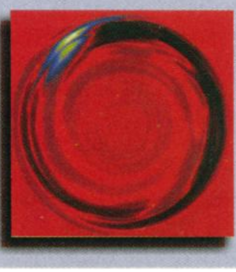
LETTERS

A "parsimonious conclusion"

Astronomers discuss how giant planets like Jupiter could form during "the dissipation of gaseous disks about young stars." (Right, a model of a protoplanetary disk, 20 astronomical units in diameter, with a gaseous protoplanet forming at the edge, indicated by yellow and green.) A reader concludes that it is likely that Early Permian insects actively consumed "nutritionally rich pollen." And it is said that "a series of genes," not just one, was probably involved in the evolution of "a tail in primitive vertebrates."



ALAN P. BOSS

Young Stars and Giant Planets

In his report "Giant planet formation by gravitational instability" (20 June, p. 1836), Alan P. Boss comments on the time scale for the dissipation of gaseous disks about young stars and the frequency of Jupiter-like planets in our Milky Way galaxy. However, his reference (citation 8 in the report) for such time scales is to a 30-page review paper by S. E. Strom *et al.* (*1*) that deals essentially only with the survival of small dust particles about young stars but not with the gas (which comprises most of the mass of "Jupiters"). The disappearance of small dust particles might mean that they are gathering together into larger objects such as "footballs" or planetesimals but, at the same time, the quantity of gas could still remain largely undiminished. I quote from the brief mention of gas in the review paper by Strom *et al.* (*1*, p. 860):

> The evidence regarding the frequency of disk formation, as well as estimates of time scales for disk evolution rests entirely on observations of excess infrared and millimeter-continuum emission produced by circumstellar dust. What is the fate of the dominant constituent of circumstellar disks—the gas? Determining the survival time for the gas component is essential to understanding the evolution of nebular disks, and is particularly crucial for establishing the time available for building the giant, gas rich outer planets.

Strom *et al.* then go on to briefly say that they have scarcely an observational clue as to the gas dissipation time and that the situation has improved only slightly in the five or so years since they wrote their paper [for example, see the report by J. H. Kastner *et al.*, "X-ray and molecular emission from the nearest region of recent star formation" (4 July, p. 67) and references therein]. Boss also refers to a "concern that giant planets might be rare in our galaxy" and that discovery of giant extrasolar planets has removed much of this concern. Now why would anyone be "concerned" that giant planets are rare? The only reason that I can think of is that they are somehow important for the protection of life on Earth-like planets [as Wetherill (*2*) and others have suggested] and that some people would be "concerned" should life not be common in the Milky Way. However, one could argue as Ward (*3*) and others have done, that most planetary systems could end up like the newly discovered ones with Jupiters in the wrong place to protect life, rather than in the right place as in our planetary system. So it is still too early to know if recent discoveries should serve to increase or diminish our concerns.

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References

1. S. E. Strom, S. Edwards, M. F. Skrutskie, in *Protostars & Planets III*, E. H. Levy and J. I. Lunine, Eds. (Univ. of Arizona Press, Tucson, 1993), pp. 837–866.
2. G. W. Wetherill, in *Planetary Systems: Formation, Evolution, and Detection*, E. Rottger, Ed. (Kluwer, Dordrecht, Netherlands, 1995).
3. W. R. Ward, *Astrophys. J.* **482**, L211 (1997).

Response: It is important to extend estimates of disk lifetimes to include direct measurements of the amount of hydrogen gas, as estimates based solely on dust grain abundances could be misleading. However, attempts to accomplish this through molecular line observations of trace gas molecules such as CO have yielded total gas masses at least 10 times smaller than those inferred from the dust measurements. Although this may be indicative of CO freezing out onto dust grains, it might also indicate that the gas is depleted relative to the dust (*1*), the opposite effect of the gas enrichment expected if dust grains are forming planetesimals.

Besides the concern regarding the habitability of terrestrial planets in planetary systems without a Jupiter to eject killer comets (*2*), there was the concern of whether or not giant planets actually existed elsewhere. At least one dedicated search had yielded no evidence for Jupiter-mass extrasolar planets (*3*), raising the chance that our solar system happened to be anomalous in containing such a massive planet, thereby calling into question any parallels between the solar system and extrasolar planetary systems.

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References

1. S. V. W. Beckwith and A. I. Sargent, *Nature* **383**, 141 (1996).
2. G. W. Wetherill, *Astrophys. Space Sci.* **212**, 23 (1994).
3. G. A. H. Walker *et al.*, *Icarus* **116**, 359 (1995).

Tail Evolution

Elizabeth Pennisi and Wade Roush (Special News Report, 4 July, p. 34), commenting on the elegant experiments of Billie J. Swalla and William R. Jeffery (Reports, 15 Nov. 1996, p. 1205) (*1*), which show that the development of a tunicate larva's tail is regulated by a single gene called *Manx*, state that the observations raise "the possibility that a single genetic change could be responsible for the innovation that led to a tail in primitive vertebrates." This seems to extrapolate beyond the conclusions of the original paper. Embryos of species with tailless larvae, such as *Molgula occulta* and a number of other species, possess all the different groups of progenitor cells of the tissues that form the tail in tadpole larvae (*2*). The difference between the two types is that one group of cells becomes differentiated and the tail subsequently becomes elongated in the species with tadpole larvae, whereas the differentiation is suppressed in the tailless larvae; the differentiation process appears to be regulated by the *Manx* gene. So the evolution of the chordates has likely involved not only the gene for differentiation and elongation of the elements of the tail, but also a series of genes regulating the formation of (and the cell groups that may become) tail muscles, chorda, and notochord with all the well-known interactions between these tissues.

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References

1. W. R. Jeffery and B. J. Swalla, *BioEssays* **14**, 219 (1992).
2. N. J. Berrill, *Philos. Trans. R. Soc. London Ser. B* **219**, 225 (1931); W. R. Jeffery and B. J. Swalla, *Dev. Biol.* **1**, 253 (1990).

Permian Pollen Eating

The Random Samples item "Permian pollen eaters" (16 May, p. 1035) provides a stimulating account of the discovery by Russian paleobiologists Alexander Rasnitsyn and Valentin Krassilov of identifiable pollen in the guts of Early Permian insects. Paleobotanist William Chaloner is quoted as saying that inadvertent consumption of pollen could explain the occurrence of this pollen. One of the preserved insects is a