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# Journal of Environmental Health Research

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*Volume 4 • Issue 1 • 2005*

# Journal of Environmental Health Research

ISSN: 14760932

## Aims and Scope

The Journal of Environmental Health Research is a peer reviewed journal published in three formats; Printed Full Journal, Printed Abstracts and Electronic Journal.

The Journal publishes original research papers, review articles, technical notes and professional evaluations covering the diverse range of topics which impinge on environmental health including; occupational health and safety, environmental protection, health promotion, housing and health, public health and epidemiology, environmental health education, food safety, environmental health management and policy, environmental health law and practice, sustainability and methodological issues arising from the design and conduct of studies.

The Journal provides a communications link between the diverse research communities, practitioners and managers in the field of environmental health and aims to promote research and knowledge awareness of practice-based issues and to highlight the importance of continuing research in environmental health issues.

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E-mail: [publications@chgl.com](mailto:publications@chgl.com). Web: [www.chgl.com](http://www.chgl.com).

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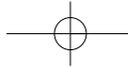
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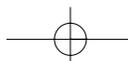
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*Journal of Environmental Health Research, Volume 4, Issue 1, 2005*





**Editors: Harold Harvey (left) and Paul Fleming**

## EDITORIAL

### Issue 4(1)

In our opinion the importance of research in environmental health cannot be over-emphasised - you would expect this from the editors of this Journal! It is very helpful, and indeed gratifying, for leading organisations to make the same point. Thus the reference in the European Commissions 'European Environmental and Health Action Plan 2004 - 2010' is welcome, "Research is crucially important in establishing the knowledge base and providing concrete measures by which European environment and health research results will be fed into policy-making, for analyzing and filling the gaps in European environment and health activities." With this statement, as part of the action plan, comes another rather important consideration if quality research is to be carried out - funding. We encourage academics, professionals and organisations to submit research proposals to the EU through the Public Health Programme and the Sixth Framework Programme for Research. In a later edition of the Journal we hope to include a paper on writing proposals for funding.

A significant proportion of the activities of environmental health departments in the UK is regulatory enforcement. In this issue of the Journal we include two papers on this theme. A leading environmental health academic, author and magistrate, Terry Moran, examines the key factors influencing magistrates when hearing environmental cases. The author challenges the commonly held opinion of the regulators, that it is the magistrates' court that has failed when there is a failure to hand out a sufficiently harsh deterrent sentence. Paul Lehane, a London based EHP, reviews the law surrounding what he refers to as body art. The act of piercing another person's body in the guise of fashion, beauty or for ritual purposes can give rise to a range of physical injuries that could constitute a serious offence under UK law. The paper examines and interprets the basic elements of common and statute law relating to physical and sexual assault in the context of the practice of body art.

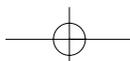
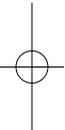
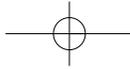
The other papers deal with issues within the core environmental health subjects of housing, food safety and environmental protection. Each paper helps to fill a gap in our knowledge and, hopefully, will feed into the policy making process and contribute to the improvement of environment and health control measures.

Carol Phillips, Professor of Microbiology, and Paul Bates contribute to the on-going research into the control of *Campylobacter*. They report on a study which investigates the effects of effluent from three potential sources - an abattoir, a cattle market and farmland grazed by cattle with nearby poultry farm - on the levels of *Campylobacter* spp. in a river.

Cheong and Neumeister-Kemp, researchers based at Murdoch University in Australia, consider the potential of high efficiency HEPA vacuuming to reduce airborne indoor fungi and fine particulates in carpeted homes. Monitoring was conducted with N-6 Andersen samplers for viable airborne fungi and cultures incubated, counted and differentiated. Outdoor samples were concurrently collected for comparison with indoor levels.

At a time of considerable debate about passive smoking and smoke-free environments Graham Perry, a Community Health Coordinator with a local health board, reports on his study which provides measures of local smoking status and exposure to ETS amongst adolescents in Wales.

**Harold Harvey and Paul Fleming (Editors)**



# Reducing airborne indoor fungi and fine particulates in carpeted Australian homes using intensive, high efficiency HEPA vacuuming

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## Abstract

The recent introduction of new vacuum cleaning technologies and systems is largely due to heightened awareness of the health effects associated with particulate matter, bacteria and fungi on interior flooring. Health effects and symptoms such as asthma, respiratory illness and skin irritations have been shown in a number of studies to be associated with airborne particulates and microbiological concentrations in indoor environments. This study investigates the influence of intensive, high efficiency HEPA vacuuming on indoor fine particulates and fungal levels and composition in non-complaint and non-mould contaminated Australian residential environments.

Baseline monitoring for airborne fungi and other air quality parameters was conducted before and after the cleaning interventions in six test and five control homes. Monitoring was conducted with N-6 Andersen samplers for viable airborne fungi for two minutes at a flow rate of 28.3 L/min. Cultures were then incubated, counted and differentiated. Outdoor samples were concurrently collected for comparison with indoor levels.

Results post-intervention show an initial increase in indoor fungal levels in the vacuum homes. The higher fungal levels and fungal genera isolated during the first vacuuming period are due to the initial loadings present in the carpet in addition to the increased activity and intensive mechanical action (rotating brush) of the vacuuming cleaning process, stirring up and resuspending dust and particulates from deep within the carpet. Subsequent vacuuming intervention periods recorded reductions in indoor fungal levels in the vacuum homes, whereas levels in the control homes were wide-ranging. The indoor fungal composition in the vacuum homes remained similar, both before and during the vacuum intervention periods with *Cladosporium* and *Penicillium*, the two dominant fungal species isolated.

Airborne indoor fine particulates in the vacuum homes were consistently lower following the vacuum interventions compared to the control homes. The

study showed that regular maintenance of carpets using high efficiency vacuuming could help in reducing airborne fine particulate levels and maintain a stable fungal spora within the indoor environment.

**Keywords:** Activity sampling, carpet, cleaning, fine particulates, HEPA, high efficiency, homes, indoor fungi, residential, vacuuming.

## Introduction

The management of cleaning maintenance and the quality of indoor air are vitally important and necessary, in order to protect both human health and the materials and equipment in the indoor environment. Cleaning and the management of cleaning maintenance is the final defence in managing indoor environmental quality (ACGIH, 1999). In the past 5-10 years, there has been heightened public awareness and interest in the health effects associated with particulate matter, bacteria and fungi present in carpets and on interior flooring of residential homes and commercial buildings. This has led to increasing research into new vacuum cleaning technologies and systems.

Contamination from indoor sources and the ensuing dispersal of airborne particulates and fungi either in the workplace or living quarters often leads to a loss of productivity and severe health effects and symptoms. It is estimated that of the 760 million cases of respiratory diseases reported annually, 20-30% may be affected by suspended particulate matter (White & Dingle, 2002; Schwela, 2000; WHO, 1997). Strong links between dust and health symptoms have been found in a number of scientific studies (Gyntelberg *et al.*, 1994; Kildeso *et al.*, 1998 & 1999; Jones, 1999).

Short-term health effects from particulate matter include skin, eye, nose and throat irritations and upper respiratory infections including bronchitis and pneumonia. Other symptoms may include headache, nausea and allergic reactions (Hansen & Burroughs, 1999; US Institute of Medicine, 2000). Particulate inhalation can further aggravate prevailing symptoms,

particularly in individuals with existing medical conditions and are immunosuppressed (Arden, 1991; American Lung Association, 1994; Etkin, 1994).

The degree to which indoor particulate matter translates to short or long term health effects is dependent on the size and concentration of the particles, the duration of exposure and the pre-existing health and condition of the exposed individual (Etkin, 1994). Of greatest health significance are the fine particulates that are small enough to be inhaled into the deepest parts of the lungs. These fine particulates are generally less than 2.5 microns in diameter and are less affected by gravitational settling and can stay suspended in the air for longer periods of time, increasing the possibility of inhalation. These fine particulates can cause damage at the cellular level by bypassing the body's respiratory system defence mechanisms (Amman *et al.*, 1986). Increased particulate levels are associated with increased mortality with ultra fine particulates being of greatest health concern (Creason, 2001; Smith, 2000; Hansen & Burroughs, 1999; US Institute of Medicine, 2000).

Despite the increasing scientific knowledge and growing awareness of the known health consequences of fine particulates, there are no set guidelines or standards for fine particulate exposure for indoor air in Australia or overseas, with little research conducted on fine particulate levels found in Australian indoor environments, particularly homes (White & Dingle, 2002). For outdoor air, the national (NEPM) PM<sub>10</sub> annual ambient average standard is 50  $\mu\text{g m}^{-3}$  (Ayers *et al.*, 1999). The US EPA has set ambient annual average PM<sub>10</sub> and PM<sub>2.5</sub> standards at 50  $\mu\text{g m}^{-3}$  and 15  $\mu\text{g m}^{-3}$  respectively. The 24-hour PM<sub>10</sub> and PM<sub>2.5</sub> standard is 150  $\mu\text{g m}^{-3}$  and 65  $\mu\text{g m}^{-3}$  respectively (USEPA, 1997).

Dust particulates can be contaminated by biological, physical and chemical sources with toxic and allergenic properties. Physical contaminants of dust include heavy metals, mineral particulates, synthetic and natural fibres (Etkin, 1994). Biological contaminants of dust include pollen, fungi, bacteria, viruses, animal dander and epithelial cells (Leese *et al.*, 1997).

Scientific research studies have increasingly linked indoor air quality (IAQ) problems and indoor fungi with major respiratory health effects such as asthma, hypersensitivity, allergies, infections, sick building syndrome, respiratory and skin irritations (Husman 2000; Garrett *et al.*, 1998; ACGIH, 1999; Wallace, 1996; Miller, 1992; Stetzenbach, 1997).

Fungi are ubiquitous and are transported from outdoor sources into the building envelope and indoor environment through a variety of means, including by adherence to human skin, clothes, shoes, pets and directly conveyed into the indoor environment or via airborne transport of spores by means of ventilation or open doors and windows. Allowing fungi to build up indoors, particularly in bedrooms, is undesirable and should be prevented in order to reduce potential health

effects (ACGIH, 1999; Schober, 1991; Solomon, 1976).

Studies have shown that proper cleaning and maintenance can reduce the various components of dust, including fungi and reduce the concentration on surfaces including floors and the levels of airborne dust if the cleaning is of a high standard (Frank *et al.*, 1997). Furthermore, the appropriate cleaning maintenance can make a significant contribution to healthy indoor air quality (Ragsdale *et al.*, 1995). Little research has been conducted on the effects cleaning has on indoor air contamination which is required to ensure the indoor environment has a high standard of air quality for human health (Walinder *et al.*, 1999).

A rigorous cleaning program aimed at preventing the build up of fungi and fine particulates present in carpets and indoor flooring is one such approach in reducing levels. Studies investigating the effectiveness of vacuuming have found that it can significantly improve indoor environmental quality by reducing the concentration of lead-containing dust, allergens, or other hazardous particulate materials on surfaces (Lioy *et al.*, 1998; Rhoads *et al.*, 1999; Hegarty *et al.*, 1995). This study focuses on an intensive, high efficiency HEPA vacuuming regime as a cleaning intervention and its effect on the level of airborne fine particulates and the level and species range of viable airborne fungi in residential carpeted environments in Perth, Western Australia.

## Carpets

Numerous studies have compared the benefits and disadvantages of carpets versus hard surface flooring. Carpets can be a reservoir for bacteria, fungi and other microorganisms (Shaughnessy *et al.*, 2002; Wickman *et al.*, 1992). Studies by Warner (1999) and Bahir *et al.* (1997) concluded that there were significant clinical benefits for allergy sufferers in the removal of carpets. Dybendal *et al.* (1991) found that carpets can store vast amounts of particulate matter and accumulate more dust, proteins and allergens per unit area than smooth hard floors. Foarde and Berry (2004) found that airborne biocontaminants concentrations were as much as three times higher over hard surface floors than over carpeted floors. Willie (1974) observed that it required approximately 10 times the air velocity to resuspend a settled particle from a carpeted surface versus a hard surface flooring.

Carpets fulfil many important health and social functions, acting as a buffer, sink and filter for a variety of potential pollutants from tracked in soil, settled dust, spills and adsorbed chemicals. As a high surface area substrate, carpets can have a positive effect by effectively reducing the airborne levels of many of these pollutants (Berry, 1993, 1994; Cole *et al.*, 1992). Carpets are also a low emitter of volatile organic compounds with a relatively rapid decay (Black *et al.*, 1993; Hodgson *et al.*, 1992). Carpets also suppress dust and noise, thus helping maintain a comfortable

indoor climate in buildings and homes (Berry, 1993, 1994; Schroder, 1990).

The critical factor however, is regular maintenance. It is essential that carpets be well maintained and cleaned to extract and remove trapped pollutants, thus minimising their opportunity to become resuspended (White, et al., 2002; Hedge, 2001; Kemp *et al.*, 1998; Berry, 1993; Dybendal *et al.*, 1991; Hunter *et al.*, 1988). If loadings of biocontaminants are allowed to build up until the carpet is no longer a sink, the carpet itself becomes a source of contamination, contributing to various respiratory illnesses and symptoms (Cole *et al.*, 1994; Norback *et al.*, 1994).

## Vacuum cleaning

Scientific studies have shown that ordinary household activities, from dusting and vacuuming to dancing, floor cleaning, bed making or even simply walking over carpeted or hard floor areas, could result in an increase in airborne particulates including fungi (Ferro *et al.*, 2002; Long *et al.*, 2000; CMHC, 1999; Franke *et al.*, 1997; Lehtonen *et al.*, 1993). The use of vacuum cleaners for cleaning and maintenance is synonymous with 20th century household chores. It is estimated that in the United States, 60% of the population utilise a vacuum cleaner for cleaning at least once a week with 12% vacuuming twice a day (Lioy *et al.*, 1999). In the work place, industries such as the hospitality industry vacuum their premises daily.

The activity of vacuum cleaning can release significant levels of particulates including fungi into the air. Depending on the characteristics of the vacuum cleaner (rotating brush head and filters), its maintenance record and age, vacuum cleaners themselves could be a source of particles. Human exposure to particulates from the activity of vacuum cleaning can be significant. Studies by Dunford (1992) and Schneider *et al.* (1994) demonstrated a worsening indoor air quality following the use of conventional vacuum cleaning equipment due to the use of bag filters, which allowed smaller particulates to escape. Particulates from the vacuum motor, inefficient vacuum bags, vacuum brushes releasing deeply embedded particles from the carpet and inefficient filters all could contribute to elevated levels (Lioy *et al.*, 1999; Franke *et al.*, 1997; Dybendal *et al.*, 1991).

Vacuum cleaners principally work on using a moving air stream to pick up dirt and debris. An internal rotating fan creates a pressure differential between the ambient air outside the vacuum cleaner and the air inside the vacuum cleaner creating a suction or partial vacuum inside the vacuum cleaner. The movement of air particles collides against any loose dust or debris and provided the suction is strong enough and the debris light enough, the resultant material is carried through the inside of the vacuum cleaner. Extra assistance in the form of rotating brushes at the intake port greatly assists in the removal efficiency of dust

and debris being loosened from the carpet (Dunford, 1992; Schneider *et al.*, 1994; Trakumas *et al.*, 2001).

There are two approaches when it comes to vacuum cleaning floor surfaces in the indoor environment. The first approach is vacuuming such that the carpeting or flooring is free of any visible dirt or large particulates. Often this process is relatively quick and simply involves a once over vacuuming of the surface of the carpet. However, heavier or smaller particulates present deep in the fibres of carpets are often not removed and remain so, with biocontaminant loadings building up and available for resuspension into the air (Gorny *et al.*, 2001; Figley *et al.*, 1993; Dybendal *et al.*, 1991; Kemp *et al.*, 1998).

Intensive vacuuming, over a longer period of time and with higher efficiency (stronger suction) and a physical or mechanical action (rotating brushes) breaking and disrupting the electrical and physical attachments to the carpet fibres is required to effectively remove not only the larger visible particulates but also the smaller and attached particulates, including fungi from deep inside the carpet pile (Kemp *et al.*, 1998).

Vacuum cleaners and systems come in many forms and designs, from upright and canister designs which capture dirt and debris in a porous bag, to wet/dry vacuum cleaners and ducted central vacuum systems, to the more recent bagless cyclone vacuums and systems utilising HEPA filters. Advances in vacuum cleaner technologies in particular in the design, suction mechanisms and collection systems, have seen the recent high efficiency bagless cyclone vacuums with HEPA filters being more efficient and effective in removing the dust, fine particulates and debris, compared to conventional older model vacuum cleaners.

Scientific studies conducted by Hegarty *et al.* (1995) and Ewers *et al.* (1994) have shown that different vacuum cleaners remove and retain different amounts of dust from the same surface. The choice of the appropriate and suitably equipped vacuum cleaner is therefore vital for efficient cleaning. An intensive, high quality deep cleaning of carpeted floors requires a combination of timing (vacuuming long enough to effectively remove particles) and suitable equipment (bagless cyclone system, rotating brush head, sufficient suction and HEPA filters).

## Materials and Methods

Eleven residential dwellings within a 15km distance from Murdoch University, Perth, Western Australia were selected for participation in this study. All homes were single storey, of brick construction over a concrete pad with their age ranging from two to more than 30 years. Specific selection criteria required that all homes be fully carpeted (wool or synthetic) and that no tobacco smoking took place within the home during the study period.

Of the eleven homes, six were randomly assigned in the 'vacuum' intervention group whilst the other five were assigned in the 'control' group. For the 'vacuum' intervention group, the entire area of exposed carpeting and flooring, fabric upholstered sofas and the participant's bed were intensively vacuumed (4 mins m<sup>2</sup> for the 1st intervention, 2 min m<sup>2</sup> thereafter) fortnightly with a vacuum cleaner (Filter Queen, HMI Industries) meeting the Australian Standard 3733 (Standards Australia, 1995), and equipped with a hospital grade filtration system (HEPA), to trap and remove particulate soil and dust, for the duration of the study period (White *et al.*, 2002).

The vacuum cleaner was equipped with a motorised head with rotating brushes to add extra power to the cleaning system. The process of conducting the initial deep cleaning took place over 4-5 hours depending on the total area of exposed carpets. Subsequent fortnightly vacuuming interventions were carried out over 2-3 hours. The area of exposed carpet ranged from 4m<sup>2</sup> to 13m<sup>2</sup>, with an average of between 6m<sup>2</sup> and 7m<sup>2</sup>. The mean whole of house carpet area was approximately 60m<sup>2</sup>. For the 'control' group, no specific vacuum cleaning interventions were conducted. No specific instructions were given to all occupants with regard to the opening or closing of windows or doors in the bedroom of the participants.

## Monitoring protocol

Prior to the vacuuming intervention, baseline air samples were obtained from the bedrooms of all eleven homes for later comparison. The baseline air quality parameters measured included fine particulate matter (particles m<sup>-3</sup>), temperature, relative humidity and airborne viable fungal levels. Windows and doors in the bedrooms were kept shut during the sampling period. Two sets of indoor measurements were taken for comparative analysis. The first measurement was taken prior to a simulated activity/impaction test and another immediately after the exercise. Outdoor air quality parameters were concurrently monitored for comparison with indoor levels. The vacuum and control homes were monitored four times during the vacuum period, at 3 weeks, 7 weeks, 11 weeks and 15 weeks.

Monitoring was conducted in the bedroom of each participant. Airborne viable indoor fungal spore sampling was conducted in the morning, in the middle of the bedroom with duplicate N-6 Andersen multi-hole impactor samplers (Andersen Instruments Inc., Atlanta GA) co-located, at a height of 1 – 1.5 m above the ground or floor surfaces, for two minutes at a flow rate of 28.3 L min<sup>-1</sup> (Foarde & Berry, 2004; Kemp *et al.*, 2002; Hyvärinen *et al.*, 1993; Lehtonen *et al.*, 1993). Outdoor control samples were collected outside the house (2 m away from house) to represent the air that may enter the buildings through open windows and doors, for comparison with indoor samples (Portnoy *et al.*, 2004; ACGIH, 1999). Monitoring of homes scheduled on a particular day was completed within

two hours, to maintain similar monitoring time period constraints (Cheong *et al.*, 2004).

In order to enumerate a broad spectrum of fungi, duplicate side-by-side sampling of airborne indoor fungi was conducted on malt extract agar (MEA - DIFCO) (broad spectrum medium) and Dichloran 18% Glycerol Agar (DG18 – Oxoid) (slow growing fungi – low water activity, a<sub>w</sub>) plates. Both media were amended with Chloramphenicol (Sigma) to limit bacterial growth. Duplicate viable outdoor air fungal samples were collected concurrently for comparison with indoor levels (ACGIH, 1999; Hyvärinen *et al.*, 2001; Samson *et al.*, 1994).

In total, ten airborne viable fungal samples were taken per house per sampling occasion. A subset of samples were then further analysed with fungal colonies differentiated to ascertain the fungal profile in each of the dwellings. Due to the substantial increase in sample numbers following the interventions, only those species identified before the cleaning intervention were targeted to track any changes occurring as a result of the intervention. New species following the interventions were not identified to species level unless they occurred at substantial concentrations.

Temperature, relative humidity and suspended particulate matter were considered as possible predictors of indoor fungal levels and were measured in tandem with airborne viable fungal sampling. Airborne fine particulate matter was measured with a P-Trak Ultrafine Particle Counter (Model 8525, TSI Inc.), capable of detecting particles in the size range 0.02 to 1.0 micrometer. The concentration range for the P-Trak was 0 to 5 x 10<sup>5</sup> particles per cubic metre (particles m<sup>-3</sup>). Temperature and relative humidity were measured with an indoor humidity gauge thermometer (accuracy 618C, 65%RH) (Model 63-1013, InterTAN Inc.).

## Simulated activity/impaction

The technique for simulating indoor activity as described in Cheong *et al.* (2004) was used to determine the influence of human activity on indoor fungal numbers and composition in the carpeted environment. To maintain quality control, the methodology had to be simple, repeatable and equipment inexpensive and readily available and accessible. A standard fully inflated (30 psi) basketball was dropped from a height of 1.5m in a grid-like pattern over the entire exposed carpeted area for a period of 60 seconds. Duplicate viable airborne fungal samples were subsequently taken following the impaction/simulated activity for both MEA and DG18 media. This technique was utilised to simulate activity during the monitoring period.

## Incubation and counting

The duplicate samples collected on the MEA and DG18 plates were transported in an insulated

container, to the laboratory for incubation and analysis, within two hours of sampling. The ten replicate culture plates were incubated for five days at 228C (618C) and 30%RH (65%RH) in a darkened climate controlled incubation room. Once incubated, the total concentration of viable culturable fungal colonies was determined with a counting loop and binocular and compound microscopes and reported as mean colony forming units per cubic meter of air (CFU m<sup>-3</sup>). Since replicate plates were collected, the data were averaged.

After counting, a subset of the fungal samples was identified to genus and species level to determine the fungal composition. Subsets were taken from samples from the pre vacuum cleaning intervention and during the vacuum cleaning intervention periods. The morphological characteristics of the fungi were determined microscopically at 40x and 100x objective magnification. Fungi were identified to genus and species level with the aid of taxonomic texts (Domsch and Gams, 1993; Anderson and Ellis, 1993; Samson *et al.*, 1995) and the Hughes-Tubaki-Barron system and Saccardo system (Barnett and Hunter, 1972). Fungal colonies that did not produce spores or conidia were classified as sterile mycelia. Fungal species that are not classed as potential human pathogens (Samson *et al.*, 1995) and did not make up significant numbers were grouped as 'others'.

## Statistical analysis

Analysis of indoor air quality data collected for this study was performed using the MS Excel V5.0 Statistical Add-ins Package. Paired t-tests assuming equal variance (P) and  $\alpha = 0.05$  and ANOVA calculations were performed for analysis of variance. Pearson product moment correlation analysis was used to investigate possible associations or relationships between the mean air temperature, relative humidity, particulate matter and total fungal colony forming units.

## Results

Two hundred and forty samples of airborne viable fungi and fine particulate readings were taken from the six vacuum homes and the five control homes over the study period beginning mid-May and ending mid-October 2000.

### *Baseline ambient airborne viable fungal, fine particulate and air quality parameters for Australian conditions*

The average ambient baseline indoor fungal levels of the eleven Australian residential homes (pre-intervention) were 467 CFU m<sup>-3</sup>. Corresponding outdoor fungal levels were 443 CFU m<sup>-3</sup>. The average indoor fungal level

**Table 1.0 Fungal taxa isolated**

<b>Yeast (Morphological group) includes all yeast like fungi found (except Aureobasidium)</b>	<b>Filamentous fungi</b>	<b>Other fungi found (not complete)</b>
<i>Rhodotorula spec.</i> , <i>Sporobolomyces roseus</i> , <i>Candida spec.</i> <i>Geomyces pannorum</i> , <i>Geotricum spp.</i>	<i>Cladosporium cladosporioides.</i> , <i>C. herbarum</i> , <i>C. sphaerospermum</i> ; <i>Penicillium chrysogenum</i> , <i>P. commune</i> , <i>P. glabrum</i> . <i>P. spp.</i> ; <i>Aspergillus fumigatus</i> , <i>A. nigar</i> , <i>A. ochraceus</i> , <i>A. sydowii</i> , <i>A. terreus</i> , <i>A. versicolor</i> , <i>A. spp.</i> ; <i>Aternaria alternata</i> , <i>Alternaria spec.</i> ; <i>Fusarium culmorum</i> , <i>F. oxisporum</i> , <i>Fusarium solani</i> , <i>F. sporotrichioides</i> <i>F.spec.</i> ; <i>Epicoccum nigrum</i> , <i>Botrytis cinerea</i> , <i>Aureobasidium pullulans</i> , <i>Rizopus stolonifer</i> .	<i>Mucor hiemalis</i> , <i>M. racemosus</i> , <i>Oidodendron griseum</i> , <i>Absidia spp.</i> , <i>Acremonium spp.</i> , <i>Beauveria bassiana</i> , <i>Chrysonilia crassa</i> , <i>Chrysosporium spp.</i> , <i>Paecilomyces voriotii</i> , <i>Phialophora spec.</i> , <i>Phoma glomerata</i> , <i>Cuvaria spec.</i> , <i>Scopulariopsis brevicaulis</i> , <i>Syncephalastrum racemosum</i> , <i>Verticillium spec.</i>

following the simulated activity/impaction was 515 CFU m<sup>-3</sup>. Ambient indoor conditions in the eleven test homes at the start of the study period included an average temperature of 20.78C, 61.7% relative humidity and 1.52 x 10<sup>-2</sup> particles m<sup>-3</sup> airborne fine particulates. Corresponding outdoor conditions included an average temperature of 19.48C, 62.2% relative humidity and 1.44 x 10<sup>-2</sup> particles m<sup>-3</sup> airborne fine particulates.

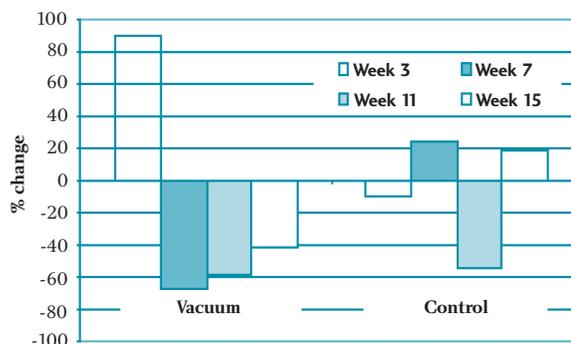
**Fungal composition**

Due to the substantial increase in sample numbers following the interventions, only those species identified before the intervention were targeted to track any changes. New species following the interventions were not identified to species level unless they occurred at substantial concentrations.

In total, seventeen fungal genera were identified in the viable airborne indoor and outdoor samples, 11 to genus level (*Cladosporium*, *Penicillium*, *Aspergillus*, *Alternaria*, *Fusarium*, *Botrytis*, *Aureobasidium*, *Rhizopus*, *Epicoccum*, *Yeast*, *Nigrospora*) and 6 to species level (*Neurospora crassa*, *Trichoderma viride*, *Chaetomium globosum*, *Ulocladium chartarum*, *Wallemia sebi*, *Mucor heimialis*). The full list of fungal taxa isolated in this study is presented in Table 1.0.

Between five and six different fungal genera were commonly isolated in each of the indoor and outdoor samples for the 11 residential homes. *Penicillium* (97.6%), *Yeast* (92.9%) and *Cladosporium* (90.5%) species were the most commonly found fungi in the indoor samples, along with *Alternaria* (64.3%) and *Aspergillus* (57.1%) species (Table 2.0). More fungal species were isolated in the outdoor samples with *Penicillium* (97.6%), *Cladosporium* (95.2%) and *Yeast* (81.0%) species the most commonly isolated fungi in all outdoor samples of the 11 test homes. Other fungi isolated outdoors include *Alternaria* (64.3%), *Aspergillus* (54.8%), *Botrytis* (47.6%) and *Fusarium* (31.0%).

**Figure 1.0 Percentage change in indoor fungal levels compared to baseline levels in vacuum and control homes.**



With activity/impaction resuspending dust, fungi and particulates from deep inside the carpet pile, a greater percentage (10.3%) and number of fungal species were isolated, in particular *Botrytis* (16.7% increase), *Alternaria* (7.1% increase), *Aspergillus* (4.8% increase) and *Cladosporium* species (2.4% increase). Other fungi isolated included *Penicillium*, *Yeast* and *Fusarium* (Table 2.0). *Cladosporium* and *Penicillium* were the two dominant fungal genera, making up 73% of the total indoor fungal composition in the eleven residential homes before the cleaning intervention.

**Vacuum cleaning intervention**

The first vacuum intervention period (Week 3) brought about an increase in indoor fungal levels in the vacuum homes. A 90% increase in indoor fungal levels (696 – 1323 CFU m<sup>-3</sup>) was recorded in the vacuum homes. This compared to a 10% decrease (238 – 215 CFU m<sup>-3</sup>) in indoor fungal levels recorded in the control homes during the same period. Subsequent vacuuming intervention periods recorded reductions in indoor

**Table 2.0 Prevalence of fungal genera prior to the cleaning intervention in vacuum and control homes expressed as a percentage (%).**

Fungal genera	Indoor (n=42)	Activity (n=42)	Outdoor (n=42)
<i>Cladosporium</i>	90.5	92.9	95.2
<i>Penicillium</i>	97.6	97.6	97.6
<i>Aspergillus</i>	57.1	61.9	54.8
<i>Alternaria</i>	64.3	71.4	64.3
<i>Yeast</i>	92.9	90.5	81.0
<i>Fusarium</i>	23.8	16.7	31.0
<i>Botrytis</i>	26.2	42.9	47.6

**Table 3.0 Average airborne fine particulate levels in the vacuum and control homes**

Average airborne fine particulates (n=195)	Vacuum homes x 10 <sup>-2</sup> particles m <sup>-3</sup> (SD)			Control homes x 10 <sup>-2</sup> particles m <sup>-3</sup> (SD)		
	Indoor	Outdoor	Activity	Indoor	Outdoor	Activity
Pre vacuum	1.67 (0.97)	1.83 (1.43)	1.49 (1.50)	1.36 (1.33)	1.06 (0.91)	1.50 (1.24)
1st vacuum intervention	1.26 (0.67)	2.54 (1.35)	1.31 (4.43)	4.22 (1.74)	5.83 (3.69)	4.43 (1.58)
final vacuum intervention	1.30 (1.5)	0.77 (0.83)	1.18 (1.46)	1.55 (1.24)	1.46 (1.34)	1.46 (1.09)

fungus levels in the vacuum homes, whereas levels in the control homes were wide-ranging (Figure 1.0).

There was a 24.5% reduction (1.67 – 1.26 x 10<sup>-2</sup> particles m<sup>-3</sup>) in airborne fine particulate levels in the homes following the first vacuuming intervention, compared to a 210% (1.36 – 4.22 x 10<sup>-2</sup> particles m<sup>-3</sup>) increase in airborne fine particulate levels in the control homes. The large increase in the control homes can be attributed to higher fine particulates in the outdoor air infiltrating

indoors. Fine particulate levels in the vacuum homes continued to decrease with subsequent vacuuming interventions. Fine particulate levels in the control homes reflected a similar pattern to that of outdoor levels (Table 3.0). There was a strong and significant correlation between indoor particulate levels before and after impaction/simulation (P=0.98, 0.09).

**Change in fungal composition**

*Cladosporium* and *Penicillium* were the two dominant

**Table 4.0 Average fungal species distribution in vacuum and control homes pre vacuum and during the vacuum cleaning intervention period**

Time period	Vacuum homes (n=6)			Control homes (n=5)		
	Indoor species*	Outdoor species*	Activity species*	Indoor species*	Outdoor species*	Activity species*
<b>Pre vacuum</b>	41% Clad 34% Pen 6% Asp 3% Alt 1% Fus 15% Yeast	51% Clad 25% Pen 8% Asp 3% Alt 1% Fus 1% Bot 7% Yeast 3% Sterile	41% Clad 35% Pen 3% Asp 4% Alt 1% Bot 1% Aur 14% Yeast	39% Clad 33% Pen 5% Asp 7% Alt 1% Rhiz 2% Epic 11% Yeast 2% Sterile	52% Clad 28% Pen 5% Asp 7% Alt 4% Fus 1% Bot 2% Epic 7% Yeast	44% Clad 32% Pen 6% Asp 7% Alt 1% Bot 1% Rhiz 10% Yeast
<b>Vacuum intervention</b>	40% Clad 30% Pen 5% Asp 2% Alt 1% Fus 2% Epic 14% Yeast 5% Sterile	23% Clad 51% Pen 5% Asp 3% Alt 2% Fus 4% Bot 2% Aur 1% Rhiz 9% Yeast	39% Clad 34% Pen 3% Asp 11% Alt 1% Bot 1% Aur 1% Rhiz 6% Yeast 3% Sterile	28% Clad 37% Pen 10% Asp 5% Alt 2% Fus 3% Epic 15% Yeast	29% Clad 46% Pen 5% Asp 3% Alt 1% Fus 2% Bot 2% Epic 11% Yeast	32% Clad 28% Pen 11% Asp 13% Alt 1% Epic 13% Yeast

\* Clad = *Cladosporium*, Pen = *Penicillium*, Asp = *Aspergillus*, Alt = *Alternaria*, Fus = *Fusarium*, Epic = *Epicoccum*, Bot = *Botrytis*, Aur = *Aureobasidium*, Rhiz = *Rhizopus*

fungal species. A change in fungal composition can be seen in the outdoor samples over time with fungal dominance changing from *Cladosporium* dominance in the beginning of the study (Clad 51-52% Pen 25-28%) to *Penicillium* dominance at the end of the study (Clad 23-29% Pen 51-46%) in the vacuum and control homes (Table 4.0).

The indoor fungal composition in the vacuum homes remained similar, both before and during the vacuum intervention periods. When subjected to impaction/activity, more species of fungi were isolated overall in the vacuum homes during the vacuum intervention, with *Alternaria* species increasing from 4% to 11%, whilst yeast species decreased from 14% to 6% (Table 4.0).

## Discussion

### Baseline culturable indoor fungal levels

The baseline culturable indoor fungal levels reported in this Australian study (mean = 467 CFU m<sup>-3</sup>) were in the same range as those reported in studies of airborne indoor fungi levels in residential Australian houses (median = 443 CFU m<sup>-3</sup>, 421 CFU m<sup>-3</sup>, 495 CFU m<sup>-3</sup>, & 812 CFU m<sup>-3</sup> (rural area)) (Cheong *et al.*, 2004; Dharmage *et al.*, 2002; Godhish *et al.*, 1996; Garrett *et al.*, 1997). As a comparison with international conditions, levels reported in this study were in a similar range to that of Californian houses (mean = 480 CFU m<sup>-3</sup>) which have a similar climatic condition to that of Perth, and complaint houses in Scotland (median = 624 CFU m<sup>-3</sup>), but higher than those reported in Finland (generally under 100 CFU m<sup>-3</sup>, colder conditions) and lower than those reported in non complaint houses in Iowa (1200 CFU m<sup>-3</sup>, farming environment) (Reponen *et al.*, 1992; Flannigan *et al.*, 1993; DeKoster & Thorne, 1995; Kozak *et al.*, 1979). The comparison of our results and those internationally supports the hypothesis of higher levels of airborne viable fungi homes in farming, or rural areas compared to those in urban residential areas (Dharmage *et al.*, 2002; Pasanen, 1992).

### Fungal composition

*Penicillium*, *Cladosporium*, *Aspergillus*, *Alternaria* and yeasts were the most common and widespread fungal taxa recovered indoors and outdoors, reflecting similar findings in fungal composition recovered in residential environments in other Australian, US and European studies (Dharmage *et al.*, 2002; Godhish *et al.*, 1993; Chew *et al.*, 2003; Kozak *et al.*, 1979; Li & Kendrick, 1995; Consentino *et al.*, 2002; De Lara *et al.*, 1990).

The change in fungal species composition from *Cladosporium* dominance in the beginning of the study (Autumn season) to *Penicillium* dominance at the end of the study (wetter Winter/Spring season) is supported by studies by Cheong *et al.* (2004), Chew *et al.* (2003), Koch *et al.* (2000), Solomon & Platts-Mills (1998) and Hirsch & Sosman (1976), who similarly found significant decreases in occurrence of *Cladosporium* and

*Alternaria* in the winter period, but is contrary to studies by Takatori *et al.* (2001) and Solomon (1976), which show *Cladosporium* species dominating wetter time periods/seasons (Table 4.0). As a direct comparison, the Australian study by Godish *et al.* (1993) found much higher levels of *Penicillium* species indoors (85.8%) rather than outdoors (65%), whereas in this study *Penicillium* species indoors were only slightly higher (35%) than outdoors (25%) during the pre vacuum intervention period (Table 4.0). This difference can be attributed to the cooler and wetter climate experienced in the east coast of Australia (where the study by Godish *et al.* was conducted) compared to the milder and drier climate of Perth, Western Australia.

It must be noted that not all *Penicillium* species prefer dry conditions. It is possible that a shift to wet loving *Penicillium* species could have occurred in our study. However, isolates were only identified to genera level, and therefore meaningful analysis of any species shift within the *Penicillium* species is not possible.

### Effect of intensive, high efficiency vacuum cleaning

In the short term, there was an overall increase in fungal genera/biodiversity following the first vacuum cleaning intervention, which is consistent with higher recorded fungal spore counts. The higher fungal levels and fungal genera isolated during the first vacuuming period are due to the initial increased activity and intensive mechanical action (rotating brush) of the vacuuming cleaning process, stirring up and resuspending dust and particulates from deep within the carpet (Gorny *et al.*, 2001; Figley *et al.*, 1993; Dybendal *et al.*, 1991; Kemp *et al.*, 1998). Studies by the Canadian Mortgage and Housing Corporation (CMHC) (2003) and Fugler (2004) found that regardless of whether HEPA filtration was available, simply operating the vacuum cleaner resulted in significantly raised dust levels during the start up phase of a clean up. We suggest that the initial increase in fungal biodiversity and numbers was due to the initial high loadings contained within the carpet. As the loadings contained in the carpet were reduced, so too does the amount available for resuspension is reduced.

Prior to the intensive vacuuming intervention, the carpet fibres are flat and horizontal, trapping dust, particulates and fungi deep in the carpet pile. Conventional vacuum cleaners, which rely on moving air alone, do not effectively remove deeply embedded dirt and particulates due to the difficulty in creating sufficient velocity and air flow required to motivate and agitate the particulates. Cleaning with a vacuum not equipped with a rotating brush head, HEPA filters, sufficient suction and dwell time (surface vacuuming time) results in only superficial and visible dust and particulates being removed from the surface of the carpet pile. This still leaves a significant amount of heavier and fine particulates, including fungi, trapped deep within the carpet pile.

These smaller particles are difficult to dislodge from the carpet pile due to the electrical attraction

(electrostatic, van der Waals, geometric factors) between the fibres of the carpets and the adhesive forces of these particles (Braun *et al.*, 2002). Vincent (1995) and Hinds (1982) put forward that the adhesive forces are proportional to the particle diameter ( $d$ ); while the removal forces are proportional to the particle mass ( $d^3$ ) for vibration and detachment by air currents is proportional to the exposed surface area of the particle ( $d^2$ ). As the size of the particles decreases, the more difficult it is to detach them from surfaces. Hinds (1982) determined that about 10 times as much force is required to remove 98% of the particles as that required to remove 50%, which explains why it is easier to remove larger particles from a surface than smaller ones. This was similarly observed in studies by Nishioka *et al.* (1999) and Braun *et al.* (2002).

Further to this discussion, Varekhov (1994) and Jennings & Lysek (2001) found that under certain external conditions, certain fungal spores are able to adhere to surfaces and create a unique microclimate via the growth of fungal hyphae and the expansion of fungal mycelium. To enhance their ability to survive and compete with other species, fungi are able to create unique microhabitats within their immediate settled surroundings, and establish the ideal moisture content and pH levels around the fungal hyphae tip (apical growth zone), creating an 'encrusted' area, thereby maximising their growth potential and competitiveness. Sheltered and attached within the carpet fibres, fungal spores have an ideal environment for growth, with readily available nutrients from dust and debris. The combination of the electrical attraction and physical attachments creates a situation whereby the removal of fungi from carpet fibres is particularly difficult. The physical and mechanical action of the rotating vacuum cleaner brushes (or similar type devices) is therefore vital in breaking the adherence forces and physical attachments of the hyphae and mycelium, and effectively removing fungi and particulates from the carpet fibres.

The vacuum cleaning intervention conducted in the vacuum homes utilised a combination of high efficiency HEPA vacuums, mechanical rotating brush head and sufficient dwell time (2-4 mins  $m^{-2}$ ) to effectively remove not only visible surface particulates but also those deeply imbedded in the carpet pile. Except for central vacuum systems with external exhausts, the same air being vacuumed into the vacuum cleaner is recirculated back into the environment. HEPA filters have an efficiency rating of 99.97% and effectively remove fine particulates, which would normally have passed through conventional bag, cloth, and paper filters. The mechanical rotating brush heads revolve at very high speeds, agitating the carpet fibres, effectively loosening dirt deeply embedded in the carpet pile and aiding in its removal. A sufficient dwell time is also important as the increased time spent on the surface of the carpet aids the suction from the motor, pulling the carpet under the nozzle and bowing it backward slightly. Studies by Fugler (2004) and CHMC (2003) yielded a 90% recovery of deposited dust if the vacuum cleaner

was passed over an area 10 times the normal number of passes. The increased number of passes and the accumulated dwell time, aids in the separation of the nap of the carpet and enhances airflow through the carpet fibres (Ristenbatt, 2004).

Continual maintenance of the carpet with intensive, high efficiency HEPA vacuum cleaning in the long term results in more and more of the deeply imbedded dust, particulates and fungi being removed from the environment. These are therefore not available for resuspension into the air and therefore decreased exposure by occupants in the indoor environment, as the loadings in the carpet pile were reduced. In our study, both airborne particulate and indoor fungi levels eventually showed reductions in the long term as previous dust and fungi available for resuspension, was effectively reduced, reflecting results similarly found by Fugler (2004) and CHMC (2003). A well-maintained carpet (low loadings) could serve as a filter for incoming particulates, trapping and holding particulates and fungi within the carpet fibres until they are removed during the next vacuuming occasion.

#### Activity vs non-activity sampling (I:A ratios)

Although many studies recognise outdoor air as a major contributor to indoor levels of fungi, not all indoor fungi found indoors can be attributed to outdoor air (Verhoeff *et al.*, 1992; Fradkin *et al.*, 1987; Solomon, 1975). In cases where the outdoor air is not the source of indoor fungi, other fungal sources inside the building need to be investigated. However, in many situations, there are often no obvious indoor fungal colonisation (visible/hidden mould) and no obvious indoor sources (Lehtonen, 1993).

Settled spores present on hard and soft surfaces in the indoor environment may become resuspended by air movement caused by various activities including human disturbance (walking, cleaning, foot traffic, etc.), or by environmental changes such as changes in air humidity and wind gusts (Ferro *et al.*, 2002; Long *et al.*, 2000; CMHC, 1999; Flannigan & Hunter, 1998; Lehtonen *et al.*, 1993; Pasanen *et al.*, 1991; Hunter *et al.*, 1988; Hirsch & Kozak *et al.*, 1979; Hirsch & Sosman, 1976). Fungal spores and fine particulates can remain airborne for long periods and are subject to drift throughout the home. They can adhere to vertical surfaces (walls) and settle on horizontal surfaces (finished furniture and smooth floors). In addition, these spores and particulates can be transferred on clothing to other places within and between homes and to schools or workplaces where they can be inhaled, thereby contributing to respiratory symptoms (Lioy *et al.*, 1999; Ferro, 2000).

Several studies have since shown that human activity has a significant effect on the concentrations of microorganisms isolated during sampling (Buttner & Stetzenbach, 1993; Greene *et al.*, 1962). The methodology used in this study to simulate activity/impaction was a simple, cheap and readily accessible technique that consistently produced higher concentrations of airborne viable spores (Cheong *et al.*, 2004).

Direct comparison of the control and vacuum homes suggests that the vacuum cleaning intervention although initially resulting in increased exposure to fungi, in the long term resulted in reduced levels of fungi indoors. Whereas fungal composition in the control homes varied with outdoor air and infiltration, in the vacuum homes fungal composition remained the same. Continual maintenance of the carpet ensures incoming outdoor fungal sources are continually removed, therefore maintaining a stable fungal spora within the indoor environment.

## Conclusion

The intensive, high efficiency HEPA vacuum cleaning intervention was effective in keeping levels of indoor fine particulates at a stable and lower level than outdoors. There was an initial increase in fungal levels, due to the initial loadings present in the carpets. After the first vacuum cleaning intervention, consistent reductions in airborne fungal and particulate levels were observed. *Penicillium*, *Cladosporium* and yeasts were the most common and widespread fungi recovered indoors and outdoors. Fungal range increased in the vacuum homes whereas it remained the same in the control homes. It is suggested that fungal sampling be undertaken under ambient no activity and simulated activity/impaction conditions to give a better indication of the influence indoor sources have on fungal levels.

Intensive high efficiency HEPA vacuuming benefits the indoor environment by maintaining not only established fungal levels indoors but also a stable indoor fungal spora. A well maintained carpet could serve as a filter for incoming particulates, trapping and holding particulates and fungi within the carpet fibres until they are removed during the next vacuuming occasion. Continual maintenance of the carpet ensures incoming fungal sources are continually removed (loadings kept low), therefore maintaining a stable fungal spora within the indoor environment, in terms of numbers and composition.

It is suggested that in future studies, a physical and biological comparison of dust loadings extracted from within the carpet, with that of airborne levels, should be conducted to further investigate the relationship between the carpet loadings and cleaning activity.

## Acknowledgments

The authors would like to thank Kevin White, Jane Jones, Scott Smith, Rita Tan and Joanne Nastov for their assistance in the field. In particular, the authors are indebted to Dr Peter Dingle for his valuable support and academic contributions in the editing of this manuscript and encouragement throughout this study.

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# Agricultural practices as a source of *Campylobacter* spp. in river water

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## Abstract

*Campylobacter* spp. are a major cause of human foodborne illness. Pigs, cattle, sheep and poultry are all capable of harbouring the organism in their intestines and therefore of shedding it in their faeces, potentially contaminating water sources via land run-off. *Campylobacter* has been previously shown to survive in water and campylobacteriosis caused by consumption of contaminated water has been reported in several countries, including the UK. This study investigates the effects of effluent from three potential sources of *Campylobacter* spp. on the levels of *Campylobacter* spp. in a river. The sources were an abattoir, a cattle market and farmland grazed by cattle with nearby a poultry farm. Samples were collected over a period of three weeks in winter to reflect a 'worst case scenario' situation as campylobacters have been shown to survive for longer periods in lower temperatures and spreading of slurry onto pasture is more common in winter.

Effluent from the abattoir did not increase the levels of *Campylobacter* in the river course and this is probably a reflection of its control through consent discharges. Both the cattle market and the farm run-off statistically significantly increased numbers of *Campylobacter* spp. in the river course to levels that may be considered to be unacceptable if the river was used for recreational activities. All suspect colonies were identified as *Campylobacter jejuni*, which is the most common species associated with human disease. However, more detailed molecular epidemiological studies are required to fully assess the significance of these levels of campylobacters on the burden of human illness.

**Key words:** *Campylobacter* spp.; river water; pollution; agricultural practices.

## Introduction

*Campylobacter* spp. are the leading cause of food-borne bacterial gastroenteritis (Park 2002). In 2001 *Campylobacter* spp. were responsible for 56,420 of the 85,581 total number of reported cases of food

poisoning in England and Wales (Public Health Laboratory, 2002).

Many studies have shown that poultry at the broiler house (Jacobs-Reitsma *et al.* 1994), and subsequently raw meat on retail sale (Flynn, 1994; Wallace *et al.* 1997; Uyttendaele *et al.* 1999; Corry and Atabay 2001), carry *Campylobacter* spp. Approximately 80% of chickens sold in the UK are contaminated, with levels from 10<sup>2</sup> to 10<sup>7</sup> per carcass being reported in different parts of the world (Corry and Atabay 2001). Although targeted on-farm control interventions do reduce the infection rate of broilers (Gibbens *et al.*, 2001) these controls are not as effective in the case of *Campylobacter* as they have proved to be against *Salmonella* infection in poultry (ACMSF, 2003).

Other farm animals such as pigs (Weijtens *et al.* 1997) and lambs (Jones *et al.* 1999) can become infected soon after birth and remain so for life. In pigs during fattening there is decrease in carriage rate (Weijtens *et al.* 1999), while in lambs, although carriage is high, shedding of *Campylobacter* spp. is often low and intermittent throughout the year (Jones *et al.* 1999). However, at slaughtering, up to 92% of lambs contain *Campylobacter* spp. in their intestine (Stanley *et al.*, 1998a).

Similarly, calves and adult cattle (> 1 year) may carry *Campylobacter* spp. in their intestines. Reported carriage rates vary between 37% and 84% (Atabay and Corry 1998). In a study in Denmark there was a high prevalence of *C. jejuni* in farm cattle and the most common serotype was serotype 2 which is also the most common serotype in Danish patients suggesting that dairy cattle may be an important reservoir for human infections (Nielsen 2002). After slaughtering, thermophilic *Campylobacter* spp. have been isolated from up to 90% of beef cattle intestines (Stanley *et al.*, 1998b).

The significance of *Campylobacter* spp. colonization of farm animals relates not only to the potential for contamination of milk at the farm and carcasses at slaughter, but also water contamination during disposal of abattoir effluents and slurries. Abattoir drain water has been shown to contain >5.1 x 10<sup>5</sup> *Campylobacter* MPN/100ml (Koenraad *et al.*, 1996).

Changes in livestock waste management have particularly encouraged the survival of *Campylobacter* spp. in the farm environment. Intensification of farming practices has resulted in the collection of liquid slurry on the farm. Studies have shown that slurry may contain *Campylobacter* spp. (Watabe *et al.* 2003) and when spread onto fields grass can become contaminated and run-off into rivers and other water sources (Stanley *et al.*, 1998b;c).

Research has shown that all water types may be contaminated with *Campylobacter* spp., including surface water (Jacob and Stelzer, 1992), river water (Stelzer and Jacob, 1992; Savill *et al.* 2001), groundwater (Stanley *et al.*, 1998c), wastewater (Jacob *et al.* 1991; Koenraad *et al.*, 1997) and sea water (Obiri-Danso and Jones, 1999). The sources of this contamination are various and include: run-off from farms (Stanley *et al.*, 1998 b;c), abattoir effluent (Koenraad *et al.*, 1996), migratory birds (Hill and Grimes 1984) and sea birds (Kaneko 1999).

There have been reported seasonal fluctuations in incidence of *Campylobacter* spp. in water environments with an increase in Autumn and Winter months (Hudson *et al.* 1999). The main reason for this is temperature since, although *Campylobacter* spp. are unable to grow in water, their survival is increased by low temperature. Since campylobacters have been shown to survive at 48C for long periods in aquatic environments (Rollins and Colwell 1986; Hazeleger *et al.* 1998) this investigation was carried out in a winter month to maximise the possibility of isolating the organism, thus reflecting a 'worst case scenario' for contamination of the water source under study. Levels of oxygen may also affect survival in water since campylobacters are sensitive to high levels of oxygen tension (Thomas *et al.*, 1999) which means that fast flowing water bodies are associated with small numbers of *Campylobacter* spp. (Godfree *et al.*, 1997). Thus a number of sites were chosen on the river to account for these variations.

Although outbreaks of campylobacteriosis are rare, with most cases being sporadic (Pebody *et al.* 1997), those caused by consumption of contaminated water have been reported in Sweden (Andersson *et al.* 1997), Norway (Melby *et al.*, 1991), and in the UK (Palmer *et al.* 1983; Anon, 2001) suggesting that, although consumption of raw or under-cooked poultry is the major cause of sporadic cases, water may play an important role as a source of animal and human infections in terms of outbreaks. Certainly campylobacters are able to survive in water microcosms (Thomas *et al.* 1999) for periods up to one year (Hanninen *et al.* 1998) and therefore water may be a source of human infection particularly where rivers are used for recreation. In this case study, further downstream from the sites investigated there is a section of the river used for canoing and therefore any campylobacters that survive will pose a risk to human illness especially considering the infective dose may be as low as 100 organisms (Black *et al.* 1988). However, any specific influence on the rate of reported

campylobacteriosis in the locality is difficult to assess since the rate is not significantly higher than that reported nationally (116.72/100,000 population compared with 113.4 /100000) and people come from all over the UK to access this recreational amenity.

## Methods

### Sampling

Water samples were collected from a local river at three weekly intervals in Winter. Four water samples were collected at equal distances apart at each site. The first sample was taken before the suspected source, therefore acting as a control, with the remaining three samples taken after the source. The three sites were chosen approximately two miles apart to allow dissipation of any contamination influencing the subsequent site.

**Site 1** was in the vicinity of abattoir dealing with cattle, sheep and pigs with slaughtering taking place between 6.00am and 5.00pm. After slaughtering the abattoir is cleaned down with water containing a disinfectant and wastewater containing blood and faeces drains into overflow pipes entering the river. There were no obvious other sources of contamination apart from the drain from the abattoir.

**Site 2** was located adjacent to a livestock market. Auctions were held four times a week and included pigs, cattle, ewes and lambs. After each market day pens are washed down with non-disinfected water and this wastewater drains into the river. Wastewater from a jet wash used for livestock lorries and trailers is also drained into the river. The reported numbers of livestock passing through the market during the time of this study is shown in Table 1.0. As at site 1 there were no obvious other sources of contamination.

**Site 3** is part of the river where livestock farming intensifies within the catchment area of the river. In the area there is one dairy farm, one sheep and beef farm and one small holding raising chickens. The surrounding flood plain is grazed by cattle and sheep and consists of a network of ditches allowing all farm run-off to enter the river.

500ml water samples were collected in sterile 1l-glass bottles at approximately 9.00am during a market day at each sampling point. Temperature was measured using a digital battery-powered thermometer and pH measured using Boy Pocket pH meter (Camlab). Flow rates (m/sec) were also measured at each sampling point. All measurements were carried out in triplicate and samples were tested within four hours.

### Isolation

The samples were filtered through 0.45mm pore filters (Whatman, Maidstone, UK). The filters were then placed into bijoux bottles containing Preston enrichment medium, consisting of nutrient broth (Lab M) with 5% (v/v), lysed horse blood (SR 48, Oxoid, Basingstoke, UK), *Campylobacter* growth supplement (SR 084E; sodium

**Table 1.0 Possible factors influencing isolation of *Campylobacter* spp. from the river over the week preceding each sampling**

Week	Rainfall (mm)	Numbers of livestock sold at cattle market *				Total numbers sold
		Lambs	Ewes	Pigs	Cattle	
1	6.1	1232	112	275	278	1897
2	2.7	2003	253	375	341	2972
3	6.3	2137	231	413	357	3138
<b>Total</b>	<b>15.1</b>	<b>5372</b>	<b>596</b>	<b>1063</b>	<b>976</b>	<b>8007</b>

\* based on markets reports from the farming literature.

pyruvate (0.250g/l), sodium metabisulfate (0.250g/l), ferrous sulfate (0.250g/l); Oxoid, Basingstoke, UK) and Preston *Campylobacter* selective supplement (SR 117E; polymyxin (5000IU/l), rifampicin (10mg/l), trimethoprim (10mg/l), cycloheximide (100mg/g); Oxoid, Basingstoke, UK.). Samples were incubated for 24 hours at 428C to allow recovery of injured cells.

Filters were removed from the broth, placed onto Preston agar consisting of nutrient agar (CM 689; Oxoid, Basingstoke, UK) with 5% (v/v) lysed horse blood and the selective supplements described above (SR 084E and SR117E) and incubated microaerobically for 48 hours at 428C.

As *Campylobacter* spp. are highly motile the remaining broth was filtered as before to enable capture of any *Campylobacter* spp. that may have moved into the broth during incubation. After filtration these filters were also placed onto Preston agar and incubated microaerobically for 48 hours at 428C. Microaerobic conditions were created using Anaerocult C (Merck, Darmstadt Germany).

After incubation, the number of colonies on each membrane filter was counted under a microscope. For each sample the counts from both filters were combined to obtain a total cfu/500mls for each sampling point.

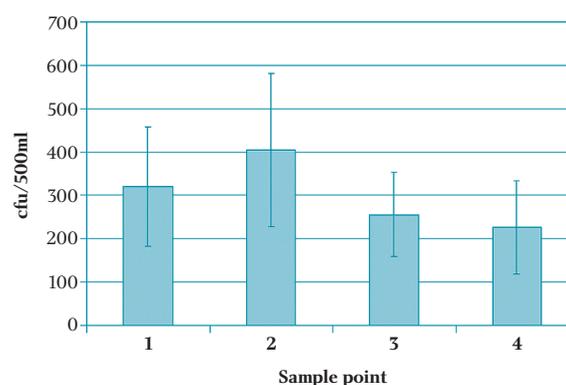
Suspect colonies were purified by streaking onto Columbia agar base (CM 331; Oxoid, Basingstoke, UK) containing 5% (v/v) lysed horse blood. All isolates were then characterised using an API *Campy* identification kit (Biomerieux, France).

Statistical analysis was undertaken using Statistical Package for Social Science (SPSS version 10). Significant differences between the mean colony counts at the control sampling point compared with the remaining three sampling points for each site were calculated using a t-test for independent samples setting  $P > 0.05$  as significance.

## Results

**Site 1.** At site 1 the mean number of *Campylobacter* spp. isolated increased between the control sample point 1 and sample point 2, the first sample after the abattoir effluent (Figure 1.0) but this was not statistically significant. Numbers of *Campylobacter* spp. isolated decreased at subsequent points but again the difference between numbers of *Campylobacter* spp.

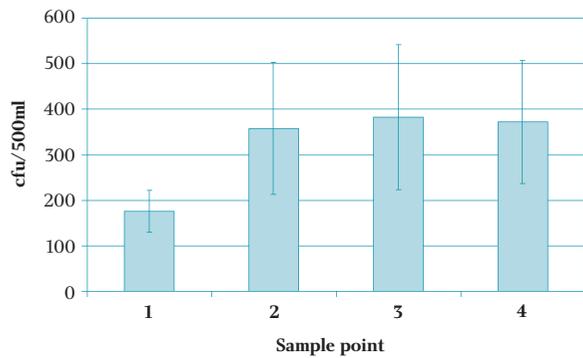
**Figure 1.0 *Campylobacter* counts (cfu/500ml) at Site 1 – near an abattoir**



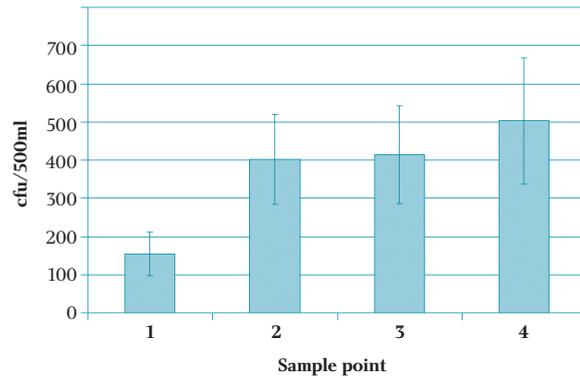
isolated before and after the abattoir effluent was not statistically significant ( $P = 0.845$ ). This suggests that the abattoir effluent did not act as a significant source of *Campylobacter* spp. in the river at this point.

**Site 2.** At site 2, numbers of *Campylobacter* isolated increased by two fold between sample points 1 (control) and 2 (Figure 2.0) and remained higher in samples 3 and 4. The difference between numbers of *Campylobacter* spp. isolated before and after the wastewater drain was statistically significant ( $P=0.005$ ). This indicates that wastewater from the

**Figure 2.0 Campylobacter counts (cfu/500ml) at Site 2 – near a livestock market**



**Figure 3.0 Campylobacter counts (cfu/500ml) at Site 3 – agricultural run-off**



cattle market probably acts as a source of *Campylobacter* spp. in the river.

**Site 3.** At site 3 numbers of campylobacters isolated significantly increased between sample points 1 and 2 (Figure 3.0) and remained significantly higher at subsequent points. Overall there was a statistically significant increase between samples taken before and after the suspected contamination from direct farm run-off (P=0.047). This suggests that farm run-off increases prevalence of *Campylobacter* spp. in the river. At this site temperatures were lower than at the other sites (Table 2.0) and flow rates higher.

All suspect colonies were identified as *Campylobacter jejuni jejuni* 2.

significantly lower than at sites 2 and 3 (P>0.001). Flow rate was significantly higher at site 3 but only at sampling points 2, 3 and 4 (P>0.001). There was no significant difference between counts at any of the control points suggesting that any contamination had been dissipated between sites. Rainfall did not significantly affect isolation rates as there was no correlation between rainfall and isolation rates.

## Discussion

The presence of *Campylobacter* spp. in the UK river under study at levels reported here correspond with other studies (Bolton et al., 1987; Hudson et al., 1999; Savill et al. 2001). There was a significant increase in *Campylobacter* counts in the river after inlets from a livestock market and agricultural run-off.

Effects of abattoir effluent did not show a statistically significant difference (P = 0.845). Therefore prevalence of *Campylobacter* spp. in the river was not increased via the abattoir effluent which contrasts to observations of

## Comparison of sites

There was no significant difference in temperature at each sampling point at each site or at the three sampling times (Table 2.0). The mean pH measured at site 1 was

**Table 2.0 Mean Water Temperatures, pH an Flow Rates at each site**

Sample point	Temperature ( 8C)			pH			Flow Rate m/sec		
	Site 1	Site 2	Site 3	Site 1	Site 2	Site 3	Site 1	Site 2	Site 3
1	6.260.8	6.060.9	5.660.65	7.660.2	7.960.05	7.960.15	7.660.7	7.861.0	6.560.5
2	6.360.9	6.460.8	6.161.5	7.760.15	8.060.1	8.060.1	12.063.3	9.860.7	15.061.0
3	6.861.7	6.760.8	5.861.2	7.760.1	7.960.05	7.960.1	15.061.5	9.460.4	24.060.8
4	6.260.8	6.560.7	6.361.1	7.760.15	7.960	8.0360.1	16.062.1	10.260.3	26.662.8
<b>Overall mean</b>	6.461.1	6.3960.7	5.9561.1	7.7160.1	7.9660.7	7.960.1	12.763.8	9.260.9	18.168.4

Koenraad *et al.*, (1996). An explanation for this may be that the abattoir waste is disinfectant treated and is controlled through consent discharges from the relevant authority. The reduction in levels of *Campylobacter* spp. resulting from the use of disinfectant may be compounded by the situation of a weir situated between sample points 2 and 3, which creates a high oxygen concentration in the water, and hence decreases survival rates of *Campylobacter* spp. (Thomas *et al.*, 1999).

Counts at sample point 1 at site 1 were high compared with other control point samples, although this was not significant. Two possible contaminating sources might have been responsible. Firstly, there is a sewage works situated about 5km up-stream (Jacob *et al.*, 1991) and secondly a large flock of wild fowl, a known source of campylobacters (Southern *et al.* 1990), is constantly present a few hundred metres up-stream due to regular feeding from the public.

At site 2 there was a statistically significant increase of *Campylobacter* spp. after the inlet of wastewater from the cattle market suggesting that wastewater from cleaning the cattle market is contaminated, probably via faeces of infected pigs, cattle and sheep, as also reported by Jones and Hobbs (1996). The numbers of animals passing through the market are shown in Table 2.0. Over the three weeks of testing the numbers isolated did increase, although not significantly, but there was no correlation either with the numbers of total animals passing through the market or any of the individual types of animals. Levels in uncontaminated rivers have been found to be less than 50 *Campylobacter* cfu /500ml (Stelzer and Jacob, 1992) compared with 358/500ml in this investigation, therefore indicating contamination at this site. Rates may have been even greater if a weir, situated a few hundred metres up-stream from the sampling points was not present. The weir may have had similar effects to that of site 1, hence decreasing survival. Other carriers of *Campylobacter* spp. in the vicinity of the sampled area include migrating wildfowl grazing on the riverbank.

Isolation rates at site 3 also show a statistically significant increase after the first agricultural contamination inlet ( $P=0.047$ ). This indicates that direct farm run-off harbours *Campylobacter* spp. and increases the levels present in the river, corresponding to results from other studies (Koenraad *et al.*, 1997; Jones and Hobbs, 1996). Contamination occurs via networks of drainage ditches taking wastewater from farms directly into the river. Although there are multiple point sources in this area, there are two obvious main probable sources. The first is a dairy farm situated north of the river which has both calves and milking cows, both potential carriers of *Campylobacter* spp. in their faeces (Atabay and Corry, 1998). Spreading of slurry on pasture is a common practice during the Winter months (as in this study) as slurry tanks are mostly full and may leach into water sources. The second is a smallholding with chickens, ducks, geese

and turkeys and, although only a small number of livestock are housed, poultry are major carriers of *Campylobacter* spp. (Berndtson *et al.* 1992; Flynn *et al.* 1994; Atabay and Corry 1997; Wallace *et al.* 1997). The land surrounding the river was continually grazed by cattle and sheep throughout this investigation. Livestock drink river water and thus may be a source of contamination. Fields that do not extend to the river are well drained by a network of ditches and some of these contained large manure heaps.

There was no correlation between water temperature and number of colonies detected. Temperatures varied only slightly within the optimal temperature survival range in water, which is between 58C and 108C (Thomas *et al.*, 1999). Therefore temperature did not influence detection rates of *Campylobacter* spp. Survival rates of *Campylobacter* spp. are only affected when pH is <3 in aquatic environments. The pHs in this study were between 7.6 and 8 which would have no effect on survival rates corresponding with findings of Obiri-Danso and Jones (1999).

The results obtained from this study do not show a correlation between flow rate and the number of colonies isolated. There was no significant difference between isolation rates between the three sites, post contamination point, whereas previous studies have shown higher isolation rates at low flow rates (Godfree *et al.*, 1997). Slow-flowing water creates low oxygen levels that aid survival and growth of *Campylobacter* spp. (Bushwell *et al.*, 1998). The fact that the isolation rates are not statistically different at sampling points 3, 3 and 4 at any of the sites, but flow rates of 15.061.0, 24.060.8 and 26.662.8 m/sec respectively at site 3, are significantly higher (Table 2.0), may suggest higher initial contamination at site 3 compared with the others.

*C. jejuni* was only identified species, which relates to the higher isolation rate of this over other species in dairy cattle (Nielsen, 2002; Wesley *et al.* 2000), in poultry (Berndtson *et al.* 1992; Wallace *et al.* 1997) and lambs (Stanley *et al.* 1998a). Therefore, in conclusion, the results of this study suggest that agricultural practices, specifically livestock markets and concentrated animal husbandry, act as a source of *Campylobacter* spp. in rivers and that river water may act as a transmission route for human illness, although more detailed molecular epidemiological studies are required to fully assess its overall significance on the burden of campylobacteriosis.

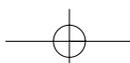
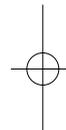
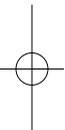
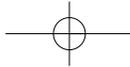
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# Magistrates' Courts and Environmental Regulators – Attitudes and Opportunities

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## Abstract

*Ratione et Consilio* (by reason and sound judgement) is the motto of the Magistrates' Association. As an approach to the resolution of environmental cases this ought to be a satisfactory basis. However, the reality is much more complex. By a combination of history, policy and jurisprudence the magistrates' courts find themselves dealing with cases which do not easily fit within their normal conceptual model of the criminal law.

This study, by examining the modern office of magistrate, the methods of environmental regulators, the theory behind the law in this area and the attitudes of magistrates, identifies and explores a number of key influencing factors.

The common opinion of the regulators, that magistrates' courts fail to hand out sufficiently harsh deterrent sentences is, it is proposed, based on a flawed view. It is based on a view which sees regulators and the courts as totally separate rather than, as they are, part of an overall regulatory system. They (the regulators), distance themselves from the perceived weakness in the regulatory system (the court) and thus removed are able to point to the deficiencies in the courts rather than to the processes at work within the entire system.

The study finds that magistrates do appear interested in environmental matters but are inevitably handicapped when dealing with such things. This is because of a lack of historical involvement, which is allied to a lack of training. Thus this study suggests that they resort to an approach of their own making. An approach which appears to search for a moral thread within the cases they try and, if found or implied, then marks the case as serious or not. They do not, indeed cannot, share the same view as the regulatory agencies about matters before them without there being a change within the overall regulatory system. Thus the schism between regulators and courts will remain.

This study offers an insight into the magistrates' court as an environmental tribunal. It challenges some of the standard assumptions in this area of the law and contributes to the ongoing debate.

**Key words:** Magistrates, Environmental offences, prosecution, punishment, regulators, role of the court.

## Regulatory Change

In the UK there is a long history of using the criminal law as a mechanism for environmental protection. Yet there remains a blurred distinction between regulatory crime and real crime. There is a lack of clarity which is attributable to historical accident, judicial ambivalence and obscure regulatory policy in the area of environmental criminal law. It is this lack of definition and clarity which results in magistrates' courts being denied clear points of reference when navigating this area of the law and results in them, for better or for worse, providing their own.

Historically the enforcement of environmental legislation was characterised by a relatively low number of prosecutions (Carter, 1992). This has been attributed to an informal regulatory style (Vogel, 1986). A style which, in the words of Vogel (1986), is typified by an absence of statutory standards, minimal use of prosecution, a flexible enforcement strategy, considerable administrative discretion, decentralised implementation, close co-operation between regulators and the regulated and restrictions on the ability of non-industry constituents to participate in the regulatory process. It is a style which has not always been seen as entirely satisfactory.

Some practitioners express their doubts about the suitability of the criminal process when dealing with environmental matters and at least one Lord Justice of Appeal has stated that he does;

*'...have reservations as to whether the criminal courts are the appropriate tribunal to determine some of the offences created by environmental legislation'* (Woolf LJ, 1992, p10).

Some writers go further and even call for the establishments of 'Environmental Courts or tribunals' (Macrory & Woods, 2003), perhaps modelled on the South Australian model (Upton, 1994), or in the words of Carnwath (1992) a lower tier court operating at a lower level...requiring a rationalisation of the existing

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jurisdictions of Magistrate, County and Crown Courts. Yet the courts are only one facet of the process of regulation and control.

Today in the United Kingdom there exists many agencies charged with regulating different aspects of what we might call the wider environmental health. These can be large agencies dealing with often technically complex matters relating to all aspects of the discipline. Many are relatively new and have been created, in part, in response to public concern. However, their creation is also attributable to a developing body of scientific and technical knowledge now capable of revealing the many and varied threats to the environment, each now increasingly being seen to require a more coherent response.

With these new regulatory bodies has come a greater willingness to have resort to the courts and the development of new concepts in, for example, environmental control. Concepts which have been recognised, in the words of Lord Justice Woolf (1992), as;

*'extremely challenging for a lay tribunal in environmental matters'.*

And this is the essence of the problem. All the perceived changes, all the concepts and initiatives created, all the new laws and all the new agencies who may wish to utilise these new laws, all the new vigour invested in prosecution, ultimately rely on traditional courts. Courts which have been designed to address the needs of earlier generations, having different problems, different priorities and different ways of thinking of the world.

## Magistrates – Justices of the Green-Peace?

One of these courts and arguably the one most likely to be involved on a day to day basis, is the magistrates' court. An obvious consequence of the evolving processes described is that magistrates are likely to be involved in ever more complex and contentious environmental issues; this without any published investigation into their attitudes towards such matters or their ability to deal with them. Indeed, there is little evidence of thought being given, even as to their suitability for such issues. The court is often considered as inexperienced and untrained in environmental matters.

As a significant feature of the system of criminal justice, the magistrates' court and magistrates generally are an influential and critical population. Yet they are a population which is remarkably anonymous and about which, in this area, little has been written.

## The Office of Magistrate

The motto of the Magistrates' Association is *Ratione et Consilio* (by reason and sound judgement). This was

the invention of the late Sir William Addison JP DL of Epping, Essex, a Chairman of the Magistrates' Association. *Ratione*, because magistrates are required to proceed by reason, and the behaviour of the reasonable man is the basis of their findings. *Consilio* to suggest that lay magistrates take counsel together on the evidence produced (Anon, 1995).

The emphasis placed on the Magistracy has long been a distinctive feature of the English legal system. Indeed, it is in the Magistrates' Courts that the vast majority of criminal cases are dealt with. There are some 1521 courtrooms in 390 Courthouses with 95% of all criminal cases being completed here. There are in England and Wales some 28,705 lay magistrates, 106 District Judges and 175 Deputy District Judges (Dept. for Constitutional Affairs 2005). Lay magistrates, are, unlike their District Judge (stipendiary) colleagues, not required to be qualified lawyers.

## Criminality and Environmental Protection

Acting as a contributing factor to the limited historical efficacy of the law is the fact that the regulation of environmental health activities has never been characterised as truly criminal. There was ambivalence in the status of such offences. That the regulation of activity was seen as not a truly criminal matter could only seek to make its accessibility to the magistracy even more problematic.

## The Approach of the Regulators

As long ago as 1877 the first Chief Alkali Inspector, R Angus Smith, recorded his view that;

*'It is better to allow some escape occasionally than to bring in a system of suspicion, and to disturb the whole trade by a constant and irritating inspection'... 'I...work simply... by advice and by friendly admonition, and the prosecutions will come in their proper time'*

Royal Commission on Noxious Vapours, 1878

This approach to use of prosecution as a weapon of last resort was deeply embedded. So much so that nearly a century later in 1971 the Chief Alkali Inspector in his report stated:

*'When the co-operative approach fails... the time arrives when corrective legal action has to be applied... Co-operation between all parties is an indispensable part of a successful anti-pollution policy. The Alkali Inspectorate has evolved such a policy over more than one hundred years... the response has been excellent'*

(Annual Report on Alkali &c. Works by the Chief Inspector (1971))

The Alkali Inspectorate was very influential in the development of our overall systems of environmental

management (McAuslan, 1991) and thus only rarely under this regime could the courts expect to encounter environmental offences. This approach, though understandable, had the effect of creating what McAuslan (1991) identified as a 'secretive closed system of regulation in which great power is vested in officials; a system which has spread into other areas of regulation' (Richardson, Ogus & Burrows, 1992). It was, and still is, a system which is no less of a secret to the magistracy than to anyone else.

It is of no surprise then that there is little real historical pedigree for the detailed involvement of the magistracy in dealing with environmental health crimes and the environmental health criminal. Thus when Carnwath (1992) said that Magistrates' Courts have had too few cases to build up any specialist experience or an appropriate tariff of penalties, this is an accurate picture and the explanation is historical. The creation of the modern office of magistrate and its evolution made it unlikely and the attitude of the regulators made it impossible.

### Regulators – Partners in Crime?

Historically, Justices would encounter environmental issues only when criminal matters were under consideration and even then not as true crimes. Further, because of the 'traditional' approaches of the agencies involved, this was perhaps too often to be a rare occurrence. Many regulatory agencies, it has been found, had adopted the co-operative approach which relied on negotiation, bargaining, education and advice to secure compliance (Hutter, 1988).

Hawkins (1984) found this attraction to informal techniques to be displayed by water authorities. Quoting one officer he recorded that;

*'...the objective of the job is not to maximise the income of the exchequer by getting fines. The job is to make the best use we can of the water for the country... we get more co-operation if we use prosecution as a last resort'* (Hawkins, 1984 p179).

Even now it is far from certain quite what the 'status' of the laws enforced are. As Hutter (1988) points out, the law in books is rarely implemented in a clear cut fashion. In this area the courts have to determine matters before them, what the law means, whether matters before them are covered by the legislation and then decide on an outcome.

The attitude of the court is significant as the views of the court might reasonably be taken to influence the views a regulatory agency might take on enforcement. The comment 'why bother if the courts give such small fines' is commonly encountered. However, the matter is more complicated than this. One reason for the non-use of prosecution as a means of enforcement is that there may be a belief that the available sanctions are neither appropriate nor effective. This is not simply a

case of fines being too small (Hutter 1988). Sometimes the fine may be, in the opinion of the officers, too large, thereby removing the possibility of money being spent on, for example, pollution prevention equipment (Richardson et al 1982). In the more marginal cases, where an enforcer cannot readily decide whether to recommend prosecution or not, his view of the court as 'an awful place' (Hawkins 1984) may even be decisive.

### Magistrates' Courts – An Effective Tribunal

There is also the deeper question of whether the nature of the adversarial system, creating a polarisation of views and even ill feeling on both sides, is in fact counter-productive in this area of the law. It may be argued that the magistrates' courts have little part to play in protecting the environment.

The sentencing function of trial courts may be questioned (Harding & Koffman 1988). In 1893 Sir Henry Hawkins called for a Sentencing Commission as a response to concerns expressed over sentencing disparities. The idea was the subject of Parliamentary debate in 1894/5 but without any practical reform. Later proposals in the 1940's from the Howard League for 'treatment tribunals' met with a similar scepticism. The use of lay justices is subject to criticism, with some commenting that sentencing is not a job for laymen (Radzinowicz & King, 1977), or expressing concerns at the ability of lay magistrates to handle highly technical issues such as a Best Practicable Means defence in Statutory Nuisance (Macrory & Woods, 2003). Yet still the court continues and its jurisdiction extends.

Others see the formal process of the law as exemplified by the magistrates' court as unhelpful. As Hawkins (1984) observes, officers of environmental enforcement agencies regard the courts as remote from, and unsympathetic to, the real problems of enforcing the law. Similarly Macrory & Woods (2003) report an Environmental Health Officer commenting that 'cases take a long time because appeals are treated no differently by the courts to prosecutions'. Magistrates may be regarded as ignorant laymen, possessing neither the knowledge nor experience of field staff, ignorant of the causes of, and treatment for, matters they consider, and lacking the technical and scientific awareness to make informed decisions. All too often officers can feel that when a case does come before the court the true issues are, in practice, obscured by rules of evidence and procedure applicable in a criminal court. Yet as Gunningham (1974) points out, this lack of expertise has never prevented the courts from concerning themselves with other activities: marriage, criminality etc. Not until the courts have dealt with a form of behaviour for some time and in some volume can one expect predictability. And it is predictability and consistency that appears to concern those involved in this area. Yet, if by their regulatory style, i.e. low levels of prosecution (Stookes P, 2002) and an attraction to

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informal methods, regulators have deprived the magistracy of experience and familiarity then they ought not to be surprised by the outcome.

It is not enough to simply claim that it is the technical complexity of environmental health cases that can cause magistrates problems. It is far too easy to claim, as Hawkins(1984) and others state, that magistrates lack the detailed technical knowledge to adequately adjudicate on these matters. The situation is altogether more complex, involving considerations of history, policy and jurisprudence.

## When is a Crime Not a Crime?

There is no substantive definition of what a crime is. Perhaps the best that can be offered is to say that a crime is conduct capable of being followed by criminal proceedings, having a criminal outcome, and a proceeding or its outcome is criminal if it has certain characteristics which mark it as criminal (Williams, 1955).

In its report the Committee on Safety and Health at Work (Robens) noted (at para 261) that the;

*'...traditional concepts of the criminal law are not readily applicable to the majority of infringements which arise under this type of legislation. Relatively few offences are clear cut, few arise from reckless indifference to the possibility of causing injury, few can be laid without qualification at the door of a particular individual. The typical infringement or combination of infringements arises rather through carelessness, oversight, lack of knowledge or mean, inadequate supervision or sheer inefficiency. In such circumstances the process of prosecution and punishment by the criminal courts is an irrelevancy... whatever the value of the threat of prosecution, the actual process of prosecution makes little direct contribution towards this end... On the other side of the coin – and this is equally important – in those relatively rare cases where deterrent punishment is clearly called for, the penalties available fall far short of what might be expected to make any real impact, particularly on the larger firms.'*

## Crimes And Quasi Crimes

In *Alphacell v Woodward* [1972] Lord Salmon placed environmental pollution clearly within the realm of other regulatory offences when he described the incident as, 'not criminal in any real sense, but acts which in the public interest are prohibited under a penalty.' The tendency of the judiciary to characterise many environmental offences, often because of their absolute nature, as not really criminal, reflects a more general view. This is the view that environmental offences are not truly criminal, there are often no obvious victims, and further suggests that they should carry neither the stigma nor perhaps the punishment of true criminal behaviour.

Hawkins (1984) identifies this as a moral ambivalence which surrounds regulatory control. He identifies the situation where there is a reluctance to regard breach of regulatory requirements as morally reprehensible. The attendant conduct is often regarded as 'morally neutral' (Kadish,1963) in contrast to those behaviours more normally seen as criminal. This is the well recognised distinction between crimes which are *mala in se* and *mala prohibita*, or those offences which are, following Curzon (1985), 'technical breaches of the law' and those offences which touch on deep rooted moral attitudes.

In crimes of strict liability there arises the question as to whether or not there may be an implied morality. A morality is implied by the enforcers in the way they enforce the law and perhaps extended to magistrates by the way they inflict punishment. Bell (1997) identified three categories of polluter: the amoral calculator motivated by greed; the political citizen who does not believe the law is necessary or reasonable, and the organisationally incompetent.

These categories do not indicate how bad the action is but instead how bad the actor is. This of course raises the very real problem for a court; how to gauge the seriousness of the offence. Is, for example, the small amount of deliberate pollution to be viewed more or less seriously than the large amount of inadvertent pollution.

Such difficulty, even though magistrates are not completely without guidance here (Environmental Law Foundation & Magistrates Association, 2003), then contributes to the situation whereby the courts, when confronted with such an offences, can find it difficult to justify to themselves the imposition of sufficiently harsh deterrent sentences. The courts recognise that culpability may have nothing to do with guilt, and thus, removed from the normal reference points of the criminal law, may display a tendency to deal with cases inconsistently.

## Survey of magistrates' attitudes

It was against the background of some of the issues raised that a study of magistrates' attitudes to environmental regulation was undertaken. The study aimed, by a survey, to examine some of the factors which may be at play when some of the issues described earlier are brought before the magistrates' court. The investigation took the form of a questionnaire survey of all lay magistrates on the bench of a large commission of the peace. The bench in question had some 381 active lay members, dealing with some 40,000 adult criminal cases in a year.

A total of 381 questionnaires were distributed with a satisfactory (Babbie & Huitt, 1979) 198 (52%) being returned.

Of those responding 44% were female. This

corresponds reasonably well with the national picture which, in 2004, found that 49% of lay magistrates were women, (Department for Constitutional Affairs, 2004).

The age data revealed a spread with the vast majority of respondents in the age ranges of 41 to 60 years of age. Hogarth (1971) has suggested that younger magistrates may tend towards extremes in sentencing decisions, while the older members of the bench tended to display more flexibility and moderation in their approach. In contrast, Harding and Koffman (1988) note that there are counter arguments to suggest that, with advancing years, comes a rigidity of viewpoint and a tendency to be out of touch with prevailing attitudes and the behaviour of younger people.

The descriptors acquired suggested that the respondents were acceptably representative of the bench in question and of the picture nationally. Using this and other information obtained it was possible to examine the relationship between age and,

- (a) the respondents' opinion on whether environmental offenders should be prosecuted more frequently and,
- (b) their opinion on the penalties given.

In all instances there was revealed no significant relationship. Neither Hogarth (1971), regarding his opinion on extremes in sentencing nor Harding and Koffman (1988), with regard to their views on rigidity of viewpoint, find support for their propositions from this study. Age did not appear to be a significant influence here, nor did gender.

## Tenure and Occupation

It was considered that the experience of a magistrate both as a magistrate (tenure) and by occupation might be an influencing factor with regard to their responses. It has been postulated that attitude to enforcement of the law may be influenced by type of occupation. Sutherland (1949) has pointed out that law enforcement may be in the hands of a social class who may be likely to sympathise with a businessman (and perhaps an environmental offender) more than a thief. The same charge could be levelled at magistrates. The low fines given for regulatory offences have in the past been explained by some as perhaps due to the general identification of magistrates with high status offenders (Paulus, 1974). This study offered the opportunity to investigate this proposition, it being possible to examine the relationship between tenure and occupation and,

- (a) opinion on frequency of prosecution,
- (b) opinion on penalties and,
- (c) appreciation of seriousness.

Once again in all instances there was revealed no significant relationship. This is an unexpected finding

as tradition suggests that experience would influence viewpoint.

This study therefore offers no support for Sutherland (1949) nor Paulus (1974).

## Training

When questioned if they had attended any environmental law training courses in the previous four years only 23 indicated that they had received some magistrate-specific training. This was largely expected as an investigation of training courses for the two years prior to the study revealed only one training course on environmentally related matters.

## Experience

In addition to training, experience must always be considered relevant to attitude. When questioned on their experience of environmental cases it was revealed that, in the previous five years, 108 magistrates had heard one or more cases in one or more relevant areas. Though this may appear to be large, when compared to the total throughput of the bench, it is a small percentage.

Thus magistrates appear likely to hear environmental cases, but this experience is equally likely to be so infrequent that there is no realistic possibility that substantial experience will be gained by any one individual. Training, which might be expected to compensate, in part, for experience is low and thus the overall experience remains limited.

## Seriousness

Magistrates questioned did appear to feel that they fully appreciated the seriousness of the cases put before them. The question was put to them: 'When dealing with environmental cases, do you fully appreciate the seriousness of the cases?' The responses are indicated in Table 1.0.

Who is the best assessor of the seriousness of the matters before the court, enforcers or magistrates? This is a key question underlying this investigation. There are no published studies on this. However, this study does at least shed some light on these issues and on the knowledge of magistrates with regard to the stated prosecution policies of the regulatory agencies.

The experience of magistrates in this area of the law is always likely to be limited. Certainly, however, one way of increasing magistrates' awareness and thus influencing the cognitive component of attitude is to make known to them the enforcement policy of the relevant environmental agency. This is unquestionably one means of assisting the courts.

**Table 1.0 'When dealing with environmental cases, do you fully appreciate the seriousness of the cases?'**

Category	Strongly Agree	Agree	No opinion	Disagree	Strongly disagree
Number	34	69	6	1	0

### The Enforcement Approach of the Regulators

It is Hawkins (1984) who recognises that law may be enforced by compulsion and coercion, or by conciliation and compromise. Studies of regulatory agencies have emphasised that enforcement should not be simply equated with prosecution. The term should be used to accommodate a, 'much wider concept defining enforcement as the whole process of compelling observance with some broadly perceived objectives of the law', (Hutter 1988).

Magistrates participating in this study indicated that they viewed the approach of enforcement agencies in the way indicated in Table 2.0.

The study also made it clear that the magistrates questioned did not simply see environmental regulators as a form of 'environmental police force'. Instead they see them having significant roles in education and monitoring. Indeed generally the roles of monitoring and education were seen as a more important role for the agencies than that of enforcement. This view is not inconsistent with the way the agencies see themselves and such findings are indicative of the courts

recognising a continued legacy of co-operation in approach to enforcement.

### Attitude

Magistrates were asked if they agreed with the statement that a proper use of discretion, based on clear principles, could better serve justice, the interests of the public and the interests of the offender, than the rigid application of the letter of the law. This question was based the Code for Crown Prosecutors and is a well established legal principle supported by empirical research. As Richardson (1982) says;

*'Casual observation alone, however, should be sufficient to demonstrate that enforcement agencies do not detect and punish every violation.'*

For all enforcing authorities it is not, nor never has been, simply a matter of whether or not to prosecute. The question on attitude was posed to obtain an indication of the respondents' appreciation of the role of the enforcers when dealing with regulatory offences. Magistrates were not found to be possessors of a uni-dimensional view of the law in this area. Over 80% of respondents had an attitude towards these offences entirely in accord with the recognised and accepted approach of the courts.

**Table 2.0 Perceived Approach of Enforcement Agencies**

Option	Magistrates' View
Statutory action recommended as a first option, prosecution actively used as a deterrent	18.2%
Prosecution and statutory action always considered but persuasion and informal action generally preferred	44.04%
Prosecution considered as a last resort and statutory action used when other options have failed	36.26%
Other	1.5%

### Prosecution

Quite what the optimal level of prosecution is remains unknown.

Magistrates were asked if they agreed with the statement that environmental offenders should be prosecuted more frequently. 79% of those responding thought that environmental offenders should be prosecuted more frequently than they are.

Sentence is a key element in deterrence and the significance of this is revealed by the fact that 70% of the respondents did not agree that the penalties for environmental offences were too high. This is particularly interesting, as a reason for the non-use of prosecution is that there may be a belief that the available sanctions are neither appropriate nor effective. That magistrates may believe the penalties to be too small is revealing of their belief in deterrence. It is not an indicator of them being 'sympathetic' to the environmental offender.

## Function

When asked how they viewed their function when sentencing an Environmental Offender, the responses in Table 3.0 and Figure 1.0 were derived.

This question is crucial as it offers an insight into magistrates' interpretation of their own role. Certainly from the findings, it would appear that magistrates see the courts as having a deterrent role in this area of the law.

## Motivation

Questioning was directed to ascertain if magistrates act according to an interpretation of purpose or letter of the law i.e. adopt a purposive approach. Some 79% of those responding claimed that, when considering the infringement of environmental laws, they considered both what provisions had been contravened and why those provisions were enacted.

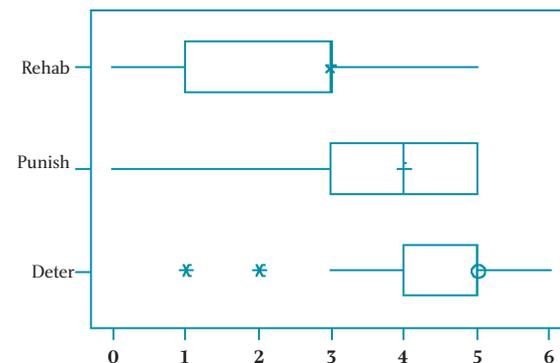
While the majority of respondents agreed with the statement that a prosecution of an environmental offender should only be taken when it appears that the offence or the circumstances of its commission is, or are, of such a character that a prosecution is required in the public interest, over a third did not. One possible interpretation of this is that those who responded negatively may accept other, unspecified criteria, as equally relevant. It is not possible to be conclusive here but if prosecution has no public interest, can any sentence have a deterrent value.

One of the questions was framed so as to try to elicit a response which might show respondents' views on the seriousness of environmental offences compared to more commonly encountered criminal cases. When examined it is clear that those questioned take environmental offences seriously (Table 4.0).

**Table 3.0: View of Function When Sentencing an Environmental Offender**

	Mean	Median
Deterrence	4.3	5
Punishment	3.9	4
Rehabilitation	2.5	3

**Figure 1.0 Box plot – Role of Sentencing**



There was a significant overlap for the bulk of the offences considered. Significantly, five of the offences had the same median score of 7 for seriousness whilst a further three shared the same median score of 8. More particularly there is an identical pattern for the offences relating to dust and noise nuisance, house burglary and the overweight lorry. Entry points for the last two are custody and a high tariff fine respectively. This would appear to support the statement that

**Table 4.0 Relative Seriousness of Offences**

	Case A	Case B	Case C	Case D	Case E	Case F	Case G	Case H	Case I
	ABH	Noise Nuisance	House Burglary	Over-weight Lorry	Shop Burglary	Dust Nuisance	Take without Consent	EPA	Theft
<b>Max</b>	10	10	10	10	10	10	10	10	10
<b>Mean</b>	8.3385	6.954	7.381	7.160	7.648	6.959	6.622	8.145	4.208
<b>Min</b>	3	2	3	2	1	3	1	2	1

Case A: Charge – Assault Occasioning Actual Bodily Harm. Case B: Non Compliance With Nuisance Abatement Notice Under The Environmental Protection Act 1990. Case C: Burglary. Case D: Overweight Lorry. Case E: Burglary. Case F: Non Compliance With Nuisance Abatement Notice Under The Environmental Protection Act 1990. Case G: Charge – Taking Without Consent. Case H: Non Compliance With Terms Of An Industrial Process Authorisation Under The Environmental Protection Act 1990. Case I: Charge – Theft

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magistrates do appreciate the seriousness of offences, though whether this is made manifest in deterrent sentences is more doubtful.

It is particularly interesting to note that the joint second most 'serious' offence was the ignoring of a Part I Environmental Protection Act 1990 authorisation. This was given the aggravating feature of being done for profit. In terms of seriousness this was viewed as seriously as a high value commercial burglary. Only the assault case was viewed more seriously, though it too had a median score of 8.

## Conclusions

A consequence of the lack of historical involvement in the area and an unclear and moral thread, is, as Croal (1988) notes, that offenders are assumed to be sympathetically and leniently dealt with in court. This treatment is attributed to the fact that, in addition to the use of strict liability in the framing of the offence, there exists a 'cultural homogeneity' between the offenders and the personnel of the court. This she notes has, arguably, led to the marginalisation of offences through a denial of moral blameworthiness and the consequent view of regulatory offences as not really criminal. When this is allied to infrequent prosecution, resulting in a lack of collective experience by the magistracy, hidden prosecution policies and ambivalence by regulatory agencies as to what they expect of the law, the problem becomes clear. The system is viewed not as the sum of its parts, but as an end point. Here any or all deficiencies are focused into a single event (a hearing or trial) and it is this single event and those who participate in it who are to blame if any deficiencies surface.

The findings of this study raise a number of interesting propositions. The study found nothing to support some of the more generally held views relating to the influence age, occupation and experience has on the magistrates' approach to their work. What is suggested, however, is that magistrates may be willing to impose morality even on an offence where it is not needed and they may then use this 'implied morality' as an indicator of seriousness and as a guide to sentencing. Thus where an offence is done for profit, the findings here indicate that magistrates will view it as more serious. The court here is not looking at how bad the pollution is but how bad the polluter is. Their focus may not be how morally bad the action (in terms of consequence) is but how morally bad is the actor (in terms of motive).

The findings of the survey indicate that magistrates can appreciate the seriousness of environmental offences, at least when compared to more mainstream criminal matters. It also suggests that they do share a similar view as to the function of the law as is held by the enforcing authorities, and further see deterrence as the most significant aim of sentence in this area. Why then is it that they are felt not to hand out sufficiently large (deterrent) penalties?

The answer surely comes back to morality or blameworthiness. It is not that the magistrates identify with the environmental offender: the survey finds no evidence of this nor for the 'cultural homogeneity' appearing to be significant. The majority of magistrates even agreed with the proposition that environmental offenders should be prosecuted more frequently. It surely comes down to the fact that the offence is not viewed ultimately as bad, i.e. morally blameworthy.

So few environmental cases have historically come before the courts that magistrates have very little with which to compare them. The typical training of magistrates does not address environmental matters and the experience of training generally is low. And though cases do generally appear to be well presented this is not enough to compensate for their scarcity. Where then do magistrates look? Surely it is to the 'true crimes' which they encounter daily. It is these which provide the datum and the method and it is this approach which helps to define the problem.

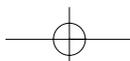
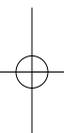
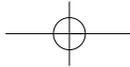
Decisions reached by magistrates must be taken to constitute the final, and public, link in the chain of environmental regulation. It is perhaps only here that the public can clearly see and hear an obvious and tangible 'result' flowing from highly complex policy issues. It is here that the final decisions will often be reached on matters distilled from a concoction of local and central government policy, the policy of industry, the choice of individuals, precedent, the decisions of individual enforcement officers and that most intangible of judicial ingredients 'common sense'. This is a complex combination especially when, in this context, magistrates are dealing with those who, according to orthodox criminal parameters, are not criminal (Taylor, Walton & Young, 1975). The criminal law has been identified by Ball and Friedman (1965) as more than a set of propositions, more than a moral code, more than a catalogue of rights and wrongs. A set of precepts and definitions lies at the heart of it and it is administered through highly organised institutions. Criminal justice does not exist only of penal statutes: it is also judges and courtrooms. Any realistic discussion of this area must recognise this.

Perhaps in the longer term labelling environmentally damaging conduct as criminal may change the public attitude towards those who break the law as well as those who are tempted to break it. It may help to erect the signposts which will assist all concerned to navigate in this developing area of the law. Perhaps even as in other areas morality will catch up with the law.

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# A case study of adolescent exposure to tobacco smoke

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## Abstract

This paper sets out the findings of a local study into the exposure of young people to tobacco smoke, through both active smoking and passive exposure to environmental tobacco smoke (ETS). The study was undertaken with 179 year-eight pupils (aged twelve to thirteen years) at one comprehensive school in Monmouthshire, Wales. The study aimed to provide measures of local smoking status and exposure to ETS at a time of considerable debate about passive smoking and smoke-free environments. Methodology included a self-complete questionnaire and saliva cotinine analysis. The findings show that over half the study group were exposed to ETS over the previous three days. Whilst public places were a common contributor, the findings suggest that home was the major source of ETS. Saliva cotinine levels demonstrated statistically significant associations between smoking status and exposure to ETS. The author concludes that more needs to be done if children are to enjoy smoke-free air and that action to deter young people from smoking should not focus only on young people but take account of the wider influences around them.

**Key Words:** Adolescent, cotinine, environmental, exposure, passive, saliva, smoking, tobacco.

## Introduction

Tobacco smoking has been identified as the leading cause of premature illness and death in developed countries (Murray and Lopez, 1996). The majority of smokers take up the habit in their teens (Thomas *et al*, 1998) and in Wales teenage smoking levels remain high particularly amongst teenage girls (Currie *et al*, 2004). In recent years exposure to environmental tobacco smoke (passive smoking) has received increasing attention.

Smoking has been identified as a key issue in the Health, Social Care and Well Being Strategy for the People of Monmouthshire (Monmouthshire Local Health Board, 2004, Monmouthshire County Council and Local Health Board, 2004). While data exist at the national level through the Health Behaviour in School Aged Children (HBSC) Study (Currie *et al*, 2004), no reliable data on adolescent smoking rates are available

at county level. Local information is required to inform local priorities.

Local measures of smoking status are needed and our knowledge of exposure to environmental tobacco smoke (ETS) is even less developed.

## Aims

The aims of the study were to:

- Assess smoking rates amongst 13 year olds locally,
- Obtain data on the level and nature of their exposure to ETS and,
- Obtain the study group's views on environmental tobacco smoke.

## Methods

The research was undertaken with the whole of year eight pupils (aged 12 and 13) at one comprehensive school in Monmouthshire, Wales. The school covers a wide geographical area comprising a small town and surrounding villages in a rural area. It is one of four comprehensive schools serving the county. Year eight at the school comprised 213 mixed ability pupils.

The research was undertaken by way of analysis of saliva cotinine concentrations and a short self-complete questionnaire. Cotinine is a metabolite of nicotine and one of several biological markers used as indicators of exposure to active or passive smoking and is generally considered as the most useful (Benowitz, 1999). Saliva samples were collected using a cotton wool dental roll (salivette). The sampling methodology was designed to eliminate risk of contamination of samples. Analysis of the samples was undertaken by ABS Laboratories (London) using solvent extraction into dichloroethane, injected into a gas chromatograph which has an FFAP column and a Nitrogen/Phosphorous Detector.

The questionnaire comprised a small number of questions relating to self-reported smoking status, smoking status of close family and best friend, whether they had spent time over the past three days indoors where someone else was smoking and their views

about ETS. To compare with national data, consistency was maintained with questions contained within the international Health Behaviour in School Aged Children (HBSC) Study.

Parents had previously been written to directly via normal post to explain the survey aims and methods, and to gain opt-out consent. Pupils had been informed, by the school, of the purpose of the survey and the voluntary nature of participation although they were encouraged to participate as part of the school approach to Personal and Social Education. The main session of field-work was undertaken on a Monday morning (12th July 2004) with a follow-up three days later to pick up absentees. Pupils were assured of anonymity regarding their responses and test results.

## Results

In total 179 pupils were surveyed. The school roll for year eight totalled 213 pupils (123 boys and 90 girls). Seven parents opted out prior to the survey, representing 3.3%. Three pupils dropped out (shown as "refused during fieldwork") because of non-acceptability of the cotton-wool salivettes. Twelve pupils were absent from school and twelve pupils did not attend but were not recorded as absent from school, representing 5.6% of the year roll.

The average age of children surveyed was 13.4 years.

### Smoking rates

#### Ever smoked

37% of boys and 58% of girls self-reported ever having smoked at least one cigarette (or cigar or pipe). This compares to Wales figures of 35.5% and 47.5% for boys and girls respectively.

#### Current smoking status

4% of boys reported smoking at least once a week compared to 17% of girls. This compares to Wales figures of 8.1% and 14.8% respectively (although the mean age of the study group was around six months lower than the Wales sample as shown in Table 1.0).

One boy who reported being a non-smoker and having never smoked had a cotinine level of 28.3. A saliva cotinine level of 15ng/ml is generally taken as a reliable cut-off point for smoking status (Murray and Lopez, 1996). Given the high cotinine level (and no identifiable passive exposure) it is probable that the subject was an active smoker. For this reason, this subject was excluded from some analyses.

### Smoking status and relationships with other smokers

43.8% of responders reported that their father smokes and 42.1% of responders reported that their mother smokes. Remaining pupils either reported not knowing whether either parent smoked or not having contact with their mother or father. There was a statistically significant association between pupils' smoking status and the smoking status of their parents ( $p < 0.01$ ) and also between pupils smoking status and the smoking status of their 'best friend' ( $p < 0.01$ ).

### Desire to give up

Over half of smokers (56%) said they wanted to give up, a third were unsure and only 11% said they did not want to give up.

### Exposure to passive smoking over the past three days

56.7% (107 no) of those surveyed reported spending time over the past two to three days indoors where someone else was smoking. There was a statistically significant association between smoking status and exposure to other people's smoke ( $p < 0.01$ ).

As illustrated in Figure 1.0, 40% of pupils were exposed to passive smoking in their own home. A total of 51% of pupils were exposed to passive smoking in their own or someone else's home. This accounted for 84% of those who reported exposure to ETS in the past three days. Figure 1.0 shows that for all sources of ETS, a greater proportion of smokers than non-smokers experienced exposure. 47% of non-smokers reported exposure to passive smoking.

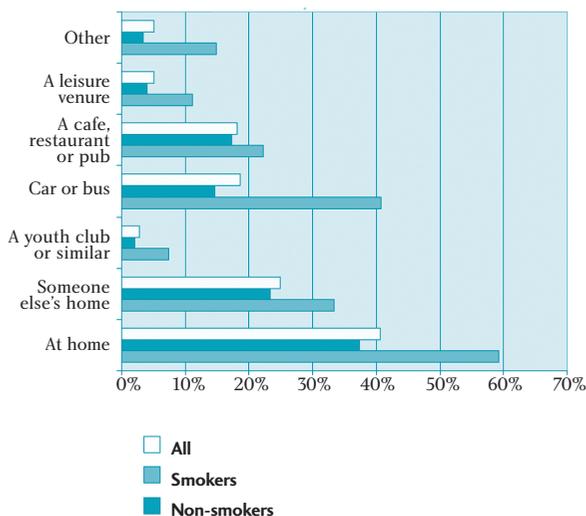
When asked whether anyone they live with smokes in the house, 33% of all respondents reported that their

**Table 1.0: Comparison of study data with national data: 13 year olds who smoke at least once a week (%) (self reported)**

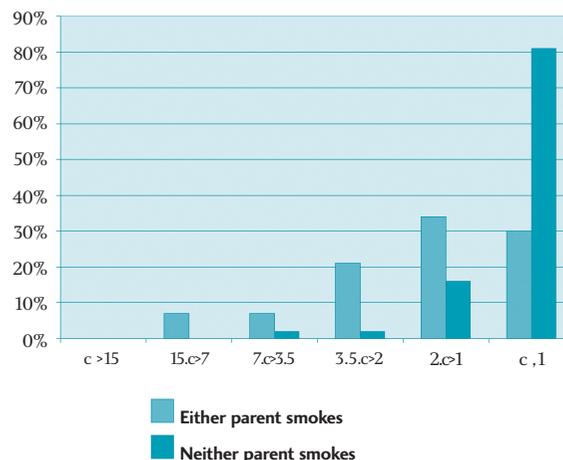
	Study group	Wales*	HBSC Average*
Boys	4%	8.1%	8.9%
Girls	17%	14.8%	7.9%
Mean age in survey	13.4	14.0	13.6

\*source: Currie *et al*, 2004.

**Figure 1.0: Place of exposure of those exposed to ETS**



**Figure 2.0: Percentage of non-smokers with given cotinine levels, by parental smoking status**



father does, 35% their mother, 15% their brother or sister and 22% someone else.

**Saliva cotinine levels**

**Cotinine levels and smoking status**

As summarised in Table 2.0, saliva cotinine concentration was strongly associated with reported smoking status. Mean cotinine levels of regular smokers was 100, with a mean of 9.0 for those smoking less than once a week and 1.04 for non-smokers. For non-smokers the mean concentration was 1.11 ng/ml for

boys and 0.93 ng/ml for girls.

Three subjects had cotinine concentrations of over 300 ng/ml, the highest being 422 ng/ml. Given the discussions above this suggests high, daily cigarette consumption.

**Cotinine levels by parental smoking habits**

As shown in Table 3.0 and Figure 2.0, mean cotinine levels were strongly associated with parental smoking status for both smokers and non-smokers.

42% of non-smokers had cotinine levels of over 1 ng/ml, including 18% with over 2.0 and 8% over 3.5. Although cotinine levels in non-smokers ranged up to 12.4 ng/ml, the highest level of a self-reported non-smoker with non-smoking parents was 3.6. The majority of non-smokers with non-smoking parents (81%, n=47) had cotinine levels below 1.0 ng/ml.

**Table 3.0: Mean cotinine levels by parental smoking status**

	Non-smokers	Smokers only
One or both parents smoke (n=89)	1.81 (n=70)	97.7 (n=19)
Neither mother or father smoke (n=63)	0.26 (n=58)	15.4 (n=5)

**Cotinine levels by exposure to ETS**

For non-smokers, cotinine levels were strongly associated with exposure to ETS. Those not exposed had a mean level of 0.22 compared to 1.71 for those exposed.

All cases except one with a cotinine level of 15 or higher (range 18.2 to 422, n=16) could be explained by

**Table 2.0: Cotinine levels by gender and self-reported smoking status**

	All respondents		Smokers		Non-smokers	
	Boys (n=100)	Girls (n=79)	Boys (n=9)	Girls (n=18)	Boys (n=91)	Girls (n=61)
<b>Mean cotinine level</b>	4.89	4.75	63.7	73.6	1.11	0.93

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**Table 4.0: Views on ETS**

	Smokers (n=27)	Non smokers (n=152)
I don't like people smoking around me	11%	82%
I think it's cool	7%	0%
I don't like smoky places	11%	70%
Lots of people smoke, it must be OK	0%	1%
Smoky places don't bother me	56%	7%
Smoking can really harm your health	59%	78%

self-reported active smoking. At a level of 28.3ng/ml and no self-reported passive exposure it is probable that this one subject was an active smoker. All subjects with a cotinine level below 15ng/ml except one were self-reported non-smokers. That one subject self-reported smoking less than once a week and had a cotinine level of 3.7.

For those non-smokers with a saliva cotinine level of 2.0ng/ml or above (26 no), exposure to ETS was identified as being from a mixture of public places or home environment or both. The four highest values for self-reported non-smokers were 12.5ng/ml and 10.6ng/ml (identified exposure at home only – parental smoking) and 9.2 and 8.3 (public places only).

**Views about environmental tobacco smoke**

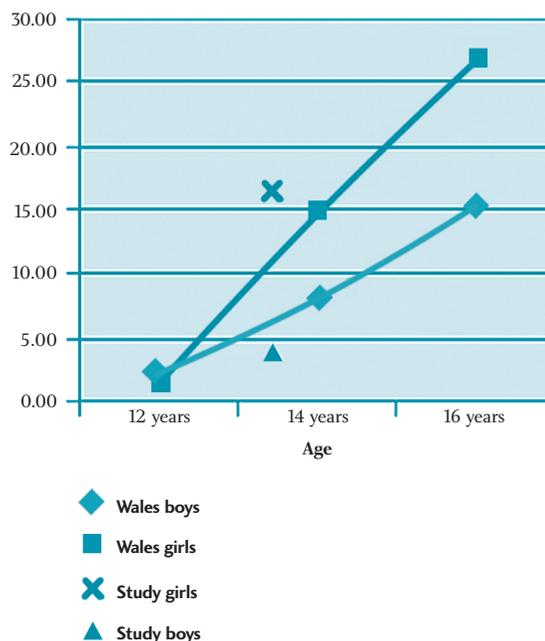
Pupils were asked which of the statements (shown in Table 4.0), if any, they agreed with. As shown, there was a strong association between responses to this question and smoking status.

No regular smoker said that they 'don't like people smoking around me'; and only one smoker said they 'don't like smoky places'. 82% of non-smokers said they don't like people smoking around them.

**Discussion and Critique**

There was some drop-out due to parental refusal and absence. These totalled 19 and although an association has been shown between school absence and smoking rates (Griesbach and Currie, 2001), the author considers that the greater potential bias arises

**Figure 3.0: Smoking rates at 11, 13 and 15 in Wales (Currie et al) and study group**



The graph illustrates smoking rates at the Wales level at "aged 11,13 and 15" with the scale showing the actual mean ages of 12.0, 14.0 and 16.0 respectively. Source: HBSC Survey

from those who did not attend (i.e. they neither 'refused' nor were recorded as absent from school on both days) if smoking status played a part in their non-attendance.

The fieldwork was undertaken in July, and the average age of the cohort (at 13.4 years) was a little more than 6 months younger than the mean age for the national survey (at 14.0 years). This is a time period of significant smoking uptake as illustrated in Figure 3.0. Given that smoking rates nationally are known to rise sharply around this age (Currie et al, 2004) this suggests a higher age for age rate than the national average.

Whilst saliva cotinine levels provide a good marker for exposure to tobacco smoke there are challenges in interpreting the data. Cotinine has a half-life of around 20 hours, therefore with no further exposure, a saliva cotinine level will be about half of what it was 20 hours ago. An obvious question is whether we can relate cotinine levels in a passive smoker to an equivalent number of cigarettes actively smoked. Even in active smokers this is problematic because other factors play a part including the type of cigarette smoked, butt length, smoking intensity and metabolism (Etter and Perneger, 2001). Studies have consistently shown levels of higher than 15ng/ml in smokers (Etter et al, 2000). Research suggests that non-smokers with exposure to 'typical levels of ETS' have cotinine levels of less than 1ng/ml with heavy exposure to ETS producing levels in the range 1 to 15ng/ml (Reagliato,

2002). Mindful of what has already been said, a typical figure of around 14ng/ml per additional cigarette smoked was suggested by Etter *et al* (2000), with a levelling off after around 20 cigarettes per day, although that study was on adults.

This study might well prompt the question of what the cotinine levels tell us about risks to health. However, its aim was not to assess health risks associated with exposure but merely to obtain a measure of levels of exposure and sources. Clearly, the assessment of direct health affects is a different question. However, the study demonstrated an association between exposure to passive smoking and active smoking status. The reasons for this are unclear, however possible explanations include non-smokers avoiding smoky places or that exposure to other people's smoke influences young people's uptake of the habit.

Survey work was undertaken in July (in term-time), therefore passive smoking exposure might reasonably be expected to be somewhat lower than might be the case during the winter months as children and adults might be out of doors more and increased ventilation tends to be provided in warmer weather.

The study was not undertaken on a sampling basis and related to one age group in one locality and its findings are not necessarily transferable to other population groups. The study comprised a small number of smokers so care is needed in drawing conclusions in relation to that sub-set.

## Key Findings

- Smoking rates amongst girls in the study group are higher than the Wales average but lower for boys.
- There is a strong relationship between exposure to other people's smoke and active smoking status.
- The study confirms a strong association between the smoking status of pupils and smoking status of their parents.
- The study suggests a strong association between smoking status and smoking status of best friends.
- Over half of the children were exposed to Environmental Tobacco Smoke (ETS) over the previous three days.
- In this study group, the greatest contributor to ETS was the home environment although a significant proportion of pupils are also exposed in public places.

## Conclusions

- Smoking rates of 13 year olds in this study should give cause for concern.
- A high proportion of the children in the study group were exposed to passive smoking, demonstrating that much more needs to be done if young people are to enjoy smoke-free air.

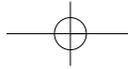
- Action to deter young people from smoking should not focus only on young people but take into account wider influences around them. A multi-faceted approach is needed.
- A strong relationship between pupils' active smoking status and their views about ETS, parental smoking habits and smoking habits of best friends suggest potential for indirect questions to be used as an indicator of smoking levels, even if only in larger groups.

## Acknowledgements

Grateful thanks are due to the following colleagues who assisted with this research: Gareth Barker (Head Teacher), Nia Chappell, Cerys Fry, Gill Johnson, Judy Moreland, Michele Wehden, Nicola Williams and Sally Williams (who assisted in taking samples during fieldwork) and Bernadette Kelly (administration, taking samples and data input).

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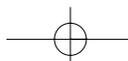
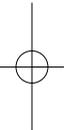
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# Assault, Consent and Body Art: A review of the law relating to assault and consent in the UK and the practice of body art

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## Abstract

The act of piercing another person's body in the guise of fashion, beauty or for ritual purposes can give rise to a range of physical injuries that could constitute a serious offence under UK law. This paper examines and interprets the basic elements of common and statute law relating to physical and sexual assault in the context of the practice of body art.

In the main it is quite clear that the law recognises certain practices as being acceptable when undertaken by consent that in other circumstances would lead to prosecution – cosmetic piercing, electrolysis, acupuncture, tattooing and semi-permanent skin colouring are all subject to specific legislative controls or are referred to in court judgements.

Whether nipple or genital piercing is an offence under the Sexual Offences Act 2003 depends on whether it is considered to be sexual. If it is, a person over 13 can consent to it, but a child under 13 cannot. If it is not sexual then it could still be an assault at common law or under the Offences Against the Person Act 1861. This issue is explored.

Branding, beading, braiding, amputation and tongue splitting lie at the extreme end of the scale of body art activities. The courts have not as yet been asked to rule on these as commercial activities but they are so extreme that such levels of violence and harm could well be classified as unacceptable to public policy and the courts could adopt the same approach as in the case of Brown (1994) which is explored in the paper. Whilst these 'extreme' activities do not fall to local authorities to control as they go beyond 'cosmetic piercing', given their association with body art they are likely to be undertaken from premises used for licensed cosmetic piercing activities.

Relevant case law is examined and the potential of the Human Rights Act 1998 to influence the interpretation of existing law is explored.

**Key Words:** Assault, body art, consent, cosmetic piercing, tattooing.

## Introduction

In 2003 The Local Government, Sexual Offences and Female Genital Mutilation Acts received Royal Assent. These had a direct relevance to Environmental Health Practitioners (EHPs) and the regulation of body art.

The Local Government Act 2003 (s120 and schedule 6) was the most significant because it extended the range of licensable activities under the Local Government (Miscellaneous Provisions) Act 1982 to include 'cosmetic piercing' and 'semi-permanent skin colouring' in addition to acupuncture, tattooing, ear piercing and electrolysis.

EHPs working in London and a few other large conurbations have been licensing such activities for some time under local Acts of Parliament. In London cosmetic piercing has been controlled since 1981 (Greater London Council (General Powers) Act) and semi-permanent skin colouring since 1991 (London Local Authorities Act).

Experience in the administration of these provisions has raised a number of questions; for example, does the practice of body art constitute an assault; can a person consent to all forms of body art; when piercing children is there a legal duty to obtain consent from a parent; at what age can nipple or genital piercing be undertaken; is there a point at which certain activities become illegal?

This paper discusses these questions and suggests some possible answers based on relevant common, statute and case law.

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## What is Body Art?

Body art is a form of human expression that has existed in various cultures of the world for thousands of years. Denton (2001) lists a range of activities and most people will be familiar with tattooing and the common piercings associated with the face (ear, nose, mouth, eyebrow), nipple and navel but the more unusual or extreme activities may benefit from a brief explanation.

**Genital Piercing.** In the male this involves piercing the glans, foreskin, frenum and scrotum, while female piercings involve the clitoris, clitoral hood, and labia (majora and minora).

**Scarification.** Cutting of the skin to encourage scar tissue to form and produce deep and clearly visible marks. It is usually carried out on the back and chest. The scars may be enhanced by using ash or tattooing ink in the wound.

**Beading.** Involves the insertion of inert beads under the surface of the skin, often of the penis.

**Tongue Splitting.** Cutting the free end of the tongue vertically to form two ends (like a snake's tongue).

**Branding.** The permanent marking of the skin by burning with hot or cold instruments.

**Braiding.** The practice of cutting adjacent strips of skin, keeping one end attached then plaiting the strips and reattaching the free ends, so that the skin heals in a plaited or braided form.

**Amputation,** usually of the fingers. Historically certain cultures practiced amputation to mark the death of a loved one or to show a serious personal failing.

**Clitoridectomy and labia removal.** The cutting away of the visible parts of the clitoris and/or labia. It may also involve the sewing together of the cut edges of the labia to prevent sexual activity.

## Law of Assault

The practice of body art gives rise to various types of bodily injury, which are subject to legal restrictions by common and statute law. The general term "assault" covers a wide range of activities including: Common Law – Common Assault (assault by threats), Battery (assault by beating) and Maiming, Statutory Law – Assault causing actual bodily harm, Wounding, Grievous bodily harm (GBH) and Wounding with intent to cause GBH.

### Assault at Common Law

Assault and battery are distinct offences at common law. An assault is any act which intentionally or recklessly causes a person to apprehend immediate unlawful force or personal violence (Card 2001). It is not necessary to

have actual contact or any physical injury (Mansfield Justices Ex p Sharkey (1985)). The offence of battery is the intentional touching of another person without the consent of that person and without lawful excuse. It need not necessarily be hostile, rude or aggressive" (Smith 2002).

A battery often (but not always) includes an assault and consequently the term "assault" is often used to cover both types of offence. A helpful starting point for considering the law of assault was given in the judgement of Lord Justice Goff in *Collins v Wilcock* (1984):

*"... the fundamental principle, plain and incontestable is that every person's body is inviolate. It has long been established that any touching of another person, however slight may amount to a battery... the law cannot draw the line between different degrees of violence and therefore totally prohibits the first and lowest stage of it, every man's person being sacred and no other having the right to meddle with it in the slightest manner...but so widely drawn a principle must inevitably be subject to exceptions... Generally speaking consent is a defence to battery and most of the physical contacts of ordinary life are not actionable because they are impliedly consented to by all who move in society and so expose themselves to the risk of bodily contact. So nobody can complain of the jostling which is inevitable from his presence in... a supermarket, an underground station or a busy street."*

Assault and battery are among a small number of offences that only exist at common law and their definition is found in the rulings of Judges. Unless statute law has set limits on punishments these are also found in common law (Card 2001). Section 39 of the Criminal Justice Act 1988 established common assault and battery as being only triable in the Magistrates' Court and set a maximum punishment of a level 5 fine or 6 months imprisonment.

### Assault in Statutory Law

Statutory offences were introduced by the Offences Against the Person Act 1861 (as amended) to deal with the more serious harms that people inflict on each other.

An assault occasioning actual bodily harm (s47) arises where an injury is the natural result of what was done. (Notman, 1994; Roberts, 1971). Typical examples of injuries at this level are – a lost or broken tooth or minor cuts and bruises.

More serious injuries fall within Sections 18 & 20 of the Act. The difference between the two being the element of "intent" necessary under section 18 which is reflected in the more severe potential sentence of life imprisonment.

Section 20 established the offence of malicious wounding where the injuries (wounding or GBH) are inflicted which are a consequence of an action but were

not intended e.g. a fight where a person receives a deep cut or a broken arm.

Section 18 deals with wounding with intent to do grievous bodily harm. Injuries such as stabbing, shooting or beating with a weapon would fall into this category. The meaning of "grievous" was addressed in *Metharam* (1961) and means that (really) serious bodily harm needs to result from the action.

There are a number of other specific statutes that are relevant to the practice of body art – the Sexual Offences Act 2003 and Female Genital Mutilation Act 2003 which will be considered with respect to genital and nipple piercing, and the Tattooing of Minors Act 1969 which prohibits the tattooing of persons under 18 years of age.

Case law has provided definitions to some key concepts which are of relevance to EHPs involved in the regulation of body art, viz:

**Wounding:** This was defined in the case of *JJC (a minor) v Eisenhower* (1983) as a break in the continuity of the whole skin. This is an important definition as the practice of body art can result in a break in the continuity of the whole of the skin. A wound from a piercing is less serious than from scarification, but both are capable of being prosecuted under s20 Offences Against the Person Act 1861.

**Unlawfully:** The judgement of Chief Justice Lord Lane in the Attorney Generals Reference (No 6 of 1980) to the Court of Appeal is authority on the extent of the lawful use of violence. The case related to a fight between two youths and considered the issue of consent:

*"It is not in the public interest that people should try to cause or should cause each other actual bodily harm for no good reason... it is immaterial whether the act occurs in private or public; it is an assault if actual bodily harm is intended and/or caused... nothing we have said is intended to cast doubt on the accepted legality of properly conducted games and sports, lawful chastisement or correction, reasonable surgical interference, dangerous exhibitions etc. these apparent exceptions can be justified as involving the exercise of a legal right, in the case of chastisement or correction, or as needed in the public interest, in other cases... the participants would have been guilty of an assault (subject to self defence) if ... they intended to and/or did cause actual bodily harm."*

The Law Lords also made reference to what was "lawful" in deciding the case of *Brown* (1994) and extended this to include tattooing and ear piercing.

**Intent:** It was argued in *Brown* (1994) that without a hostile intent no offence of assault is committed. This could also be applied to body art where there is no hostile intent. Lord Mustil commented on this, although he dissented from the majority decision on the appeal as a whole:

*"Hostility is present in the great majority of offences dealt with by the Courts under the Act of 1861. Nevertheless I cannot accept it as a statement of the existing law." Later he said "The Doctor who hastens the end of a patient to terminate his agony acts with the best intentions and quite without hostility to him in any ordinary sense of the word, yet there is no doubt that notwithstanding the patient's consent, he is guilty of murder. Hostility cannot, it seems to me, be a crucial factor which in itself determines guilt or innocence."*

### Prosecuting cases of assault

The Crown Prosecution Service (CPS) applies a two-stage test to all cases before deciding whether or not to take a prosecution. The first test is that of "evidential sufficiency" – is there enough evidence against the defendant? There must be a "realistic prospect of conviction".

If the first stage is passed the second stage is that of public interest. "Is it in the public interest to bring the case to court"? The Crown Prosecutor must consider the public interest in going on with a prosecution and balance the factors for and against prosecution carefully and fairly before coming to a decision.

A prosecution will usually take place unless the public interest factors against prosecution clearly outweigh those in favour of prosecution. Broadly speaking, the more serious the offence, the more likely it will go ahead. A prosecution is less likely to proceed where a court would impose a nominal penalty or the loss or harm can be described as minor and was the result of a single incident, particularly if it was caused by a misjudgement (CPS 2004).

In most cases of assault the victim's lack of consent is an important element of the case. However in a number of the decided cases (*Brown* (1994), *Slingsby* (1995) and *Wilson* (1997)) the victims did not make any complaint to the police and were willing participants in the activity causing the injury but the prosecutions took place nevertheless.

### Consent to acts of violence

Under certain circumstances the courts have ruled that it is not in the public interest for people to give consent to acts of force against their own body.

To establish an offence of common law assault or battery it is usually necessary for the prosecution to prove that the victim did not consent to the defendant's actions but this may not be necessary if the public interest requires otherwise or in circumstances where a "breach of the peace" exists (*Coney* (1882)). There is a "breach of the peace" whenever harm is actually done or is likely to be done to a person or in their presence to their property, or a person is in fear of being harmed (*Pritchard* 2001).

Beyond consent to common law assault or battery the issue is somewhat confusing as the appeal cases of

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Brown (1994) and Wilson (1997) illustrate. It was held by the House of Lords in Brown that consent was not a defence to offences of actual bodily harm, wounding or GBH, whilst in Wilson the Court of Appeal decided that it was a defence to actual bodily harm.

#### **Brown (1994)**

Brown and five co-defendants were convicted of offences of wounding and actual bodily harm under the Offences Against the Person Act 1861 (as amended). They willingly and enthusiastically participated in acts of sado-masochistic violence. No complaint had been made to the Police about the acts, which were identified whilst investigating other matters. No serious or permanent injury resulted from the activities. The Crown Court trial Judge ruled that the consent of the victim afforded no defence to the charges. They pleaded guilty and received custodial sentences. Their convictions were upheld by both the Court of Appeal and the House of Lords. Some of the injuries inflicted by Brown and his co-defendants were similar to those associated with body art, though the circumstances in which they were inflicted were very different. For example one man had his foreskin nailed to a piece of wood, resulting in a puncture wound similar to a cosmetic piercing, whilst another had his scrotum cut with a knife resulting in injuries similar to scarification. All parties accepted that consent was available as a defence to a common law assault or battery in circumstances where there was no breach of the peace and that grievous bodily harm could not be consented to. They argued that the line where consent was not available as a defence needed to be drawn at some point above common assault and below maiming. Maiming has been unlawful in common law since the Reign of Henry IV as it deprived the King of fit men to serve in the army or navy (Brown (1994)). It was suggested that consent could be given to actual bodily harm and wounding, but not to grievous bodily harm. The Lords rejected these arguments. Lord Jauncey of Tullichettle summarised the broad position stating:

*“The basic argument propounded by all the appellants was that the receivers having in every case consented to what was inflicted upon them no offence had been committed under Sections 20 or 47 of the Offences Against the Person Act 1861. All the appellants recognised however that so broad a proposition could not stand up and that there must be some limitation upon the harm which an individual could consent to receive at the hand of another. The line between injuries to the infliction of which an individual could consent and injuries to whose infliction he could not consent must be drawn ... where the public interest required.”*

The House of Lords upheld the convictions and decided that as a matter of public policy the violence associated with sado-masochistic homosexual practices was not something that fell within the exempt categories of violence. Laskey, one of the co-defendants appealed to the European Court of Human Rights in Strasbourg, where the conviction was held not to contravene Article 8 of the European Convention on Human Rights (right to respect for private life) as being necessary in a

democratic society for the protection of health and morals (Laskey, Jaggard and Brown v UK 1997).

#### **Wilson (1997)**

Wilson was convicted of actual bodily harm for branding his initials on his wife's buttocks at her request. He appealed to the Court of Appeal who criticised the decision to bring the case to trial at all and drew an important distinction between the case and that of Brown. Lord Justice Russell said:

*“Mrs Wilson not only consented to that which the appellant did, she insisted on it. There was no aggressive intent on the part of the appellant. On the contrary far from wishing to cause injury to his wife, the appellants desire was to assist her in what she regarded as the acquisition of a piece of personal adornment, perhaps in this day and age no less understandable than the piercing of nostrils or even tongues for the purpose of inserting decorative jewellery. In our judgement Brown is not authority for the proposition that consent is no defence to a charge under section 47 of the Act of 1862 in all circumstances where actual bodily harm is deliberately inflicted. The Lords referred to tattooing as being an activity which, if carried out with the consent of an adult, does not involve an offence under section 47 albeit that actual bodily harm is deliberately inflicted. For our part we cannot detect any logical differences between what the appellant did and what he might have done in the way of tattooing. Does public policy or the public interest demand that the appellant should be visited by the sanctions of the criminal law? The majority in Brown clearly took the view that such considerations were relevant. If that is so, then we are firmly of the opinion that it is not in the public interest that activities such as the appellant's... should amount to criminal behaviour. Consensual activity between husband and wife, in the privacy of the matrimonial home, is not, in our judgement, normally a proper matter for criminal investigation, let alone criminal prosecution.”*

Wilson's conviction was quashed by the Court of Appeal. The Court took quite a different view to the House of Lords in Brown (1994) as to the nature of the injury and the situation and circumstances in which it was performed. It is significant that the Court expressed a view that to seek a piece of personal adornment (branding) was no less surprising than to have a piercing. This clearly indicates that the Court of Appeal drew a distinction between the violence and injuries associated with sado-masochistic sexual behaviour and loving non-sexual behaviour.

The commercial practice of body art probably falls somewhere between the two, being neither overtly sexual in nature, but it is not undertaken as part of a loving relationship.

#### **The quality of consent**

When considering consent the Courts will have regard to the circumstances of the person as there are situations where it might be invalid. In Brown (1994)

Lord Slynn of Hadley set out general principles relating to consent:

*“Three propositions seem to me to be clear. It is inherent in the conception of assault and battery that the victim does not consent. Secondly, consent must be full and free and must be as to the actual level of force used or pain inflicted. Thirdly there exist areas where the law disregards the victim’s consent even where that consent is freely and fully given. These areas may relate to the person (e.g. a child); they may relate to the place (e.g. public); or they may relate to the nature of the harm done.”*

In the case of *F v West Berkshire Authority* (1989) Lord Goff made reference to those who:

*“by reason of their youth or mental disorder are unable to give consent.”*

Subject to any overriding public policy objections there is a two-limb test for consent: the person giving consent must be capable of giving it in terms of their age and mental state, and, it is given fully and freely with the knowledge of the actual level of force used or pain inflicted.

### Consent and age

Many parents expect to have a say in what their children do and rely on the law to support this, but this is not necessarily the view of the Courts as the case of *Gillick v West Norfolk and Wisbech Area Health Authority* (1985) demonstrates. Following the publication of advice on the legality of doctors prescribing contraceptives to girls under 16 (the legal age for consent to sexual intercourse without parental consent), Mrs Gillick sought an assurance from her local area health authority that her daughters would not be given advice or prescribed contraceptives without her prior knowledge and consent. The health authority refused and Mrs Gillick took action against them and the matter was appealed to the House of Lords.

The case provided some useful guidance on the consideration of age and consent. The Lords held that a child became increasingly independent as it grew older, and that parental authority dwindled correspondingly. Parental rights were recognised by the law only as long as they were needed for the protection of the child and such rights yielded to the child’s right to make his own decisions when he reached a sufficient understanding and intelligence to be capable of making up his own mind.

Based on this judgement it would appear that if a piercer is satisfied that a young person requesting a piercing had reached sufficient intelligence and understanding to be capable of making up his/her own mind the piercing could be undertaken without authority from a parent or guardian. However the younger the person the more difficult it must be to reach the necessary threshold of intelligence and understanding.

## Sexual Offences and Body Art

Nipple and genital piercing could be offences under either The Sexual Offences Act 2003 or the Female Genital Mutilation Act 2003. The Sexual Offences Act 2003 largely repealed the Sexual Offences Act 1956 and lowered the age at which a young person can consent to a sexual assault from 16 to 13. Under s3 a person (A) commits an offence of sexual assault if:

- (a) he (A) intentionally touches another person (B),
- (b) the touching is sexual,
- (c) (B) does not consent to the touching, and,
- (d) A does not reasonably believe that B consents.

Whether a belief is reasonable is determined having regard to all the circumstances, including any steps A has taken to ascertain whether B consents (s3(2)). Section 78 defines touching as “sexual” if a reasonable person would consider that ‘whatever its circumstances or any person’s purpose in relation to it, it is because of its nature sexual’, or, ‘because of its nature it may be sexual and because of its circumstances or the purpose if any person in relation to it (or both) it is sexual’.

The s7 offence of Sexual Assault of a child under 13 is similar to that under s3 but there is no provision for the child to give consent.

Whether nipple or genital piercing is “sexual touching” will depend on how a “reasonable person” views the activity. If it is not considered “sexual” it would allow a person under 13 to give consent within the context of the Sexual Offences 2003 Act. If however it was considered to be “sexual touching” a person over 13 could consent to it.

The only activity that is clearly prohibited by the Sexual Offences Act 2003 is the sexual touching of a person under 13. Non-sexual touching of a person of any age is not an offence under the Act but could still be an assault under common law or statutory law if it was undertaken without consent, or if the level of injury was sufficiently serious. Two further decided cases are worthy of mention in relation to consent and sexual assault. In *Boyea* (1992) the defendant caused injury to a female during willing vigorous sexual activity. His conviction under the Sexual Offences Act 1956 was upheld by the Court of Appeal on the grounds that his conduct was likely to cause harm. He was guilty of an indecent assault even if he did not intend or foresee that harm was likely to be caused. *Slingsby* (Slingsby (1995)) was charged with manslaughter by an unlawful and dangerous act after causing the death of a woman from an injury with his cygnet ring during consensual sexual activity which led to a fatal septicaemia. It was ruled by Justice Judge that it would be contrary to principle to treat as criminal an activity which would not otherwise amount to an offence, merely because an injury was caused (Smith 2002). These two cases lead to different conclusions. Based on *Boyea* a piercer undertaking nipple or genital piercings might be liable to prosecution for a sexual assault as the resultant

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injuries of piercing are both intended and foreseeable. The case of Slingsby suggests that as long as the activity of nipple or genital piercing is legally carried out the infliction of an injury would not be an offence.

If there is no sexual element involved in the practices of body art the provision of the Sexual Offences Act 2003 will not apply and the fundamental question posed by the cases Brown (1994) and Wilson (1997) remain – can a person give consent to the level of injury inflicted by body art if it exceeds common assault?

The other statute of relevance to genital piercing is the Female Genital Mutilation Act 2003 Section 1. This makes it an offence for any person to infibulate or otherwise mutilate the whole or any part of a girl's labia majora, labia minora or clitoris. Having regard to the meaning of "infibulate" and "mutilate" in the Concise Oxford Dictionary (1988), it is suggested that piercing does not fall within the ambit of the Act.

## Where does this leave the practices involved in Body Art?

Consent is a defence to common law assault and battery in the course of every day contacts or in situations where a breach of the peace does not occur. Following the case of Brown (1994) however, it is not a defence to claim consent to the infliction of actual bodily harm or wounding or grievous bodily harm, unless that injury arises from a lawful activity or some other category recognised by the Courts as being of a right e.g. self defence or reasonable chastisement of a child or in the public interest.

The Court of Appeal in Wilson (1997) allowed consent as a defence to actual bodily harm in the context of an ongoing loving relationship carried out in private. The Wilson case did not address consent to wounding or GBH and no cases have yet considered consent to assault in the context of the commercial practice of body art.

Unless body art is recognised as being lawful a practitioner commits an offence under either s47 or s20 of the Offences Against the Person Act 1861 each time they perform a piercing.

## Is Body Art Lawful?

Table 1.0 sets out a hierarchical view of body art based on the level of injury.

A distinction can be made between the various categories of body art based on the level of statutory control.

### *Activities expressly permitted by statute*

In England and Wales the main control of cosmetic piercing falls under the Local Government

(Miscellaneous Provisions) Act 1982 (as amended), and a number of local Acts. Cosmetic piercing is not defined but a common factor across the activities typically involves the use of a needle or other pointed implement to pierce the skin. Using this as a definition of cosmetic piercing it would appear that some of the more extreme practices associated with body art such as scarification, branding and tongue splitting would not be subject to any legal control via registration or licensing, as they do not involve piercing of the skin. As the law stands cosmetic piercing, tattooing, acupuncture and electrolysis are lawful (but see below) and would fall within the list of activities that the Courts would recognise as such.

### *Activities expressly prohibited by statute or limited by direct implication*

Relatively few activities are specifically prohibited by statute or limited by implication but female genital mutilation, sexual assault and tattooing a person under 18 years of age do fit into this category.

The Female Genital Mutilation Act 2003 and Sexual Offences Act 2003 have already been considered. The Tattooing of Minors Act 1969 prohibits under 18's from being tattooed and defines a tattoo as "the insertion into the skin of any colouring material designed to leave a permanent mark."

The inclusion of 'semi-permanent skin colouring' in the amended Local Government (Miscellaneous Provisions) Act 1982 prompts the question of whether this activity falls within the provisions of the Tattooing of Minors Act 1969. When properly applied to the epidermal layers of skin the colouring is not intended to be permanent and therefore falls outside the definition of tattooing and so could be applied to a person of any age.

### *Activities not specifically legislated for*

Many of the more extreme activities of body art fall in to a category that is neither specifically permitted nor prohibited by statute (see Table 1.0 level 5).

Based on the judgements of the Higher Courts, particularly Brown (1994), and the AG Reference No 6 (1980), it is suggested that the more extreme body art practices (branding, braiding, beading, scarification, tongue splitting and amputation) do not fall within the recognised exemptions to violence and would be illegal despite the consent of the victim. This is based on a public policy consideration that such levels of violence and injury are not something that society should endorse. Although the decision in Wilson (1997) established that consent may be a defence to actual bodily harm (branding) in certain circumstances, the commercial application of practices leading to actual bodily harm are different and some of the more extreme practices result in wounding or grievous bodily harm.

**Table 1.0: Hierarchical view of body art based on the level of injury**

Level of injury	Category of activity	Level of injury based on Offences Against the Person Act 1861
1	Acupuncture Electrolysis Ear piercing and cosmetic piercing (facial and naval)  Controlled by Local Government (Miscellaneous Provisions) Act 1982 as amended and London Local Authorities Act 1991	Piercing – Section 20 wounding as the continuity of the skin is broken  Actual bodily harm (s47) if the insertion of a needle in acupuncture or electrolysis is not considered to be a wound
2	Tattooing  Subject to Tattooing of Minors Act 1969	Actual bodily harm (s47) if the insertion of a needle is not considered to be a wound, otherwise Section 20 wounding as the continuity of the skin is broken
3	Nipple piercing (consider Sexual assault for under 13 – Sexual Offences Act 2003)	Piercing – Section 20 wounding as the continuity of the skin is broken
4	Genital piercing (consider sexual assault for under 13 – Sexual Offences Act 2003 and Female Genital Mutilation Act 2003)	Piercing – Section 20 wounding as the continuity of the skin is broken
5	Other body modification such as scarification, branding, braiding, beading, amputation, tongue splitting, clitoridectomy and labia removal. (Offences Against the Person Act 1861, Sexual Offences Act 2003, Female Genital Mutilation Act 2003)	Branding – ABH if it does not break the skin otherwise all result in wounding and some in GHB

## The Human Rights Act 1998

All the decided cases referred to pre-date the Human Rights Act 1998. There are two possible ways in which this Act could impact on the practice of body art. One of the Rights is the Freedom of Expression (Schedule 1, Article 10 of the Convention). This Right may be interfered with by the UK Government where it is judged necessary in a democratic society and is prescribed by law for a legitimate purpose. If it could be argued that to alter your body through body art is an expression of oneself within the meaning of the Human Rights Act then the courts could decide that there should be no interference with the right to free expression other than on the grounds of health or safety. If this were the case all forms of body art could be legal, but could still be subject to some form of control or regulation, through licensing, to ensure standards of training knowledge and competence of practitioners and premises.

The second way in which the Human Rights Act 1998 could affect body art is in the way that existing statutes and case law is interpreted. Section 3 requires, so far as is reasonably practicable, that primary and subordinate law must be read and given effect in a way which is compatible with the convention rights. The White Paper

which preceded the Act (HM Government 1997) said that the Courts will be required to interpret legislation so as to uphold the Convention rights unless the legislation itself is so clearly incompatible with the Convention.

Previously decisions by the higher courts (House of Lords and Court of Appeal) were binding on the lower Courts (Magistrates Courts and Crown Courts) under the doctrine of precedent. To give effect to the Human Rights Act a lower court may now ignore a decision of a superior court on the meaning of a statute (Card 2001).

## Conclusions

- The act of piercing another person's body in the guise of fashion, beauty or for ritual purposes is a potentially serious offence under a variety of statutes.
- In the main it is quite clear that the law recognises certain practices as being acceptable and, although causing harm that in other circumstances would lead to conviction, are not subject to punishment when undertaken by consent. Such activities include cosmetic piercing (ear, nose, lip, tongue, eyebrow and navel) electrolysis, acupuncture,

tattooing and semi-permanent skin colouring. All are subject to specific legislative controls or are referred to in legal judgements.

- Cosmetic piercing is legal per se as it is regulated by statute and this includes nipple and genital piercing in the absence of any specific exclusion in either the Local Government (Miscellaneous Provisions) Act 1982 or the London Local Authorities Act 1991.
- Whether nipple or genital piercing is an offence under the Sexual Offences Act 2003 depends on whether it is considered to be sexual. If it is, a person over 13 can consent to it, but a child under 13 cannot. If it is not sexual then it could still be an assault at common law or under the Offences Against the Person Act 1861.
- At the extreme end of the scale of body art activities lies branding, beading, braiding, amputation and tongue splitting. The Courts have not been asked to rule on these as commercial activities but as they are extreme the courts could well classify such levels of violence and harm to be unacceptable to public policy and adopt the same approach as in *Brown* (1994). These activities do not fall to local authorities to control as they go beyond "cosmetic piercing". Given their association with body art, however, they are likely to be undertaken from premises used for licensed activities controlled by local authorities. Although not licensable the fact that these extreme practices are likely to be undertaken from commercial premises where cosmetic piercing is undertaken in a regulated environment could be a factor that the courts find persuasive if they were to considering their legality.
- Clitoridectomy and labia removal are unlawful under the Female Genital Mutilation Act 2003.

## Acknowledgements

The help of the two anonymous reviewers is gratefully acknowledged.

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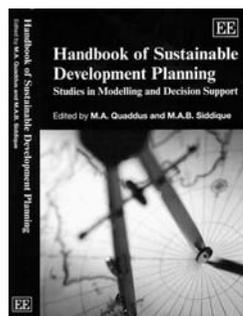
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## Book Reviews



### Handbook of Sustainable Development Planning

M.A. Quaddas and  
M.A.B. Siddique (eds.)

Edward Elgar Publishers 2004, 360 pp  
Hardback £115.00

Fair and just management of current resources must involve projecting forward what impact our decisions will have on the overlapping environments in which we exist. For almost two decades the Brundtland report has, to varying degrees, positively influenced public policy. Meanwhile public policy processes have come under increasing pressure to be more accountable and accessible. This inevitably applies pressure to the decision-making process and is the sphere of operation into which this book has been launched. Readers of this book will be convinced, if not so already, of the robust decision structures necessary to comprehensively address sustainable development issues.

This Handbook makes the bold claim of being both authoritative and comprehensive. In many regards this holds true: contributors are world-class scholars supported by a strong research and publications record, while the case studies and modelling investigations are of international significance. Dealing with issues that demand a planning response – such as environmental management (natural disasters) and water management (New York City water supply) – the book is both timely and relevant. An underpinning concept of the Handbook is the idea of decision support across both quantitative and qualitative modelling. This is essential given the variety of possible methods and availability or desirability of mathematical-based modelling that may point instead to human involvement (and vice versa), both of which may benefit from decision support mechanisms.

At the end of several of the chapters the reader is left with a sense of wanting more, where it is suggested future research may lead, an indication of the book's nature. After all, this publication is a compendium of articles many of which originate in research papers elsewhere. Just as the reader has a sense of receiving wisdom from the experiences noted in the Handbook, it is time to move on to another issue in this whistle-stop tour. Depth rather than detail is perhaps what is lacking. Indeed, the constant need to establish the context of each chapter would not be necessary in a more focused publication. Several contributors felt an interpretation of 'sustainable development' (see the number of index entries for this subject) was required in

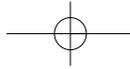
their opening material. Yet this is perhaps a strength, for this is a dip-in, dip-out type of book whereby each chapter can be read independently, an eclectic mix of narrative and mathematical modelling.

Included in the Handbook is research with a solid empirical basis that will prove useful reference material, but it is difficult to imagine that NGOs, planners, consultants or policymakers – the majority target audience – will commit the time required to fully digest this publication. Reading the Handbook cover to cover might leave some readers disappointed in terms of making sense of the material presented. My one comment in relation to the structure of the book is that the sheer amount of information calls for a guiding introductory chapter similar in format to what is presently the final chapter.

This is not a literary masterpiece that flows from one chapter to the next, but this was not anyway expected. The editors admit from the outset, unashamedly, that a single sustainable development planning model does not exist and this is reflected in the disjointed format; anyone looking for a secret formula to address the troublesome development issues presently faced by the world will be disappointed. The diversity of understanding supports the effort put into bringing this Handbook together. What connects the various elements is the common desire of contributors to add worthy research and expertise to the debate for others to learn from; this is the achievement of the Handbook.

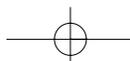
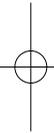
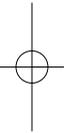
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## NOTES FOR AUTHORS

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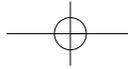
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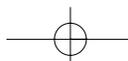
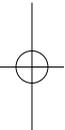
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