LETTERS

Letters to the Editor

Letters (~300 words) discuss material published in *Science* in the previous 6 months or issues of general interest. They can be submitted by e-mail (science_letters@aaas.org), the Web (www.letter2science.org), or regular mail (1200 New York Ave., NW, Washington, DC 20005, USA). Letters are not acknowledged upon receipt, nor are authors generally consulted before publication. Whether published in full or in part, letters are subject to editing for clarity and space.

Formation of Planets: Disks or Cores?

THE NOTION THAT RECENT ASTRONOMICAL observations favor the "disk instability" scenario of direct formation of giant planets as clumps in protoplanetary disks, rather than a scenario in which protoplanetary disks are seeded by heavy-element cores, is getting a lot of press attention, as attested to by Robert Irion's well-written article "When do planets form? Inquiring astronomers want to know" (News Focus, 6 June, p. 1498). However, the more prolonged core formation model remains a perfectly viable mechanism. Recent observations suggesting typical gas lifetimes in disks of around 3 million years rather than 10 million years do not represent a sufficient enough revision to militate against the core formation scenario. Observations by the Space Infrared Telescope Facility (SIRTF) may provide a more definitive constraint.

There are problems with the disk instability model. The simulations do not really make giant planets; they make condensations that have a density larger than the background nebula but much less than that of the bulk interiors of giant planets. Furthermore, to make these condensations requires starting the disk in a somewhat unstable state that is not necessarily achievable through the evolution of real disks and must be regarded as contrived pending observational evidence.

Finally, the 1995 Galileo Probe measurements of Jupiter's atmosphere argue against the disk instability model being relevant to Jupiter. The disk instability model would have produced a giant planet of solar composition at the orbit of Jupiter. But the atmosphere of Jupiter is not solar composition. Going further, the Jovian nitrogen isotopic ratio tightly constrains the source of rocky and icy bodies that enriched Jupiter during formation and tends to favor the core formation model (*1*). One could argue that Jupiter formed one way and most extrasolar giant planets formed a different way. We cannot rule that out, and future observations from the James Webb Space Telescope (JWST), the Atacama Large Millimeter Array (ALMA), and the Giant Segmented Mirror Telescope (GSMT) might help us test this possibility, but it would not make a simple picture.

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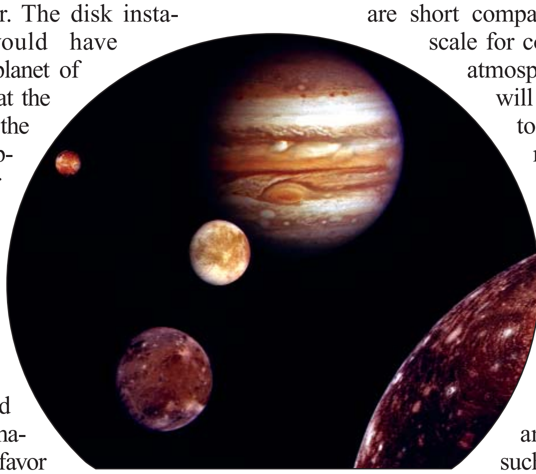
Reference
1. J. I. Lunine, A. Coradini, D. Gautier, T. C. Owen, G. Wuchterl, in *Jupiter*, F. Bagenal, Ed. (Cambridge Univ. Press, Cambridge, in press).



There is much debate about the formation of large planets like Jupiter.

Response

LUNINE RAISES A NUMBER OF POINTS WITH regard to the question of the formation mechanism of Jupiter and the many gas giant planets now being found outside the Solar System. Robert Irion's article, for which I was a source, reports that astronomers are finding that disk lifetimes appear to be too short for the commonly accepted mechanism, core accretion, to be able to form most of the rising number of extrasolar planets, although some disks might live long enough for at least Jupiter to have formed. Disk instability, the competing mechanism, can form giant planets in even the shortest-lived disks, so if a universal formation mechanism is desired, disk instability has the advantage at present. It requires a marginally unstable disk of the sort that is likely to occur during the evolution of protoplanetary disks, with a mass similar to that required by core accretion and a temperature in agreement with the chemical speciation in comets and observations of protoplanetary disks. Self-gravitating clumps formed by disk instability will contract to planetary densities in times that are short compared with the time scale for core accretion. Their atmospheric composition will be nonsolar, due to the accretion of rock/ice planetesimals following their formation, in much the same way as in the core accretion mechanism. Although theorists have much work to do in exploring these and other issues, such as the many problems with core accretion (e.g., inward migration and loss of the cores prior to envelope accretion, the possible lack of a significant core for Jupiter, and even slower growth of cores in the ice giant planet region), future observations should help resolve the question of giant planet formation, as Lunine concludes.

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Science and Security: A European View

AS D. J. GALAS AND H. RIGGS WRITE IN THEIR Editorial "Global science and U.S. security" (20 June, p. 1847), the United States is famous for attracting the world's brightest minds and most brilliant talents. A significant portion of top-notch research has been and is still being done by an international community of nonimmigrant and immigrant postdocs who help populate the best U.S. universities. Many international scientists see the recent actions of the United States and President Bush as blatant violations of international law and conventions and are greatly offended by them. Additionally, the difficulties for young scientists in obtaining exchange visitor visas, not to mention immigrant visas, and the tightened security measures and repressive surveillance actions against scientists in general are already taking their toll on international scientific cooperation.

Once considered a must for most European scientists, a postdoctoral stay in a U.S. laboratory is no longer so attractive. Many fear humiliation and a flare-up of antiforeigner sentiments. Instead, they consider Canada as a valuable alternative. In addition, many European scientists are avoiding scientific conferences in the United States, for fear of being picked out as potential terrorists by U.S. authorities and interrogated and fingerprinted.

If the present trend of U.S. isolationism persists and if no countermeasures are taken, there is indeed danger that U.S. science may slip into mediocrity, as Galas and Riggs point out. Sacrificing the international character of science for security will eventually have a very bad impact on the scientific community, not only in the United States but also worldwide.

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Is There Really a Leak in the Pipeline?

JEFFREY MERVIS'S ARTICLE ON THE NATIONAL Science Board (NSB) draft report about the supply of scientific workers ("Report asks colleagues to plug a leaky people pipeline," News of the Week, 30 May, p. 1353) emphasizes the problem of a leaky pipeline of workers and various recommendations for dealing with it, while the bulk of the NSB report suggests fixes that will simply stuff more people into the pipeline. In other words, the report contains many of the same old nostrums for dealing with the perennial worry about the supply of scientists and engineers.

I have mixed observations about whether this shortage of scientists and engineers is, in fact, real. On the one hand, we import 100,000 engineers per year. On the other hand, I have heard dire statements about this looming shortage since I began my scientific/engineering education in 1970. Yet scientists and engineers still have difficulty finding employment during periodic downturns in the economy. This suggests that supply nearly equals demand, and the problem is mainly one of matching job openings to potential applicants. A contingent of émigrés from the former Soviet block came to the United States about 10 years ago, drawn by the promise of a shortage of scientists and engineers, and were disappointed to find that the advertised shortage was, in fact, a shortage of technicians. So, perhaps some of the problem is misclassification.

Do we need more scientists and engineers at the B.Sc. level and above? The report suggests that "increased financial support is needed for academic research to develop more adequate models of domestic supply and demand for science and engineering skills." But it dilutes this good-sense goal with another: "to attract more talented undergraduates to science and engineering majors in areas of need and encourage them to continue on to graduate school." A footnote states that of the approximately 8 million employed persons whose highest degree is in science or engineering, only 3 million are employed in occupations classified as science and engineering. The draft report contains a graph showing, at age 24, an increasing proportion of graduates with 4-year degrees in every industrialized nation between 1975 and 1999. In the case of the United States, this increase is from 4 to 6 per 100. Do we need more than this?

The report does not address that a major leak in the scientist/engineer pipeline occurs in the 2-year colleges. There are large numbers of students who declare science or engineering as their major in these colleges, but we do not see them transfer into 4-year programs. The NSB report has very little to say about the value of the A.Sc. degree toward meeting the needs of a technical workforce.

The leaky pipeline probably involves curriculum issues. The most consistent complaint I hear from students about why they do not consider or why they quit engineering is that it requires too much mathematics. This complaint crosses regional, ethnic, institutional, and sex boundaries. It is a rare student who enjoys mathematics, and for most students entering college, a lifetime of enhanced earnings does not adequately compensate for the perceived misery of 2 years of mathematics. Will better counseling give them a better perspective or only make them avoid engineering earlier?

Many of my engineering colleagues feel that we demand too many mathematics courses. I do not agree, but I am concerned that we are giving the wrong sort of mathematics training. I consistently encounter students who, despite 2 recent years of calculus courses, cannot manipulate algebraic expressions and cannot solve a linear, first-order differential equation. Something is wrong when students consistently complain about the mathematics burdens, yet complete this sequence of courses performing at only a college algebra level of competence and still go on to become successful engineers. There is no mention of curriculum study in the NSB report.

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Genes and Risk

IN HER ARTICLE "TYING GENETICS TO THE RISK of environmental disease" (News of the Week, 25 April, p. 563), Jocelyn Kaiser writes that the Environmental Genomic Project (EGP) "will help toxicologists and other scientists calculate individual susceptibility to diseases triggered by pollutants, diet, and other environmental factors." However, the value of individuals knowing their genetic profile in order to help "make lifestyle changes to lower their risk" may not be so straightforward.

Recent work (*1*) identifies the importance of variants in three genes coding for inflammatory signaling proteins as modulators of coal dust/silica mediated lung fibrosis. However, as a clinical tool measured by receiver operating characteristic (ROC) curves classifying individual risk of lung fibrosis, the collective information on polymorphisms for these three genes added very little capacity over a simple measure of years of work as an underground coal miner.

To place the question in a broader context, "the role of genetic information does not appear to play a necessary role as a causal determinant of silicosis, and silica exposure does, this cannot be said for other occupationally mediated diseases. Indeed, genetic variants may be necessary determinants in the cause of immunologically mediated disease. Also, large differences in dose response relations among genetic variants may suggest a value in using genetic information to prevent and treat toxicologically mediated disease" (*1*, p. 381).

The value of genetic information for individual (i.e., clinical) risk classification will have to be judged on a gene-by-gene, exposure-by-exposure, and disease-by-disease basis.

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Reference
1. E. McCanlies *et al.*, *Ann. Occup. Hyg.* **46**, 375 (2002).

TECHNICAL COMMENT ABSTRACTS

COMMENT ON "On the Origin of Interictal Activity in Human Temporal Lobe Epilepsy in Vitro"

Christian Wozny, Anatol Kivi, Thomas-Nicolas Lehmann, Christoph Dehnicke, Uwe Heinemann, Joachim Behr

Ammon's horn sclerosis (AHS) in resected hippocampi of patients suffering from temporal lobe epilepsy has important prognostic implications for freedom from seizures postoperatively. However, contrary to the proposal of Cohen *et al.* (Reports, 15 Nov 2002, p. 1418), we report that both synaptic and cellular alterations enhance seizure susceptibility of the subiculum in the absence of classical AHS.

Full text at www.sciencemag.org/cgi/content/full/301/5632/463c

RESPONSE TO COMMENT ON "On the Origin of Interictal Activity in Human Temporal Lobe Epilepsy in Vitro"

Ivan Cohen, Vincent Navarro, Gilles Huberfeld, Stéphane Clemenceau, Michel Baulac, Richard Miles

The data of Wozny *et al.* are important in showing that seizure susceptibility may arise earlier in the progression of this epileptic syndrome than previously thought. The definition of classical AHS can be questioned and the involvement of GABAergic signaling should be examined further.

Full text at www.sciencemag.org/cgi/content/full/301/5632/463d