AAS in its Second Century: Future Challenges and Culture Change

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I'd like to thank the Centennial Committee under Don Osterbrock's leadership for organizing the special events at this Centennial meeting, and for the invitation to share my thoughts with you, and to speak alongside other past presidents, John Bahcall, and Sydney Wolff.

It gives me special pleasure to speak to you this morning. By any measure, we are in the midst of a remarkable and dynamic time for astronomy and astronomers. The last fifteen years have witnessed a five-fold increase in large optical telescope area for American astronomers; and the membership of the AAS has increased substantially in that time. Over the past seven years, astronomy departments have boosted their hiring of astronomers by nearly a third. And it is difficult to open a newspaper nowadays without reading about astronomy's latest exciting discovery. We share this success with our colleagues from nations around the world, many of which stand with us at the forefront of research, and others who lead the way in some areas.

But now is not the time to rest on our accomplishments. As the AAS crosses the threshold of its second century, we confront a changed world—and we confront a science that has changed, both in practice and in the participants.

This morning I hope to identify three goals that will help us meet the challenges of the next century. First, we must reaffirm our commitment to research excellence. Second, we must rededicate ourselves to expanding opportunities in astronomy—and to giving our students the skills they need to succeed within the profession, or wherever their career may take them. Third, we must stand up and participate—both within the field of astronomy and beyond—and share our successes with our colleagues and the commmunity.

Let me begin with the importance of basic research. Foremost among the challenges we face in this new century is our dwindling investment in basic research.

Not only has basic research decreased as a fraction of the national budget, but the NSF astronomy budget has dropped 30 percent in its share of the total budget since 1981. We have been forced to close radio and optical telescopes and shut down satellites. Grant applicants have felt the pinch too: for every NSF grant awarded, six applicants are rejected—an all-time high.

Despite these ominous numbers, there can be no dispute over the need for research excellence. New ideas, new technologies, and a vision of our future are what drive Astronomy. Einstein once said ''Imagination is more important than knowledge.'' And excellence in research not only furthers our knowledge, but fuels our imagination.

How do we maintain our commitment to research excellence in this new era? We must first have a clear vision of our scientific goals and the tools we need to accomplish these goals. Another way is to take advantage of the synergies within our discipline.

We must capitalize on the connections between fields. Insight and discovery can result from these connections. Big science and small science not only can co-exist but can reinforce and complement one another. We must share not only our facilities, public and private, but also our ideas. We cannot afford a narrow and exclusive focus on our own subfield or area of research. The scientist who sees only a smudge at the edge of the universe misses the stars and galaxies along the way.

The AAS plays an important role in promoting excellence in research by fostering dialogue within the discipline. The society offers a forum in which the astronomical community can share ideas and shape priorities. This is happening with the decadal survey now in progress. Broad scientific vision developed through the survey builds the framework for the future. And through meetings and journals, the AAS provides a platform from which to report scientific results, furthering the exchange of ideas and driving future achievement.

In addition to broadening the scientific vision within our discipline, we must broaden our conception of the aim of a graduate education in the discipline. We must ensure that all our graduate students have a chance to succeed in astronomy—or, as is increasingly the case, outside astronomy if they so choose.

Allow me to share some numbers with you. One-third of astronomy PhDs in America end up in tenure-track positions. This number has not changed in over 25 years. And although half of all PhDs may follow pure research careers, fully 40 to 50 percent instead take jobs outside of academia.

These numbers raise a simple and fundamental question: Are we doing right by half of our students? Are we preparing them so that they will be good enough to get a job outide of astronomy should they so choose? The AAS sponsored a year-long study of graduate education to answer this question.

The study included town meetings and discussions from coast to coast aimed at identifying ways we could strengthen astronomy programs by preparing students for careers outside the academy. The study suggested a variety of improvements ranging from offering professional master's degrees, to establishing liaisons with industry, to improving the communications skills of our students. And we must value that diversity of approach in our faculties.

Years ago it was fashionable to talk about a pipeline. Students entered, moved with the flow, and at the end of the pipeline emerged as narrowly-focused professionals. But a

better metaphor—one more reflective of today's career development—was offered recently by William Bowen and Derek Bok, former presidents of Princeton and Harvard, respectively. They likened a career to a river. There are tributaries and braided channels, quiet pools, and rapid laminar flow in the deep central waters.

Yet the key point is that whatever the individual channel, most of the water flows through to the ocean. The final destination is the same; only the paths are varied. And so, in structuring graduate programs, we should be mindful that career development is a river—and we should take our guidance not from a preconceived model, but from the real-world, individual needs of today's students.

Another important challenge we face is expanding opportunity for women in the profession. To see how far we've come to date, we only need look at the cover of the 1999 AAS Phone Book, which features a picture taken over a century ago at the dedication of the Yerkes Observatory. Out of the fifty astronomers, there are only three women astronomers. Compare this picure to the photograph on the cover of the Centennial volume that you received for this meeting. That photograph reflects the state of our profession today, where 21 percent of the active members of the AAS are women, as are 25 percent of the graduate students.

Yet as far as we've come, we still have far to go. Only seven percent of full professors are women in the face of a 10 to 20 percent PhD production rate. A survey by the American Association of University Professors concluded that although the salary disparities between genders have generally declined over the past decade, they remain substantial and in some institutions have even increased. And a recent study by MIT on the status of tenured women on its science faculty raised new concerns. Specific data collected on lab space, research grants, awards, and teaching assignments underscore that gender disparities still exist. Over time, these slight disadvantages accumulate and can ultimately hinder or even derail careers.

Like MIT, we need to take bold action to acknowledge the problem and to solve it. We need to expand opportunities not only for women, but for minorities as well, who now constitute ten percent of the membership in the AAS. We simply cannot afford to ignore the brainpower and the talents of such a large percentage of humanity.

My third and final point is to emphasize the need for participation—for astronomers to get off the sidelines and into the ball game. This idea is far from radical; in fact, the need for scientists to engage the public has been around for a long, long time.

In 1609, Galileo was stuck in Venice. He decided to move to Florence, where he thought opportunities might be better and salaries certainly would be higher. So Galileo wrote a letter seeking employment to the lieutenant of the Grand Duke of Tuscany. In the letter Galileo described his many talents—in addition to abstract mathematics, he had been designing irrigation devices for gardens and predicting the trajectory of artillery shells. Galileo was, quite literally, a Renaissance Man. In any event, he wrote that in addition to researching mathematics, he would give something back in return. Galileo explained, ''It would not be fitting to receive a generous salary from a free state without serving the public for it. To ask something from the public, we have to satisfy the public, and not just one person.''

Galileo was not just a savvy mathematician, he was a savvy politician. He understood that further advances in his research hinged not just on satisfying a narrow audience of fellow scientists, but on satisfying a far broader constituency—the public. Once again, we can learn from Galileo. Communicating our results and educating students provides a rich return on our nation's investment.

We are fortunate in one respect: Astronomy is one of the most popular sciences. Many newspapers and TV programs report the latest astronomical discoveries, which are often simple to communicate and easy to understand. Young people in particular are captured by the excitement of astronomy—it rivals dinosaurs in popularity. Astronomy is a key science. Initial excitement can be enlarged to understanding and an appreciation of technical subjects. Maybe even to a technical career.

But we risk forfeiting all this advantage and goodwill when astronomers remain silent. Rather than celebrate our triumphs and successes in our observatory, or within our narrow circle of colleagues, we have a responsibility to share our results with the taxpayers who, after all, are supporting us. And we have a responsibility to build interest and support for astronomy among the public, which in turn builds interest and support for astronomy in Congress.

Our work is cut out for us: Despite the centrality of basic research to the security and prosperity of our nation, the civilian R+D investment has fallen over the past 30 years from 6.5 cents of every federal dollar to 1.9 cents.

As president of our society, I was struck by the attitude of some members who thought that once they had elected officers and a council, their work was done—they could sit back, relax, and let the officers go to work. These members were right about one thing—the officers do work very hard on behalf of the society.

But they were wrong in thinking the officers could do it alone. Building support in Congress for astronomy is not something that can be done from within Washington—our representatives want to know how federal budgets and programs affect life outside the beltway. When I was meeting in Washington to advocate basic research in general and astronomy in particular, a senator said to me: ''You are elected. It's your job to speak to us. But I want to hear from the real world out there. I want to hear that our budgets for the NSF and NASA and their programs really do impact my constituents.''

It is the Society's membership, not its officers, who will determine the future of our profession. So we must all participate in shaping this future—whether that means becoming active politically, or simply being an active participant within the astronomical community by serving on peer-review committees or acting as a visiting scientist at a federal funding agency. The stakes are too high for us to remain silent and allow others to control the debate.

This morning, I have called for changes in the culture of our profession. In addition to pursuing scientific goals, we must reconsider the structure of our graduate programs with

an eye toward expanding opportunity for all. And we must play an active role in the public debate over astronomy and inform and educate the public about our work.

Earlier I spoke about a river—a river whose twists and turns, and rapids or pools describe the complexities of our professional lives. So it is particularly appropriate that we are meeting in Chicago. Chicago has a well-known river that runs north of this ballroom and is crossed by Michigan Avenue. At the beginning of this century, the citizens of Chicago were displeased with their river because it flowed into the pristine waters of Lake Michigan carrying the jetsam of a city. And so they took matters into their own hands. In a remarkable feat of engineering, they actually changed the direction of flow of the Chicago River, from Lake Michigan back into Illinois. What was believed impossible was indeed accomplished.

We can do the same. We can make the changes if we want. The future of astronomy and our profession will be driven by scientific achievement, the education of the next generation of young people, and an American public excited by the discoveries already made—and those yet to come. Let us work together within our community and the AAS to make this future a reality.