalties are mild relative to the wider damage done. The response that science is self-correcting is valid, yet resources are wasted to disprove results from unprofessional research.

ABSTRACT

Ethical conduct in astronomical research and education underlies the integrity of the profession. Here we present a brief discussion of three areas where ethics training and awareness can be improved and result in substantial benefits: A) authorship and publication practices, B) data and the research record, and C) protection of the environment. Further reading on these and other important topics not included here may be found at: http://astro.berkeley.edu/~kalas/ethics/pages/lectures.html

1. INTRODUCTION

Dozens of comprehensive books have been published within the past 20 years concerning ethical issues and responsible conduct in scientific research. Ethics guidelines and training have been established for the medical professions, engineering, and other disciplines involving human subjects. For physics and astronomy, the American Physical Society, Sigma Xi, and various research agencies in the United States and Europe offer ethics guidelines. Despite the existence of these resources, ethics education for astronomers depends on the apprenticeship model for doctoral and postdoctoral mentoring.

The apprenticeship-mentoring model will become increasingly unreliable because: (1) the ethnic and cultural diversity that now exists in astronomy brings very different ethical norms to the field, (2) ever larger research groups means that mentors devote less time in sharing the ethical values implicit in the scientific method with junior colleagues, and (3) the scope of astronomy research has expanded into domains where even the most experienced astronomers are unprepared to manage ethical dilemmas.

To appreciate why ethical awareness and conduct is an important component for the profession, consider some of the roles and responsibilities of astronomers:

1. Astronomers steward "big science", multi-billion dollar, publicly funded endeavors, such as the Hubble Space Telescope.

2. Astronomers influence a spectrum of high-impact projects, some with life-and-death implications. For example, planetary scientists are engaged in the debate regarding global climate change, instrumentalists invent technologies with dual-use potential (e.g., surveillance, defense), whereas others have expertise in quantifying the probability of catastrophic impacts.

3. Astronomers interact with teams of colleagues, including subordinates and service personnel, and face ethical dilemmas that fall outside the familiar realm of publishing research or peer review.

4. A large fraction of the undergraduate population receives their only college science instruction from an astronomer. Therefore, the Astronomy 101 course may be the singular opportunity for students to formally explore ethics in science. Thus, the stakeholders in astronomy ethics are spread across

the globe, among various public and private institutions, and throughout the education system.

5. Many people care about what astronomers predict or conclude. Globally, astronomers form a highly respected "natural fraternity" that may influence opinions on other matters such as the Earth's environment and international conflict.

6. The ethical behavior of astronomers is very much in the public spotlight, e.g., in a recent article in the New York Times (March 27, 2008), Dennis Overby notes that "Astronomers still argue about whether Jocelyn Burnell-Bell, who discovered the first pulsar while a graduate student at Cambridge University in England, should have shared in the subsequent Nobel Prize given to her adviser, Antony Hewish".

2. AUTHORSHIP AND PUBLICATIONS

Plagiarism, falsification, and fabrication are three cardinal science sins identified by the *National Academy of Sciences*. Yet, the ethical dilemmas of authorship and publication may be the most common concern among the broadest spectrum of astronomy students, postdocs, faculty, researchers, technicians, managers, and even entire institutions. As Hunt (1991) explained: "Few issues in scientific life can now match authorship of collaborative work for its potential to distract and destroy."

Publications are a key metric for the scientific success of researchers and institutions, and therefore directly relate to promotion and funding. The impact of publications therefore goes significantly beyond the core goals of disseminating research in a manner that assures credit where credit is due. With this much at stake, publications are a key area where ethical dilemmas and abuses arise. For example, one reason that the journal *Science* sends an e-mail to all authors for a submitted paper is that every week there will be a few instances where an author does not exist or who is not aware that they have authorship on a paper (Brooks Hanson, *private comm*.). Though such abuses typically originate from medical/pharmaceutical-related research, recall that one reason bubble fusion put Physics in hot water is that the lead investigator, Taleyarkhan, placed a student's name on a research paper without the student's knowledge (Reich 2008). In many types of astronomical research, answering simple questions such as "Who should be an author?" can be confounding, and authoritative answers are difficult to find.

Table 1 from the study of Ancker and Flanagin (2007) indicates that publications in astronomy lag behind the best practices in other professions in terms of another type of ethical dilemma - conflict of interest.

Table 1 Frequency and types of published conflict of interest policies for authors among 84 journals in 12 scientific disciplines

ISI category	No. with policy for authors/ total *n*	'Conflict of interest' explained through:		Financial interests defined by:		Potential conflict managed through:	
		Definition	Examples	Monetary limit	Time limit[a]	Disclosure	Ban[b]
Medicine, general and internal	7/7	3/7	6/7	0	4/7	7/7	2/7
Chemistry-multidisciplinary	6/7	6/6	6/7	0	0	6/6	0
Multidisciplinary sciences	4/7	3/4	2/4	2/4	2/4	4/4	0
Psychology	4/7	0	2/4	0	0	4/4	0
Medicine, research and experimental	3/7	1/3	3/7	0	0	3/3	0
Plant sciences	2/7	0	0	0	0	2/2	0
Astronomy/ astrophysics	1/7	0	0	0	0	1/1	0
Biological sciences	1/7	0	0	0	0	1/1	0
Biology	0/7	–	–	–	–		–
Engineering-multidisciplinary	0/7	–	–	–	–		–
Physics-multidisciplinary	0/7	–	–	–	–		–
Zoology	0/7	–	–	–	–		–
All	28/84 (33%)	13/28 (46%)	19/28 (68%)	2/28 (7%)	6/28 (21%)	28/28 (100%)	2/28 (7%)

An entire volume can be written on the various ethical dilemmas that arise with authorship and publications, but perhaps the Decadal Review would consider the following suggestions:

(1) The integrity of the profession can be guarded and improved if the astronomical journals review and adopt the best practices of journals in other disciplines as well as in *Science* and *Nature.* For example, the following practices could be implemented

   a. Editors for astronomical journals are given comprehensive training on best practices and ethical considerations.

   b. Journals clearly define their policies and opinions regarding authorship issues for submitting authors, and best refereeing practices (including conflict of interest disclosures) when peer reviewers are solicited.

   c. Astronomical journals use electronic means to validate all authors and scan for cases of biased or inadequate attribution, plagiarism and image manipulation.

   d. Penalties are defined and enforced.

(2) Awareness of science ethics can improve profession-wide with a top-down approach where journal editors actively disseminate the norms and procedures that result from recommendation (1) above. Among the possible activities are implementing routine workshops/lectures at the meetings of the *American Astronomical Society*, as well as visiting institutions to present colloquia and moderate discussions on these topics.

(3) Innovations and experimentation should be encouraged. For example, are peer reviews in astronomy less biased if the referee is blind to the authorship?

(4) The best practices that inform authors/referees of unacceptable conduct, as well as methods to guard against bias, plagiarism, etc., should be directly applied to the related process of proposal authorship and peer review.

3. DATA AND THE RESEARCH RECORD

Answers to simple questions such as "What is data?", "Who owns these data?", or "How long should I keep it and does ownership change over time?" are not entirely obvious. Data are often at the center of disputes regarding authorship, intellectual property, research integrity, mentoring and collaboration. The Decadal Review should also consider that data issues are becoming increasingly complex and well worth attention. Consider the following questionable research practices involving data:

- Failure to retain research data.
- Maintaining inadequate research records.
- Refusing reasonable access to research data.
- Misrepresenting speculations as fact or releasing preliminary research results, without sufficient data to allow critical review.
- Selecting and reporting data to improve the appearance of the data or to increase its significance.
- Suppressing negative data that may result in needless repetition.

Federal regulations give guidance, yet documents such as "OMB Circular No. A-110, 2CFR 215" are hardly disseminated or enforced in the astronomical community. The Decadal Review should consider that:

a) Astronomical data can have unique properties that are inadequately treated by federal regulations. For example, samples of meteorites, interstellar dust, etc. are not defined as data and require special consideration. Do such samples, and other types of astronomical data, fall under the doctrine of *res communis*?

b) Record-keeping is taught informally, and there is a falling away from careful and complete record-keeping practices.

c) There is little advanced discussion of data ownership and rights over time. For example, "Who owns the data?" may be answered quite differently by the institution, the observatory, the lead investigator and the junior researcher.

d) The responsible stewardship of data requires funding.

Astronomers have weighed in on these complex issues, but the profession would be best served with a centralized and codified version. For example, the essay by Beckwith (1999) on data stewardship is found in a newsletter that is easily missed over time. Organizations such as NASA, NSF AST, or the AAS have significantly greater institutional memory and authority to establish guidelines that might help smaller institutions and individuals conform to the best practices regarding data and the research record.

4. ENVIRONMENTAL ETHICS

Perhaps the main organized effort to preserve an environment is the planetary protection policies established by NASA ("all of the planets, all of the time"), which has a pedigree going back to the Outer Space Treaty of 1967. Mainly, this is a dispassionate argument for avoiding the contamination of a planet where future experiments require samples preserved in their pristine state. However, part of the argument should be that it is unethical to alter a pristine environment without significant justification. With more nations and cultures developing the means of space exploration, such values may not necessarily be shared by other space agencies. The decadal review might consider if the Outer Space Treaty and associated treaties have components that are out of date or inadequate. For example, given technological advances since 1967, are there components of the Outer Space Treaty that are now irrelevant, yet compliance is both costly and interferes with mission objectives? Or is the opposite true, that planetary protection requires greater funding?

More down to Earth, astronomers have recently faced ethical dilemmas where advancing or preserving the profession have an associated cost to the environment. Three examples are:

1) Possible endangered species, such as the Wekiu Bug, entered into the delay of the NASA Keck outrigger telescopes on Mauna Kea, Hawaii.

2) AAS Informational Email 2007-6 requested input from the astronomical community regarding the cost-benefit of operating Rattlesnake Mountain Observatory in a region designated as an ecology reserve (Hanford Reach National Monument).

3) In November 30, 2008, the Austin, TX, newspaper *American-Statesman* reported that astronomer John Lacy terminated his membership in SOFIA due to the observatory's anticipated fossil-fuel pollution (Lockett 2008).

These examples illustrate that the research activities of the profession – whether in space, on the ground, or in between – have environmental impacts that require awareness and responsible planning. Many of these topics had been faced by astronomers in the past (e.g., at Mt. Graham), yet lessons-learned are perhaps inadequately preserved and disseminated.

Given the examples above, the Decadal Review could exercise awareness regarding environmental issues when recommending key projects or evaluating problems in the profession. Even if the Decadal Review reaches a conclusion that the cost to the environment for a given project or professional activity is greatly outweighed by the benefit to scientific research or science education, it is important to keep in mind that other scientists and non-scientists may possibly arrive at a different conclusion. Given the lasting impact of Decadal Review statements, the Decadal Review has a chance to raise the level of environmental sensitivity across a very broad audience.

References:

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