nature
www.nature.com/nature
Vol 447 | Issue no. 7148 | 28 June 2007

All for one...

Many medium-sized university departments feel they are engaged in an unequal struggle against larger and more-entrenched rivals. But there is a way in which they can fight back.

A few years ago, the outlook for physics departments in Scotland was not auspicious. Today, the future is much brighter, thanks to a mechanism that could benefit universities elsewhere. The Scottish Universities Physics Alliance (SUPA), which has forged operational links between six physics departments, looks set to overcome a challenging situation by pooling resources and aiming high.

Like many of their counterparts, the departments in the alliance are fighting for research funds with dozens of rivals, including some élite institutions. They are also competing globally for talented graduate students. Faced with such challenges, medium-sized university departments have few attractive options. They can try to enrol more undergraduates, perhaps by lowering standards, in order to attract block funding that British agencies give to support teaching. In extreme cases, the response has been simply to give up — several chemistry and physics departments have closed in Europe in recent years.

SUPA's founders believe that it is possible to thrive by joining forces. Although this sounds easy, it isn't. Most university department chairs did not work their way up to their positions over decades just to throw whatever influence they have into a pot with five or six of their fiercest local rivals. Universities in every corner of the world experience such rivalries, and variations in quality can make departments reluctant to work with each other on equal terms. And if the universities' top administrators don't buy in, joint ventures between departments are liable to be short-lived.

That may be why the kind of fusion that SUPA has attempted is still relatively rare. But, two-and-a-half years after its formal launch, the experiment is drawing attention from abroad, as well as considerable financial support from both the participating universities and the Scottish Funding Council, which will shortly review a substantial application for funds for the project's second phase.

The alliance is run by a handful of staff in Edinburgh. Physics departments at the participating universities — St Andrews, Edinburgh, Glasgow, Heriot-Watt, Paisley and Strathclyde — have agreed to share authority over hiring decisions and research planning. A board of these departments, together with Ian Halliday, SUPA chief executive and a Scottish physicist of international standing, meets regularly to steer the alliance. The total operation has some 200 faculty members and 400 graduate students, and attracts about £30 million (US$60 million) in research grants each year.

At the alliance's annual meeting earlier this month, Halliday said that it is already attracting applications from top-tier candidates for its joint graduate school, and is increasing the calibre of its staff appointments. It remains a challenge to catch the very best students, however, and getting full attendance at video-linked graduate-student classes is also none too easy. Progress in the quality of research — the project's overriding objective — will, of course, take time to achieve.

But if imitation is the highest form of flattery, the project has already enjoyed some measure of success. Similar projects are under way in several disciplines in Scotland and the model has drawn interest from as far afield as Canada and Spain, where departments face the same basic challenges in trying to compete globally. And university administrators and funding agencies seem to be impressed that departments are ready to do something different in order to succeed.

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There is also a political aspect to the alliance's momentum. When Roger McClure, chief executive of the Scottish Funding Council, says that SUPA's strong early run has been "forged by centuries of oppression", the alliance's many English-born physicists enjoy the joke. But he has a serious point: it may be easier for universities in a place such as Scotland to find a genuine common cause than in, say, the midlands of England, where a sense of regional identity is less firmly established.

The SUPA example suggests that, where administrators, department heads and faculty members can find a common cause, it is possible for a group of medium-sized departments to make an impact. Those who draw the appropriate lessons should prosper in a scientific world in which departments must be internationally competitive to survive. ■

Meanings of 'life'

Synthetic biology provides a welcome antidote to chronic vitalism.

Many a technology has at some time or another been deemed an affront to God, but perhaps none invites the accusation as directly as synthetic biology. Only a deity predisposed to cut-and-paste would suffer any serious challenge from genetic engineering as it has been practised in the past. But the efforts to design living organisms from scratch — either with a wholly artificial genome made by DNA synthesis technology or, more ambitiously, by using non-natural, bespoke molecular machinery — really might seem to justify the suggestion, made recently by the ETC Group, an environmental pressure group based in Ottawa, Canada, that "for the first time, God has competition".

That accusation was levelled at scientists from the J. Craig Venter Institute in Rockville, Maryland, based on the suspicion that they had synthesized an organism with an artificial genome in the laboratory. The suspicion was unfounded, but this feat will surely be achieved in the next few years, judging from the advances reported earlier this 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. ■