TIM THORSON

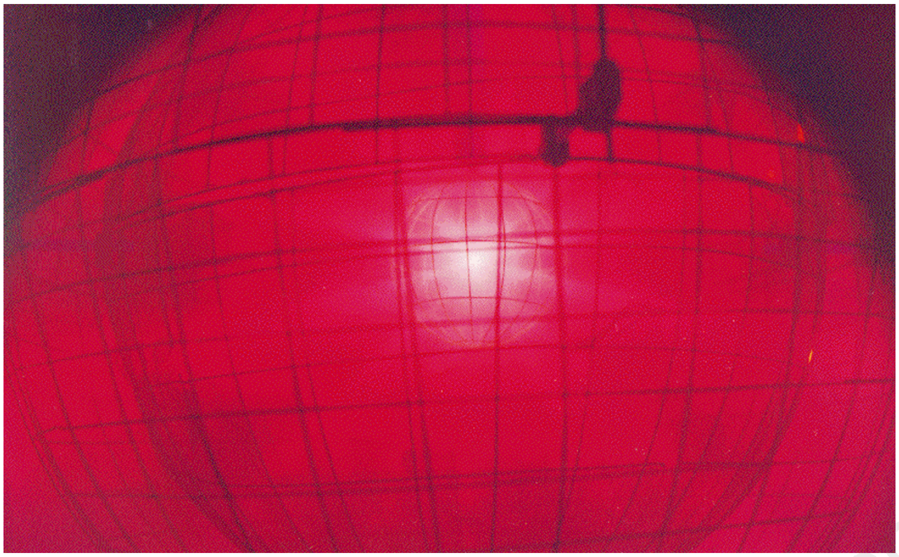

Figure 2 **Plasma in an inertial-electrostatic confinement device at the University of Wisconsin. This type of device has provided proof-in-principle that fusion can be produced with D–^{3}He, a second-generation fuel, at low levels of power input.**

Institute of Technology). A D–T version, IGNITOR, is under scrutiny as a possible option for the next step in the US fusion programme. Another Maxwellian D–^{3}He plasma concept is based on confinement using a dipole magnetic field produced by a single superconducting ring magnet (L. Bromberg, MIT); a modest-sized dipole experiment aimed at exploring it further has recently begun construction at MIT.

These two lines of thinking illustrate the main routes to advanced-fuel fusion using Maxwellian plasmas: high magnetic field or high values of beta, the ratio of plasma pressure to magnetic-field pressure. Several high-beta confinement concepts were mentioned briefly at the miniconference, such as the field-reversed configuration, spheromak, spherical torus and reversed-field pinch.

The third approach to be debated was inertial-electrostatic confinement (Fig. 2), which has both non-Maxwellian and oscillating Maxwellian embodiments (D. Barnes, Los Alamos National Lab.). In these devices, for which exploratory experiments have been successful, electrons in a Penning trap form spherically-symmetric electrostatic potential wells, producing a radially convergent ion flow. The very high plasma density that results may even allow burning of a D–D fuel. Finally, there is the idea of a colliding-beam reactor, which is based on maintaining large-orbit ion currents circulating in opposite directions (N. Rostoker, Univ. California, Irvine). This method might be used in either a pure colliding-beam form or to induce stability in field-reversed configurations.

The fireworks in the ensuing discussions showed that there is a sharp division of opinion about such basic principles as net energy production and engineering feasibility, and thus about the prospects for the new fuels and confinement techniques. Some arguments centred around the technology needed to drive the plasmas (M. Lampf and W. M. Manheimer, Naval Research Laboratory); others on the accuracy of the calculations of net energy production in both Maxwellian and non-Maxwellian plasmas (T. H. Rider, MIT; W. M. Nevins, Lawrence Livermore National Lab.). There was general agreement that D–^{3}He (but probably not p–^{11}B) fuel could be burned in Maxwellian plasmas. For non-Maxwellian plasmas, however, there was a disagreement between proponents and opponents of the approach. Several of the proponents discussed power plants that would rely on non-Maxwellian plasmas where the calculations of collisional effects, and of the energy losses due to the emission of *bremsstrahlung* and synchrotron radiation, are difficult and subject to debate.

Neither side yielded on the prospects for the second- and third-generation fuels. But there was general consensus on the overwhelming benefits if they could be made to operate efficiently. Even the task of procuring ^{3}He from the Moon did not raise eyebrows, perhaps because many NASA reviews have assessed the engineering approaches to such an undertaking and found them to be feasible.

The session ended on the same question on which it began — can at least one of the alternative concepts demonstrate net energy production with an advanced fuel? The answer seems to be a long way off at the present level of theoretical and experimental research. At the least, however, the two sides are now confronting the issues. □

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Daedalus

Brandy and cigars

Smoking has gone from the height of chic to the depth of infamy in only a few decades. And yet, compared to other addictive drugs, tobacco is socially almost harmless. Its users do not become career criminals, loud-mouthed tearaways or menaces on the roads. They damage only themselves; their only anti-social behaviour is to spread the nasty smell of smoke.

And even that nasty smell, says Daedalus, is not central to the habit. It just so happens that free nicotine, the addictive agent in tobacco, reacts readily with oxygen. Tobacco itself contains nicotine in combination, largely as the stable citrate. Smoking is a way of freeing it on demand, and getting it into the smoker in seconds, before it has a chance to oxidize. Daedalus is therefore devising an oxygen-free vehicle for nicotine.

His brilliant idea is to combine it with another widely used drug, alcohol. Brewing, of course, exploits the conversion of sugars to alcohol. The reaction needs no oxygen; indeed, it gives off carbon dioxide which tends to keep air away. Many sources of plant sugar, from potatoes to barley to grapes to elderflowers, can be fermented to an alcoholic wine or beer. So DREADCO chemists are now inventing tobacco wine. Their crucial new technique is to conduct the process from the very beginning in an atmosphere of carbon dioxide. No oxygen can get in, even in the early stages. Once the product is bottled, of course, the oxygen problem is essentially solved. Tiny traces of the gas may slowly diffuse in through the cork; but as in conventional wines this will probably go to producing higher esters and aldehydes which enhance the flavour and bouquet.

Tobacco wine should be widely welcomed. Unlike the various distressing 'improved cigarettes' devised by the tobacco companies over the years, it will fill a well-understood niche in the market. It will probably not be very alcoholic. With a bottle or can of tobacco wine at their side, smokers will find it easy to give up their cigarettes. They will be able to enjoy their addiction without the tars and combustion-products which make smoking hazardous and unpopular. Indeed, they will be able to deny and sublimate their addiction in the manner perfected by innumerable alcoholics. They will develop an exaggerated, connoisseur's awareness and appreciation of infinitesimal subtleties of smell and flavour in the product.

David Jones

