Allomyces in the Devonian

SIR — We have found fossil fungi morphologically similar to *Allomyces*, the modern experimental fungus, in thin sections of early Devonian (400 million-year-old) megaplants. The fungus exhibits an isomorphic alternation of generations in which sporothalli that produce zoosporangia and resting sporangia alternate with gametothalli that form chains of gametangia. This life history is identical to that of the *Allomyces* subgenus *Euallomyces* and underscores the diversity in thallus morphology and reproduction in early terrestrial zoosporic fungi.

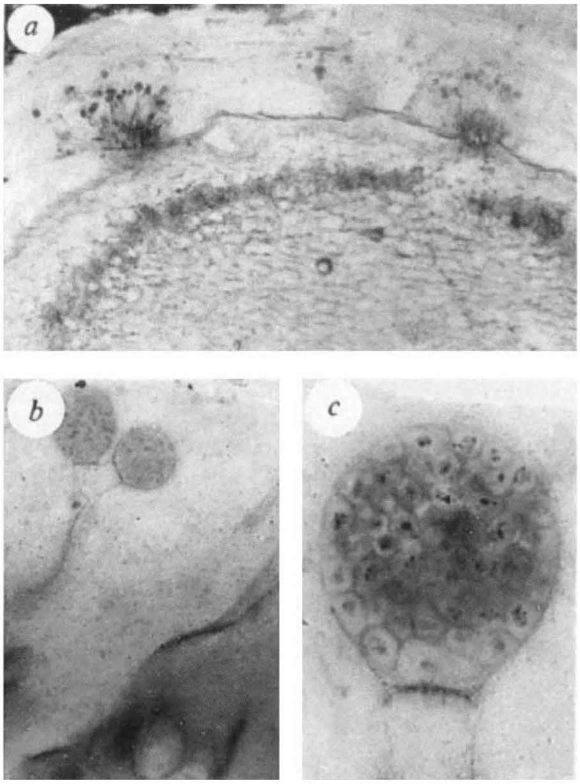
The fungus was saprophytic on *Aglaophyton major*, an early Devonian land plant, and occurs in small tufts on the surface of stems (*a* in the figure). It consists of nonseptate hyphae each 9–18 µm in diameter, which develop into two types of morphologically identical thalli (*b*). On one type of thallus (sporothallus) are terminal zoosporangia (*b*) and thick-walled resting sporangia. Zoospores are ellipsoidal, approximately 5 µm in diameter, and have a dark inclusion (*c*) which may be equivalent to the prominent nuclear cap of living blastocladialean zoospores[1]. The other thallus type (gametothallus) produces pairs of barrel-shaped gametangia in which the terminal one is always slightly larger.

The fossil fungus is most similar to living members of the Blastocladiales, a group regarded as more derived than other Chytridiomycetes. The presence of isomorphic thalli, each forming different reproductive structures (zoosporangia and resistant sporangia on sporothalli; gametangia of two distinct types on gametothalli), demonstrates that this fossil fungus possessed an isomorphic alternation of generations, a life-history pattern that has been documented in only a few living fungi.

Despite the investigation of various characters including zoospore flagellation[2], ultrastructure[3], thallus morphology[4], nutritional mode[5] and ribosomal RNA sequences[6], there is no consensus regarding the evolution of the Chytridiomycetes. The most comprehensive phylogenetic analysis[7] places chytridiaceous fungi in three distinct groups: Spizellomycetales–Chytridiales–Monoblepharidales; Neocallimasticales; and Blastocladiales. Similarly, there is no agreement regarding the origin of the Blastocladiales from other chytrid groups[3], because these same chert deposits also contain other chytrids that morphologically resemble members of the Spizellomycetales[8,9]. Nevertheless, because the Rhynie chert specimens represent the oldest fossils attributable to the Blastocladiales, they provide the only method available to calibrate molecular-clock datasets used to infer the phylogeny of fungal groups. Finally, the presence of this fungus by early Devonian time not only underscores the antiquity of the order but, perhaps more important, demonstrates that thallus morphology and reproductive systems in some terrestrial fungi were established very early, and apparently have changed little since then.

T. N. Taylor
Department of Plant Biology and Byrd Polar Research Center, Ohio State University, Columbus, Ohio 43210, USA
W. Remy
H. Hass
Westfalische Wilhelms-Universität, Forschungsstelle für Paläobotanik, 48143 Münster, Germany

1. Fuller, M. S. & Olson, L W. *J. gen. Microbiol.* **66**, 171–183 (1971).
2. Sparrow, F. K. *Aquatic Phycomycetes* **1–1**, 187 (Univ. Michigan Press, 1960).
3. Barr, D. J. S. *Handbook of Protoctista* 454–466 (Jones and Bartlett, Boston, 1990).
4. Emerson, R. & Robertson, J. A. *Am. J. Bot.* **61**, 303–317 (1974).
5. Cantino, E. C. in *The Fungi - an Advanced Treatise* 283–337 (Academic, New York, 1966).
6. Li, J. & Heath, B. *Can. J. Bot.* **70**, 1738–1746 (1992).
7. Li, J., Heath, B. & Packer, L. *Can. J. Bot.* **71**, 393–407 (1992).
8. Taylor, T. N., Remy, W. & Hass, H. *Am. J. Bot.* **79**, 1233–1241 (1992).
9. Taylor, T. N., Hass, H. & Remy, W. *Mycologia* **84**, 901–910 (1992).



Allomyces-like fossil fungus. *a*, Partial transverse section of *Aglaophyton major* stem showing fungal tufts. × 40. *b*, Sporothallus with terminal zoosporangia (left) and gametothallus (right) with pairs of gametangia. × 400. *c*, Detail of zoosporangium containing cleaved zoospores with dark inclusions. × 1,200.

Fast pulsations in Wolf–Rayet stars

SIR — The interesting report[1] of the discovery of rapid pulsations in a Wolf–Rayet star suggests that asteroseismology can be used to study the interior structure and dynamics of these stars shrouded by hot, optically dense stellar winds in the same way as it is used to study the Sun[2] and other distant stars[3]. Here we report a significant null result in our attempt to confirm the existence of rapid oscillations with a period of 627 s in the Wolf–Rayet star WR40 (HD96548).

We acquired high-speed photometric observations of WR40 on 15 nights spanning 205 days from 9 December 1992 to 1 July 1993 using the 0.5- , 0.75- and 1.0-m telescopes of the South African Astronomical Observatory at Sutherland (see table). The programme star was monitored continuously over a time span of 1–2 h without any comparison star measurements. The reliability of this technique is proven for variability in the period regime of interest here[4]. The Fourier transforms of our 15 light curves are shown in the figure. In general, the noise level in our transforms is somewhat lower than that reported in ref. 1, but there is no evidence of coherent oscillations at 1.6 mHz. Although the figure shows only the frequency range $0 \leq \nu \leq 5$ mHz, we have examined the transforms up to the Nyquist frequency of our data (12.5 mHz) and verified that there are no statistically significant peaks in the first Nyquist interval.

A caveat we must mention is that the Johnson *B* and Strömgren *v* filters we used pass different amounts of emission line flux compared to the Geneva *B* filter used in ref. 1. This is an important consideration because the variations (or lack thereof) are attributed to the continuum, which arises in deeper regions than the emission lines. The Strömgren *v* filter approximates a Geneva *B* filter fairly well.

It is worth noting that the 627-s oscillations were detected using a charge-coupled device (CCD) photometer with no on-frame comparison stars. All earlier searches for rapid oscillations in this star