Raw data showing the discovery of the mutant *tau* hamster. Each line represents 24 hours. Successive days are mounted beneath each other. Dark pen marks indicate periods of wheel-running activity; dark bar at top, time of darkness on a light-dark 14-10-hour schedule; arrows, change of lighting schedule from light-dark 14-10-hour to continuous darkness (DD). (Courtesy of M. Ralph.)

chiasmatic nuclei (SCN) in the brain are the site of circadian pacemakers in mammals, but this assertion has not been proved. True, lesions in this area abolish circadian rhythms of activity and other variables¹, but this does not prove that a pacemaker resides there. It could simply mean that the integrity of this area is necessary for the expression of rhythmicity. Transplanting fetal SCN into animals whose own SCN have been ablated can result in restoration of rhythms. This again does not prove that the SCN contain a pacemaker. The circadian machinery might be elsewhere, with the SCN simply providing some input necessary for its functioning. What is required is a demonstration that transplants produce rhythms that have characteristics which are specific to the clock of the donor.

In sparrows, removal of the pineal results in a loss of circadian rhythmicity. Menaker and his co-workers have previously shown that transplants of the pineal gland restore rhythmicity to pinealectomized sparrows, but also that the phase of the donor's rhythm determines the phase of the recipient's rhythm⁴. Thus, the time of day at which the recipient sparrows become active depends on whether the donor birds have been kept on a normal or a reversed LD cycle. This still is not quite definitive because the phase of a rhythm is a temporary characteristic that can be quickly shifted in various ways. It would be more convincing to transplant a persisting stable characteristic of a clock such as the speed with which it runs. In sparrows, however, there is too little inter-individual variation and too much intra-individual variation to make transplanting periodicity convincing.

There have been some attempts to transplant periodicity between strains of rats with different clock speeds, but activity

rhythms in rats are generally not as clear as those in hamsters. A hamster mutant with a period outside the range of those for the wild-type is the ideal subject for this kind of work.

Ralph's new data show that the period of the circadian-activity rhythms of wild-type hamsters can be shortened first by ablating their own SCN and then by inserting fetal mutant SCN. Conversely, the period of mutant hamsters can be lengthened by replacing their own SCN with fetal wild-type SCN. This result is the confirmation of the pacemaker role played by the SCN. It is also a striking example of the transplantation of a behaviour.

The mutant (*tau*) hamster is likely also to provide insight into other questions about biological rhythms. Attempts to discover the gene product of this single locus and to unravel its molecular biology have already begun. It will be interesting to make comparisons with the fruitfly period (*per*) gene, which has already been cloned and sequenced (see the recent discussion in News and Views⁵). Understanding fundamentals about rhythmicity will eventually help in ameliorating rhythm disturbances such as those occurring in jet lag, shift work and some types of affective disorder. A nice touch is that Ralph and Menaker have rejected the option of trying to patent the mutant hamster. Altogether, this is textbook science at its best. □

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Daedalus

A reducing diet

COOKING is not a consciously chemical discipline. Only by trial and error have chefs learnt to exploit the hydrolysis and denaturing of proteins, the partial oxidation of fats, and the Maillard reaction between proteins and sugars, to produce their wide palette of sumptuous and tempting flavours. It is largely oxygen that develops the subtleties of taste, by forming the delicate traces of higher aldehydes, ketones and esters that impart flavour; but over-oxidation gives sour, acrid fatty acids. So cooking limits oxidation: typically by careful temperature control, or (as in frying and boiling) by submersion.

Modern industrial food processing uses anti-oxidant additives; but Daedalus has a more wholesome approach. The traditional chef has to join his battle with oxygen over an open stove, and faces rancid, burnt or over-cooked disaster if he loses it. But modern electric and microwave ovens are quite independent of air. So DREADCO's chefs are cooking all sorts of dishes not in air, but in a non-oxidizing atmosphere of nitrogen or argon.

This new sort of cooking has many benefits. Very high temperatures can be explored under full control: the food cannot burst into flame. Controlled amounts of oxygen can be introduced at crucial stages, to promote the development of new and subtle flavours without going too far: just as wine develops its subtle bouquet from the slight leakage of oxygen into the bottle through the cork, but is spoiled if too much gets in. Gourmets should revel in the new and unexpected flavours that will thus be teased out of quite ordinary foodstuffs. Dull and obvious products like lentils and rhubarb and corned beef may come alive with subtle delights; hidden virtues may be revealed in marrow, tapioca, and the British sausage; the range of delightful complementary pairs, like eggs and bacon, and fish and chips, may be wonderfully extended. Culinary anaesthetics like salty gravy and sugary custard may no longer be needed. Even hopeless raw materials like lettuce and battery chicken may at last be made to taste of something.

More boldly still, the DREADCO chefs are filling their new ovens with frankly reducing atmospheres: hydrogen, carbon monoxide, even ammonia. The entirely novel flavours thus developed may be so strange and amazing as to be positively overwhelming. The hydrogen-reduction oven may be best employed as a 'decooker' to rescue overdone cooking. By converting the sour fatty acids of over-oxidation back to flavoursome aldehydes again, an over-cooked joint, deadburnt cake or pyrolysed pie might be reclaimed for the gourmet's table.

David Jones