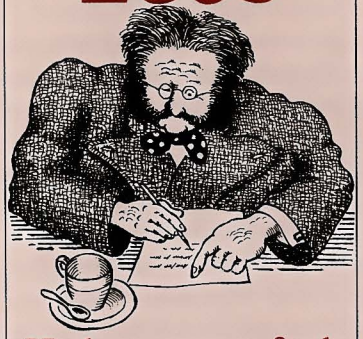
LETTERS TO ECOS



Hydrogen as a fuel

The article 'Hydrogen — Fuel of the Future' in *Ecos* No. 32, Winter 1982, seemed to me generally to be a well-balanced account of the pros and cons of this potentially exciting energy source but one still requiring much investigation before its practicality can be assessed.

As a scientist, I was impressed by your journal's report on Dr Bradhurst's solar-powered hydrogen-generator and, as an organic chemist, by the report on Dr Sasse's work on organo-metallic-catalyzed generation of hydrogen from water by the action of sunlight.

Although having no expertise in the area, I was earlier an advocate in private circles of the potential of hydrogen as a fuel, but at the same time pointed out to my friends some of its disadvantages: the extremely high ratio of storage-to-active weight, whether as the gas in high-pressure cylinders or adsorbed as hydride in suitable metals or metal-alloys; and, what could be an unacceptable daily social risk, that of explosion in case of a traffic accident.

Your article suggested that storage of hydrogen as metal hydride is safer than as gaseous hydrogen, which is, to quote, 'more dangerously explosive than petrol'. The evidence quoted, on the effects of incendiary bullets, is inconclusive and, in my opinion, suspect: did the incendiary bullets in fact start a fire and, if they did, was hydrogen released from the metal hydride, as would be required for its use to store hydrogen as a fuel? As 'the hydride burnt only along the path of the bullet', it seems that the potentially important effects of a secondary fire were not studied.

In the penultimate paragraph of the article there are several questionable assertions and/or implications:

'Dr Bradhurst estimates that, right now in Australia, electrolytic hydrogen produced with off-peak electricity would be cheaper than petrol'. We might first ask: 'Per kilogram or per kilojoule?' But 'right now' is surely irrelevant. Off-peak pricing is a device (perfectly legitimate) to encourage more uniform total demand for electricity throughout the 24-hour day but, if electricity were used to produce any significant amount of hydrogen at night, demand at that time might even become 'on-peak', and all users would lose the off-peak benefit. In any case, why should electricity producers give the advantage of an artificially low price to the producer of a competing energy source for the ultimate consumer? After all, 'Heat your Home with Hydrogen' would be a catchy tag (and such a process would not be enormously more dangerous than using LPG or natural gas for the same purpose). The statement that it will be cheaper to produce hydrogen than liquid fuels from coal may also be true, but this gets us back to the storage problem mentioned above.

Finally, I wish to comment on the caption to one of the illustrations in the article: 'The exhaust of a hydrogen-powered vehicle is largely water. It has been said that it's clean enough to drink.' By the same token,

the exhaust of a (non-leaded) petrol-powered car would be largely soda-water — but would it be fit to drink? It's the small, not the large, that counts in such matters. Or are we to understand that no lubricant will get into the exhaust of a hydrogen-powered vehicle, or perhaps that it will not be lubricated? And are there no oxides of nitrogen produced in the combustion of hydrogen in air?

To be sure, we need to be investigating now possible alternatives for today's petroleum-based fuels, and hydrogen and its various possible sources represent one valid approach, but I am suspicious of the emotive appeal, 'it's clean enough to drink'.

The desiderata for new fuels include, I believe, renewable sources and, especially for vehicle propulsion, recognition of the convenience of liquids, both at points of supply and for carriage by the vehicle itself. I am aware, of course, that methanol and ethanol are both current subjects of study, partly, no doubt, for the above reasons, but I have often thought that serious consideration should be given to butan-1-ol: it may be obtained by fermentation from probably the same renewable sources as ethanol, but it is much less volatile (boiling point, 118°C), has a much higher flash point (115°C), is marginally denser, and has a distinctly higher heat of combustion (36 kilojoules per gram) than ethanol (30 kJ per g) or methanol (22 kJ per g). I realize that current petrol or diesel engines might not accept such a fuel without (perhaps substantial) modification, but that need not be an insuperable problem.

N.V. Riggs, Professor of Organic Chemistry, University of New England.

I would like to comment on three points raised by Professor Riggs. These relate to the safety of hydride storage tanks, the relative cost of hydrogen and petrol, and the pollution from hydrogen-fuelled vehicles.

The incendiary bullet experiments demonstrated a unique 'fail-safe' aspect of hydride storage tanks. The initial fire caused by the bullet was extinguished because the sudden reduction in hydrogen pressure rapidly cooled the alloy, inhibiting further release of the hydrogen.

The cost of hydrogen produced with off-peak power at current prices is about 25% less than petrol on an energy basis (assuming 3·15 cents per kWh for off-peak power, a cell voltage of 2·0, 46·8 cents per litre for petrol, and vehicle fuel consumption figures of 12 L per 100 km for petrol, and 40 km per kg for hydrogen). It is my personal view that off-peak power could be used to the mutual advantage of both user and supplier for applications such as battery charging and hydrogen generation without creating inverse peaks in the demand curve. At a time of rapidly increasing petrol costs — that is, 'right now' — surely this could not be more relevant.

Finally, there is general agreement that the use of hydrogen as a vehicle fuel results in greatly reduced exhaust pollution by comparison with petrol-driven vehicles (up to three orders of magnitude in some cases). Oxides of nitrogen are also less than those for petrol-fuelled vehicles and can be further reduced by water-injection. Perhaps the water from the exhaust really is fit to drink? But surely that is irrelevant.

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