CLOSEOUT FOR M93080046

In August 1993 OIG was informed by the University[1] that it was conducting an investigation into allegations of misconduct in science against the subject.[2] At the conclusion of the University's investigation, OIG began its own investigation. OIG's investigation report and NSF's Acting Deputy Director's 9 April 1999 letter describing his determination constitute the closeout for this case.

[1] The [redacted]

[2] [redacted], an Associate Professor of [redacted] in the [redacted] at the University.

NATIONAL SCIENCE FOUNDATION
4201 WILSON BOULEVARD
ARLINGTON, VIRGINIA 22230

April 9, 1999

OFFICE OF THE
DEPUTY DIRECTOR

Dr. [redacted]
Institute of [redacted]
University of [redacted]
[redacted]

VIA CERTIFIED MAIL – RETURN RECEIPT REQUESTED

Re: Notice of Misconduct in Science Determination

Dear Dr. [redacted]

The National Science Foundation's (NSF) Office of Inspector General (OIG) issued an investigative report in which it concluded that you falsified an NSF proposal by misrepresenting your research capabilities and the status of your research. A copy of the final investigative report is enclosed.

Scientific Misconduct and Proposed Sanctions

Under NSF's misconduct in science and engineering regulations, "misconduct" is defined to include "fabrication, falsification, plagiarism, or other serious deviation from accepted practices in proposing, carrying out or reporting results from activities funded by NSF." 45 CFR §689.1(a). The Foundation's administrative record indicates that you falsified an NSF proposal submitted in 1993 by misrepresenting your research capabilities and the status of your research during the term of a previous award. Your misrepresentation of your research capabilities and the status of your research constitutes falsification and is a serious deviation from accepted practices within the scientific community. We, therefore, conclude that you committed misconduct in science.

In deciding what sanction is appropriate when misconduct is found, NSF must consider the seriousness of the misconduct; whether it was deliberate or careless; whether it was an isolated event or part of a pattern; and whether the misconduct affects only certain funding requests or has implications for any application for funding involving the subject of the misconduct finding. 45 CFR §689.2(b).

According to the Investigative Report, in your proposal you deliberately created the false impression that you were able to examine [redacted] techniques – a procedure critical to your proposed research. The NSF program officer and reviewers of your proposal relied on your misrepresentations in awarding you the substantial long-term grant you received in 1994.

The case file indicates that you were furnished with a copy of the draft Investigative Report, and you provided a written response on May 29, 1997. In your response, you state that you never intended to mislead readers of your proposal even though you concede that your proposal could have been misinterpreted. After a full review, I do not believe the record supports your position. Although your response downplays the distinction between using [redacted] in your experiments, the record shows that your reported ability to [redacted] was a critical aspect of your research and that you would not have been awarded the level of support you received in its absence. You clearly had the incentive to misrepresent your laboratory's ability to perform the [redacted] procedure on [redacted] and this undermines your explanation that the statements were unintentional or careless.

I therefore take the following action:

- If you submit any research proposal or reports to the National Science Foundation or report on the results of NSF-supported research within two years from the date of this letter, you must submit to NSF's OIG a copy of the proposal or report, along with a separate written certification. The certification shall state that: (a) you recently reviewed NSF's misconduct in science regulations and to the best of your knowledge, the document is free of any such misconduct; (b) to the best of your knowledge, the proposal or report accurately reflects the status and results of your research; and (c) to the best of your knowledge, all statements in the proposal or report as to research results and the capabilities of your laboratory are backed by appropriate documentation. The certification should be sent to the Associate Inspector General for Scientific Integrity, 4201 Wilson Boulevard, Arlington, Virginia, 22230 at the same time that you submit the research proposal or report to NSF or report the results of NSF-funded research.

- In addition, during this two year period, if you submit any proposal or report to NSF, or report on the results of NSF-funded research, your Department Chairperson or Dean must also submit an assurance to the OIG that to the best of his or her knowledge; (a) your research proposal or report does not contain any falsification or fabrication, (b) the document accurately represents the status or results of your research, and (c) any statements in your proposal or report as to research results or the capabilities of your laboratory are backed by appropriate documentation.

Procedures Governing Scientific Misconduct Allegations

Under our regulations, you have 30 days after receipt of this letter to submit an appeal of this decision, in writing, to the Director of the Foundation. 45 CFR §689.9(a). Any appeal should be addressed to the Director at the National Science Foundation, 4201 Wilson Boulevard, Arlington, Virginia 22230. For your information, we are attaching a

copy of the Foundation's misconduct in science regulations. If you have any questions about the foregoing, please call Lawrence Rudolph, General Counsel, at (703) 306-1060.

Sincerely,

Joseph Bordogna
Acting Deputy Director

Enclosures (2)
Investigative Report
Misconduct in Science Regulations

Confidential

Office of Inspector General

Investigation Report

OIG Case M93080046

6 October 1997

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REPORT OF AN INVESTIGATION INTO ALLEGATIONS OF MISCONDUCT IN SCIENCE

SUMMARY

The Office of Inspector General (OIG) at the National Science Foundation (NSF) has concluded that Dr. [redacted] (the subject), a tenured Associate Professor of [redacted] in the Institute of [redacted] at the University of [redacted] he University) provided materially misleading and incomplete information that rendered key aspects of proposals and progress reports he submitted to NSF fundamentally false. OIG recommends that NSF find that the subject committed misconduct in science and take the following actions as a final disposition in this case:

1. Send the subject a letter of reprimand informing him that he was found to have committed misconduct in science.

2. Require, for a period of 3 years from the final disposition of this case, or for the term of his next award, whichever is longer, that each of the subject's submissions to NSF (including annual progress reports, requests for supplemental funding, and proposals) include, as part of the submission, a certification by the subject that he has reviewed NSF's misconduct in science regulation, and that the submission is free of misconduct.

3. Ensure, for the same period, that each of the subject's pending or future submissions to NSF include, as part of the submission, a signed assurance from a University official who is qualified to understand the laboratory's supporting research data and documentation that the official has reviewed those records and that all portions of the submission that rely on those records are accurate and complete.

4. Require, for the same period, that the subject send copies of the University official's assurances and the subject's certifications to the Assistant Inspector General for Oversight in NSF's Office of Inspector General, for retention in that Office's confidential file on this matter.

5. Reduce, during the same period, the annual increment for any award to the subject to $65,000 annually or to an amount commensurate with the program officer's evaluation of the subject's actual research capabilities.

6. Limit, during the same period, the term of any award to the subject to a maximum of 2 years or for a duration commensurate with the program officer's evaluation of the subject's actual research capabilities.

7. Consider, for the same period, requesting that assurances be submitted by the subject with his requests for funds from NSF's REU program, such as assurances from a University official who is qualified to understand experiment and data recording practices that the recording practices the subject imparts to his students and the subject's practice for reviewing records in his laboratory comply with acceptable scientific norms.

We believe that if NSF takes the recommended actions, NSF's interests will be adequately protected. However, the subject currently has funding from the Public Health Service and action short of debarment will not ensure that the interests of other federal agencies are protected. We recommend that NSF consider requiring that certifications and assurances similar to those described above be included with the subject's submissions to other federal agencies and, if it concludes that such steps are impracticable or will not sufficiently protect the federal government's interest, that it debar the subject for 3 years.

INTRODUCTION

NSF'S DEFINITION OF MISCONDUCT IN SCIENCE

NSF defines misconduct in science in relevant part as "[f]abrication, falsification, plagiarism, or other serious deviation from accepted practices in proposing, carrying out, or reporting results from activities funded by NSF." 45 C.F.R. § 689.1(a)(1).[1] OIG understands this regulation to give three examples of, and a general standard—the "other serious deviation from accepted practices" clause—that defines, misconduct in science. OIG views the "other serious deviation clause" as forming the legal basis for a finding of misconduct in science in all cases, including cases categorized as fabrication, falsification, or plagiarism.[2] OIG further understands that an act cannot be a "serious deviation" from accepted practices so as to constitute misconduct in science unless the act is committed with a culpable state of mind.[3]

In a misconduct proceeding, it is NSF's burden to show both elements—*i.e.* that an act seriously deviates from accepted practices *and* that the subject acted with a culpable state of mind—by a preponderance of the evidence. 45 C.F.R.§ 689.2(d). Because state of mind cannot be observed, NSF must generally infer knowledge or intent from surrounding circumstances. Like the courts, NSF may infer that a person intends the natural and probable

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[1] NSF's definition of misconduct in science also includes "[r]etaliation of any kind against a person who reported or provided information about suspected or alleged misconduct and who has not acted in bad faith." 45 C.F.R. § 689.2(a)(2). That portion of the definition is not implicated in this case.

[2] For a discussion of OIG's interpretation of the misconduct in science regulation, *see* our Semiannual Report to the Congress Number 13 at 27.

[3] For a discussion of OIG's interpretation of the level of culpability necessary to sustain a finding of misconduct, *see* our Semiannual Report to the Congress Number 9 at 36.

consequences of his or her acts, and may appropriately consider the consistency and reasonableness of a person's position, as well as his or her interest in the outcome of the proceeding, in making determinations of credibility and intent.

STANDARDS APPLICABLE TO CONTENTS OF NSF PROPOSALS AND PROGRESS REPORTS

Before considering whether a subject has seriously deviated from accepted practices in the scientific community in proposing, carrying out, or reporting results from activities funded by NSF and, therefore, whether he committed misconduct in science under NSF's definition, it is important to be aware of the requirements applicable to the preparation of NSF proposals and progress reports. We describe below the requirements articulated by NSF for these submissions. Where helpful, we also describe the evolution of those requirements.

1. Proposals

NSF makes funding determinations under the National Science Foundation Act, 42 U.S.C. § 1861, *et seq.*, based on the assessment of proposals by the cognizant NSF staff, assisted by merit reviewers. Accordingly, NSF has consistently required that applicants provide sufficient information—including accurate descriptions of supporting data, analyses, and methods, and of their progress under prior NSF awards—to permit proposals to be fairly and objectively assessed relative to the state of the field, current NSF awards, and other proposals with which they compete. *E.g., Grants for Scientific Research*, NSF76-38 at 1-2. For instance, NSF stated as early as 1955 that proposals should include "the design of experiments to be undertaken, if any, and the procedure to be followed should be outlined." *Grants for Scientific Research* (April 1955) at 3. Similarly, the direction that proposals include "an adequate description of experimental methods and procedures," NSF92-89 at 4, was adopted in 1973. NSF73-12 at 8.

The October 1992 version of NSF's Application Guide, entitled *Grants for Research and Education in Science and Engineering (GRESE)*, NSF92-89, was in force in 1993, when the subject submitted the renewal proposals evaluated in this report. Its directives, which were "mandatory **unless superseded**," *id.* at 1 (emphasis in original), required Principal Investigators (PIs) to certify that the statements in a proposal, excluding scientific hypotheses and scientific opinions, were "*true and complete, to the best of their knowledge . . .*" *Id.* at 2 (emphasis added).[4] The *GRESE* stated that

> The main body of the proposal should be a clear statement of the work to be undertaken and should include: objectives for the period of the proposed work and expected significance; relation to longer-term goals of the investigator's

[4] The subject so certified in the renewal proposals discussed in this report. Exhs. 5 and 8 at 2.

project; and relation to the present state of knowledge in the field, to work in progress by the investigator under other support, and to work in progress elsewhere. *The statement should outline the general plan of work, including* the broad design of activities to be undertaken, *an adequate description of experimental methods and procedures. . . .*

Id. at 4 (emphasis added). The *GRESE* required that proposals

present the: (1) objectives and scientific or educational significance of the proposed work; (2) *suitability of the methods to be employed;* (3) *qualifications of the investigator and the grantee organization;* (4) effect of the activity on the infrastructure of science, engineering and education, in these areas; and (5) amount of funding required. *It should present the merits of the proposed project clearly and should be prepared with the care and thoroughness of a paper submitted for publication. Sufficient information should be provided that reviewers will be able to evaluate the proposal in accordance with the four merit review criteria established by the National Science Board* (see p. 10).

Id. at 1 (emphasis added).[5]

The first of the four NSF Board review criteria to which the *GRESE* referred was research performance competence, which "relates to *the capability of the investigator(s), the technical soundness of the proposed approach*, and the adequacy of the institutional resources available." NSF92-89 at 10 (emphasis added). Consistent with NSF's prior statements to the community,[6] the *GRESE* described this criterion as "*essential* to the evaluation of the quality of every proposal," and stated that it encompassed "*the investigator's record of past research accomplishments. . . .*" *Id.* (emphasis added).

The second NSF Board review criterion to which the *GRESE* referred was the "*intrinsic merit* of the research." *Id.* (emphasis added). The *GRESE* explained that this

[5] NSF has consistently advised the community of applicants that these are the essential elements of a research proposal. Much of the quoted text flows verbatim from NSF's 1973 *Grants for Scientific Research.* NSF73-12 at 2. *See also,* NSF83-57 (Oct. 1989) at 1-2; NSF90-77 at 1. Effective October 1997, NSF will implement review criteria revised by the National Science Board in March 1997. Those criteria continue to stress considerations about the quality and feasibility of the proposed research and the capabilities of the proposer.

[6] As early as 1951, NSF stated that the scientific merit of the research and the competence of the investigator were considered important parts of the review process. *See Grants for Scientific Research* (Dec. 1951) at 1. Since 1976, NSF application guides have described the review criteria used to evaluate submissions. *See* NSF76-38 at 21. NSF introduced the research performance competence criterion in 1981. NSF81-79 at 8. NSF thus has a long-standing expectation that has been clearly articulated with increasing detail to the scientific community that proposals submitted to it should contain sufficient accurate information for reviewers and NSF staff to objectively evaluate the PI's technical abilities and proposed research.

criterion "is used to assess the likelihood that the research will lead to new discoveries or fundamental advances within its field of science . . . or have substantial impact on progress in that field . . . ." *Id.*

NSF has required since 1960 that *renewal* proposals include a description of *progress* under NSF funding. *E.g.*, NSF60-2 at 9; NSF63-27 at 15; NSF 76-38 at 17-18. NSF formalized this requirement when, in 1987, it required that proposals contain a separate section entitled "*Results from Prior NSF Support.*" NSF83-57 (rev.1/87) at 4.

By 1992, when the subject submitted the renewal proposals at issue in this case, NSF's *GRESE* stressed that reviewers would be asked to comment on the quality of prior NSF work, NSF92-89 at 4, and listed six requirements for this section including a summary of the completed work, publications acknowledging the award(s) and "a description of the relation of the completed work to the proposed work." *Id.* Up to 5 pages (out of the 15 allotted to the project description) could be used in describing the results of prior NSF support.[7] *Id.*

2. Award Progress

NSF has a fiduciary responsibility to monitor a PI's progress under an award. Since PIs may encounter major problems or significant discoveries that affect the relevance of the original objectives, NSF provides PIs with the flexibility to change the objectives or scope of an award. However, major changes require prior written approval by NSF. *E.g.*, NSF90-77 at 13; NSF92-89 at 16.

NSF consistently, and with increasing clarity, has told PIs that progress reports are required during the term of an award, and since 1978, has explicitly required that these reports include a discussion of problems encountered by the PI. NSF78-41 at 18.

The *GRESE* in force when the subject submitted his 1991 progress report stated that annual progress reports under continuing grants should "briefly summarize activity during the past year, identify any significant scientific developments, *and describe any problems encountered.*" NSF90-77 at 14 (emphasis added).

The *GRESE* in force when the subject submitted his 1992 progress report repeated the requirement for a description of problems encountered, NSF92-89 at 16, and added a second statement that the report should include "an indication of *any current problems* or favorable or unusual developments." *Id.* at 35 (emphasis added).

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[7] The page limit did not apply to the bibliography. NSF has consistently required a bibliography containing "complete" citations, *e.g.*, NSF92-89 at 6; NSF90-77 at 4; NSF83-57 (Oct. 1989) at 5, consistent with its expectation of "strict adherence to the rules of proper scholarship and attribution, which are at the heart of the research community, the communication of research results, and the competitive merit review system on the basis of which NSF makes awards." NSF92-89 at 1; NSF90-77 at 1; NSF83-57 (Oct. 1989) at 2.

PROCEDURAL BACKGROUND

The subject was the principal investigator on a 1990 NSF award, [redacted] entitled "[redacted] (1990 award), in the (then) [redacted] Program (Program). The total award provided $[redacted]: a grant of $[redacted] in research support over a 3-year period; Research Experiences for Undergraduates (REU) supplements totaling $[redacted] for three students; and a $[redacted] supplement to purchase a microscope.[8] The funding period ran from [redacted]1990 to [redacted]1995. This award was large for the Program, and totaled approximately $20,000 more per year than the average award.

In January 1993, the subject submitted a renewal proposal to NSF (the original renewal proposal).[9] In March 1993, after reading the original renewal proposal, the subject's graduate student informed a University administrator that she believed it contained misrepresentations. The University formed a committee of inquiry to address these allegations. On 2 April 1993, the subject withdrew the original renewal proposal from NSF consideration.

Later in April 1993, the subject submitted a revised renewal proposal.[10] NSF awarded a 5-year continuing grant on the basis of that proposal on 6 April 1994 and provided $[redacted] in support the first year. For each of the remaining 4 years of this renewal award, NSF projected that it would provide more than $100,000 in support. Like the 1990 award, the renewal award totaled approximately $20,000 more per year than the average award in the Program. The renewal award is currently in its fourth year. To date, NSF has provided four REU supplements (totaling $[redacted]) to provide support for undergraduate students working in the subject's laboratory under the renewal award.

In August 1993, the University informed OIG that it had found there was substance to the allegations of misconduct in science based on the contents of the original renewal proposal, and that it was forming a committee to investigate the allegations. Consistent with NSF's position that awardee institutions bear primary responsibility for prevention, detection, and investigation of misconduct, 45 C.F.R. § 689.3, OIG deferred our inquiry and any investigation until the efforts at the University were concluded.

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[8] The 1990 proposal is Exh. 1; the 1991 progress report Exh. 2; the 1992 request for funding for equipment Exh. 3; and the 1992 progress report Exh. 4.

[9] The original renewal proposal, [redacted], was entitled "[redacted]" and sought $[redacted] for research support. It is Exh. 5.

[10] The revised renewal proposal, [redacted] also entitled "[redacted]" also sought $[redacted] for research support. It is Exh. 8.

In July 1994, the University provided us with its investigation report. It later supplemented that report with information we requested after reviewing the report. On the basis of its investigation, the University concluded that the subject had committed "scientific misconduct in research."[11] Exh. 14 at 7. The report and the University's letter of reprimand are Exhs. 14 and 16; relevant appendices to the University's report are Exhs. 5, 6, 8, 9, 10. Supplemental information provided by the University in response to our request is found in Exhs. 11, 19 and 20.[12]

Following our receipt of the University investigation report, we conducted our own investigation.[13] We concluded that the allegations raised before the University, and an additional series of acts that came to light in the course of our own and the University's investigation, constituted misconduct in science under NSF's regulation. We sent the subject a draft of our investigation report and all supporting exhibits. His written comments, which we have taken into account, are included at Exh. 32.

We set forth below the evidence, drawn primarily from the subject's written submissions to NSF and the subject's statements to the University and to us,[14] that compels

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[11] All findings by the committee of investigation were unanimous, based on evidence the committee found to be clear and convincing. Exh. 14 at 2; Exh. 19 at 2. The University defines misconduct as "fabrication, falsification, plagiarism, or other practices that seriously deviate from those that are commonly accepted within the scientific or scholarly community for proposing, conducting, or reporting research. It does not include honest error or honest differences in interpretations or judgments of data." University policy statement on *Alleged Misconduct in Research.* The University advised us that, in applying this definition, it places "a lesser importance" on intent than does NSF and that its committee did not assess intent in making its findings of misconduct. Exh. 19 at 1-2; Exh. 20 at 2.

[12] Both the subject's graduate student and the subject reviewed and commented on the University's draft investigation report. Their comments are Exhs. 12 and 13, respectively.

[13] As part of our investigation, we visited the subject, and provided him with a copy of Exh. 11. We introduced ourselves, identified our professional positions and degrees, *cf.* Exh. 32 at 9, and provided the subject with the following advice, in writing, at the outset of our interview with him:

> The Office of Inspector General (OIG) is requesting information under the authority of the Inspector General Act of 1978, as amended, as well as the National Science Foundation (NSF) regulations on misconduct in science and engineering . . . The information you supply may be used during the course of an inquiry or investigation concerning misconduct in science and engineering, as well as for the routine uses specified in NSF Systems Notice 53 (published at 55 Federal Register 5308 (February 14, 1990)). OIG requests that you furnish information on a voluntary basis. You may, but are not required to, have a lawyer of your choice present at any meeting with OIG personnel. If you choose not to provide the requested information, OIG may reach conclusions concerning an allegation of misconduct without the benefit of your input.

The subject acknowledged by his signature on 19 March 1996 that he had "read and understood" this notice.

[14] The subject provided us with four affidavits during our interviews with him. Exhs. 23-26. The subject also rewrote parts of his 1993 proposal during the course of our investigation. Our letter describing the purpose for the rewrite and the rewritten proposal (the 1996 revision) are Exhs. 27 and 28, respectively. In our judgment, the 1996

our conclusions that he committed misconduct in science. Where relevant, we also cite the reasoning of the University's investigation report which reflects the mores of the scientific community at the subject's institution.[15] We begin by describing the field of research in which the particular acts take place. We then describe the acts at issue, the accepted scientific practices that we believe were violated by those acts, and the evidence and our conclusions concerning the subject's state of mind. We then present our analysis of whether the acts should be deemed to be misconduct in science under NSF's regulation. Finally, we turn to the disposition we recommend to the agency. Where relevant to our discussion, we reference the allegations that the University addressed, the conclusions it reached, and the actions it took.

THE FIELD OF RESEARCH

The subject is a [redacted] biologist who has described himself as "the world's expert on [redacted], period." Exh. 11 at 63. The proposals here at issue describe the subject's actual and proposed research on [redacted] This report largely focuses on the subject's descriptions of his research progress toward isolating and characterizing [redacted][16] which was Specific Aim 3 of his 1990 award and was also the work he proposed to do under Specific Aim 2, parts (a) and (b) of his 1993 renewal proposals.[17] Exh. 25 at 1, 2; Exh. 1 at 19; Exhs. 5 and 8 at 16.

In its [redacted] stage [redacted] s a [redacted] It [redacted]. It is known as a "[redacted] during its [redacted] age, once it has formed all its [redacted] structures but before it has [redacted] The [redacted] structures in the [redacted] and [redacted] are distinctly different. Unlike the [redacted], the [redacted] is [redacted] in a [redacted] and is particularly resistant to [redacted] techniques. *E.g.*, Exh. 6 at 2; Exh. 11 at 37. [redacted] are differentially responsive to [redacted] or other [redacted]. *E.g.*, Exhs. 5 and 8 at 6-7.

The subject's 1990 award and 1993 renewal proposals focus on individually identified [redacted] in [redacted] that synthesize and release certain [redacted]

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revision did not alleviate the concerns raised by the subject's initial submissions. The program officer's review of the 1996 revision, which reinforced that judgment, is at Exh. 29.

[15] The subject complains that the University did not give him access to testimony by witnesses in its investigation. Exh. 32 at 8. We cannot control the University's internal process. We have ensured that the subject had full access to all information on which we rely in this Report.

[16] [redacted] refer to the [redacted].

[17] We stress here, as throughout this report, that it is the subject's descriptions of his work and his research progress—not the research area or the validity of his results—with which we take issue.

[redacted] referred to in the subject's proposals as [redacted]. A [redacted] that alters its behavior in response to the presence of [redacted] is a [redacted] target."

[redacted] influence a variety of [redacted] behaviors in different [redacted] at different stages in the [redacted] cycle of [redacted]. At the time the subject wrote his proposals, he claimed that, although [redacted] are the *physiological* target of [redacted][18] [redacted] are not; *in vivo*,[19] [redacted] stimulate [redacted] and, in the [redacted] they affect [redacted] during several different activities. In an artificial environment, *in vitro*,[20] [redacted] can be made to respond to selected [redacted] preparations. Exh. 1 at 3, 5; Exhs. 5 and 8 at 3, 6-7; Exh. 25 at 1.

The subject's research prior to his receipt of support from NSF had led him to propose that [redacted] influence [redacted] in the [redacted] via the [redacted], [redacted]. [redacted] in turn, alters the [redacted] ([redacted]) concentration, and fluctuations in this [redacted] concentration influence [redacted]. Exh. 1 at 10. The subject sought to test this proposal by identifying and characterizing [redacted] in the [redacted] and determining which are modulated by [redacted] using [redacted] techniques[21] on [redacted]. Exh. 1 at 13, 21; Exhs. 5 and 8 at 16, 18.[22]

THE CONDUCT AT ISSUE

Overview

We set forth below a brief overview of the subject's research difficulties. We highlight ways in which we believe the subject's presentation of his past and anticipated research in his 1993 proposals (as well as in progress reports) masked both his lack of progress and his laboratory's difficulty performing certain experiments in a way that rendered those submissions fundamentally false. This made NSF unable fairly and objectively to evaluate or monitor the research, and therefore directly, centrally, and materially undermined NSF's ability to perform its mission.

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[18] "Physiological" means "characteristic of, or appropriate to, an organism's normal functioning." *Merriam Webster's Collegiate Dictionary* (10th ed. 1993).

[19] "*In vivo*" means in the living organism. *Id.*

[20] "*In vitro*" means outside the living body and in an artificial environment. *Id.*

[21] [redacted]

[22] The revised renewal proposal proposed to conduct these experiments on [redacted] as well as [redacted] Exh. 8 at 18.

Aim 3 of the 1990 award proposed to identify [redacted]-dependent [redacted] currents in individually isolated [redacted] or [redacted], using [redacted] substitutions and/or pharmacological [redacted] to isolate the [redacted] currents from other currents. Exh. 1 at 19, 21. This effort was one of three "co-equal" Aims identified in that proposal. Exh. 23; Exh. 1 at 12-13. The subject ran into serious difficulties, however, in conducting this research. His laboratory was never reliably able to perform this research because: (1) it was unable reliably to prepare the [redacted] or [redacted] necessary for [redacted]; and (2) on those few occasions when it was successful in dissociating [redacted] or [redacted], it could not reliably [redacted] the [redacted]. What it could do was [redacted] and [redacted]. As noted above, however, the research interest in Aim 3 (1990) focused on [redacted] and [redacted].

The subject's laboratory accordingly made little to no progress toward Aim 3 (1990), and the subject therefore included Aim 3 (1990) as Aim 2, parts (a) and (b), of his 1993 renewal proposals. The subject never noted in the renewal proposals, however, that Aim 2, parts (a) and (b) (1993), was identical to Aim 3 (1990); and, more importantly, as set forth below in greater detail, the subject never disclosed, in his submissions to NSF, the difficulties he had had in initiating the research described in Aim 3 (1990), as required by NSF policies and procedures. In two instances the subject stated that experiments had been performed when, in fact, they had not. In addition, the subject presented past work performed elsewhere without NSF support as progress made by his laboratory under the 1990 NSF award.

Specifically:

I. In his original renewal proposal, the subject reproduced a [redacted] that, from the legend and referential text, implied that the data were gathered using [redacted] when, in fact, they were gathered using [redacted]. This action made it appear that his laboratory had a greater capacity to [redacted] as contemplated in Aim 3 (1990)/Aim 2 (1993) than was in fact the case.

II. In his renewal proposals, the subject included a misleading description of his laboratory's ability to dissociate [redacted]. This description masked the difficulty his laboratory had experienced dissociating such [redacted] in a reproducible way as required to conduct the research contemplated in Aim 3 (1990)/Aim 2 (1993).

III. In the original renewal proposal, the subject claimed that his laboratory had shown that two compounds, [redacted][23] and [redacted][24] could be used to control variables ([redacted]) that had to be controlled for the proposed [redacted]

[23] [redacted] is the abbreviation for [redacted] blocks the [redacted].

[24] [redacted] is the abbreviation for [redacted] is used to block [redacted].

[redacted] experiments to be successful. These claims made it appear that his laboratory had developed the techniques and experimental conditions necessary to conduct meaningful experiments in order to secure useful results from [redacted] performed under Aim 3 (1990)/Aim 2 (1993). His laboratory had made neither showing.

IV. In progress reports under the 1990 award and in the 1993 renewal proposals, the subject re-presented research that he had performed with a colleague in 1988 in that colleague's laboratory and that he had cited as background support for Aim 3 (1990), as having been performed by his laboratory under the 1990 award. These presentations diverted attention from his laboratory's lack of progress on Aim 3 (1990).

We set forth below the subject's statements, and our analysis of why and how they were fundamentally false and misleading, and of the subject's state of mind.

I. THE PRESENTATION OF INFORMATION ABOUT THE ABILITY TO PERFORM [redacted] ON [redacted] WAS KNOWINGLY MISLEADING[25]

A. The Statements

Figure 7 of the 1993 renewal proposals demonstrates the successful performance of the [redacted] procedure on [redacted]. Exhs. 5 and 8 at 17.

The legend for Figure 7 in the *original* renewal proposal reads

> Figure 7. Family of [redacted] in [redacted]. Inset: [redacted] of [redacted] during same experiment.

Exh. 5 at 17. While the legend is technically correct in that a "[redacted]" was used, the associated text makes it clear that the [redacted] of interest is that of the [redacted]. Moreover, the text could not reasonably be interpreted to suggest that [redacted] were used. For example, the "Significance and Background" section of the original renewal proposal states that [redacted] act at four different points in the [redacted] of [redacted] with different target [redacted] and [redacted] effects at each point, with the hindgut being the primary [redacted] target in the [redacted] stage "whereas the [redacted] is the principal target *in* [redacted]" *Id.* at 6, 7 (emphasis added). Nothing in either submission says that the [redacted] is a physiological target of [redacted] The discussion is accompanied by a figure illustrating that the [redacted] is the physiological target of [redacted] in the [redacted]. *Id.* at 7, Figure 1.

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[25] This was Allegation 1 in the University investigation.

Similarly, the section in the original renewal proposal on results from NSF support on Aim 3 (1990) entitled "Mode of action of the [redacted] on the [redacted]" describes a model for this action and states, "[w]e have recently been able to [redacted] to test this model." *Id.* at 10 (emphasis added). It then states that the experiments to test this model are discussed in Aim 2 of the renewal proposal. *Id.* The "Methods" discussion for Aim 2 states that experiments to support that Aim "will be conducted on [redacted] isolated from [redacted]," *id.* at 18 (emphasis added). The text on Aim 2 elsewhere references Figure 7 as evidence of the subject's ability to "achieve a [redacted] preparation suggest[ing] that the proposed experiments are feasible." *Id.* at 16.

The *revised* renewal proposal was submitted after the graduate student told the University that she believed the subject's handling of this issue in the original renewal proposal was misleading. The subject's cover letter to the program officer and merit reviewers states that all changes from the original renewal proposal were highlighted. Exh. 7; *accord* Exh. 8 at 5 (changes "shaded").

The revised renewal proposal contains no changes to the portions of the "Significance and Background" and "Results from Prior NSF Support" sections relevant to the [redacted] action on the [redacted]. The relevant portion of the Methods section contains the additional, highlighted, statement that "[w]e will investigate these issues in [redacted], both of which respond to the [redacted]" and also added that experiments would be performed on [redacted] isolated from [redacted] (which was highlighted) as well as [redacted] *Id.* at 16, 18 (citation omitted; emphasis added). The legend to Figure 7 has also been modified to read (with additions here denoted *like this*)

> Figure 7. Family of [redacted] in [redacted].
> Inset: [redacted] of [redacted] during same experiment.

Id. at 17 (emphasis added). The change to the legend was not highlighted in the revised renewal proposal.

B. How the Statements were False and Misleading

From the context in which Figure 7 is presented in the original renewal proposal, the data in that Figure can be taken only as having been collected on [redacted] and not [redacted]. The statements and Figure 7 therefore imply that the subject's laboratory could, and expected to, perform the demanding [redacted] procedure on [redacted]. This was important because, in his proposals and papers, the subject had identified the [redacted] as the physiological target of [redacted], Exh. 1 at 3; Exhs. 5 and 8 at 3, 6-7; Exh. 25 at 1, and it was therefore experiments on the [redacted] that were of central importance to a discussion of significant scientific developments, or problems, in achieving Aim 3.

In fact, as the subject concedes he knew, the experiments producing the data contained in Figure 7 were conducted on [redacted]. Exh. 25 at 2; Exh. 11 at 76.

Moreover, the [redacted] procedure was far more difficult to perform on [redacted] than on [redacted], and the subject was acutely aware that his laboratory had had little success in [redacted] Exh. 32 at 2. The subject himself could not then do this procedure. Exh. 11 at 34-36. He told the committee of investigation that the graduate student's [redacted] tracings were messy, and that if she had showed him a good [redacted] tracing, he "probably would have taken her out to dinner." *Id.* at 81, 163. The laboratory's success rate in 1993 using the [redacted] technique was "much higher with [redacted] from [redacted] (final) [redacted] compared to [redacted] (>75% vs ca. 5%)." Exh. 28 at 18. *See also* Exh. 11 at 61. The subject, however, did not explain any of this in his renewal proposals.

The University committee of investigation unanimously found that the statements relevant to this allegation in the *original* renewal proposal were "simply misleading." Exh. 14 at 13. As the University Vice Provost said in reprimanding the subject, "inadequate labeling of Figure 7 in the original proposal in juxtaposition with text at pages 16 and 18 . . . misrepresented research upon which the proposal was founded, and it invited the reader to conclude that [redacted] had been used in the experimentation." Exh. 16 at 1.

The University reached a similar conclusion with respect to the *revised* renewal proposal. The committee of investigation found, also unanimously

> The revised proposal attempts to correct some of these statements but still does not explicitly state that the [redacted] has not been successfully examined using [redacted] techniques. The single sentence [in the revised renewal proposal] stating that the [redacted] will respond to [redacted] would require significant expansion if the reader were to understand its implications. The [redacted] is not a physiological target for the [redacted] and responds at significantly higher [redacted] of the [redacted]
>
> . . . [I]f [the subject] had stated in the original proposal that the only successful [redacted] experiments had been performed on [redacted] the proposal as written would be significantly weakened. . . .
>
> However, nowhere in the revised proposal is the explicit statement made that a [redacted] preparation of [redacted] had not been accomplished. The direct statement would make clear what has and has not been done.

Exh. 14 at 12-13.

The subject has effectively conceded as much. The subject admitted to the University that [redacted] was a "very poor second alternative" to [redacted]. Exh. 11 at 98. He also admitted during our investigation that Figure 7 was from [redacted] but that the original renewal proposal does not state that fact, and that "program officers and reviewers *could not have interpreted this work to be from* [redacted]." Exh. 25 at 2 (emphasis added). *See also* Exh. 11 at 161-62 (there was nothing in Figure 7 that would tell an expert that it came from [redacted]).

We concur. The *original* proposal is misleading in its presentation of facts that were fundamental to the fair and objective assessment of the subject's ability to conduct the proposed research because the text states that the experiment will be performed on [redacted], and, in conjunction with Figure 7, implies that the subject's laboratory could successfully [redacted]. Although the subject withdrew the original renewal proposal after the student made her concerns public, that proposal had been fully certified and submitted to NSF for funding.

We agree with the University that the *revised* renewal proposal was also, although less so, misleading. The revised renewal proposal remained misleading because it implied that the laboratory's ability to perform experiments on [redacted] preparations were equivalent and that information from either preparation had the same *in vivo* implications.[26] Both implications were important to NSF review criteria, including research performance competence and (although somewhat less so) intrinsic merit; and both were false. *See* page 12, above.

The subject now claims there were four "quite valid reasons" to use [redacted] to study the questions raised in Aim 2 of the revised renewal proposal. Exh. 32 at 2. First, he cites a 1985 paper by [redacted][27] as demonstrating that the [redacted] response to [redacted] was identical to that of the [redacted]. This paper does show that application of [redacted] factors to *in vitro* [redacted] preparations or injection of these factors into [redacted] increases [redacted]. However, the authors caution: "the physiological role of [redacted] in [redacted] are uncertain. It is not possible to conclude that they act to regulate the [redacted] *in vivo* simply because they are [redacted] in the [redacted] assay. . . . This at least demonstrates the possibility of control by either or both [redacted] *in*

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[26] The subject originally conceded that [redacted] do not act physiologically on the [redacted]. Exh. 11 at 106. He has stated in published work that in a "[redacted] were "very sensitive" to a [redacted] preparation of [redacted], [redacted] at [redacted] but that "the [redacted] is probably not the primary target of [redacted] on day 4 since *in vivo* [redacted] activity remained essentially unaltered during the period when [redacted] [wa]s released." [redacted] at [redacted] (parenthetical omitted).

[27] [redacted]

vivo, although it does not show that it occurs naturally."[28] They added that they had "no evidence for a physiological role for either [redacted] factor in any [redacted] stage."[29]

Second, the subject cites two papers, including [redacted], as the basis for his conclusion that "the [redacted] was likely to be [the] physiological target of the [redacted] because the [redacted] were released into the [redacted] at least twice prior to [redacted] . . ." However, the simple release of these molecules in the [redacted] does not mean that their target [redacted] is the [redacted] More importantly, this statement is inconsistent with the description of [redacted] action in his original and revised renewal proposals in which he states:

> [redacted] also stimulates the [redacted] assisting in [redacted] behavior prior to [redacted]. In [redacted] the [redacted] perform a very different role; they twice act as [redacted] . . . .
>
> It should be clear even from this brief summary that all four [redacted][30] are not identical. Each has its own distinctive set of characteristics that result in very different physiological and/or behavioral consequences. The type and time course of the four [redacted] effects are dependent on many parameters including target [redacted] and [redacted], method of transmission, and differential [redacted] of the [redacted] containing [redacted]. For example, target sensitivity is [redacted]-dependent: the [redacted] is the primary [redacted] target in [redacted] and [redacted] stages where as the [redacted] is the principal target in [redacted] **(Fig. 1)**.

Exhs. 5 and 8 at 6-7. The figure identifies the [redacted] as the only [redacted] target but identifies the [redacted] as the [redacted] target.

Third, the subject states, "the fact that the [redacted] elicited the same [redacted] and [redacted] responses on the [redacted] and [redacted] strongly implied that [redacted] contained the same [redacted] and that studying either preparation would give the same answer in terms of [redacted]." However, the subject's proposals to NSF emphasized not simply whether [redacted] and [redacted] preparations could be shown to respond to [redacted] but his interest in determining the *physiological* role of [redacted] on the [redacted] We agree that there can be valid reasons for studying a nonphysiological

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[28] *Id.* at 411.

[29] *Id.* at 412.

[30] "[redacted] are released 4 times during the [redacted] once during [redacted] once a the onset of [redacted], and twice in the [redacted] **Fig. 1)**." Exh.5 at 6. Figure 1 of the renewal proposals graphically display these four [redacted] and the behavior each elicits on the target [redacted]. Exhs. 5 and 8 at 7.

target, especially if the physiological target proves, as in this case, to be refractory to study. However, the rationale for this approach must be explained in a proposal if NSF is to determine whether this approach is scientifically valid and merits funding.

Fourth, the subject seeks to justify the switch to [redacted] preparations because his student was "unable to replicate her Fall 92 success at [redacted] recording in the winter of 1993 and was concentrating on the [redacted] preparation as a means to finish her degree at the time the revised proposal was submitted." Exh. 32 at 2. Although the student's inability to conduct studies on the [redacted] could justify changing the laboratory's experimental approach, the subject's laboratory's actual capabilities and the intellectual basis for his experimental approach should have been clearly stated.

The matter before NSF is not whether the subject could have proposed to do a different research project or whether scientific support existed for that other project. Rather it is whether the subject's presentation of information in the original renewal proposal or the revised renewal proposal (written after he knew his student could not replicate her results) seriously misrepresented his research accomplishments and capabilities.

C. The Subject's State of Mind

The subject claims that he did not intend what he concedes was the natural effect of his presentation in the *original* renewal proposal: falsely to imply that his laboratory had been conducting [redacted] experiments or [redacted]. Exh. 25 at 2. We believe the evidence shows the contrary: that the concededly misleading nature of this presentation was intentional.

The evidence establishes—and the University unanimously found—that the subject understood that the data in Figure 7 had been collected using [redacted], and that the [redacted] distinction was presented as critical to the proposal as written. *See* Exh. 14 at 9-10; Exh. 1 at 3; Exhs. 5 and 8 at 3, 6-7; Exh. 25 at 1; Exh. 29 at 3;[31] footnote 26 above. As the University observed in reprimanding the subject, "[h]aving written and assembled the proposal, [he] knew of the possibility of this misinterpretation, and [he] knew that [he] had no verifiable evidence to support that such research had been done." Exh. 16 at 1.

The subject also had ample motive to mislead NSF on this issue. The subject was convinced that if, in assessing his technical capabilities and his relevant research experience, reviewers believed that he was unable to perform the [redacted] technique, his request for renewal funding would be jeopardized

[31] The program officer believes that the distinction between [redacted] should have been more fully discussed and the difficulties in using [redacted] should have been noted. *Id.*

> [T]his is—was very crucial, because I did not have the expertise, so I couldn't cite a paper in my CV that said that we could do this. And [the reviewers] would then in turn say to me, 'Well, prove that you can do it. I'm sorry, we're not going to give you the money—unless you can prove you can do this we are not going to give you the money.'
>
> The reason I put that figure in was just for that.

Exh. 11 at 159. *See also id.* at 77 ("I wanted to show the reviewers that we could do that, and that was the point of that figure. That's all.")[32]

Because he had presented the distinction between [redacted] as critical to the significance of the work he proposed, the subject knew that his laboratory's ability to successfully perform the [redacted] technique on [redacted] was essential to the performance, as originally described, of Aim 3 (1990) and Aim 2 (1993). He also knew that (unlike [redacted]) it was virtually impossible, at that time, for his laboratory to perform reportable [redacted] on [redacted]. The subject admits as of the time he submitted the original renewal proposal, his laboratory had only an "infrequent ability . . . to [redacted]. Exh. 32 at 1. He also concedes that, by the time he submitted the revised renewal proposal, he knew his laboratory was "unable to replicate [its] Fall 92 success at [redacted] recordings." *Id.* at 2.

Yet, notwithstanding NSF's requirement that such reports "describe any problems encountered," NSF90-77 at 14; NSF92-89 at 16, in two separate progress reports to NSF under the 1990 award, the subject had claimed, in sections entitled "Mode of action of the [redacted] on the [redacted]," (emphasis added), that his laboratory was [redacted] or [redacted] individual [redacted], without disclosing the difficulties it was experiencing in applying such techniques to the [redacted] Exh. 2 at 3; Exh. 4 at 2. Similarly, he had not availed himself of the opportunity to describe these problems as part of a change of scope in his award.[33]

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[32] We note in this connection that, although the subject told the program officer and reviewers that changes from the previous submission had been highlighted or shaded, Exh. 8 at 5; Exh. 7, he failed to shade the addition of the word "[redacted]" to the legend of Figure 7. This meant that readers' attention would be drawn to the shaded changes and they would be unaware that the subject had failed, in his withdrawn proposal, accurately to label Figure 7 as data derived from [redacted]. Although the subject claims that the reason [redacted] was not shaded was because he could not get this particular word to shade, Exh. 26 at 1, he could have marked this change by hand. Moreover, it is consistent with the subject's presentation of his motivation that he omitted the word [redacted] from Figure 7 of the original renewal proposal and failed to shade that word in the revised renewal proposal because he believed that, if reviewers were to realize his laboratory's actual capabilities, they would have expressed serious criticism about its ability to conduct the proposed [redacted] experiments on [redacted]. Exh. 11 at 159, 77.

[33] *See* Grant General Conditions, GC-1 (10/88), Article 13 (proposed changes to the phenomenon under study or the objectives of a project should be communicated in writing to NSF). *See also,* NSF90-77 at 13 (major changes in objectives or scope should be communicated in writing); NSF92-89 at 16 (same).

II. THE DESCRIPTION OF THE ABILITY TO PRODUCE [redacted] WAS KNOWINGLY MISLEADING[34]

A. The Statement

We investigated the allegation that the method described in the *original* renewal proposal for dissociating [redacted]—that is, for producing from [redacted] that retain their [redacted]—did not work, as described in the proposal, "*routinely*." Exh. 5 at 18 (emphasis added).

Page 18 of the *original* renewal proposal states, in pertinent part

> Experiments will be performed on [redacted] *isolated from* [redacted] After dissection, whole [redacted] are incubated for 5 min in a [redacted] saline containing 10X normal [redacted]. Following trituration and several rinses in normal saline, [redacted] are placed in a 0 [redacted] saline and vortexed gently for 5-10 min. This procedure *routinely* produces [redacted] that retain their [redacted]

Id. at 18 (emphasis added).

B. How the Statement was False and Misleading

An NSF proposal must contain sufficient information for the Foundation and its reviewers to evaluate the technical soundness of the proposed approach, the subject's capabilities, and the likelihood that the research will have substantial impact on progress in a field or will lead to new discoveries. NSF92-89 at 10.

The reason for isolating [redacted] as described in this portion of the renewal proposals was to use them in [redacted] experiments to identify and assess [redacted] dependent [redacted] channels in [redacted] as contemplated by Aim 2 (1993) and by Aim 3 (1990). Given this purpose, the quoted portion of the original renewal proposal would be understood by a reasonable reader to mean that the described procedure had *reliably* produced isolated [redacted] suitable for [redacted] experiments.[35] *See* Exh. 14 at 19. That was false.

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[34] This was Allegation 4 in the University investigation.

[35] Although text under the caption "Interpretation of results and potential difficulties" qualifies the laboratory's ability to perform the [redacted] work in certain circumstances (specifically, if it is unable to find a [redacted] current influenced by [redacted], it nowhere qualifies the laboratory's stated ability to produce the [redacted] necessary to perform the experiments. Exh. 5 at 17-18; *see also* Exh. 8 at 18.

At the time the subject wrote and submitted the original renewal proposal, the subject's laboratory had rarely, and certainly *not* routinely, been successful in isolating [redacted] suitable for [redacted].[36] Exh. 11 at 58-59, 81-82; Exh. 6 at 2. The subject's laboratory was able to isolate and [redacted] routinely. The dissociation protocol used for [redacted], however, was different from the one described in the proposal, which was used for [redacted]. Exh. 14, at 19; *see* Exh. 8 at 18 (correcting this language).[37]

The *revised* renewal proposal corrects the procedural description by including methods to be employed to dissociate [redacted] and by deleting the word "routinely." However, although it purports to disclose "potential difficulties," Exh. 8 at 18, the revised renewal proposal does not mention that the subject's laboratory had substantially less success with the [redacted] procedure than with the [redacted] procedure. This omission was important because even in the subject's own view, the use of [redacted] was a "very poor second alternative" for accomplishing the research objectives stated in his proposals.[38] Exh. 11 at 98; Exh. 8 at 17-18. *See* page 14, above.

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[36] The subject acknowledges the "consistent inability to generate [redacted]" of the graduate student charged with this task. Exh. 32, at 3. Although he now claims that he could generate [redacted] routinely, *id.*, he told the University investigation committee that he gave the student dissociated [redacted] "relatively infrequently," and that ordinarily these [redacted] did not work with [redacted] experiments. Exh. 11 at 82-83. The conceded fact that his laboratory was unable to produce [redacted] recordings in winter 1993 from these [redacted] Exh. 32 at 2, could have been because (1) the [redacted] were not suitable for [redacted] or (2) although the student could routinely [redacted], she was unable to apply successfully the same technique to [redacted]. The subject's ability to use the dissociation protocol years earlier in [redacted] to produce [redacted] suitable for the [redacted] studies displayed in Figure 5 of the renewal proposals does not contribute to a discussion about the whether [redacted] produced by this same method were suitable for [redacted], an entirely different type of experiment. *See id.* at 4.

[37] The corresponding portion of the revised renewal proposal reads, in pertinent part (with deletions denoted ~~like this~~ and additions LIKE THIS):

> Experiments will be performed on [redacted] isolated from [redacted] AND [redacted]. THE FORMER ARE ISOLATED BY ~~After dissection, whole~~ [redacted] ~~are~~ incubated ING WHOLE [redacted] ~~for 5 min~~ in a [redacted] saline containing 10X normal [redacted]. Following trituration and several rinses in normal saline, [redacted] are placed in a 0 [redacted] saline and vortexed gently for 5-10 min. [redacted] ARE OBTAINED FOLLOWING INCUBATION OF [redacted] IN [redacted] MEDIA CONTAINING [redacted] (5 MG/ML), [redacted] (5 MG/ML), [redacted] (10 MG/ML), AND [redacted] (CRUDE EXTRACT, 20 MG/ML) FOR 48-50 MIN AT 37°C. BOTH ~~This~~ procedures ~~routinely~~ produces [redacted] ISOLATED [redacted] that retain their [redacted]

Exh. 8 at 18.

[38] The issue at hand is the seriousness of the subject's failure to disclose this information to NSF's program officer or reviewers. It is entirely irrelevant that the subject disclosed it, well after the fact, during the University and OIG investigations. *See* Exh. 32 at 1.

In both documents, therefore, NSF and its reviewers were falsely led to believe that the subject's laboratory could successfully dissociate [redacted] in a way that would permit the [redacted] procedure to be used on the [redacted], which was the focus of the discussion.

C. The Subject's State of Mind

The evidence demonstrates that the subject knowingly misrepresented his laboratory's ability to dissociate [redacted] for [redacted] in the original renewal proposal.

As noted, a dissociation protocol that produced [redacted] suitable for [redacted] was essential to the achievement of Aim 3 (1990) and Aim 2 (1993). The subject believed that his requested renewal funding would be jeopardized if reviewers were to conclude that his laboratory could not reliably accomplish this task after the years of difficulty-free effort reflected in his progress reports. *Cf.* Exh. 11 at 77, 159; Exh. 2 at 3; Exh. 4 at 2. The fact that those reports did not reflect his laboratory's actual difficulties, in violation of NSF's requirement that they describe "any problems encountered," NSF90-77 at 14, gave him additional incentive to hide the actual facts in the renewal proposal. The inference is clear that he wanted to conceal his difficulties in order to increase the likelihood that the proposal would be funded and decrease the likelihood that the misleading nature of his earlier progress reports would come to light. *See* Part IV, below, at page 27, *et seq.*

During our investigation, the subject told us that there were three reasons why he took the approach he did in the renewal proposals rather than simply state that he would initially conduct the work in [redacted] and, if he had success, expand the work into [redacted]

> First, given the limited success of the [redacted] prep, I fully expected it to be a viable prep in the very near future. Second, I decided that the [redacted] distinction was not as important as other issues discussed in my proposal because both in vitro preparations respond in the same manner to [redacted] application. Third, the 15-page limit on the size of the proposal severely restricted my ability to discuss all issues fully.

Exh. 25 at 2-3.

The subject could not reasonably have believed that the [redacted] preparation would be viable in the "very near future" as he claims. The subject knew that his graduate student had been trying to dissociate [redacted] suitable for [redacted] for more than 2 years with virtually no success. Exh. 11 at 59, 116; Exh. 25 at 1. At the least, the subject had no reasonable experimental basis to expect that his laboratory's success rate would improve. In fact at the time the *original* renewal proposal was being drafted, the subject knew that, because his graduate student was experiencing so much difficulty working with [redacted], the student's project had been realigned to include experiments on both

[redacted]. Exh. 25 at 1. By the time he submitted the *revised* renewal proposal, he knew she had been unable to replicate what little success she had had [redacted]. Exh. 32 at 2.

The subject's after-the-fact claim that the [redacted] distinction was not important because both *in vitro* preparations respond in the same manner to [redacted] application is similarly unpersuasive. As set forth above, the subject repeatedly asserted that [redacted], not [redacted], were the physiological target for [redacted] and the thrust of the discussion about Aim 2 in both renewal proposals focused on the "physiological" effect of [redacted] on [redacted] currents. *E.g.*, Exhs. 5 and 8 at 17. Further, all of the subject's prior work elucidating the mechanism by which [redacted] influence the [redacted] concentration in [redacted] via [redacted] was conducted in [redacted], not [redacted]. Although the subject could have speculated (in his progress reports, his renewal proposals, or in discussions about changes of scope with his program officer) that, on the molecular level, the [redacted] respond the same way, he did not. In fact, his own evidence showed that the [redacted] responded to [redacted], but at a much higher, nonphysiological, [redacted]. His own evidence could not eliminate the possibility that, in the [redacted] another mechanism might be mimicking the *in vivo* mechanism he had shown in [redacted]. *See* Exh. 29 at 3-4. The subject effectively conceded as much when, in again revising the renewal proposal during the course of this investigation in an effort to eliminate any misleading aspects (the 1996 revision, Exh. 28), he clarified that his laboratory would "test [the] supposition" that the "downstream effects of the [redacted] on the [redacted] will also be identical in both stages" by "ascertain[ing] whether [redacted] causes a rise in [redacted] levels of [redacted] in [redacted] using standard [redacted] measurement techniques that we have used previously." Exh. 28 at 18 (citation omitted).

Finally, we view as disingenuous the assertion that the page limit forced the subject to omit all discussion of these significant considerations. In the 1996 revision, the subject added approximately 20 lines of text related to his proposal to test the effects of [redacted] on [redacted] and, as the laboratory's [redacted] technique improved, on [redacted]. *Id.* at 7, 13, 16, 17, 18. This much additional text should not have posed serious length problems for the proposal.

We conclude that the subject acted knowingly when he falsely described the procedure for producing, and his laboratory's ability to produce, [redacted] suitable for [redacted] in the original renewal proposal, when he completely omitted from both 1993 renewal proposals any description of his difficulties, and when he failed to clarify in the revised 1993 renewal proposal that his laboratory's ability to prepare [redacted] varied significantly from its ability to prepare [redacted].

III. EXPERIMENTAL RESULTS WERE RECKLESSLY MISSTATED IN TWO INSTANCES[39]

A. The Statements

The *original* renewal proposal contains the following statement about an experiment with TEA

> We have found that [redacted] blocks the majority of net [redacted], and substituting [redacted] for [redacted] eliminates the remaining [redacted].

Exh. 5 at 16. After stating that [redacted] would be [redacted] by [redacted], the proposal makes the following statements

> In our hands, [redacted] blocks [redacted] at a concentration of 10^{-4}M.

and

> Fortunately [redacted] blocks [redacted] in [redacted] without apparent interference with [redacted].

Id. at 17 and 18, respectively.

B. How the Statements were False and Misleading

These statements were simply false.[40] *See* Exh. 9 at 2.

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[39] These were Allegations 2 and 3 in the University investigation.

[40] In the revised renewal proposal, the subject accordingly revised these statements. He replaced the assertion about [redacted] with a plan

> For example, the 3 major [redacted] currents present in [redacted], the delayed rectifier, a [redacted] current, and a [redacted]-like current, will be eliminated using a combination of [redacted], and a [redacted] protocol that inactivates [redacted] currents, respectively.

Exh. 8 at 16. Relying on studies he conducted *after* the allegations were raised (which was after the original renewal proposal was submitted), Exh. 9 at 2, he replaced the statements about [redacted] with

> Our preliminary studies with [redacted] suggest that it blocks [redacted] at a concentration of 10^{-4}M.

Exh. 8 at 17, and

> Fortunately, [redacted] blocks [redacted] in [redacted] although we do not yet know whether [redacted] interferes with [redacted].

The subject told the University he had relied for these statements on oral communications with the graduate student. Exh. 9 at 1 and 2. However, the graduate student told the University that she had not performed the [redacted] experiment. Exh. 6 at 1-2. With respect to [redacted] the student said that her results simply showed that, in preliminary experiments involving *intact* [redacted] rather than the isolated [redacted] described in the renewal proposal, [redacted] at a *10-fold higher* concentration (10^{-3}M) than that described in the renewal proposal, had stopped [redacted]. *Id.* Her results did not address whether [redacted] would interfere with [redacted] or [redacted] in isolated [redacted] at the lower concentration. *Id.*

By removing them from the revised renewal proposal, Exh. 8 at 16-18, the subject conceded the inaccuracy of his statements, in the original renewal proposal, about [redacted] and [redacted]. We do not deem it necessary for purposes of this report to address the flat disagreement between the subject and the graduate student over the content of the discussions they may have had.[41] For reasons set forth below, we believe the subject's contention that he included statements in his original renewal proposal based *solely* on oral discussions with this graduate student is enough to establish that he deviated in a serious way from accepted practices and therefore committed misconduct in science.

C. Nature of The Alleged Misconduct

The subject claims that he included the statements about [redacted] and [redacted] experiments based on oral discussions with his graduate student. He admitted to the University that he took *no* steps to verify the accuracy of his understanding of the experimental results or the reliability of the work on which they were purportedly based. Exh. 9 at 1-2 (he did not review her data) and 3 (he did not ask her to review the renewal proposal before he submitted it to NSF). Although we do not consider this to be *as* serious a violation of accepted practices as those set forth in Parts I, II and, particularly, Part IV, of this report, in the circumstances the subject concedes were true, we conclude this does seriously deviate from accepted practices.

Those circumstances were as follows.

Id. at 18.

[41] The student claimed she never told the subject that she had done these experiments. She believes she told the subject she had not done the [redacted] experiments. Although she may have told him about her [redacted] experiments, these differed from those he reported. Exh. 6 at 1-2.

The subject believed his graduate student had demonstrated an inability reliably to perform some, but not other, experiments.[42] The subject described at length to the committee of investigation his knowledge of the student's research failures in several different laboratories at two institutions before she came to his laboratory. Exh. 11 at 12-16. As described above, she was unable for more than 2 years predictably to [redacted] in his laboratory. According to the subject

> She did very well in my lab for a few months and then started to flounder. She floundered for several years and her work went poorly. And I tried very hard and consistently tried to work with her and assist her in every way possible. However, her work went poorly. . . .

Exh. 11 at 13.

> [H]ere's a case, in my judgment, where a student only did anything when I helped her. The minute the student stopped receiving my help, physical help, the student did nothing. The student kept coming back to me to ask me for help and I would give to it [sic] her. But there comes a point, I believe, especially when we are talking about a senior graduate student, when the student has to go out and do it by themselves. And in this particular case that never happened.

Id. at 29-30.

> Her recent performance at meetings, either privately with me or publicly with her committee, demonstrated a serious lack of organization and focus. For a variety of reasons she inevitably came to each meeting without all of her data.

Exh. 9 at 2. He characterized those of her logs which he had viewed as "not very understandable or complete."[43] Exh. 11 at 38-39.

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[42] The subject's 1990 proposal contains a glowing description of the graduate student's capabilities. He states she is "a gifted [redacted] who has been the major contributor to our studies on the [redacted] of the [redacted] Her productivity is more typical of a postdoctoral associate than of a graduate student and it is planned that she will be a major contributor to the [redacted] studies proposed here. . . . It is probable that she will finish her Ph.D. before the three years of the grant are completed . . . ." Exh. 1 at 32. Over the 3 years leading to submission of the 1993 renewal proposals, his impression apparently underwent a radical transformation.

[43] The University committee of investigation agreed. It said

> The notebook pages . . . were essentially unintelligible to anyone except [the graduate student]. There were few complete thoughts and only a few notes describing experiments. These notes required [the graduate student's] intervention to decipher. Thus, there was no way that the committee could independently establish that certain experiments had or had not been performed. The committee was rather surprised that such a notebook would have been considered acceptable by [the subject].

In circumstances where a mentor has serious concerns about a student's ability to conduct experiments and organize and present results, it violates accepted practices for the mentor to rely, in documents that are supposed to be "prepared with the care and thoroughness of a paper submitted for publication," NSF92-89 at 1, on oral conversations with the student. He should instead insist on reviewing her data or, at a bare minimum, permit her to review the relevant portions of his proposed submission.

The subject essentially agreed when he told scientists on the University committee of investigation that it was "[a]bsolutely" his practice to spread out copies of his students' data in front of him when he was writing a paper. Exh. 11 at 137. When the committee inquired

> So you use quite a drastically different procedure writing a proposal for a grant versus writing an article to be submitted?

he said

> No. No. . . . When I write a grant I have the data in front of me. When I . . . write a paper I have the data in front of me. When I'm thinking about a question at home I don't have the data in front of me.

Id.

The University committee of investigation said that the subject's claimed actions were

> not acceptable scientific practice. A simple way to assure that such statements of results are correct is to ask each person involved in a particular set of experiments to read that section of the proposal (or the complete proposal). In the absence of that simple check, the investigator should have obtained written documentation of results. This is not a matter of mistrust in a student, technician, or postdoctoral fellow and their work. Such documentation provides a means to be certain that results are reported correctly.

Exh. 14 at 17. Similarly, the program officer told us

> It is NOT common nor should [it] be acceptable that PIs present data or experiments if they have not actually reviewed the primary data. . . . I feel very strongly about this point. This includes seeing the numbers, the gra[ph]s, etc. . . . An oral explanation without subsequent review of the data would be unacceptable in my laboratory.

Exh. 19 at 2. *See* Appendix B.

Exh. 21 at 1.

We agree. A reasonably prudent scientist proceeding in good faith would have insisted on carefully reviewing this graduate student's written record of her experiments, or at the very least on having the student review his written summary of her results *before* reporting them as factually accurate in an NSF proposal. Close review is particularly necessary for students with no track record and students with a problematic track record. Had the subject taken some of these minimally expected steps, the renewal proposal presumably would have described more closely the student's results and the allegations would not have arisen.

D. The Subject's State of Mind

The University committee unanimously concluded that, in this instance, the subject "was negligent to quote results from his memory without seeking documentation for those results," and that this was not acceptable scientific practice. Exh. 14 at 17. As noted above, under the University policy defining misconduct, the committee had no need to, and did not, consider whether the subject's conduct was more than negligent. Exh. 19 at 2. OIG concludes that the subject's action was reckless and therefore also constitutes misconduct in science under NSF's definition.[44]

Evidence about [redacted] effect on [redacted] of the [redacted] was important support for the project described in Aim 2 of the original renewal proposal. It was an affirmative demonstration of the research plan described in the preceding sentence of the proposal, that "[redacted] will be isolated from other currents using a combination of [redacted] and [redacted]." Exh. 5 at 16. Similarly, the claimed results of the [redacted] experiments were important because [redacted] stops [redacted] that disrupt the seal between the [redacted] and the [redacted]. This seal is necessary for the [redacted] experiments proposed in Aim 2. However, the subject knew that, for [redacted] to be useful, it had to block the [redacted] of the [redacted] **without** disrupting

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[44] As set forth in OIG Semiannual Report No. 9 at 36, for purposes of NSF's misconduct in science regulation, OIG views the difference between negligent and reckless conduct as follows

> A person acts negligently if, according to community standards, that person should have acted differently because a reasonable person in the same circumstances would have acted differently. A person acts recklessly if, according to community standards, that person acts in a way that is a serious deviation from the way a reasonable person would have acted in the same circumstances.

The University's then Vice Provost believed that the subject's actions in relying on oral statements by the graduate student "represent practices that seriously deviate from those that are commonly accepted within the scientific community for proposing, conducting, and reporting research." Exh. 20 at 2.

the other [redacted] the subject was interested in studying. *See id.* at 17; Exh. 11 at 96; Exh. 9 at 2.[45]

If, as the graduate student claims, these experiments were not performed and, if they therefore had not been cited as support for the subject's experimental design, the research design in Aim 2 (1993) would have appeared more speculative. Given the subject's stated doubt as to his graduate student's competence and apparent recognition that the accepted level of care required in preparing papers and grant proposals generally requires personal review of the data, his complete failure to check, or provide for a check on, his descriptions of experiments important to establishing the soundness of his experimental design before he certified to the accuracy of those descriptions on the cover page of the renewal proposal constitutes at a minimum, reckless conduct. At worst (if, as the graduate student says, she never told the subject she had performed these experiments), it reflects the intent to deceive NSF and its reviewers as to his proposal's likelihood of success.

IV. DESCRIPTIONS OF PROGRESS ON AIM 3 OF THE 1990 PROPOSAL WERE KNOWINGLY MISLEADING

A. Background

1. Background to the 1990 Award

The background portion of the 1990 proposal describes research suggesting that [redacted] increase the [redacted] in [redacted] through the [redacted] Exh. 1 at 10.

In 1988, before he received any NSF support, the subject and a collaborator conducted 20-30 repetitions of an experiment designed to determine whether they could measure an [redacted]-mediated rise in [redacted] (collectively the [redacted] Experiment"). In the [redacted] Experiment, noncontracting individual [redacted] were filled with a fluorescent indicator [redacted][46] The subject and his collaborator then measured changes in fluorescence to determine the [redacted] within [redacted]-filled [redacted] when they were exposed to [redacted] in the presence or absence of [redacted]. Exh. 1 at 10, 11; Exh. 24 at 1-2.

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[45] The subject now claims that these results were a "relatively minor technical achievement." Exh. 32 at 5. Whether or not they were minor, they were crucial to the subject's ability to conduct the experiments. Moreover, the very fact that he included the statements in the renewal proposals raises a strong inference that he considered them important to a solid presentation of his experimental design. *Cf.* Exh. 25 at 2-3 (the subject claims he omitted details of his experimental design because of the page limitations for NSF proposals).

[46] [redacted] changes its fluorescence in the presence or absence of [redacted] Those changes may be measured with the aid of a fluorescence microscope and a spectrophotometer.

Data collected in the [redacted] Experiment from a single [redacted] were set out in Figure 6 in the background section of the 1990 proposal. Exh. 1 at 11; Exh. 24 at 2. The proposal described the Experiment as showing "a small yet consistent rise" in [redacted] when [redacted] were exposed to [redacted]. Exh. 1 at 10, and stated that the rise in [redacted] was "only partially reduced" in the presence of [redacted], which blocked [redacted]. *Id.* The [redacted] blockage effect was cited to a 1989 abstract by the graduate student and the subject. *Id.*

The findings about the influence of changes in the [redacted] on electrical activity were supported by the statement that [redacted] (a compound that specifically binds [redacted], thereby making it [redacted]) reduced [redacted] frequency and blocked the [redacted] effect of [redacted]. *Id.* at 10. Conversely, a compound that increased the [redacted] caused an increase in [redacted] frequency. *Id.*

The proposal articulated a hypothesis based on this work

> The data from the [redacted] experiments suggest that [redacted] may be modulating [redacted][47] by simultaneously increasing [redacted] permeability at the [redacted] and [redacted] release from [redacted] stores. Taken together, these results lend credence to the hypothesis that [redacted] alters [redacted], which then causes a change in [redacted]

Id. at 10.

In part, the [redacted] Experiment and associated analysis provided the justification for the project described as Aim 3 (1990).

2. Aim 3 of the 1990 Award

Aim 3 proposed to build on conclusions from the [redacted] Experiment and the subject's studies on [redacted] "by isolating and characterizing the [redacted] in the [redacted] using standard [redacted] procedures." *Id at* 19. The proposal stated that these experiments would be performed by the graduate student, who had "extensive [redacted] training in [redacted] procedures." *Id.*

Reviewers were enthusiastic about the subject's proposed work, and thought that the subject's laboratory was technically capable of performing the experiments. The proposal was funded.

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[47] Brackets signify concentration. The notations [redacted] and [redacted] are used to denote the [redacted], *vis-a-vis* the [redacted]: *i.e.*, [redacted] of the [redacted].

B. The Statements

1. 1991 Statement of Progress on Aim 3

The 1991 progress report states that it discusses, among other things, work completed in the first nine months of NSF support on Aim 3 of the 1990 award. Exh. 2 at 1, 3. Although the proposal never states so the bulk of the associated text repeats information known to the subject in 1988, before the proposal was funded. Almost half of the text is identical to the text in the background section of the 1990 proposal. However, the collaborator is no longer mentioned and the 1989 abstract is no longer cited. The remainder subtly alters the presentation of information: the "small yet consistent [redacted]" in [redacted] is presented as the equally correct, but seemingly more impressive "two-fold increase" in [redacted] and the data "suggesting" how [redacted] might work is presented as the basis for a "model." *Id.*[48]

2. 1992 Statement of Progress on Aim 3

The 1992 progress report for the second year's work states

> During our first year of support, we made significant progress towards achieving all three specific aims . . . . This work was detailed in an earlier progress report submitted July 1, 1991. Since that time we have continued working on these issues . . . . Each of these is discussed below.

Exh. 4 at 1. The report continues

> Work performed prior to the current grant period ascertained that the [redacted] act on the [redacted] via an increase in [redacted] levels of [redacted]. Our work *during the first year of the current grant period using* the [redacted] dye [redacted] demonstrated that [redacted] triggers a rise in [redacted].

Id. at 2 (emphasis added).[49]

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[48] Very little of the report referred to work actually done during the award period. One sentence of the 1991 progress report states that either of two compounds that bind [redacted] ([redacted] and [redacted]) decrease [redacted] and block the effects of [redacted]-and [redacted] Another states that the subject's laboratory was "[redacted] individual [redacted] to determine the presence of an [redacted]-sensitive [redacted]." *Id.* at 3.

[49] The report then describes "recent" experiments using "[redacted]nd [redacted] techniques to determine the presence of an [redacted]sensitive [redacted]n the [redacted]" *Id.*

3. Description of Results from Prior NSF Support in the Original and Revised 1993 Renewal Proposals

The 1993 renewal proposals describe progress on Aim 3 of the 1990 award under the caption *"Results From Prior NSF Support."* Exhs. 5 and 8 at 8, 10. After identifying the "NSF support" as the 1990 award, the proposals say

> During [the period] of support, we have made substantial progress towards achieving all three specific aims . . . . Each of these issues is discussed below.

Exhs. 5 and 8 at 8. The vast majority of the discussion of progress on Aim 3 describes work completed before the subject's receipt of NSF support and that had originally been described in the *background* section of the 1990 proposal.

Figure 5 of that section is *identical* to Figure 6 from the background section of the 1990 proposal and the text describes the experiment it presents as "recent." Exhs. 5 and 8 at 10; Exh. 24 at 2. Yet, as the subject has admitted throughout the investigations, the underlying data for the text and identical Figures came from the [redacted] Experiment he conducted with his collaborator, while visiting the collaborator's laboratory in [redacted] in 1988. Exh. 11 at 90-91; Exh. 24 at 1-2; Exh. 32 at 6.

Also, much of the description of the 1988 [redacted] Experiment mirrors text from the *background* section of the 1990 proposal, with the same subtle alterations found in the 1991 progress report to make it sound like recent work. In addition, text about [redacted] that in 1990 was cited to the 1989 abstract, and in the 1991 progress report was presented without citation, is now cited to a 1991 abstract the subject co-authored with a student. Approximately one third of the discussion on Aim 3 presents the results of work published before the award period; almost half describes the 1988 [redacted] Experiment.

With respect to actual accomplishments under Aim 3 (1990), about which one would expect to read under the caption of "prior support," the renewal proposals contain little more than one line about the [redacted] and [redacted] experiments,[50] and state that the laboratory has "recently been able to [redacted] individual [redacted] to test this model." Exhs. 5 and 8 at 10; *see also id.* at 16; Exh. 25 at 2.

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[50] The original renewal proposal refers to both [redacted] and [redacted] experiments. The revised renewal proposal does not mention [redacted]. Exhs. 5 and 8 at 10. When we asked why, the subject said the [redacted] work "was not as strong as the [redacted] work and it had not been done as many times." Exh. 24 at 1. The subject originally told us that the [redacted] work was a "repeat of work done first in 1984-6" but revised that to a "modification" of that work. *Id.* The text of the renewal proposals are consistent with the proposition that no new information was gathered about [redacted]. *Cf.* Exh. 1 at 10; Exhs. 5 and 8 at 10.

C. How the Statements were False and Misleading

As a result of our investigation, and as described above, we learned that the subject's laboratory *did not* make "substantial progress" toward Aim 3 (1990).[51] Exhs. 5 and 8 at 8.

In addition, although the text of the proposals and progress reports nowhere so indicates, the [redacted] Experiment data, which were preliminary[52] and did not yield repeatable results,[53] were all collected with a collaborator at the collaborator's laboratory in [redacted] in 1988. The subject performed *no* [redacted] experiments during the period of the award.[54] Exh. 24 at 1-2; Exh. 32 at 1-2.

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[51] The subject denies his proposals were misleading. He states that his laboratory has consistently achieved or exceeded the aims set forth in his proposals, and that the proposals accurately predicted the research that was ultimately completed. Exh. 32 at 10. These assertions are simply false. Because he failed to accomplish the goals of Aim 3 (1990), he reiterated them as Aim 2 (1993). Exh. 25 at 1;\, *see also* Appendix A.

[52] The subject described these data as "preliminary" in his successful 1992 request for funds to purchase a [redacted] microscope and during the University investigation. Exh. 3 at 2; Exh. 11 at 91.

[53] The subject states in the renewal proposals that "it has been difficult to obtain repeatable results in multiple trials on the same preparation" due to what he characterized as "the incomplete buffering ability of this indicator under constantly changing [redacted] conditions." Exhs. 5 and 8 at 18. The following exchange occurred during the subject's discussion with the committee of investigation about Figure 5 of the renewal proposals (Figure 6 of the 1990 award)

> Q: . . . . Now is that a real difference [in the response of [redacted] in the presence or absence of [redacted]]? Is this a real difference or is this one example?
>
> A: This is one example.
>
> Q: But is that a consistent pattern?
>
> A: Okay, I did it twice.
>
> Q: You did it twice. So that's a fairly reliable difference pattern you're saying?
>
> A: Well, both of them that were done successfully did that.

Exh. 11 at 89-90. The subject has taken different positions as to the number of instances in which the Experiment worked, and the number in which it did not work. He told the committee of investigation that the Experiment "worked twice towards the end," Exh. 11 at 89, 91; but he told us that he had had two successful runs with [redacted] in the presence of [redacted] and four to five successful runs with [redacted] in the absence of [redacted]. Exh. 24 at 1.

[54] The subject told us that he had included the [redacted] Experiment because at the very outset of the 1990 award, he "*plotted* the remaining 2-3 sets of data that were originally collected in 1988. From these *plots* I concluded that my initial conclusion reached in 1988 was correct. . . . [I]n actuality [I] was describing my *plots* of the remaining two data sets and their incorporation into the total data for those experiments." Exh. 24 at 1 (emphasis added). He told us that, despite the equipment funds he received from NSF, he had been unable to complete the set-up required for him to conduct these experiments in his own laboratory. Exh. 23.

The subject originally used the [redacted] Experiment as background support for Aim 3 (1990). Then, when his laboratory encountered difficulties in performing that work, he used descriptions of the [redacted] Experiment as a substitute for progress toward Aim 3 (1990).[55] The subject generally described the 1988 [redacted] Experiment in a way that would cause reasonable readers to conclude that his data were not preliminary and that they demonstrated acceptable research progress under the 1990 award.[56]

The program officer advised us that when PIs present preliminary data in proposals they should provide information about the number of replicates and the variability among such experiments. The program officer said, "[i]f data are not labelled as 'pilot,' then I assume and expect them to be already published or in the process of preparing for publication. PIs should label pilot data as such and . . . discuss the quality of these data." Exh. 21 at 1. This caution is particularly important in [redacted] research where the results from experiments employing [redacted] can be highly variable.

We concluded that the subject's presentations about [redacted] were designed to and did mask the subject's lack of progress and the difficulties experienced by the subject's laboratory on Aim 3 of the 1990 award (which, as a result of those difficulties, *see* below, was re-cast as Aim 2 of the renewal proposals).

1. The 1991 Progress Report

Nothing in the subject's presentation of the 1988 [redacted] Experiment as work performed on Aim 3 in the first 9 months of NSF support for the 1990 award indicates what portion of that work was conducted during the grant period. Although the subject now concedes that the Experiment was performed entirely before the grant period, and that the only work he conducted during that period consisted of plotting an additional 2-3 runs, the description of the 1988 [redacted] Experiment follows a phrase about the subject's "work during the past year," Exh. 2 at 3, and includes such other phrases suggestive of recent activity as "[o]ur experiments establish;" "[t]o test further the hypothesis . . . we directly measured;" and "from these data, we have proposed a model . . . ." *Id.* Other aspects of the report reinforce the impression that these data were obtained by the subject after the grant was awarded. Notably, citation to the pre-grant collaborator is deleted, and text that in 1990 was cited to a 1989 abstract is presented without citation. *Id.*

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[55] As set forth in parts I and II at pages 11 through 22 above, those difficulties included problems preparing [redacted] for [redacted] as well as reliably [redacted] those [redacted], both of which were central to the ability to make any progress on Aim 3.

[56] We take no issue with the preliminary nature of these data or their reliability, *per se*. What we do challenge is the subject's misleading presentation of these data over the course of the 1990 award and in the 1993 renewal proposals as if they were more than preliminary and as if they were *gathered* under the 1990 award.

The subject conceded during the investigation that a program officer reading this report "could have read" what he had written "as the [redacted] experiments conducted in 1988 were conducted under my 1990 award and not that I had plotted the remaining two runs." Exh. 24 at 1. We conclude that the subject's description of the 1988 [redacted] Experiment could *only* have been interpreted by a reasonable reader as meaning that it had been conducted under the 1990 award.

In addition, although the 1991 progress report states that the subject's laboratory was [redacted] individual [redacted], it fails even to mention the difficulties the laboratory was experiencing with the research described as Aim 3. As set forth in parts I and II at pages 11 through 22 above, those difficulties included the [redacted] and [redacted] of a [redacted], both of which were essential tools for conducting the research described in Aim 3.

2. The 1992 Progress Report

The 1992 progress report continues to present the 1988 [redacted] Experiment as progress under the award. Its descriptions of this Experiment, found in the section entitled, "Mode of action of the [redacted] on the [redacted]" are similar to those contained in the 1991 progress report. Exh. 4 at 2. It describes the 1988 [redacted] Experiment following a phrase about the subject's "work during the first year of the current grant period using the [redacted]" *Id.* at 2. The section on the [redacted] concludes by stating that the subject had recently used [redacted] and [redacted] techniques to identify [redacted] and that "one and perhaps a second" had been identified. *Id.* It fails to mention any problems the laboratory was experiencing with the [redacted] preparation and [redacted] techniques. *Id.*

3. The Description of Results from Prior NSF Support in the Original and Revised 1993 Renewal Proposals

The 1993 renewal proposals also cast the [redacted] Experiment as work done during, rather than before, the start date for the subject's 1990 grant. Exhs. 5 and 8 at 10. There is no text that states or suggests that the subject simply plotted the data gathered from two or three runs conducted in 1988. Notably, Figure 5 in the renewal proposals, which is identical to Figure 6 in the 1990 proposal, has not been modified to show that the additional plots the subject claimed to have performed during the grant period had solidified his conclusions or, indeed, contributed in any way to his analysis of the "preliminary" data he had secured and plotted before the grant was awarded. In addition, citation to the pre-grant collaborator has again been deleted. Text that, in 1990, was cited to the 1989 abstract and, in the 1991 progress report, was presented without citation is now cited to a 1991 abstract the subject co-authored.[57] The presentation in the renewal proposals retains the language inserted in the 1991 progress report that inflates the significance of the work. *Id.*

[57] That text read as follows in the renewal proposals

We concluded that the subject's discussion of the [redacted] Experiment in the 1993 proposals could only be interpreted by a reasonable program officer as describing an *experiment* conducted under the 1990 award, in the subject's laboratory, without a collaborator. The program officer concurs. Referring to Figure 5 and the associated text, she states

> I can not find any indication that Figure 5 is preliminary data. Indeed, the [subject] states that 'from these data, we have proposed a model . . . .' This is not presented as preliminary, it is presented as solid strong evidence supporting the development of a model. . . . When I read this section, I am assuming that the data were generated by [the subject's] laboratory and are very solid and can be replicated.
>
> * * *
>
> . . . I [would] have never interpreted the figure as pilot data.

Exh. 21 at 2.

The combination of omissions and misstatements was particularly material at this stage. As the program officer advised us

> I . . . believe that the difficulties obtaining repeatable results would be of great interest to the reviewers and the program officer. If reviewers had been aware of potential problems or difficulties then the fact that the results were obtained in 1988 would raise questions about either productivity and/or reliability. I

Interestingly, the [redacted]nduced rise in [redacted] was **partially** blocked in the presence of 10m*M* [redacted], a blocker of [redacted] from the [redacted] milieu ([redacted]

Exhs. 5 and 8 at 10 (emphasis in original). In the 1990 proposal it read

> Interestingly, the [redacted] induced increase in [redacted] was only partially blocked in the presence of 10mM [redacted] a blocker of [redacted] in the [redacted] see next section).

Exh. 1 at 10. The 1991 abstract cited in the renewal proposal describes no *new* work that supported the proposition for which it is cited. It simply states

> Previous work on the [redacted] has shown that [redacted] works via an [redacted] second [redacted] system. [redacted] added to individual, [redacted] filled [redacted] causes an immediate rise in [redacted] This rise is partially blocked in the presence of 10mM [redacted], suggesting that the rise in [redacted] is due both to the opening of [redacted] and to release by [redacted] stores.

[redacted]. (Note: [redacted] and [redacted] are different acronyms for the same compound.)

personally was unaware that he [w]as having difficulties with obtaining repeatable results and this was also true for all but one reviewer . . . .[58]

Exh. 29 at 1.

One of the few sentences in this section that addresses work actually performed during the award period states that the subject's laboratory has "recently been able to [redacted] individual [redacted]," and that such experiments are discussed in Aim 2 of the renewal proposals. Exhs. 5 and 8 at 10. Although that information was crucial to the fair and objective evaluation of the laboratory's research performance competence, including the technical soundness of the re-proposed approach, *see* NSF92-89 at 10, the renewal proposals give no indication of the extensive difficulty encountered by the subject's laboratory in performing those same experiments on [redacted] as Aim 3 (1990), nor do they suggest alternative approaches based on the subject's actual experience.

D. The Subject's State of Mind

In evaluating the subject's state of mind, we first discuss those facts that created a motive for the subject's miscasting of the 1988 [redacted] Experiment as progress under the 1990 award: the subject's perceived need to hide his laboratory's difficulties performing, and lack of progress toward, the research described as Aim 3 (1990)/Aim 2 (1993). We then identify additional facts that convince us that he intentionally misrepresented the [redacted] Experiment to achieve this end.

1. Motive

As set forth above, it was essential to the subject's ability to conduct the research originally described as Aim 3 (1990) that his laboratory first be able to isolate [redacted] suitable for [redacted] and that it then be able to [redacted] such [redacted] Because the subject's laboratory remained unable to perform either technique reliably, it made no significant progress toward this Aim during the period of the award. Instead of describing "significant scientific developments and . . . any problems encountered," NSF92-89 at 16, NSF90-77 at 14, in his progress reports, he chose to describe prior work as progress and to omit discussing his problems.

Had the subject not discussed the 1988 [redacted] data he would have had little to report in the progress section of his renewal proposals. In 1993, for example, in the discussion of his laboratory's progress under Aim 3 (1990), the subject simply said, "[w]e

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[58] That reviewer's stated concern focused on the absence of supporting data for the subject's plan to isolate [redacted] through [redacted] and the use of blockers, not on the [redacted] Experiment. *See* 15 July 1993 *ad hoc* review at 1. These concerns were not based on any affirmative statements by the subject concerning difficulties with or limitations in the data.

have recently been able to [redacted] individual [redacted] to test this model." Exhs. 5 and 8 at 10. He said nothing about the substance of his laboratory's research over the grant period. (Indeed, the one Figure that could be taken as progress (Figure 7, described above at Part I, pages 11 through 20) is presented elsewhere in the proposal.) He did not discuss his laboratory's progress in [redacted] and [redacted] and how that might relate to progress toward Aim 3 (1990); he did not discuss the difficulties he had encountered in the research as it was described in Aim 3 (1990)—that is, [redacted] dissociated [redacted] He recast Aim 3 (1990) as Aim 2 (1993) without stating "the relation of the completed work to the proposed work," NSF92-89 at 4, and without modifying the proposed work in light of the difficulties his laboratory had experienced during the 1990 grant period. As noted above, this was because he felt that to acknowledge his laboratory's difficulties in this area would jeopardize the funding sought in the renewal proposals.[59] *See* page 17 above; Exh. 11 at 159.

This provided the subject with a strong motive to cast the [redacted] Experiment in such a way that it appeared to represent progress toward Aim 3 (1990). When we asked him why Aim 3 (1990) and Aim 2 (1993) were so similar, he said that "[b]ecause [his graduate student] had not made significant progress on the research described as two elements in Specific Aim 3 of my 1990 proposal, I included this research in my 1993 proposal as two of the three elements of Specific Aim 2." Exh. 25 at 1.[60]

The subject's presentations from 1991 through 1993 of the 1988 [redacted] Experiment combined with his silence, during that period, about his laboratory's problems in making progress toward Aim 3 (1990), misled the program officer and reviewers about his progress on the research initially funded in 1990 and the likelihood of success of the research he was re-proposing to do. Both of these were elements of the review criteria, specifically research performance competence and intrinsic merit of the research.

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[59] The subject's instincts were sound: a fair and accurate portrayal of his laboratory's actual difficulties and accomplishments might well have resulted in diminished support. The program officer does not believe reviewers would have rated the 1996 revision as positively as they rated the April 1993 renewal proposal. Based on the 1996 revision, the program officer "would never have recommended five years of support;" and believed serious questions would have been raised about the feasibility of Aim 2; *if* support had been recommended by the panel, the program officer "would have probably recommended two years . . . but at a reduced level . . . ." Exh. 29 at 4. *Cf. id.* ("If questions were raised about all of the specific aims, I do not believe that the [advisory] panel and/or ad hoc reviewers would have been as enthusiastic for the proposal. I definitely would not have recommended this level or duration of support.")

[60] The 1988 [redacted] Experiment was background research supporting Aim 3 (1990), which envisioned new and different work. The work proposed in the first two parts of Aim 2 (1993) is virtually identical to that proposed in Aim 3 (1990). Exh. 1 at 18-21; Exhs. 5 and 8 at 16-18. (Indeed, the second part of Aim 2 (1993) is virtually a verbatim transcription of text from the 1990 proposal. *Id.*) The third and final part of Aim 2 (1993) is a further extension of the new work that the subject proposed but did not perform.

2. Intent

The subject originally described the 1988 [redacted] Experiment in the background section of the 1990 proposal. He gathered no additional data during the period of his NSF award and had not purchased the equipment to perform such runs; he knew the [redacted] Experiment was only preliminary and had been performed with a collaborator in the collaborator's laboratory before, rather than during the grant period. Exh. 24 at 1-2; Exh. 11 at 89-91; Exh. 3, at 2; Exhs. 5 and 8 at 18. The subject nevertheless described the 1988 [redacted] Experiment at length in the 1991 progress report and again in 1992. In 1993, he moved the description of the [redacted] Experiment from *background* to a section purporting to describe *progress* achieved by his laboratory under the award.

The subject justifies his treatment of the [redacted] Experiment as progress on the grounds that he was describing his "plotting of the two runs of data collected in 1988 and the reanalyses of all the data," which, he maintained, were completed during the grant period. Exh. 24 at 1; Exh. 32 at 6-7. Yet, the subject omitted from all of his submissions to NSF any mention of the two plots he now claims constituted his only actual progress with respect to [redacted] The Figure that depicts the [redacted] Experiment in the 1990 proposal and the 1993 renewal proposals contains two separate plots: one represents the influence of [redacted] and the other the absence of [redacted]. Exhs. 5 and 8 at 10, Figure 5. The subject told us he conducted a total of 2 runs in the presence of [redacted] and 4-5 runs in the absence of [redacted] Exh. 24 at 1. He said that, before the award period, he plotted all of the data sets except 2-3 runs in the absence of [redacted] and that he plotted these runs during the award period. *Id.* Notably, however, the Figure remained *unchanged* from its first appearance in the 1990 proposal. The subject said, "[t]he plot appearing in my 1990 and 1993 grants is the best data run I obtained in the 1988 [experiments]." Exh. 24 at 2. *Accord* Exh. 32 at 7.

Likewise, the text contained *no* mention of additional plots or re-analysis. Although there were textual changes, these only served to inflate the apparent weight of the original findings and to make it appear that the Experiment had been undertaken by the subject alone, in his own laboratory, during the course of the 1990 award. Those changes—including recasting a "small, yet consistent rise" as a "two-fold increase," characterizing as a model what had been a suggestion, deleting all citation to the collaborator,[61] replacing citation to a

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[61] The original phrases were, "in collaboration with Dr. [redacted] at the Department of [redacted] University of [redacted]" and "analyzed on Dr. [redacted] system." Exh. 1 at 10. The subject said he failed to acknowledge Dr. [redacted] because of space limitations and lack of relevance. Exh. 24 at 1. Space limitations and lack of relevance are neither acceptable nor, in this instance, plausible excuses for failing to properly acknowledge a collaborator. For brevity he could have simply replaced his original 22 words of acknowledgment with "in collaboration with [redacted] or with a bibliographic citation that acknowledged [redacted]. (There was no page limit on bibliographic citations. NSF92-89 at 6.) In 1991 the subject published a review article ([redacted] containing a description of the [redacted] Experiment that is essentially a verbatim transcription of the presentation in the background section of the 1990 proposal. Notably the acknowledgment to the collaborator and reference to working in the collaborator's laboratory have been deleted from this review article. Yet, authors of

1989 abstract with citation to a 1991 abstract, describing the [redacted] results as "recent," and placing the updated description in the "results" portion of the proposal—can only be viewed as knowing and intentional.

The subject knowingly provided NSF with false and misleading information and omitted critical information in order to suggest that this was his own work accomplished in his laboratory under his 1990 award, to create the impression that his research program was more successful than it was, and to achieve the most positive reviews possible, so that he would receive out-year funding on the 1990 award and the renewal proposal would be funded.

OIG ANALYSIS: MISCONDUCT IN SCIENCE

The evidence we describe above demonstrates, in our judgment, that, for each of the allegations discussed, the subject committed acts that deviated from accepted practices in proposing and reporting work to NSF, and that he did so with a culpable state of mind. The University concluded that each of these acts that it considered constituted scientific misconduct under the University's definition. We believe that these acts, both collectively and separately, constitute serious deviations from accepted practices in the scientific community, and should be found to be misconduct in science under NSF's regulation.

NSF trusts scientists to accurately describe their results, their methods, the quality of their data, and their progress under their NSF awards so that their progress and proposals can be evaluated in comparison with the work of others in their field. NSF and its merit reviewers must be able to rely on the accuracy of a scientist's submissions. Neither NSF nor its reviewers have the resources to independently review every notebook, publication and datum to ensure that they have been accurately described.

The NSF *GRESE* instructs that proposals should provide "an adequate description of experimental methods and procedures." NSF92-82 at 4. PIs submitting renewal proposals are told to assume "that reviewers will not have access to the previous proposals." *Id.* at 14. Reviewers critique the presented work based on the assumption that results are presented honestly. While scientists may present their work favorably, they may not reasonably fail to check the supporting data or omit critical details so that readers would substantially misinterpret when and what was done or proposed.

Of the four criteria used to assess a proposal, two are particularly relevant to this discussion: the scientist's research performance competence (review criterion 1) and the intrinsic merit of the research (criterion 2). Criterion 1 "relates to the capability of the

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such articles are expected to acknowledge the contributions of others and such acknowledgments are not constrained by the space limitations imposed on NSF proposals.

investigator(s), [and] the technical soundness of the proposed approach . . . ." *Id.* at 10. Criterion 2 "is used to assess the likelihood that the research will lead to new discoveries or fundamental advances within its field of science . . . or have substantial impact on progress in that field . . . ." *Id.*

The subject knowingly (and in one instance at least recklessly) precluded NSF and its reviewers from accurately assessing his proposal on the basis of these crucial criteria. His presentations caused, and were designed to cause, reasonable readers substantially to misinterpret what he had done, what he was capable of doing, and what he realistically could be expected to accomplish with NSF's funds. The fact that the subject's laboratory had failed, for more than 2 years, to make significant progress toward [redacted] was crucial to NSF's ability to evaluate the likelihood of success of his proposed research. The 1993 revised renewal proposal—which resulted in a large award—similarly failed to provide available and required information for NSF to make an informed assessment and decision. Several reviewers of the 1993 proposal praised the subject's progress under his 1990 award. They did not know that the [redacted] Experiments described as progress under the award were difficult-to-repeat, preliminary results obtained prior to the receipt of the 1990 award, that the subject had merely plotted two sets of data gathered with the aid of the collaborator, and that, because of his student's difficulties, he was again proposing to do work originally proposed in his 1990 award. When provided by OIG with the actual facts, the program officer said that if these facts had been known at the time, the program officer would have committed only 2 years of support, and at a reduced level, if support had been recommended by the panel. Exh. 29 at 4.[62]

There is a significant risk, moreover, that the misleading nature of the subject's presentation had another, but no less important, effect. NSF and panel merit reviewers draw on their knowledge of successful and unsuccessful research approaches when evaluating proposals and making funding recommendations vis-a-vis other applicants. Because the subject failed to qualify his laboratory's progress with a fair and objective description of the problems his laboratory had encountered, NSF and its reviewers could only conclude that this was a viable experimental approach to an important research question—a conclusion they might misapply in other instances.

We conclude that the subject seriously deviated from accepted practices in the scientific community in proposing, carrying out, and reporting results from activities funded by NSF when, in order to influence NSF funding decisions on his annual funding increments and renewal proposals, he violated NSF's requirements and knowingly miscast his laboratory's ability to prepare [redacted] for [redacted]

[62] The program officer's evaluation was based on the more accurate factual presentation in the 1996 revision. OIG did not ask for, and the program officer did not, factor into that assessment any conclusion as to whether the subject's earlier, misleading, presentations constituted misconduct in science or rendered him presently irresponsible to conduct federally funded research.

[redacted] experiments, page 18, *et seq.*, above; knowingly miscast his laboratory's ability to perform [redacted] on those [redacted], page 11, *et seq.*; misreported experimental results with either the intention to mislead or the reckless failure to check the supporting data, page 22, *et seq.*; and knowingly substituted an inflated discussion of old data for a discussion of his laboratory's actual progress and knowingly failed to disclose his laboratory's problems (and, hence, its actual technical capabilities) under the award. Page 27, *et seq.* Each of these actions constitutes misconduct in science under NSF's definition.

OIG's RECOMMENDED DISPOSITION

Under § 689.2(b) of NSF's misconduct in science and engineering regulation, in deciding what actions are appropriate when misconduct is found, NSF officials should consider the seriousness of the misconduct, the intent with which the subject acted, any evidence of a pattern, and finally, the relevance of the misconduct to other funding requests or awards involving the institution or individual.

We have set forth at length in the previous section our analysis of the seriousness of the subject's deviations from accepted practices. We believe that the subject's presentation of the 1988 [redacted] Experiment as having been conducted under the NSF award—a presentation that spanned the 1991 progress report, the 1992 progress report, and both of the 1993 renewal proposals—can and should be viewed as a pattern and practice of misconduct. That misconduct was rendered more serious by the fact that the subject failed to provide his collaborator on the 1988 [redacted] Experiment with appropriate credit either in publication or in NSF submissions after 1990. The fact that the subject also falsely presented his laboratory's ability to dissociate [redacted], its ability to [redacted] those [redacted], and the results of the [redacted] and [redacted] experiments, strengthens our view that the subject engaged in a broad pattern of misrepresenting information to ensure his professional success.

The above conclusion is also supported by evidence drawn from the subject's presentation in these same documents about his laboratory's [redacted] method for [redacted]. As set forth in Appendix A, we found that the subject omitted information about his ability to [redacted] when he described experiments that were designed to measure the [redacted] quantitative response to [redacted] exposure. His comments before the University committee of investigation showed that he knew he was in the process of working out the method for successfully [redacted] these [redacted] for extended periods of time, and that he did not know if they maintained differentiated functions. In fact, with the loss of each undergraduate student, his laboratory had to redevelop the capability of conducting these experiments. Such information would be important to NSF and its reviewers' assessment of his abilities to accomplish Aim 1 of his 1993 proposal.

The evidence demonstrates that the subject lacks the judgment and present responsibility necessary to administer his current NSF award. Over an extended period of time, he repeatedly falsified information in proposals and progress reports in ways that

rendered them fundamentally misleading with respect to key criteria on which he knew federal funding decisions are based. These practices also raise concerns about his suitability as a research mentor. Information about the training he affords his graduate and undergraduate students, *see* Part II above, and Appendix B below,[63] demonstrate the seriousness of those concerns.

Nothing in his response to the graduate student's allegations or the University's or OIG's investigations demonstrates that the subject understands how the principles set forth in NSF's definition of misconduct in science apply to his actions. We find it troubling, in this regard, that *even after* the graduate student expressed concerns to the University about the accuracy of the statements in the renewal proposals that are discussed in Parts I, II and III of this report, many of which the subject has now conceded were misleading, the subject continued to maintain that the problems were not that serious. Exh. 11 at 50-51.

We believe the evidence shows that NSF cannot rely on the truthfulness of the subject's submissions to protect the federal government's interests. NSF should conclude that the subject committed serious deviations from accepted practices and thus misconduct in science and should take the following actions:

1. Send the subject a letter of reprimand informing him that he was found to have committed misconduct in science.

2. Require, for a period of 3 years from the final disposition of this case, or for the term of his next award, whichever is longer, that each of the subject's submissions to NSF (including annual progress reports, requests for supplemental funding, and proposals) include, as part of the submission, a certification by the subject that he has reviewed NSF's misconduct in science regulation, and that the submission is free of misconduct.

3. Ensure, for the same period, that each of the subject's pending or future submissions to NSF include, as part of the submission, a signed assurance from a University official who is qualified to understand the laboratory's supporting research data and documentation that the official has reviewed those records and that all portions of the submission that rely on those records are accurate and complete.

4. Require, for the same period, that the subject send copies of the University official's assurances and the subject's certifications to the Assistant Inspector General for Oversight in NSF's Office of Inspector General, for retention in that Office's confidential file on this matter.

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[63] We note that our concerns in this regard stem from the subject's own descriptions of his mentoring practices, and the University committee's assessment of the records maintained by the subject's graduate student under the subject's tutelage, an assessment with which he essentially concurs. *See* Exh. 11 at 39. We did not (nor did we need to) rely on any information which the subject has lacked a fair opportunity to rebut. *Cf.* Exh. 32 at 8.

5. Reduce, during the same period, the annual increment for any award to the subject to $65,000 annually or to an amount commensurate with the program officer's evaluation of the subject's actual research capabilities.

6. Limit, during the same period, the term of any award to the subject to a maximum of 2 years or for a duration commensurate with the program officer's evaluation of the subject's actual research capabilities.

7. Consider, for the same period, requesting that assurances be submitted by the subject with his requests for funds from NSF's REU program, such as assurances from a University official who is qualified to understand experiment and data recording practices that the recording practices the subject imparts to his students and the subject's practice for reviewing records in his laboratory comply with acceptable scientific norms.

We believe that if NSF takes the recommended actions, NSF's interests will be adequately protected. However, the subject currently has funding from the Public Health Service and action short of debarment will not ensure that the interests of other federal agencies are protected. We recommend that NSF consider requiring that certifications and assurances similar to those described above be included with the subject's submissions to other federal agencies and, if it concludes that such steps are impracticable or will not sufficiently protect the federal government's interest, that it debar the subject for 3 years.

THE SUBJECT'S COMMENTS ON THE DRAFT INVESTIGATION REPORT

In September 1997 we received the subject's comments on our draft investigation report. Exh. 32. In the final report, we refute, or cite to, those comments where appropriate. We also altered the report in the following respects to reflect concerns raised by the subject with which, on consideration, we agreed:

In light of the subject's concerns about the fairness of the University proceedings, *see* Exh. 32 at 8, we verified, and made plain, that our conclusions do not depend on information presented to the University that has not been not shared with the subject. We note the University's conclusions, however, because they afford important insight into the mores of the subject's own academic community.

In light of the subject's stated concerns about our interview, Exh. 32 at 9, we noted that he had been fully advised of our positions, that the interview was voluntary and that he was entitled to be accompanied by counsel, if he so desired. *See* page 7, above.

We modified our original recommendation 4 (now recommendation 7) (about mentoring) in response to the subject's concerns that our original, more stringent, recommendation might place excessive weight on the negative evidence. *See* Exh. 32 at 8, 9.

We believe our revised recommendation appropriately alerts the agency to concerns raised by the uncontested evidence (including statements by the subject, *see* page 23, above).

Finally, we modified our recommendation about the length of awards entered into after any action based on this report to permit the subject to positively affect the result by affirmatively demonstrating to the program officer his laboratory's actual research capabilities.

Appendix A

Culturing [redacted]

In this section we will describe the subject's efforts to [redacted] *in vitro*. There are two ways in which the subject's description of these efforts are similar to his descriptions of the [redacted] Experiment and therefore relevant to this report. First, the subject provided insufficient information about the state of his research for NSF staff and reviewers to accurately assess his ability to extend that work. Second, the subject recycled prior descriptions of his work as current progress and failed, at the same time, to explain why he was not making progress on the project described in the proposal. We view the subject's treatment of the [redacted] experiments as reflecting a pattern of misrepresenting his research efforts. However, for the reasons explained below, we do not view the [redacted] work as misconduct in science.

The Evidence

The subject's 1990 proposal does not describe experiments on cultured [redacted]. The subject's first discussion of these experiments appears in his 1991 progress report as an extension of the project described in Aim 2 (1990). This discussion states, "[w]e are currently pursuing *in vitro* experiments on [redacted] to quantitatively ascertain the morphological and biochemical effects" of a [redacted] Exh. 2 at 2. It is apparent from the 1992 progress report, Exh. 4 at 2, that the subject's laboratory continued working on these experiments in the next year. That report states that the laboratory had developed an [redacted] culture system in which the [redacted] "remain [redacted] and [redacted] for up to three weeks"[64] and that it was "currently" determining these [redacted] responsiveness to [redacted] treatment. *Id.* The "Results from Prior NSF Support" section in the subject's 1993 renewal proposals states "[w]e have been developing a culture system to analyze the effects of [redacted] more quantitatively, and these experiments are described in Specific Aim #1 of this proposal." Exhs. 5 and 8 at 10.

Aim 1 of the renewal proposals is

> To investigate the role of [redacted] in a more quantitative manner, we have developed an *in vitro* culture system in which [redacted] can be maintained

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[64] Two hallmarks of successful *in vitro* [redacted] are high [redacted] and [redacted]." [redacted] is a measure of the number of [redacted] found in a sample where both the total number of [redacted] and [redacted] have been counted. It is the ratio of the counts of [redacted] to [redacted] expressed as a percentage. [redacted] is a general term used to express the visual appearance of the [redacted] and their ability to maintain a particular differentiated function or set of differentiated functions in [redacted]. For [redacted] like the subject's [redacted], it is usually a measure of the [redacted] ability to maintain a differentiated function like [redacted] activity or [redacted] responsiveness. Low [redacted] and loss of differentiated function are usually considered to be indicators of suboptimal culture conditions.

for up to 3 weeks. Our immediate goal is to determine whether [redacted] can alter [redacted] expression *in vitro*.

Id. at 13. The renewal proposals' description of the experimental design for this Aim again informs the reader that "we have *recently* succeeded in culturing [redacted] for 3 weeks, a duration adequate for the studies proposed here . . . ." *Id.* at 14 (emphasis added). Although the proposals provide no information about whether the [redacted] retained important differentiated functions (such as [redacted] responsiveness or [redacted] activity) after they were removed from the [redacted] and placed in [redacted] they do state that the laboratory has determined that the presence of certain compounds is "essential for [redacted] and [redacted]." *Id.* at 16. The subject told the University committee of investigation that the cultured [redacted] was "10 percent," and that he did not know if the [redacted] had [redacted] activity. Exh. 11 at 73. The program officer told us that if the subject's proposal had contained this information about the [redacted] rate of the [redacted] or his ignorance as to whether they retained differentiated function, it would have had "a major effect on the critique of specific aim 1." Exh. 21 at 5.

The subject also told the University committee of investigation that when the grant was written the student who had conducted the [redacted] culturing experiments was "getting to the point of having [the [redacted]] [redacted] for several weeks, often times three weeks." Exh. 11 at 74. The student then left the laboratory, without training his replacement. By October 1993, the subject estimated that the replacement student was "now" able to keep the [redacted] for "a couple weeks." *Id.* at 75. In a 25 April 1994 request to NSF for REU funds, the subject states that the funds would support the replacement student, who had been working on the [redacted] culture project for 18 months, and who had "already succeeded in growing these [redacted] in culture and is *just* beginning a set of manipulations aimed at determining the mechanisms underlying this [redacted]." Exh. 15 (emphasis added).

The subject's November 1994 progress report describes the [redacted] physical appearance when they are exposed to [redacted] and demonstrates that the [redacted] are responsive, at some level, to the presence of [redacted]. Exh. 17 at 1-2. This sort of qualitative information about whether the cultured [redacted] retained a sensitivity to the [redacted] was a necessary precondition for the quantitative experiments described in Aim 1 (1993).

A subsequent, 17 February 1995, letter requesting additional REU support for yet another new student who had been working in the subject's laboratory "for the past nine months" states, "we have *recently* been able to individually culture these [[redacted]] in order to study [the [redacted]] phenomenon more quantitatively. Using these cultured [redacted], the student will determine if [redacted] act directly on these [redacted]." The subject continued, "[h]er success is such that she has been able to maintain these [redacted] in culture for up to 3 weeks and has generated some very nice data showing the [redacted] dependence of the [redacted] patterns of these [redacted]." Exh. 18 (emphasis added).

The subject claimed success culturing [redacted] and [redacted] for 3 weeks in the August 1992 progress report for his 1990 award, but then claimed *recent* success in this same endeavor in the January 1993 renewal proposal and again in the 1995 REU request. This and his statements to the University committee of investigation make plain that the laboratory has, through a succession of students, lost and regained the ability to culture [redacted] What is disturbing about how the subject reported the laboratory's abilities is that it is similar to his actions in repeatedly presenting the [redacted] Experiment as recent results to disguise both lack of progress and technical difficulties. The similarity in the subject's actions in these two situations is particularly apparent from a comparison of the remarkably similar descriptions of the Aim 1 (1993) [redacted] culture work found in the November 1994 and December 1995 progress reports. The December report describes what "previous experiments have determined" and continues:

> *To investigate the role of* [redacted] *in a more quantitative manner, we have developed an in vitro culture system* in which *individual* [redacted] can be grown *for up to* 21 days.
>
> Our culture experiments have focussed initially on the morphological changes exhibited by the [redacted]. We have determined that different *physiologically*-relevant *concentrations of* [redacted] *causes major* [redacted] *-dependent changes in the morphology of the* [redacted] *reared in vitro. Cultured* [redacted] *grown in low* [redacted] *concentration* produce primary [redacted] with *little or no* secondary or tertiary [redacted] *whereas higher* [redacted] *concentrations induce large* [redacted] *with a profusion of secondary and tertiary* [redacted] [redacted] grown in low [redacted] for 5 days followed by a 5 day exposure to high levels of [redacted] contain a full complement of primary, secondary, and tertiary [redacted]. Thus *in vitro effects of* [redacted] *closely resemble the in vivo morphological remodelling of the* [redacted] *demonstrating that the culture system can be used to study* [redacted] *effects. Current work is focussing on using* [redacted] *to trigger the* [redacted] *-to-* [redacted] *in vitro.*

Exh. 22, at 2 (emphasis added). The italicized text is a direct transcription from the November 1994 progress report. Exh. 17 at 1-2. In addition, and notably, the subject has not, from his own description of his research efforts, made much progress on Aim 1, and rather than describe any difficulties he may have encountered in the quantitative experiments, he has chosen to reiterate qualitative results.

In the September 1996 progress report the subject states

> [W]e have been investigating the effects of [redacted] on these [redacted] in culture and have demonstrated that different concentrations of [redacted] produce differential effects on the type and extent of process [redacted] in these [redacted] We also have demonstrated that [redacted] application reduces or abolishes [redacted]

[redacted] in these [redacted]. Thus, the *in vitro* [redacted] culture system appears to mimic the *in vivo* situation.

Exh. 30 at 1-2.

In contrast, in his most recently submitted NSF proposal, the subject's description of this work suggests that his laboratory has made progress in understanding the actual quantitative influence of a [redacted] on [redacted] Exh. 31 at 11.[65]

Our Conclusions

Although we think that Aim 1 (1993) would have attracted more criticism from reviewers had the subject provided more details, we view this situation as less serious than that described in Part IV of the report because:

- The progress described all occurred within the 1993 award. The subject did not substitute a description of research performed with a collaborator before the award that had not been supported by NSF for a description of work he actually performed on this Aim. (He simply repeated the same progress in several reports.)

- In this instance, the subject's repeated characterization of the [redacted] culture work as "recent" appears to be accurate—each time a new student was hired to conduct the [redacted] culture experiments the student began by developing the culturing skills necessary to keep these [redacted] for 3 weeks. It also appears that the subject was eventually able to gather data related to the project described in the proposal.

We are nevertheless concerned because the description of the laboratory's abilities (to culture [redacted] suitable for these experiments) and knowledge (about the [redacted] responsiveness to the [redacted], and hence their suitability for the experiments) found in the 1993 proposals did not provide reviewers or NSF staff sufficient information to accurately assess the riskiness of this particular project and, by their omissions, could reasonably be interpreted to indicate that the project was less risky than it was. With respect to the repetition found in the progress reports, if the subject had not been able to report success in other areas of research, pressures similar to those he experienced in attempting to conduct the research described as Aim 3 (1990) may have escalated his descriptions to serious misrepresentations like those described in Part IV of this report.

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[65] For the purposes of this report, we do not take issue with the subject's amount or rate of progress on this Aim.

Appendix B

The Subject as a Mentor for the Next Generation of Scientists

> In research training, a mentor is defined as someone who is ultimately responsible for the guidance and the academic, technical, and ethical development of a student.

Francis L. Macrina, *Scientific Integrity: An Introductory Text with Cases* (1995) at 15.

> Mentors inform, instruct, and provide an example for their trainees. The actions and activities of mentors affect the intellect and attitude of their trainees. . . . [T]rainees emerge from their programs with an intellectual and ethical framework strongly shaped by their mentors. Indeed, trainees often assume the traits and values of their mentors. Thus, mentors are the stewards of scientific integrity.

Id.

Mentors to undergraduate students usually provide the students' first introduction to proper laboratory and research conduct, including the proper recording of research results in a laboratory notebook.[66] Such documentation, in turn, permits the mentor to evaluate a

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[66] The importance of documentation is described in *Writing the Laboratory Notebook* by Howard M. Kanare,

> A laboratory notebook is one of a scientist's most valuable tools. It contains the permanent written record of the researcher's mental and physical activities from experiment and observation, to the ultimate understanding of physical phenomena. The act of writing in the notebook causes the scientist to stop and think about what is being done in the laboratory. It is in this way an essential part of 'doing good science.'
>
> * * *
>
> The information written into a research notebook is used for several purposes. Most importantly, the pages of the notebook are used to preserve the experimental data and observation that are part of any scientific investigation. The notes must be clear, concise, and complete. The properly kept notebook contains unambiguous statements of 'the truth' as observed by the scientist. . . .
>
> The guiding principle for notekeeping is to write with enough detail and clarity that another scientist could pick up the notebook at some time in the future, repeat the work based on the written descriptions, and make the same observations that were originally recorded. . . .
>
> . . . The notebook provides a forum in which data and observations are analyzed, discussed, evaluated, and interpreted. . . . This process leads to the writing of reports, technical papers, patent disclosures, and correspondence with colleagues.

Id. at 1,2.

student's practical understanding of how a good experiment is designed, conducted, and documented. Critical review of student documentation allows the mentor to assess the quality of the student and the data, and to correct fundamental errors in the data or the student's approach to designing experiments. Left uncorrected, a student who has developed sloppy recording practices can see hard, well-meaning effort become unpublishable or worse, can unintentionally reach, rely on, and even publish, erroneous results.

Noting that "[t]he undergraduate years are critical in the educational sequence, as career-choice points and as the first real opportunities for in-depth study," *e.g.* NSF88-28 at 1, NSF has explained that its REU awards are designed to "involve students in meaningful ways in either ongoing research programs or research projects." *Id.*

Since 1990, the subject has received over $30,000 from NSF's REU program.[67] During our investigation we learned that the undergraduate students in his laboratory received minimal guidance from the subject about essential scientific practices. The subject told the University committee of investigation that he gave new students instruction on how to keep a logbook but that he did not give them feedback on how to keep good notes or check their books, which he considered to be solely for their individual use. Exh. 11 at 40. As noted in the body of the report, the University committee of investigation concluded that the subject's graduate student's

> notebook pages . . . were essentially unintelligible to anyone except [the graduate student]. There were few complete thoughts and only a few notes describing experiments. These notes required [the graduate student's] intervention to decipher. Thus, there was no way that the committee could independently establish that certain experiments had or had not been performed. The committee was rather surprised that such a notebook would have been considered acceptable by [the subject].

Exh. 19 at 2.

We are concerned that the subject's understanding, and execution, of his responsibilities for training students are inconsistent with NSF's and the University's understanding of these responsibilities. Recommendation 7 is directed at addressing this concern.

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[67] In his 1990 proposal, the subject included an "Education and Human Resources Statement." He there said, "[t]he research described in this proposal will contribute in several ways to the development of human resources in science and to science education. . . . The experience of working in a research laboratory will be especially beneficial for the several undergraduates involved in our research, exposing them to a scientific environment and hopefully helping them to choose a career in science." Exh. 1 at 36.