LETTER TO THE EDITOR

Alan Bell
Medical Consultant,
Environmental and Occupational Health,
The Associated Octel Co Ltd

In the November 1993 edition of the *NSW Public Health Bulletin*, Corbett and Cowie referred to lead in petrol (Pb-P) and to children's blood lead (Pb-B) levels and recommended the increased use of unleaded petrol (ULP)[1]. When Pb-P is phased down the aromatic hydrocarbons in petrol are increased (Figure 4), resulting in higher air levels of carcinogenic benzene and other air toxics. In some countries this has increased the risks of leukaemias in the general community and occupationally. Therefore, it is not medically appropriate to consider lead only when changes are made to the composition of petrol.

Lead

The *Bulletin* article stated that from 1976 to 1990 in the US, Pb-P phasedown was "associated with a significant reduction" in mean Pb-B levels[1]. As shown in Figure 5, Pb-Bs in the US have been declining and continue to decline independently of the increased use of Pb-P[2]. After the UK phasedown from 0.4 grams/litre to 0.15 grams/litre, tests showed that, although a 63 per cent decline in air lead levels (Pb-A) reduced Pb-B levels in those living near major roads, the data suggest that dietary lead intake, rather than Pb-A or leaded dust, was the "major contributor" to Pb-B levels[3].

By 1988 Sydney's Pb-As (Figure 6) were below the National Health and Medical Research Council (NHMRC) recommendation[4] of 1.5 µg/m³.

Corbett and Cowie expressed concern about raised Pb-B levels[1]. They did not state that the average level in a 1993 survey of 252 Melbourne children was only 5.4 µg/dL[5]. Other recent studies[6,7], not involving contaminated soil, have reported Pb-B levels similar to Victoria[5].

Reference was made[1] to a review by the South Australian Health Commission, tabulating Pb-B levels from 1975-1990[8], and an estimate that "45 per cent of preschool children have Pb-B levels about 10 µg/dL"[9]. The commission referred to the limitations of its estimates and stressed the need for caution. The findings of the commission's review – in which more than two-thirds of the surveys were taken from industrial or contaminated sites[8] – are not applicable to current situations. When discussing the "IQ deficit" caused from Pb-B levels, the *Bulletin* article should have stated that Pb-B levels relate to group averages and therefore cannot be applied to individual Pb-B level[10].

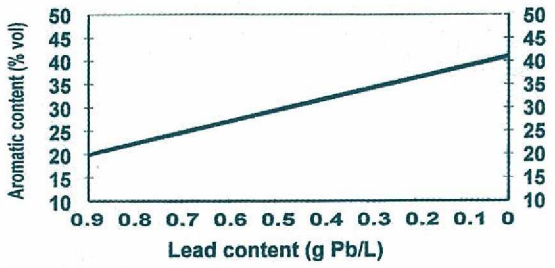
Corbett and Cowie stated that a NSW cost-benefit analysis was being prepared incorporating "loss of IQ"[1]. The US Environmental Protection Agency (EPA) 1989 statistical lead uptake model[11] used in many Australian calculations and cost-benefit analyses has been superseded[12]. The validity of Australian estimates[9] must be re-examined in light of this revision and should include estimates of petrol-related cancers. In California the cost per "case avoided ranges from $22 to $40 million"[13].

Aromatic hydrocarbons

As lead is phased down, aromatic hydrocarbons are usually increased[2]. During the combustion process benzene and other carcinogens are produced in the exhaust gases.

FIGURE 4

AUSTRALIAN REFINERIES
AROMATIC CONTENT INCREASES AS LEAD IS PHASED OUT



Source: Octel Gasoline Surveys 1974-1993

FIGURE 5

TRENDS IN LEAD IN BLOOD AND LEAD IN PETROL 1930-90

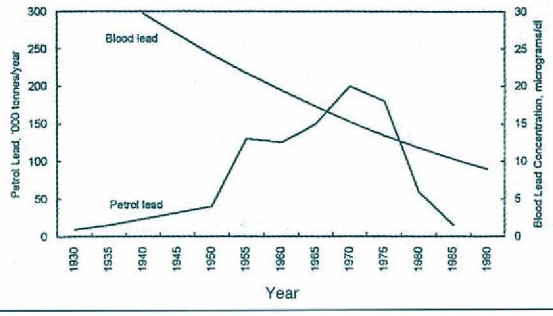
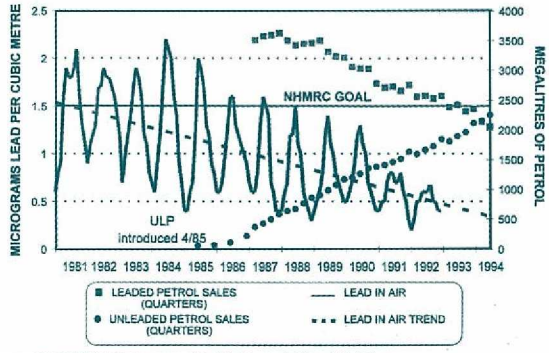


FIGURE 6

LEAD IN AIR TRENDS – SYDNEY SUBURBS (90 DAY AVERAGES)



Source: SPCC/NSW EPA Reports and ABARE Quarterly Mineral Statistics

Benzene does not have to be present in petrol for benzene to be produced[14]. Benzene, toluene and xylenes are carcinogenic[15]. In 1993 the NHMRC recommended that substantial octane enhancement of fuels should not be achieved by using carcinogenic additives[16].

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There are worrying reports about the possibilities of leukaemias in children partly related to travelling in cars[17], of breast cancers from aromatics[18,19] and, as estimated by an Italian Government committee, possibly large numbers of additional leukaemias and lung cancers[20]. There are American estimates of additional cancers from benzene and 1,3-butadiene from vehicle emissions[21]. Previous Australian occupational exposures to total hydrocarbons and benzene may have caused haematological malignancies[22].

Associated Octel commissioned a university to determine air levels of benzene and toluene in Sydney's Central Business District (CBD). The benzene results are shown in Table 4.

TABLE 4

BENZENE IN AIR (PARTS PER BILLION – PPB)

Period	Daily average	Peak	% of "time" ≥5
15/1/94 to 14/2/94	4.1	10.2	27
25/6/94 to 14/7/94	7.6	25.9	87

Toluene air levels were much higher[23].

A British expert panel recommended an air quality standard (running annual average) of 5 ppb of benzene which later should be reduced to 1 ppb[24]. Thus Sydney's CBD measurements should be cause for concern.

In 1994 the Federazione Nazionale Pro Natura requested the Commission of the European Communities (CEC) to initiate proceedings against the Italian Government which "encourages the use of high aromatic and unleaded fuels even in cars not equipped with catalysts", showing "a complete disregard for health". It also requested the CEC urgently "to authorise a temporary return to 0.3 g Pb/L maximum level for lead (in low-leaded petrol) in the event that this should be the only practical way to reduce the aromatic content of petrol below 30-32 per cent by weight, and to ban the use of unleaded petrol with a high aromatic content in cars"[25] with no catalysts.

As lead has been phased out, fuels have become more polluting[21]. The NRMA has stated that "if the oil industry cannot reduce lead without increasing benzene, the timing of this stage of the [phasedown] program should be reviewed"[26].

Because only 40 per cent of Australian vehicles have catalysts and because the annual level of benzene in air and some other carcinogens are not known, a moratorium on promoting unleaded petrol for pre-1986 cars should be implemented. At the current switch-over rates, the use of Pb-P will be eliminated by 2007.

Clearly, protecting health is not as simple as only taking the lead out of petrol.

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1. Corbett S, Cowie C. A Clever Country – The health benefits of removing lead from petrol. *NSW Public Health Bulletin* 1993; 4(11):121-122.
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AUTHORS' REPLY

Christine Cowie and Stephen Corbett
Environmental Health, Food and Nutrition Branch
NSW Health Department

We would like to offer the following comments in reply to Dr Bell's letter about our article[1] on lead in petrol.

Dr Bell correctly raises concerns about the possible health hazards of using benzene or other polycyclic aromatic

hydrocarbons (PAHs) as alternatives to lead in petrol. There is concern in Italy and in some other European countries that the use of these alternative octane boosters will increase ambient benzene levels and may lead to an increased incidence of some cancers, particularly leukaemia.

We believe that the reduction of lead in petrol in Europe is not directly comparable to the Australian situation. Dr Bell has ignored the issue of octane rating, which is critical to his debate. Octane rating is a measure of the compression of the petrol-air mixture in a car engine: a higher octane rating ensures higher compression and greater engine efficiency. Lead or aromatic compounds can be added to petrol to increase octane rating. In Australia, unleaded petrol has a specified Research Octane Number (RON) of 91 and leaded petrol has a RON of 97. In Europe the RON of unleaded petrol is 95 and 98.

In Europe the removal of lead from petrol was accompanied by the addition of benzene and other aromatic hydrocarbons to achieve the higher octane rating for unleaded petrol. Figure 4 in Dr Bell's letter illustrates the increase in the volume of aromatic compounds used when lead in petrol is reduced. This graph is not relevant in the Australian context. In Australia, we are seeking to lower lead in petrol while at the same time lowering octane demand, thereby avoiding the use of alternative additives to petrol. Figure 7, provided by the Australian Institute of Petroleum (AIP), indicates that aromatic and olefin (a hydrocarbon) content of unleaded petrol has, if anything, fallen slightly over the period 1992-1994.

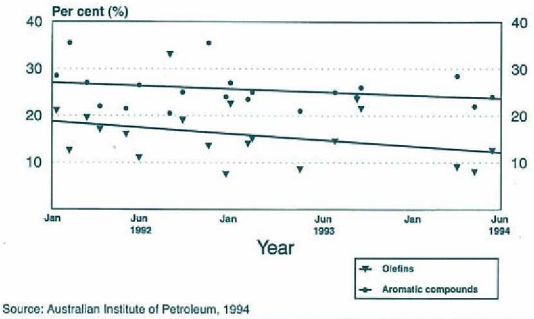
When the lead level in leaded petrol in NSW was reduced from 0.4 to 0.3 g/L in February 1994, octane rating was also decreased from 97 to 96 RON. Further reductions to lead in petrol to 0.02 g/L occurred in late 1994. Benzene content in petrol varies depending on the fuel batch, because of variations in the crude fuel stock and blending compositions. However, the AIP[2] advises that there will be little or no noticeable increase in benzene content of petrol with lead at 0.2 g/L. Reducing the lead in petrol while maintaining octane rating requires changes to refinery operations which can be achieved at cost to the refinery. One Australian refinery has been able to produce petrol with a lead content of 0.15 g/L by improving its refining technologies[3].

In Australia the average level of benzene in both leaded petrol (LP) and unleaded petrol (ULP) is between 2.6 per cent and 2.8 per cent[2]. Although premium unleaded petrol (PULP) has a much higher benzene content (4 per cent) than ULP or LP, the large price differential (PULP costs up to 8-15 cents/litre more) ensures there is little incentive to use PULP in pre-catalyst vehicles. This is reflected in the very small proportion (1 per cent) that PULP contributes to total sales of petrol in Australia. Furthermore, spot measurements of petrol taken by Octel indicate that the total aromatic contents of LP (20-33 per cent) and ULP (24-34 per cent) are similar[4].

Overseas experts have claimed[5] that ULP should not be used in cars without catalytic converters. Dr Bell has upheld this claim in his letter. In Europe ULP with a much higher aromatic content was introduced without the requirement for catalytic converters. In Australia, the introduction of ULP in 1986 was accompanied by the requirement for all new vehicles to be fitted with emission reduction equipment. Vehicle manufacturers achieved this by the use of catalytic converters.

FIGURE 7

OLEFIN AND AROMATIC CONTENT OF ULP FROM NSW REFINERIES



Source: Australian Institute of Petroleum, 1994

For the above reasons and because aromatic contents of LP and ULP are similar, a switch-over to ULP for the pre-1986 vehicles which can operate on ULP is not expected to increase emissions of benzene or other aromatics in Australia, irrespective of the presence or absence of a catalytic converter.

There has been limited air monitoring of ambient benzene levels in Sydney. The levels quoted by Dr Bell are based on a limited number of samples collected from George Street, one of Sydney CBD's busiest streets. The NSW Environment Protection Authority will shortly begin a pilot air toxics monitoring program including benzene and other volatile organic compounds. Preliminary monitoring by the EPA has shown that ambient benzene levels are unlikely to be above 1 part per billion in most of metropolitan Sydney.

Benzene is an acknowledged cause of leukaemia. Although exposure to ambient benzene levels is hypothesised to be associated with increased levels of childhood leukaemia, further sophisticated studies are required to determine whether this association is causal.

Dr Bell challenges the information provided in our article which discusses comparative rates of decline of lead in petrol in the US and Australia and the mean blood lead in the US population. Figure 5 in Dr Bell's article is very misleading. The repeated surveys on which it is based are a mixture of occupational and population groups and are not comparable. The National Health & Nutrition Examination Surveys (NHANES) data which we quoted were based on repeated random surveys.

There have been drastic decreases in blood lead in the US[6]. Data from the US indicate there was a decrease of 77 per cent in blood lead levels of non-Hispanic white children aged 1-5 years from 13.7 µg/dL in 1976 to about 3.2 µg/dL in 1991; and a 72 per cent decrease in blood lead levels of non-Hispanic black children from 20.2 to 5.6 µg/dL. The change

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was attributed to the removal of 99.8 per cent of lead from fuel and the removal of lead from soldered cans.

There is little doubt that blood lead levels have been decreasing over the past few decades. This is due to the significant decline of lead in food through the virtual elimination of lead soldered cans, decreasing air lead levels, and the banning of lead-based paint.

The association of blood lead with decreasing cognitive development has been measured on a population basis. Although the effect of an average loss of 2-3 IQ points may be difficult to detect in an individual, its consequence on the general child population is considered to be significant. The proportion of children with very high IQs will fall, while the proportion of children with low IQs requiring remedial teaching will increase.

Dr Bell asserts that the review of blood lead data made by the South Australian Health Commission[7] stressed the need for caution in interpretation of its results. In our article we agreed that the prevalence of children with blood lead levels above 10 µg/dL was likely to be lower than 45 per cent. Recent NSW studies of children living in non-point source areas have found slightly higher mean blood lead levels: 7.5 µg/dL in Eastern Sydney[8] with 12.6 per cent above 10 µg/dL, and a mean of 11.4 µg/dL in the inner western suburbs of Sydney[9] with about 50 per cent of children with a blood lead level above 10 µg/dL. An opportunistic survey[10] of blood lead levels in a paediatric population in Newcastle found a mean blood lead level of 5.9 µg/dL, with blood lead levels 1.4 µg/dL higher in the inner city compared with non-metropolitan areas.

Despite the fall in blood lead levels, recent surveys indicate there is still a significant number of children with blood lead levels above the national goal for blood lead of 10 µg/dL. US data indicate that even further reductions in blood lead can be achieved. This is important as there is yet no evidence of a threshold level of lead below which no effects occur.

We maintain that it would be irresponsible to allow continued dispersion of lead from a known source, while alternatives are available. However, if it is decided that additives to petrol other than lead are required to sustain octane demand, we strongly echo the NHMRC's statement that "such enhancement should not be achieved by the use of known carcinogenic additives"[11].

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2. Australian Institute of Petroleum. Petroleum topics – Benzene in petrol. August 1994.
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4. Perreau W, Gidlow DA, Larbey RJ. A summary of Octel's response to the proposals of the Federal and New South Wales governments. Associated Octel Company Ltd. June 11, 1993.
5. Green petrol a hazard to health. *New Scientist*, November 1993.
6. Pirkle JL, Brody DJ, Gunter EW et al. The decline in blood lead levels in the United States: The National Health and Nutrition Examination Surveys (NHANES). *JAMA* 1994; 272(4):284-291.
7. Edwards-Bert P et al. National review of public exposure of lead in Australia. South Australian Health Commission, 1993.
8. Cowie C, Black D, Ferson M et al. Blood lead levels in 1-4-year-old children attending child care centres in the Eastern Sydney Area. Abstract at the Second NSW Public Health Network Conference, March 29-30, 1994.
9. Fett MJ, Mira M, Smith J et al. Community prevalence survey of children's blood lead levels and environmental lead contamination in inner Sydney. *Med J Aust* 1992; 157:441-445.
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TABLE 5

Public Health Unit	Director	Telephone	Facsimile	Street Address	Postal Address
Central Coast	Dr Peter Lewis	043 20 4545	043 20 4550	"Birralee", Wyoming Hospital Cnr Pacific Highway and Kinarra Avenue Wyoming NSW 2250	"Birralee" PO Box 172W Gosford NSW 2250
Central Sydney	Dr Mark Bek (Acting Director)	02 550 6810	02 565 1690	Level 6 West Queen Mary Building Grose Street Camperdown NSW 2050	PO Box 374 Camperdown NSW 2050
Southern Sydney	Dr Jeremy McAnulty	02 350 3377	02 350 3474	Level 1, James Laws House St George Hospital Kogarah NSW 2217	PO Box 482 Kogarah NSW 2217
Central Western	Dr Dan Russell	063 32 8505	063 32 8577	Webb's Chambers, 175 George Street Bathurst NSW 2795	PO Box 143 Bathurst NSW 2795
Eastern Sydney	Dr Mark Ferson	02 313 8322	02 313 6291	Royal South Sydney Hospital Ground Floor, Esme Cahill Building Joynton Avenue Zetland NSW 2017	Locked Bag 88 Randwick NSW 2031
Hunter	Dr John Stephenson	049 29 1292	049 29 4037	Irene Hall Pacific Highway Newcastle NSW 2300	PO Box 11A Newcastle NSW 2300
Illawarra	Dr Victoria Westley-Wise (Acting)	042 26 4677	042 26 4917	18 Madoline Street Gwynneville NSW 2500	PO Box 66 Keiraville NSW 2500
Northern Districts	Ms Christine Robertson (Acting)	067 66 2288	067 66 3003	Suite 7, Second Floor, Parry Shire Building 470 Peel Street Tamworth NSW 2340	PO Box 597 Tamworth NSW 2340
North Coast	Dr John Beard	066 21 7231	066 22 2151	No. 31 Uralba Street Lismore NSW 2480	PO Box 498 Lismore NSW 2480
Northern Sydney	Dr Don Holt	02 477 9400	02 482 1650	c/- Hornsby Ku-ring-gai Hospital Palmerston Road Hornsby NSW 2077	Same as street address
Western NSW	Dr Michael Douglas	068 81 2235	068 84 7223	62 Windsor Parade Dubbo NSW 2830	PO Box M61 East Dubbo 2830
South Eastern	Dr Paul Van Buynder	048 27 3432	048 27 3438	Kenmore Hospital, Taralga Road Goulburn NSW 2580	PO Box 300 Goulburn NSW 2580
South West	Mr Tony Kolbe	060 23 0350	060 23 0168	475 Townsend Street Albury NSW 2640	PO Box 503 Albury NSW 2640
South Western Sydney	Dr Greg Stewart	02 828 5944	02 828 5955	Hugh Jardine Building c/- Liverpool Hospital Liverpool NSW 2170	Private Bag 17 Liverpool NSW 2170
Western Sydney and Wentworth	Dr Anthony Capon	02 840 3603	02 840 3608	13 New Street North Parramatta NSW 2151	Same as street address