month at the Kavli Futures Symposium in Ilulissat, Greenland, on the convergence of synthetic biology and nanotechnology, and the progress towards artificial cells.

But should such efforts be regarded as 'creating life'? The idea that such creation is a momentous step has deep roots running from the medieval homunculus portrayed by Paracelsus and the golem of Jewish legend to the modern faustian myth of Frankenstein. It will surely be hard to uproot. This is unfortunate, as the idea is close to meaningless.

There is a popular notion that life is something that appears when a clear threshold is crossed. One might have hoped that such perceptions of a need for a qualitative difference between inert and living matter — such vitalism — would have been interred alongside the pre-darwinian belief that organisms are generated spontaneously from decaying matter. Scientists who regard themselves as well beyond such beliefs nevertheless bolster them when they attempt to draw up criteria for what constitutes 'life'. It would be a service to more than synthetic biology if we might now be permitted to dismiss the idea that life is a precise scientific concept.

One of the broader cultural benefits of attempts to make artificial cells is that they force us to confront the contextual contingency of this troublesome idea. The trigger for the ETC Group's protest was a patent filed by the Venter Institute in October 2006 on a "minimal bacterial genome" — a subset of genes, identified in *Mycoplasma genitalium*, required for the organism to be viable "in a rich bacterial culture medium". That last sounds like a detail, but is in fact essential. The minimal requirements depend on the environment — on what the organism does and doesn't have to synthesize, for example, and what stresses it experiences. Too much minimization and you end up with cells on life support. And participants at the Greenland meeting added the reminder that cells do not live alone, but in colonies and, in general, in ecosystems. Life is not a solitary pursuit, nor can evolution happen without the opportunity for competition.

"It would be a service to more than synthetic biology if we might now be permitted to dismiss the idea that life is a precise scientific concept."

Synthetic biology's view of life as a molecular process lacking moral thresholds at the level of the cell is a powerful one. And it can and perhaps should be invoked to challenge characterizations of life that are sometimes used to defend religious dogma about the embryo. If this view undermines the notion that a 'divine spark' abruptly gives value to a fertilized egg — recognizing as it does that the formation of a new being is gradual, contingent and precarious — then the role of the term 'life' in that debate might acquire the ambiguity that it has always warranted. ■

Electric skies?

How to navigate a flight path to greener air travel.

The widespread availability and affordability of air travel has delivered unprecedented opportunity to travel and a world that is more closely interlinked than ever before. But air transport is also a substantial contributor to greenhouse-gas emissions, leading to a flurry of discussion about what could be done to reduce its 'carbon footprint'.

The airlines and the aerospace industry are increasingly conscious that this concern could put a damper on the growth of their businesses. The Boeing 787, the first exemplar of which is expected to be rolled out of the factory next week and flown next month, is said to be 20% more fuel efficient than the airliners it will replace. Richard Branson's Virgin Airlines said earlier in the year that it plans to begin testing unspecified biofuels in airliners. And EasyJet, a low-cost European airline, has said that it hopes to halve its emissions per passenger kilometre by 2015.

It is by no means clear how much of this is public-relations talk, aimed at deflecting growing public disquiet about the carbon emissions associated with flying. But in the long term, there can be no doubt that the industry will pursue technologies to cut emissions.

One such technology — the use of light carbon-fibre composites in place of aluminium alloys for airframe construction — is incorporated, for the first time in civil aviation history, in the Boeing 787. Further improvements in the strength-to-weight ratio of aircraft structures will come from composites that rely on carbon nanotubes, instead of polymer-based fibres. The cost of the bulk manufacture of nanotubes is steadily decreasing, although important technical barriers still need to be overcome. Problems associated with optimizing the properties of these composites are discussed in a News and Views Q&A in this issue (see page 1066).

But although the use of new high-performance materials can contribute substantially to the sort of efficiency improvements attained by the 787, truly impressive reductions in airliner emissions would require the industry to take the thoroughly radical (and currently inconceivable) step of replacing the gas turbine engine as the airliners' means of propulsion.

A paper published earlier this month (P. J. Masson *et al. Supercond. Sci. Technol.* **20,** 748–756; 2007) puts forward a hypothesis that high-temperature superconducting technologies could provide a route to all-electric aircraft that burn hydrogen fuels and have electrical systems powered by fuel cells. Although highly speculative as to its practicability, it would greatly reduce carbon emissions assuming also that the hydrogen could be produced by nuclear or renewable technologies.

If 'clean' air travel is indeed achievable, it remains a long way off, and will only be developed through a concerted effort between scientists, engineers, governments and businesses. At the Paris Air Show last week, European research commissioner Janez Potočnik announced a 'clean sky' research initiative, under which the European Commission will invest €800 million (US$1 billion) from 2008, while hoping to attract a similar amount from private industry. But it will take more than that. Equally commendably, Louis Gallois, the chief executive of Airbus, called for an unprecedented meeting of airliner and aeroengine makers (including Airbus and arch-rival Boeing) later this year to discuss global collaboration on the technical challenges ahead. These obstacles are considerable, but such an approach gives hope of surmounting them. ■