Halogen lamp carcinogenicity

SIR — The risk of indoor pollution by chemicals and radionuclides is much in the news. Less attention is paid to hazards associated with exposure to harmful ultraviolet radiations emitted by certain illumination systems, which are used more and more extensively in the workplace and at home. The potent genotoxicity of the light emitted by uncovered quartz halogen lamps was demonstrated recently both by using a mutagenicity test in *his⁻ Salmonella typhimurium*[1] and a DNA repair test in *Escherichia coli*.[2] At variance with solar irradiation, exerting mutagenic effects over a broad ultraviolet range, and with fluorescent light, delivering mainly ultraviolet B emissions, the mutagenicity of halogen lamps is due to far-ultraviolet wavelengths[1]. Moreover, the spectrum of sensitivity of *E. coli* strains lacking DNA repair mechanisms is similar for halogen lamps and a monochromatic ultraviolet (254 nm) source[2]. We observed some residual mutagenicity even after filtering both natural and artificial light through various cloths, but mutagenicity was prevented by glass and plastic covers.

These findings prompted us to investigate the carcinogenicity of halogen lamps using animal models. We recently started a large study, using MF1 and SKH-1 hairless mice, after completing a pilot study with SKH-1 adult mice in which four control mice were kept under natural light–dark cycle. Four mice were exposed 12 h per day at 50 cm distance from a 12 V, 50 W uncovered halogen quartz lamp equipped with a dichroic mirror, accounting for an illuminance of 10,000 lux. Under these conditions a mutagenic response was induced in *S. typhimurium* in less than 1 min. A further group of four mice was exposed to the same lamp, but a 2-mm-thick transparent glass sheet, totally preventing genotoxic effects, was interposed close to the lamp. After 12 months, the appearance of these mice and of the four controls was normal. By contrast, all four animals exposed to the uncovered lamp started to develop skin lesions, the earliest appearing after 3–4 months and growing in size and number, up to 15–20 per animal, until overlapping and covering large portions of the regions of skin directly exposed to the light. Skin tumours of up to 3 cm in diameter were detected. Histological analysis revealed the presence in all four animals of relatively benign forms, such as papillomas and appendage/basal tumours, as well as atypical squamous cell proliferation of increasing malignancy — keratoacanthoma-like tumours, carcinomas *in situ* and squamocellular carcinomas (P. Fiallo, personal communication).

Although based on only 12 animals, the results obtained in our pilot study are striking and fully confirm the expectations of *in vitro* genotoxicity studies. Extrapolation of animal data to humans is not straightforward. Nevertheless, the illumination doses and times in our study, although high, are not so far from the levels to which some people are exposed, particularly in the workplace.

Note that the aforementioned genotoxicity data, as well as physical measurements[1], provide evidence for the emission by halogen lamps of far-ultraviolet radiation, which is likely to be the range of wavelength inducing melanoma[3]. It is also important that the light emitted by halogen lamps is much more genotoxic than sunlight[1,2], which is well known to contribute to cancer prevalence and mortality in humans[4], and than fluorescent light, whose carcinogenicity is under debate[5]. Luckily, prevention is simple. Suitable glass or plastic covers, already used in some commercially available models, should be made compulsory for all new halogen lamps, and should be installed on all lamps already in use.

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Li in V404 Cygni

SIR — Casares *et al.* report[1] that the X-ray transient GS2023+338, which has been identified with V404 Cygni, must have a mass of at least 6.26 ± 0.31 solar masses and hence is likely to be a black hole. They report that the spectrum of the companion, from whose orbit they derive minimum masses, may be either that of a G9 (± 1)V dwarf star or of a K0 (± 4)III giant star. The nature of the companion may be used to establish the distance to the system and hence the X-ray luminosity during the outburst. Figure 2 of ref. 1 indicates that the companion may show the Li I resonance line at 6,707.8 Å. If that identification is correct, the cool star is most likely to be a young dwarf such as that found in the Pleiades[2,3], rather than a K giant. The V404 Cyg system is then 10× closer than the model favoured in ref. 1, relieving the problem of a fantastically large X-ray luminosity at outburst.

To establish the wavelength of the possible lithium line, we have measured all the prominent dips in the spectrum of V404 Cyg as displayed by Casares *et al.*[1] with a transparent ruler. The wavelengths, solar wavelengths[4] and displacements are shown in the table. For blended lines, the solar wavelength is a mean weighted by the equivalent width. The mean of all $\Delta\lambda$s of identifiable lines is 1.91 ± 0.48 Å (mean error, m.e.), and the mean $\Delta\lambda$ of the seven lines between 6,630 and 6,730 Å (hence closest to the Li I line) is 1.85 ± 0.37 Å (m.e.). Using these values to correct the measured wavelength of 6,706.1 Å yields 6,708.01 or 6,707.95 Å, which are within 1 m.e. of the intrinsic wavelength of the Li I blend, 6,707.83 (assuming no ^{8}Li to be present and the ^{7}Li lines to be saturated). A similar set of measurements of

WAVELENGTH MEASUREMENTS OF V404 CYGNI

λ_{V404}	$\lambda_\odot$	$\Delta\lambda$	λ_{V404}	$\lambda_\odot$	$\Delta\lambda$
6,352.7	6,355.03	2.33	6,506.8	?	—
63.6	b1	—	14.1	?	—
68.1	?	—	16.8	18.37	1.57
90.7	93.61	2.91	90.7	92.93	2.23
97.5	6,400.00	2.50	95.6	97.87	2.27
6,406.3	08.03	2.00	6,606.8	6,609.12	2.32
10.0	11.66	1.66	10.9	?	—
20.0	20.75	0.75	15.4	?	—
29.0	30.86	1.86	22.7	?	—
37.9	39.08	1.18	32.0	33.76	1.76
48.4	49.82	1.42	42.0	43.64	1.64
53.4	55.60	2.20	51.2	?	—
60.7	62.60	1.90	61.8	63.40	1.60
69.5	71.67	2.17	76.3	78.00	1.70
74.3	75.63	1.33	6,701.8	6,703.58	1.78
80.0	82.18	2.18	06.1	—	—
92.9	94.49	1.59	15.9	17.69	1.79
6,497.7	b1	—	24.0	26.67	2.67
			6,736.8	?	—

Values from Fig. 2 of ref. 1. Numbers in Å. $\lambda_\odot$ is the solar wavelength.