CORRESPONDENCE

Tanks are unsafe

SIR — The discussion about the effectiveness of "enhanced radiation weapons" (ERWs) against vehicles such as tanks brought up the question of whether advanced radiation shields in the armour of tanks could substantially improve the protection factor[1,2] against radiation from ERWs.

Tables 1–3 give the results of a series of shielding calculations. Based on the methods used in ref. 3 (for example, the use of code ANISN), we assumed an explosion height of 500 m.

Three different shields have been proposed[1] incorporating a strong neutron poison into the sandwich structure of the armour of modern tanks. Each shield is based on a layer of a strong neutron absorber (B_{nat} and ^6Li), and they differ only by the amount of neutron absorber present in the shield (0.1 cm B, 0.5 cm B and 1 cm $^6Li_2O$).

Total shielding is defined by:

$$C_{tot} = \frac{(D_n + D_\gamma)_F}{(D_n + D_\gamma)_B}$$

where D_n and D_γ are the neutron and gamma radiation dose rates in rads and subscript F refers to the layer in front of the shield and B, that behind the corresponding layer. Neutron and gamma shielding are defined by:

$$C_n = \frac{(D_n)_F}{(D_n)_B} \quad \text{and} \quad C_\gamma = \frac{(D_\gamma)_F}{(D_\gamma)_B}$$

The tables clearly show that the neutron radiation determines the total radiation dose in all cases.

To determine what effect various cross section libraries have on the shielding factors, three different cross section libraries were used (ENDFB IV, VITAMIN C and LASL), and the differences were insignificant (Table 1).

The total protection factors of the classical armour of tanks (about 10 cm steel wall) lay in the range 2–2.5, and the relatively complicated and heavy shields considered here exhibit a total protection factor between 6 and 7. Even for a 1-cm thick $^6Li_2$ layer, the shielding factor does not increase substantially. The physical reason is, of course, that the neutron spectrum is too broad to make the neutron poison an effective absorber in all energy levels.

Thus still more moderator material would be necessary to guarantee a sufficiently high protection factor. The protection factor should be of the order of magnitude of 1,000 to reduce a dose of 20,000–30,000 rads to a few tens of rads. This dose could be survived without the biological and psychological effects of a radiation illness.

Water is a cheap and practical shield material for protection against radiation from ERWs. Assuming an explosion height of 500–1,000 m, the half-value thickness of water is about 15 cm and a very thick water shield would be needed for the required protection factor.

In conclusion, it seems impossible to design a practical shield for manoeuvrable tanks with a sufficiently high protection factor — such a shield would be too heavy. This confirms our previous findings[3] that protection against radiation from an enhanced neutron weapon is much easier (and cheaper) for the civilian population than for tank crews.

W. SEIFRITZ
P. KÖHLER
J. STEPANEK

Swiss Federal Institute for Reactor Research, Würenlingen, Switzerland

1. Baruch, J.E.F. *Nature* **292**, 792 (1981).
2. Gsponer, A. *La Bombe à Neutrons est-elle une arme antichar vraiement efficace?* (Geneva Internation Peace Research Institute, GIPRI-82-05, 28 February 1982).
3. Köhler, P., Seifritz, W. & Stepanek, J. Protection against Enhanced Radiation Weapons in *Atomkernenergie* (in the press).

Table 1 Neutron-, gamma- and total shielding factors of a 0.1-cm boron-containing shield

Material sequence of shield	C_n			C_γ			C_{tot}			D_n/D_γ		
	A	B	C	A	B	C	A	B	C	A	B	C
500 m air	1	1	1	1	1	1	1	1	1	7.72	7.38	6.23
5 cm steel	1.94	1.93	1.94	1.27	1.35	1.31	1.83	1.84	1.81	6.03	5.15	4.21
10 cm water	6.05	6.16	6.17	1.87	1.96	1.99	4.82	4.91	4.78	2.38	2.35	2.00
0.1 cm boron	6.15	6.35	6.37	1.91	2.01	2.03	4.91	5.05	4.92	2.4	2.33	1.99
1 cm lead	6.53	6.75	6.75	3.83	4.11	4.01	6.04	6.27	6.17	4.52	4.5	3.7

Values assume an ERW explosion at a height of 500 m. Three different cross section libraries were used in the calculations (A, ENDFB IV; B, VITAMIN C: C, LASL). The last column gives the neutron- to gamma dose ratios at the various positions within the shield.

Table 2 Neutron-, gamma- and total shielding factors of a 0.5-cm boron-containing shield

Material sequence of shield	C_n	C_γ	C_{tot}	D_n/D_γ
500 m air	1	1	1	7.39
5 cm steel	1.94	1.35	1.84	5.16
10 cm water	6.20	1.96	4.93	2.33
0.5 cm boron	6.53	2.17	5.27	2.46
1 cm lead	7.03	4.30	6.53	4.52

Values assume an ERW explosion height of 500 m. VITAMIN C nuclear cross sections were used. The last column gives the neutron- to gamma dose ratios of the various positions within the shield.

Table 3 Neutron-, gamma- and total shielding factors of ^{6}Li-containing shield

Material sequence of shield	C_n	C_γ	C_{tot}	D_n/D_γ
500 m air	1	1	1	7.39
5 cm steel	1.94	1.37	1.85	5.24
10 cm water	6.28	2.21	5.15	2.6
1 cm $^6Li_2O$	6.77	2.48	5.61	2.71
1 cm lead	7.29	4.47	6.78	4.54

Values assume an ERW explosion height of 500 m. VITAMIN C nuclear cross sections were used. The last column gives the neutron- to gamma dose ratios at the various positions within the shield.

Falling stock

SIR *Nature* has decided to apply one of its news pages to a biotechnology stock report (*Nature* 12 August, p.599). As a financial analyst who specializes in biotechnology, I must question the need for printing information such as this in a professional journal of science. It would be rather like a drug stock index in *The Lancet*. In addition, I find the selection of stocks arbitrary. Collagen Corporation is a superior company and a good investment, but what does conversion of two cowhides per month into pure, injectible collagen have to do with "biotechnology?" And in the chauvinism department, why exclude such Japanese Corporations as Ajinomoto, Kyowa Hakko and Green Cross? More seriously, the stock index is so heavily weighted by Novo Industri A/S and AB Fortia, two Scandinavian companies, that perhaps you could perhaps call it the "*Nature* ScandIndex".

SCOTT R. KING

Brooklyn, New York, USA

Polish defection

SIR — The article "Norway's Arctic diplomatic fix" (*Nature* 9 September, p.97) grossly misrepresents the development in connection with the defection of two members of the Polish geophysical station in Svalbard in August 1982.

According to a report to the local newspaper in Svalbard, the "*Sysselmannen*" — governor of Svalbard — sent a helicopter to the station on 3 August to collect a station member who had asked for political asylum in Norway. On 10 August another member defected. There was no "race" between Norwegian and Soviet helicopters, and no intervention by Soviet helicopter crews or by the Soviet authorities in Barentsburg in order to prevent the defections.

Since the article also refers to the duties of our institute in relation to foreign expeditions, we would like to point out that it provides information on the scientific activity in Norwegian Polar areas and also on governmental laws and regulations, but has no obligation to give free access to its scientific material. In due time, the data are published in our own scientific series, a monograph series, *Skrifter*, and a bulletin, *Polar Research*, or in international periodicals.

TORE GJELSVIK
(Director)

Norwegian Polar Research Institute, Oslo, Norway