

clone 1's estimated 1,500 years of existence, the authors' preliminary molecular analyses suggest that it has remained genetically highly conserved across its enormous biomass. Given the likelihood of mutation, sexual and somatic nuclear recombination, and more novel if rare genetic events described for similar fungal systems, the genetic stability of the clone is indeed remarkable.

Other matters concerning the stability of the thallus remain to be settled. Is the establishment of such an infection centre a rare event, and has the persistence of clone 1 in a fluctuating environment been a matter of chance, or does it possess a better than average set of fitness attributes? And has clone 1 supplanted adjacent, lesser individuals during its 1,500-year lifetime? At least it should be around long enough for some of these questions to be answered.

The suggestion of Smith *et al.* that clone 1 deserves recognition as one of the largest of living organisms, rivalling the blue whale or the giant redwood, invites closer scrutiny. The blue whale and redwood exhibit relatively determinate growth within a defined boundary, whereas fungal mycelia do not. Substantial rhizomorphic systems such as those of clone 1 may also expand and regress considerably in response to the local availability of food sources, and to events such as fire, climatic fluctuation and forest succession. Furthermore, after 1,500 years, clone 1 is likely to have become fragmented into a number of independently functioning components, as demonstrated by another study (*b* in Fig. 1) in which large *Armillaria* clones were shown to have become physically disjunct. The clone's structure may be more akin to that of some vegetatively reproducing plants such as grasses¹¹ and bracken, and some ancient elms. So although clone 1's reputation as a champion genotype may yet be secure, its status as a champion organism depends upon one's interpretation of the rules. □

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Back to the drawing board

Peter W. Stephens

In the short time since the discovery of superconductivity in doped C_{60} fullerenes, a simple relationship has emerged between the size of the crystalline unit cell and the superconducting transition temperature. This important result has guided the search for variants with higher transition temperatures and has acted as an important ingredient in models of the superconductivity. Now, according to two papers in this issue^{1,2}, new doped fullerenes have been synthesized which violate the simple rule. Inasmuch as one learns more from the violation of a rule than from its establishment, this result will surely stimulate new insights into these intriguing superconductors.

Data on superconducting fullerides, with the chemical formula A_3C_{60} (where A is an alkali atom), have been accumulating for a year and point the way towards a simple correlation between structure and superconductivity: the larger the lattice spacing (a_0), the higher the superconducting transition temperature (T_c). It was first discovered³ that T_c in K_3C_{60} and Rb_3C_{60} plummets as pressure is applied to the samples. A similar observation was made⁴ by comparing fullerenes doped with mixtures of K, Rb and Cs. All have the same structure, but the larger alkali ions push a_0 to larger values. A plot of T_c against a_0 shows a steady increase of about 55 K per Å. (Nature always reserves the right to terminate such an encouraging empirical relationship, and indeed it does not

appear to be possible even to prepare the end point of that series, Cs_3C_{60} .)

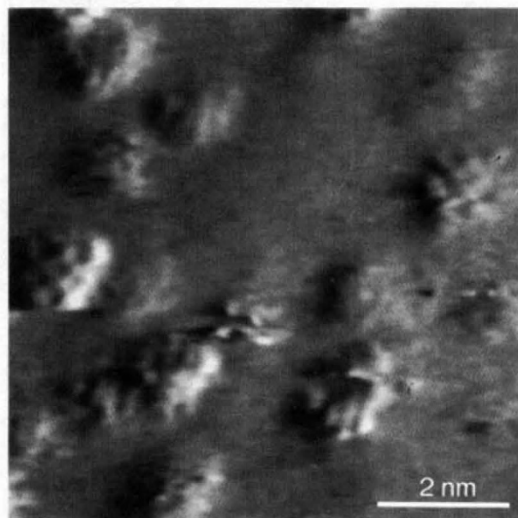
The two sets of observations were brought together only recently by measurements of the compressibility of fullerides⁵. A compilation of the pressure and cation alloy data shows that for K, Rb and their mixtures (including those with Cs), the lattice constant governs the superconducting transition temperature, with the specific cations having only a minimal effect.

In general, the relationship between the atomic structure of a solid and its superconductive properties is not a simple issue; even within a particular family of superconductors, there are enough uncontrolled factors in forming new varieties that it is unusual to find a trend that can be exploited with confidence. For example, although it is generally the case that the transition temperature of high- T_c cuprate superconductors rises as more intervening layers of atoms are inserted between the all-important CuO planes, numerous exceptions have frustrated the design of materials with a higher T_c by this rule.

Another example is afforded by Nb_3Sn , which is used commercially in very-high-field superconducting magnets. Although dozens of members of this family are known, it is a difficult job to correlate their superconductive properties with structural information. Indeed, of all the known superconducting materials, the alkali-doped fullerenes provided the best opportunity of corre-

C_{60} structure brought into view

THE soccerball shape of C_{60} is possibly more familiar now than any other molecular structure, apart perhaps from the hexagon of benzene or the double helix of DNA. Yet only now is it being seen directly. This image, taken with a scanning-tunnelling microscope, just reveals the internal arrangement of individual C_{60} molecules attached to the surface of a gold crystal (Y. Zhang, X. Gao & M. J. Weaver *J. Am. chem. Soc.* **96**, 510–513; 1992). The interconnected rings of each molecule are just apparent; in some cases the central (uppermost) ring is surrounded by five other rings, in others six — reflecting the mixture of five- and six-membered rings of the fullerene. The authors suggest that they can see the internal structure because the molecules become wedged into deep ruts on the surface of the gold. On other surfaces, the molecules are free to rotate on timescales far short of the few seconds it takes a scanning microscope to complete an image, erasing any detail.



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