

The Election is Over... Science won... Now what?

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The U.S. Presidential Election is now over. The candidate who said he would support science has won, and in his inaugural address has reiterated his intention to "restore science to its rightful place." The candidate who derided science, by e.g. telling funny stories about research into bear DNA, has proven to be a gracious loser and is likely to continue to be an important asset to the nation.

President Obama has appointed excellent people to oversee science policy and promised to spend a very large sum of additional money on science. Part of this spending will be included in the recovery package, intended to bring the economy back from the brink of collapse. Additional and longer-term spending is promised for the scientific programs in NSF, DOE, NIH, and Department of Commerce.

Of course, physics would like to share in the additional work resulting from this spending. If we follow the practices of the past, we would, through our organizations, continue to send our lobbyists out to argue for increased spending across the board for all our research and (perhaps) teaching programs. However, I argue that now is the time to be creative and selective and push to the fore those physics programs that can be most effective and helpful in attaining national goals.

Our national labs could better serve us by setting a broader mission including more applied work. The new secretary of Energy, Steve Chu, is a physicist who has moved the DOE Berkeley lab toward a wide variety of energy- and climate- related projects. The Presidential Science adviser, John Holdren, is physicist with a long background of advocacy for substantial national effort on both climate and energy. To build upon this leadership, each of our great national laboratories should pick a few important missions and institute a wide variety of medium and long- term projects in these mission-areas.

Specifically, the three weapons labs (Los Alamos, Livermore, Sandia) should

move beyond their nuclear weapons mission, with some of the new work focused upon national security in the broadest sense. For example these labs can help set designs, priorities, and specifications for protecting computers and computer networks from viruses, worms, and other unwelcome intrusions. Livermore and the Argonne have already put together an energy generation proposal which makes use of the laser fusion (NIF) complex at Livermore. Protection against both biological weapons and major epidemics could well be added to the mission of these labs. Work related to preventing nuclear accidents and nuclear sabotage are already in their mission, and could be further extended.

The other great national labs should focus more on making industry more effective. For example, US automakers need help in long-term research and planning so they might begin to catch up with other automobile manufacturers. Other such programs might aim toward automated highways, more secure power grids, or innovative biofuels, or even improved urban and suburban design. Such programs could function in the relatively open environment of the national labs since the goal would be to move an entire industries forward rather than help a particular firm within the industry. In doing this, each lab should have the job of developing expertise in one or more of the various energy and climate fields and serving as advisors to the President, Congress, and the public in this area.

Government scientists should be encouraged to speak their mind on public issues and be protected by law when they do so. It is likely that views will be expressed, both to congress and to the public, which I will find distressing. However, a wider range of views will help the public see that scientific knowledge is only partial and leaves considerable room for the exercise of citizen judgments on important issues. Neither classification for specious security concerns nor political considerations should be used, as they have been, for limiting public knowledge on important topics.

Private industry probably remains the largest employer of physicists. Some of this work has proven to be unproductive, particularly that in banking, securities, and financial markets. In the other areas, there has been relatively little “blue-skies” research aimed at opening new areas in the very long term. The biggest firms have not only eliminated work aimed at long-term changes but also moved their research operation abroad where they

might find employees who are both cheaper and more docile. Smaller firms employ physicists for short-term and engineering functions, but they do not encourage them to be part of a community of physicists by, for example, joining APS. This discouragement limits the interchange of information, and thereby weakens scientific and technological work in the US.

In the next months, through the department of commerce and various recovery programs the government will provide substantial aid to a variety of firms in trouble. I would advocate that the aid be aimed at firms which produce a useful product, rather than move information or money. Further, these funds selectively employed to aid R & D within these companies. To convert the government aid into broadly usable knowledge, I would suggest that the aided firms be particularly encouraged to make public their results through patents, reports at scientific meetings, and publications. Increased cooperation with openly published research at government labs and universities would also broaden and deepen the work.

Many firms and their corporate leaders have argued that we need more scientists and engineers in the US. The growth of the technical workforce could be encouraged by the firms themselves by raising their wages for this kind of employee. They could also make their work more attractive by encouraging the technical people to maintain their professional contacts, and giving them more job security. As these goals are met, we might expect these jobs to be attractive to more people from the US so that of our own people would join the technical work force. We could make up for any temporary shortage of technical people by issuing visas for additional members of the technical workforce. These visa could be made more useful to the whole workforce if they required employment at attractive wage levels and if they permitted the visa-holder to move freely from job to job.

Technical work in industry, particularly in smaller firms, would be considerably aided by a broader dissemination of scientific knowledge. For this reason, I would argue that federal requirements be brought to bear upon government labs, industry, and universities so that all getting government support would be required to pay the journals to make all their work "free to read", i.e. available to all. One could expect Europeans, who are often intellectually committed to open access, to follow suit quite quickly. Increased publication cost would improve the overall quality of the journals by

reducing the number of “me too” and substandard papers. This application of a “free to read” requirement for US papers would only cost a few thousand dollars per paper, and would thus be a minor increment in our research funding, but it could be a major improvement in the dissemination of scientific results.

University and college research should have additional, but more selective funding. The research should be supported only if the met one or more of four goals:

1. educational value. Students should learn to think, criticize, and evaluate ideas. Most students are likely to be employed in fields different from the ones they learned in school. Some areas of research are better training grounds than others. Small science, for example, is good because it enables students to work through a problem from initial concept to final critical evaluation. Areas better for training should be encouraged.
2. potential use. Long term knowledge in such narrow areas as nuclear forensics (the identification of nuclear materials remaining after an attack or accident) and such broad areas as materials science are likely to prove useful for economic and security purposes.
3. food for the spirit. Some areas of science speak to the imagination and love of intellectual adventure. Some find this in space science, others in the wonders of pure mathematics. The spirit of scientific practitioners and the general public deserve the best and most nourishing food. However, there is no need for glut in any particular subfield.
4. The maintenance of human knowledge. Books are often not enough. Some knowledge will be lost if not practiced. Universities and national labs are proper places for keeping knowledge alive. A modest but continuing investment in, say, the design of lighter-than-air aircraft might be justified. Nuclear weapons may fall in the same category.

Education is the most crucial part of any program to revitalize America. In our rush to make easy money in dot com’s, real estate, and securities we have largely neglected the teaching and learning of the real things which will be necessary for building and maintaining a prosperous society. Science is the first and most obvious component of such knowledge. An understanding

of the language and culture of people living far away, and among us, is equally important. A good understanding of the obligation that one human owes another is more subtle, but not less important.

We physicists can do something, but not everything to help out. First, we should recognize that we can help most by using our professional knowledge as scientists and educators. A group of physicists have tried to redesign the beginning university courses in physics, and by implication other subjects, by using new teaching methods and evidence-based evaluation of their impact. All of us in teaching establishments should applaud these efforts and carefully assess their outcome. A careful commitment to good teaching, even when the methods are not novel should remain a regular and broadly practiced part of our profession.

Further, we can help school education by a playing a role in the education of potential school teachers. Many different physics departments have added their hospitality, teaching, and effort to such programs. The various physics societies have begun to support such programs in a few schools around the country. More could be done to promote these programs, but a good start has been made. In parallel, it is quite important that teachers of science at all levels be welcomed by us as fellow professionals, engaged in the same vocation as researchers. Equally, it is true that all branches of our profession should reward ability and hard work without regard for nationality, gender, religious views or other characteristics irrelevant for the practice of the profession.

Our professional societies can play a larger role in the worthwhile work of the physics profession. The AAAS has pointed the way by adding education to the subject matter of its journal, *Science*, to make education and research parallel foci of the journal. APS has pointed the way to *pro bono* public policy activities by supporting an excellent study on research strategies for energy efficiency. Professional societies like these represent the public face of our profession. Through them, and through our other individual and institutional work we should get behind the new administration in its efforts to move us beyond the present mess in into a situation in which science, education, and rationality will be the basis of more security and more solidly based prosperity.

Leo Kadanoff was President of the APS in 2007. His views do not necessarily represent those of APS.
