

David J. Gross

The frontier physicist

The Nobel Prize in Physics in 2004 was awarded to David J. Gross, H. David Politzer and Frank Wilczek for their discovery of how quarks interact within protons.

How important is an interdisciplinary approach in addressing urgent scientific questions, and how can we foster such collaborations?

The natural world does not recognize the artificial separation of academia into traditional disciplines. Inevitably, as science evolves, many of the most interesting questions in nature fall into the cracks between the disciplines and benefit enormously from the attention of scientists from different cultures. Fostering collaborations is non-trivial since the separate disciplines often find it difficult to communicate due to language barriers and university departmental structures.

At my institute (Kavli Institute for Theoretical Physics) we have been rather successful at fostering interdisciplinary research at the crossroads between physics and allied fields, such as biology, chemistry, Earth sciences and mathematics. We do this by bringing scientists together in loosely organized, parallel programmes in which, the emphasis is on discussion and collaboration over an extended period, we have found it possible to exchange ideas over disciplinary boundaries and form new, interdisciplinary collaborations.

Bell Labs and other corporate research sites, which led to many Nobel prizes, are on the decline or have closed. Is corporate, basic research critically needed, or is research in academia sufficient?

The demise of Bell Labs and other corporate research labs is very unfortunate, but an inevitable consequence of the short-term profit seeking of today's corporations. Bell could afford to support curiosity driven research that often led to unanticipated applications, largely because it was a monopoly regulated by the government. Today's corporations are happy to have the public pay for research at universities and then turn the fruits of that research into profit-making applications. I do not think that direct corporate research is necessary for healthy science, except of course in producing real products

from applied knowledge. In some cases profit motives are even harmful, leading to secrecy and distortions that impede the progress of science.

Is there a country in which you feel that the management and handling of science funding is undertaken in an exemplary way?

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management of science. But with time, the US system has ossified,

No, there is not. Fifty years ago the answer would have been the United States with its new institutions (the National Science Foundation and the National Institute of Health) that were a model of innovative

PROFILE

- Director of the Kavli Institute for Theoretical Physics, University of California, Santa Barbara
- Born on 19 February 1941 in Washington, DC
- First 'job' at age 11 was proofreading his father's book *The Legislative Struggle: A Study in Social Combat*
- Family moved to Israel in 1953
- Returned to US for graduate studies at the University of Berkeley in 1962
- Became a Junior Fellow at the Harvard Society of Fellows in 1966
- Switched to working on string theory in the 1980s, developing the concept of heterotic string in 1984

and levels of support for the non-biological sciences have declined precipitously. The institutions created half a century ago have not responded adequately to the rapidly changing directions of science. The structure of the NSF, with well-defined and separate directorates and divisions, and with most contracts controlled by individual program directors (who are often reluctant to allocate their funds to other programs), places enormous obstacles to the support of new, and especially interdisciplinary fields of research. Although the NSF is eloquent in its appreciation of interdisciplinary research, it has not been able to overcome these obstacles or make the structural changes necessary to do so. After 60 years of operation the foundation desperately needs a comprehensive review of its structure and procedures.

Many people consider the peer-review system broken. Do you share their view, and do you have a solution?

The peer-review system, to paraphrase Winston Churchill, is the worst form of scientific management except all the other forms that have been tried. There is no substitute for peer review, but peer review is not a guarantee of fairness. Grant administrators have tremendous discretion in selection of reviewers and interpretation of reviews, making it possible to direct the course of science from within the funding agency. Transparency is a key to fairness, and two keys to transparency are oversight and responsible interaction with the working scientific community.

Peer review works best in selecting good projects from bad in well-defined areas of research. But research projects that fall outside current trends, as well as interdisciplinary approaches, are often disfavoured. This fault can be corrected by setting aside funds for innovative, but risky, ideas.



FLEMING, C./LINDAU LAUREATE MEETINGS