



Meeting of the BIO Advisory Committee Summary Minutes April 25-26, 1996

THURSDAY, APRIL 25 - MORNING SESSION

Welcome and Approval of Minutes

Dr. Paul Magee, Chair of the Advisory Committee for Biological Sciences (BIOAC), convened the meeting at 8:45 am with a welcome to members and guests.

Dr. Mary Clutter, Assistant Director for the Biological Sciences (BIO) informed the BIOAC that an omnibus appropriations bill would be signed this morning, funding NSF for the remainder of FY 1996. The minutes from the November 1995 meeting were unanimously approved by the BIOAC.

Overview of FY 1997 Budget Request

Dr. Clutter gave an overview of the FY 1997 budget request for NSF overall and BIO in particular. She commented that NSF, NIH and part of NASA are the only agencies mentioned in the President's federal research investment package. She also noted that the FY 1997 budget request is characterized by a balance across major fields of science and key program functions. She went on to discuss NSF's FY 1997 budget request in light of FY 1995 and FY 1996 funding levels.

Dr. Clutter also discussed trends in federal discretionary funding, and non-defense research and development in particular. She discussed projections for federal discretionary spending through FY 2002.

Dr. Burt Ensley asked Dr. Clutter to comment on why the Academic Research Infrastructure (ARI) program account has a funding level of zero in the FY 1997 request. Dr. Clutter noted that this \$100M line consists of two parts: \$50M for larger scale instrumentation and \$50M for laboratory renovations. The shared instrumentation funds will be distributed to the research directorates. It was decided not to request \$50M for laboratory renovations since that would have an inconsequential impact on an \$11B problem.

The BIOAC also discussed the following issues:

- The Directorate for Social, Behavioral and Economic Sciences' (SBE) involvement in a proposed urban LTER site.
- Implications of offering small versus large grants to PIs.
- The effectiveness of NSF and NIH funding mechanisms in comparison to organizations such as the Howard Hughes Foundation, which puts greater amounts of money in a smaller number of institutions
- The implications for NSF of budget cuts at other agencies that fund basic research.
- The effectiveness of partnerships between the NSF and other Federal agencies. The NSF-EPA partnership was discussed in particular.

In addition, Dr. Cathie Woteki, Department of Agriculture, discussed the implementation of the Government Performance and Results Act (GPRA), which is set to begin in 1999.

Discussion with the Deputy Director NSF, Dr. Anne C. Petersen

Dr. Petersen thanked the BIOAC for their three workshops on the issue of integrating research and education and noted that she and the Director appreciate their recommendations.

Dr. Petersen stated that she feels that it is very important for the scientific community to be aware that the federal budgetary climate for research is changing and that there will be increased accountability for the federal research investment. She discussed how it is essential to develop a post-Cold War rationale for federal research and development funding, which includes societal as well as economic benefits.

Dr. Petersen discussed the importance of integrating research and education to ensure a scientific and technologically literate public to meet our future workforce needs and maintain US leadership in science and technology. She noted that NSF must play a role in promoting this integration and that the Advisory Committees provide valuable guidance on this.

Dr. Petersen gave an overview of the Recognition Awards for Integrating Research and Education (RAIRE), NSF's newest initiative to promote the integration of research and education. She also mentioned other programs targeted at this need, such as CAREER, GOALI, and RTGs. She stressed that NSF is planning no dramatic changes to proposal requirements and that they will take an incremental approach towards promoting the integration of research and education.

Dr. William Greenough asked how RAIRE awards will be used by the universities. Dr. Petersen responded that the awards will be given for past accomplishments and that the recipients will use the money to publicize and extend these efforts.

Dr. Barbara Webster commented that PBS television programs highlighting science and research are an excellent example of public education on the value of science and research and wanted to know if NSF would continue to support such programs. Dr. Petersen stated that the Directorate for Education and Human Resources (EHR) is cutting the Informal Science Education budget because they feel that these projects will be taken up by other sources. She also noted that at the request of our authorization committee, the General Accounting Office (GAO) is looking at spending at all agencies for public outreach activities. Dr. Petersen

commented that she believes the ultimate argument will be over the appropriateness of NSF funding these activities.

The BIOAC also discussed the following issues with Dr. Petersen:

- Further exploration of the proposed cuts to the ARI program
- The appropriateness of NSF support for community colleges
- NSF's public relations efforts to gain attention for the Foundation's successes
- The use of qualitative measures to meet GPRA requirements

Report on BIO Science Retreat

Dr. James Edwards gave an overview of the BIO Science Retreat (February 1996), which was an opportunity to identify important emerging areas in the biological sciences. He discussed the sources of information and what we need to know about these emerging areas.

BIO's Division Directors talked about the four thrust areas and the needed actions:

Arabidopsis Sequencing

Dr. Thomas Brady (Acting Division Director, Division of Environmental Biology) discussed how the Arabidopsis project began in 1990, where it is now, and the plan itself.

Dr. Brady also reviewed the 1995 progress report on the Arabidopsis genome. He mentioned as an example of the research completed thus far the leafy gene which has been transferred from Arabidopsis to aspen tree tissue cultures. The leafy gene can cause aspen to flower within 10 months, and this will have great impact on the hardwood and ornamental forestry industries.

Dr. Brady stated that one of the goals being considered is to complete most of the sequencing of Arabidopsis by 2002, with some "fine tuning" for several years thereafter. The BIOAC and Dr. Brady discussed how much it would cost to complete the sequence of the Arabidopsis genome (approximately \$50 million), how the money would be spent, and the possibility of industry partnerships. Dr. Brady noted that the money would probably go to collaborations among large sequencing centers. He stated that other Federal agencies and international efforts are included in the program as well. The BIOAC stressed the importance of continued partnerships and collaborations.

The Analysis of Biological Systems

Dr. Bruce Umminger (Division Director, Integrative Biology and Neuroscience) gave an overview of a proposed Analysis of Biological Systems (ABS) initiative. He noted that it is a combination and expansion of two current activities, Biosystems Analysis and Control (BAC) and Modeling of Biological Systems (MOBS). Dr. Umminger stated that BIO is considering making an announcement to solicit collaborative proposals in this area and that a new working group is being formed to discuss how the former BAC and MOBS programs interface, proposal review issues, etc. BIO intends to encourage workshops and symposia to let the community know NSF is interested in proposals in ABS. Dr. Umminger also mentioned two new cross-Directorate initiatives that will interface with ABS, one in Learning and Intelligent Systems and another in Machinery for Predictability.

The BIOAC and Dr. Umminger discussed how well these cross-disciplinary collaborations are working and how NSF can best explain their importance to the public, Congress, and the Administration. The BIOAC also discussed the appropriateness of leveraging funds from industry and other government agencies for this and other cross-disciplinary initiatives.

Development of Cross-Disciplinary Enabling Tools

Dr. James Brown (Division Director, Biological Instrumentation and Resources) discussed a proposal to encourage the development of cross-disciplinary enabling tools. He stated that this idea was mentioned as an important area at the Impact of Emerging Technologies workshop and at the BAC workshop. This initiative would enable the development of cross-disciplinary collaborations on technology development.

Dr. Pete Magee asked how major biological instruments typically arise. Dr. Brown stated that many have arisen out of adapting skills from other disciplines for use in meeting biological needs.

Dr. Gregory Florant asked how NSF would handle funding someone to develop an instrument, which he or she later makes a profit from. Dr. Brown noted that NSF's focus is typically outside of the commercially viable arena. Dr. Edwards added that NSF encourages patenting.

Exploring Microbial Diversity

Dr. Julius Jackson discussed BIO's rationale and process in deciding to make an investment in microbial biology. He stated that currently, we only know about a small subset of microbes and that there is much to be learned, including the quantitative relationship between microbes and information about microbes that live in extreme environmental conditions, for example. Dr. Jackson then discussed basic research examples that eventually led to important applications. He stressed that the study of microbial diversity is an emerging opportunity for BIO. BIO intends to distribute a Dear Colleague letter on the study of microbes in a number of habitats. This thrust will focus on exploring for new microbes and expanding our knowledge of the diversity of microbes.

The BIOAC discussed how this initiative relates to the information coming out of microbial genome sequencing. Dr. Jackson noted that it would involve building and sharing databases, and therefore contribute to and benefit from existing databases, including genomic ones. The BIOAC also discussed the role of partnerships and international collaboration in this initiative. Dr. Jackson mentioned that partnerships with the Department of Energy and the Office of Naval Research are possible, as well as cross-Directorate partnerships (i.e., EHR, GEO).

Several members of the BIOAC felt that these initiatives are exciting areas of science to promote, but that, except for Arabidopsis, they need to become more focused and tangible benefits need to be identified.

THURSDAY, APRIL 25 - AFTERNOON SESSION

Working Lunch- Discussion of New NSF Activities for Integrating Research and Education

Dr. Robert Watson (Director, Division of Undergraduate Education, EHR) discussed two issues relevant to the integration of research and education, the Institution-Wide Reform Initiative and the Education and Human Resources Advisory Committee (EHRAC) Report on EHR Review of Undergraduate Education.

Institution Wide Reform Initiative

Dr. Watson gave an overview of the program, including its budgetary outlook, goals, and objectives. The goals of the initiative are to:

1. Prepare an increasingly diverse student body (all students in all institutions) for an information and technology based future
2. Encourage improved learning of science and mathematics by all students
3. Encourage changes in pedagogy and curriculum content

He stated that the initiative is an opportunity for institutions to acknowledge that problems exist and address them in a systematic way. EHR will announce 23 awards within the next 1-2 months, which will cover a wide breadth of institution types.

EHRAC Committee Report on EHR Review of Undergraduate Education

Dr. Watson stated that the report addresses the preparation of future teachers (K-12), needs of industrial/technological workforce, SMET majors, and SMET literacy for all. The report covers curriculum, education technology, pedagogy, institutional practices and the need for comprehensive reform, and key student transitions (i.e., between education levels and from education to employment). The final report will include action-oriented recommendations.

Dr. Watson also discussed the methodology of the review, which included symposia and a national conference, as well as hearings at NSF, focus groups, and discussions with NSF research directorates and other Federal agencies.

The BIOAC discussed the notion of science and engineering as a core for undergraduate education. Some committee members were concerned that this may alienate non-science and technology faculty and students with other interests. They felt that great care needs to be taken in determining the kind of scientific literacy necessary for the non-science major in order to build appreciation and basic understanding. Dr. Judith Ramaley noted that the report should not just be directed at scientists, but needs to be considered by all liberal arts faculty in order to develop a more holistic education. This means that science needs to be seen as a liberal art rather than a core for education.

Reports from BIO AC Workshops

The Changing Environment for Biological Sciences- Dr. Judith Ramaley, Past Chair

Dr. Ramaley stated that this workshop was based on a regional strategy, because that is how the participating institutions are trying to interact. The institutions present included Research 1 and 2 universities, community colleges, liberal arts colleges, and doctoral universities. Workshop attendees discussed how these institutions can create a stronger environment to

teach math and science through collective interactions. They also provided ideas for what NSF could do to strengthen biology education and reinforce collaborations among different types of institutions. In general, they were quite laudatory of BIO's work. Their recommendations for BIO focused on existing programs and changes in the review process to increase effectiveness in supporting the biological sciences at different institutions and the integration of research and education.

The Changing Environment for Biological Research and Graduate Education in Universities

Dr. Nina Fedoroff, Chair-Designate

This workshop focused on a single institution (Penn State) and addressed research and graduate education. The workshop attendees identified the availability of grants, increased expectations of teaching, and better preparation of students for careers outside of academe as pressing factors in research universities. They also identified institutional barriers to change and discussed how NSF and institutions could have an impact on these barriers. The university reward system, the grants system, and departmental evaluation issues were highlighted as barriers to interdisciplinary research and education. The participants provided several recommendations to Penn State and NSF, including:

- promoting changes in promotion and tenure criteria that carry weight at the top levels of institution administration
- provide support to graduate students outside of a research grant long enough so that students can have meaningful experiences outside of research in order to prepare for careers other than in academe.

The BIOAC discussed whether or not ethnic diversity should be a factor in these workshop discussions and the importance of increasing minority representation among faculty as a force driving change.

The Changing Environment for Biological Sciences in our Nation's Colleges and Universities

Dr. Paul Magee, Chair

This workshop included 10 research universities from the upper Midwest. The participants discussed the importance of alliances with foreign scientists, graduate and undergraduate education, and the need for change to the promotion and tenure system, among other issues. Dr. Magee stated that he feels that ethnic diversity is never really high on the agenda at workshops such as these, even though everyone says it should be. He feels that this is an issue that is not really pushed by faculty.

Dr. Ramaley asked Dr. Clutter to comment on what she took away from each workshop. Dr. Clutter said that although the participants varied quite a bit, the same issues kept coming up. In particular, participants discussed the desire for change and the need for NSF to act as the catalyst because there are too many barriers to change at the institutional level.

The committee discussed the impact of potential reductions in administrative staff at universities, particularly in terms of research and grant administration.

Dr. Magee noted four themes that developed from the workshops:

1. Reemphasizing balance among the roles of teaching, research and service for professors
2. Interpretation of science for the public
3. Opportunities outside of research for post-docs and graduate students to prepare them for careers outside of academe
4. Encouraging collaborative ventures at the national and international levels

Dr. Fedoroff stated that institutional barriers to change was a major theme, as well.

Dr. Magee then asked the BIOAC to meet in breakout groups and requested that they address the following issues:

- Should there be more workshops?
- If so, should they take on different forms and/or foci?
- Are there ideas for new programs or revisions of current programs?

The breakout groups were organized around each of the workshops discussed above.

Issues From Breakout Groups

The Changing Environment for Biological Research and Graduate Education in Universities Breakout Group

Dr. Burt Ensley reported on the issues discussed by this group. The group discussed how institutional resistance to change and burdensome workloads for professors will make implementing changes in graduate and undergraduate teaching difficult. Some suggestions on this issue include:

- EHR could prepare "movies" of master professors for service classes
- NSF could fund projects to prepare high quality professional lectures

This group also discussed the faculty reward system and interdisciplinary research. They felt that university departments are power groups and don't encourage interdisciplinary research. Change in this attitude needs to be encouraged from top levels of administration. One suggestion for achieving this was to ask the NRC rating committee to change rating categories to reflect the importance of interdisciplinary research and quality teaching. They suggested that NSF hold a workshop with the NRC rating committee to address this issue.

The group also suggested that NSF fund more training grants to provide graduate students the opportunity to prepare for careers outside of academe and encourage interdisciplinary research.

The Changing Environment for Biological Sciences Breakout Group

Dr. Ramaley reported on this group's discussion. They discussed the faculty reward system and the overload of responsibilities faculty often face (e.g., workload and how work is organized). They suggested that NSF consider this overload in its programs (e.g., CAREER awards). This group also addressed the integration of research and education. They stressed that money should not be diverted from research and that PIs would benefit from examples of ways in which research and education can be integrated when developing their proposals. The

group suggested that NSF examine the RUI program for answers on how to achieve the same level of research productivity while including more undergraduates in research labs. This could include a workshop with grantees and students to discuss ways to achieve this and making the integration of research and education an explicit part of the proposal process.

This breakout group felt that NSF should be involved in PBS and NPR programs on science in order to provide better public education on the importance of science.

They also suggested that NSF address the following questions in assessing the review process for collaborative proposals:

- How do reviewers respond to collaborative proposals at NSF?
- How are they reviewed, what criteria are used, and are we sending mixed messages?
- Do we have the right review procedures to evaluate collaborative proposals?

The breakout group felt that more workshops should be held and that they should represent a range of institutions in order to adequately compare and contrast institution types.

The Changing Environment for Biological Sciences in our Nation's Colleges and Universities Breakout Group

Dr. Magee reported on this group's discussion. This group focused their discussion on future workshops, the integration of research and education, and career development opportunities for graduate students and post-docs.

The group felt that small, regional workshops will work best because they can empower faculty by making them feel that their voice is being heard. Another advantage to regional workshops is that they are close enough to participating institutions so that attendees do not have to fly in order to attend. This will assure a higher attendance rate and greater cross-section of administration and faculty. They suggested that BIOAC alumni might organize these workshops in order to relieve pressure on current members. Each workshop organizer would write his or her own background paper so that while all workshops will cover similar themes, each would have its own flavor.

The group felt that scientific excellence must be redefined to include education at all levels and service. Again, they felt that a workshop would be a useful venue for faculty and administration to respond to this issue. They stated that NSF should include the integration of research and education as a meaningful part of the review process.

On the subject of career development for post-docs and graduate students, the group suggested that NSF provide supplements to research grants which would include 3 months salary to allow the recipient to engage in an activity outside of research (i.e., business or law courses, internships, etc.).

The group also suggested that a BIOAC web page be established that includes reports from workshops, minutes, composition of the BIOAC, and a place for people to respond to issues and questions from the BIOAC.

The BIOAC discussed what integrating research and education means and how it has become such a priority. They stressed that NSF needs to maintain a portfolio of programs that

promotes it, for the Foundation has in the past contributed to the problem of rewarding faculty just for research and not for education.

FRIDAY, APRIL 26 - MORNING SESSION

Follow-on Activities for Breakout Groups

Dr. Magee asked the BIOAC to discuss if NSF should ask for evidence of discovery-based curriculum and teaching in proposals in order to push integrating research and education beyond just including undergraduates in the lab. Dr. Fedoroff noted that changes to graduate and post-doc experiences outside of research should be addressed as well. In general, the BIOAC was in favor of including some sort of education component in the proposal requirements.

The BIOAC also discussed various options to encourage training outside of research for graduate students and post-docs, including research training groups, training grants, supplements to research grants, and leveraging funds from universities to support activities outside of research. Dr. Fedoroff and Dr. Florant also noted the importance for NSF to clearly articulate the education component of its mission. Dr. Fedoroff also suggested funding more than one PI on a grant so that graduate students can be shared and therefore get a more interdisciplinary experience.

Members of the BIOAC stressed the need to demonstrate to reviewers and applicants what integrating research and education means and the variety of methods that can be employed to achieve it. They also noted that this needs to be a Foundation wide effort and requires the cooperation of program officers, as well as demonstrating to university administration that NSF considers this important.

The BIOAC discussion then turned to BIO's proposed science thrusts. Dr. Clutter briefly reviewed the FY1997 Authorization markup, which suggests that NSF may receive less money in 1998 than it did in 1995.

Arabidopsis in Five- Some of the BIOAC members felt that genome sequencing is not creative and therefore NSF should focus more on gene function. Others noted that although sequencing itself is not creative, the information garnered from it can be used in very creative ways. They also noted that this is an excellent opportunity to bring Arabidopsis scientists together to foster the exchange of ideas and information. Dr. Fedoroff was concerned that the goal to sequence the genome in five years not overshadow the research that will develop from sequencing.

Development of Cross-Disciplinary Enabling Tools- Some members of the BIOAC saw this as an important area, but felt that the \$2 million investment BIO tentatively plans to make is not enough to make it a priority.

Analysis of Biological Systems- Dr. Fedoroff noted that she is very excited about this area of biology but was concerned that there is only a small number of biologists willing to take part in

the integration necessary to do it. She felt that NSF should promote this initiative, but wait to develop a program announcement until a critical mass has been achieved. Other members of the BIOAC expressed similar concerns. Some members felt that a RFP could catalyze further development of this area.

Exploring Microbial Diversity - The BIOAC felt that this was a very timely initiative and has the potential to yield tremendous amounts of important information with implications for bioremediation, pharmaceutical use, and the changing global environment.

Discussion of the Future of Science and Technology Centers

Dr. Edwards gave a presentation on the future of Science and Technology Centers (STCs) in relation to their value in the biosciences. He reviewed the history of the STCs, their characteristics, key attributes, how they fit into the continuum of grant types offered by the NSF, and the 1996 funding levels for BIO's STCs and other center-like activities. He stated that NSF is currently evaluating the STCs, with the NAPA report being the first step. The NAPA review was mandated by the Senate to evaluate STC management. Currently there is an external review being conducted and the information from it will be passed on to the NAS for final review. Dr. Edwards stated that advisory committee feedback is also an important component to the STC review and that their comments would be passed along to the STC Advisory Committee. Dr. Edwards asked the BIOAC to address the following questions:

- Are STCs valuable and/or essential in furthering progress in biology?
- Are STCs instrumental in enhancing education, knowledge, and cross-disciplinary research?
- Should the scope of STCs be changed?
- Should another STC competition be held?

Dr. Edwards also asked the BIOAC to consider the following options:

- Continue STC program, with:
 - proposals handled in each directorate, or
 - NSF-wide competition
- Modify STC program (and have a new competition, with options as above)
- Terminate STC program

Overall, the BIOAC is very supportive of the STC program, particularly the centers' accomplishments in outreach, integrating research and education, and collaborative research. They were also impressed with how well some STCs have been able to leverage their NSF funds to raise more money.

Some members of the BIOAC are concerned that some centers have been funded for too long, and suggested shortening the amount of time a STC is eligible for NSF support.

Dr. Frank Ruddle suggested staggering the competition so that a new center is started every two years rather than starting several at one time so that NSF could take advantage of emerging areas quickly.

Some members of the BIOAC were concerned that the quality of the projects funded within a STC may not be as good as those funded directly through NSF programs. This concern grew

mostly out of the fact that some STCs do not utilize a peer review process in evaluating projects.

Dr. Florant was concerned about the level of ethnic diversity present in STCs. Dr. Edwards said that NSF is working with the STCs to increase diversity, but that perhaps we have not made enough progress so far.

Dr. Fedoroff asked how STCs might keep their outreach activities going once NSF funding ceases. The technical coordinators for BIO STCs discussed how each of their STCs would probably address this issue. Overall, they stated that some outreach programs will not survive, but that others will in a scaled-down version.

Dr. Judith Ramaley, Dr. Paul Magee, and Dr. Nina Fedoroff will submit a report on this session to Dr. Clutter and Dr. Edwards.

Future Business

Dr. Magee noted that Dr. Lane is enthusiastic about the BIOAC workshops held in March. He then asked for volunteers to coordinate the next set of workshops. Drs. Helen Berman and Burt Ensley, Dr. Frank Harris, Dr. Rita Colwell, Dr. Gregory Florant, Drs. Mary Allen and George Langford, Dr. Barbara Webster, and Dr. Frank Ruddle agreed to organize workshops.

Dr. Fedoroff was concerned that the BIOAC should have some sort of activity at the national level as well. She felt that smaller workshops raise consciousness on the issues, but one is needed on a grander scale to effect change. She suggested next year's NAS convocation as a mechanism to achieve this.

Dr. Clutter noted that several members were rotating off the BIOAC and thanked them for their service. She asked if any of them would consider serving another year.

Dr. Clutter requested that all BIOAC members provide suggestions for new members as soon as possible.

The next BIOAC meeting will be held November 7-8, 1996.

BIO will develop a BIOAC home page to post minutes, meeting agendas, background papers, workshop reports, comments, and other BIOAC related information.

Dr. Magee adjourned the meeting at approximately 12:00 p.m.

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