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Nickolas Vakas
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Interests and the Shaping of an Occupational Health and Safety Controversy: The BAe 146 Case

A thesis submitted in fulfilment of the requirements for the award of the degree

Doctor of Philosophy

from

University of Wollongong

by

Nickolas Vakas, BA (Hons)

School of Social Sciences, Media and Communication

2007

Certification

I, Nickolas Vakas, declare that this thesis, submitted for the award of Doctor of Philosophy in the School of Social Sciences, Media and Communication, University of Wollongong, is wholly my own work unless otherwise referenced or acknowledged. The document has not been submitted for qualifications at any other academic institution.

Nickolas Vakas

13 April 2007

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Abbreviations

AMRA	Aerospace Medical Research Association
AAIB	Air Accidents Investigation Branch
APSA	Airline Passenger Safety Association
AAAI	American Academy of Allergy and Immunology
ACC	American Chemistry Council
ACSH	American Council of Science and Health
ASHRAE	American Society for Heating, Refrigeration, Air-conditioning Engineers
ADA	American Disabilities Act
APA	Ansett Pilots Association
AFA	Association for Flight attendants
ALF	Atlantic Legal Foundation
AD	Airworthiness Directive
AFAP	Australian Federation of Air Pilots
ATSB	Australian Transport Safety Bureau
ASCIA	Australasian Society of Clinical Immunology and Allergy
APU	auxiliary power unit
AHI	Aviation Health Institute
AOPIS	Aviation Organophosphate Information Site
ASRC	Aviation Rulemaking Advisory Committee
ASF	Aviation Safety Forum
BNA	beta-naphtylamine
BA	British Aerospace
BALPA	British Air Line Pilots Association
BASI	Bureau of Air Safety Investigations
BTCE	Bureau of Transport and Communications and Economics
CO	carbon monoxide
CMA	Chemical Manufactures Association
CFC	Chronic Fatigue Syndrome
CAAP	Civil Aviation Advisory Publication
CAA	Civil Aviation Authority
CAR/s	Civil Aviation Regulation/s
CASA	Civil Aviation Safety Authority
CAQPCCA	Committee on Air Quality in Passenger Cabins of Commercial Aircraft
CAIR	Confidential Air Incident Reports
CJC	Consumer Justice Centre
CAPC	Contaminated Air Protection Conference
DOCP	di-ortho-cresylphosphate
DVT	Deep Vein Thrombosis
EI	Environmental Illness
ESRI	Environmental Sensitivities Research Institute
EU	European Union

FAA	Federal Aviation Authority
FAR/s	Federal Aviation Regulation/s
FIFRA	Federal Insecticide, Fungicide and Rodenticide Act
FAAA	Flight Attendants' Association of Australia
FODCOM	Fight Operations Department Communication
HISS	Hazardous Substances Information System
HLSCI	House of Lords Select Committee Inquiry
IEI	Idiopathic Environmental Intolerances
IARC	International Agency for Research on Cancer
ILO	International Labour Organisation
IPCS	International Program on Chemical Safety
ISF	Intolerance to smells and fumes
the List	List of Designated Hazardous Substances
MCA	Manufacturers Chemists' Association
MSDB	Material Safety Data Bulletins
MSDS	Material Safety Data Sheets
MCRS	Medical Claims Review Services
MJO	Mobil Jet Oil II
MJO291	Mobil Jet Oil 291
MOCP	mono-ortho-cresyl phosphate
MCS	Multiple Chemical Sensitivity
NAS	National Academy of Sciences
NCAHF	National Council Against Health Fraud
NJS	National Jet Systems
NASDAC	National Aviation Safety Data Analysis Centre
NHMRC	National Health and Medical Research Council
NICNAS	National Industrial Chemicals Notification and Assessment Scheme
NIOSH	National Institute for Occupational Health and Safety
NMAS	National Medical Advisory Service
NOHSC	National Occupational Health and Safety Commission
NRC	National Research Council (US)
NTSB	National Transport Safety Board
NTE	neuropathy target esterase
OHS	Occupational Health and Safety
OP	organophosphate
OPIDN	organophosphorus ester-induced delayed neurotoxicity
OPICN	organophosphorus ester-induced chronic neurotoxicity
PAN	phenyl-alpha-naphtylamine
PBN	phenyl-beta-naphtylamine
PET	Positron Emission Tomography
PR	public relations

RSI	Repetitive Strain Injury
SVOC	semi volatile organic chemicals
SSK	Sociology of Scientific Knowledge
SHK	Swedish Board of Accident Investigation
SLAPP	Strategic Lawsuit Against Public Participation
TLV	Threshold Limit Values
TVOC	total concentration of volatile organic compounds
TOCP	tri-ortho-cresyl phosphate
TCP	tricresyl phosphate
TMPP	trimethylolpropane phosphate
UNEP	United Nations Environment Programme
VOC	volatile organic compounds
WHO	World Health Organisation

Abstract

This thesis examines the controversy surrounding aircraft cabin air contaminated with oil. The focus is on the British Aerospace BAe 146 aircraft in Australia and the Australian Senate Inquiry which examined this aircraft. The aim is to examine bias in assessment and decision making processes surrounding health and safety by key stakeholders. The methodology utilises an interests-based approach drawing on two broad research disciplines, science and technology studies and the sociology of medicine. A number of stakeholders are scrutinised in order to better understand the health and safety implications for aircraft crew and passengers.

Aviation industry deregulation is evaluated to provide a historical context to the often competing interests in aviation. The roles of the Civil Aviation Safety Authority and the Australian Transport Safety Bureau are assessed both in terms of their obligations and claims. The hazard posed by Mobil Jet Oil II, the key cabin contaminant, is examined via research, publications such as Material Safety Data Sheets and government classification. British Aerospace assertions of aircraft safety are examined via its interpretation of a number of studies.

The findings of the Australian Senate Inquiry are compared to the UK House of Lords Inquiry into cabin air quality and the US National Research Council study into cabin air quality. Finally the debates surrounding long term health implications such as Multiple Chemical Sensitivity are examined and research undertaken by pilots associations and other researchers asserting health problems is assessed.

This thesis argues that key industry, government and regulatory stakeholders have shown significant bias in recognising and responding to the health and safety issues of cabin contamination. The consequences of such neglect, particularly when numerous other aircraft have been found to have similar problems, are increased risks to crew, passengers and aircraft. The risks of cabin fume exposure include short term health problems and long term illness, disease and disability.

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Chapter 1: Introduction

This thesis examines the contamination of aircraft cabin air by fumes and the marginalisation of this problem by industry, regulators and government. The focus is on the British Aerospace BAe 146 aircraft in Australia. These aircraft have been documented globally to have the greatest number of cabin fume problems. The cause of the fumes in this aircraft's cabin air is jet oil that leaks from the engines. The controversy concerns the health and safety issues posed by cabin fume contamination.

The reasons behind my examination of aircraft cabin fumes are numerous. I initially became interested because the people exposed to cabin fumes were largely dismissed by regulators. This fitted with my interest in health and safety issues and their interaction with decision making and influencing bodies. Another interest I have is health and safety problems on the periphery of medical opinion. That is problems that have not achieved a widespread consensus. This is the case with the illnesses linked to cabin fume exposure from acute to chronic conditions, including Multiple Chemical Sensitivity (MCS).

The reasoning often provided for the lack of consensus for such problems is an absence of a widely accepted causative model and/or locating problems with a particular population group, often supported by psychological labels. This is in contrast to identifying problems with workplace or environmental exposures. Psychological explanations have often been used to account for illness and disability in terms of particular susceptibilities not present in the general population. Groups targeted have often been based on their particular flaws arising from their ethnicity, class and gender. They thus seek to blame the victim for illness acquired in the workplace or

environment. For example women have been targeted as the problem in relation to Repetitive Strain Injury (RSI), and in the use of labels such as hysteria.

My concern for marginalised health and safety issues developed as a consequence of the neglect of many such problems in the past. Often many years had passed until large numbers of people with illness, disease and disability and increased opposition had begun to undermine the white noise of victim blaming. Often numerous lives and, in the case of asbestos and tobacco many thousands of lives, have been shortened.

Examining an emerging controversy I hoped would help to highlight decision making processes in order to better understand assessments. In my early examination of the cabin fume controversy I was struck by an apparent lack of concern for this issue by the dominant stakeholders. This was even more disturbing when I learned that the BAe 146 controversy is one part of a contamination problem that characterises many aircraft and include the McDonald Douglas MD-80, Airbus A320 and Boeing 737 and 757. This lack of concern was not only for crew but the flying public and even the safety of people on the ground in the event of a crash. Thus examining the BAe 146 controversy has inevitably led to a much larger problem. The contamination of cabin air in these other aircraft has also been systematically neglected.

In exploring the BAe 146 controversy there are a number of threads that need to be explored in order to understand the issues. Here, the difficulty for crew to gain acknowledgement that this was an important issue helped shape my theoretical approach. I resolved to examine the issue from the perspective of bias in the assessment and decision making process. Chapter 2 sets out my methodology which is an interests approach that draws on a range of theoretical perspectives from science and technology

studies to the sociology of medicine. I have argued for an interests position that lies towards the realist end of the constructivist and realist conceptions of interests. This is due to the limitations of an analysis based simply on constructivist or realist models. In essence this approach serves to both identify the constructed nature of knowledge claims by stakeholders in the debate and to make claims of bias and flawed assessment processes.

In addition, I argue this approach allows judgements to be made regarding competing knowledge claims, to decide which have the greater claim to legitimacy. By default, identifying and attributing bias allows alternative views to gain greater legitimacy. These claims are not predicated on ‘good or better’ science or ‘good or better’ medicine. However, better assessments are possible in the light of the biased and flawed practices identified. Rather my analysis relies on a multi-dimensional approach to examine health and safety problems and the adverse consequences arising from exposure to cabin fumes.

These problems were initially brought to public and political attention by those directly affected, the flight crew (pilots and flight engineers) and cabin crew (flight attendants), who have provided the impetus for a Senate inquiry in Australia as well as inquiries in the UK and US. In Australia, the Chairman of the Senate Inquiry examining BAe 146 aircraft, Senator John Woodley (2000), acknowledged and praised aircraft crew and unions as the primary movers for establishing and progressing the inquiry. Thus lay knowledge is an important consideration in understanding the issue. This is in contrast with the view of constructivists who privilege expertise in science and medicine and

realists who overly privilege social structures. In both cases lay knowledge is undervalued.

In undertaking an interests approach it became necessary to examine key areas that help shape and inform the BAe 146 controversy. This included regulation, assessments of jet oil, the aviation industry's role in safety and health assessments, inquiries and government responses, and debates surrounding illnesses. The examination of these different areas sought to locate science, medicine and policy in a broader context to understand the process of decision making or lack thereof. The aim was to develop an understanding that provides more insight than an analysis based on a more narrowly focused study, for example on aviation regulatory policy. A broader analysis that identifies failures in health and safety assessment in a range of areas would, I argue, increase the legitimacy of those aircraft crew, unions and researchers' claims that assert health and safety problems.

A focus of this thesis in exploring the diverse influences on this controversy is the Australian Senate Inquiry into cabin air quality and air safety of BAe 146 aircraft. This inquiry began, on 22 March 1999, as part of a broader aviation inquiry. The BAe 146 inquiry was originally one of four sections to the proposed inquiry, and had a scope that required, 'the examination of air safety, with particular reference to cabin air quality in BAe 146 aircraft' (SRRATRC 2000, p. x). Due to the heightened concern, reports and submissions regarding cabin fumes in this particular aircraft, a separate inquiry was established. A large and diverse range of submissions were made. Of the 53 submissions 31 were public and 22 confidential. These submissions along with those made at the eight public hearings and three in-camera hearings formed the basis of the

Inquiry's final report published in October 2000. Submissions were made from the manufacturer British Aerospace (BA)¹, known as BAE Systems since November 1999, airline operators, unions, affected aircraft crew, researchers and medical practitioners.

An examination in Chapter 3 of a number of aviation industry studies on cabin air quality serves to highlight the competing health and safety claims. Particular attention is given to the manufacturer of BAe 146 aircraft, BA.

Jet oil has been documented in cabin contamination on numerous aircraft types including the BAe 146; other contaminants such as hydraulic fluids have also been identified as a problem in aircraft such as the McDonald Douglas MD-80. In Chapter 4 I examine jet oil assessments, hazards of exposure, information on risks via examination of Material Safety Data Sheets and government bodies' role in documenting and assessing hazards posed to exposure. Particular attention is given to Mobil Jet Oil II (MJO), the oil used in Australian BAe 146 aircraft.

The historical context of safety in aviation regulation is examined in Chapter 5. Also considered is the regulatory response to health and safety issues of the BAe 146 controversy by the Civil Aviation Safety Authority (CASA) and the Australian Transport Safety Bureau (ATSB).

As mentioned this thesis draws extensively on the Australian Senate Inquiry into BAe 146 and the many submissions; in Chapter 6 I examine the assessments and recommendations of the Senate Inquiry *Air Safety and Cabin Air Quality in the BAe 146*

¹ I will refer to the manufacturer as British Aerospace unless otherwise stated.

Aircraft (SRRATRC 2000). I also consider two other enquires findings: the British House of Lords Report *Air Travel and Health* (HLSCST 2000) and the US Congress sponsored investigation *The Airliner Cabin Environment and the Health of Passengers and Crew* (CAQPCCA 2002). Both address cabin fume contamination amongst other issues.

In Chapter 7, I examine long term health debates in particular over MCS. The role of industry organisations in marginalising the health claims of people is given particular attention. Aircraft crew accounts of their health and safety experiences are used to highlight the human impact of the cabin fume issue. This chapter also examines research arising from aircraft crew, unions and researchers that identify a range of health and safety problems.

The BAe 146 problem is part of a global problem of cabin contamination where denial, delay and reaction have dominated over acknowledgement and proactive measures. Coverage of September 11 characterised the passenger aircraft as a flying bomb in which flight crew, cabin crew and passengers were overpowered by the hijackers on board. This thesis examines the ‘remote control’ of aircraft, and those people on board, by governments, regulators and industry.

Chapter 2: Methodology: Developing an Interests Framework

Introduction

The controversy surrounding the cabin fume issue involves a range of competing knowledge claims and parties. Simplifying, these interests revolve around whether oil fumes that penetrate the aircraft cabin environment pose a health and safety problem, and identifying what are appropriate responses. Literature from STS and related literature is examined in order to develop an interest-based framework. The aim is to examine bias in the assessment and decision making processes.

The examination of the cabin fumes controversy on BAe 146 aircraft necessitates the investigation of a range of scientific, technical, regulatory, governmental, union, industry and lay information. This information is drawn principally from the BAe 146 Senate Inquiry, carried out by the Australian Parliament, the first government to conduct a detailed investigation on the health and safety implications. An interest-based methodological framework is advanced in this chapter which, while informed by the social constructivism of the sociology of science and sociology of medicine, argues for a framework that is more thoroughly located at the realist end, of what can be termed the relativist realist continuum. In addition a multi-level approach is adopted to provide a detailed understanding of the interconnectedness of contending knowledge claims at various levels: controversy (micro), and the interrelationships between institutional (meso) and social structural (macro) influences.

The issues of health and safety in relation to cabin fumes and the evaluation of competing knowledge claims are important; there are repercussions for aircraft crew health and the flying public as well as those who may be injured indirectly. Moreover, regulatory and governmental responses to health and safety arising out of exposure to chemicals have wider implications particularly defining illness, its seriousness and appropriate measures for dealing with such illnesses.

This thesis focuses on the problem of bias/agenda-setting surrounding the assessments and responses to health and safety issues involving jet oil contamination of cabin air and

the debates around short and long-term health effects. Long-term health discussions have increasingly been associated with chemical sensitivity, much contested both in the BAe 146 controversy and beyond. Emerging from these competing debates is a complex mix of values, scientific/medical claims and regulatory policy; understanding these is important in assessing bias and identifying alternatives.

Will technology [and science] studies become a debate among meaningful positions or a display of fashionable postures?’²

Despite a wide acceptance within contemporary STS that knowledge is socially informed, disagreement remains over the extent to which the wider social context - the meso and macro factors - interact with the shaping of scientific knowledge claims – the micro factors (Edge 1995). These disagreements have shaped a range of theoretical models within STS.

Martin (1979) argued, in *The Bias of Science*, that scientists are influenced by social values and that these values are reflected in the production of scientific knowledge. This now widely held view in STS and SSK studies may be challenged by citing disciplines or research primarily exploring knowledge or epistemological concerns, which appear to involve limited interaction with wider society. It is more difficult, even for positivists, to contend that science involved in regulatory decisions is value free because values are more obvious. Even the more esoteric knowledge pursuits, which claim to be ‘interest-free’, may have been shaped by social conflict and ideological influences on the scientific actors.³ Moreover, studies of disciplines such as physics, logic and theoretical reasoning have, over recent years, demonstrated wider social influences in their knowledge claims, for example, under the scrutiny of gender analysis (Harding 1993a, p. 4).

Even some, still otherwise positivist, scientists have acknowledged the limitations of science as regulatory considerations transcend, to various degrees, the scope of science. Weinberg, with his notion of trans-scientific issues, argued that:

² Winner, L. (1994). "Reply to Mark Elam." *Science, Technology and Human Values* **19**(1): 107-109.

³ See for example Shapin, S. (1982). *The Politics of Observation: Cerebral Anatomy and the Social Interests in the Edinburgh Phrenology Disputes*. *Sociology of Scientific Knowledge*. H. M. Collins. Bath, Bath University Press.

The deleterious side effects of technology, or the attempts to deal with social problems through the procedures of science – hang on the answers to questions which can be asked of science and *yet cannot be answered by science* (Weinberg 1972, p. 209).

The difficulty in achieving a comprehensive answer, or conditional closure of a regulatory controversy, with science alone suggests that an emphasis on the micro aspects of scientific knowledge production is unlikely to yield more than a fragmentary picture of regulatory processes.

Aware to some extent of the values embedded in the science of regulatory analysis, Weinberg has attempted to extend his notion of ‘trans-scientific’ issues to the concept of ‘regulatory science’ (Weinberg 1985, pp. 67-68). Regulatory science, he argues, has less exacting ‘norms of scientific proof’ than those of ordinary or core science (Weinberg 1985, pp. 67-68). This demarcation is an example of boundary creation within science and may serve as a protective device for core science and as a rhetorical argument to diminish regulatory science by lending greater legitimacy to knowledge arising from the ‘less’ value laden core scientific activities (see Gieryn 1983). Moreover, Weinberg remains technocratic in his belief that appropriate technical and scientific knowledge will provide practical solutions to social hazards. He neglects the wider social values in the construction of appropriate science and technological solutions. Economic and political pressures can prevent the adoption of existing and safer practices, for example, in chemical plants such as Bhopal. Or as is argued in this thesis, a limited focus on what are deemed appropriate scientific criteria has provided some of the justification for economic and political decisions that has resulted in the ongoing contamination of aircraft cabin environment to the detriment of aircraft, aircraft crew and passenger safety.

Regulatory science consequently appears to be more contested than core science. This arises from political pressures to dispute knowledge assertion, time constraints on scientific assessments, and the wide impact that state regulatory decisions can generate (Shackley and Wynne 1995, pp. 219-230). Thus, the notion of regulatory science provides a worthwhile contrast, albeit not a clear one, with that of core science.

What is clear in regulatory science and the broader state regulatory context is the value-ladenness of assertions and consequently regulatory processes. The concept of ‘interests’ is useful in accounting for how negotiation, and settlement, or lack thereof, occurs between scientists, industry and government regulators, environmentalists, unions and employees. These interrelationships arise from institutional and structural relationships. For example in terms of class analysis, industry’s primary concern is with profit maximisation whereas employees have a more significant stake in health and safety. Ultimately these relationships are an empirical and theoretical issue that needs to be examined in detail to evaluate interests, although my research methodology is premised on a concern for the social values of health and safety of employees and public.

The theoretical framework of interests that I develop also incorporates values, as do all theoretical positions, and this shapes the empirical information, as do other considerations such as the availability of information.⁴ An interests approach is used in this thesis to overcome traditionally narrow theoretical models that have limited problem definition and consequently do not adequately address the problem they set out to explore. For example, numerous texts that have examined regulatory processes tend to rely on pluralist frameworks, which focus on group interactions.⁵ Overcoming these somewhat narrow perspectives, particularly in examining the role of government, requires recognition that structural location is an important consideration in conceptualising interests.⁶

First, a definition of ‘interests’ will be offered, then an examination of the ‘interests model’ within the sociology of scientific knowledge and its limitations. Second is an examination of the weak program’s challenge to the internalism of the strong program, and the attempt to extend interests to an institutional (meso) level. Third, I explore the sociology of medicine literature examining similar debates between constructivism and

⁴ For example, the Office of the Senate while initially providing me with documentation dealing with the Senate Inquiry refused to provide additional documents in spite of originally claiming these would be made available.

⁵ See for example Brickman, R., S. Jasanoff and T. Ilgen (1985). Controlling Chemicals: The Politics of Regulation in Europe and the United States. Ithaca, Cornell University Press, Jasanoff, S. (1986). Risk Management and Political Culture. New York, Russell Sage Foundation.

⁶ For a detailed discussion of the importance of structural factors in developing an interests approach see Russell, S. (1991). *Interests and the Shaping of Technology: An Unresolved Debate Reappears*. Wollongong, University of Wollongong.

social structure theory to provide a more comprehensive interests framework in relation to conceptualising human health and safety. Finally, an interests framework that incorporates structural considerations is delineated.

Shifting Interests away from the Sociology of Scientific Knowledge

Interests: An Introduction and Initial Definition

Historically, the identification, examination and attribution of social interests is intrinsic to the sociology of knowledge and is identified with two distinctive modern intellectual traditions: first, that of Marx and Mannheim; and second, that of Durkheim (Lynch and Fuhrman 1991, p.106; Restivo 1991, p. 233). Due to the scope of the sociology of knowledge and its comparatively recent systematic application to scientific knowledge, a definition of interests is appropriate:

Ideas (and predicates, classifications, and representations) re-present social practices and social interests. Social interests are material or symbolic resources thought to be relevant to group survival and necessary for gaining, sustaining, or advantages in relative power, privilege, and prestige. Attributed interests are social interests thought to be relevant to and necessary for a group's survival and relative power by outsiders, and may be more or less congruent with insider views. Interest attribution is itself a form of social interest (Restivo 1991, p. 106).

The Strong Program

The interests model, associated with the Sociology of Scientific Knowledge (SSK), particularly the work of Barnes and Bloor, attempts to establish the concerns and judgements of 'disinterested' scientists within particular contexts (Barnes 1974; Bloor 1976; Barnes 1977; Bloor 1982; see also Shapin 1982). This is done without the sociologist or historian making judgements on the truth or falsity of differing knowledge claims. The principles of symmetry and impartiality underpin the 'strong program' and provide a challenge to the authority of science through the adoption of a relativist analysis. Researchers are also required to account for their position with respect to their analysis by relating their beliefs to the social context of the scientific community being examined and to any conclusions reached: it must be reflexive. Group

and professional interests and goals within particular institutional dynamics are examined as a social product to account for conclusions rather than simply relying on scientific ‘facts’ as reflected in nature to explain scientific practice.

There remains, however, a reticence within the interests model of Barnes and Bloor in the development of a broader conception of interests at the micro and particularly at the meso and macro levels. This was not always the case as Shapin (1982) was receptive to macro, meso and micro analysis of interests. The absence of structural and institutional influences, and the role of power on the production or construction of scientific knowledge, considerably limits the interests model. This becomes apparent when researchers attempt to develop a coherent understanding of scientific and technological controversies that can have serious social, economic and political consequences.

Cabin fumes on aircraft, toxic chemicals such as pesticides, and global warming clearly require a broader interpretation of the interaction of science, institutions and the state to understand the processes of regulatory assessments and responses. State regulations require judgements on what is appropriate and what interests need to be met (Jasanoff 1990). Consideration of power imbalances and the assessment of social consequences require value analysis not suited to a strict relativist analysis of interests found in the strong program.

The Politics of Research: From Extreme Relativism to Partisan

The non-partisanship claims within STS of the interests model have been much contested for over twenty years. Woolgar (1981) argues the adherents of the strong program fail to account of their own assessments of and reasons for research therefore they have not attained their stated position as a non-partisan researcher. Lukes (1982, p. 298), on the other hand, argues that the implication of the relativism espoused by Barnes and Bloor is that ‘evidence would never even show up’. While a somewhat harsh criticism, it points to limitations in the development of broader political and social judgements. Such agnosticism appears confirmed in the logical development of Woolgar’s (1988) criticism of the strong program with his adoption of a radical

reflexive analysis with a multiplicity of meanings. The result is that evidence and judgements appear inconsequential compared to the act of discourse.

For those who have rejected the extreme relativist position of authors such as Woolgar, such as Collins and Yearley (1992), some form of partisanship seems inescapable. Scott, Martin and Richards argue that examining the social development of knowledge claims undermines the claims of the dominant cognitive model, resulting in a de facto partisanship between the analyst and less authoritative knowledge claims (Scott, Richards et al. 1990; Collins 1991; Martin, Richards et al. 1991). Bammer and Martin's (1992) examination of partisanship in the ongoing Repetitive Strain Injury (RSI) debate illustrates that the adoption of particular theoretical models generates a form of de facto partisanship, whether this is openly acknowledged or not.

Wynne and Jasanoff (Jasanoff 1996; Wynne 1996b), each concerned with the development of SSK in the policy arena, have responded to this ongoing debate. They have acknowledged, in contrast to Collins' claim of research neutrality, that knowledge claims are inherently political as claimed by Scott et al. Wynne (1996b, pp. 361-362) points out that the differing research issues studied may explain their differing accounts; Collins is more concerned with evenly balanced scientific disputes such as lasers, while Scott et al's cases deal with issues where power is less evenly distributed, such as anti-fluoridationists and the Vitamin C controversy with Linus Pauling. The latter engage and challenge knowledge of dominant interests not only at the scientific level but also at the level of government policy and industry.

The increasing acknowledgement of the role of politics and partisanship within sociology of science studies has marked a shift further from the strong program's tenets of symmetry and impartiality towards realism. Still, many constructivists have avoided a more pronounced realist shift in acknowledging the influence of history and social structure in the shaping of an area of inquiry. Constructivism can be pragmatically adapted and shift from a stronger constructivist (more relativist) to a weaker constructivism (more realist) position. This shift can be observed within a particular analyses beginning with a stronger constructivist position lending greater weight to the principles of symmetry and impartiality and concluding with a less impartial more partisan position (see Richards 1991).

Authors also vary the strength of their constructivism according to not only the issues studied but *their* political aims. This flexibility is apparent particularly when defending their theoretical position. For example, Wynne argues that to avoid reifying the ‘identities and interests of participants’ which he contends both Collins and Scott et al have done, the ‘identity (and interests) of parties to a conflict is open, and has to be problematised analytically. Simply to use such factors unreflexively as explanatory terms is to reify them by default as independent givens – which, after the reflexive turn is no longer tenable’ (Wynne 1996b, pp. 362-363).

Wynne’s critique of perceived encroachment of realist tendencies is somewhat reductive. It is important not to examine a particular case study with strongly preconceived models of how particular group, institutional and structural dynamics will develop as these need to be examined empirically to determine relationships, interactions and processes. However, assuming a strong fluidity of social and historical relations as many constructivists do, one can fail to apprehend the prior structuring of social and institutional dynamics. Biases in the assessment of occupational health is a case in point, for example the establishment and running of government regulatory bodies which are structured to favour industry and government views rather than those of unions and employees, which is a political bias; or the concealing of hazards by corporations, which is a class bias in the accessibility of knowledge (Biggins 1988). For example, corporations have colluded to destroy evidence in legal cases in attempts to limit costs and deny liability. British American Tobacco Australia Services was found by Justice Evans to have destroyed 30000 documents in a court case in an attempt to avoid liability (Birnbauer 2002, p. 1). Company executives and lawyers in Australia, US and Britain apparently agreed on this strategy. Such incidents reveal the prior structuring of health issues in order to cloud causative relationships between cancer and smoking. Public claims by tobacco corporations have long denied links between cancer and smoking despite awareness of research, until quite recently. Thus case studies should not begin from a naïve constructivist ‘clean slate’ with respect to the social and institutional dynamics but need to consider history.

Wynne acknowledges that the tenets of the SSK approach cannot be fully achieved in policy analysis but he takes a strong stance against interest attribution. In one example

cited, the Winscale-Sellafield Inquiry based on a previous study of his (see Wynne 1982), he attempts, using the individualising language of ‘actors’, to avoid the realist claims of environmental actors of an already excessively contaminated environment by focusing on government institutional actors as being ‘less than competent, impartial and trustworthy’ (Wynne 1996b, p. 364). However, he argues this reified the government actors involved but classed this as necessary for assessment arguing that a social realist position was ‘implied, but not advanced as an absolute principle’ (Wynne 1996b, p. 365). While Wynne attempts to avoid any a priori interests regarding the identification of untruthfulness of government (see Wynne 1996b, p. 386 note 28) his ahistorical approach does not identify why untruthfulness is problematised.

Why should he/we care? In selecting untruthfulness, he is selecting a category that is not spontaneously derived from a particular situation but one that has historical resonances that have shaped meaning, acceptability, and has future implications. Government and industry misrepresentations have prompted criticism and protest, which in turn have led to the formation of organizations that have sought to counter such bias. The establishment of organizations such as Workers Health Centres in Australia enabled the supply of information, medical assistance and support to workers outside the traditional avenues of industry and government. Moreover, the majority of health and safety agreements contain provisions for workers to call in their own consultants and view government and industry workplace reports. At an international level, the International Labour Organisation (ILO) Convention 155 (established 1974) stated that workers have a role in selecting the experts that are called to a workplace (Biggins 1988, p. 129). These measures suggest that bias has occurred and will likely continue to occur if mechanisms are not set in place to provide some redress. Legislation has often accompanied such challenges and is thus bound up in the historical development of the social structures of state apparatuses including regulatory authorities; consequently it is not appropriate to discuss historically decoupled actors. Thus regardless of attempts to the contrary Wynne has defined an a priori interest albeit against his stated aim. This is not to dismiss the examination of untruthfulness, or bias, indeed it is an important part of the purpose of this thesis, but recognise these are not derived from a narrowly focused interest free context but one where interests have been and continue to be shaped.

Another problem with Wynne's SSK analysis is the effective dismissal of environmental activists' agency because of their realist commitments, namely claims that the number of leaks from the plant led to an increasing radioactive risk. This results in a further narrowing of problem identification through the effective marginalisation of lay knowledge that does not easily fit with industry and government data. Winner (1986, p. 139) appears to take a broader view of hazard evaluation arguing that if, 'there is some chance, perhaps a very remote chance, of harm from activities that are assumed to be socially beneficial in other respects. If one is able to recognize and care about the possibility of such harm, one is eligible to enter the discussion'. In contrast to Wynne, the Richardson et al (Richardson, Sherman et al. 1993, pp. 19-22) study on public hearings for the Alberta-Pacific bleached kraft pulp mills argue that the process is more open-ended; public hearings can both reinforce existing status quo and suggest alternatives. They state that 'the effects of language that Wynne discusses — value imposition, inevitability, tolerance, acceptance — are deterrents to criticism and agency, and obstacles to the mobilization of opposition to any development project' (Richardson, Sherman et al. 1993, pp. 21-22). Wynne's reductionist approach to public interest advocates, in denying agency, and appears to contradict his constructivist program, though it does reflect constructivists' preference for science rather than the somewhat messier lay knowledge claims.

In other works Wynne takes a broader conception of lay knowledge and, takes a weaker constructivist position. Wynne acknowledges lay realist conceptions can provide specialist knowledge of the local environment that scientists are not aware of or ignore. The case of radioactive contamination of Cumbrian sheep farms is a case in point (1996a). This case demonstrated the superior insights of many farmers in identifying the differences in environment and landscape across farms where scientists conflated such variations. On one occasion, scientists ignored farmers' expertise when designing field experiments and when these were subsequently abandoned they did not explicitly acknowledge farmers' criticisms (Wynne 1996a, pp 62-67).

These are important insights into the relationship between science and lay knowledge and suggest a shift by Wynne toward the realist end of the relativist-realist continuum compared to his stronger constructivist assertions in other work when arguing against interests theory (Wynne 1996b). However, even here he implicitly takes a

circumscribed rather scientific view of lay knowledge. Wynne fits the sheep farmers' assessments into the arena of what may be viewed as acceptable scientific practices, seeking to improve science rather than challenging significant assumptions, and is still at pains to locate his work in a constructivist anti-realist tradition.

This is a pragmatic approach, the strength or weakness of the constructivism adopted by Wynne depending on the weighting given constructivist and realist models. In essence when Wynne argued strongly against interests the weighting was more theoretical, emphasising a stronger constructivism, than with more empirical approaches. With the examination of the sheep farmers there was a greater reliance on empirical lay information and a weaker constructivist position emerged. The result was a more realist position in analysis and assessment: not realist in the sense that lay knowledge is argued to be inherently superior to scientific knowledge, but one that argues that lay knowledge is intrinsic to a just, inclusive society and one that can inform 'good science':

In seeking the basis of more legitimate, less alienating forms of public knowledge, and stable authority out of present conditions of incoherence and disorientation, new constitutional norms of valid knowledge may be articulated. Necessary and legitimate involvement of lay publics in this process will also automatically involve them in negotiations, direct or indirect, of the intellectual contents of those new universals (Wynne 1996a, p. 78)

Wynne still remains circumspect on stepping into the gladiatorial arena and taking a strong stance on particular issues other than shouting for the valid role for the Christians (sheep farmers/lay public) from the stands of the arena against the lions (scientific positivists) but not what needs to be changed other than greater involvement. This support is also premised on the Christians' ability to engage in a meaningful (read scientific) way in terms of challenging Roman law (science). If they talk about persecution more generally within Roman society they are deemed not competent because of the difficulty of formalising this according to Roman law (science) because they are bringing in history and other practices. Wynne's attention to the plight of the Christians is of course admirable from a moral point of view (more realism here) as he remains more engaged with society and hence more flexibly realist than many of his contemporary constructivists who provide little counter to challenge social bias and

therefore injustice. Still like his more relativist contemporaries there is conservatism in his analysis.

Restivo argues that conservatism is intrinsic to the leading relativists and constructivists⁷ as they do not challenge science per se nor scientific method in the sense that they themselves have attempted to use science as a basis for their methodology. Bloor was 'more than happy to see sociology resting on the same foundations and assumptions as other sciences' (quoted in Restivo 1994, pp. 27-28). Latour contends that the 'new sociologists of science are no more "relativist" than Einstein' (quoted in Restivo 1994, p. 27), while Collins asserts that science is 'the best institution for generating knowledge about the natural world' (quoted in Restivo 1994, p. 27). Increasingly apparent is a conservatism in examining values of scientific practice and consequently its application to technology. This, according to Restivo, is because of the acceptance of the status quo: that science is the best means of reaching a better society (Restivo 1994, pp. 28-29).

The Strong Program meets the Weak Program and the Sociology of Medicine

The Weak Program

Chubin and Restivo advocate a 'weak program' of the SSK that adopts a prescriptive methodology yet still holds to the social negotiation of knowledge claims by scientists put forward in the strong program (Chubin and Restivo 1992). They call for a broader assessment, which includes interests, ideological loading, details of how the research is spatially and temporally located and impediments to 'ethical social action', with the aim of influencing policy. In jettisoning the apolitical relativism of the strong program, reflexivity is now viewed in terms of the social researchers' goals in accounting for the social costs to populations and environments.

Similarly, Chubin and Restivo attempted to develop a multilevel analysis. Its application to the cancer controversy illustrates that arbitration of scientific knowledge

⁷ Constructivism is intrinsic to the strong program. Though it is sometimes examined separately, in essence it views 'scientific knowledge [as]...a product of social work, a *discursive* accomplishment' Restivo, S. (1994). Science, Society and Values: Toward a Sociology of Objectivity. London, Associated University Press.

often occurs from ‘outside’ of science: where ‘closure’ may be viewed opportunistically by government bureaucracies, without consideration of all stakeholders (Chubin and Restivo 1992, pp. 62-77). The approach has challenged the narrow focus of the traditional interests model. However, it has been argued that the weak program’s reliance on convincing policymakers, without a more developed analysis of political power and decision making, leaves arguments based on rationality wanting (Rowse 1986, pp. 146-147).

Nonetheless, Abraham (1993; 1994) has provided an insightful analysis on the regulation of drugs using the weak program. By adopting a comparative regulatory analysis between the policies of Britain and the US, he has tried to identify the interest of the key groups; pharmaceutical companies, government regulators, scientists and patients.⁸ Abraham not only identifies interests but attributes a public interest in his approach. He argues that enhanced public access to information and participation is of benefit to shift the debate away from technical considerations to those of public health.

The Sociology of Medicine

The acknowledgement of the contingent nature of knowledge and the advocacy of a broader socially located approach to theory development has emerged within numerous other disciplines often overlapping with the sociology of scientific knowledge. Of importance in examining debates around health and safety of cabin fumes is the sociology of health and medicine. This discipline has provided a number of useful insights in conceptualising interests and an acknowledgement that social, cultural (Nettleton 1995, pp. 18-31; Lupton 2000), legal, political, economic and ideological values (Doyal and Pennell 1983; MacCarthy 1987; Lolas 1994) influence the resulting account of health and illness.

⁸ The scientific ‘doubt’ over the safety of the drug benoxaprofen was shown to favour the pharmaceutical interests by regulatory authorities and industry scientists. This was despite increasing evidence that fatalities had occurred as a result of this drug’s use. Moreover, while scientific uncertainty may justify a range of regulatory policies, in this instance the doubt was used to legitimate inaction of the part of Committee on the Safety of Medicines and Food and Drug Administration (FDA) in the US. The exposure to public examination of the weight given to government and industry science can, Abraham argues, provide impetus to alter science and regulation policy with the result that a greater commitment to public health evolves Abraham, J. (1994). "Distributing the Benefit of Doubt: Scientists, Regulators, and Drug Safety." *Science, Technology and Human Values* **19**(4): 493-492..

Constructivism has become a dominant theoretical model within the sociology of medicine but as will be argued it remains under-developed in addressing occupational health and safety issues, and state regulatory responses. Constructivism does offer a number of insights into the development of a more robust theoretical framework and proponents have been critical of the extreme relativism of the strong program (Turner 2000, p. 21). The sociology of medicine is of benefit in evaluating debates of contested health issues that have arisen during the cabin fume crisis including Multiple Chemical Sensitivity⁹ (MCS). There is a questioning and challenge of medical knowledge claims and categories due to them no longer being perceived as objective, the knowledge being conditional rather than derived from 'hard facts', being influenced by other social formations and constraints. This recognition has generated space for an expansion of legitimate interests, for example calls for an increased role for lay interpretations of their experience because of an increasing recognition that these views are legitimate and contribute to understanding the issue (Nettleton 1995, pp. 36-37; Kleinman and Seeman 2000; Rubinstein, Scrimshaw et al. 2000, p. 42; Turner 2000). This recognition of the importance of lay knowledge in problem identification has also emerged within sociology around the issue of MCS (Kroll-Smith and Floyd 1997).

Illness and Clinical Entities

Constructivists have problematised 'disease entities' or the knowledge produced about a particular disorder that includes the measurement, categorisation and evaluation of the disease and its organisation within medical knowledge. They acknowledge this systemisation is culturally and historically mediated and consequently subject to revision, negotiation and change. However, some constructivists such as Turner tend to accept the relative consistency of the 'clinical entity', the 'configuration or pattern that is observed by a doctor in (a bedside) interaction with a patient' (Turner 2000, p. 21).

This model may be justified as Turner has done with a focus on clinical entities that have apparently changed little. The description of clinical entities presented by the plague or smallpox has remained consistent over hundreds of years, though constructivists have acknowledged the response by medicine, the conceptualisation of

⁹ There are many terms used to describe MCS including Environmental Illness (EI); for ease and due to its widespread acceptance I have chosen to use MCS.

the disease entity, has altered dramatically following the developments such as germ theory. This approach becomes less tenable when there is controversy about what constitutes a 'clinical entity'; this is the case with the symptoms of cabin fumes and MCS where people can present with a range of symptoms.

HIV/AIDs fits this presentation of a variable clinical entity. This variability delayed the identification of a generally held causal mechanism, as people would manifest, become ill and die from a range of associated illnesses such as pneumonia. Thus 'clinical entity' needs to be viewed, similar to a disease entity, as socially arbitrated. MCS is still being debated as a clinical entity¹⁰ in spite of symptoms associated with this illness gaining prominence in the 1980s. The variability is not simply a product of the illness but also the social context where arbiters of 'legitimate' knowledge pass judgement.

This is not to argue that the symptoms, pain and discomfort of people experiencing such illness are not real for those affected, but the doctors' assessments of a clinical entity are socially negotiated and not self evident. For doctors and those ill, illnesses are problems in search of a box, with which they can be categorised. The values, assumptions and treatment options form the basis of far reaching social and political implications. The box is not simply built in a consensual manner but may, as is the case with cabin fumes and chemical sensitivities, involve conflict between various medical, toxicological, health and social researchers, those whose health is affected, industry and the state.

Historically clinical entities, those 'self-evident' symptoms, cannot readily be disentangled from the conceptualising values – the disease entities - that one projects onto the illness. For example stuttering was originally conceptualised as psychological because symptomology was *read* as such. Nowadays stuttering is viewed as a physiological problem that can be treated and even cured using speech and breath training. Those with health problems may manifest psychological differences but these according to Crawford (1977) are often better viewed as consequences of a physiological problem, particularly in the area of occupational health where such measures can minimise industry costs.

¹⁰ The 9th International Congress of Toxicology had a debate titled 'Multiple Chemical Sensitivity (MCS) is a defined clinical entity' with a speaker for and against. International Union Of Toxicology (2001). Debate 1: Multiple Chemical Sensitivity (MCS) is a defined clinical entity. 9th International Congress of Toxicology - Toxicology and Sustainable Development: Meeting the Challenge, Brisbane, 8-12 July.

The psychological labelling of problems that are physiological, often triggered by environmental/workplace exposure to toxic chemicals or repetitive processes in the case of RSI, serves as a convenient ideological control device by locating responsibility for the illness with the individual(s) affected, that is victim blaming (Quinlan 1988). Even recognition of a physiological illness by medicine results in attention to the individual and not their workplace or environment (Quinlan and Bohle 1991b, p. 41). This deflects attention from the environment/workplace concerned and avoids responsibility for change and other measures including compensation. The individualising, or victim blaming, process is intrinsic to the cabin fumes controversy.

A Multilevel Approach

Rubinstein et al have advocated a multilevel or anthropological holistic approach - similar to the approach of the weak program proponents - which 'refers to the methodological and epistemological view that the proper understanding of human behaviour depends upon integrating information from all sectors of society and from all levels of empirical investigation relevant to human experience' (Rubinstein, Scrimshaw et al. 2000, p. 38). This appears a difficult undertaking particularly given the limitations research has to operate under, such as tightly circumscribed studies that examine only a small number of factors, conducted within a short time frame or focused closely on particular aspects of social life. Rubinstein et al argue: 'that more tightly focused studies need not completely exclude holism' but those seeking to incorporate such an approach need to

remain alert to factors or influences that were not within the original scope of data to be collected, and to include these in the research if they seem important to the problem at hand. Thus, even a focused study, can change and expand in response to the researchers' willingness and ability to take the broad view (Rubinstein, Scrimshaw et al. 2000, p. 39).

The classification and evaluation of information is important to the selection of information of a model. Rubinstein et al examine two views:

On the one hand, the normative-realist interpretation of sociomedical categories leads to the world view the hallmarks of which are reliance on

technology for ‘objective’ problem assessment, an emphasis on the role of expert knowledge, and a limited acceptance of the authenticity of people’s reports of their experience. On the other hand, the pragmatist-nominalist approach supports a world view that sees technology as socially situated, expert knowledge as partial and tentative, and people’s reports of their experience as authentic and important for problem construction (Rubinstein, Scrimshaw et al. 2000, p. 42).

Traditionally, the latter pragmatist-nominalist approach avoids reliance on universals while the former normative-realist approach is dependent on universals to underpin expertise and objective knowledge claims to justify particular positions. Rubinstein et al. assert that ‘All heuristics have biases’, and what the realist perspective offers is ‘given’ accounts derived from prevailing social structures which privilege particular - and problematic - socio-medical research (Rubinstein, Scrimshaw et al. 2000, p. 44). Other researchers have argued that the meaning of human activities is ‘established as a result of the conjoint adjustive responses of interacting communicating individuals’ (Maines quoted in Rubinstein, Scrimshaw et al. 2000, p. 44). This has indeed been the traditional problem of realist and social structuralist accounts; however, the constructivism offered to overcome such deficiencies tends to set in place a somewhat reified dichotomy. It does not follow that the adoption of a realist perspective will lead to the problems identified (see Abraham 1995; van Zwanenberg and Millstone 2000). Nor does it follow that the weaknesses inherent in universalist claims can be avoided by seeking refuge in constructivism. Universalism can and has been reincarnated using constructivism resulting in reductionist individualist and pluralist frameworks albeit compensated for through a multi-level analysis¹¹.

¹¹ Furedi, who cites the social constructivism of Mary Douglas and Aaron Wildavsky in his examination of risk, offers a crude neo-Darwin universalism, viewing society’s attempts to regulate risks as undermining human potential.

The clearest expression of society’s loss of nerve has been the institutionalisation of intermediaries who are invited to contain the tensions and conflict that inevitably arise from the struggle to survive. This tendency is underwritten by the sentiment that people are both unable and unfit to manage their problems. This conviction is highlighted in the recurrent comparison that is drawn between the ‘greedy’ 1980s and the ‘caring’ 1990s. Such comparisons articulate a criticism of individual pursuit of self-interest and

Still, the preference of Rubinstein et al. for the pragmatist-nominalist view to broaden problem identification and definition provides important insights. They argue for the extension of present knowledge and research so as to obtain a better understanding of the dynamic and contingent knowledge of sociomedical issues. Regardless of the perspective, research incorporates particular views and assumptions of the study and the way empirical analysis should develop. Consequently 'these assumptions privilege particular ways of making and supporting knowledge claims about social life and its relation to health and illness' (Rubinstein, Scrimshaw et al. 2000, p. 45).

Acknowledging the shortcoming of research which is always based on incomplete information, the failure to 'strive to make our research multilevel in nature will mean that the definition of the problem is always underspecified' (Rubinstein, Scrimshaw et al. 2000, p. 45).

The constructivism outlined in the previous discussion has a number of strengths that mirrors developments in the sociology of scientific knowledge, which will be applied to the cabin fume controversy. These include problematising the notion of expertise, incorporating a multilevel perspective and the recognition that different knowledge, such as lay, can assist in problem identification. However, like the weak program the strongly argued discussion by Rubinstein et al. (2000) for a broader multilevel approach remains itself underspecified, as there is a reticence to deal with structural considerations such as politics, power and state decision-making in informing an analytical approach. Explicit is a belief that one can escape the problems inherent in traditional realist and structural accounts with a constructivist analysis. The reality is they are being constructed anew, a positivism by stealth which occurs when social structural considerations are omitted from the analysis.

Other contemporary medical sociologists adopt this incarnation of socially constructed knowledge that eschews structural considerations preferring the language and

an implicit demand for regulation. Although this standpoint often seems like an enlightened attack on private greed, it can also be seen as a invitation to curb the human potential Furedi, F. (1997). Culture of Fear: Risk Taking and the Morality of Low Expectation. London, Cassell.

framework of poststructuralism (Lupton 2000). Lupton does address values and politics but these remain somewhat under specified in her examination of cultural, media and individual issues. This extends to the inclusion of lay discourses, which holds the promise of a broader examination of both agency and structure in society. For example, why is it that many health sociology studies on lay interpretations focus more on agency, peoples responses as being fear of germs and ‘hysterical’ concerns with bodily secretions or the states attempt to control peoples agency through health monitoring and management (see Lupton 2003, pp. 33-39, 108-112). That is rather than institutional (meso) and particularly social structural (macro) influences that can hasten or ameliorate the spread/treatment of illness particularly those that occur occupationally or via public exposure to industry hazards. Kroker and Cook view contemporary diseases, ‘anorexia, AIDS and herpes, as “postructuralist diseases, tracing the inscription of power on the text of the flesh and privileging the ruin of the surface of the body”’ (quoted in Lupton 2003, p. 38). The attempt to transcend institutional/structural issues with the focus on postructuralist and ‘hysterical’ illness has a medieval effect, that of re-establishing illness as taboo and so reintroducing the baggage such a label entails, such as individual fatalism for the illness arising from the transgression of cultural or religious practices. This is ironic given many governments and people in developing countries have attempted to overcome such perceptions when attempting to stem the spread of AIDS.

The type of lay agency considered is also limited. Lupton tends to view lay discourses unproblematically and largely in terms of public misconceptions of the causes of disease that consequently generate problems for doctors and epidemiologists. I am not arguing that lay responses are necessarily correct but failure to adequately incorporate lay interpretations of institutional and structural considerations reinforces the individualising of social problems and validates psychological models both of which mask the social causation of illness. A discussion by Lupton under the heading of *Causes of Disease and Illness from a Lay Perspective* avoids social causation of disease other than in terms of individual failure to take responsibility for their actions; the roles of industry and government are omitted. Lupton appears to support the view that the illnesses focused on are held to be the result of ‘lifestyle’ and therefore implicitly should be amenable to ‘rational’ medical advice above ‘irrational’ belief systems. Lupton concluded:

It is worthy of note that strong evidence was present in many of these studies about the resistance of people (especially some working-class people) to official discourses on health, including the fatalistic response to the advice that one should maintain control over one's lifestyle to ensure good health (Lupton 2003, p. 112).

The assumption that professionals know best appears a curious position for a constructivist. This is not to argue that health outcomes do not involve individual decisions. But, what has increasingly become apparent with much constructivism is a conservatism that deflects attention from societal responsibility for ill health toward locating it with the individual. More sensitive analysts have pointed out that fatalism can emerge in people as a result of a denial of involvement in decision making by more powerful interests (see Crenson 1971; Gaventa 1980).

Many constructivists that attempt to avoid engaging in broader institutional and structural considerations perpetuate, whether consciously or not, an individualistic focus in health care. This in turn legitimates the lack of response by government and industry via their silence. As Crawford argues;

by focusing on the individual instead of the economic system, the ideology [of individual responsibility] performs its classical role of obscuring the class structure of work. The failure to maintain health in the workplace is attributed to some personal flaw. The more than 2.5 million people disabled by occupational accidents and diseases each year and the additional 114,000 killed [in the US] are not explained by the hazards or pace of work as much as by the lack of sufficient caution by workers, laziness about wearing respirators or the like, psychological maladjustment, and even the worker's genetic susceptibility. Correspondingly, the overworked, overstressed worker is offered TM, biofeedback, psychological counselling, or some other "holistic" approach to health behaviour change, leaving intact the structure of incentives and sanctions of employers which reward the retention of health-denying behaviour (Crawford 1977, p. 673).

Medicine, a key arbiter of illness, is not receptive to lay opinion that diverges from dominant positions and will often label the more recalcitrant as having a psychological disorder. Diane Crumpler, a person living with chemical sensitivity, observed:

A doctor's self-concept is bound to his success as a healer. The patient who presents repeatedly, with problems beyond his knowledge, challenges his professional ability. The doctor feels he must provide a diagnosis and a remedy, and so resorts to the trite verdict of psychosomosis or an unknown virus - concepts which do fit what he was taught in medical school... They claim much of the evidence — case studies like our own — is clinical or anecdotal, lacking 'real' proof. Yet these same doctors will accept unconditionally the contention that our problems are psychosomatic — a theory which offers no physical proof at all (Crumpler 1994, p. 172).

For Crumpler initial understanding of her health problems occurred outside of medicine through lived experiences of reacting to chemicals and identifying with similarly affected neighbours and people (Crumpler 1994, pp. 36-41).

Kroll-Smith and Floyd's (1997, pp. 144-145) examination of lay epistemology of people with Environmental Illness (EI), also known as MCS, pointed out that people's claims often differ from modern medical opinion because they must provide a 'justificationary conversation' to convince others to alter *their* practices and policies. One person with MCS stated:

I knew I was going to have to tell my coworkers a convincing story the morning I wore a carbon-filtered face mask to work. My supervisor had agreed to let me wear it "on a trial basis," but she told me she would have to reassign me if it bothered the other employees. I practiced what I was going to say all the way to work (quoted in Kroll-Smith and Floyd 1997, p. 145).

Constructivism offers valuable insights in acknowledging knowledge, illness and the body are culturally and socially shaped, but there remains a lacuna. Constructivism within the sociology of medicine tends to ignore the *social determinants of illness* and *illness construction as a product of structural location*. Explicit is a belief that one can escape the problems inherent in traditional realist accounts utilising constructivist

discourse by examination of ‘interacting communicating individuals’ but in doing so a reductionist methodology emerges. Institutions, social structures and dominant ideologies are not adequately considered. The result is a pluralist analysis that avoids substantive discussion and engagement with social structures and within the tensions of expert-lay knowledge claims there is a privileging of medical expertise.

The selection of ‘apparently’ less structurally related, or poststructuralist, diseases and illnesses for inquiry often makes constructivist studies easier and more coherent in terms of constructivist discourse. Consequently the lack of consideration of occupational health and safety issues by constructivists is telling. Pollution, regulation and the relationship of disease and illness to hazardous industries appear under represented in constructivist discourses (see Petersen and Waddell 1998; Lupton 2003). Even when they are addressed the examination is often cursory (see Petersen and Lupton 1996). This is not to wholly dismiss such contributions but recognise that the appropriateness of a theory depends on the issue studied and the appropriateness of the issue depends on the theory. Thus the notion of poststructuralist diseases and illnesses are oxymoronic when one considers environmental and occupational illnesses/diseases such as asbestos related mesothelioma, RSI and MCS.

The social causation of health and illness has three components: ‘social production’, ‘social heritage’ and ‘exposure and resource’ (Siegrist 2000). First, social production involves labelling of individuals, most often associated with ascribing a mental illness to a person as a form of social control. Second, social heritage is attributed to the genetic and parental factors that impact on health. Third, exposure and resource, the most important according to Siegrist, holds that ‘society determines the health of individuals mainly by exposing them to specific health-detrimental risks in their social environment’ (Siegrist 2000, p. 101). Recently, the exposure and resource model has included the ‘psychosocial’ that focuses on a person’s stressful environment as a cause of illness. This is in addition to the traditional ‘material’ determinants, the social and environmental health damaging factors such as toxic work places, traffic accidents, poverty, pollution etc. It appears that exposure and resource perspectives – or for that matter social production and social heritage - are not amenable to simply a constructivist analysis as social structures play a critical role in the production of ill health, the lived experiences and knowledge claims. The benefits of including social

structure within a theoretical framework and the weaknesses of constructivism are explored further below.

A Broader Methodological Approach: The Shift to an Interest Framework

Martin and Richards have attempted to redress the limitations of the SSK or constructivist approaches in the studies of controversies by advocating a synthesis of theoretical models (Martin and Richards 1995). They suggest the inclusion of group politics and social structural approaches because they assert controversies cannot be reduced to one theoretical model. The utility of a particular synthesis does, nonetheless, depend on the controversy being examined. Group politics involves the examination of contending interest groups via conflict and compromise. This pluralist theory, also evident in the weak program examines groups such as activists, regulators and the scientific community in terms of their attempts to gain power over contending groups. A structural analysis using concepts such as class and/or the state, for example a Marxist analysis, provides another level of analysis as does Marxist influenced analysis that examines prevailing ideologies and power relationships (see Lukes 1974).

Inclusion of a structural analysis is of benefit in examining regulatory policy and processes lacking in the narrow interest and constructivist models. Moreover, in contrast to pluralist models, incorporating a structural analysis that views society and power distribution as inherently unequal provides a greater understanding of social context. This recognition enables a study of interests to be more strongly grounded within the wider social context. An examination of social structures often places the researcher at odds with dominant institutions and governments because of the researcher's focus on understanding information and practices about what constitutes a healthier and safer work and public environment (Quinlan and Bohle 1991a; Rosen 1993). A study of health and safety that includes opposition to dominant structures, which seek to marginalise or bias such concerns, is therefore better addressed within a theoretical framework that is more realist/structuralist than constructivist/pluralist. This is because of the latter's blindness to social structure and reductionism of complex social issues as the previous theoretical discussion has demonstrated. This is best understood as a shift along a continuum towards a realist conception of interests but incorporating the insights of constructivism rather than outright rejection.

Winner (1993) has also criticised social constructivism as it favours, within its broad analysis of technical possibilities, particular social interests while omitting others. He argues the failure by social constructivists to question or address the outcomes of particular technological choices is at odds with the critical traditions of Marx, Ellul, Heidegger, Mumford and Illich that attempt to develop their inquiries toward a more just and equitable society.

The application of the Empirical Program of Relativism to an analysis of technology, by Pinch and Biker (1984), has generated criticism of benefit to the development of a more theoretically robust interest-based analysis. Russell (1986) argued that the reduction of complex social relations by Pinch and Biker, to individual actors/groups, neglects the social consequences of technology. This is a result of their adoption of an essentially pluralist analysis that views the distribution of power as effectively equal. Russell acknowledges that relativism has value as a heuristic device to examine technical arguments while suspending judgements but contends that problems arise in analysing technology. These include the neglect of social influences and the possible extension of relativism from a limited methodology to a broader theoretical position, which can lead to the appearance of political neutrality. Russell argues that a political commitment is necessary to highlight alternative technologies and social aims; he advocates in essence a radical analysis to stress the inclusion and exclusion of interests.

Russell and Williams (Russell 1986; Russell and Williams 1987) call for the development of a Marxist orientated social model, which does not reify social relations but seeks to understand the dynamic relationships between the state, capital, labour, racial and gender divisions, social movements, and professional groupings. This need not lead to a deterministic theory of interests sometimes equated with the more instrumentalist forms of Marxist theory¹². Contemporary radical theory views the state as having both a degree of autonomy in its operation while seeking to maintain wider social relations and the capitalist mode of production. Jessop argues for a multi-levelled historical analysis incorporating empirical study of state relations to account for change to avoid notions of determinism (Jessop 1982, pp. 211-220). Similarly, within health

¹² For a discussion on the limitations of Marxist theory in the health research see Turner Turner, B. S. (1987). Medical Power and Social Knowledge. London, Sage.

sociology Willis has argued for a multiple theoretical approach encompassing a non-deterministic materialism. This approach is premised on coercion, unlike traditional industrial sociological perspectives, which have tended to rely on consensus when examining health and safety in the workplace (Willis 1994, pp. 151-154).

Turner adopts a pragmatic approach recognising the interdependence between the research topic and the theoretical position adopted. While arguing that the theoretician Merleau-Ponty on phenomenology is appropriate for understanding pain and that Parson's 'sick role' assists understanding doctor patient relations,

I felt that neither Merleau-Ponty nor Parsons was adequate for understanding the impact of the state or the environment or social class on the distribution of health and illness globally. One had to look for a neo-Marxist or political economy paradigm to examine these questions. I think this is an illustration of what I intend by a 'strategy of inclusion', that, rather than being forced to choose between those particular competing paradigms, one could see them as addressing very different issues at rather different levels. Another way of describing this procedure is to talk about epistemological pragmatism, that is epistemological and theoretical questions should be framed in terms of specific levels or specific problems, depending upon the range of interest, the topic and orientation of the sociologist (Turner 1992, p. 237).

Occupational Health and Safety: Interests, Bias and Agenda-Setting

The previous discussion has highlighted the strengths and weaknesses of traditional interests models within STS studies and constructivist models within both STS and the sociology of medicine in providing a methodology to examine occupational health and safety issues. I have argued for a shift in conceptualising interests from the strong relativist towards a realist conception of interests. In so doing I have attempted to avoid the pitfalls of traditional realist accounts. Even authors such as Jasanoff, who argues for SSK use in the policy analysis, have acknowledged that relativist discourses are inherently political and that, 'at the bottom, a deeply normative project that runs through even the most playful narratives that we in science and technology studies construct about the common production of knowledge and social order' (Jasanoff 1996, p. 413).

While their accounts add to a body of information that informs, the problem with even the weaker forms of constructivism offered by Jasanoff is still the submerging of many issues relating to social structure and power under such playful narratives. The previous discussion of various relativist positions has highlighted the tendency to legitimate existing social structures and their associated knowledge claims and narrow what constitutes legitimate knowledge.

Habermas argues interests underpin theory and knowledge whether or not it is acknowledged and when interests are acknowledged the potential is emancipatory.

The ontological illusion of pure theory behind which knowledge-constitutive interests become invisible promotes the fiction that Socratic dialogue is possible everywhere and at any time. From the beginning philosophy has presumed that the autonomy and responsibility posited with the structure of language are not only anticipated but real. It is pure theory, wanting to derive everything from itself, that succumbs to unacknowledged external conditions and becomes ideological. Only when philosophy discovers in the dialectical course of history the traces of violence that deform repeated attempts at dialogue and recurrently close off the path to unconstrained communication does it further the process whose suspension it otherwise legitimates...the unity of knowledge and interest proves itself in a dialectic that takes the historical traces of suppressed dialogue and reconstructs what has been suppressed (Habermas 1978, pp. 314-315).

A recognition that interests are not arbitrary but are created by social structures is intrinsic to identifying and attributing interest. Industry has a significant role in creating the environment and therefore health and safety conditions (George and Davis 1998, p. 302). The state has increasingly become involved in the establishment of regulations and institutions to supervise health and safety and by doing so has, in part, offset a perceived widespread industry disregard for health and safety. In Australia, regulatory bodies such as the National Occupational Health and Safety Commission and Workcover are symptomatic of the state's involvement in shaping definitions of health, illness, injury and safety (George and Davis 1998, p. 300). Such regulatory bodies often

favour industry and government interests over employee interests due to their established structure and operation, what Biggins (1988) terms a class bias.

This thesis argues that the health and safety in particular of aircraft crew and public should be protected, an a priori interests position if you like. The interests of various stakeholders are not explicitly identified at this stage but emerge in the following chapters as a product of empirical analysis of the cabin fume controversy apart from the already outlined concern for the health and safety of aircraft crew/public. A multi-level analysis is adopted to address the various levels from the controversy at the micro level, the role of institutions at a meso level and the social structure at a macro level. I am concerned with bias on the part of researchers, institutions, industry and the state that seeks to undermine health and safety. Claims of bias will not simply revolve around what constitutes truth or falsity but will be contextualised in light of regulatory obligations, scientific/medical claims and the socio-political context. Thus a multi-dimensional approach is adopted to examine differing claims such as scientific assessments of jet oils and the positions of industry, regulatory authorities and government regarding health and safety.

As discussed many constructivists have not adequately come to terms with the value of lay knowledge as a legitimate and often critical knowledge source in understanding particular issues and so ignore one section, often more¹³, of a multi-dimensional debate because of an incompatibility to *their* theoretical and empirical program. Debates are, however, inherently political with a historical context; and the effective marginalisation of lay knowledge *is* also a political action. Thus it can be interpreted as a bias on the part of researchers and those interests such as industry and regulatory authorities who seek to dismiss such concerns:

Lay knowledge is a proclamation of ‘the privilege of experience’. Once biomedical and other scientific knowledge becomes caught in the crossfire of opinions it inevitably involves dealing with questions like: ‘How do we wish to live?’, or ‘Why do we feel ill all the time?’ It means taking account of these questions and being prepared to discuss them in the formulation of environmental and health policies. The lay challenge

¹³ Lay opinion by its very nature often generates multiple views.

to medical knowledge is not a complaint about the aesthetics of discourse, it is a political challenge to the status of scientific knowledge and the power of those whom we are encouraged to trust with such knowledge (Williams and Popay 1994).

Many theorists have adopted a normative definition of human needs and highlighted the detrimental outcomes of science and technology through examining prevailing social structures such as the state and prevailing ideologies. These approaches often require the identification and attribution of interests to address perceived problems for example; feminists (Coney 1988), Marxists (Rose and Rose 1976), environmentalists (Beder 1996), those who challenge racism (Harding 1993b), third-world activists (Third World Network 1988), bias in pharmaceutical regulation (Abraham 1995) and the impact of occupational health and safety issues on workers (Doyal and Pennell 1983; Quinlan and Bohle 1991a). The position taken by the authors is also a product of the issues they are examining.

Abraham (1995) argues strongly for adopting a realist conception of interests in an examination of scientific bias in the pharmaceutical industry. His study of pharmaceutical regulation presumed rather than demonstrated that pharmaceutical companies had an interest in making profit from their products and that the public had an interest in medications that would be therapeutic. However, he also acknowledged that the form of this private/public relationship is an empirical concern (Abraham 1995, pp. 33-34). He premises interests on 'rational' actions but acknowledges that not all pharmaceutical employees' or scientists' interests will necessarily coincide with those of a pharmaceutical company. Similarly, I argue the aviation industry has an interest in profit maximisation for their products and services whereas aircraft crew and public have an interest in safe and non-health threatening aviation. However, I do acknowledge that this is premised on 'rational' actions and on the structured differences between employee/public and employer concerns.

Abraham's definition of scientific bias is also appropriate and based on the assumption that in spite of disagreements 'scientists do agree on some standards ... bias in science, then, is the advocacy/practice of claims/actions that are non-credible because they are inconsistent with the very scientific standards which the advocate/practitioner accepts as

legitimate, and are convergent with identifiable interests/values' (Abraham 1995, p. 29). This is an appropriate definition for bias from an analyst's point of view which encompasses the uses of the science in the policy arena, namely examining how science is socially constructed from the research areas selected, conclusions that do not follow from research, the failure to research particular areas and how information is interpreted in the policy area. This approach is applied in my examination of jet oils and research on cabin air quality.

The examination of occupational health and safety responses by institutions and the prevailing social structures necessitate a broader definition of bias than that offered by Abraham. Regulations and policy established by the state with the assistance of industry build occupational health and safety regimes that are biased against employees in favour of industry. This is often done in the face of considerable employee resistance. For Willis occupational health and safety conditions are best viewed in terms of coercion because,

occupational health and safety has always been part of the contestation around the issue of what are the limits to which an employer can go in damaging the health of their employees as part of the employment contract in pursuit of surplus value. Such contestation over the limits has not simply been based on attempts by employers to control the labour process, but also on **creating the conditions** under which workers may consent to the limits negotiated (emphasis added) (Willis 1994, p.155)

Health and safety remain an empirical issue for the particular area of concern not least because of the necessity to understand the particular **conditions** and identify preventative measures. Aviation has a number of safety regulations that set out occupational health and safety **conditions**; this includes Civil Aviation Regulations (CARs) and Federal Aviation Regulations (FARs).¹⁴ Therefore while acknowledging

¹⁴ CAR 2 (*major defect*)

.... as in relation to an aircraft, means a defect of such a kind that it may effect the safety of the aircraft or cause the aircraft to become a danger to person or property.

CAR 48.0 (*Flight time limitations*).

1.4: Notwithstanding anything contained in these orders, a flight crew member shall not fly, and an operator shall not require that person to fly if either the flight crew members is suffering from, or considering the circumstances of the particular flight to be undertaken, is likely to suffer from fatigue or illness which may affect judgement or performance to the extent that safety may be impaired;

that regulations are open to interpretation they provide a basis from which to evaluate how regulators, industry and state behave. Thus bias can also be viewed as a failure to adhere to the regulations and established practices. That is those created conditions under which people work and live. The analysis of bias which this thesis utilises with respect to regulations is made more robust by examining whether this bias is systematic and ongoing.

The examination of health and safety is extended further via an examination of the health problems that have arisen from exposure to cabin fumes. Particular attention is given to long term health problems such as MCS. The Macquarie Dictionary defines bias as ‘one which prevents unprejudiced consideration of a question’ (Butler, Atkinson et al. 1991, p. 169). So when those flying on aircraft ask the question ‘Why do we feel ill all the time’ and are stymied, victimised and denied recognition for their health problems, bias can be attributed to the exercise of power that denies these people legitimacy and recognition of their illness. Debates surrounding MCS will be explored to more fully understand the key interests involved in its social shaping.

This thesis shifts interests away from relativist and constructivist conceptions and locates it further along the continuum toward a realist position. Marginalising the influence of structural relations by constructivist models opens those adopting such theoretical/methodological approaches to a range of problems as this chapter has argued and also leads, ironically for poststructuralist theoretical accounts, to determinism. By excluding or marginalising the influence of structural relations researchers are susceptible to determinism by not adequately considering the less obvious exercise of

Civil Aviation Advisory Publication (CAAP) 51-1 (O) advises
(c) smoke, toxic or noxious fumes inside the aircraft is considered a major defect.

Federal Aviation Regulations (FARs)
FAR 23.831 (*Ventilation and heating*)

(a) Under normal operating conditions and in the event of any probable failure conditions of any system which would adversely affect the ventilation air, the ventilation system must be designed to provide a sufficient amount of uncontaminated air to enable the crew members to perform their duties without undue discomfort or fatigue and to provide reasonable passenger comfort.

(b) Crew and passenger compartment air must be free from harmful or hazardous concentrations of gases or vapours.

(c) There must be provisions made to ensure that the conditions prescribed in paragraph (b) of this section are met after reasonably probable failures or malfunctioning of the ventilating, heating, pressurisation or other systems and equipment SRRATRC (2000). Air Safety and Cabin Air Quality in the BAe 146 Aircraft, Parliament of the Commonwealth of Australia.

power. Bachrach and Baratz (1970) have argued that power is often 'latent' and that this potential can shape responses without recourse to its obvious exercise. Their concept of 'non-decisions', in which other interests are prevented from engaging in decision making or undermined via agenda setting, is important. This can take a range of forms from overt action to prevent demands reaching a political forum to a perceived threat of sanctions that limit alternative views and processes. Crenson's (1971) comparative study of air pollution regulation in US cities is a case in point, as is Harrison and Hoberg's (1991) study of dioxin and radon. Gaventa's (1980) study of Appalachian communities and multinational mining companies not only examines agenda setting but ideological influences in minimising community opposition. Social scientists who neglect to address these aspects of regulatory power tend to legitimate their ongoing use. The following chapter will begin the empirical process and examine industry's role in constructing health and safety which will be followed by a chapter on jet oil, the substance primarily associated with BAe 146 cabin contamination.

Chapter 3: Industry's Role in Constructing Health and Safety

Introduction

Cabin fumes¹⁵ on the BAe 146 aircraft have resulted in a large number of health complaints from aircraft crew. This has prompted research and government inquiries into their origins and the resultant health and safety implications. Some aircraft crew, such as pilots, have been unable to land aircraft due to disorientation following exposure to oil fumes, (BASI 1999) some aircraft crew have required emergency treatment at hospitals (van Netten 1998, p. 733) and others have been forced to resign from work due to ongoing health problems including chemical sensitivity (Baker 1998, p. 1; Australia Senate 1999f, p. 69). There is an emerging consensus that these fumes cause short term health effects - irritation to the eyes, nose, throat, head and chest. Parties to the consensus include the major interests in this controversy including airline operators, manufacturers, cabin crew, unions, government researchers and courts. This consensus was slow in developing for the manufacturer of the BAe 146, British Aerospace (BA), and since late 1999 known as BAE Systems. This new company is now one of the largest arms manufacturers in the world.

In spite of the general consensus on short-term health effects, long term health effects such as Multiple Chemical Sensitivity (MCS) remains highly contested. Toxicologist Chris Winder defines long term health effects as those lasting longer than one year (Winder 2000b). Manufacturers, airlines and regulators do not accept that exposure to cabin fumes results in long term ill health. In contrast, cabin crew, unions and a number of doctors and researchers have argued that exposure can result in long term illness.

This chapter examines the claims of BA in order to demonstrate their marginalisation of both short-term and long-term health effects as well as the safety implications. A number of scientific studies cited by BA to support its arguments are deconstructed. The following analysis seeks to highlight the attempts by BA to construct such illnesses as

¹⁵ I have chosen the term fume as opposed to odour as it is more commonly used to describe organic chemical emissions. A discussion of these terms and their relative objective (fume) and subjective (odour) connotations occurs later in this chapter.

non-issues. In other words to shape debates and issues to exclude information perceived as damaging by BA.

The creation of a non-issue involves the removing of ambiguities, potential and actual problems, and conflicting recommendations. The aim is to put forward clear statements and in this instance influence government and regulators. Statements will usually conform to the interests of the party making the claims. The creation of a non-issue often requires the support of other interested and influential parties (see Crenson 1971). This alignment can be viewed as a network of legitimacy supporting common interests; this does not have to be an organised network such as a cartel but simply knowledge that there is common ground. Shaping of information via selective quotation, reaching conclusions that do not follow from research and omitting documented health and safety problems is also a bias. The problem can in this way be made to disappear from wider scrutiny.

BA stated in their submission to the Senate Inquiry that they had received reports regarding,

cabin air odours...from time to time and have predominantly been determined to be due to minor systems failures such as leaks from oil seals on the aircraft engines or auxiliary power unit (APU). The engine and APU manufacturers introduced modifications in 1992 that were designed to prevent oil leakage into the air conditioning system. These are being embodied in the aircraft all over the world with excellent results (Australia Senate 1999i, p. 127).

Before going on to address BA claims it is useful to consider the background to the early fume events from a BAe 146 crew member involved in negotiations to improve cabin air quality. The submissions of other crew members are examined in Chapter 7.

A Long History: Fumes and Illness

Kerri Allison, a flight attendant with 20 years experience, was one of many aircraft crew who made a submission to the Senate Inquiry. In her submission she documented that the 'BAe 146 from the very beginning [when purchased by Eastwest Airlines in 1990]

had a foul smell which passengers would comment on all the time ... A lot of East West Flight Attendants complained of headaches, fatigue biliousness, sore throats & red watery eyes' (Australia Senate 2000w).

Allison included two letters in her submission dated August 1992 from Ken Crawford the Assistant General Manager of Eastwest acknowledging the problem and discussing with her joint measures undertaken with BA and engine manufacturers to reduce cabin fumes (Crawford 1992b; Crawford 1992a). From early on airlines attempted to keep the problems of fume events from outside scrutiny. Crawford stressed 'that the reporting of any odour is conducted through the proper channels and not the subject of discussion outside of Eastwest' (Crawford 1992a). A number of modifications were undertaken and new filters were put into the BAe 146 aircraft in November 1992 however, Allison notes 'the fume problem was still there' (Australia Senate 2000w).

Eastwest had a policy of encouraging the reporting of fume incidents and Allison was apart of the Safety Committee which placed log books on aircraft to record the flight attendant, fume symptoms, date and sector. Nonetheless, following the takeover of Eastwest by Ansett 'these books mysteriously disappeared' (Australia Senate 2000w).

In October 1993, Allison recounts a major fume incident she was involved in. This incident also involved Alysia Chew who was forced to leave work due to illness and pursued compensation for a range of health problems including MCS. This case is discussed in detail in Chapter 7 along with other reports of crew ill health and disability. Allison recounts the health problems of many crew members that were on this particular October flight. She notes that Captain Brett Bradford and the First Officer have developed a rare lung disease called Sarcoidosis. Allison herself was diagnosed with breast cancer in 1998 but returned to work flying in September 1999. She notes that she was 'highly chemically sensitive to the drugs and radiation she was given' to treat her breast cancer (Australia Senate 2000w). Allison also paints a disturbing picture of the health problems of aircraft crew noting that of

approximately 130 East West Flight Attendants. Four of which have since died 3 of which were cancer related. Another 4 Flight Attendants have cancer. 3 Breast Cancer including me, and 1 with Bowel Cancer.

All the Flight Attendants were under 47 years old, the youngest the first to die I believe was only 27 years old (Australia Senate 2000w).

Concluding her submission to the Senate Inquiry Allison stated that,

I am most concerned for my colleagues that the recognised issue of oil fumes on the BAE 146 Aircraft has continued unresolved for too long (Australia Senate 2000w).

The Fume Source

Cabin fumes enter via the air-conditioning system of the BAe 146 aircraft. Air enters the aircraft after being heated and compressed from the jet engines. This process is common to most modern commercial jet aircraft. In-flight, air is drawn from the engines just prior to combustion. At this point it is over 500°C. The air then goes to catalytic converters to remove 'minor contaminants' from the engine lubrication system. It then travels through a heat exchanger which cools the air further (200°C) and onto two airpack units on either side of the aircraft. The airpack units cool the air to between 50° and 60°C for use in the cabin environment. This engine air provides passenger air, heating and pressure control for the plane. The major source of cabin fumes has been traced to the failure of two bearings, numbers 1 and 9, in the turbojet engines (Model ALF 502R5) that allow jet engine oil to enter the air-stream via leaking seals (van Netten 1998, pp. 733-744). The oil would follow the airflow into the cabin environment after being cooled.

Another source of cabin fumes is the APU supplied by AlliedSignal. This jet unit powered engine located at the rear of the plane supplies air for the cabin whilst on the ground and during take off when the main engines do not have sufficient air for the task. Cabin fumes from the APU are caused by exhaust drawn into the cabin environment (van Netten 1998, p. 733) and by oil leakage into the bleed air similar to the main engines (Fox 1997b, p. 10). The oil used in the main engine is generally the same used in the APU within BAe146 aircraft. In Australia this is Mobil Jet Oil II. Its assessment is examined in the next chapter.

British Aerospace: Setting the Agenda

BA argued that three scientific studies, which it included in its first submission to the Australian Senate Inquiry into BAe 146, 'have found no health or toxicity issues are identified with the air supply on board BAe-146' (Australia Senate 1999i, p. 127).

These studies were by;

- Vladimir Vasak, a Qantas Occupational Hygienist subcontracted to Ansett Australia, *Cabin Air Contamination in BAe 146 in EastWest Airlines* (Vasak 1992a)
- Christiaan van Netten of British Columbia University, *Air Quality and Health Effects Associated with the Operation of BAe 146-200 Aircraft*, originally done in 1996 (van Netten 1998, pp. 733-739)
- Richard Fox, principal investigator of AlliedSignal (now Honeywell), the manufacturer of the BAe 146 engines, undertaken with the assistance of Ansett, *Final Report: Air Quality Testing aboard Ansett Airlines BAe146 Aircraft* (1997) (Fox 1997b)

According to BA it participated in two of these studies, those by Vasak and Fox, but did not elaborate on what this entailed (Australia Senate 2000j). BA concluded that there has 'never been any evidence of any toxicity in the BAe146 cabin air...[of studies since 1992] none have established any risk to safety of either the passengers or the crew or breach of accepted safety standards' (Australia Senate 1999i, p. 130). **No evidence** of toxicity or risk in the air supply, is not the same as claiming that there is **no toxicity or risk** or that **no safety or health effects** have arisen from cabin fume exposure.

Nonetheless, this is the implication BA intended to convey. The three studies' assessments and claims will be examined and juxtaposed with BA's interpretation of them in order to deconstruct the scientific knowledge claims surrounding health and safety.

An examination of the studies cited by BA is instructive in the interpretation of scientific assessments and the construction of non-issues. Studies become tools to support arguments and actions in meeting the objectives of particular interests, through selection and omission of 'factual' information. The pragmatic philosophical school epitomised by William James and embodied in part by scientific research practice may be summed up by the statement that: 'A proposition is true if the results that follow

from it are useful' (Silver 1998, p. 503). While the scientific researcher does make judgements on the utility of research such judgements are also made by scientific peers, industry, regulators and government. These judgements determine how various interests utilise research and assign values regarding its interpretation and utility. Many researchers have pointed out scientific knowledge interpretation and reinterpretation is not limited to expert communities and researchers (Allen 1987; Richards 1996; Wynne 1996b).

Vasak Study

Vasak presented the results of two analyses by Workcover in 1992 which reviewed jet oil samples from original filters that ducted air into the cabin and absorbent tubes which drew cabin air through them. The results noted that heating of the Mobil Jet Oil II (MJO) and its passing through a catalytic converter can significantly alter the chemical constituents of the oil. Also due to the low volatility of the oil 'a full identification of the individual trace components could not be carried out by Workcover' (Vasak 1992a, p. 2). Vasak noted in one study that Workcover found 'no similarity' between collected samples obtained from aircraft filters and the unused MJO which made 'quantitative evaluation of the samples impossible', (Vasak 1992a, p. 1) but the samples indicated that MJO had undergone some change¹⁶. In another analysis samples of MJO were linked to the contaminant identified in the cabin environment. The study noted fumes could cause 'discomfort' though there was at present no evidence of lasting health effects. Nonetheless 'a clean cabin atmosphere as far as technically possible will always be the principle aim of the occupational hygiene' (Vasak 1992a, p. 4).

¹⁶ Vasak did not recommend testing of flight crew in this report but in earlier correspondence, on the 16 May 1992, to Workcover concerning this same research he cautioned that,

Further identification and possibly toxicological investigation would be necessary in the case of any analytical evidence of serious contamination of the cabin air by unknown compounds (originating from the thermal degradation of the oil, its additives or other gaseous or volatile compounds) or any adverse medical findings on the flight crew, occupationally related to the inhalation exposure in the aircraft.

In the case of a justified medical concern following a continuing inhalation exposure to the contaminated air in the aircraft cabin some biological tests may be of some help. (e.g. inhibition of cholinesterase in a case of a proved exposure to a toxic organophosphate) Vasak, V. (1992b). Letter to Robert Geyer Laboratory Services WorkCover Authority - Dated 16 May 1992.

The Vasak study was also very small due to methodological difficulties which necessitated a number of analytical approaches. In his concluding comments Vasak stated that:

Unless the problem of the cabin air contamination is satisfactorily resolved soon by technical means e.g. new catalytic converters, electrostatic precipitators, filters or a “burn off” procedure, further tests should be carried out. Greater number of representative samples is required to confirm a low concentration of oil mist in the cabin as this can vary with operation of the aircraft and its maintenance (Vasak 1992a, p. 4).

To sum up, the Vasak study had significant difficulty analysing and identifying samples. Recommendations included examining a range of technical measures and increasing the number of samples of cabin air taken due to aircraft variation to resolve cabin air contamination (Vasak 1992a). Vasak made a ‘strong suggestion’ that called on BA to provide a testing procedure based on one designed by the US SAE E31 Committee to examine cabin air contamination by jet oil and associated break down products (Vasak 1992a, p. 4). This testing procedure would allow instant evaluation of all organic products in cabin air. In contrast the BA assessment of the Vasak report did not address the tentative and incomplete nature of the report’s findings and effectively ignored Vasak’s recommendations. BA noted that,

The report stated that there was no evidence which would support the opinion that reported cabin odour would have lasting adverse health effects on flight crew or passengers (emphasis in original)
(Australia Senate 1999i, p. 128).

The shift from researcher assessment to industry assessment is marked by a shift from indeterminacy of the assessment of cabin fumes to a selective ‘certainty’ of ‘no evidence’ of lasting health effects. Recommendations for further action are ignored. This selective appraisal by BA serves to construct both short term and long term health as non-issues. Interestingly, Graham Saunders, the Co-ordinator of the Chemical Safety Unit at Workcover, noted in 1998 that earlier sampling undertaken by Workcover ‘was not carried out in flight and the

comment was made at the time that the contamination is spasmodic so the results of our testing may not necessarily be representative of actual situations' (Saunders 1998).

van Netten Study

The second study cited by BA was by van Netten and conducted in Canada, for Air BC, in 1996. This study identified leaking oil seals in the engine as leading to a number of health effects. The study involved five aircraft. Four were BAe 146 aircraft; two had experienced air quality problems the previous day (numbers one and two). One of the two other BAe's was fitted with standard air system and the other with an experimental charcoal filter. Another aeroplane used as a reference was a de Havilland Dash 8-100 (van Netten 1998).

The study by van Netten noted previous studies had linked oil fumes to faulty oil seals (No. 1 and No. 9) on the engine and noted that this was followed by daily inspection that replaced faulty oil seals when they were identified. These measures minimised oil cabin exposures but did not eliminate them. van Netten also confirmed a faulty oil seal in aircraft one. During inflight testing of aircraft one it was noted that, 'two minutes after take off an oily smell with a distinct detergent and sour smell overtone, which changed to a hot oil smell after a few minutes, came into the cabin' (van Netten 1998, p. 735). Assessment of volatile organic compounds (VOC) was via activated charcoal tubes and for organic compounds filter cassettes were used, both were attached to portable air pumps (van Netten 1998, p. 734). A number of VOC were also identified including methylated propane, butane ester derivatives and siloxane but tricresyl phosphate (TCP) was not identified. The primary source of the oil smell was found by isolating each engine and determined to be engine four – in particular the number 9 seal (van Netten 1998, p.735).

Strangely the oil was changed the day before testing from Castrol 5000 to Exxon 2380. This is odd given that testing ideally should mirror closely the problem to be tested. This is perhaps best understood by an apparent correspondence with an increasing number of health complaints following a shift in jet engine oil from Exxon 2380 to Castrol 5000, in 1996. Health complaints, though present with the Exxon 2380, were

more numerous following the shift to Castrol 5000 (van Netten 1998, pp. 733-744). The unexplored though obvious assumption is that Exxon oil may present less of a hazard and its use during testing is used to shape more favourable research conclusions. Both these oils are similar to Mobil Jet Oil II in containing TCP at around 3 per cent and tri-ortho-cresyl phosphate (TOCP). Another similarity with Mobil (see next Chapter) was the secrecy that surrounded the formulation of Castrol and Exxon oils, which prevented detailed assessment (van Netten 1998, p. 736).

The other aircraft (number two) with fume problems had also experienced ‘a distinct oil odour which became highly pronounced when air supply came from engine two was introduced to the cabin’ (van Netten 1998, p. 736). In contrast to plane one which was tested in flight this plane was tested on the ground and testing involved a focus on carbon monoxide (CO) levels. This focus was due to the difficulty in assessing the oils in part due to the secrecy of the oil companies (van Netten 1998, pp. 735-736) but also because,

one can expect a number of contaminants to pass through the [catalytic] converter in an original or semialtered state. This makes it even more difficult to zero in on a particular agent for testing. For this reason it was decided to monitor for the most acute toxic agent that could potentially be generated if the catalytic converter was not operating efficiently...carbon monoxide (van Netten 1998, p.736).

Consequently, the oil constituents were not critically evaluated and an alternative assessment using CO was adopted. This somewhat indirect measure of cabin contamination was detected in the second plane at 3 ppm. The standard set by the American Conference of Governmental Industrial Hygienists is 25 ppm for an occupational setting (van Netten 1998, p.737). The study recommended installing CO monitoring instruments into aircraft.

The study by van Netten also attempted to ascertain the air quality of ‘properly maintained’ BAe 146 (numbers three and four) aircraft compared to another aircraft, a Dash-8. This study found no measurable level of CO and the study concluded that ‘normal BAe-146 aircraft compared favourably with that of a Dash-8 not associated

with problems' (van Netten 1998, p. 739). This was done to provide a benchmark where differences in air quality can be quantified and acted upon, but failed to address oil based cabin contamination due to a limited focus on CO. So 'normal' was constructed narrowly by van Netten. This comparative aspect of the study was to become the focus of industry assessments, including BA, whilst those aspects that raised health concerns and suggested responses were ignored.

The van Netten report also documented exposure descriptions by flight crews over a four month period, symptoms included 'burning eyes, nasal congestion, sore throat, and tingling lips. Several experienced disorientation, were unable to continue with their duties, and were administered oxygen' (van Netten 1998, p. 735). van Netten also noted that no ongoing symptoms have been reported and that symptoms generally resolved within 24 hours. However, the study was not established to examine long term health effects, and there was no follow up after four months. The seriousness of the effects during that four month period is evident in a number of crew requiring emergency treatment in hospital. Table 1, based on the four month study, documented a range of symptoms of flight crew; of 200 flight crew involved in the survey 112 reported symptoms.

Table 1 Symptoms Reported by Flight Crew During a 4-Month Period

Five aircraft involving 35 flights each. Total individuals with symptoms = 112; total flight crew present = 200 (van Netten 1998, p. 735)

Please see print copy for Table 1

The symptoms also fitted a number of possible conclusions according to van Netten. They,

appeared consistent with those associated with low level carbon monoxide exposure, including headaches, nausea, light-headedness, and disorientation. Some of the other symptoms, including burning eyes, burning throat, watering eyes, and sinus congestion appeared more consistent with exposure to an irritant such as smoke or VOCs. The tingling and numbness experienced by some individuals appear to indicate some neurological involvement, indicating possible exposure to volatile neurotoxic hydrocarbons such as hexane and octane, as well as tricresyl phosphates (TCPs) known ingredients in jet engine oils (van Netten 1998, p.737).

BA in referring to this study by van Netten misrepresented the obvious health and safety issues documented in this study by ignoring health issues raised and focused on 'normal' BAe146 aircraft. BA stated:

No health or toxicity issues were identified and his published report stated that the air quality of a normal BAe 146 compared favourably with that of a Dash 8 aircraft not associated with cabin air problems

(emphasis in original)(Australia Senate 1999i, p. 128).

BA ignored other observations by van Netten such as the health effects arising from fume exposure and a recommendation to include CO monitoring equipment. This construction of his scientific knowledge claims was noted by van Netten when he spoke as a witness in the Senate inquiry:

They do not mention, for instance, that I also make other conclusions which they do not always seem to be quoting me on. So I call it a case of selective quotation from my reports (Australia Senate 2000d, p. 212).

The disregard for aircraft crew and passenger health is illustrated when BA claim 'no health or toxicity issues were identified'. As with the Vasak study BA ignored the difficulties with direct scientific evaluation of the jet oil and the report's recommendations. The van Netten study of flight crew and the serious 'short term' health effects documented were similarly ignored. The creative interpretation of the van Netten report is yet another example of BA's attempt to construct health and safety as a non-issue.

AlliedSignal Study

The 1997 study by AlliedSignal (now Honeywell), the manufacturer of the engines, involved three test areas. This test research was conducted with a number of people from Ansett Australia. The testing consisted of one aircraft on the ground using pack burnouts (heating up of air-conditioning ducts), one inflight test on a non-revenue flight (no passengers) using canisters to capture samples during various stages of the flight in conjunction with temperature, airflow and humidity measurements and 4 short tests on a revenue flight (passengers) to evaluate the impact of recirculating air on total air quality.

As with the Vasak study an examination of the filters revealed a significant number of constituents of the oil could not be identified. The report stated that no TOCP isomers were detected however, of 46 chemicals that were detected 11 were unidentified, that is 24 per cent of chemicals were not identified (Fox 1997b, p. 11). The report did acknowledge that other phosphate isomers were detected (Fox 1997b, p. 3).

The study also indicated the ineffectiveness of filters but was contradictory. During pack burns of air-conditioning units, 'No improvement was seen on the analyser over air quality with filters in place' compared to air quality without filters in place (Fox 1997b, p. 7). The performance for both new and older high time filters (over 1000 hours of service) was found to be similar for contaminant removal (Fox 1997b, p. 3) indicating that hydrocarbons are passing through both filters. Moreover, it was noted the filters had selective absorption characteristics which were included in the appendix (Fox 1997b, p. 7). However, BA did not include the appendix when they gave this report to the Senate inquiry. In spite of these problems with the filter the report went on to conclude that immediately changing the filters following hydrocarbon breakthrough 'corrected this problem' (Fox 1997b, p. 11).

In the conclusion those problems of VOCs entering cabin air are deemed by the researcher to be within 'safety limits' (Fox 1997b, p. 11). Contamination levels on 'normal flights' ranged between 30 and 40 per cent of the National Institute for Occupational Health and Safety (NIOHS) standards (Fox 1997b, p. 3). Nonetheless, the claim of safety is problematic for a number of reasons.

First, the report also documented cabin contamination on these flights ranged from '100% to 130% of accepted safety standards' (Fox 1997b, p. 3). This contradiction is elaborated further but not resolved by going to another version of the same AlliedSignal report, different from the one BA submitted to the Senate Inquiry. This other version is very similar but contains some noticeable differences. It is dated 25 November 1997 whereas the BA copy was dated 23-25 August 1997. Both versions have the same title and 'final report' written on the front cover. In the November version is the reference to '100% to 130% of accepted safety standards in the aft galley' (Fox 1997a, p. 2).

Second, other problematic issues for those on such aircraft include: the effects of this exposure may be significantly higher than the NIOHS standards because these are ‘terrestrial’ occupational standards and do not factor in the effects of pressurisation; passengers are not employees yet their exposure is implicitly deemed acceptable using a workplace standard for air quality; and 24 per cent of filter samples were not identified. Also, part of the process to reduce air contamination is reducing air flow to 40 per cent recycled and 60 per cent ‘fresh’, and filters appear to be ineffective at removing VOCs. These problems with claimed health and safety of the cabin environment will be expanded on when AlliedSignal’s recommendations are discussed below.

Even if some filters such as activated charcoal filters prove to be more effective at removing smoke and smell, as van Netten argues, this may allow other associated hazards to go undetected such as carbon monoxide because there will be no warning (Australia Senate 2000d, p. 212). Also while modifications took place on engine seals there remained problems with fumes penetrating the cabin environment.

A discussion of symptoms from exposure to jet oil does occur in the introductory summary though in a circumscribed manner. There is mention of chemicals resulting from pack burnouts of, ‘Irritating and carcinogenic compounds present include formaldehyde, tetrahydrofuran, and cumene. These compounds cause skin, respiratory system, and eye irritation as well as nausea and narcosis if present in excessive levels’ (Fox 1997b, p. 2). These adverse health affects are identified with maintenance practices, pack burnouts - which the report recommends stopping – but the report plays down cabin contamination arising from the more general problems of the BAe 146 such as fume contamination.

An assessment of filters by the study resulted in claims that there is no evidence to support flight crew developing symptoms from TOCP exposure (Fox 1997b, p. 11). The oils manufacturer, though not mentioned by name was held to support this claim in an attached memo, but the memo was not included in the BA submission of the report. An examination of the 25 November version of this report also makes the same claim and has a letter from Mobil attached (Fox 1997a, pp. 10-11, A1-1). However, Mobil’s letter

is simply a statement of the proportions of TOCP in TCP (0.5 per cent) and in MJO (0.02 per cent). Mobil makes no claim as to any involvement in testing cabin air or filters. In addition, narrowing down exposure problems to one component of jet oil, while a common strategy by those seeking to deny a causal link to jet oil, does not remove the many other components of jet oil from a causal association (see Chapter 4).

AlliedSignal Recommendations

In light of ongoing cabin air contamination five recommendations were suggested but only four were numbered in the BA submitted version of the Fox report. The first, dealing with filtration, called for cleanable filters as standard filters do not consistently provide 1000 hours of service. However, efficient filters (up to 97 per cent following cleaning) suggested for use were still undergoing development. The study also found new filters were not effective and were found to be equivalent to older filters in their ability to absorb hydrocarbons, but did limit large amounts of hydrocarbons in the case of hydrocarbon breakthrough where a significant leak occurred. Therefore recommendations are somewhat contradictory as the study also identified the ineffectiveness of both new and old filters. Importantly the report did recommend ceasing pack burns. According to Fox, reports had previously indicated that pack burns performed on a daily basis reduced ‘odour complaints’, but those operators conducting these pack burns are exposed to ‘hydrocarbons approaching the recommended allowable limits’ (Fox 1997b, pp. 10-12).

Also a method to quickly check if filter breakthrough was occurring was suggested by using formaldehyde analyzer to determine if this substance and other hydrocarbons were coming through the filter. The BA submitted version of this report had this included within the first recommendation (Fox 1997b, pp. 12-13). In the later version of the Fox report this became a separate recommendation, recommendation two, and a formaldehyde monitor was replaced by a somewhat broader assessment tool, a hydrocarbon monitor (Fox 1997a).

The role of filtration does remain problematic as it does not address the oil leakage but provides an ‘end of pipe’ solution. This approach has characterised industry’s general response to the problems of pollution. This response does not attempt to alter the

existing process to generate ‘clean technologies’ rather additions or ‘cleaning technologies’ are added to limit the pollution escaping into the environment (Beder 1996, pp. 240-241). This ‘end of pipe’ approach has also been embraced by Western regulators who do not view pollution as a problem, provided environmental standards are being met (Hajer 1996, pp. 248-249). Such standards are often flexible or inadequate and are open to exploitation by industry. In the case of cabin air quality there is no standard for VOCs (see Chapter 5). Thus filters in the absence of long term effectiveness and a lack of regulation may simply serve to be seen to be doing something rather than substantively improving the health and safety of aircraft crew and passengers. The attractiveness of filters and many other ‘end of pipe’ solutions is also the cost. They are less expensive than other measures generally because economic ‘externalities’ such as public health and the environment are not factored into calculations. Nonetheless installing them allows industry to be seen to be doing something without substantially addressing the problems with the underlying systems causing the problem or addressing the resultant health issues.

The underlying technologies themselves can often be ad hoc. The engines used on the BAe 146 were not originally designed for aircraft but helicopters and were used during the Vietnam War (Australia Senate 2000l, pp. 21-22). They did not have an air intake feed off the engine for internal cabin use. This was added subsequently when the engines were modified to be used on BAe 146 aircraft (Armstrong 2000). Also this study by AlliedSignal did not address the underlying seal leaks in their engines that have allowed jet oil to enter the cabin environment.

The second recommendation of the BA submitted Fox report was to ‘reinstate’ recirculated cabin air as a means of raising humidity and lowering organic contaminants. The AlliedSignal study was contradictory in its assessment of the benefits of recirculated air. Despite early comments to the contrary the Fox study argued in the conclusion that increasing recirculated air reduces the amount of organic chemicals entering the aircraft (Fox 1997b, p. 12). This is a questionable approach to minimise organic chemical exposure by using 40 per cent recirculated air and is yet another end of pipe solution to cabin fumes that does not address the underlying problem. van Netten, who compared 100 per cent ‘fresh’ air from the engines to using 40 per cent

recirculated, noted, as did the AlliedSignal Study, that there was little difference between the two air qualities (Fox 1997b, p.12; van Netten 1998, p. 737). Unlike the AlliedSignal study van Netten stated, ‘A difference would probably have been observed if the 100 percent fresh air had been **clean** and the test cycle for the 60/40 percent mix had been long enough for the pollutants to build up’ (emphasis added) (van Netten 1998, p. 737).

The airlines benefit from airflow reduction strategies by saving in costs instead of implementing more expensive remediation or replacement measures. Cutting airflow to the passenger cabin by around a third has become an increasingly routine practice to reduce costs, it has been reported that turning off one air pack saves airlines \$80 US in fuel costs an hour (Fairechild 1992, pp. 73-74). Endes also points to airlines reducing fresh air to save on fuel consumption arguing that with airlines undergoing pressure to cut costs they are unlikely to take the initiative to improve air quality (cited in BTCE 1994, pp. 371-372). This measure suggests an increased emphasis on economics at the expense of crew and passenger health. These economic aims are often hidden under the pretext of improving cabin air quality for aircrew and passenger health.

Subsequent documentation tendered to the Senate Inquiry by BA stated that UK legislation of airflow volume requirements was accepted by CASA and other international regulatory authorities when the BAe 146 was certified. The UK CAA standard JAR25.831 stated:

Each passenger and crew compartment must be ventilated, and each crew compartment must have enough fresh air (but not less than 10 cu.ft. per minute per crew member) to enable crew members to perform their duties without undue discomfort or fatigue (Australia Senate 2000j).

According to BA fresh air flow per person to pilots was, in cubic feet per minute, 101.4 for fresh and 60.9 for recirculated; the passenger cabin was respectively 15.0 and 9.0 for a cabin pressurisation of 8,000ft (Australia Senate 2000j). This is a significant difference between the flight deck and passenger cabin but there are no minimum

requirements for flight attendants and passengers.¹⁷ These figures for the passenger cabin are for 90 passengers and 3 flight attendants but BAe 146 can hold up to 120 passengers which would further erode air quality for passengers and aircraft crew. Other air quality considerations are the availability of oxygen. AlliedSignal study stated that oxygen levels were 20.9 per cent throughout the flight except a slight drop during take off in the galley to 19.9 per cent (Fox 1997b, p. 9). The implication is that this is the same amount of oxygen that is available at sea level which is 20.9 per cent, this has also been implied by other authors (Rayman 1997, pp. 432-433). Winder argues that while the proportion of oxygen in the air stays the same as it is at sea level, ‘the actual amount of oxygen in the air declines’ as a result of decreasing pressure. The maximum safe pressure for work in aircraft is equivalent to outside air pressure at 2500-2500m or 6562-8202ft (Australia Senate 1999f, p. 54). There is a small margin of safety which can often result in many workers becoming hypoxic which in turn can lead to greater exposure to toxic chemicals as their respiration rate can increase. Also, people are more susceptible to toxic exposures. For example, the toxicity of carbon monoxide is 50 per cent higher at 8000 feet than at sea level (Australia Senate 1999f, p. 54; see also Winder and Balouet 2002, pp 155-157) .

The third and fourth recommendations of the BA submitted Fox report call for an increase in cabin air movement and a reduction in the amount of carbon dioxide accumulation in the aft galley (Fox 1997b, p. 12). The recommendations arise from low airflow rates in the centre aisle and elevated levels of carbon dioxide when dry ice was used at the rear of the cabin. Symptoms of high levels of carbon dioxide were mentioned and included, ‘burning eyes as well as muscle aches, headaches etc’ (Fox 1997b, p. 12). The report stated that when the toilet louver was opened ‘toilet odours’ moved forward; ‘Indications are that there is not enough air exchange in the aft galley area’ (Fox 1997b, p. 12).

¹⁷ On 5 June 1996 the ventilation standard 25.831 was amended and now stated cabin occupants were also to receive a minimum amount of 10 cubic feet per minute the same as flight crew. This was done so that cabin crew members were not fatigued or caused discomfort in performing their duties and to allow ‘adequate’ airflow to clear smoke in the event of a problem. However, it does not apply to existing aircraft types, such as the BAe 146, or derived in the future from such types but those designed after 5 June 2006 CAQPCA (2002). The Airliner Cabin Environment and the Health of Passengers and Crew. Washington D.C., National Academy Press. Thus by today’s standards, if these were applicable, the BAe 146 could not be operated in recirculated mode as it supplies only 9 cubic feet per minute and does not provide even adequate airflow in the event of smoke or fumes.

What is interesting is the location of these two issues as distinct recommendations, where there was no specific recommendation calling for measures to reduce jet oil fumes. The carbon dioxide levels in the BAe 146 do not appear to be the same magnitude as jet oil contamination. Moreover, increasing the circulation of cabin air in the cabin has been criticised by van Netten because it would increase exposure to passengers as fumes would no longer be concentrated at the ceiling level (Australia Senate 2000d, p. 206). This would shift the problem around rather than substantively addressing it. Increasing passenger exposure would possibly lessen crew exposure due to a more even distribution. Nonetheless, the increased activity of cabin crew, less so pilots, who are engaged in moving about the cabin performing their duties, would still result in higher respiration rates and thus greater absorption of fumes. Previous airflow patterns may also account for the higher numbers of women as they are over represented as cabin crew and work at a height (standing) where fumes have been concentrated. These additional ‘end of pipe’ solutions provide little in the way of addressing the underlying causes of cabin fumes but they contribute to the general diminishing of health and safety issues arising from jet oil contamination.

The Fox report done with Ansett support, using Ansett BAe 146 aircraft, does not view safety or health as a serious concern. This still begs the question what is the motivation for the study. The impetus appears to be an attempt to deflect attention away from the health and safety issues arising from jet oil contamination. The BA assessment of this report has done this even more concisely, **‘The report concluded that the air supply was within safety limits’** (emphasis in original) (Australia Senate 1999i, p. 128). This positions health and safety problems arising from oil fumes as a non-issue.

Omissions by British Aerospace

The ‘optional modifications’ that arose in 1998 as a result of discussions between BA and Ansett, which focused on improving ‘the working environment within the vestibule (galley) area of the BAe 146’, are also conspicuous in their failure to address oil fumes entering the cabin. Introduced modifications were

- Removal of potential odours from the toilet compartment and the reduction in carbon dioxide levels (caused by the use of dry ice) by installing an electricity operated toilet extraction system.

- Improved air movement in the vestibule (galley) through an additional air outlet in the forward and rear vestibule.
- Improved lighting within the vestibule area.
- Extension of the conditioned air tubes in order to provide air outlets in the roof panels between the overhead luggage lockers (Australia Senate 1999i, p. 128).

These recommendations also fail to address numerous recommendations outlined in the three studies cited by BA. Even changing air filter practices was omitted.

BA concluded by noting that it had worked since 1992 with AlliedSignal, the engine and APU manufacturer, to introduce a range of ‘optional modifications’. BA added that:

There has never been any evidence of any toxicity in the BAe 146 cabin air, and since 1992 there have been a number of independent analyses into the BAe 146 air quality, and none of them have established any risk to the safety of either the passengers or the crew or breach of accepted safety standards (Australia Senate 1999i, p. 128).

This statement appears incongruous, especially given their review of the three aforementioned studies, though given their marginalisation of health and safety issues this is understandable. Embedded in their analysis is a claimed lack of ‘evidence’. While a strict medical causation to symptomology may be elusive, there is certainly sufficient evidence that links exposure to jet oils with both short term health and long term effects. The scientific evidence that BA demands may be better understood as a tool to limit health and safety issues surrounding cabin fumes via omission and their interpretation of research. The scientific knowledge claims of the reports cited are reshaped to meet BA’s interests which appear directed at minimising the potential for enhanced regulatory scrutiny and increased legislation. Thus minimising the costs of more substantive modifications and potential litigation from those adversely affected by cabin fumes. BA’s selective assessment of the scientific studies it has cited is a case in point as is its neglect to consider other studies relating to the BAe 146,

for example the one by Lee (1999) and those involving other aircraft (Rayman and McNaughton 1983; Kelso, Charlesworth et al. 1988). Both the Lee and Kelso studies had detected TCP in their analysis, though Lee did not view this as an issue of concern.

The omission by BA of a January 1998 Fox (1998) study is very significant and further highlights their tactics. This study examined specific contaminants arising from oil seal leakage and engine exhaust and identified a range of strategies to improve cabin environment. Strategies identified the ways contamination may be reduced,¹⁸ and additional system modifications that can be implemented.¹⁹ Such omissions serve to reinforce BA agenda to make cabin contamination a non-issue.

Crucially BA has also failed to examine actual inflight incidents and the reports of flight crew and cabin crew. It did however comment on the July 1997 BAe 146 incident noting a ‘pilot suffered vertigo following selection of an engine air source on a system previously diagnosed as faulty owing to a failed engine oil seal’ (Australia Senate 1999i, p. 129). This was an attempt to lay the blame on the pilot, as CASA had also done. The reality was, as CASA later admitted, that there was no crew restriction and that this fault was classed as a ‘deferred

¹⁸ Fox noted contamination may be limited by:

- Improving existing VOC, ozone, and particulate removal equipment
- Implementing improved maintenance and cleaning practices
- Performing additional aircraft system modifications
 - Addition of ozone converters where necessary
 - Addition of VOC filters where needed
 - Addition of particulate filtration as needed
- Evaluate filter change intervals
- Service mechanical deficiencies
 - Repair hydraulic fluid leaks
 - Install seals around compartments where fluids can be drawn into air supply through leaks
 - Clean up excess lubricants and hydraulic fluid
 - Develop improved cleaning and equipment servicing procedures and schedule as needed
 - Implement system for monitoring air quality Fox, R. (1998). Aircraft Cabin Air Supply Contaminants and Their Mitigation - 19 January, Allied Signal Aerospace Corporation.

¹⁹ Fox noted additional modifications can include:

- Add filtration to ground supply air-conditioning units
- Continue to improve oil seals for longevity and durability
- Continue to improve combustor designs to minimize any possibility of exhaust backflow
- Increase airflow to areas of aircraft interior as dictated by aircraft environment Ibid.

defect' and labelled 'Repair at company convenience'. This is discussed in Chapter 5. Thus the blame shifts onto the airline operator National Jet Systems.

Language Choice and Interests Meet

The language used to describe the BAe 146 contamination with oil contaminants is instructive of how health and safety are constructed to meet the objectives of particular interests. The Macquarie Dictionary's first definition of odour states, 'that property of a substance which affects the sense of smell: rank odours' and the definition for fume is 'any smokelike or vaporous exhalation from matter or substances' (Butler, Atkinson et al. 1991, pp. 1233, 707). Firstly the former has a less serious connotation than the latter. The use of 'odour' to describe both toilet smells and that of oil fumes tends to diminish the importance of the latter. Odour is a more muted descriptor and has a more subjective implication whereas fumes, or smoke, are more objective. More objective terms were absent in the Fox study. The Fox report avoids using the term 'fumes' and instead it uses 'foul odours' and 'odour complaints' (Fox 1997b, pp. 5, 10). The subjective construction of 'odours' attempts to circumscribe those people affected by jet oil as out of the ordinary with the health problem largely residing with the individual. This individualising of health issues characterises many forums surrounding health, particularly those on the periphery of accepted medical opinion such as MCS.

The term fumes has a more objective connotation and thus provides less utility in shifting the problem from aircraft manufactures and operators to cabin crew and passengers. The Vasak study used more objective language terms such as 'oil mist' and 'air contaminants' in both conclusion and the final comment section (Vasak 1992a, pp. 2-4). The van Netten study was also more candid in examining air contamination using terms such as 'smoke', 'blue smoke' and 'contaminating the air'; it recounted a range of terms used by flight crew to describe air contamination from 'sharp odour in cabin' to 'acrid noxious fumes filling cabin' (van Netten 1998, pp. 733-737). More subjective terminology was favoured by BA, with the terms 'cabin air odours' and 'cabin odours', used in their initial submission to the Senate Inquiry (Australia Senate 1999i); later submissions also used the term 'odour' rather than 'fume' (Australia Senate 2000i). This changed only with the BA submission that addressed the 12 November 1999 Swedish BAe 146 where two pilots were affected by cabin fumes. BA issued an All

Operator Message calling on flight crew to use oxygen masks if they ‘experience any fumes or unusual physical symptoms’ (Australia Senate 2000j).

British Aerospace: Boundary Moving and Doublespeak

BA has continued to maintain a contradictory stance regarding the acknowledgement of health and safety effects. BA response to the November 1999 Swedish incident did, as mentioned, include a call for flight crew to put on oxygen masks. However, following full engine testing and dismantling of the engine revealed nothing significant with the engines ‘that made BAE Systems or the investigator think it necessary to take further action at this time (Australia Senate 2000j). This diverged with final report of the Swedish Board of Accident Investigation (SHK) in which problems were found with engine carbon seals on bearings 1, 2, 4, 5 and 9 indicating that leaks occurred on all of these except bearing two which had minor cracks (SHK 2001, pp. 18-19).

The following March the aircraft was flown over the same flight path from Malmo to Bromma and the air quality tested. BAE Systems noted that while results were still to be evaluated ‘nothing significant was found at the time’. The final Swedish report noted elevated total concentration of volatile organic compounds (TVOC) but due to the small number of measurements could not ‘specify the source of the contamination’ (SHK 2001, p. 22). However, as BAE Systems and the SHK explained this was undertaken without the original engine in place because it had been overhauled (Australia Senate 2000k; SHK 2001) leaving the worth of this testing as little more than an exercise in public relations rather than science.

It was not until yet another two pilots in the UK were affected by fumes on 5 November 2000 that forced BAE Systems and UK CAA to act on this issue. BAE Systems Service Bulletin 21-150 dated 20 March 2001 and made mandatory by the UK CAA the following day marked a turning point albeit still a qualified one. This bulletin was made mandatory by CASA in an Airworthiness Directive on 3 April 2003. BAE Systems reason for this change was that,

Incidents have been reported involving impaired performance of the flight crew. There is some circumstantial evidence that the events have been caused by inhalation of an agent(s) resulting from oil and /or oil breakdown products leaking from the engine(s) or APU and contaminating the environmental control system.

In the past oil leaks and cabin/flight deck smells and fumes may have come to be regarded as a nuisance rather than a potential flight safety issue.

However whilst investigations are being carried out to determine the nature of any agents that may be released into the cabin environment and to define any necessary corrective actions, oil leaks and cabin flight deck smells must be regarded as a potential threat to flight safety not just a nuisance (BAE Systems 2001, p. 1).

Here BAE Systems admitted a flight safety risk and also used the term fume. A mandatory inspection was required in the event of 'suspected' contamination of air supply with oil but the plane was not grounded and could continue flying for the day in order to get back to base (BAE Systems 2001, p. 2, 8).

Bill Black, Senior Vice President, Engineering Customer Support and Quality of BA, offered an assessment which conflicted with the initial submission to the Senate Inquiry of the health and safety implications of the cabin fumes in BAe 146 aircraft.

With the weight of human evidence and suffering, which is quite clear, there must be something there. We are comfortable on the one hand that there is no flight safety risk. We are comfortable that our aircraft meet all of the rules. But, when you look at the weight of evidence, it is impossible to conclude that there is an issue.

In our review of the worldwide review of air cabin quality, we think there may be relationship here (Australia Senate 1999b, p. 90).

This appears to be an acknowledgement at least of short term health effects due to ‘evidence’ but he maintains there is no flight safety risk. Black, as a result of reviewing the international literature on cabin air quality, goes on to admit, in contrast to the first submission to the inquiry, ‘there may be a relationship there’ regarding health effects (Australia Senate 1999b, p. 90). However now BA attempts to couch this as a general problem with the aviation industry because BAe 146 does ‘not leak any more’ or ‘produce harmful chemicals in the cabin’ (Australia Senate 1999b, p. 90). Black also states:

It may well be that the work which has been done by ASHRAE [American Society for Heating, Refrigeration, Air-conditioning Engineers] and by ASTM [American Society for Testing of Materials] is working towards a conclusion that there is a general industry-wide health issue. That is what we need to focus on and that is what we need to try to encourage (Australia Senate 1999b, p. 90).

This, while fitting in with BA’s general denial of responsibility, attempts to shift the focus away from BA. Instead of a simple denial, health and safety are now held to be an industry wide issue that should not be addressed by singling out one particular manufacturer. Now the apparent admission of health effects is constructed as ‘normal’ as BA attempts to diffuse the focus on its aircraft by blurring the boundary between its aircraft and others. Yet this strategy mirrors the previous one as BA still avoids taking responsibility by reconstructing health and safety as a non-issue for BA though suggesting it may be one for the industry as a whole.

This begs the question: what is the global problem of cabin fumes? While many aircraft have had fume incidents the only other aircraft that has had such large numbers of adverse health effects for aircraft crew and high numbers of cabin fume incidents has been the MD-80 aircraft at Alaska Airlines. Alaskan aircraft crew have reported problems of air quality since the early 1990s and over 600 of 1,575 flight attendants have reported problems linked to engine and hydraulic oil entering the cabin environment (Johnson and Lane 1998). In addition, to the BAe 146 and the MD 80 aircraft, Jean Christophe Balouet points out that the

Boeing 737 and Airbus 300 are the other main planes responsible for cabin fume exposure. The aircraft operators involved are Ansett, NJS/Qantas, Alaska Airlines, Air BC and Canadian. These aircraft and operators account for over 90 per cent of the problems world wide but only 3 per cent of world flights. The BAe 146 is the worst offender and Ansett is the worst airline according to Balouet (Australia Senate 2000h, p. 35).

The majority report by the Senate Inquiry was also concerned about the contradictory statements by BA. Finding that BA ‘ignored statistical evidence’, Ansett admitted that 1 in 131 flights recorded fume events which averages one per week (SRRATRC 2000, p. 18).

In a subsequent submission to the Senate Inquiry a clarification of Black’s comments was offered by BA. BA reiterated an admission of a general health issue associated with the airline industry as a whole and not simply the BAe 146. They chose to add three riders to these comments:

- As BAe neither employs nor has been party to an examination of any of the persons concerned, we obviously cannot comment on the precise clinical nature or cause of any individual’s symptoms.
- None of the test results or other data gathered to date has (to BAe’s knowledge) produced any evidence of a connection between any such general health issue and the BAe 146 (or indeed the aircraft industry generally).
- We nevertheless acknowledge that the general health issue to which Mr Black referred would benefit from further research (Australia Senate 2000i, p. 33).

In yet another submission BA continued to deny there are short term health risks and also rejected any suggestion that they had accepted this (Australia Senate 2000j, p. 4).

BAE Systems has also pointed out that the BAe 146 is certified in 37 countries and Australian certification occurred after a ‘detailed technical review of the Airworthiness Requirements and design of the Aircraft’ (Australia Senate 2000j,

p. 128). Dick Best, a former District Manager of Airworthiness at CASA who was responsible for certifying the safety of the BAe 146-300 series jet in 1989, stated that he was unaware of whether any reports of fumes had been made to CASA then. However, if he had known at the time then ‘we would have investigated it further to determine whether it met the certification standards’ (Coulthart and O'Donnell 2000). Best was more candid in a subsequent submission to the Senate Inquiry. Best did – due to industry intelligence of air contamination resulting in health problems with aircraft crew – put in an internal Risk Observation Report in 1998 to CASA. He stated, ‘the numbers were significant and warranted detailed investigation by CASA’ (Australia Senate 2000v). However, Best points out CASA did not conduct its own investigation and relied on airline operators’ reports. These reports attempted to demarcate the issue as an occupational health and safety issue rather than an aircraft safety issue.

Summary

BA’s comments are disingenuous as the preceding analysis of BA’s first submission has indicated. First, BA has played a crucial part in shaping the discourse of health effects, attempting to establish them as non-issues. Health and safety issues and data have been removed or down played in BA’s analysis of research as has any suggestion of a causative mechanism. Knowledge claims have been reconstituted to meet BA’s interests in side-lining health and safety. Second, BA selectively uses research evidence to ‘prove’ that there are no health effects, thus presenting only one side of a much contested issue. Third, while BA calls for further research it has largely failed to acknowledge or support research aimed at dealing with jet oil fumes. For example it ignored calls for further research in the scientific papers it cited in its initial submission. The Vasak study called for BA to provide a testing procedure based on protocols developed in the US (Vasak 1992a, p. 4) and, when questioned by the Senate about whether this additional testing had been done BA referred to research done by AlliedSignal and van Netten (Australia Senate 1999b). However BA was not involved in this research.

The call for 'further research' is better viewed as a rhetorical device to delay action on health and safety issues further cementing BA's agenda to move these issues to the periphery of debate. Moreover, research BA has been involved in is often not publicly available such as work BA has undertaken with the researcher Marshman that is classified and states that 'data used are the property of BAe systems' and 'restricted commercial'. Lord Tyler notes that this 'is scarcely reassuring' (Tyler 2005, p. 399).

The three studies reviewed in this chapter illustrated that increased industry involvement in the Fox AlliedSignal/Ansett study and Vasak study resulted in a greater marginalisation of oil fume health and safety issues than the van Netten study. Only the van Netten study attempted to quantify the symptoms of the aircraft crew. A coming together of industry interests is apparent between BA the airframe manufacturer, AlliedSignal the manufacturer of the Engines and APU, and Ansett/Qantas the operators. This convergence seeks to limit claims of short-term health and safety effects and even more so those that are long-term. Thus serious health and safety issues are constructed as non issues using more innocuous and personally subjective terms such as 'toilet odours' and higher carbon dioxide levels as a result of 'dry ice'. Make shift solutions are presented such as new filters and the use of 40 per cent recirculated air. The last has the added bonus of cutting flying costs under the pretence of reducing organic chemicals in the air. The lungs of passengers and crew become the chemical filters and humidifiers, saving airlines money on more expensive measures to improve cabin air quality.

The following chapter will examine the debates surrounding jet oil which is the chemical that has made its way into the cabin environment from aircraft engines.

Chapter 4: Jet Oil Hazards

Introduction

This chapter addresses the hazard posed by jet oils, in particular conflicting assessments of the hazard posed by Mobil Jet Oil II (MJO). Aircraft crew have suffered adverse health effects as a result of exposure, the severity of which has been much contested. Several types of aircraft around the world have, over more than 15 years, been the source of cabin fumes that have led to adverse health effects for those on board. The two planes most commonly cited are the British Aerospace BAe146 and the MacDonald Douglas MD-80. Hydraulic fluids have also been implicated in cabin fume contamination of some aircraft but according to Ansett there is no pathway for hydraulic fluids to enter the air conditioning system of the BAe-146 (Australia Senate 1999b, p. 54).

I argue in this chapter that the downplaying of the hazard posed by jet oil in terms of aircraft safety and health is not justified. This critique contributes to the aims of this thesis in highlighting the role of various industrial, regulatory, government and other interests in marginalising safety and health issues related to cabin fumes. This has resulted in an effective bias against a more considered view of cabin fumes. First this chapter will briefly examine a turning point in this controversy, when the two pilots were affected by cabin contamination with jet oil in July 1997. Second, industry and scientific assessments of jet oils will be examined followed by an analysis of labels and Material Safety Data Sheets (MSDS)/Material Safety Data Bulletins (MSDB). Third is a review of what constitutes normal and abnormal usage of jet oils, followed by an examination of a National Industrial Chemicals Notification Assessment Scheme (NICNAS) Overview of MJO and finally an examination of values adopted and their relationship to assessments of MJO.

In Australia, the increased political and media attention cabin fumes have received is the result of two pilots being incapacitated following the presence of oil fumes in cabin air in a National Jet Systems (NJS) BAe 146 aircraft on the 10 July 1997 whilst on descent into Melbourne. The Bureau of Air Safety Investigations (BASI), now known as the

Australian Transport Safety Bureau (ATSB), conducted an investigation. The report noted, concerning the pilot in command,

following the onset of the fumes, he had experienced difficulty in concentrating on the operation of the aircraft, and had suffered from a loss of situational awareness. By the time the aircraft had reached an altitude of approximately 2,000 ft, his control inputs had become jerky and he began suffering vertigo. He relinquished control of the aircraft to the co-pilot, who continued with the approach and landing (BASI 1999).

After the pilots landed and got some fresh air, the effects of the oil fumes appeared to dissipate. After six hours however, the commanding pilot began suffering pressure headaches that continued for the following 10 days (BASI 1999).

What came to light for the BASI during the investigation, but was already known in the aviation industry, was that fume and smoke contamination of the cabin was neither new nor rare. During the investigation cabin and flight crew of BAe146's from various Australian airlines reported a variety of health problems. These included a range of symptoms from sore eyes, nose and throat to more severe reactions, and skin disorders (rashes, itchiness, blotching), dizziness, balance problems (some being unable to walk straight), fatigue and severe reactions to oil-based products (such as plastics and perfume), slurred speech and feelings of intoxication (BASI 1999).

The commanding pilot was not the only one that felt the effects of oil fumes during the decent into Melbourne: another pilot who had been in the cockpit also felt nauseous. Given two pilots out of three were affected, this raises serious health and safety concerns but, particularly when this aircraft's usual complement is two pilots, a future occurrence could be disastrous. Nonetheless the incident was classed in the BASI report as a Category Four investigation where 'occurrences are those where the facts do not indicate a serious safety deficiency' (BASI 1998). The subsequent establishment of a Senate Inquiry and attention given to cabin fumes by government, industry, unions, doctors, researchers and those affected suggests the emergence of a serious safety and health issue. This is further evidenced with ongoing fume contamination of aircraft and the loss of health and employment by numerous flight crew and cabin crew.

Jet Engine Oil Contamination has a History

During the Senate inquiry, Ansett Australia claimed to have documented cabin air contamination since 1991 in the BAe 146. According to Captain Jensen, a spokesperson for Ansett:

It was then that East West Airlines crew first reported odours on the [BAe 146] –300 Series. East West was a part of the Ansett group and was later integrated into the Ansett brand. The odours were traced back to Mobil jet oil 2 leaking into the air conditioning system (Australia Senate 1999b, p. 52).

According to Ansett their worst period was 1992 when 1.5 percent of flights were affected (one report every 66 flights). This had dropped to 0.7 per cent of flights in 1998 (one report every 142 flights) and in the first half of 1999 this was 0.625 per cent (one report every 160 flights) (Australia Senate 1999b, p55). These reports were based on engineering log reports. Ansett had introduced a crew reporting system and during the first half of 1999 which had a figure of 0.2 per cent of flights (one report every 500 flights). The difference between the engineering log reports and crew reports in 1999 may be due to underreporting because of a lack of awareness of fume issue, concern for job security or simply not considered the fume issue worthy of recording. As of May 2000 Ansett operated 12 BAe-146 Aircraft: 10 were for passengers and 2 were freighters (Australia Senate 2000a, p. 242).

Qantas also acknowledged fume contamination of the cabin environment in its BAe 146 aircraft which are run through its wholly owned regional airline companies Southern Australian Airlines and Airlink. National Jet Systems, an independent company, is contracted by Qantas to provide the maintenance and repairs of Southern Australian Airlines. Another contract covers National Jet Systems operating 13 BAe 146 aircraft on behalf of Airlink; this contract includes provision of flight and cabin crews and the provision of maintenance and repairs. In spite of these contractual arrangements with NJS, Qantas has acknowledged that it has the ‘fundamental obligation for the safe and reliable operation of the aircraft’ (Australia Senate 2000b, p. 125). The Qantas BAe 146 fleet commenced operation in 1991 but Qantas claimed that at that time there

were few problems with cabin air quality. However, it acknowledged after 1996-1997 the number of cabin air quality reports increased. In 1999, Qantas documented reports for 0.12 per cent of flights at this time (one cabin air quality report every 785 flights). These planes fly 900 flights a fortnight, so the average reporting of cabin air contamination for 13 Qantas planes is over two reports a month (Australia Senate 2000b, pp. 125-126).

In spite of admissions of cabin contamination, Jensen attempts to direct attention toward other odour sources, and by implication affirm the safety of the jet oil.

However, other factors do contribute, such as synthetic fibres and panels in the cabin and smells from the galley and toilet. Mobil jet oil 2 has been in use in the industry for over 35 years, and last year alone over 1.4 billion passengers flew on jets that were serviced by this oil (Australia Senate 1999b, p. 52).

Health and safety implications of other sources do not appear to be of the same magnitude as that of MJO. As the BASI report into 10 July 1997 incident noted the adverse reactions were to oil ‘fumes’ not merely the less ominous ‘smells’ or ‘odours’ that Ansett attempted to conflate them with.

Ansett (Australia Senate 2000a, pp. 242-245) and Qantas (Australia Senate 2000b, p. 125-129) acknowledged short-term health effects of oil fumes and, though taking steps to minimise fume leakage into aircraft cabins, were at considerable pains to curtail suggestions that there were long-term health implications of exposure to oil fumes. Both airlines and the subcontractor NJS also affirmed the safety of aircraft despite fume incidents (SRRATRC 2000, pp. 58-60).

Jet Oil Research and Regulation

Research into jet oil and its toxic constituents is largely undertaken by the petrochemical industry (Barth, Kinkead et al. 1993; Freudenthal, Rausch et al. 1993; Daughtrey, Biles et al. 1996; Craig and Barth 1999; Mackerer, Barth et al. 1999) and provides the basis from which regulatory assessments are derived and health and safety information, such as MSDS/MSDB, are produced. The US defence forces have also contributed to this body of research (Rayman and McNaughton 1983; Centers 1992;

Kinthead 1992; Latendresse, Brooks et al. 1993; Wyman 1993; Ruby and Striebich 1995). The Australian Defence Force has also investigated oil contamination of cabin air in Hercules aircraft (Kelso, Charlesworth et al. 1988). A number of researchers have noted that exposure to lubricants containing tricresyl phosphate (TCP) and the many compounds that make up these formulations can cause neurotoxic damage referred to as organophosphate-induced delayed neurotoxicity (OPIDN). This has occurred with people, and a number of animals including hens that were subject to experimental testing. Symptoms include ataxia, flaccid paresis²⁰, and paralysis (Kinthead 1992; Freudenthal, Rausch et al. 1993, p. 409; Latendresse, Brooks et al. 1993, p. 392; Daughtrey, Biles et al. 1996, p. 244; Craig and Barth 1999, pp. 281-284; Mackerer, Barth et al. 1999, p. 295).

Human cases of OPIDN poisoning from TCP exposure are numerous, most commonly arising from food contamination. The World Health Organisation (WHO) estimates that more than 60,000 people worldwide have been poisoned from TCP (Mackerer, Barth et al. 1999, p.295). One of the largest incidents occurred in 1959 when cooking oil contaminated with unused jet engine oil containing 3 per cent TCP poisoned 10 000 people in Morocco (Mackerer, Barth et al. 1999, p.295). Another important source of exposure to TCP is that which occurs occupationally (Freudenthal, Rausch et al. 1993, p. 410; Latendresse, Brooks et al. 1993, p. 392; Craig and Barth 1999).

MJO is acknowledged as the dominant oil used in Australian jet aircraft and according to Mobil it has 51 per cent of the world market for jet oils, of this 90 per cent is MJO. Mobil estimated that 45 per cent of turbine engines around the world use MJO (Australia Senate 2000b, p. 145). Whilst there is some variation in the formulation of jet oils, other jet oils that have been implicated in the contamination of cabin air in north America - Castrol 5000 and Exxon 2380 - have a similar make up of toxic constituents (van Netten and Leung 2000). Moreover, no replacement has yet been found for TCP which provides unique anti-wear properties for jet oils.

²⁰ Ataxia is a loss of coordination. Flaccid paresis is muscle paralysis.

The market for MJO is set to expand further following the merger of Mobil with Exxon in 1999. The new company ExxonMobil²¹ did not change the names of many of its products including MJO, but as a condition of the merger was prevented from selling Mobil branded jet oils to those customers that had historically used Exxon jet oil. This merger condition ended on 1 January 2003. Now ExxonMobil is keen to market Mobil Jet Oils to former Exxon jet oil users and many more potential customers (ExxonMobil 2003). Also the size of the corporation is likely to increase its influence in how its products are regulated and classified globally. Thus an examination of this jet oil is relevant not only to the Australian context but internationally.

The National Occupational Health and Safety Commission (NOHSC) produce the guidelines for the assessment of hazardous substances in Australia. The first step in classifying hazardous substances requires use of the *List of Designated Hazardous Substances* (the List) (NOHSC 1994b; NOHSC 1999b) and *Approved Criteria for Classification of Hazardous Substances* (NOHSC 1994a; NOHSC 1999a; NOHSC 2004). Complementing the latest *Approved Criteria for Classification of Hazardous Substances* and replacing the List of 1999 is the Hazardous Substances Information System (HISS) (NOHSC 2005). These publications are used by chemical manufacturers to develop Material Safety Data Sheets (MSDS) and Material Safety Data Bulletins (MSDB) to provide essential information to those employees working with such chemicals (NOHSC 1994c). MSDS also provide information to health professionals and are used internationally to identify what chemicals a person has been exposed to so as to respond appropriately (Frazier, Beasley et al.; Beach 2002). Therefore the accuracy and comprehensiveness of MSDS are critical in understanding and quickly responding to any health problems.

Determining whether a substance is hazardous to health is an important step in providing this necessary information to employees and health professions. In Australia, for manufacturers and importers to determine whether a substance is hazardous they have to 'first refer to the List of Designated Hazardous Substances...If the substance is on the List, it is a hazardous substance'. However, if a substance 'is not included on the List, the manufacturer or importer will need to use the Approved Criteria to determine if

²¹ I will continue to use Mobil for the company name except where indicated.

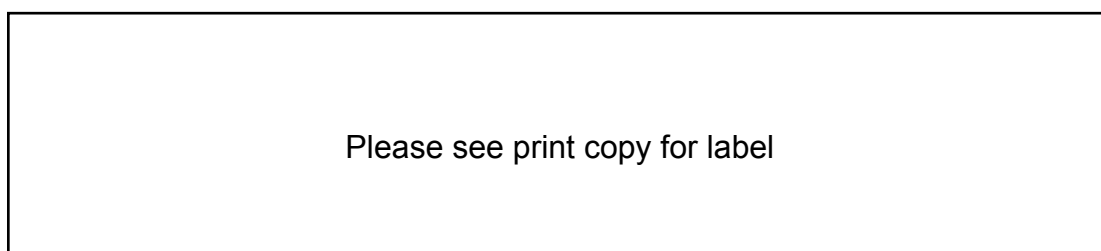
it is hazardous to health' (NOHSC 1994a, p. ix; NOHSC 1999a, p ix). The wording is virtually the same for the 2004 edition (NOHSC, p. vii). This is reiterated further on in all three texts,

a hazardous substance means a substance which:
is listed on the *List of Designated Hazardous Substances* ...; or
has been classified as a hazardous substance by the manufacturer or
importer in accordance with *Approved Criteria for Classifying
Hazardous Substances* (NOHSC 1994a, p.1; NOHSC 1999a, p. 2;
NOHSC 2004, p. 3).²²

All three editions also make clear that the List is the initial reference to use even for mixtures, which is the case for jet oils, and notes the importance of the correct classification of substances in producing MSDS and labels as required by State, Territory and Commonwealth governments (NOHSC 1994a, p.2; NOHSC 1999a, p. 2; NOHSC 2004, p. 3). A substance that is classified as hazardous, or not hazardous, should be noted in the introductory section of the MSDS. The wording to be used is either 'Hazardous according to criteria of Worksafe Australia' or 'Not classified as hazardous according to criteria of Worksafe Australia' (NOHSC 1994c, p. 17). Moreover, Approved criteria are aligned to the European Union (EU) criteria and are updated to reflect changes in the criteria of the EU.

Labels and Material Safety Data Sheet/Bulletins

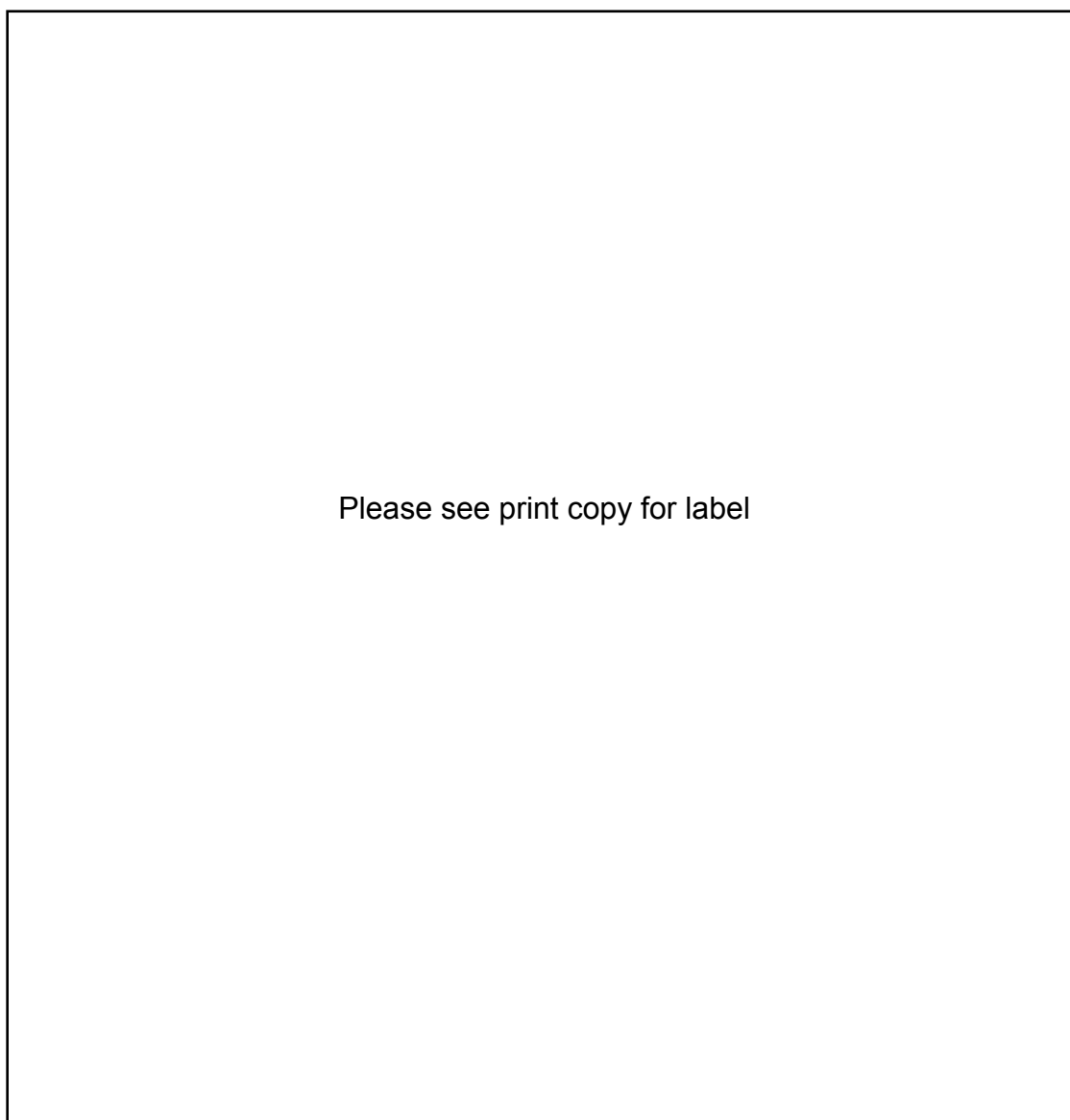
The MJO warning label on the oil can appears to acknowledge the health hazard posed by this oil in the workplace. The warning label has changed over time. The pre 1992 label read:



(Australia Senate 1999f, p. 63)

²² Note: The 2004 edition of the Approved Criteria wording varies slightly. Point one states 'is included on the List'.

Mobil's post 1992 label highlights additional health hazards of Jet Oil 2 exposure:



(Australia Senate 1999f, p. 64)

In spite of such label changes, suggesting an increased awareness of the hazard posed by this oil Mobil has tended to downplay hazards associated with this oil. This begs the question of how Mobil has interpreted its NOHSC requirements in formulating health and safety warnings.

Table 1 in the appendix examines the health and safety warnings of two Australian MJO MSDS and one Bulletin in relation to the regulatory requirements outlined above. A

label on a box of MJO is used as a general ingredient benchmark. To attract health and safety warnings the concentration of ingredients has to be above the cut off threshold level for that particular substance. Given the range of TCP on the MSDS and MSDB is between 1 and 5 per cent the classification should be 'Toxic' not the 'Harmful' category Mobil claims. Chris Winder, former Chief Toxicologist and Director of the Chemicals Section of the NOHSC and Associate Professor in Chemical Safety and Head of the School of Safety Science at the University of New South Wales, noted the incorrect labelling of risk and safety phrases - downplaying the health and safety risks - and consequent incorrect hazard classification of MJO. Even the updated label on the oil can which effectively covers the R39 warning does not include the classification Toxic (R23/24/25) (see Table 1 in the appendix for R rating explanation) (Australia Senate 1999f, pp. 63-64).

Occupational health and safety standards allow industry to self regulate and thus arbitrate apparent contradictions in standards. Not only has Mobil failed to acknowledge the classification Toxic on MSDS/MSDB and to use the appropriate risk and safety phrases but also the lower claim of Harmful does not attract all the appropriate risk and safety warnings. These warnings have decreased as is evidenced in the MJO MSDS of 2004; see Table 1 in the appendix.

Winder (Australia Senate 1999a; Australia Senate 1999f) argues that the toxicity of this oil does suggest it can pose long-term health effects to those exposed. MJO has remained largely unmodified since its development in 1960 and, according to Winder, has not benefited from the chemical industry's recent attempts to reduce the toxicity of such chemical mixtures. These attempts have focused on TCP, a mixture of 10 separate though similarly structured chemicals that make up jet lubrication oils. Many of these chemicals particularly the ortho-cresyl phosphate isomers are very toxic. One of these chemicals is tri-ortho-cresyl phosphate (TOCP). This chemical has been targeted by the chemical manufacturers for reduction in tricresyl phosphate to reduce overall toxicity however many of the other constituents are also toxic. Some of the chemicals in this mixture are more toxic than TOCP: di-ortho-cresyl phosphate (DOCP) molecules are five times more toxic and mono-ortho-cresyl phosphate (MOCP) molecules 10 times more toxic (Australia Senate 1999a).

Mobil scientists who critiqued Winder's submission and claimed that MJO should not be classified as toxic did not challenge him on the issue directly but stated that MJO is non-hazardous according to NOHSC document *Approved Criteria for Classifying Hazardous Substances* (Mackerer and Ladov 2000, p 46). The previous discussion has pointed out that the List is the first point to ascertain whether a substance is hazardous. According to NOHSC's own documentation, if a substance is on the List and is at an appropriate concentration (which MJO is) then it should be classified as hazardous and toxic. The approach taken by Mobil is that if it is 'deemed' not hazardous in one document (read *Approved Criteria*) the other document does not need to be consulted. Interestingly, the assessment process is assisted by NOHSC, which asserts that, 'only manufacturers and importers of substances supplied for use at work have the responsibility to determine whether a substance meets the classification criteria detailed in the National Commission's *Approved Criteria for Classifying Hazardous Substances*' (NOHSC:3017 1994, p. 9). Still, this failure to consider the List, for a 1999 MSDB, is overlooked also by NOHSC which asserts that Mobil is complying with guidelines (Holland 1999).

However, the NOHSC while endorsing its and Mobil's decision-making is attempting to provide a little distance between itself and Mobil's assessment process. Steven Holland of the Hazardous Substance Unit of NOHSC states that:

to clarify the derivation of the statement '*Not hazardous by Worksafe criteria*', I would suggest the following words be added, "*as determined by Mobil, based on toxicity test data on the product*", to follow or placed below the statement (Holland 1999).

The requirement for meeting this rather weak Worksafe condition was that it be placed in the MSDS when it is next revised. This addition is perhaps akin to an insurance policy, deflecting responsibility onto Mobil, should more information come to light revealing more 'concrete' evidence regarding the health implications of MJO. Given Mobil's dominant position in providing and assessing appropriate evidence on MJO one might assume this would be difficult and self-regulation would continue in the absence of stronger concern.

This appears to be borne out in the subsequent Mobil MJO MSDS released in Australia. Mobil did not use the more encompassing term ‘Not hazardous by Worksafe criteria’ as it had done previously or the additional wording suggested by NOHSC. Instead Mobil appears to deflect responsibility back to NOHSC by asserting that ‘Material is not hazardous as defined by the Approved Criteria for Classifying Hazardous Substances NOHSC: 1008’ (Mobil-Aus 2004), thus redirecting responsibility back to NOHSC for its acceptance of Mobil’s claims of not using the List. This boundary tussle casts both NOHSC and Mobil in a poor light for neglecting the requirements of the List and the obligation to use one of two terms, as mentioned previously, ‘Hazardous according to criteria of Worksafe Australia’ or ‘Not classified as hazardous according to criteria of Worksafe Australia’ rather than the posturing that both have engaged in.

The discussion above referred to the 1999 MSDB and 2004 MSDS but other discrepancies between data sheets also suggest a concerted effort to downplay the hazard posed by MJO. The Australian 1992 MJO MSDS contained no Worksafe Classification, understandable given guidelines began in 1994, but the 1997 MSDB stated that it was ‘Harmful by Worksafe criteria’ (Mobil-Aus 1997). Then in the 1999 MSDB, the Worksafe Classification, now appearing, stated ‘Not hazardous by Worksafe criteria’. Judy Cullinane, a former aircrew member of BAe 146 aircraft, noted this contradiction between the previous material safety data information in her submission to the Senate inquiry (Australia Senate 2000n, p.81). Given Mobil (Plummer 1999b) has acknowledged no change in the composition of MJO in the 1990s, and NOHSC written guidelines had not changed, it appears the measure was simply initiated by Mobil according to its own judgements thus downplaying the hazard posed by MJO. This change was then approved by NOHSC.

The testing dosage for US and Australian MSDS/MSDB are based on the US EPA limit. The US EPA had revised in 1991 their Acute Delayed Neurotoxicity Guidelines for a single-dose-level downward from 5g/kg to the new standard of 2g/kg. A 1992 US Navy analysis of Mobil jet oils examined their potential to cause OPDIN; part of the analysis was to compare the new and old EPA protocols with the older more rigorous and costly Navy protocols which used multiple (five a day) dose regimen (Kinkead 1992, pp. 5-6) .

The US Navy study illustrated higher brain function impairment following multiple dose exposure compared with a single dose exposure. The study illustrated that while the total daily dose was 2000mg/kg/day for both single and multiple dose regimes, the single dose regime for Mobil Jet Oil with 3% TCP indicated minimal brain neuropathy target esterase (NTE). The inhibition of NTE is implicated in the production of OPDIN. However, the multiple doses demonstrated a statistically significant inhibition of brain NTE activity in the hen population (32-45%). Also even for multiple doses to a total of 1000mg/kg/day it was statistically significant (36-40%). The Mobil jet oil with 3% TOCP had a higher statistical significance for the repeated dose regime for multiple dose 2000mg/kg/day 80-89% and for 1000mg/kg/day 70%. For a single dose regime of 2000mg/kg/day the significance was 45% and for 5000mg/kg/day 42-45% (Kinkead 1992, p. 13-14).

This study used these results, and a study on clinical signs and histopathology, to assess OPDIN causing potential. The single dose 3% TCP Mobil Jet Oil (2000mg/kg) resulted in minimal NTE and was not found to cause OPDIN. The multiple dose 3% TOCP (2000mg/kg and 1000mg/kg) Mobil Jet Oil indicated OPDIN, as did the former EPA test limit of 5000mg/kg. The new single dose level of 3% TOCP (2000mg/kg) did not indicate OPDIN. Thus ‘the jet oil containing 3% TOTP²³ would not have been considered as a potential OPIDN candidate if tested only at the revised EPA test level of 2000 mg/kg...It is possible that neurotoxic agents may not be identified using the lower standard of 2000mg/kg’ (Kinkead 1992, p. 23).

This study is important in highlighting the inability of the new EPA testing regime to detect potential OPIDN causing chemicals and brain impairment, NTE. The study illustrates the differing outcomes of a hazard posed is dependent not only on amount of jet oil exposure but the duration, because incremental exposure can exceed a one off dose even if the incremental exposure is significantly less than that of a one off dose. What the new protocol meant was that future research utilising the new protocol lessens the potential to detect effects. Interestingly the new testing protocol was strongly reliant on in a recent Mobil study (Mackerer, Barth et al. 1999) that claimed Mobil jet oil did

²³ This research paper used the acronym TOTP for Triothocresyl phosphate but I have chosen to use more common acronym TOCP.

not pose a health hazard for cabin air and was cited by Mobil management to demonstrate the safety of MJO.

This change in protocol may help explain the decrease in hazard effects listed with latter MSDS. The 1988 MSDS on skin effects stated, 'the liquid is slightly toxic and mildly irritating' but the subsequent MSDS/MSDB information suggests a lower toxicity (see Table 2). However, there have been other changes that cannot be explained by a change in protocol, such as in inhalation exposure, which appears to have changed in order to fit new air quality standards. The 1992 claim in an Australian MJO MSDS that inhalation is 'slightly toxic' is at odds with later claims. This is evident if the 1992 reading is converted to mg/m^3 as the reading would be greater than $1000\text{mg}/\text{m}^3$ for a 7 hour exposure. So it is strange that a claim of 'minimally toxic' is made with greater than $5000\text{mg}/\text{m}^3$, a five fold increase in exposure if this was over the same time frame (see Table 2).

The time frame is actually more, according to Mobil's claims. Mobil argued it was possible to breath MJO containing 3 % TCP 'at five milligrams per cubic metre, which is the accepted maximum workplace level for lubrication oils, five days a week, eight hours a day, in an ongoing sense without absorbing a toxic dose through inhalation' (Australia Senate 2000b, p. 142). This claim alone seems incompatible with the Mobil's 1992 claims. Numerous other problems emerge with Mobil's assertions if we examine what the standard cited by Mobil actually says. First, the standard refers to oil mists in general, rather than the more hazardous aviation specific jet oils, second the $5\text{mg}/\text{m}^3$ is based on a temperature of 25°C at sea level (1 atmosphere) (NOHSC 1995, pp. 71, 94). While TCP has not been given an oil mist standard TOCP is $0.1\text{mg}/\text{m}^3$ (NOHSC 1995, pp. 102).

Planes are pressured to 8000m at cruising altitude which results in a lower amount of oxygen available to aircraft crew and passengers which is likely to exacerbate the hazard posed by oil fumes. Neither can this standard capture the complex processes that may happen to jet oil at altitude entering the cabin environment that includes burning and pyrolysis. As Lesley Williams a former

flight attendant argued this standard is inadequate as aircraft crew do not conform to the hours contained in the standard, and work at altitude. Williams pointed out that Ansett's own documentation admitted as much: the Ansett *Human Performance and Limitations* document stated 'The acceptable threshold levels used on the ground in industry are unacceptable in a cabin at altitude as any reduction in pilot performance could have dire effects' (Australia Senate 1999k, p. 115; Australia Senate 2000t; Australia Senate use ref 131 2000, pp. 222-223). Moreover, aircraft crews were doubtless not expecting to be exposed to oil fumes in their workplace, nor had they undergone the requisite training including reading of MSDS and bulletins (this would have been required by aviation mechanics who work with engines and change oils), and certainly the flying public are not expected to tolerate a workplace standard albeit a rather inadequate one with respect to exposure to jet oil fumes and mists.

Mobil also claims that people are not able to be exposed to a toxic dose for different types of exposure. In addition to this claim being made for inhalation it is also made for skin exposure, Mobil argues 'we have established that it is possible to cover your entire body surface with the liquid for six hours and not absorb a toxic dose through the skin' (Australia Senate 2000b, p. 142). An examination of MSDS claims also indicates terms such as 'practically non toxic' and 'minimally toxic' (see Table 2). However, Mobil defines what is toxic as can be seen in Table 1 (see appendix) it uses the term harmful where it is required according to the List to use toxic. Therefore, what are we to make of claims of non toxic when Mobil does not acknowledge the toxicity of MJO on its labels, MSDS and bulletins, and consistently downplays the health hazard posed by MJO? Pilots that have been exposed to this product in cabin air have not been able to think clearly or coordinate control inputs of an aircraft so should we still be consoled that this may not be a toxic dose according to Mobil's assessment criteria?

Aircraft crew have no reason to make up their symptoms. Many aircraft crew have had to cease flying due to illness and disability with the resultant loss of career and earnings. Many have suffered severe financial hardship and have not been compensated. The widespread occurrence of illness and disability, and pilot incapacity, in Australia and overseas tend to undermine claims such as minimally toxic.

Table 2 - Australian Material Safety Data Information for Mobil Jet Oil II

Please see print copy for Table 2

²⁴ Mobil-Aus (1988). Mobil Jet Oil II Chemwatch MSDS-Aust. Vol 2 - Submission 17 Ms Judy Cullinane Appendix 16, Senate - Inquiry into Air Safety - BAe 146 Cabin Air Quality -1999.

²⁵ Mobil-Aus (1992). Mobil Jet Oil II MSDS. Vol 2 - Submission 17 Ms Judy Cullinane Appendix 16A, Senate - Inquiry into Air Safety - BAe 146 Cabin Air Quality -1999.

²⁶ Mobil-Aus (1997). Mobil Jet Oil II MSDB. Vol 2 - Submission 17 Ms Judy Cullinane Appendix 16D, Senate - Inquiry into Air Safety - BAe 146 Cabin Air Quality -1999.

²⁷ Mobil-Aus, (1999). Mobil Jet Oil II MSDB.

²⁸ Mobil-Aus, (2004). Mobil Jet Oil II MSDS. 19 August.

Normal and Abnormal use of Mobil Jet Oil

There is also a decline in the risk language used in Australian and US MSDS/MSDB.

The health hazard section in a US 1991 MSDS sheet stated:

This product contains tricresyl phosphate. Overexposure by ingest may produce nervous system disorders including GI disturbances, numbness, muscular cramps and weakness, These effects (sic) may be delayed.

Prolonged or repeated skin contact has produced inhibition of cholinesterases in animals (Mobil-US 1991).

In contrast, a 1996 US MSDS health hazard section stated:

Practically non-toxic. May cause eye irritation. Prolonged or repeated skin contact may cause irritation, dizziness, nausea, unconsciousness (Mobil-US 1996).

These two US MSDS were produced by Mobil in Pennington New Jersey, but an examination of a MSDB produced in 1996 originating from Fairfax Virginia contains more detailed health risk information and a classification as hazardous omitted in the 1996 Pennington MSDS.

3. HAZARDS IDENTIFICATION

US OSHA HAZARD COMMUNICATION STANDARD: Product assessed in accordance with OSHA 29 CFR 1910.1200 and determined to be hazardous.

EFFECTS OF OVEREXPOSURE: This product is not expected to produce neurotoxic effects under normal conditions of use and with appropriate personal hygiene practices. This product contains tricresyl phosphate (TCP). Overexposure to TCP by swallowing, prolonged or repeated breathing of oil mist, or prolonged or repeated skin contact may produce nervous system disorders including gastrointestinal disturbances, muscular cramps, weakness and paralysis. Paralysis may be delayed. Refer to emergency and first aid procedures for additional information (Mobil-US 1996).

The 1996 US MSDS was circumspect with its opening qualification of relative safety under ‘normal’ conditions. Normal conditions may be an attempt at boundary creation by Mobil to limit liability from exposure arising outside normal conditions, for example the increased political and social pressures being directed at the growing cabin fume controversy. Thus liability is directed towards aircraft operators and manufacturers of the BAe 146. The use of ‘normal conditions’ is also used in Australia MSDS and bulletins. The 1999 Australian MSDS hazardous identification section was the same as the US except that it did not include a hazardous classification, and had replaced ‘neurotoxic’ effects with the pronoun ‘these’ downplaying the hazard of this oil. So what constitutes normal conditions is a little more opaque in the Australia edition.

3. HAZARDS IDENTIFICATION

EFFECTS OF OVEREXPOSURE: This product is not expected to produce **these** effects under normal conditions of use and appropriate personal hygiene practices. This product ... for additional information (emphasis added) (Mobil-Aus 1999).

Such language is in contrast to the national code of practice for MSDS which points out that the language ‘should be simple, clear and precise... Vague and misleading expression should not be used’ (NOHSC 1994c, p. 14).

In spite of Mobil’s equivocal language, the corporation appears to suggest there are health effects associated with this product, but these arise outside ‘normal’ usage practice. The entry of oil fumes into the aircraft cabins appears to be considered ‘abnormal’. Whether such boundary creation between normal and abnormal removes any ethical or legal obligations from Mobil to ensure its product is used safely is unclear. Part of such a claim would be that such abnormal conditions as fumes in cabin air were unforeseen and beyond Mobil’s influence in terms of appropriate warnings. However, as early as 1983, a Mobil report sent from head office in the US to Mobil Australia answered enquiries made to Mobil Australia by an Australian airline operator. The enquiry centred on the health effects of oil fumes entering the cabin environment. Mobil stated that regarding commercial airlines there were,

no incidents of adverse health effects. Obviously, if cabin air becomes contaminated with any lubricant and/or its decomposition products, in

sufficient quantities, some degree of discomfort due to eye, nose and throat irritation could be experienced. Problems like this can be generally traced to improper design, improper maintenance or malfunctioning of the aircraft (Ladov E. N. 1999).

Such aircraft problems appear to be an important aspect of cabin fume contamination, and lend support to Mobil's argument for a demarcation between normal and abnormal exposure. Mobil has nonetheless attempted to extend its claimed safety of MJO outside normal use patterns to cabin fume exposure, as well as claiming that Mobil jet oil in and of itself is a safe product (Mackerer and Ladov 2000).

National Industrial Chemicals Notification and Assessment Scheme Overview

Mobil (Plummer 1999b) has challenged a NICNAS report entitled *Mobil Jet Oil II: Overview of Available Scientific Background Information* which is an overview of published material (Kristensen 1999). This report raised a number of concerns about the safety of MJO including Mobil secrecy surrounding toxic ingredients, a lack of reliable data on the inhalation of oils and Mobil's failure to address NICNAS questions over ingredients. The Australian Federation of Air Pilots and airline crew prompted this report when they made requests for a review of the hazardous properties of MJO due to cabin contamination with MJO. Mobil asserts that this report 'presents a misleading picture of potential health and safety hazards associated with Mobil Jet Oil II' and is concerned about the 'lack of context' in which the chemical constituents are examined that may convince the Senate Inquiry and members of the public that the 'product displays certain health and safety risks, when in fact it does not' (Plummer 1999b). Mobil also argues that MJO is not hazardous according to NOHSC's own criteria and that scientific studies 'demonstrate that exposure to jet oils does not pose a significant risk to human health' (Plummer 1999b). A later Senate Inquiry submission by Mobil also takes the same position (Mackerer and Ladov 2000).

One specific point Mobil raises with respect to the Overview is the reference to phenyl-beta-naphtylamine (PBN) and beta-naphtylamine (BNA). Both these are classed as carcinogens in the NOHSC *List of Hazardous Substances*, respectively category 3 (animal studies indicate that human exposure may result in cancer development) and

category 1 (sufficient evidence to assign a causal link between human exposure and cancer development) (Kristensen 1999, pp. 173-176). Mobil is concerned because it claims these are present in small amounts in jet oil and implies that only one of the additive oxidants, phenyl-alpha-naphtylamine (PAN) (also known as 1-Naphthalenamine, N-Phenyl), contains these substances and that PAN contains a maximum of 0.5% PBN and a maximum of 0.005% of BNA.

Because assessments of concentrations are based on minimum amounts that could be present and not the maximum amounts Mobil is inconsistent in its claim for rigor in attempting to accurately convey health risks as low. Mobil argues that 'PAN is used in MJO formulation at about 1%, the *maximum* levels of PBN and BNA that could *potentially* be present are 0.005% (50 parts per million) and 0.00005% (.5 part per million)(Plummer 1999a). Indeed Mobil's MSDS, both Australian and US MSDS and bulletins, state a 1 per cent concentration but these also state the range for this substance is 1-5%, although this changes to 1% with the 2004 publications in both countries.

Thus the qualification 'about' could mean more than one per cent; if one takes the 5 per cent figure also mentioned by Mobil, 'maximum levels' are not maximum in an absolute sense. At 5 per cent PBN would be 0.025% (250 parts per million) and BNA would be 0.00025% (2.5 parts per million). Consequently, Mobil's emphasis on the one per cent maximum levels and the associated levels of PBN and BNA is on the conservative side of their own figures. Moreover, Mobil's own researchers have noted 'significant variability' of chemical constituents in jet oils, both when examining 'samples from different suppliers and different batches from the same supplier' (Mackerer, Barth et al. 1999, pp. 313-314).

Another concern raised by Mobil was the Overview's examination of TOCP. Mobil argues that the discussion was not relevant because 'the potential maximum concentration of this impurity in the product is around 1 part per million' (Plummer 1999b). According to NICNAS the concentration of TOCP and other toxic isomers in MJO is not known, in part because Mobil does not readily supply details of the chemical constituents of its oil as well as the oil's variability (Kristensen 1999, p. 177).

Studies have shown that TOCP range from 0.36-2 per cent in commercial TCP, and the Overview states that TOCP in MJO is not likely exceed 0.06 per cent. If it was 0.06 per cent the concentration would be 600 parts per million, a significant increase to that claimed by Mobil as the potential maximum. The Overview also noted that there were 'no reliable data on absorption via inhalation' (Kristensen 1999, p. 170). Even a study involving researchers from Mobil noted a higher TOCP reading than that claimed by Mobil to the Senate Inquiry. The Mobil researchers used a range of generic aviation oils supplied by Mobil ranging from no TCP up to 3 per cent (Freudenthal, Rausch et al. 1993). The TCP component, contained 0.4 per cent TOCP, therefore the jet oil that contained 3 % TCP had .012% TOCP equivalent to 120 parts per million (Table 1 in Freudenthal, Rausch et al. 1993, p. 411). One might assume the 3 per cent TCP oil formulation used in the study would be close to commercial MJO given Mobil was supplying the oil and the study's aim was 'to determine the threshold concentration of TCP in aviation engine oil able to cause delayed peripheral neuropathy in adults [sic] hens after repeated exposure'(Freudenthal, Rausch et al. 1993, p.410).

This study also found that despite a reduction in recent years of TOCP to below 0.5 per cent in commercial TCP to enhance safety, other factors were not given sufficient consideration. Principally, other isomeric impurities contained in TCP apart from TOCP appeared to be responsible for increased neuropathy in one animal group studied (Freudenthal, Rausch et al. 1993, pp. 414-415). The study found that effects on chickens given the jet oil with 3% TCP included 'slight incoordination to severe leg weakness with loss of reflexes' and loss of body weight, ataxia and NTE inhibition. The latter three were significantly greater than the corn oil control with .5% TOCP²⁹ or jet oils with 1 % TCP. This suggests that other 'impurities' in TCP previously thought less toxic have toxicological properties that may act synergistically or have a discrete toxicological effect that enhances the neurological damage to test animals.

²⁹ Jet Oil 3% TCP loss of body weight 13% and clinical signs of ataxia 73%, NTE inhibition Brain 77% - Spinal Cord 62%, Corn Oil .5% TOCP 3% loss of body weight and clinical signs of ataxia 10%, NTE inhibition Brain 71% - Spinal Cord 55% Freudenthal, R., I, L. Rausch, J. Gerhart, M, M. Barth, L, C. Mackerer, R and E. Bisinger, C (1993). "Subchronic Neurotoxicity of Oil Formulations containing Either Tricresyl Phosphate or Tri-Orthocresyl Phosphate." Journal of the American College of Toxicology 12(4): 409-416.

A later Mobil submission to the Senate Inquiry stated an even lower amount of TOCP than the earlier Mobil submission. It stated that in TCP, TOCP levels were less than 5ppb (0.005ppm) (Mackerer and Ladov 2000, p. 48). The concentration in MJO would be less than .00015ppm, a significant drop from the maximum of 1 part per million of the earlier Mobil submission discussed above. The later submission did give figures for the concentrations of two other ortho-cresyl components in TCP that of MOCP of approximately 3070ppm and DOCP of approximately 6ppm (Mackerer and Ladov 2000, p. 48). Winder pointed out that these are even more toxic than TOCP and consequently a focus on low levels of TOCP has downplayed toxicity by a factor of 30,730 (see Table 3).

Table 3 - Tricresyl Phosphate: Toxicity of Isomers

Please see print copy for Table 3

(Winder and Balouet 2002, p. 154)

Mobil stated that a new oil developed and being trialled by airlines and engine manufacturers, Mobil Jet Oil 291 (MJO291), 'is non-neurotoxic' (Australia Senate 2000b). The later Mackerer Mobil submission also discussed the lower toxicity TCP used in MJO291. While the ortho-cresol components in TCP use for MJO was 0.16 per cent the MJO291 was approximately 0.06, with TOCP calculated at less than 1ppb, MOCP approximately 1760ppm and DOCP approximately 1.1ppm (Mackerer and Ladov 2000, p. 48). Using the same process for calculating equivalent toxicity in Table 3 the equivalent toxicity is 17,606, around half that of the TCP used in MJO (Winder and Balouet 2002, p. 154). This indicates a significantly lower toxicity for these three isomers though Winder notes that other non cresyl isomers such as xylenols and phenolics present in TCP can have similar neurotoxic affects (Winder and Balouet 2002, p. 154). Thus MJO291 does not appear non-neurotoxic.

Mobil was also critical of the inclusion of the section on trimethylolpropane phosphate (TMPP) in the Overview, because it ‘does not apply to MJO’ (Plummer 1999b). NICNAS faxed (25 August 1999) and emailed (2 September 1999) Mobil seeking documentation and clarification on MJO chemical makeup including whether MJO contained TMPP. A letter from Mobil dated 3 September 1999 stated that ‘Mobil Jet Oils do not contain esters of the alcohol trimethylolpropane’ however Mobil did not supply supporting documentation, except a MSDS, and no copy of the label text, stating that this is been awaited on from the US where the oil is manufactured (Plummer 1999a). This is somewhat incongruous for a multinational corporation claiming on the one hand that this oil does not contain trimethylolpropane and on the other not having the documentation readily available to support this claim or adequately document other ingredients. Given the significant variability of jet oils including MJO and the hazard posed by TMPP it is understandable that the NICNAS Overview included the TMPP discussion. Also significant is that NICNAS Overview was reliant on documentation provided by the Australian Federation of Air Pilots, such as the MJO label and earlier MSDS (Kristensen 1999, p. 169).

The trimethylolpropane discussion in the Overview drew on US Airforce and Navy research that indicated that some jet engine oils that contain TCP and trimethylolpropane could produce a strong neurotoxin - TMPP. This can occur when these oils are heated to temperatures ranging from 250-750 degrees Celsius. Animal studies have shown convulsions and death have occurred from injections of 1 mg/kg and dermally from 50-100mg/kg (Kristensen 1999, p. 177). Centers warns of the ‘extraordinarily dangerous situation’ for those conducting research into lubricants with TMPP and TCP. A significant difficulty is that, while many synthetic lubrications do not contain TMPP, ‘formulations are typically proprietary, [therefore] it is not possible for most users to determine which formulations might be potentially harmful’ (Centers 1992, p. 679; See also Wyman 1993).

The NICNAS Overview did not challenge directly the reason the List was not used by Mobil to classify MJO instead of the Approved Criteria, though it did so obliquely by noting that in the List TCP isomers containing ortho-cresyl ‘are classified as toxic and

assigned risk phrases R23/24/25 (Toxic by inhalation, in contact with skin and if swallowed) and R39 (Danger of very serious irreversible effect)' (Kristensen 1999, p. 172). The Overview also noted that even if the concentration of particular ingredients exceed the Approved Criteria threshold for particular chemicals MJO could if tested as a whole and determined as safe be designated as such by Mobil. However, the Overview offered a cautionary summary by pointing out that toxicologically a product containing two or more chemical ingredients can be more or less than the sum of the particular toxicological profiles, and so can react to form more toxic components either in the environment or inside an exposed person (Kristensen 1999, p. 178).

Values in Assessment

The values used to make assessments are another source of decision-making that requires closer examination such as changes in the EPA protocol discussed and Mobil's assertions that the NICNAS study lacked context. Value judgements are intrinsic to the debate and provide a way of interpreting scientific results to meet social and political aims. Mobil refers to scientific information such as Mackerer and Barth et al (1999), that the Overview also referred to, as evidence that exposure to 'jet oils does not pose a significant risk to human health' (Plummer 1999b). Mackerer et al do make a strong claim on jet engine oils safety, they qualify this by arguing for the need to take steps to ensure inadvertent and intentional contamination of foodstuffs which have poisoned thousands of people in the past is not repeated. Mackerer et al state 'it would be virtually impossible for a person to receive enough JEO + 3% Class 3 or 4 TCP in the normal workplace or in an aircraft cabin to develop OPIDN' (Mackerer, Barth et al. 1999, p. 327; See also Mackerer and Ladov 2000). However, the conclusions are derived from the testing of ingested oil products by rats and chickens and not inhalation of mists or fumes generated by burning or pyrolysis of jet oils. Thus the added complexity and large numbers of chemicals produced from oil undergoing these changes in aircraft were not addressed. Health effects less than those required for OPIDIN are not considered in relation to human health effects nor is the safety of an aircraft.

Another article by Mobil researchers also omits consideration of testing of burnt or pyrolysis of jet oil and as with Mackerer et al does not review published journal articles

or statements of people exposed to cabin fume incidents (Craig and Barth 1999). For example as far back as 1977, Montgomery documented the effects of acute intoxication following jet oil fume exposure on cabin crew. Symptoms included nausea, dizziness, vomiting and incoordination although a causative mechanism was not able to be identified due to the many toxic components produced during fume production (Montgomery 1977). Neither was mention made of more recent journal publications addressing cabin fume issues such as Rayman et al (1983) which documented cockpit contamination of USAF flights with petroleum products, and van Netten's article which examined BAe 146 air quality (van Netten 1998).

The Craig and Barth article suggests 'the risks from inhalation appear to be minimal' based on one 1965 research paper examining fume exposure on Rabbits and Hens. This article does site US OSHA Threshold Limit Values (TLV) for oil mists 5 mg/m^3 , but in the context of terrestrial workplaces, and suggests the adoption of the lower TOCP standard of $.1 \text{ mg/m}^3$ for low-ortho TCP³⁰ as an interim measure because;

Worker exposure to TCP is a hazard and a potential source of risk. The degree of risk is primarily a function of the relative neurotoxicity of the TCP in question, a property that may vary from highly potent to virtually non-toxic. Thus, it is impossible to erect exposure standards for TCP without qualifications and specifications that define its relative neurotoxicity... Without determining the relative toxicity of a particular brand of TCP, TOCP standards might not be protective if applied to total TCP concentrations (Craig and Barth 1999, pp.296-298).

Proprietary secrecy, batch variability and an acknowledgement by Mobil researchers that low ortho-TCP can be more toxic than TOCP mean that even a switch to TOCP standards 'might not be protective'. This still leaves the question of health and safety for cabin air not addressed.

Scientific studies cannot predict all adverse reactions that human beings may develop following exposure. These studies are usually based on animal studies that are of short duration and cannot fully grasp long-term consequences of such exposure. The

³⁰ Both these TLV are the same as set in Australia by NOHSC as previously discussed.

appearance of scientific certainty is thus garnered by arguing against the possibility of extreme exposure such as OPIDN, playing down the effects of more moderate exposure. Researchers also adhere to a large number of assumptions on the suitability of animal testing protocols to humans, such as relative equivalence between animal models and a human population so that extrapolation of results can take place. Often judgements are made on a limited knowledge base such as inhalation effects. The resultant knowledge construction is necessarily narrow and imbued with the research values of scientists; in the case of MJO there is a lessening of nervous system effects on humans for those that do not meet the OPIDN 'gold' standard. Thus safety is narrowly defined. To avoid simply accepting this limited definition of safety and risk requires recognition that these are socially negotiated judgements and measures. Lowrance captures this essence with his definition of safe, 'A thing is safe if its risks are judged to be acceptable' (Lowrance 1976, p. 8).

As previously mentioned, even though a range of 1-5 per cent as well as 1 percent is given for the concentration of PAN, it does not necessarily follow that carcinogens such as PBN and BNA or other hazards within these predefined levels are accurately accounted for or are even acknowledged. Many substances are not included in MSDB and MSDS because they are not deemed hazardous. Production processes are complex and researchers have acknowledged batch variability, but claims that hazardous levels of chemicals are not present in sufficient quantities would assume rigorous production standards.

Mobil has, however, not been a rigorous plant manager with respect to Avgas production and while different to jet oil production it provides an insight into the values and priorities of Mobil management. The contamination of Avgas in January 2000 from Mobil's Victorian Altona plant grounded many planes and highlighted significant safety issues related to Mobil's management practices at the production plant. This incident also reflects badly on corporation management more generally. Mobil had not acted on previous recommendations to improve plant processes, following a prior Avgas contamination in April 1999. The ATSB report noted that had these been acted on the current contamination could have been avoided (ATSB 2001c, p. 62). Regarding the current contamination the ATSB report noted;

The refiner's risk management process considered an overly narrow predefined set of undesirable outcomes. The process did not allow Mobil to identify all the undesirable outcomes (such as hazards to aviation safety) that could prevent them from producing products that were fit for purpose and from achieving their broader organisational objectives (ATSB 2001c, p.61).

Researchers have noted the difficulty of identifying chemical constituents. This can be the result of the scientific and technical limitations of both equipment and researchers, and the denial of access to information as Mobil has done. For those researchers within a company where access to information is not as problematic decisions still have to be made regarding how much effort and expense is expended on assessment. Value judgements related to the categorisation of an identified hazard are embedded throughout the assessment process. What is classed as the threshold limit of exposure or an 'active' ingredient is a case in point.

The chemical industry and regulators have long defined chemical constituents in terms of actives and inerts (and/or impurities). The Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) defined an active ingredient as one which will 'prevent, destroy, repel, or mitigate any pest' and inert ingredient is one which 'is not active' (FIFRA quoted in NCAP 1988, p. 1). The International Agency for Research on Cancer (IARC) classed sixteen chemicals as inert that have carcinogenic potential; three are known carcinogens, one is a probable carcinogen and twelve are possible carcinogens (NCAP 1988, p. 5). The outcome of the US EPA classification process appears arbitrary, for example formaldehyde, a probable carcinogen, is designated List 1 therefore it must be displayed on the label, but crystalline quartz silica, a known carcinogen, is designated a lower rating.

Mobil argued that PBN and BNA are 'present as impurities only at trace levels'. This was used to justify their removal from MSDB list of 'ingredients' after 1992 (Plummer 1999b). This is despite, according to Mobil, no change in MJO formulation in the 1990s. Mobil's approach suggests it views the hazardous nature of these chemicals simply in terms of their potential to generate adverse publicity by creating 'undue public

concern' (Plummer 1999b), that may in turn lead to changes in regulatory standards for MJO.

The shortcomings of scientific evaluation by Mobil, both acknowledged and otherwise, and much of the qualification of the hazard posed, have largely been omitted from Mobil management. In 1991, in correspondence between Mobil and Ansett, statements included 'there is no risk to health with normal use of Mobil aviation products containing Tricresyl Phosphate because the amount of TOCP is less the (sic) 0.1%' (Tresider 1999). The letter also stated that 'The warnings listed on the cans and information in the MSDS refers to misuse (drinking) of Mobil Aviation products' (Tresider 1999). Such broad categorical claims contradict Mobil's own MSDS warnings which clearly document a range of risk and safety information including inhalation and skin contact (see Table 1 in the appendix). Another letter in 1997, from the Medical Manager at Mobil to Ansett General Manager, stated, 'There is no evidence from the industrial hygiene and other studies available to me that any oil mist or other products of thermal degradation which may occur in cabin air during operations presents a significant hazard to the health of cabin occupants' (Clark 1997). These statements overly simplify the issue and neglect the effects of exposure that are not deemed significant, which for Mobil equates to OPIDN. More recent statements by Mobil reinforce this position. In April 2000 a letter from Mobil Australia stated that apart from OPIDN;

We do not believe that other human toxic effects are produced by TCP whether the exposure is acute, subacute or chronic.

In summary, we do not believe that any of the symptoms, reported by individuals claiming to have been exposed to mists or odours of Mobil Jet Oil II, were caused by exposure to the oil or any of its components. Neurological effects claimed to occur from low-level chronic exposure, or cumulative effects from multiple exposures, are strictly anecdotal and are not supported by concurrent documentation of exposure or of biochemical, or pathological effects known to be produced in humans by TCP. In the absence of proven exposure and recognisable toxicologic

sequelae known to be related to TCP, the allegations appear to be simply unfounded speculation...

We believe that the toxicity of Jet Oil II would not be altered by reduced pressure or oxygen level - however, this would not necessarily be true of pyrolysis or combustion products of the oil...

The more frequent symptoms, i.e. disorientation, blurred vision, impaired memory, altered coordination, nausea, loss of balance, headache, dizziness, increased heart rate, loss of consciousness, shortness of breath.... are consistent with hypoxia. I suggest that hypoxia might result from one or more of the following: low oxygen level, presence of carbon monoxide, elevated oxygen demand possibly resulting from increased muscular activity and/or hyperventilation possibly aggravated by high carbon dioxide levels and stress from lack of sleep.

Mobil's turbine oils are designed to meet appropriate standards for engine performance, safety and product stewardship. Our risk assessments define the conditions under which we consider Jet Oil II to be of negligible risk through inhalation, dermal and ingestion exposure. That information has been provided to our customers and is available publicly through our published papers in the peer-reviewed scientific literature. Based on the results of this research, we believe Jet Oil II is of negligible risk to maintenance workers, passengers, and flight staff potentially exposed to an oil vapour or mist (S. Potts Manager External Relations quoted in SRRATRC 2000, pp.43-44).

Mobil continues to omit, conceal or divert attention from the risks posed by MJO, though it does admit that that MJO toxicity could be altered by combustion or pyrolysis. Mobil in its published research and other publications fails to acknowledge that jet oils become more hazardous with age. The only mention in the MSDS/MSDB reviewed in this chapter was an entry in a 1995 US MJO MSDS which stated 'Warning! Used motor oils were shown to cause

skin cancer when repeatedly applied to mice without cleaning skin' (Mobil-US 1995, p. 2). Thus MJO leaking into a cabin that has been in the engines longer is likely to pose a greater hazard than an aircraft with newly changed oil. Also while Potts mentions other factors that could contribute to symptoms of aircraft crew such as carbon monoxide and low oxygen levels she tends to distance MJO from a causative role. But burning or pyrolysis of jet oils is likely to be implicated in increases in carbon monoxide and limit the available oxygen at altitude. Also a concern is Mobil's attempt to individualise symptomology as a result of physical exercise and stress, yet at the same time fail to review research or undertake research into aircraft crew or passengers exposed to cabin fumes.

Future Changes?

The EU has introduced changes to CAS numbers of TCP to discourage use of the general TCP mixture number of CAS No. 1330-78-5 which is to be deleted and so that better disclosure of ortho-cresyl containing mixtures can occur (Winder and Balouet 2002, p. 151). The two numbers are CAS No. 78-30-8 containing ortho-cresyl isomers and CAS No. 78-32-0 containing meta and para isomers. Winder points out that the new CAS numbers will assist in identifying toxic ortho-cresyl ingredients and the reason that this has not been adopted may be linked to the undesirability from a marketing perspective. Winder calls for the application of new ortho CAS numbers to provide additional information and meet standards given the problems of appropriate labelling identified. However, a difficulty appears to arise under the new NOHSC new guidelines: the HSIS (NOHSC 2005).

Given the newer MJO291 has a lower level of ortho-isomers this appears to allow the use of the non ortho CAS No. 78-32-0. Given the HSIS does not include the generic TCP CAS No. 1330-78-5 it appears that future MSDS/MSDB not only for MJO291 but other manufacturers may further downplay the hazard of such jet oils leading to a further erosion of health and safety warnings for employees and medical professionals. As with the removal PBN and BNA, TCP has the potential to become a 'trace' amount of little consequence in those oils judged low ortho. However, the most recent 2006 Australian MSDB from Mobil has continued to retain the older TCP CAS No. 1330-78-5 that Mobil has used previously (Mobil-Aus 2006).

Strangely NICNAS has also continued to use the older CAS No: 1330-78-5 in the Priority Existing Chemical Program which has placed the ingredients of MJO on a 'priority list'. Also the priority has altered the representation of MJO; originally MJO was mentioned by name and key chemicals listed in the 'standby section' of the 2002-2003 listing however the name MJO was removed in the 2006 edition and the chemicals listed alphabetically when it was placed on the priority list (NICNAS 2003; NICNAS 2006). A significant wait has occurred for MJO to be assessed by NICNAS and if this eventually does occur it may simply focus on individually components rather than the whole product leading to results that may contribute little to the debate regarding cabin fumes.

Summary

Mobil has failed to adequately convey the risks associated with MJO. This includes the failure to display all chemicals in MJO on MSDS and the removal of statements about numerous chemicals deemed not hazardous by Mobil. Mobil has over many years used incorrect risk and safety phrases on MSDS/MSDB, utilising Harmful safety phrases instead of Toxic. Mobil was still unable to apply appropriate risk and safety warnings to MSDS/MSDB following the flawed procedural justification for the assessment of the 1999 MSDB offered by Mobil and by NOHSC. The non-hazardous claim and Harmful categorisation still did not result in appropriate risk and safety phrases which have only declined with the 2004 MJO MSDS. The discretion given manufacturers in the Approved Criteria to judge the hazard of a material appears to have resulted in the downplaying of the risks.

This ability of Mobil to define what constitutes toxic, harmful and safe brings into doubt the appropriateness of MSDS/MSDB guidelines that lead to assessments based on Mobil's judgements. So, while MJO has not undergone any significant change since the 1960s its hazard potential has decreased according to MSDS/MSDB, which has led to insufficient warnings for employers, employees and medical practitioners attempting to identify the types of chemicals people are exposed to. The role of NOHSC in allowing inappropriate labelling of MSDS/MSDB is an important part of the process of downplaying the hazard of MJO.

The oils hazardous constituents, complexity and the influence of other environmental factors such as heating reactions in combination with a pressurised space of an aircraft cabin make it difficult to sustain claims of no health hazard to those exposed. It appears that MJO has significant health effects in spite of Mobil's often contradictory claims to the contrary. Mobil's safety claims particularly claims of safety from fume exposure in aircraft are not supported by the evidence of their researchers. The result is a bias against a more considered assessment of the hazard posed by jet oil. The symptomology of cabin crew alone should prompt a more considered approach to health of the crew and passengers, and the safety of the aircraft from both Mobil and NOHSC.

The previous discussion of MJO has suggested that scientific assessments and regulatory practice that has surrounded MJO is insufficient to claim that this substance does not pose a hazard to human health. Mobil and NOHSC are not alone in asserting MJO safety. The airlines operating the BAe146 in Australia have also taken this stance and attempted to 'prove' this with 'appropriate' research though they also extend such claims to the aircraft.

Debates surrounding deregulation are examined in the following chapter. In addition, the role of Civil Aviation Safety Authority and the Australian Transport Safety Bureau are scrutinized.

Chapter 5: Aircraft Regulation: Rhetoric and Practice

Introduction

This chapter examines the response of an Australian aviation regulatory and investigative body to safety and health issues arising from the contamination of cabin air with oil fumes. Prior to this examination aircraft regulation is examined more broadly in order to better understand the motivations and constraints placed on such aviation bodies. First, debates surrounding the deregulation of the aircraft industry and the relationship with safety are examined in order to provide a historical context to the development of safety and by implication health priorities in the aviation industry. Also examined is the dominant role of economics in the shaping of safety, the rather limited conception of safety in the literature and a tendency to focus on accidents ignoring less 'catastrophic' incidents. Second, the relationship between two government bodies and health and safety will be examined using the Senate Inquiry into the BAe 146. The response and arguments of the Civil Aviation Safety Authority (CASA), the key aviation regulatory organisation, and the Australian Transport Safety Bureau (ATSB), the key aviation investigative organisation, are examined. The arguments of these bodies are reactive, adapting and changing to a considerable degree to avoid a more considered response to health and safety. These responses are calculated to play down the health and safety issues and thus insulate the airline operators from the economic costs of substantively and proactively addressing the problem.

Deregulation: Constructing and Deconstructing Safety

The deregulation of the airline industry is a global phenomenon that has shaped and continues to shape regulatory responses to health and safety by governments and their aviation organisations. Regulatory reform is not a chronologically bound event that can be reduced to a particular time and place; rather it is an ongoing process. In Australia deregulation policy was begun in the early 1990s following its introduction in the US and Europe. The impact of reform policies in Australia is still being felt with the collapse of airlines - such as Compass one and Compass two, more recently Ansett - and new airlines entering the market - such as Impulse (subsequently bought by Qantas) and Virgin - in 2000.

This chapter argues that deregulation has had an adverse impact on safety not necessarily in gross terms, that is major accidents and lives lost, but by a more subtle erosion of safety and health standards. The result has been regulation that has not given sufficient attention to these issues as they relate to aircrew or passengers.

Supporters of deregulation have emphasised the economic gains as a consequence of deregulation but key to these supporters' position is an argument that safety has not been sacrificed. Supporters' arguments for reductions in government oversight have tended to focus narrowly on accidents particularly those resulting in loss of life and equipment. What has resulted is a neglect of many other aspects of safety including the health of aircrew and passengers.

Poor safety is not simply about fatalities or major accidents but many other considerations. One study of airline pilots, in the US, found that 97 per cent believed that deregulation has led to a fall in safety standards. Problems included 'lagging and inadequate maintenance; pressure to avoid delays; lowered hiring and experience standards for new pilots; increased use of waivers and exemptions from safety rules; increased flying hours for pilots; [and] the profusion of new, inexperienced airlines' (quoted in Dempsey and Goetz 1992, p. 300). Many supporters of deregulation have neglected to address these and other less catastrophic aspects of industry practice which will eventually impinge on aircraft safety (see Findlay 1985; Levine 1985; Moore 1989). Even an OECD study on international aviation policy examined safety only cursorily (OECD 1997).

In Australia, aircraft regulation is the responsibility of the CASA, formerly the Civil Aviation Authority (CAA), and investigation of accidents and incidents is the responsibility of the ATSB, formerly the Bureau of Air Safety Investigations (BASI). There are equivalents in the US and Europe. In the US, the Federal Aviation Authority (FAA) is responsible not only for US domestic regulatory standards but is increasingly involved in setting global aviation standards. The US Airline Deregulation Act of 1978 marked the dramatic shift in global airline regulation. This Act emphasised the use of competitive market forces to enhance competition, efficiency, lower prices, innovation

and maintenance of a profitable airline (Dempsey and Goetz 1992, pp. 193-196). While the maintenance of existing safety standards was incorporated as part of this Act the result was according to Dempsey effective erosion of safety standards.

Government and regulatory authorities have now shifted regulatory responsibility onto the airlines in areas of pricing and service delivery, placing increased emphasis on a self-regulatory model which has been motivated by the drive to increase economic efficiencies (USGAO 1996, p. 14). Results have included lowering airfares, increasing competition by encouraging new airlines to enter the market and the replacement of jet aircraft by turboprop aircraft in less viable markets (USGAO 1996, p. 4). This begs the question what priority is given to health and safety.

Safety was one of the justifications for the early, regulated model of the airline industry prior to deregulation (Reynolds-Feighan 1992, p. 3). Some have argued that safety and deregulation should not be viewed as closely interconnected, because there has not been an increase in aircraft fatalities following deregulation (Findlay 1985; Levine 1985). Questions have also been raised as to why the number of airlines and the cost of airfares should be controlled given strict safety standards imposed by the FAA (Reynolds-Feighan 1992, p. 3). There is merit in not simplifying issues of safety simply to deregulation as many other issues are involved such as government oversight, organisational philosophy and the technological and scientific systems adopted in the design process which may not be directly affected by deregulation. However, it is important to recognise safety has come under increasing pressure as economics has increased in relative importance to that of safety. According to Nance major airlines had prior to 1978 'always kept their operational safety levels far above the federal legal minimums (though Congress in 1978 was blind to that fact) by passing the cost of safety-related functions through to the ticket prices' (Nance 1986, p. 10).

Nance argues that the flying public 'was not told by Congress or the proponents of deregulation the ultimate truth about the enticing free-market proposal: If prices are cut, costs must be cut, and something more than executive salaries and union contracts will have to give. The cost of safety would be one of those affected items' (Nance 1986, pp. 340-341). The belief by Congress that there would be no decline in safety because it

ordered the FAA to prevent a decline in air safety was misplaced because, ‘It was a belief that was based on a profound misunderstanding of the fact that the FAA could enforce only the legal minimums - and the mainstream of the airline system built so laboriously (and balanced so delicately) over nearly thirty years had *never* rested on the legal minimums... Thus the Deregulation Act itself mandated a lowering of safety standards for the U.S. commercial aviation across the board’ (Nance 1986, p. 341).

Given the FAA pre-eminence in setting global standards, legal minimums became the benchmark internationally as other countries followed a deregulatory model. In Australia, Alan Terrell in a report to the CAA in 1993 noted ‘that safety standards/levels have been reduced so that they are closer to the regulated margins’ (quoted in Australian Government 1995, p.27)

Deregulation has resulted in upheavals internationally in the industry including new airlines entering the market and the collapse of a number of airlines. There has been a decline in profits, aircraft sales and the development of new aircraft. These factors have resulted in an ageing of existing aircraft fleets. Citibank banker Frank Bradley noted that ‘although the few strong carriers are possible launching platforms for new aircraft, the broad platform which the US industry has provided in the past, and upon which US manufacturers built their commercial business, will not be there’ (quoted in Hayward 1986, p. 25).

Governments and regulators have become increasingly accommodating to the resulting pressures on airlines. This has not been assisted by the often-competing responsibilities assigned to the FAA and CASA; both are accountable to provide aviation safety and promote civil aviation. Mary Schiavo, a former inspector-general at the US Department of Transportation responsible for evaluating FAA practices noted ‘the FAA couldn’t reconcile its conflicting duties, and ... often it supported the business of aviation at the expense of safety’ (quoted in Weir 1999, p. 225). A parliamentary inquiry in Australia noted that deregulatory reforms initiated in the early 1990s utilising the concept ‘affordable safety’ removed costs to industry, emphasised efficiency which included plans to get rid of 50% of CAA staff in six years, devolved areas of responsibility to industry ‘but did not produce commensurate safety benefits’ (Australian Government

1995, pp. 112-114). In November 1994, a CAA employee Dr Helen James turned whistleblower and accused the CAA CEO of misleading the board by deleting key parts of a report dealing with the deterioration of safety and claimed that the CAA had become an unethical organisation (Australian Government 1995, pp. 105, 119-120).

Deregulation critics (Dempsey and Goetz 1992) and supporters (Moore 1989) have acknowledged a decline³¹ in commercial aircraft fatalities since deregulation. Those supporters of deregulation argue that this decline in accidents and fatalities show deregulation has not had an adverse impact on safety. Authors such as Levine offer a narrow view of safety when he asks; 'Does economic deregulation mean operational **catastrophe** in the form of drastically impaired safety' and later answers this question stating that 'Predictions of **catastrophe** connected with economic deregulation have fortunately proved wide of the mark, as liberalized environments have experienced unprecedentedly favourable safety records' (emphasis added) (Levine 1985, pp. 2, 10). The modifier 'catastrophe' is used by Levine to push the discussion to the extreme end of the safety continuum and thus ignore those safety issues that do not pose an immediate loss of life or aircraft. There was, however, a downward trend in fatalities and accidents in commercial aviation prior to deregulation (Moore 1989, pp. 13-15). This may indicate technological considerations such as backup systems and other safety systems embedded in aircraft design practice that would not easily be dispensed with following deregulation. Increasing strains on such systems due to ageing of aircraft fleets may eventually see those safety margins diminished.

Nader and Smith, examining US deregulation, argue that a comparison between large commercial aircraft (Federal Aviation Regulation (FAR) 121 carriers - over 60 seats), smaller commercial aircraft (FAR 135 carriers - 60 or less seats) and private aircraft could lead to different conclusions (Nader and Smith 1993, pp. 25-27). Even in a

³¹ However, such claims have been challenged. Peter Patrick, in a submission to the Plane Safe Inquiry in 1994, had challenged CAA safety claims in particular that safety had not changed over the last 10 years. He examined the pre-CAA (1981-87) and CAA (1988-94) statistics noting that 'Virtually all measures of magnitude point to substantial increases in fatality, levels in general aviation since the creation of the CAA' and that the increase was nearly 10% Australian Government (1995). Plane Safe - Inquiry into Aviation Safety: the Commuter and General Aviation Sectors. Report from the House of Representatives Standing Committee on Transport, Communications and Infrastructure. Canberra, Australian Government Publishing Service. While in testimony to the inquiry he did not blame the CAA but noted this could have occurred regardless of who regulated the industry. However, it was during this period that the Australian airline industry was deregulated. From 1994 General Aviation fatalities started to trend lower ATSB (2001a). Australian Aircraft Civil Accidents 1990-2000, Australian Safety and Transport Bureau.

deregulated environment larger commercial aircraft are more tightly regulated and have fewer accidents and fatalities compared to less regulated, smaller commercial aircraft. In addition, small and private aircraft have more accidents and lower regulatory standards than larger commercial aircraft. The phenomenon is also evident in Australia with lower rates of accidents for larger commercial aircraft (ATSB 2001a).

Thus stronger regulation could be viewed as one reason for the safety of larger aircraft; also possible is that smaller aircraft for a range of reasons are more likely to have accidents. Such distinctions in analysing the relative safety of aircraft categories have not been made by a number of deregulation supporters (see Moore 1989; OECD 1997; Thierer 1998). Even so, comparison with other carrier classes is difficult because of different modes of operation and equipment, but as will be shown this argument can be used to ignore the issues arising from the increasing numbers of smaller commercial aircraft being utilised by the airlines.

Rose argues against the inclusion of other carrier classes in comparative analysis of safety due to differences in services, technology, and scale and scope of operations because this would generate misleading results (Rose 1989, p.102). Nonetheless, the replacement of many larger commercial carriers with smaller commercial aircraft carriers following deregulation appears to warrant closer comparative examination, since there appears to be an increased risk for crew and commuters (Oster and Zorn 1989, p. 138). The exclusion of smaller commercial aircraft and their increased role in the deregulated airline industry means Rose's examination of financial influences on air safety is inadequate. Oster argues that passengers on small commercial airlines were three times more likely to be killed in smaller planes in the post deregulation period than in larger ones (Oster and Zorn 1989, p. 138). There is also a growing overlap between smaller and larger commercial aircraft services. Nance has been critical of this blurring due to smaller aircraft being less safe than larger aircraft, thus 'when small commuter lines enter into marketing arrangements, with major airline's logo and name on the side of their diminutive airplanes, the implicit misrepresentation borders on fraud' (Nance 1989, p. 198). That is, the safety reputation of larger aircraft should not be likened to smaller aircraft when operators of smaller aircraft adopt the same trading name as that of a company using larger aircraft.

Some supportive analysis of deregulation, for example econometric analysis, has taken a more detailed view of the relationship between deregulation and safety examining a number of concerns raised by critics of deregulation (Rose 1989). Econometric analysis, though attempting a broader approach to issues of airline safety, remains reductionist because of the narrow focus on arguments dealing with serious accidents and fatalities in spite of a claimed concern to examine other less serious incidents. Kanafani and Keller compare the safety of new airlines entering the market compared with existing carriers. They define accidents as ‘occurrences involving injury to people or damage to property’ and while there is consideration of less serious ‘incidents’ the resulting analysis focused on serious accidents when comparing existing carrier safety with new carrier entrants (Kanafani and Keller 1989, pp. 124-128). Another study also focused on whether passengers would be seriously injured or killed and examined a range of factors including equipment failure, weather, pilot and ground crew. These authors argued that less serious incidents are a,

useful element to include ...[because] A robust safety measure would encompass all unintended happenings, regardless of their severity. While fatal and serious-injury accidents may be a portent of problems that could lead to more severe accidents in the future (Oster and Zorn 1989, p.135).

This initial concern was not borne out in their analysis, which was centred on accidents resulting in fatalities (Oster and Zorn 1989, pp. 137-152). Rose’s examination of financial factors on airline safety following deregulation based on fatal and non-fatal accidents claimed aggregate safety to be ‘superb’ with ‘no sign of deterioration’ (Rose 1989, p. 111). Rose does suggest that airlines with higher profit margins appear to be linked to lower accident rates, which means that those less profitable airlines require greater scrutiny of ‘safety practices and performances’ (Rose 1989, p. 111). The lack of airline profitability since deregulation and the inclusion in profits of interest paid out to creditors as part of aviation industry returns mean ‘A carrier can be incurring sizeable losses, be on the verge of bankruptcy – and still it could show a favourable “rate of return”, because the very interest payments that are threatening its solvency, would be counted as part of that return’ (Brenner 1988, p. 261) Given that 25 to 33 per cent of

airlines report an operating loss in any one year and in some years such as 1990 this has risen to 60 per cent (BTCE 1994, p 171), safety standards appear under a significant degree of economic pressure. Thus Rose's claims of aggregate safety are somewhat misplaced given the high proportion of airlines facing economic difficulties.

Constructing Safety: Now you see it now you don't

In spite of Rose's empirical and theoretical shortcomings, governments appear to support the thrust of her analysis and that of other researchers that take a circumscribed view of safety by placing an emphasis on major accidents and death as criteria for safety and health assessment. A 1995 Australian government report on aviation safety found Australian research agrees with Rose's assessments (Australian Government 1995, pp. 54-55). The report also echoed Rose's concern regarding the impact of profits arising from deregulation as placing an increased strain on maintaining safety standards. The report stressed the need to strengthen standards if safety was eroded. An Industry Commission report concluded that to 'the extent that greater competition provides an incentive for some operators not to comply fully with safety requirements, there may be a case for strengthening enforcement procedures' (quoted in Australian Government 1995, p. 55). The Industry Commission report stated that a reduction in profits provides 'the essential preconditions which endangers safety' (quoted in Australian Government 1995, p. 57). However, as in previous studies, the definition of safety used by the government report was restrictive, arguing that safety is 'the probability that a flight will result in an accident' (Moses and Savage quoted in Australian Government 1995, p. 27).

What is illustrated in this government report is the difficulty in even establishing measurements of safety given this restrictive definition because accidents and their measurement were deemed insufficient indicators:

3.43 The committee finds there was limited information on inputs, no information on outputs and limited information on outcomes. The accident statistics are of limited use and there are no surveys or safety indicators that can be used as effective alternatives of the statistics. In short, there is a scarcity of measurements of safety.

3.44 However, there is an abundance of accusations, acrimony and personality conflicts (Australian Government 1995, p 37).

Australia is not alone in not gathering information and developing models to evaluate risk and safety. The FAA has also failed to carry out suitable inspections. A 1991 General Accounting Office report noted the 'FAA does not seem to have a system for assessing airline risk' (quoted in Nader and Smith 1993, pp. 98-99)

According to the Plane Safe Inquiry submissions from aircraft operators could assist policy development and recommended CASA publish serious defects on a monthly basis identifying the operator to help stem 'destructive competition', and the erosion of maintenance practices and safety (Australian Government 1995, p 58). CASA was reticent arguing the media could abuse the situation. Operators were also reluctant; for example, the submission by Ansett appeared condescending. Ansett's submission claimed 'that buyers of aviation generally lacked the expertise to determine whether a specific deficiency affects safety. Ansett also stated that the only information on deficiencies which directly affect safety should be published'. The Inquiry noted rather portentously that 'The Ansett submission was defensive and patronising to the consumer. The company should be aware of the emphasis placed on the customer by airlines and the heavy penalty the market extracts for operators who do not satisfy the customer' (Australian Government 1995, p 59).

The selection of what constitutes appropriate data is a political issue and highlights the difficulty in developing safety assessments when key stakeholders choose not to record such information. Even what constitutes aviation fatalities is subject to interpretation. One such instance were the claims of the CAA Chairman Dick Smith. Smith claimed that there was only one passenger death in his first full year of his tenure but there were 16 fatalities in the first full year of his predecessor's tenure (Australian Government 1995, p. 33). If we accept that safety was essentially about major accidents leading to fatalities, this would suggest that safety improved under Dick Smith. However, the committee identified problems with Smith's assessments for example;

Smith excluded crew fatalities. This was on the grounds that 'fatal accidents were caused by crew foolishness and a government decision that regulations should protect third party and property, not people from themselves' (Australian Government 1995, p. 34).

The committee found Smith's claims 'an arbitrary and absurd way of compiling and interpreting statistics' (Australian Government 1995, p. 34). This was an unashamed disregard for safety and health considerations and the argument that aircrew deaths should not be included by a past head of CASA poses an obvious difficulty for aircrew and others asserting safety and health concerns arising from cabin fumes. The government's role in shaping regulatory institutions and policies should not be overlooked: it selects the head of the organisation and shapes the operating goals, for example establishing deregulatory policies.

The previous discussion has highlighted the increased role of economics in aviation following the implementation of deregulation policies and the subsequent decreased emphasis on safety. Also highlighted is an emphasis on accidents rather than the less dramatic incidents which is understandable at one level but suggests a gap in adequately conceptualising and addressing safety. A brief discussion of 'latent failures' occurs below prior to an examination of CASA and ATSB responses to cabin fume contamination.

Latent Failures: Prevention vs. Reaction

The notion of latent failures in aviation is based on the work of James Reason which has become known as the Reason model. This widely accepted model in aviation distinguishes between 'active failures' - those associated with the actions of people undertaking an activity such as 'train drivers, signalmen, pilots, air traffic controllers' - and 'latent failures':

These are decisions or actions, the damaging consequences of which may lie dormant for a long time, only becoming evident when they combine with local triggering factors (that is, active failures, technical faults, atypical system conditions etc.) to breach the system's defences. Their defining feature is that they were present within the system well before the onset of a recognisable accident sequence. They are most likely to be spawned by those whose activities are removed in both time and space from the direct human-machine interface: designers, high level decision makers, regulators, managers and maintenance staff (Reason 1991, p. 4).

The Reason model ultimately seeks a preventative approach rather than one that simply reacts to circumstance. The editor of the BASI journal agreed with this sentiment stating that, ‘the aviation industry will continue to sharpen its focus on the human factors in aviation safety, not least on the ‘latent failures’ in aviation systems’ (Editor 1991, p. 2). In the same editorial the related issue of Occupational Health and Safety (OHS) was discussed, noting that, ‘governments, unions and employees ...now recognised [OHS] as a serious issue’ (Editor 1991, p. 2). The Commonwealth Bureau of Transport and Communications and Economics (BTCE) talked about the importance of examining aviation safety broadly and viewing responsibility for safety as not being bound by a reactive safety model that often limits regulatory responsibility as residing solely with CASA, because;

it is also not a fully satisfactory model of accident causation and prevention...A more realistic view of safety sees CASA as merely one of the possible defences against accidents as outlined in the Reason model of accident causation and prevention...The Reason model is now widely used – for example by BASI, the FAA, Ansett and Qantas (BTCE 1997, p. 34).

The previous discussion has cast some light on researchers, regulators and governments that as Reason put it are at a distance in both time and space from the aircraft machinery and people that operate and travel on them. It highlighted the policies of deregulation as undercutting safety culture. Regulatory and industry policies are inextricably bound to day to day running of aircraft. The connections are not always clear but attempts need to be made to understand them, and attempt to avoid failures, not only major accidents, but those incidents and health problems associated with fume contamination of aircraft that do not quite get the necessary attention or fit current understandings and practices.

If we consider flight and cabin crews’ ability to perform certain tasks is bound up with their good health we can see the Reason model would encompass health issues. Even passengers would be included in such modelling as they become consequences of a failure of a system. According to World Health Organisation, ‘Health is a state of complete, mental and social well-being and not merely the absence of disease or

infirmity' (World Health Organisation 1946). While the majority of aircraft fume contamination would be classed as incidents these would, according to the Reason model, require scrutiny particularly when pilots are not able to function and have to hand over duties to other pilots or when two pilots are affected.

Latent failures can by their very nature appear to operate at a distance to an actual event. They consequently can be deemed not significant by high level decision makers and regulators. Of course it may have been the very actions of these same decision makers and regulators that contributed to the event. Given the wide acceptance within the aviation community of the Reason model the examination of the different aviation interests in this thesis provides a useful examination of this model's practical application. That is, what steps have been taken by the aviation community to identify latency and causation issues surrounding the cabin fumes controversy and what strategies have been put in place to prevent these reoccurring?

The Regulatory Response to BAe-146 Controversy: CASA

According to the Australian Federation of Air Pilots (AFAP), CASA's response to the BAe-146 aircraft controversy has been one of marginalisation and neglect of a range of regulatory obligations. This developed to such an extent that AFAP viewed CASA as not dealing with a serious safety and health issue because CASA was too closely aligned to the aircraft operators. In addition CASA was unable to deal with reports adequately because of a lack of confidentiality. During the preliminary phases of the Senate Inquiry, AFAP argued that as a result of these failings CASA was unsuitable to head an inquiry into the BAe 146 (Australia Senate 2000l, p. 30). The Senate inquiry revealed CASA interests were aligned to aircraft manufacturers and larger operators, and not the health and safety of aircraft crew and passengers. A preventative approach advocated by the Reason model was not adopted by CASA as it sought to marginalise health and safety concerns, including long term ill health, that encompass Multiple Chemical Sensitivity (MCS) and Aerotoxic Syndrome. CASA's submission to the Senate Inquiry makes a number of important claims intimating their stance on health and safety, which are examined in detail below.

- CASA argues, in their 16 September 1999 submission to the Senate Inquiry, that a review of test methods and results by ‘a team of Australian medical experts ... has declared that there is no contaminant present in the cabin environment that will induce any long term or permanent effects on the passengers or crew’ (Australia Senate 2000o, p. 167).

The expert team cited is problematic because of their close association with aircraft companies; the team was established by Ansett and chaired by David Lewis the Medical Director at Ansett. Mark Donohoe, a doctor involved in the care of a number of aircraft crew with MCS, viewed the body as neither independent nor neutral (Australia Senate 1999d, p. 9). He cited two members of the group, Dr Robert Loblay and Dr Patrick Carol, as both making prior statements disparaging people claiming long-term health effects similar to those on BAe 146 aircraft. Laura Cox, the Senior Industrial Officer of the AFAP, was more forthright:

There is no such thing as independence where a commercial entity selects its experts...CASA should not be operating in such a way that they simply take a commercial entity’s report – and I am not casting aspersions on Ansett here, but they may have compiled that report for their own purposes. This is being accepted by the regulatory authority as the be-all and end-all. This is totally unacceptable in our view (Australia Senate 2000b, p. 117).

Judy Cullinane, former flight attendant and member of Ansett Odour Committee, made similar comments. Cullinane had to leave her work as a consequence of MCS attributed to cabin fumes on the BAe 146. Cullinane was present at the Odour Committee when the committee of experts report was handed round and noted that all members of the expert committee except one was paid by Ansett for their services (Australia Senate 2000n, p. 65-66). The expert committee signed off on the *External Panel of Specialists BAe 146 Odour Occurrences - Consensus Statement* (Moore, Carroll et al. 1998) on 25 March 1998. However, there were significant gaps in the literature they reviewed. Cullinane mentions the Richard Fox study of January 1998 that was not included in the literature review (Australia Senate 2000n, p. 70). Other studies dealing with cabin contamination of the BAe 146 were omitted such as Vasak (1992a). Nonetheless, Kevin Sleight proposed the Odour Committee endorse the consensus statement so that

committee could be ended, but union and staff representatives on the committee refused to sign (Australia Senate 2000n, p. 70). CASA's assessments appear to be overly reliant on selective aircraft industry assessments compared to union assessments and those that have supported the adverse health claims of the aircraft crew.

Another problem with industry assessments is an over reliance on testing aircraft cabin air, rather than an examination of the aircraft crew that have suffered from exposure to cabin fumes. Chapter 7 will examine health and safety assessments from the perspective of individuals' health experiences such as MCS, via the work of unions, aircraft crew and researchers.

The CASA submission denying long-term ill health is at odds with its own medical assessment measures that deal with issues such as MCS. In August 1999, Susan Michaelis, a pilot with National Jet Systems, was reviewed by CASA Aviation Medical Office. Michaelis' symptoms resulted from oil fumes whilst operating BAe-146 aircraft. These symptoms increased in number and intensity and included nausea, fatigue, headaches and nose and throat irritations. As a result of long-term ill health the office found Michaelis unfit to work and did not issue her with a Civil Aviation Safety medical certificate and as a consequence she is no longer able to fly (Australia Senate 2000s, p. 216). This difference between rhetoric and practice of CASA suggests a bias in favour of aircraft operators and manufactures of the BAe 146.

In September 1999, the Australian Federation of Air Pilots (AFAP) called for an independent inquiry into the BAe 146 because of the CASA's failure to call an inquiry. According to AFAP, CASA is obliged to conduct an investigation as legislated in the Civil Aviation Act, Regulations and Orders (Australia Senate 2000l, p. 30).

CASA has ignored legal obligations, according to numerous submissions to the Senate Inquiry. Regulatory obligations were identified by the AFAP who represent the interests of flight crew and the public (Australia Senate 2000l; Australia Senate 2000n). Only later did CASA acknowledge some of these obligations, albeit grudgingly and in a heavily qualified way. Arising largely from advocate submissions and debate during the Senate Inquiry a number of regulations were found applicable to cabin air quality,

placing a legislative obligation on CASA and the accident and incident investigator ATSB. These include the current Civil Aviation Regulations (CARs) that were made in accordance with the *Civil Aviation Act 1988* and US Federal Aviation Regulations (FARs), which have been incorporated in Australian CARs.

The following Civil Aviation Regulations on crew health are considered relevant:

- CAR 2 (*major defect*)
...as in relation to an aircraft, means a defect of such a kind that it may effect the safety of the aircraft or cause the aircraft to become a danger to person or property.
- CAR 48.0 (Flight time limitations).
1.4: Notwithstanding anything contained in these orders, a flight crew member shall not fly, and an operator shall not require that person to fly if either the flight crew members is suffering from, or considering the circumstances of the particular flight to be undertaken, is likely to suffer from fatigue or illness which may affect judgement or performance to the extent that safety may be impaired; (SRRATRC 2000, p. 1)
- Civil Aviation Advisory Publication (CAAP) 51-1 (o) advises
(c) smoke, toxic or noxious fumes inside the aircraft is considered a major defect (SRRATRC 2000 p. 2).

The FARs deemed applicable by the Senate Inquiry are:

- FAR 23.831 (Ventilation and heating)
(a) Under normal operating conditions and in the event of any probable failure conditions of any system which would adversely affect the ventilation air, the ventilation system must be designed to provide a sufficient amount of uncontaminated air to enable the crew members to perform their duties without undue discomfort or fatigue and to provide reasonable passenger comfort.

- (b) Crew and passenger compartment air must be free from harmful or hazardous concentrations of gases or vapours.
- (c) There must be provisions made to ensure that the conditions prescribed in paragraph (b) of this section are met after reasonable probable failures or malfunctioning of the ventilating, heating, pressurisation or other systems and equipment (SRRATRC 2000, p. 2).

The legislation appears to place legal obligations on both CASA and the ATSB to ensure a safe and healthy aircraft environment, which they have not met. Both bodies have argued they have met their obligations. Why is this so?

- CASA claimed that the aircraft environment may generate discomfort, ‘The close confinement of people in a claustrophobic aluminium tube can be extremely stressful experience. Add to this the associated chemical cocktail of human odours, scented disinfectants, airline food, dry cleaning residues on seats, surface cleaning chemicals and extremes of low humidity and there is little wonder that levels of discomfort are heightened’ (Australia Senate 2000o, p. 167).

Aircraft flying may be indeed uncomfortable for many people for the above reasons however diarising of other sources of concern in this instance serves to dismiss more substantive issues such as adverse outcomes arising from oil based fumes. This neglect implies those suffering ill effects have some form of stress disorder or hypochondria if symptoms are more than simple discomfort. British Aerospace, Allied Signal and Ansett also focused their attention on less controversial aspects of cabin air (see Chapter 3). Contributing to the labelling of such people as malingerers is the claim by the Director of CASA Mick Toller, on 1 November 1999, that Australia - which has 29 BAe 146 Aircraft; 15 per cent of the world total of 206 aircraft - is the ‘only country where we have any evidence of any reports’ (Australia Senate 1999a, p. 43). However, the October 1998 edition of *The Journal of Applied Occupational and Environmental Hygiene* specifically dealt with oil contamination of cabin air in Canada on BAe 146 aircraft operated by AirBC (van Netten 1998). In a survey of five aircraft, 112 out of 200 flight crew had symptoms over a four-month period (van Netten 1998, p. 735). This

tactic of constructing people as malingerers only found in one country, hence as novel, is more grounded in political gamesmanship than a proactive response. Such victim blaming strategies have also been attempted with people with other controversial injuries/illnesses such as Repetitive Strain Injury (Bammer and Martin 1988, p. 351). In addition, discussing aircraft in general does not explain why the BAe 146 has the highest number of people internationally that experience ‘discomfort’.

- CASA claimed ‘at no time was tricresylphosphate ever identified in any sample gathered in an Australian aircraft’ (Australia Senate 2000o, p. 167).

This statement is incorrect as testing by the Australian Department of Defence in 1988 found tricresyl phosphate (TCP) in air filter bags on Hercules aircraft (Kelso, Charlesworth et al. 1988, p. 10). It is also incorrect regarding BAe 146 aircraft as a scientific study carried out by George Lee from Scientific Services identified TCP when conducting a pack burn³² on board an aircraft. Lee had sent a letter to David Lewis the Medical Director of Ansett outlining his findings on 15 December 1997 (Lee 1999). Lee also mentions that he liaised with CASA to obtain permission for his equipment to be used on board Australian aircraft. Thus it seems incongruous that CASA was unaware of the report’s findings. Captain Les Carver, President of the AFAP, and Lesley Williams, a former Flight Attendant, were sceptical of CASA’s claimed ignorance of the Lee report (Australia Senate 2000m, p. 76). Williams wondered what knowledge CASA had of TCP being detected outside Australia given their initial denial (Australia Senate 2000t, p. 225).

CASA’s close links to aircraft operators is evident in arguments concerning TCP. On two occasions Lewis denied to the Senate Inquiry, on 2 November 1999, that TCP had been detected in the aircraft cabin air (Australia Senate 1999b, p. 62, 67). Carver found Lewis’ claim ‘extraordinary’ given the awareness Lewis had of Lee’s report (Australia Senate 2000m, p. 76). Lewis, when questioned about the toxicity of TCP, argued that total cabin air is changed in less than four minutes resulting in a ‘very low’ purge time if TCP entered the cabin environment (Australia Senate 1999b, p. 67). This assumes that air contamination can be immediately identified and isolated which recent history of the

³² A pack burn is the heating up of air flowing through air-conditioning ducts to burn out contaminants.

BAe 146 has demonstrated was not always the case with pilots not realising air has been contaminated until affected (see BASI 1999). Ongoing low level fume contamination from small leaks and contaminated ducting persists even though it may not immediately generate visible or physical reactions.

Lewis makes a number of insupportable claims regarding cabin air safety. He argues that mechanical damage would be greater than the impact on people. He asserts ‘if the contamination did happen, you would need a lot of oil and that would affect the engines more than the people’ (Australia Senate 1999b, p. 67). While this response attempts to remove jet oil from the equation, it fails to consider the large numbers of people that have suffered ill health. When queried about people’s susceptibility, Lewis isolates them by emphasising their subjective³³ assessments via smell: ‘Again, I must repeat, it is individual susceptibility to smell, not to a chemical’ (Australia Senate 1999b, p. 67). This is a calculated attempt to remove jet oil from consideration and marginalise suggestions of a linkage between adverse health outcomes and exposure to jet oil and its by products in cabin air. Dismissing jet oil as a causative mechanism was a tactic also adopted by British Aerospace, Allied Signal and Mobil (see Chapter 3 and 4).

On 1 May 2000, during questioning before the Senate Inquiry Lewis was confronted with a report from a fellow member of the Ansett Odour Committee, George Sleigh. The report found TCP was detected in small quantities. Lewis attempted to downplay the situation, stating:

That is right. When you took it back, there was an unmeasurable blip where the TCP group occurs. When it was analysed further and further - it would have been meta TCP, which is virtually non-toxic anyway - it was not measurable, it was just a little hiccup on the graph. Professor George Sleigh has written a summary to that effect. We are talking about equipment that can measure molecules, and when they finally enlarged and enlarged the test thing it was meta TCP, not ortho and not the others, and it is supposed to be non-toxic. We have never had a positive TCP ever (Australia Senate 2000a, p. 260).

³³ See Chapter 3 for a discussion on subjective and objective terminology regarding aircraft cabin contamination.

The final report of the Senate Inquiry noted Lewis' statement contradicted his denial that no form of TCP had been detected (SRRATRC 2000, p.76). Yet despite the admission, Lewis continues to deny a positive TCP test based on his reinterpretation of what constitutes a TCP report.

The reinterpretation of TCP detection by Ansett goes beyond mere linguistic juggling to influencing 'external' experts and selective interpretation of results. Lee was apparently instructed by Ansett to lower the test temperature of pack burns following the detection of a low level of TCP (Lee 1999). Following this he no longer detected TCP. Yet Ansett had used Lee amongst other external experts to assert their commitment to quality research and test methods. Other external experts brought in by Ansett included Professor Vlad Vasak, Richard Fox of Allied Signal (see Chapter 3 for a review of these studies), Dr Rob Liddell, a former CASA medical director, and Professor Western of Monash University. Ansett stated that, 'All of them concluded that the aircraft is well within safety standards and that there is no serious health hazards associated with exposure to BAe 146 cabin air' (Australia Senate 1999b, pp. 53-54). Ansett appears to have a significant role in setting assessment criteria as well as arriving at conclusions of such assessments. Thus CASA's acceptance of such science suggests a convergence of regulatory and industry interests.

- CASA claimed that 'The cabin environment in the BAe 146 aircraft is as chemically clean, if not cleaner, than other transport aircraft in service today' (Australia Senate 2000o, p. 167).

When queried about this statement by the Senate Committee on 1 November 1999 David Villers, Airworthiness Engineer at CASA, stated that the information used was based on a number of studies done on behalf of Ansett (Australia Senate 1999a, p. 38). Villers' statement is very similar to the conclusions of the Allied Signal study that was undertaken in conjunction with Ansett and also represents the position of British Aerospace.³⁴ Qantas also argued that 'all tests' indicated that cabin air quality was safe in aircraft it has responsibility for (Australia Senate 2000b, p. 126). Villers mentioned that the chemicals found are 'standard chemicals' such as dry-cleaning fluids and deodorants, pointing out their commonality to all aircraft, adding that, 'There is nothing

³⁴ Chapter 3 evaluates the Allied Signal study and addresses the selectivity and neglect of health and safety concerns.

special about the 146 in this regard. There is nothing that I am aware of that would indicate that we have other than the same atmosphere in the 146 as we have in any other transport category aircraft' (Australia Senate 1999a, p. 38-39). The only qualification is acknowledgement that some cabin areas have poor ventilation, associated with carbon dioxide and stagnant air, although these are in the process of being modified by Australian operators. CASA narrowed the focus to low levels of standard chemicals and stagnant air, thus circumscribing solutions to increasing circulation patterns and avoiding the issue of oil contamination of the cabin environment.

The basis of CASA's assessment rests on and mirrors industry assessments, which includes problem identification and solutions, and in spite of deficiencies in the analysis suggests a strong self-regulatory position and neglect of a considered approach to the evaluation of cabin fumes. On 13 March 2000 the head of CASA, Mick Toller, belatedly admitted to the Senate Committee that the BAe 146 engines 'certainly do seem to suffer more oil leaks than others' and that both CASA and the ATSB had a number of records 'which would appear to be attributable to faults within engines that can be easily detected' (Australia Senate 2000e, p. 181). This contradicts CASA's earlier claims and consequently undermines their justification for minimal regulatory intervention.

The Air Quality Standard that Never Was

- CASA claimed that the aircraft met design standards when initially introduced and in operation they continue to 'meet the latest standards for conditioned air quality' and while the 'environmental control systems are complex, their design is governed by international accepted standards, and the systems are subject to rigorous design approval process' (Australia Senate 2000o, pp. 166-167). Moreover, 'In terms of national standards for offices and workplaces, these aircraft are far cleaner (less contaminated) than their earthbound counterparts' (Australia Senate 2000o, p. 168).

The large number of health problems reported by aircraft crew on board BAe-146 aircraft in Australia compared to other aircraft suggests problems with the analysis and results, and with the appropriateness and interpretation of the 'latest', 'national' and 'international' standards. The Senate report on the BAe 146 contained thirty pages

summarising fume symptoms of people from August 1992 to February 1998 (2000, pp. 121-150). The Flight Attendants' Association of Australia (FAAA) provided this information not the regulators, manufacturers or operators (Australia Senate 2000q). This demarcation of interests was indicative of the Inquiry as a whole as such health information came largely from unions, concerned researchers and aircraft crew.

The first two of the 309 entries provide some insight into the health problems faced by the crew; symptoms on the 5 August 1992 were identified as 'Shortness of breath, palpitations, need O₂ [oxygen]' and on the 24 December 1993 symptoms included 'Vomiting, light-headedness, headache, faintness, breathlessness' (SRRATRC 2000, p.121). CASA has not given adequate weight to such health problems or their safety implications in their submission. Moreover, it is likely the summary in the Senate report has not captured the full extent due to under reporting by cabin crew fearful of workplace discrimination, loss of pilot's licence and also a lack of understanding of the effects of aircraft fumes (Australia Senate 2000l, pp. 25, 30).

Yet another problem with CASA's analysis is the absence of any studies carried out during significant fume events such as that occurring from a major oil seal failure. Both van Netten and Winder have pointed to the absence of testing during a major fume event (Australia Senate 2000d, p. 212; Winder 2000b).

CASA has been criticised for not adhering to its own regulations regarding cabin fumes. In response CASA has claimed that there are specific cabin air standards and that cabin air quality is cleaner than offices and factories. This is nebulous reasoning given that any work situation where people vomit, experience a loss of balance, slurred speech or require oxygen should be deemed unacceptable. When long-term illness and disability of aircraft crew are added there is even less justification for inaction.

The claimed adherence to air quality standards has also been made by operators and manufactures in the aviation industry. According to Qantas its aircraft at National Jet Systems 'meet Australian certification requirements for cabin air' which were confirmed with meetings with CASA (Australia Senate 2000p, p. 182). Both British Aerospace and Ansett had also asserted oil contamination of cabin air is within existing

standards to the Senate inquiry, in essence that BAe-146 cabin air contamination rates are equal to, as BA put it, an 'Industry Standard Level' (Australia Senate 1999b, p. 77). These claims have been disputed by the FAAA who have argued that 'such a standard does not exist' (Australia Senate 2000r, p. 189). This is also the position of Ansett Pilots Association (APA) which states that 'There is no current standard for air quality on commercial aircraft today' (quoted in Australia Senate 1999a, p 38). What do exist are various regulatory policies covering safety and health which, according to the AFAP, CASA is legally obliged to act on, but has not done so (Australia Senate 2000l, p. 31).

In spite of CASA's assertions, there are no explicit standards on cabin air quality, though the American Society for Heating, Refrigeration, Air-conditioning Engineers (ASHRAE) is in the process of developing international standards.³⁵ CASA representatives later admitted this lack of standards during questioning at the Senate Committee hearings on 1 November 1999. CASA Airworthiness Engineer David Villers when asked to present a copy of the 'international accepted standards' for commercial aircraft air quality mentioned the US Federal Aviation Regulations (FARs) section 25 and the Joint Aviation Regulations section 25. However, he said these regulations 'are limited' and 'very general' because, while they have requirements for cabin ventilation and contamination, the emphasis is on carbon monoxide, carbon dioxide and ozone in cabin air (Australia Senate 1999a, pp. 38-39). Villers then stated:

Perhaps an important section is a statement under section 25.831 of FAR 25, which says that:

Crew and passenger compartment air must be free from harmful or hazardous concentrations of gasses and vapours.

That is the only statement that is in there at present. What constitutes 'harmful' or 'hazardous' is left up to other standards, and generally they are getting into the health standards (Australia Senate 1999a, p. 38).

Villers admitted that 'there are no worldwide standards for air quality in aircraft' and pointed to the ASHRAE who were in the process of research, but he was not aware of their attempts to develop new standards (Australia Senate 1999a, p. 39).

³⁵ Research is currently being undertaken by ASHRAE to develop a standard SPC 161 for air quality in transport Janczewski, J. N. (1999). "IAQ on Passenger Planes." *ASHRAE Journal*(September): 18-22, Pierce, M. W., J. N. Janczewski, B. Roethlisberger and M. G. Janczewski (1999). "Air Quality On Commercial Aircraft." *ASHRAE Journal*(September): 26-34.

Villers then responded to a question on the development of an air standard in Australia following from the work of ASHRAE by arguing,

We are not in a position in Australia to enforce our own unique requirements. We have to accept what is done overseas in these regards so that we can get the aircraft and use them in Australia at a reasonable cost to the operators. We would adopt whatever comes out of the Americans and the Europeans (Australia Senate 1999a, p. 40).

Such deference and qualification are in contrast to CASA's initial submission to the Inquiry where CASA had relied more on its own integrity and authority when claiming BAe 146 compliance with air quality standards. This 'new' obligation has more than a whiff of pragmatism in side stepping regulatory intervention.

Thus we find that the initial claims of CASA, Qantas, Ansett and British Aerospace that BAe 146 cabin air meets standards regarding cabin air quality have mirage like qualities. On closer examination their construction disappears and the claims of the FAAA and APA are vindicated. The regulator and industry claims beg the question: what is the purpose of claiming compliance with cabin air standards? Two inferences can be drawn from the prior analysis; first, embedded within assertions of 'standard' compliance are claims that aircraft safety and aircraft crew/passenger safety and health are being met;³⁶ second, such claims forestall further more thorough evaluation and scrutiny of health and safety issues arising from cabin contamination. The claim of standards compliance is an attempt to establish knowledge claims that avoid pressure for more explicit goal orientated safety policy and remediation measures; so health and safety surrounding cabin fumes effectively becomes a non-issue. This in turn denies legitimacy for those people with short term and long-term health affects.

³⁶ I have separated aircraft safety and crew safety and health issues here because this is the dichotomy that CASA later uses to claim its role is limited to aircraft safety.

CASA Redefines its Role: Divide and Rule

CASA's admissions that there are no strict standards and an admission there is a regulatory obligation on CASA, as the AFAP had argued, are qualified by CASA, for example when Villers defers health related issues to other authorities (Australia Senate 1999a, p. 38). Here CASA is engaging in boundary work around its knowledge claims and regulatory obligations. While initially claiming authority to pass judgement both on aircraft safety and aircraft crew/passenger health and safety issues CASA officials are now attempting to extricate themselves from the latter.

CASA's new position was clarified during a Senate Committee hearing of 13 March 2000. Mick Toller when questioned about CASA's regulatory obligations with respect to the disorientating effects of cabin fumes on pilots stated:

The simple answer there is that at our level we do not know. We suggested to you last time that, to a certain extent - I think this is still true - this is an occupational health and safety issue. We are an aviation safety regulator. That is not meant to show in any way that we are not tracking the situation, aware of the situation, or concerned about the situation. But it sits well outside the standard expertise of the aviation regulator who is concerned about what are, effectively, the short-term to medium-term effects on aviation safety (Australia Senate 2000e, p. 182).

Responding 'we do not know' and being 'outside the standard expertise' is a significant departure from previous claims, based on aircraft industry research, for example that the aircraft are 'chemically clean'.

The mounting evidence before the Committee on cabin fumes resulted in Toller being asked what would cause a re-evaluation of CASA's position. He stated that it would be higher incidents of visible type fumes arising from leaking oil seals and other such events, and a higher level of incidents of those fumes that 'cannot be attributed to something simple' (Australia Senate 2000e, pp. 181-182). Thus ongoing fume incidents, providing they do not *increase* (whatever that means given CASA's flexible interpretations) are apparently deemed normal and not subject to intervention.

Toller's division of major and minor incidents is then reduced further into respectively those with a causative mechanism and those with a non-causative mechanism.

It is not when you switch off the air bleed from this engine or when you switch off that particular pack, then you have solved the problem. It is the more general one of people genuinely saying that they have felt ill over a period of time, with no apparent cause. If you have no apparent cause, it is obviously very difficult to take action (Australia Senate 2000e, p. 183).

Thus, in spite of CASA's claim not to have the expertise, they have effectively divided those who experience adverse effects from fume incidents into legitimate and illegitimate. That is, those who suffer *immediate, short term* health effects that arise from *identifiable* major fume leaks are now viewed as legitimate - in contrast to CASA's initial submission - while those people who suffer *delayed, long term* health effects '*with no apparent cause*', such as those with MCS, are illegitimate.

CASA has thus embraced divide and rule tactics. No longer able to dismiss health effects arising from cabin fumes as a whole, there is a division between acceptable and non-acceptable illness. The irony is that, having accepted or recognised health effects, CASA still does not believe any further action is necessary, and that the self regulatory and modest process of modifications on the BAe 146 by the airlines are sufficient.

Australian Transport Safety Bureau: From Temporary Advocate to Apologist

The exception to CASA's minimalist position on the cabin fume controversy would appear to be a major accident that results in loss of property or life. Flight incidents where there is a potential threat to life and property do not appear to be covered. This is at odds to its regulatory obligations and adherence to the Reason model. This is further evidenced in not only CASA's disregard to its obligations and support for industry self-regulation on the issue but opposition to the ATSB recommendations in the incident report about two pilots overcome by fumes.

This occurrence brief called for CASA and the aircraft manufacturer British Aerospace to conduct a joint investigation into cabin fumes in the BAe 146 (BASI 1999). Given CASA's opposition to the recommendations, there is little motivation for British Aerospace to re-evaluate its position. According to the ATSB (Australia Senate 1999a, p. 24) it has no power to make either party adopt recommendations, which also means there is little pressure on the airlines operating BAe 146 aircraft. The ATSB does have more discretionary powers than it has claimed but has largely chosen not to pursue these. This is examined below. Thus it appears both CASA and the ATSB are unable to meet problems with flight safety and aircraft crew health and safety surrounding the BAe 146 aircraft.

The ATSB has more limited intervention powers compared to CASA because it is specifically concerned with safety investigations and not the broader regulatory responsibilities required of CASA. The ATSB acts following an occurrence involving air safety, which necessitates formal reporting of an occurrence prior to commencing an investigation. According to Carol Boughton, director of safety investigations at the ATSB, there is provision for initiating an investigation providing there is an issue affecting safety of the aircraft. The health of aircraft crew and passengers is not an issue per se. Only when health has an impact on the safety of the aircraft is there scope for involvement (Australia Senate 1999a, pp. 26-27).

The initial cabin fume BASI occurrence report based on the July 1997 incident involving Captain Kolver became one of the catalysts for the Senate Inquiry (BASI 1999). The report linked this incident with oil contamination and an ongoing history of oil fume contamination of BAe 146 Aircraft and the health of aircraft crew. This was the strongest formal recognition by an Australian government authority up to this time of the flight safety and aircraft crew health and safety risk posed by oil fumes entering cabin air.

Aware of other fume incidents relating to the BAe 146 the ATSB apparently chose not to assign these a high priority. There were 12 reported BAe 146 aircraft incidents involving 'the general description of smoke, fumes or fire' between January 1991 and 1

November 1999 (Australia Senate 1999a, p. 21). The ATSB however lacked the detailed information to determine whether these, apart from the 1999 report of the July 1997 incident, were related to fume incidents arising from oil. This lack of detail concerning previous incidents and a downplaying of ongoing fume occurrences suggests the 1999 report may be a one off in terms of a strong stance by the ATSB. This in turn appears to indicate that the role of the safety investigator is being constrained by internal and external political and economic pressures.

The ATSB's role in minimising health and safety problems is evident in its assessment practices, which devolve responsibility to industry to self regulate. The ATSB assessment process is, at least in part, conducted by the aircraft operators rather than ATSB inspectors, which suggests a potential conflict of interest particularly where 'nothing' is found when cabin crew complain of adverse health affects of cabin fumes. As Brett Leyshon of the ASTB stated:

Those occurrences could be as simple as the spillage of food in a galley causing a fire to failure of an electronic component causing fumes to this particular occurrence - that is, the ingress of fumes from a failed seal within an engine - to multiple reports of 'nothing found' on investigation by the operator (Australia Senate 1999a, p. 25).

Reports to the ATSB can be submitted from a range of people and groups, according to the legislation, and include aircraft operators and owners and the crew of aircraft (Australia Senate 2000e, p. 197). Despite significant evidence of fume incidents before the Senate Inquiry these were not leading to the generation of a large number of reports. When questioned by Senators about the steps the ATSB was taking to encourage and protect employees reporting incidents the ATSB did not offer any new measures other than advocating the use of existing Confidential Air Incident Reports (CAIR). A flaw in confidential reporting, pointed out by Senator O'Brien, was that reporters may still be identified particularly when the crew is small. This is the case for the BAe 146 compared to other larger aircraft and if the plane is a transport plane the general crew complement is just two pilots. Brett Leyshon, of the ATSB, conceded this was possible but did not address the problem of confidentiality of CAIR reporting (Australia Senate 1999a, pp. 23-24).

The ATSB's failure to acknowledge weaknesses in the CAIR appears to be an attempt at deflecting attention away from taking further action regarding the BAe 146. After all BASI acknowledged limitations of the CAIR reporting system as far back as 1992 noting that a full investigation often could not take place without disclosing the reporter's identity (Wilson 1992, p. 24). Moreover, BASI acknowledged that while the number of accidents remained constant, incidents declined in comparison. The ratio of incidents to accidents reported 'decreased from 18:1 to 12:1 between 1985 and 1990 and is trending downwards towards 10:1'. Terry Wilson, a BASI Acting Manager Investigation Branch, believed this was not due to a decrease in the number of incidents but to a decrease in the number reported (Wilson 1992, p. 24). Clearly the ongoing limited reporting results in a failure to provide the necessary information to flag safety problems. The restructured ATSB apparently does not wish to acknowledge or to take more proactive measures to address this issue, which suggests a significant failure on its part. Moreover, this is a systemic rather than one off problem with BAe 146 aircraft so the issue is not solely dependent on confidential reporting but broader research and initiatives.

Between 1 November 1999 and the hearings on the 13 March 2000 three more fume occurrences on the BAe 146 were reported to the ATSB (Australia Senate 2000e, p. 193). One of these was a major engine failure and another was from Captain Frank Kolver. Fume incidents have continued to occur though the publication of Occurrence Briefs has been slow. One incident occurring on 30 April 2000 and published on the 20 November that year documented that a co-pilot and flight attendant became nauseous and developed headaches, to the extent that the co-pilot was forced to resort to oxygen (ATSB 2000). A previous crew on the same plane had also experienced contamination of the No 2 air-conditioning pack but the problem had not been rectified when the next crew took over and the plane was allowed to continue flying. The crew on the return flight said the contamination was lessened when the No 2 pack was switched off. When inspection did occur the maintenance personnel were not able to 'find any evidence of contamination' but subsequent replacement of the auxiliary power unit appeared to rectify the situation according to the co-pilot (ATSB 2000).

Comparing the Occurrence Briefs of 30 April (ATSB 2000) incident and the 10 July 1997 incident (BASI 1999), a decline in the concern the ATSB attaches to such incidents is revealed. The latter exhibits a marked brevity and an absence of concern for the safety and health of the flight crew and flying public. There were no recommendations as in the previous report despite both incidents affecting the flight crews' ability to carry out their duties in a competent manner. The earlier Brief classed the injury level as 'minor'. The April Brief classed the injury level as 'none' in spite of the similar nature of the symptoms suffered by the pilots during both incidents. In contrast to the earlier Brief there was no analysis of the ongoing safety and health problems, long-term exposure implications to crew and passengers or even a general reference to these problems with BAe 146 planes. The ATSB consequently has backed away from the safety and health concerns it had previously felt justified to raise. Thus the organisation appears more like a detached observer and documenter of industry measures and failures than an investigator. Such an approach also reflects poorly on its own investigative practices.

Throughout the Senate Inquiry the ATSB sought to absolve itself from investigative responsibility by placing reporting responsibility onto airline operators and airline employees. Carol Boughton, the Director of Safety Investigations at the ATSB, when asked whether the action the ATSB had taken to date was appropriate, given the airline's reporting system detailing crew illnesses (Australia Senate 2000e, p. 199), turned aside this question by simply referring to legislative requirements on the operator to report to the ATSB when there is 'any occurrence which is considered to have an impact on safety of flight' (Australia Senate 2000e, p 199). She added,

We can only go on their judgement. The operator has made the judgement that this was not of sufficient importance to report to us (Australia Senate 2000e, p 199).

Safety here is narrowly defined and subject to the operator's discretion. This is clearly a curious statement for an authority charged with investigating aircraft incidents, accidents, promoting safety and ultimately fostering preventive measures.

Subsequently Senator Forshaw pressed the issue, asking what would be the response of the ATSB if it were made aware of reports already made to a company when the company had not reported to the ATSB (Australia Senate 2000e, p 199). In this instance Leyshon deflected the question away from the ATSB and the aircraft industry and onto the aircrew:

The obligation under the act also extends to the crew member. If the crew member believes that the report submitted to the company may not have been forwarded on, the obligation is still on them to use an appropriate forum outside the company to report it to us. If they are worried about confidentiality, we have the confidential aviation incident reporting system where confidentiality can be maintained (Australia Senate 2000e, p 199).

The ATSB offers the existence of a confidential reporting system as a mantra-like claim but this is poor justification for regulatory inactivity. While lacking in powers to implement recommendations it has significant investigative powers that have not been pursued with the BAe-146 aircraft. The ATSB is covered by the Air Navigation Act 1920, Part 2A. According to the ATSB:

Section 19CA of the ACT states that the object of an investigation is to determine the circumstances surrounding any accident, serious incident, incident or safety deficiency to prevent the occurrence of other similar events. The results of these determinations form the basis for safety recommendations and advisory notices, statistical analyses, research, safety studies and ultimately accident preventions programs. As with equivalent overseas organisations, the ATSB has no power to implement its recommendations (ATSB 2001b, p. ii).

The unsustainable claims of the ATSB in light of the above legislative requirements suggest rationalisations are best understood in terms of its political interests. The ATSB on this issue now appears more closely aligned with CASA and the airline industry than previously. CASA had after all attempted an informal arrangement - which is discussed below - with ATSB to downplay, without success, the 10 July 1997 incident prior to its publication.

The political rather than legislative imperative behind this regulatory inaction is demonstrated by a later incident. Despite ATSB claims to the contrary they are able to take more significant action in pursuing safety and health issues. The ATSB can even investigate CASA's regulatory failings. For example, following Ansett's failure to carry out safety checks on Boeing 767-200s CASA ordered an investigation focusing on Ansett and Boeing's failure to carry out defect inspections after 25 000 flights (Connolly 2000, p. 3). The ATSB launched an inquiry into the manufacturer and operator as well as the role of CASA in this safety failure, in particular assessing CASA's practices in its role of ensuring airlines meet compliance regulations (ATSB 2001d).

Thus contrary to previous claims, ATSB has powers to take a pro-active position on safety and critically assess CASA, manufacturers and operators rather than simply relying on their assessment and definition of a safety risk. In light of the ATSB response to the ongoing problems with the BAe 146, their position appears ad hoc and reliant more on political motivations than safety and health concerns. The ATSB, like CASA, has attempted to construct cabin fumes as a non-issue.

The ATSB and CASA: The Struggle over Health and Safety

The ATSB appears to have a broader conception of safety and health than CASA regarding cabin contamination. Still the ATSB, as discussed, has increasingly embraced CASA's position on cabin fumes. Prior to this convergence in outlook between the regulators, BASI/ATSB resisted considerable pressure from CASA. This is evident in the correspondence between the two concerning the report on cabin fumes based on the 10 July 1997 incident involving Captain Kolver. In a letter from CASA to ATSB dated 3 June 1999 (Smith 1999), regarding the preliminary report on this incident, CASA made ill-informed claims in blaming the crew of the plane and declaring cabin fume contamination was safe. This was aimed at forcing ATSB to change its critical assessment of this safety incident and the wider flight safety and OHS issues identified in the final Occurrence Brief report (BASI 1999). There were three key problems with CASA's response to the Occurrence Brief.

First, CASA claimed the crew, principally Captain Kolver, failed to comply with a ‘no use notification’ because ‘faulty components which allowed fumes to enter the cockpit had been identified prior to the incident, and correctly recorded in the aircraft’s documentation as not to be used’. CASA went on to claim BASI/ATSB failed to comment on this ‘restriction’ adding that ‘CASA has conducted considerable work on this subject since this incident, often in conjunction with your staff. To provide a complete picture of the issue, the report should note that work’ (Smith 1999). No mention was made in this letter of any responsibility on the part of the manufacturers or operator, National Jet Systems, for this contamination.

Following the BASI/ATSB rejection of these claims, Mick Toller, the Director of CASA, admitted to the Senate Inquiry that CASA was relying on ‘hearsay evidence’ and there was ‘no actual crew restriction on operation’ (Australia Senate 1999a, p. 40). The problem was classed as a ‘deferred defect’, which was signed off by an engineer and stated ‘Repair at the company convenience’. Repair at the company convenience, according to Toller, means that the company did not view this as ‘sufficiently serious to require immediate repair’ (Australia Senate 1999a, p. 41). CASA’s unfounded victim blaming is compounded by a picture of the regulator as prepared to go to great lengths to protect the airline industry by avoiding the attribution of any blame for the condition of the aircraft to either manufacturers or operator. Research into this incident on CASA’s part also appears bizarre given the tragic impact such neglect has on flight safety and aircraft crew and passenger health and safety.

Second, in the letter CASA claimed, ‘In trials to measure contamination from a failed seal, a seal was removed and the engine run - no harmful fumes passed into the cabin’ (Smith 1999), but CASA now claims that it no longer feels qualified to adjudicate on what constitutes harmful. Therefore it begs the question: should CASA’s previous claims regarding no health harm be dismissed retrospectively given its modified position? This inability to adjudicate issues of harm, and such poor and obviously partisan research practices, raises concerns about the role of this regulator.

Third, in spite of requests by ATSB, CASA did not supply information regarding its claims but sought a meeting prior to the issuing of the final report. CASA also rejected

ATSB's call for it to further investigate the engines with the manufacturer, claiming this had already occurred (Smith 1999). Given cabin fumes are an ongoing issue the measures adopted are clearly unsatisfactory. These instances suggest CASA was attempting a less formal process to limit the report's conclusions and recommendations. Since the ATSB failed to receive any reports from CASA it went ahead and published the report without meeting.

ATSB Mirroring CASA on Crew Health and Safety

ATSB acknowledged, in contrast to CASA, that incapacitation of aircraft crew due to oil fumes was an issue of aviation safety. ATSB also acknowledged that long-term exposure of aircraft crew and passengers to fumes needed to be examined. The key co-ordinating authority to address both of these was, according to the ATSB, CASA (BASI 1999). The implication was that both incapacitation and long term health problems posed both a flight safety and a health problem. Particularly when this report documented 'more disabling reactions' that included 'dizziness, balance problems, extreme tiredness, extreme reaction to all oil-base products (including plastics and cosmetics), feelings of intoxication, slurred speech [and] inability to walk straight' (BASI 1999). This position was to change during the course of the Senate Inquiry. ATSB no longer viewed long-term health problems as a safety issue but argued that they still deserved to be investigated by CASA (Australia Senate 1999a, pp. 33-34). During the Senate hearing on 13 March 2000 Brett Leyshon of the ATSB stated:

The crew are not there simply to direct passengers to seats and to serve meals. They serve an important safety function throughout the flight, even a normal flight. Removing those removes a layer of safety to the passengers in the cabin (Australia Senate 2000e, p. 197).

However, the issue of health was qualified into immediate and long term, the immediate safety of flight, where you jeopardise crew - and I use 'crew' in the general term of cabin and cockpit crew - and then there were the longer - term exposure problems in the workplace. As has been said, this is a problem everyone now acknowledges. There is a long-term occupational problem (Australia Senate 2000e, p. 198).

The problem with long-term health, according to ATSB, is the lack of federal regulation because while aircraft crew would be covered by a particular state's OHS legislation there is insufficient linkage between states. ATSB now suggests that these types of OHS issues are more appropriately addressed by state OH&S agencies because they are not part of their charter (Australia Senate 2000e, p. 198).

Closer scrutiny by OHS agencies is a worthy suggestion however it does not follow that long-term health issues are not a safety problem. If crew are not 'incapacitated' but are working on aircraft with long term health problems that include feelings of intoxication, dizziness and balance problems this is clearly a safety issue. While these symptoms are not recognised as a safety issue by ATSB for cabin fumes exposure they would be recognised if they were self inflicted, for example if aircraft crew consumed alcohol or drugs that resulted in such effects.

This division of health into short and long-term has a marked similarity to the previously discussed approach used by CASA to avoid obligation. This convergence of viewpoints between these two bodies is in contrast to the earlier position of the ATSB. This alignment of interests suggests political change within ATSB on the BAe 146 issue.

Similar to the CASA's OHS position, ATSB has now sought to individualise a systemic problem with the aircraft and its regulation. Boughton claims that ATSB 'cannot make that judgement' between an OHS issue and a flight safety issue in the case of aircraft crew incapacitation (Australia Senate 2000e, p. 198). The responsibility, according to Boughton, rests with the crew to report problems to ATSB, and this side steps ATSB's own flight safety responsibilities to investigate and study 'the aviation system to identify underlying factors and trends that have the potential to adversely affect safety' (ATSB 2001b, p. ii).

Reports have nonetheless been made. The ATSB Occurrence Brief based on the 10 June 1997 incident (BASI 1999) provides at the minimum a trigger for a more comprehensive investigation. However, the ATSB obligation has conveniently been replaced by a practice of 'shoot the messenger', joining the CASA team against aircraft

crew and passengers. It also negates the proactive aims of the Reason model that both the ATSB and CASA have claimed to subscribe to.

Tombstone Regulation: Employees and their Institutions

On 16 September 1999, Mick Toller in a letter to the Senate Rural and Regional Affairs and Transport References Committee addressing the cabin fume issue stated CASA does ‘not propose to introduce any additional requirements for BAe 146 environmental control systems’ and that it was satisfied with the research undertaken by Qantas and Ansett regarding the cabin fume problem (Australia Senate 2000o, p. 164). CASA has adhered to this position even though it did subsequently acknowledge ‘legitimate’ short-term health affects. The ATSB has also taken a similarly conservative stance. Institutional interests of these bodies have shifted as a response to external pressures such as the Senate Inquiry. Internal pressures by some regulatory employees are also evident and indicate divergent interests within these institutions.

Information has been previously brought to the attention of CASA by their staff but ‘evidence’ is a problematic concept for a regulator that holds different views on evidence. Contamination of the cabin environment was raised by CASA staff in 1998 but CASA did not pursue the concerns raised. Richard Best who has since left CASA was a District Manager of Airworthiness when he submitted a Risk Observation Report on 13 October 1998 dealing with cabin fumes on the BAe 146 (Best 1998). Concerns raised in the report based on industry intelligence include contamination dating back to 1992, adverse effects on cabin crew viewed doubtfully by operators and manufacturers, inadequate testing and inability of personnel such as Mac Robertson of CASA and Clive Phillips of BASI ‘to have a high priority assigned to this situation’ (Best 1998). Best recommended more stringent testing using Gas Liquid Chromatography to evaluate whether the aircraft meet certification standards.

In correspondence from CASA to Best, the regulator claimed the issue had reached ‘a satisfactory ending’ and criticised his industry intelligence as arising from someone who is ‘out of date with events, or has an axe to grind’ (Villers 1998). Of particular concern were Best’s claims that regulators had not given a high priority to the situation adding that the last six months had seen a good deal of effort to improve the air quality on the

BAe 146. The six months of good effort appear inadequate given the issue dates at least from 1992 and the claims that contamination has been satisfactorily dealt with belie ongoing fume contamination of cabin air.

Clive Philips, an aircraft engineer, pilot and manager of the Melbourne office of BASI, was responsible for the Occurrence Brief based on the 10 July 1997 incident (BASI 1999). As previously discussed the report made important comments and recommendations regarding health and safety compared to previous and subsequent outputs from ATSB on the BAe 146 but it was strikingly different to that originally produced by Philips. Prior to Philips leaving BASI the report had been 25 pages, whereas after he left the report was reduced to five (Australia Senate 2000f, p. 120). The final report omitted more detailed information: a large body of information on cabin fumes that included information from other crew members and reviews of scientific studies. The diminution of the report was apparently done internally from within BASI prior to distribution to organisations such as CASA (Australia Senate 2000f, p. 121). Senators John Woodley and Winston Crane found this of concern given the report was only 25 pages to begin with (Australia Senate 2000b, pp. 120-121). This ‘Slash and burn’, as Philips put it (Australia Senate 2000f, p. 120), supports Best’s claims that regulatory authorities have not given significant attention to the cabin fumes issue.

Both Best and Phillips highlight fractures in the public face of these institutions’ knowledge claims, further casting into doubt CASA and ATSB claims of the relative safety of the BAe 146. The actions of these public interest advocates also reveal the difficulty of resisting a culture that is more closely aligned to the airline company interests. That both Best and Phillips were managers with many years experience is worrying, given the marginalisation of the issues they raised, and consequently sends a strong message to other personnel with less seniority: toe the line on the BAe 146 issue.

Another worrying issue is that the communication of information regarding regulatory failures often arises from previous employees, the reason being that current employees are fearful that whistleblowers can find themselves out of a job. Best and Phillips are two of many aviation regulatory employees that have left in recent years. Many have spoken out about the failure of these authorities to protect aircraft crew and passengers

as once high standards have been progressively eroded as a result of deregulation. CASA used to more frequently issue Airworthiness Directives to make modifications to aircraft on safety grounds compulsory. Now such directives have become far more infrequent as deregulatory policies have been incorporated by CASA. The modifications that have been undertaken on the BAe 146 have all been voluntary up until 2001 when an Airworthiness Directive was issued following two pilots of the same plane being incapacitated in the UK. One former Manager with CASA, Alan Emmerson, stated that CASA 'can now only issue Airworthiness Directives if there has actually been a problem in an aeroplane and by a problem I mean perhaps a wing falling off. Now this is what we call tombstone regulation you don't take any action to fix a problem until someone is dead' (Alan Emmerson quoted on ABC Television 2001a).

Summary

Deregulation in the aviation industry has resulted in an erosion of safety standards as the new competitive market forces have placed downward pressure on the profitability of airlines both internationally and in Australia. Within aviation debates there is an emphasis on accidents to the detriment of a more considered understanding of the less catastrophic incidents. The post-deregulation period has involved a shift from a more preventative or precautionary model to one that has a greater focus on self-regulation and consequently is a model that instead reacts to events. As has been shown, health and safety considerations by CASA and ASTB are transitory, altering to meet the various facets of the BAe 146 controversy while remaining piecemeal and ineffective.

Legislation when available is selectively used to achieve particular outcomes rather than meet the regulator's or investigator's obligations to the aircraft crew and communities. The result is a regulatory and investigation system that has devolved responsibility to airlines, allowing these government aviation bodies to claim that they have discharged their duty. Ironically this approach also disadvantages the aviation industry as in the event of a major crisis such government bodies are able to blame others including airline operators, as Ansett found out a little late to avoid its own demise. In spite of the claimed widespread adoption of the Reason model, by government aviation authorities, with its concern for 'latent factors' to inform decision making and create a safer flying environment there appears minimal evidence of its application by CASA or the ATSB

with their BAe 146 investigations. Rather economic concerns of the airline industry appear a major guide in developing responses to the cabin fume controversy.

Consideration of latent failures by regulators, operators and government bodies would appear to preclude simplistic scapegoating of aircraft crew as there is a greater emphasis on prevention rather than reaction. Unfortunately there has been a concerted effort to locate the source of the long standing problem of aircraft cabin fumes onto the aircraft crew. The following chapter will examine the findings of the Australian Senate Inquiry, and those of the UK House of Lords inquiry into cabin air quality and the US National Research Council study into cabin air quality.

Chapter 6: The Australian Senate Inquiry and the International Context

Introduction

This chapter will examine the scope and recommendations of the Australian Senate Inquiry, and the government response to the recommendations. The conclusions and recommendations of this report, *Air Safety and Cabin Air Quality in the BAe 146 Aircraft* (SRRATRC 2000), recognised the problem of cabin air contamination by oils and its health effects. Also international developments in cabin air quality will be examined, in particularly recent major inquiries from the UK and US.

The examination of UK and US inquiries is crucial to understanding how the contamination of the cabin environment by jet oils, and hydraulic fluids which is the case with MD-80 aircraft, have been dealt with internationally. What this chapter will demonstrate is a bias against a considered and proactive position on cabin contamination. This contributes to the broader aims of this thesis by highlighting the aims of various interests involved in this controversy and by so doing strengthens an analysis that suggests a systematic, though not necessarily organised, bias against health and safety issues related to cabin contamination.

Context and Scope of Report

The inquiry was the first detailed Australian government investigation into the operational and health impacts of oil fumes entering the cabins of commercial aircraft. Australia was also the first country to complete such a comprehensive inquiry and helped to encourage a number of other related inquiries. This included the broader, but less comprehensive in terms of cabin fumes, British House of Lords Report *Air Travel and Health* (HLSCST 2000) and the US Congress sponsored investigation *The Airliner Cabin Environment and the Health of Passengers and Crew* (CAQPCCA 2002). There have been previous inquiries into cabin air quality such as those undertaken in the US (see for example CACAQ 1986; Subcommittee on Aviation of the Committee on Public Works and Transportation 1994). However, these studies tended to focus on cosmic radiation, humidity, reduced ventilation, microorganisms and environmental pollutants

such as carbon monoxide, carbon dioxide, ozone and tobacco smoke with less attention given to jet oils, volatile organic compounds, and pesticides. A number of recommendations emerged from these earlier US inquiries to improve air quality but, to date, the only significant response has been to limit tobacco smoking on domestic aircraft. Other recommendations to improve cabin air quality have largely been ignored by the Federal Aviation Authority (FAA) and the US government.

The scope of the Australian Senate Inquiry report explicitly included health and safety. These are:

- the design, engineering and working operations of the air conditioning and air supply in the BAe 146 aircraft and the physical effects – both short and medium-term – on cabin crew and passengers of that system in day-to-day flying operations in Australia;
- incidents and occurrences relevant to the level of safety achieved in day-to-day flying operations of the BAe 146 in Australian conditions;
- the response by the BAe 146 aircraft manufacturer, by Australian aircraft operators, by the air industry regulators, and by air safety supervisor and investigation bodies to continuing complaints regarding cabin air quality in the BAe 146 (SRRATRC 2000, p. 97-98).

The range of the inquiry was extensive, however compromises were made in assessments and recommendations. The report acknowledged exposure to fumes resulted in short and medium term health problems however, two key areas the committee did not make explicit conclusions on was an acknowledgement of a flight safety risk posed by fumes and long term health effects, though the recommendations do argue for investigations that encompass these areas. For example recommendation four called for NOHSC to include aerotoxic syndrome within its codes to assist Workers Compensation and insurance claims and recommendation one called for the effective grounding of aircraft until repairs are carried out to prevent oil leaks, smoke and fumes. The chair of the inquiry Senator Woodley noted that a stronger position on long term

health effects of cabin fume exposure, supported by himself and others on the committee, was not possible if they wanted the increased standing a unanimous report would give (Woodley 2000). The issue of long term health effects will be examined in the following chapter.

The Committee was critical of CASA, British Aerospace and Australian airlines for not implementing the recommendations of the BASI/ATSB report. The Committee stated that the failure ‘to implement the recommendations was not justified’ (SRRATRC 2000, p. 99). Also, claims that safety of the aircraft is not an issue by these organisations are untenable according to the Committee because ‘the reported occurrences, some of which are serious, provide an argument that CASA, the manufacturer and airlines have not yet provided a satisfactory solution to this question’ (SRRATRC 2000, p. 99).

The Committee was particularly critical of CASA and its Director Mick Toller. According to the Committee Toller had made ‘mistaken’ claims when he asserted senior pilot Captain Kolver had not followed instructions by the operator National Jet Systems (see Chapter 3). The Committee found CASA’s response to oil leaks was ‘inadequate’ given the evidence of an ‘explicit link between occupational health of pilots and safety of aircraft made by BASI/ATSB, several medical professionals and some pilots’ (SRRATRC 2000, p. 99). The Committee also found that while the incidents of reports of reports of fumes had decreased over the previous three years ‘there appears no real possibility of such occurrences being eradicated totally as long as air is brought into the jet aircraft by bleeding air from the engines (SRRATRC 2000, p. 97).

Senate Recommendations

The Senate report recommendations called for a range of measures designed to improve the occupational health and safety (OHS) conditions of aircrew and passengers and the safety of the aircraft. Of the eight recommendations four specifically related to CASA, one, two, three and eight. Recommendation one called for the aircraft to be removed from flying and ‘immediately repaired’ to stop fumes, smoke or oil leaks. Those recommendations directed at CASA suggested there was and continues to be major problems with the regulator’s response to the fume issue. The aim of the Committee

was ultimately to bring these regulatory lapses to the government so that they may appropriately direct CASA and other bodies. The recommendations are:

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In addition to those recommendations aimed at CASA other recommendations sought government intervention to direct statutory authorities to fill additional gaps in developing appropriate OHS measures. Recommendation four, five and seven asked the government to respectively direct the National Occupational Health and Safety Commission (NOHSC), the National Health and Medical Research Council (NHMRC) and National Industrial Chemicals Notification and Assessment Scheme (NICNAS) to undertake appropriate reviews.

Recommendation six was a request that the government appoint a retired judicial officer to undertake a review of the long delays of employees' compensation cases. The recommendations identified gaps in existing regulatory measures and OHS practices for aircraft and provide a basis for a safer working/travelling environment for aircraft crew and passengers. Importantly recommendations also sought to provide a more comprehensive understanding of the health effects resulting from exposure and to create a process to legitimate the claims of those people who have experienced health effects that have been much contested.

The Australian government should have responded to the Senate report by February 2001, three months after the Senate Committees report was presented to parliament. Following this lapse and with ongoing fume incidents as well as media attention, a

number of politicians questioned the lack of response by government, regulators, airlines and manufacturers.

In contrast to Australia, by March 2001 the United Kingdom and Canadian authorities issued official procedural practices for flight crew faced by fumes/smoke in aircraft. The UK Civil Aviation Authority (CAA) said that the ‘first action’ in the event of fumes or smoke is for the flight crew to use oxygen and the Canadian Transport Safety Board instructed that when faced by a situation when ‘odor/smoke [sic] from an unknown source occurs, the decision to initiate a diversion and a potential emergency landing must be made quickly’ (quoted in Australia Senate 2001, p. 23311).

On the 29 March 2001 Australian Senator Woodley made a passionate plea in the Senate;

Flight crew continue to be laid off due to ill health without workers compensation and passengers are being affected...So I am here today to say to the Minister for Transport and Regional Services, John Anderson, and the Civil Aviation Safety Authority and to the airlines, ‘Shame on you. Australian people are being injured while you deny the problem and dither around.’ I call on all those responsible to take action now and to respond to the Senate report. It lays out what needs to be done. It should be done (Australia Senate 2001, pp. 23311-23312).

In February and March the following year, with still no response from the government, Robert McClelland MP placed questions on notice asking when the government will produce a response. He also asked specific questions relating to the implementation of the Senate committee’s recommendations. The response in May 2002 echoed the fullness of time speech from the television program *Yes Minister*, that is, the government claimed it was waiting so that they could consider international studies and blamed an Australian federal election for delays. But, the answers to three different questions put by McClelland were the same and did not address the substance of the questions (Australia House of Representatives 2002, pp. 2851-2853). The government did not make clear which international studies it was awaiting; two other major international studies, the British House of Lords and the US National Academy of Sciences (NAS) inquiries into cabin air, had by this time been released.

The answer to a forth question from McClelland also incorporated the same response from the government with some additions including a reference to the measures undertaken by CASA. The Minister for Transport John Anderson pointed out that CASA issued an Australian Airworthiness Directive (AD) on 3 April 2001, based on a bulletin distributed by BAE Systems. This AD according to Anderson ‘**follows recommendations from the United Kingdom...** and requires all operators to undertake inspections of oil contamination at intervals not to exceed 500 flights’ (emphasis added) (Australia House of Representatives 2002, pp. 2852).

Thus by May 2002, in spite of arguably the most thorough government inquiry in the world into jet oil contamination of the cabin environment, neither the Australian government nor CASA had taken the initiative to improve the occupational health and safety of aircraft crew and passengers on BAe 146 aircraft. Finally, on the 19 August 2002, after nearly two years, the government released its response to the eight recommendations basically comprising two measures (Australia Senate 2002a, pp. 3079-3088).

Measure 1: The Reference Group – Representative?

The first measure was the planned establishment of a Reference Group coordinated by CASA and containing representatives from Department of Transport and Regional Services, CASA, ATSB, NOHSC, Aviation Safety Forum (ASF), Qantas, National Jet Systems (NJS), Australian Federation of Air Pilots (AFAP), Flight Attendants Association of Australia (AFAA), Australian Licensed Aircraft Engineers Association and Airline Passenger Safety Association (APSA). The Group’s terms of reference is to monitor international research and developments, and work with those researchers, regulatory bodies and countries conducting research to ‘develop a harmonised view of the cabin air environment’ (Australia Senate 2002a, p. 3080; Australia Senate 2002b, pp. 6800-6801). The Group was also to finalise the Government’s response to the Recommendations of the BAe 146 Senate Report.

The Reference Group was scheduled to meet every six months and report to the Deputy Prime Minister and Minister for Transport and Regional Services after each meeting

through the CASA Chairman, Ted Anson. The costs of each organisation's involvement in the Group, including travel, are borne by the particular organisation. Secretariat support will be provided by CASA. The Terms of Reference of the Group and the ongoing meeting timetable were to be reviewed after four meetings or as requested by the Deputy Prime Minister and Minister for Transport and Regional Services. It is worth noting that while the Reference Group looks reasonably inclusive that apart from the NOHSC there is an absence of health researchers. No provision was made on the Group for NHMRC or NICNAS, which the Senate Committee had included in recommendations, or medical/occupational health professionals. Such health professionals would be in a far better position to evaluate the health of those travelling on planes and to critically examine any proposed measures to improve the cabin environment. There also appears to be limited independent community representation.

The ASF, established by the government in 2000 to provide advice to CASA, is made up of aviation industry people as well as a community representative – Hilary Caldwell the founding member of the APSA. The APSA, founded in 1998, is also included separately in the Reference Group and is therefore the only community organisation represented. The inclusion of APSA in the Reference Group is arguably more about government influence in the decision making³⁷ process rather than engaging with the community, given the APSA made no submissions to the BAe-146 Senate Inquiry and aircraft crew and passenger health advocates who did make submissions are conspicuously absent from the Reference Group with the exception of two unions, the AFAF and the AFAA.

The government response also made much of the approval by BAE Systems of Mobil Jet Oil 291 (MJO291), which uses a lower toxicity tricresyl phosphate (TCP), to be used in BAe 146 aircraft. However, it incorrectly claimed that the operators of BAe 146 aircraft have changed their oil from Mobil Jet Oil II (MJO) to MJO291 (Australia Senate 2002a). What had occurred was a trial using MJO291. This trial according to

³⁷ Another community aviation organisation, Air Safety Australia, was critical of organisations that were 'very compliant' over their support for CASA's proposal to introduce Enforceable Voluntary Undertakings. According to Air Safety Australia consultation involved a number of groups including Airline Passenger Safety Association supporting CASA's proposal but this was 'done in great secrecy, with very compliant organisations' and did not represent grass-roots pilots position on the issue Anons, (2001b). A Great Win For Air Safety Australia. <http://www.airsafety.com.au/ba10abel.htm> 2-2-05.

Drew Wagner the NOHSC representative at the first Reference Group meeting in October 2002 found MJO291 did not lubricate the seals properly. Thus MJO is still being used on aircraft while other options are explored (Borger 2003, p. 8).

Measure 2: An Airworthiness Directive – What Problem?

The second measure was CASA issuing an Australia AD on the 3 April 2001. It is difficult to view this as a government proposal given it followed from the UK CAA, as previously discussed. The government went on to state that cabin air quality is a global issue that requires an internationally accepted approach, working cooperatively with other countries to produce ‘standards that are internationally harmonised’ (Australia Senate 2002a, p. 3080). The government did offer responses to each Senate recommendation however these responses invariably led to the same two government measures or assertions that sufficient action had already been taken or assertions that there were existing mechanisms in place to deal with the recommendations. Thus the many problems identified by the Senate Inquiry are dealt with not by new standards and safety measures, but with the older tool of rhetoric.

The government essentially sought to maintain the status quo and leave CASA as the key arbiter on aircraft safety and health of aircraft crew and passengers. However, given CASA’s failure to take responsibility for crew health and safety, the government’s response serves to reinforce and legitimate CASA’s approach. This does not reflect well on either the government or CASA particularly given CASA’s inability to respond in a timely and professional manner to BAe 146 fume issues or its broader regulatory responsibilities. Though an international response to cabin fumes is important, particularly given other aircraft identified as causing cabin fumes, the government’s quest for harmony does not give sufficient weight to the BAe 146 aircraft that have many documented fume problems.

So, the government’s efforts appear to be aimed at thwarting the development of an appropriate response to cabin fumes both domestically and internationally. Had the government supported and championed the Senate’s claims domestically and internationally this would have provided a stronger impetus for the US and British governments and their respective regulators to hasten the development of appropriate

measures to deal with the threat posed by cabin fumes in BAe-146 and other aircraft. The Senate Inquiry's flight safety and health recommendations have effectively been ignored.

The Australian government's lack of sincerity on the issue of cabin fumes is illustrated by its deferring to the House of Lords Select Committee Inquiry (HLSCI) to justify not adopting Recommendation 5 of the Senate Inquiry. This recommendation was aimed at involving the NHMRC in a research program on the effect of exposure to cabin air of aircraft crew and passengers. The Australian government stated that the:

UK Committee concluded that tri ortho creysl phosphate and volatile organic compounds, which have been cited as potential causes of the symptoms complained of by cabin crew, have been found in such low levels that concerns about significant health risks are not substantiated. The Committee found no substance in any of the extreme claims about health risks from air travel (Australia Senate 2002a p. 3086).

Firstly the Senate Inquiry investigation was a more detailed examination of the issue of cabin fumes and the potential effects on aircraft crew than was the UK Select Committee. In contrast, the UK Committee was a more general inquiry into air travel and health covering a multitude of health issues including Deep Vein Thrombosis (DVT), stress, cosmic radiation and cabin air contaminants. The UK Committee acknowledges the greater depth of the Australian Senate report in this area (HLSCST 2000, par. 4.40). Secondly, the Senate Inquiry, unlike the UK Committee, specifically examined the BAe 146 aircraft that according to researchers has the highest rate of cabin fume incidents of any aircraft based on the number of reported incidents.

UK Inquiry and Government Response

Interestingly, while the HLSCI was, like the Australian Senate Inquiry, born out of increased health and safety complaints associated with cabin air, the former gave relatively little attention to oil-based cabin air contaminants. In spite of a reduced emphasis on such contaminants the UK Committee adopted a number of strategies to downplay the issue of oil leaking into the cabin air, for example claiming:

The absence of confirmed cases of tri-ortho-cresyl phosphate (TOCP) poisoning from cabin air and the very low levels of TOCP that would be found in even in the highly unlikely worst case contamination from oil leaking into the air supply lead us to conclude that concerns about significant risk to the health of airline passengers and crew are not substantiated (see par 1.72 HLSCST 2000).

The UK Committee artificially narrows cabin fume exposure to ‘confirmed cases’ of TOCP poisoning, undoubtedly knowing the difficulty in detecting this substance in cabin air or individuals during a fume event. This is compounded by the lack of research into both cabin air and passenger health over the longer term. Moreover the focus on the TOCP component ignores semi volatile organic chemicals (SVOC) and volatile organic compounds (VOC) in general and also TCP components of jet oil and the many hazardous chemicals that make them up. Mobil researchers have noted that jet oils contain substances even more toxic than TOCP (Freudenthal, Rausch et al. 1993). Also the issue of synergistic effects is omitted.

Importantly, the UK Committee noted there was no systematic health recording of flight crew and flight attendants apart from mortality data, stating that ‘there are no recorded data on crew health by which retrospective epidemiological studies could be carried out’ (HLSCST 2000, par 8.23). The Committee’s recommendations further contribute to this gap in knowledge by failing to recommend health assessments or long-term monitoring of either aircraft crew or passengers. There were no recommendations that dealt specifically with SVOC/VOC assessments in cabin air though there were general research recommendations for the Government to commission research into ‘real time monitoring of air quality and other aspects of the cabin environment’. These recommendations were targeted at establishing minimum standards for cabin ventilation and ‘extracting maximum value from available and improved medical records of aircrew concerning any long-term effects from exposure to the cabin environment’ (HLSCST 2000, par 1.43).

Although these general recommendations appear to include cabin fumes there is a reticence to address this aspect by the Committee. In spite of the claimed ‘highly

unlikely' event of cabin contamination with oil there is considerable evidence that these events have occurred hundreds of times. For example Appendix Four of the Australian Senate Report included 30 pages of documented fume events and symptoms of varying severity of aircraft crew between August 1992 and December 1999 provided by the FAAA (SRRATRC 2000, pp. 121-150). As previously discussed the ATSB had also documented cabin fumes in incident reports.

Furthermore, while the Australian Senate report gave considerable attention to the health of aircrew there is a conspicuous absence from the Select Committee report on aircrew health. This is disturbing given their knowledge of the Australia Senate Inquiry and its Report. This silence is exacerbated by the failure of the CAA, Airlines, British Air Line Pilots Association (BALPA) and Amalgamated Engineering and Electrical Union (representing flight attendants) to adequately raise aircrew health. The Committee stated that:

We received no views at all from aircrew or their representatives about medical needs for the protection and preservation of their long term health (HLSCST 2000, par 3.46).

In addition, recommendation 4 of the Select Committee stated

We were surprised at the lack of attention – by regulators, airlines, and aircrew trade unions – to the health of aircrew. We are aware that there are serious issues of medical confidentiality and job security involved. Nevertheless, we recommend that the present rules, agreements and attitudes regarding the monitoring and recording of the general health of aircrew, over and above fitness to operate, should be reconsidered urgently (HLSCST 2000, par 1.11).

In their response to the Select Committee recommendations, the British government was also critical of the lack of response to aircrew health by airlines, regulators and airline trade unions. This criticism was contained in the government response presented to the House of Lords in mid February 2001, but was omitted in the later published version on

the 26 February³⁸. A possible reason this criticism was omitted in the published government response is a realisation by the UK Government that such criticism may rebound in light of the government's role in regulating aircraft. There was also a significant amount of information available internationally and domestically to both the House of Lords Select Committee and the Government that does not allow them to avoid responsibility by seeking to blame others.

The president of BALPA Lord Clinton-Davis disagreed with the criticisms of airline trade unions by the Select Committee and the British government. He argued that BALPA was asked to keep their submission short believing key points were to be considered elsewhere, a naïve view given the vagaries of inquiries that a member of the House of Lords should be well aware of. He also stated that airline unions were strongly focused on prevention and aircrew health and was at a loss given the Australian Senate Inquiry to,

understand how the Select Committee concluded that there was no risk to passengers and crew from contamination of cabin air by toxic fumes. In that respect, the committee has misled itself. It came to that conclusion without research into what may be abnormal operating conditions, such as leaking of an oil seal (House of Lords 2001, Column 465-466).

When presenting the report to the House, the head of the Select Committee Baroness Wilcox stated without apparent irony that 'I am glad to be able to bring renewed attention to bear on an area of public health which we found to be woefully neglected' (House of Lords 2001, Column 459). This attention did not lead to any specific recommendations on cabin fumes and SVOC/VOC by the Select Committee. This absence was compounded when the UK government premised its reply stating that its 'response deals directly only with those recommendations which the report addresses to the Government or the CAA' (United Kingdom Government 2001, p. 1). Thus the UK government attempted to sidestep responsibility and did not respond to the issue of cabin fumes.

³⁸ The House of Lords Hansard of 16 February makes reference to the government response to their report and mentions the government criticism that followed recommendation four of the Select Committee recommendations House of Lords (2001). Official Hansard 16 February. The subsequent published British Government's report has omitted this criticism following recommendation four United Kingdom Government, (2001). Air travel and health: Government response to Select Committee report 1/2/04.

The UK government took up a number of recommendations and like the Select Committee report there was a focus on educating the public so that they can take responsibility for their health. Like the Australian government, the UK government established a working group, the Aviation Health Working Group. The UK government also commissioned a study called the 'Possible Effects on Health of Aircraft Cabin Environments'. A number of Select Committee recommendations, generally supported by the UK government, sought to inform and re-educate the travelling public on health information ranging from their own fitness to fly and the issue of Deep Vein Thrombosis (United Kingdom Government 2001). Traveller information and health awareness is an important issue but the issue of cabin fumes and associated health and safety problems were neglected.

Both the Select Committee report and the UK government response effectively dismissed the importance of documented international cabin fume incidents. This was in spite of the evidence of the Australian Senate Inquiry, an incident in Sweden where passengers, cabin crew and two pilots were affected, and reporting in the UK media. The UK *Independent on Sunday*, in December 1998, reported the fume incidents in Australia on BAe-146 aircraft noting that one pilot reported she felt 'as drunk as a skunk', and in the US on the McDonnell-Douglas MD-80s in which 19 former Alaska Airlines attendants were suing the Airline (Lynch and Rowe 1998). The *Independent* also discussed Aerospace Medical Research Association (AMRA) research into aircraft following complaints of US Air Force Pilots in the 1980s. The AMRA concluded that complaints were not rare and cabin air leakages posed 'a clear threat to flying safety because of acute toxic effects' (Lynch and Rowe 1998). On 19 December 1999, the *Guardian* reported ongoing fume problems in US, Canada, Australia and in Sweden. In Sweden a BAe 146 aircraft, on 12 November 1999, was affected by cabin air contamination, later confirmed to be oil fumes. The chairman of the Swedish Board of Accident Investigation said the incident was 'extremely serious' and 'The crew was affected by something in the air, but we don't know what. When the plane landed some of the passengers were like zombies and could not be woken. Fortunately the plane was

at 2,500 m. Had it been much lower we would have a major disaster on our hands' (Barnett 1999).

The House of Lords Committee and the UK government apparently chose not to place much weight on these international incidents in their assessments but they also failed to adequately consider domestic reports. The *Guardian* article had also reported on British pilots who suffered symptoms similar to farmers who have experienced organophosphate (OP) poisoning; one British pilot had been off work for several months with suspected OP poisoning (Barnett 1999). The House of Lords Committee report downplayed such media concerns noting on the first page of Chapter 1,

We have not found substance in extreme claims about health risks from air travel. A significant minority have some real fear for their health when flying, and there are those in the media and elsewhere who feed such fears. We encourage people to look at the facts set out in our Report in an open-minded way (HLSCST 2000).

This is quite a courageous statement given the Select Committees reports' lack of 'facts' relating to fume incidents. The statement also attempts to individualise a systemic problem with many aircraft to one concerning a minority of fearful people.

Interestingly the Lords Committee and government have also apparently ignored information from within the government and regulatory establishment. In the House of Commons members of the Organophosphate Group, Ian Gibson MP and Paul Tyler MP raised concerns surrounding exposure to these chemicals in cabin air. In June 2000, Tyler had read to the House of Commons part of the BALPA and the Aviation Health Institute (AHI) submissions to the House of Lords inquiry on the aircraft cabin environment. BALPA stated that they had raised the issue of cabin fumes with CAA and the DETR however both responded that this situation could be appropriately dealt with by shutting down either the affected engine or air conditioning unit. But as BALPA noted this occurs only after crew and passengers have been subject to exposure (House of Commons 2000, Column 206WH).

The AHI document noted that passengers and crew 'are being subjected to organophosphates exposure from oil seal leaks into the air conditions systems' and the

most common planes this occurs on are the Airbus 320, MD-80 and BAe 146'. The document went on to state that the UK

DETR [Department of Environment, Transport and Regions] has confirmed that the failure of oil seals occurs in one in every 22,000 flights, resulting in organophosphate exposure. At Heathrow, where there are 440,000 aircraft movements, this could effect 20 aircraft a year or some 2,000 passengers (House of Commons 2000, Column 205WH).

Tyler proceeded to list numerous cabin fume incidents internationally including the Swedish incident on the 12 November 1999. He noted that 'The Department of Health, the Department of the Environment, Transport and Regions, the Health and Safety Executive, the Environment Agency and the Civil Aviation Authority do not accept responsibility for threats to human health once an aircraft has left the ground' he added that 'the OP saga remains a chronicle of disinformation, dither and delay over many decades' (House of Commons 2000, Column 208WH).

On 5 November 2000 two pilots were affected by fumes on a BAe 146 aircraft on descent to Birmingham, as had occurred in Australia and Sweden. Following these incidents, a more measured approach to the issue developed albeit belatedly. An immediate investigation was launched by the Air Accidents Investigation Branch (AAIB), the UK equivalent of the ATSB. On the 28 December 2000, the CAA issued a Fight Operations Department Communication (FODCOM) on Incapacitation Procedures requesting operators to inform their aircrew to be aware of the possibility of toxic fumes entering the cabin air; this situation occurred in 'a number of recent incidents' in which both pilots have been affected. The FODCOM recommended the immediate donning of oxygen masks by flight crew at any sign of smoke or fumes, or incapacitation of pilots (Chapman 2000, pp. 3-4). The FODCOM noted that no procedures had been developed to cope with two pilots being affected due to the remoteness of such a possibility; apparently the Australian and Swedish incidents were not significant considerations. A number of recommendations and research flowed from the incident and the AAIB investigation including discussions between the AAIB and CAA to formulate recommendations. On 21 March 2001 CAA declared as mandatory BAE Systems Service Bulletin 21-150 that set out modifications to the BAe 146 air

conditioning system, auxiliary power unit (APU) and engines. In Australia, this became the basis of the CASA AD on the 3 April 2001.

It would undoubtedly have been too late to include the 5 November incident in the House of Lords Report *Air Travel and Health* (HLSCST 2000) released on the 15 November. The response by the Select Committee the following February suggests little had changed. On 16 February 2001, the chair of the inquiry Baroness Wilcox presented the report to parliament and addressed the government's response making two points worth noting. One was that the government's response indicated there was no urgency and many of the inquiry recommendations would be passed to an inter-departmental working group (House of Lords 2001, Column 461). This delaying strategy has much in common with the Australian government approach, although the UK government response to their inquiry was much speedier.

The second point was a paraphrasing of paragraph 1.72 (previously cited above) from the Report, with no qualification in light of the 5 November 2000 incident that Wilcox would undoubtedly have been briefed on. What was offered was just a misplaced certainty that reinforced the Report's comments on oil contamination of cabin air:

The biggest concern about gaseous contamination involved...triorthocresyl phosphate (TOCP). In concentrated form, this chemical is extremely toxic, but is found in lubricants in very small concentrations. Even in the worse case scenario of all - an engine's oil being lost into the pressurised air directed into the cabin - we did not find that safety levels would be breached. Moreover, there is no possibility of even that level of contamination catching people unawares because the air would be thick with nauseating oily vapours (House of Lords 2001, Column 462).

Again we see the narrowing of jet oils and TCP to TOCP then dismissing it as an area of concern as was done in the House of Lords Report. A claim that flight safety would not be affected by fumes entering the cabin and that people could not be caught unawares does not hold up to scrutiny in the light of previous incidents.

The failure of Wilcox's assessment is illustrated by an examination of three incidents that have received additional attention due to two or more pilots being affected. In the Australian VH-NJF BAe 146 incident on 10 July 1997 oil fumes were smelt but 'no smoke or mist was present within the cockpit' yet two of the pilots were affected (BASI 1999). In the Swedish SE-DRE BAe 146 incident on 12 November 1999 flight attendants and flight crew did not notice any smoke or fumes, but for a short period the commander noticed an odour he could not place which a flight attendant described as burnt sulphur. During the course of three-flight legs, a range of symptoms affected three of the cabin crew and two pilots. The commander was dizzy, groggy and poorly coordinated and handed controls over to the co-pilot (SHK 2001, pp. 8-9). While this report was published after the House of Lords inquiry it was widely reported in the media, discussed in parliament and preliminary reports would in all likelihood have been provided to the House of Lords Inquiry. In the UK G-JEAK BAe 146 incident of the 5 November 2000 two passengers had reported an oily/petrol smell however neither cabin crew or pilots detected anything unusual until two pilots were affected. The first officer was nauseous and had difficulty concentrating and went on to 100% oxygen and took no further part in flying the aircraft. The flight commander took over duties but he 'also felt 'light headed' and had difficulty in judging height during the ensuing approach and landing' (AAIB 2004, pp.3-4).

An examination of the CAA assessments of some of the many UK aircraft affected by fumes leaves little doubt of the seriousness of the issue. Responding to the AAIB recommendations 2000-6 and 2000-7 in May 2001 the CAA undertook a research program. Part of this research program entailed reviewing their database and categorising incidents by severity.

The UK incident on 5 November 2000 was classed according to the CAA as an 'Incapacitation' which is the highest rating, meaning the pilot is 'Unable to perform duties', see Table 1. Previous fume incidents on board aircraft included 'Partial Incapacitation' where a pilot is 'able to perform duties but with great difficulty' on BAe 146 aircraft in 1997 and 1998, and 'Impairment' that indicated a pilot is 'able to perform duties with some difficulty and/or making minor mistakes' of pilots on BAe 146 and B757 aircraft in 1997 and 1998 (AAIB 2004, pp. 12, 45). It was also noted,

‘that, in most cases, the symptoms were not severe enough to cause serious incapacitation or impairment of abilities, but were enough to reduce the efficiency of the crew. This was **still considered to be a flight safety issue**’ (emphasis added) (AAIB 2004, p. 33). The report did incorrectly argue that most incidents were classed as an ‘irritancy’. Nonetheless it is unclear whether this information was made available to the Select Committee by the CAA, if it was made available it provides a further indictment of the Committee’s assessments. If it was not, then failure rests with the CAA and the government. In either case aircraft crew and passengers have had their safety and health compromised.

It is worth noting the disingenuous and circular approach undertaken by authorities that is clearly illustrated by CAA comments in September 2000 which selectively denies the problem by misleadingly isolating CAA concern to UK registered commercial passenger aircraft then putting responsibility for safety back to not only the UK inquiry but other non-UK inquiries. In a statement to a BBC program *Costing the Earth*,

The UK Civil Aviation Authority said it had received no reports over the last five years of OP leaks on UK-registered commercial passenger aircraft. But if any evidence arose from investigations by the Swedish, Australian and UK Governments, it said it would act upon it (Kirby 2000).

This is a serious issue given the eventual CAA response was not to the numerous incidents it was aware of (see Table 1) in UK airspace but to two pilots being affected in UK airspace. Clearly the CAA acted in a similar reactive manner to its Australian counterpart.

Table 1: CAA Flight Deck Occurrences and Severity Rating

Please see print copy for Table 1

(AAIB 2004, pp. 12, 45)

³⁹ Correct to 14/11/03.

The US report from the National Research Council

In the US, as in the UK and Australia, an inquiry was set up to address the increasing number of health and safety complaints by cabin crew and public regarding cabin air quality. The US Congress, in 2000, directed the FAA to request the NRC to perform a study to evaluate cabin air quality to determine related health effects. The NRC created a new committee to oversee the inquiry, the Committee on Air Quality in Passenger Cabins of Commercial Aircraft (CAQPCCA). This process required the Committee to address toxicological and pathogen assessments; the systems responsible for cabin air and how contamination may enter; measurements of contamination in cabin air; and develop recommendations to improve cabin air quality. The focus was on general commercial aircraft rather than particular problem aircraft as the Committee viewed the health related issues as relevant to most commercial aircraft. So in scope it had similarities with the British House of Lords inquiry rather than the more focused Australian Senate Inquiry, though unlike the British inquiry it was a more rigorous study, less prone to hyperbolae. In 2002, the committee published their findings in *The Airliner Cabin Environment and the Health of Passengers and Crew* (CAQPCCA 2002).

According to the Committee another reason for the inquiry was the inadequate response by the FAA to the previous NRC recommendations from the 1986 inquiry; though the Committee appears overly generous in claiming that the FAA did ban smoking on domestic flights in the US (CAQPCCA 2002, pp 1-2, 25). The ban was pushed through by Congress, not the FAA, in two laws in 1987 and 1989 (Anons 2001a, p. 9). In reality the majority of NRC recommendations were not acted on. The only significant action was reducing carbon dioxide (CO₂) in cabin air from 30,000ppm to 5,000ppm following an urgent review request. The reduction occurred 10 years after the request.

A key recommendation of the 1986 report aimed to provide a body of information to identify a range of cabin issues over the long term.

Empirical evidence is lacking in quality and quantity for a scientific evaluation of the quality of airliner cabin air or of the probable health effects of short or long exposure to it. Standards directly applicable to commercial aircraft have not been established for cabin ventilation rates,

environmental conditions, and air contaminants, and adequate data on these factors are not available. The Committee therefore recommends that FAA establish a program for the systematic measurement, by unbiased independent groups, of the concentrations of carbon monoxide, respirable suspended particles, microbial aerosols, and ozone and the measurement of actual ventilation rates, cabin pressures, and cosmic radiation on representative sample of routine commercial flights. These findings should be subject to peer review. This would provide a basis for establishing appropriate standards if justified and for requiring regular monitoring if necessary (emphasis in original) (CACAQ 1986, pp.11-12).

Further recommendations included that the 'FAA establish a program to monitor selected health effects on airliner crews' and that the 'FAA collect these data in such a way as to permit comparison of onboard incidents with those in other settings' (emphasis in original) (CACAQ 1986, p.12) The FAA interpreted the ongoing commitment for monitoring as a one off study which was undertaken in 1987. The current Committee was at a loss given the explicit nature of the recommendations and found the FAA actions 'regrettable' (CAQPCCA 2002, p. 25).

The current Committee, upon reviewing the available information including more recent research, again stated the necessity for a surveillance program for both health and air quality monitoring. The Committee concluded that current systems for health data collection were 'woefully inadequate and do not permit any quantitative assessment of the relationship between cabin exposure and potential health effects on cabin crew or passengers' (CAQPCCA 2002, p. 250). The recommendations included monitoring those factors previously recommended from the earlier NRC report and also included engine oils, hydraulic fluids and pesticide exposure. In addition there were recommendations to record health effects and complaints from crew and passengers and to link this health data systematically with air quality monitoring data. The documenting of health effects during flight is to include both routine and non-routine conditions with the cabin crew as the primary focus for study (CAQPCCA 2002, pp. 120-121, 214, 289). This surveillance and research program was encapsulated as Recommendations

two, four, eight and nine. Recommendation ten called for Congress to appoint a lead federal agency and allocate appropriate funds to undertake the research program, adding that an independent advisory program be established to oversee and monitor research goals and ensure findings are made public (CAQPCCA 2002, pp. 7-13).

Recommendation one of the Committee called on the FAA to justify, using quantitative evidence, current and proposed Federal Aviation Regulations (FAR) for air quality, noting that if these are found inadequate they should be revised. For ventilation the operational standard should be consistent with the aircraft's design. Recommendation three stated the FAA should investigate and report on the feasibility of installing air cleaning equipment to remove particles and vapours from the air conditioning system 'on all aircraft to prevent or minimise the introduction of contaminants into the passenger cabin during ground operation, normal flight, and air-quality incidents' (CAQPCCA 2002, p. 10). Recommendation seven restated the NRC 1986 report's recommendation for the establishment of a regulation to require all passengers to be removed from an aircraft within 30 minutes of an air-conditioning break down or shut down whilst on the ground. At other times full ventilation is to be maintained whilst the plane is on the ground. Recommendation five dealt with developing responses to allergens for sensitive people. In particular it called for preventing the transport of small animals in cabins and the training of cabin crew to deal with severe reactions such as anaphylaxis and asthma attacks. Recommendation six called for the FAA and airlines, working with American Medical Association and the Aerospace Medical Association, to provide cabin crew, passengers and health professions appropriate health information related to air travel (CAQPCCA 2002, p. 10).

Narrow Criteria and Low Incident Numbers

The Committee despite recommendations dealing with cabin contamination, such as jet oils and hydraulic oils, did tend to downplay these health and safety issues. For example there is a reticence to acknowledge fume incidents that have been implicated in health and safety effects experienced by aircrew such as those documented by ATSB, the UK CAA, Swedish SHK and those recorded by Unions. The Committee appears to have dismissed many such reports due to the rather narrow criteria of their inquiry which includes a focus on cabin crew. Cabin crew have historically not had the attention flight

crew have with respect to health and safety and this inquiry has done much to help correct such omissions. However, it appears the focus on cabin crew is doing both a disservice in this instance because the exclusion of flight crew health and safety issues a large amount of cabin fume data is excluded. This is in contrast to both the Australian Senate Inquiry and the UK House of Lords Inquiry which addressed not only cabin crew and passengers but flight crew.

The rigid criteria of the US Committee are further evidenced in statements that it ‘was unable to find any objective information that would substantiate and document frank neurotoxicity in persons exposed to such mists and fumes on aircraft’ though it did go on to add ‘such a possibility cannot be a priori discounted if airborne concentrations of TCP are substantial and exposures long enough’ (CAQPCCA 2002, p. 194). What of effects on aircrew that are serious enough to affect operational ability but not deemed ‘neurotoxic’ which according to the above logic must include those incidents where flight crew have been unable to continue flying and have had to relinquish control or of cabin crew that have been unable to perform their functions? Moreover, regulatory authorities by and large document the affects on flight crew not cabin crew which further contributes to a lack of information on cabin crew. Thus claims of a lack of evidence are easier to make though harder to sustain when scrutinised more closely.

The narrow logic of the Committee is also evident in their dismissal of attempts to characterise the numbers of cabin fume contamination, or incident⁴⁰ events each year. For example, the following paragraph from the Committee publication seeks to marginalise the numbers of reported fume reports; the paragraph opens with newspaper reports and then moves to research reports. The paragraph’s closing remarks attempt to dismiss and play down the numbers of cabin fume events in particular and serves as an attempt to marginalise both journalists’ and researchers’ claims.

Over the years, newspaper reports have documented incidents in which smoke, fumes, or mists have entered a passenger cabin or cockpit
(Norton 1998, Acohido 2000, Arlidge and Clark). Many estimates have

⁴⁰ Air quality incidents are defined by the Committee ‘as events that result in the intake of potential contaminants, including engine oils and hydraulic fluids, through the environmental control system into the cabin’ CAQPCCA (2002). The Airliner Cabin Environment and the Health of Passengers and Crew. Washington D.C., National Academy Press.

been provided of the frequency of such events ranging from one in 22,000 flights (Winder 2000) to one in 1,000 flights (Hood). In testimony before an Australian Senate inquiry, Jean Christophe Balouet stated that 70 “major smoke/haze events” and 500 “severe fume events” have been estimated to occur each year worldwide (Parliament of the Commonwealth of Australia 2000). The committee was not able to verify any of the estimates (References as cited in original text) (CAQPCCA 2002, p. 111).

Later the Committee cites an article by Winder and Balouet who, ‘argue that in-cabin leaks, smoke, and fume events could expose up to 40,000 passengers and crew worldwide each year, although the committee was unable to verify the source for this assertion’ (CAQPCCA 2002, p. 236-237). This Committee took particular aim at these researchers’ claims.

The Committee acknowledges that airlines do not publish fume contamination information however it is curious the Committee, if not able to verify the particular figures, did not seek out estimates of fume incidents from regulatory authorities such as the FAA, UK CAA and ATSB, flight attendant associations and pilot associations. They seem to prefer to cast cabin contamination figures into doubt rather than document less contested numbers. After all less contested figures would perhaps have compelled stronger recommendations from the Committee.

If we examine the claim of 1 in 22,000 incidents of fume events by Winder (Winder 2000a) he cites the source as the UK CAA though does not reference this, but it should have been relatively easy for the Committee to contact the UK CAA or UK DETR to verify such a claim. As mentioned previously in the discussion of the UK inquiry, the DETR notes a 1 in 22,000 flights failure of oil seals resulting in cabin contamination confirming Winder’s acknowledgment. In addition, the UK CAA had also stated publicly that fume events occurred less than 1 in 22,000 in August 1999 (Bevan and Rogers 1999).

What of the other figures cited? The Hood figure of 1 in 1000 cites the source as van Netten, who has been analysing oil leakage data from airlines, however does not reference this (Hood 2001). The Hood article noted that incidence levels vary depending on aircraft type and maintenance practices. In the following paragraph the Committee cites research undertaken by van Netten - this appears like an eleventh hour entry by van Netten to correct the author(s) of this chapter (van Netten is a member of the Committee) - this entry confirms Hood's attribution but no mention is made that Hood's figure came from van Netten. The Committee noted, without dismissing these statistics, that van Netten's review was of three airlines over several years that documented fume incidents for particular aircraft, '3.88 per 1,000 Flight cycles for BAe 146, 1.29 per 1,000 flight cycles for the A320, 1.25 per 1,000 flight cycles for the B747, 1.04 per 1,000 flight cycles for the DC-10, 1.02 per 1000 flight cycles for the MD-80, 0.63 per 1000 flight cycles for the B767, and 0.09 per 1,000 flight cycles for the B737' (CAQPCCA 2002, p. 111).

The figures of 70 "major smoke/haze events" and 500 "severe fume events" were made in a submission to the Australian Senate Inquiry but not referenced. The admissions examined in the Jet Oil chapter of Ansett and Qantas highlight figures that would lend support to the global claims particularly when taken with fume events and symptoms recorded by the Flight Attendants Association of Australia. Ansett admitted that in 1992 1.5 per cent of flights were affected (one report every 66 flights) which fell to, in the first half of 1999, 0.625 per cent (one report every 160 flights) (Australia Senate 1999b, p. 55). Qantas admitted that in 1999 0.12 per cent of flights (one cabin air quality report every 785 flights) were affected (Australia Senate 2000b, pp. 125-126). The Flight Attendants Association documented fume events between August 1992 and December 1999; this included 80 fume events recorded in 1998 and 45 recorded in 1999 (SRRATRC 2000, pp. 131-150). Balouet and Winder's assertions appear reasonable given that the BAe 146 in Australia is one subset, albeit a particularly problematic one, of a global BAe 146 problem and this aircraft is also a subset of other aircraft types that have generated fumes such as the MD-80. However, the language used to characterise the issue is likely to remain contested.

Moving on to the claim of 40,000 people exposed each year worldwide, which was made at a presentation to the Aerospace Medical Association by Balouet, we can again examine the UK DETR figure of 1 in 22000 flights. The figure of 2000 was the number of passengers likely to be exposed each year at Heathrow based on this figure. If this was applied to 30 major airports to allow for any overlap in passengers and passenger numbers, a figure of 40,000 crew and passengers that could be exposed is quite reasonable.

Contradictions and gaps in the analysis

The Committee also appears to contradict itself when noting that ‘many cabin crews and passengers have reported incidents of smoke or odours in the cabin’ (CAQPCCA 2002, p. 5) yet table S-1 of the recommendations noted that the ‘frequency of incidents is very uncertain, but is expected to be relatively low’ (CAQPCCA 2002, p. 8). The implication is that the Committee does not place much weight on cabin crew, passenger and media reporting. As with the UK House of Lords inquiry the Committee has largely neglected the many media reports documenting cabin fume events and the safety and health hazard posed by such events.

The Committee did make particular mention of two problem aircraft, the BAe-146 with a focus on Australia and MD-80 with a focus on the US, but the discussion for both was couched narrowly in terms of problem - fume contamination - and addressing the problem - the application of an Airworthiness Directive (CAQPCCA 2002, p. 112). The Committee failed to adequately consider not only material that came to light from the Australian Senate Inquiry but incorrectly attributed the Airworthiness Directive issued in Australia for BAe 146 aircraft as an outcome of the Australia Senate Inquiry. This as noted previously came about as a result of the UK CAA issuing one.

The discussion on MD-80 aircraft incorporates an ahistorical focus that has avoided a more detailed chronology of events that would elicit a more considered approach. This is less understandable than the cursory approach given the BAe-146 given many of the MD-80 problems identified have occurred over many years in the US. In spite of the Committee’s aims to be a general examination of the study of cabin air the manner it

has drawn on material appears calculated to obscure rather than clarify the issue of cabin fumes by directing attention at other cabin issues such as ozone.

A study in 1990 by the National Institute for Occupational Health and Safety (NIOSH) is a case in point. This study was undertaken at the request of the Association for Flight attendants (AFA) to 'evaluate potential exposures to toxic gases and/or a lack of oxygen' in cabin air on board Alaskan Airlines MD-80 aircraft as a result of symptoms experienced by flight attendants that included 'headache, blurred vision, dizziness, mental confusion and numbness' (Sussell and Singal 1993, p. 1). This study examined carbon monoxide, carbon dioxide, ozone and VOC; also symptomology and medical records of flight attendants were reviewed. The study concluded that it was unable to determine the health hazard in the cabin air but importantly investigations by the NIOSH were done after procedural and material changes by Alaskan Airlines (Sussell and Singal 1993, p. 29). The symptomology of flight attendants also led to the conclusion that carbon monoxide exposure was not a cause of incidents and that 'there was no medical or flight history data to suggest that abnormally low cabin pressure, humidity, or oxygen concentration were appreciable causative factors' (Sussell and Singal 1993, p. 30). The report also dismissed ozone as a major factor because its symptomology of respiratory irritation would predominate, not the neurological and systemic symptoms evident in the flight attendants. Also respiratory symptoms would be expected to be greater at higher altitudes which did not occur. The report also concluded that the symptoms reported by the flight attendants were more like those of a US Air Force flight crew exposed to oil products. Concerning flight attendant symptoms the reported noted:

fatigue, throat discomfort, musculoskeletal pains, and eye problems were all more prevalent than dizziness among the 1330 participants. This suggests that the Alaska Airlines incident reports, at least in part, reflect unusual occurrences, not merely the recording of the most common work-related symptoms (Sussell and Singal 1993, p. 30).

The Sussell and Singal study was cited with respect to cabin air quality by the Committee but the focus was on ozone. The Committee argued that the method of ozone analysis was not sufficient to demonstrate that the testing protocol for ozone was

adequate to detect compliance with regulations (SRRATRC 2000, p. 91). This is not to dismiss ozone as a issue of worthy of concern but such a one off comment in light of the study's aims and crew health issues appears to suggest an increased technical focus on ozone standards is the best outcome for flight attendants suffering health problems on MD-80 aircraft.

Furthermore, Sussell and Singal made five recommendations. The first included a call for Alaskan Airlines to maintain a detailed log of reported incidents including time, altitude, symptoms and their duration, and exposures identified. The study also noted the appropriateness of all commercial airlines to keep such records. Other recommendations included a call for the company to continue to investigate possible causes; and for management and staff to cooperate on a joint health and safety committee (Sussell and Singal 1993, p.31). Interestingly such proactive airline operator focused recommendations are absent from the Committee recommendations, except for recommendation seven that called for a regulation for the removal of passengers on the ground if ventilation failed or was shutdown.

A 1997 study on Alaskan Airlines, undertaken by the AFA, followed up on this NIOSH study due to ongoing health complaints (Witkowski 1999). The Committee gave this study a cursory response and did not link the two reports as studies of the same airline that had continued to have cabin air problems which this later report linked to hydraulic fluid and jet oil. This in turn casts the Committee's sole focus on ozone when citing the Sussell and Singal report into an apparent attempt to down play oil leaks into the cabin environment. Moreover, the conclusions and recommendations of the Committee chapter on 'Chemical Contaminants and Their Sources' tend to deflect attention away from substantive recommendations that may prevent oil fumes entering the cabin environment. Instead the focus is on monitoring for example ozone, carbon monoxide and more research into the products that may be generated by jet oils lubricating oils and deicing fluids entering the cabin environment (CAQPCCA 2002, p. 119-221).

Certainties, Probabilities and Scientific Rigour

Interestingly, while the Committee acknowledges that laboratory experiments on jet oils and hydraulic fluids have identified TCP isomers and other compounds it believes these

types of experiments do ‘not positively identify components that would be present in bleed air as a result of equipment failures’ (CAQPCCA 2002, p. 113). Such statements suggest the Committee is attempting to identify certainties rather than a more realistic approach which would suggest probabilities, and begs the question of what would positively identify components.

The Committee applies a different standard to its own suggested models. The Committee’s final recommendations suggest a focus on real time monitoring of aircraft cabin air rather than testing of chemicals such as jet oils in a laboratory (see table S-2 in CAQPCCA 2002). The removal of laboratory experiments on toxicology of jet oils in favour of cabin air monitoring is also unlikely to yield certainties. As chapter 4 demonstrated oil assessments are an important aspect for health and safety considerations and these are dominated by oil manufacturer interests. Had laboratory research into jet oils and hydraulic fluids been recommended, as was done by the Australian Senate Inquiry, this would have provided more information on the health effects resulting from exposure. The proviso being that such recommendations were acted on.

The real time monitoring approach for oil and fluid leaks, according to the Committee, needs to include evaluation of maintenance records of problematic aircraft to identify fluid loss, service periods of oil seals, and in the cabin environment sampling of filters, monitoring of particulate matter and carbon monoxide. However, ‘the committee has not suggested sampling for volatile organic compounds or semi volatile organic compounds because no available sampling techniques are practical or feasible on aircraft’ (CAQPCCA 2002, p. 284). Due to the large number of aircraft that would be required to get a reasonable sample it was suggested that studies could focus on problem aircraft. What such a quantitative methodology will produce, particularly in the absence of laboratory research into jet oils and hydraulic oils, is not certainties nor even probabilities but a complex mix of chemicals, pathogens and possible exposures where a causative model is unlikely to be found. During a subsequent chapter on Health Surveillance the Committee was not receptive to the methodology undertaken by the AFA study on Alaskan airlines. The Committee was critical of the lack of data provided in terms of persons at risk and other benchmarks (CAQPCCA 2002, pp. 245-247).

However, the Committee's claims of increased scientific rigour are disingenuous in light of their failure to adequately consider the history of Alaskan Airlines and the Sussell report. What the Committee has done is use claims of appropriate scientific research selectively to justify attempts to downplay cabin fumes.

This approach is further evidenced in the placement of jet oils and hydraulic oils contamination of the cabin environment into a moderate concern category below cabin pressure and ozone, both placed in a high concern category (CAQPCCA 2002, p. 8). Notwithstanding the rationale offered by the committee, that while potential health effects of exposure is high 'the likelihood of exposure to them at high concentrations is believed to be low' (CAQPCCA 2002, p. 7). If flight safety and health were adequately considered in relation to oil contamination, and not marginalised by the inquiry, a higher category of concern would more likely eventuate. For example consideration of the many cabin crew and pilots that have been unable to discharge their flight duties, experienced illness and for some been unable to return to work due to permanent disability.

The widely reported problems and large numbers of people exposed to airline contamination with oils have largely been omitted from the Committee's report. The circumstances surrounding flight attendant Terri Nixon's experience is a case in point. On an MD-80 flight, on 30 June 1996, Nixon became nauseous while two other flight attendants became disorientated and went onto oxygen. Two children were also vomiting. Nixon had difficulty breathing, had a throbbing head and subsequently vomited as did two other flight attendants. Nixon noted that 'We were not in control of our thought processes' (quoted in Acohido 1999). There was no explanation for this event and Alaskan Airlines classed it as an anomaly (Acohido 1999). Alaskan Airlines acknowledged receiving 1,600 reports of crew and public illness over the past decade which it classed as 'unexplained'. Alaskan Airlines also had refused to pay crew medical bills linked to such illnesses (Acohido 1999).

Numerous unions were following these illness patterns. In 1997 Alaskan mechanics suspected jet oil and hydraulic oil leaking from the APU. A few Alaskan employees with access to the computer records system began searching for information linking

leaks and air quality problems to the APU. This information was passed onto the flight attendants union. One researcher 'noticed a correlation between reports of unexplained illnesses and repairs for fluid leaks on MD-80s'. This was supported by other documents such as an internal memo dated 28 August 1995 between engineering supervisors that noted 'hydraulic fluid leaks in the tail cone' of MD-80s 'create the potential for that fluid to directly contaminate the environmental control system or be ingested into the APU inlet and subsequently into the APU bleed air'(quoted in Acohido 1999). Meanwhile contamination continued with hospitalisation of four passengers and three flight attendants following exposure to hydraulic fluid on an Alaskan Airlines MD-80 aircraft in 1998 (Norton 1998).

Yet another failure of the Committee was not to give adequate consideration to the maintenance failures of particularly problematic airlines such as Alaskan Airlines. In 2000 the FAA undertook two separate audits of Alaskan Airlines repair facilities and threatened to shut down these facilities as a consequence of serious deficiencies identified with its maintenance practices unless practices changed (Miletich and Acohido 2000). These deficiencies included a failure by personnel at Alaskan Airlines to follow maintenance procedures and the identification of maintenance manuals with vaguely written sections. At this time Alaskan Captain David Crawley wrote a letter to the Alaskan vice president of flight operations. The pilot commented on the minimalist approach to maintenance of a MD80 aircraft. This included deferring maintenance on engines with cracks and taking off at near maximum weight levels. Also mentioned were possible problems with a particular jackscrew assembly that was also suspected in Flight 261 in which an MD-80 aircraft crashed killing 88 people on 31 January 2000 (Miletich and Acohido 2000). Crawley compared the plane he flew on 934 with Flight 261 known as 963. Crawley noted that 'As far as I know aircraft 934 is still out there flying with it's (sic) long list of deferred problems...This airplane may be a ticking time bomb Aircraft 963 was and no one know it' (quoted in Miletich and Acohido 2000). A spokesperson for Alaskan Airlines dismissed Crawley concerns. These maintenance failures may also help explain the high incidence of fume problems on Alaskan Airlines aircraft.

Often the failure of airline companies and regulators has left only legal action, for example the lawsuit in which Alaskan Airlines agreed to pay \$725,000 to 26 flight attendants affected by cabin fumes; other cases are pending against McDonnell Douglas/Boeing and Allied Signal (Miletich 2001). The impact of an accident due to pilots or flight attendants being unable to perform duties would reach beyond the individual health effects, though as previously mentioned pilots have largely been removed from the Committee study on cabin contamination. The Committee's neglect of the health problems of flight attendants also suggests they have failed this group in spite of their claimed focus.

The Committee has deflected attention away from jet oil and hydraulic fluid contamination by drawing attention to a range of other cabin issues that included cleaning fluids, pesticides, tuberculosis, airborne allergens, carbon dioxide, ozone, carbon monoxide and infectious agents. Whilst not attempting to dismiss such points as worthy of examination it appears they have been used to argue against a more proactive position with respect to jet oils and hydraulic fluids. This has included a marginalisation of health conditions such Multiple Chemical Sensitivity (MCS) and Aerotoxic Syndrome. These will be examined further in the following chapter. This pattern of deflection also has a history as noted in 1999 by Christopher Withowski, the Director of Air Safety and Health for the AFA.

Although there have been many studies of the levels of carbon dioxide, cabin humidity, air flow, and temperature in the air cabin environment, as well as several studies on the levels of potential volatile organic compounds in the cabin environment, these studies have carefully avoided considering a problem which is well understood and recognized. For over 20 years, the FAA, manufacturers and the carriers have known that hydraulic fluid and lubrication oil enter the bleed air system of aircraft and accumulate in the air-conditioning system where they can release fumes into the passenger cabin. While manufactures and carriers have established procedures for purging the bleed air systems when they become contaminated with these fluids, there has been little or no public acknowledgment that this is a possible source of air quality problems. While there has been fairly systematic consideration of these

contaminants by manufacturers, the results of these studies have not been discussed publicly nor made available to affected flight attendants and the flying public. Instead, public discussion of the problems on board aircraft is generally confined to illness spread by other passengers, and in some circles, tangential issues of comfort associated with space and lengthy study proposals for considering the effect of flight attendant uniforms on thermal comfort. While the first is an issue of some interest and the others may be, the focus on these issues serves to divert attention from the effect of known contaminants on passengers, pilots and flight attendants (1999).

According to Withowski one reason that industry has been reticent in undertaking research is because cabin fumes is virtually impossible to eliminate with the existing design of environmental control systems of aircraft (Bevan and Rogers 1999).

The FAA response to the Committee

An examination of the FAA response, prepared by the Airliner Cabin Environment Report Response Team, to key recommendations that relate to cabin contamination highlights a reticence to substantially address the issues. In response to NRC recommendation one, the FAA agreed with the NRC on the need to investigate the adequacy of current and proposed FAR related to cabin air quality including engine oil and hydraulic fluid leakages. From FAA's own investigations it noted that while 'smoke' in cockpit and cabin incident numbers were 'statistically very low ... during some events, crewmembers were impaired in the performance of their duties'. Adding that there 'have been a number of reports of foreign airline crew members having their performance impaired to the point that they had to be assisted in performing their flight duties or had to relinquish their flying duties during flight. This is a matter of great concern to FAA' (ACERRT 2002, pp. 3-5). The FAA was worried with the difference in the number of reported incidents between their National Aviation Safety Data Analysis Centre databases (NASDAC) and those reported to industry organisations, though most aviation regulatory bodies' reports are only required to be filed where an impact on aircraft safety has occurred. A review of the adequacy of FAR and improving recording of air quality incidents has been tasked to another body, the Aviation

Rulemaking Advisory Committee (ASRC). This body was to provide assessment and final recommendations by 2004. This was subsequently deferred by the FAA, in favour of a more obscure process because of ‘new initiatives to collect data on air quality’ (Jordan 2003). Clear timelines and goals tasked to the ASRC were replaced with the collection of ‘substantial data’ that will be available ‘by the close of 2006 or early 2007’ (Jordan 2003). Moreover, there was a marked increase in confidence by the FAA, as claimed by its Federal Air Surgeon, in existing standards,

Our regulatory scheme ensures that passengers and crewmembers have enough uncontaminated air to allow for reasonable comfort during normal operating conditions, protects passengers and crew from hazardous ozone, carbon monoxide, and carbon dioxide exposure, and establishes standards for pressurized compartments in transport category airplanes (Jordan 2003).

Recommendation four of the NRC, that of carbon monoxide monitoring was not accepted by the FAA. This could be used as a contaminate indicator of the presence of jet oils and be used as a warning for cabin and flight crew. The FAA response to recommendations eight and nine, respectively the surveillance and research programs, was chiefly delivered in terms of future possibilities of research (ACERRT 2002). As the Association of Flight Attendants noted there was a liberal use of qualifiers such as ‘could’, ‘should’ and ‘would’ (AFA 2003). The FAA agreed with the NRC recommendations for routine flights noting that sampling could be done on a small number of flights. The FAA response to monitoring during non-routine flights was more circumspect. The FAA did acknowledge it ‘could provide some laboratory analytical support for the ad hoc [air] sampling program’ (ACERRT 2002, p. 29). But other recommendations to examine aircraft fume incidents including examining problem aircraft, maintenance records and analysis of air filtration systems would ‘require further investigation by both government and industry to determine feasibility and potential effectiveness’ (ACERRT 2002, p. 29). The FAA also dismissed the worth of surveillance surveys and interviews stating that ‘it must be noted that while the identification of air quality incidents and air sampling may be improved by a number of methods, the health effects information from surveys and interviews will remain

primarily subjective' (ACERRT 2002, pp. 29-30). Such statements undermine the previous statements of concern regarding reported impairment of airline crew members.

A similar response was also offered to proposed research programs by the FAA and reflects their agreement with the NRC report that cabin fume incidents do not pose a flight safety or health risk. The FAA did note that 'while the [NRC] report does not identify significant flight safety issues related to the cabin environment, these too deserve future research attention' (ACERRT 2002, p. 32). The approach by the FAA suggests a clouding rather than clarification of the issue. In spite of the large body of evidence occurring over 20 years related to health and safety effects resulting from fume exposure the FAA still chooses to divert attention to 'comfort' as if this issue was new: the FAA states 'the most difficult step may be to accurately relate the cabin air quality to a given effect and to determine if the effect is health or comfort related' (ACERRT 2002, p. 32). Regarding health surveillance research into flight attendants the FAA offers a similar refrain noting that 'the researcher is faced with subjective health questionnaire data that may or may not be supported by medical information' (ACERRT 2002, p. 33).

In September 2003, the US Senate allocated US\$8,500,000 to implement the recommendation plan developed by the FAA Airliner Cabin Environment Response Team for an air quality demonstration program 'to identify, analyze, and study incidents of cabin air contamination associated with typical flight operations monitored with onboard sensors and demonstrate decontamination of aircraft by adapting proven technologies such as vapour hydrogen peroxide' (US Senate 2003, p. 28). Of the money \$3,750,000 was allocated to the Centre of Domestic Preparedness for 'testing and validating decontamination procedures and technologies' (US Senate 2003, p. 28). The US Senate also allocated an additional \$3,000,000 above the budget request for aeromedical research to meet the FAA reauthorisation bill that requires research called for by the NRC report. The Senate 'directs the [FAA] Administrator to conduct surveillance to monitor ozone on a representative number of flights; collect pesticide exposure data; analyze samples of residue from aircraft ventilation ducts and filters after air quality incidents to identify the contaminants to which passengers and crew were exposed; analyze and study cabin air pressure and altitude; and, establish an air quality

incident reporting system' (US Senate 2003, p. 39). The FAA reticence at developing substantive and proactive policies with respect to cabin air contamination with jet oil and hydraulic fluids mean such research is unlikely to yield to substantive regulatory or policy change if their response to the NRC report is any indication.

Summary

The preceding discussion has demonstrated that government inquiries into flight safety and the health of crew and passengers have systematically minimised risk from exposure to fumes entering the cabin environment from oils or hydraulic fluids. This contributes to the overall aims of this thesis in identifying the neglect and marginalisation of this issue by regulators, industry, oil manufacturers and airlines. The arguments by the Australian Senate Inquiry, and particularly the Australian Government, UK House of Lords inquiry and the US NAS inquiry (and the FAA), have been found seriously wanting. Their role in omitting unwelcome information, marginalising contrary views and constructing untenable conclusions from a considerable body of available information may be viewed as reflecting *their* biases against a more considered and proactive evaluation of the health and safety issues.

The Australian Senate Inquiry acknowledged short and medium health effects but did not acknowledge long term health effects or the effects on flight safety such as crew incapacitation. Nonetheless, it did make a number of preventative recommendations that may have, if enacted, strengthened this enquires findings. Yet, the Australian government has largely ignored these recommendations. Still the Australian Senate inquiry remains the most creditable inquiry when compared to those in the UK and US.

The UK Inquiry was a rather reactive and crude attempt to marginalise significant health and safety issues and was reliant more on rhetoric than substance as the previous discussion has demonstrated. This inquiry found no real health and safety issue and attempted to individualise a systemic problem to a psychological issue by attributing cabin fume contamination to individual fear or media generated fear. The UK inquiry like the US inquiry ignored and marginalised a significant body of research and importantly the reports of aircrew. The US inquiry used research and information

selectively to justify the marginalisation of previous research and to minimise the reporting of the large numbers of fume incidents that have occurred.

The claimed relative safety and health of flight crew, cabin crew and passengers exposed to such chemicals are spurious claims that cannot in good judgement be made in light of the above information. Numerous flight crew and cabin crew have been unable to perform their duties until after the affects of exposure diminished, often requiring removal from the plane and being taken to hospital; the UK Air Accidents Investigation Branch found there is an undeniable safety issue and the Australian Senate Inquiry noted health issues do arise from exposure albeit not long term. The following chapter will examine the debates surrounding longer term health effects which cover a range of health problems including MCS.

Chapter 7: Multiple Chemical Sensitivity and Aerotoxic Syndrome

Introduction

Cabin crew, flight crew and passengers have experienced a range of flight safety and health problems resulting from jet oil, and hydraulic fluid, entering the cabin environment. The Australian Senate Inquiry investigation acknowledged the problem and made strong recommendations to resolve many of the associated problems but both the US and UK inquiries were comparatively weaker in both problem recognition and recommendations, particularly the UK inquiry. Regulatory authorities and the airline industry have largely failed to take proactive measures and continually denied significant problems.

The absence of a substantive response has placed an increased burden on affected aircraft crew to justify and ‘prove’ their claims. To this end a number of surveys have been undertaken by union bodies and researchers to document incidents and record symptoms but there are numerous difficulties. First, many of the acute and chronic symptoms are not accepted by key stakeholders and simply classed as anecdotal. Second, even when some qualified acknowledgement is offered of acute symptoms, chronic symptoms are strenuously denied and also labelled anecdotal, minor irritations or psychological. Third, some of the chronic symptoms often fall under the condition of Multiple Chemical Sensitivity (MCS), a much contested illness not limited to fume exposure in aircraft, but associated with exposure to numerous other chemicals, particularly pesticides. Population groups susceptible to MCS include farmers exposed to pesticides and former soldiers with chemical sensitivities termed Gulf War Syndrome.

The previous chapters have demonstrated that exposure to cabin contamination by jet oils (and hydraulic fluids) poses both a flight safety risk and a health risk to those on board. This chapter contributes to the overall thesis aims by highlighting a failure to adequately deal with the cabin fume issue by the key interests in this debate. This chapter will argue that long term health problems experienced by some crew members such as MCS are legitimate and deserve to be appropriately acknowledged by the aviation industry,

regulators, many in the medical profession and government. Due to the failure of these key stakeholders to acknowledge this illness it is necessary to examine some of the influences underpinning the MCS debates.

First, I will give a brief overview of the four key medical approaches taken in response to chemical exposures followed by the lay perspective. Second, I will examine debates around the definition of MCS, in particular the political and economic dimensions driving the controversy. A key political struggle I examine is the suggested name change for MCS by a workshop organised by the International Program on Chemical Safety (IPCS). Third, I will examine the medical profession's role and its relationship with industry front groups; this will include examination of its role in legal action. Fourth, I will examine the case of a BAe 146 flight attendant, Alysia Chew, seeking compensation for health damage that includes MCS. Fifth, I will examine a number of doctors and aircraft crew who made submissions and/or testified at BAe 146 Senate Inquiry. Sixth, I will consider some of the more recent research on the health and safety effects of cabin fumes focusing on the British Airline Pilots Association (BALPA) conference in 2005. Finally, I examine the response by industry and their supporters to changing circumstances including the demise of Ansett.

I argue that the reports of aircraft crew and research documenting the health and safety problems by aircraft unions and researchers provides the most legitimate understanding of the health of aircraft crew. This is because of the history of fume events, crew experiences on aircraft, and illness and disability provide the most coherent picture of the cabin fume issue. Examining the limitations of industry views serves to strengthen the legitimacy of those that have documented these health and safety problems. This is in spite of a lack of consensus on a causative model of MCS and other long term health problems. The difficulty surrounding a widely agreed model of MCS is not sufficient to deny acknowledgement of people's health problems nor is it sufficient to justify inaction on the part of regulators, government, health professionals or to delay implementation of proactive measures to prevent continued problems.

The role of industry in undermining claims of those identified with MCS needs to be recognised as a political and economic process. This in turn allows MCS to be viewed not simply in medical terms but as a social product much like other contested illnesses such as asbestos and tobacco related illnesses. MCS is politically and economically shaped from early causation models to government and regulatory responses and finally to compensation and modifications to existing practices for industry failures.

The relationship between flying and both acute and chronic illness has been documented in previous chapters. The relationship of industry interests and their supporters in thwarting a more considered understanding and acceptance of long term illnesses such as MCS will be demonstrated in this chapter in part by examining industry arguments and claims to legitimacy in making such arguments. I argue that the research documenting the health problems in conjunction with the experiences of plane crew and symptoms is sufficient to assert the legitimacy of those people with long term health problems such as MCS. The political and economic influences on MCS debates play a significant role in the construction of MCS and arguably are more important than the often cited gaps in medical understanding.

Five Perspectives

People's reactions to chemicals, are generally assessed using at least one of four causative perspectives: toxicology, allergy, psychology and clinical ecology/environmental medicine. Another perspective that has developed as a consequence of the lack of fit and recognition by traditional medicine, and marginalisation by industry and government, is the lay perspective. Before briefly examining these perspectives it is worthwhile providing some working definitions while recognising that such definitions are also contested. An *illness* is referred to as the experience of being unwell; this may or may not have a clearly defined cause. A *chronic disease* refers to a 'disturbance or abnormality lasting more than six months' (Bates and Linder-Pelz 1987, p. 57).

Ongoing health problems that limit a person's ability may also be viewed as a disability.

According to the Disability Discrimination Act (1992) a person that has a disability has

- (a) total or partial loss of the person's bodily or mental functions; or
- (b) total or partial loss of a part of the body; or
- (c) the presence in the body of organisms causing disease or illness; or
- (d) the presence in the body of organisms capable of causing disease or illness; or
- (e) the malfunction, malformation or disfigurement of a part of the person's body;

or

(f) a disorder or malfunction that results in the person learning differently from a person without the disorder or malfunction; or

(g) a disorder, illness or disease that affects a person's thought processes, perception of reality, emotions or judgment or that results in disturbed behaviour;

and includes a disability that:

- (h) presently exists; or
- (i) previously existed but no longer exists; or
- (j) may exist in the future; or
- (k) is imputed to a person (Australian Government 2006).

The NSW Government classifies those people with MCS on a case by case basis as to whether they are eligible for services under the Disability Services Act (1993). Eligibility for MCS is based on the condition resulting in:

- An intellectual, psychiatric, sensory, physical or like impairment that is permanent or likely to be permanent,
- A significantly reduced capacity in one or more life activities such as communication, learning, mobility, decision-making or self care,
- And the individual requires support, whether or not of an ongoing nature (Parliament of NSW 2002, p. 1998).

Those people that develop illness, disease and disability in the workplace are best understood in terms of *injuries* rather than *accidents*. This is because accident suggests a model of causation as one of a random series of events that could not be prevented (Quinlan and Bohle 1991a, pp. 92-93). Previous chapters have made the case that cabin

contaminations have clear causal paths. In addition the term injury is appropriate for the public that enter such workplaces particularly those that are essential to the viability and practices of workplaces as is the case with passengers on aircraft.

The toxicological perspective views illness as generally related to the dose of a toxic component but are not strictly proportional to dose, as illness can be influenced by the health of the individual, social indicators and the environment. Such reactions may be broken down into acute, where symptoms generally resolve and chronic, where the symptoms persist. It is difficult to measure the dose of an environmental or workplace hazard. Furthermore, focusing on individual exposure, that is, the amount actually absorbed, has difficulties (Daugherty 1998, p. 271). For example assessments are generally made in terms of cancer production which can take many years to develop but other criteria include mutagenic and teratogenic reactions. Acute reactions may include reversible conditions – such as skin, eye and breathing complaints – termed irritations (Daugherty 1998, p. 27).

New disciplines, such as occupational medicine, have developed within medicine to account for toxic reactions. Due to the inherent problems associated with measuring individual and environmental exposure many within occupational medicine place a strong emphasis on recording of patient history - their occupational and environmental history - to gain a fuller understanding of the present illness (LaDou 1990, pp. 5-6). However, in part the development of occupational medicine was a response to workers compensation claims and the profession's position may be viewed as conflicting with those who are ill. They can assess employees' health and certify illness legitimating sick leave and compensation but they have also been viewed as aligned to employers' interests to minimise compensation and sick leave claims (Quinlan and Bohle 1991a, p. 43). Diana Chapman-Walsh found that occupational physicians employed by corporations faced difficulties because senior managers dominated health priorities and policies (cited in Emmett 1996, p. 1127). Thus managers are able to shape health policy that can be at odds with employee health interests.

The allergy perspective views reactions generally in terms of the sensitivity of an individual or group. Thus they are differentiated from the larger population that has no perceptible ill effects. Allergists tend to focus on the individual as site of the problem and consider the patients' immunological reactivity in terms of problem identification and intervention. Common allergic reactions include those from dusts and foods. Responses such as anaphylaxis while rare can result in death. So-called 'true allergies' are immunological responses such as those involving the blood antibody IgE, and are held to develop as a consequence of certain exposures such as pollen (Breneman 1987, pp. v-vi; Terr 1997). Those people's reactions that do not fit the true allergic model, or other accepted non allergic reactions recognised by allergists such as food intolerance, are often viewed as having psychological problems. This position is particularly evident in the arguments put forward by those allergists involved in MCS debates. The labelling of the ill with psychological problems has been historically used by some doctors to deny workers compensation claims; applying labels to people that included "attitudinal pathos", "compensation neurosis" ...and "malingering" (Quinlan and Bohle 1991a, p. 42).

The psychological perspective has increasingly been used to account for those people including those with MCS that do not fit toxicological or allergic explanatory models (Black 1993; Waddell 1993; Terr 1997; Barrett and Gots 1998; Staudenmayer 1999). Authors such as Barrett and Gots, Black, Staudenmayer and Terr have argued that the lack of scientific 'proof' for an organic causation in the face of symptoms is best understood in terms of underlying psychological problems. Importantly amongst many opponents of a chemical exposure basis for MCS is an opposition to examining causation except in terms of locating the problem with the individual. Staudenmayer (1999, p. 313) argues against examination of the etiology of symptoms rather he argues that an 'effect be established'. Barrett and Gots argue 'the ultimate cause of symptoms is irrelevant' (1998, p. 16). Such logic tends to legitimate the position of industries and business and undermines the claims of people with MCS. This appears more politically motivated than arising out of considered scientific investigation.

Some allergists who are strongly critical of the claims of clinical ecology have pointed out that clinical reports used to support claims that MCS is largely psychological ‘are seriously flawed by selection bias’ (Loblay 1993, p. 1987). Loblay observes that psychological problems are common amongst people with MCS but notes that other clinical studies have tended to support the view that some people are more sensitive to low levels of chemicals.

In their highly regarded review in 1994 Davidoff and Fogarty examined ten papers that focused on psychological origins of MCS and identified a range of problems. The review, that included articles by Terr and Staudenmayer et al, identified numerous problems with study design, sample selection and ‘seven measurement problems identified, including no control for investigator bias’ (quoted in Ashford and Miller 1998, pp. 277-278).

Another perspective is that of clinical ecology, also known as environmental medicine, which arose out of the work of Theron Randolph. This perspective has focused attention on those people who do not necessarily fit neatly into toxicological or allergic explanatory models (Randolph 1962). Affected people include those with MCS; their condition, according to this discipline, arises from chemical exposure via air, food and water. The labels sensitive and hypersensitive are applied to them. In contrast to traditional allergy models, ecology models are broadened to explicitly include the environmental contamination of individuals, the wider environment where exposure occurs and non allergic mediated responses. Pollutants include biological, chemical and physical components (Rea 1988). Early clinical ecology and allergy were similar in focus as the initial definition of allergy in 1906 was ‘altered reactivity’ regardless of origin. The emergence of an immunologic model of allergy, particularly when IgE was discovered in 1967, help provide a scientific basis to treatments such as allergy shots that had previously been termed ‘witchcraft’ and ‘voodoo medicine’ by other medical doctors. Clinical ecologists and allergists have continued a rather acrimonious struggle, with allergists claiming a scientific basis to their practice and clinical ecologists stressing the significance of clinical observations (Ashford and Miller 1998, pp. 20-25).

A growing number of medical doctors do accept MCS although this illness has not achieved wide acceptance within medical practice (Ashford and Miller 1998; Donohoe 1998). Ashford and Miller suggest that MCS is a two step process;

- 1) Loss of tolerance following acute or chronic exposure to various environmental agents, such as pesticides, solvents, or contaminated air in a sick building: and
- 2) subsequent triggering of symptoms by extremely small quantities of previously tolerated chemicals, drugs, foods, and food/drug combinations (1998, p. 289).

Numerous often contested definitions have developed to define MCS. A 1999 Consensus statement signed by 34 specialists added a sixth criterion to the widely agreed 1989 list. The 1989 list was formulated by 89 specialists with extensive experience with people with MCS though diverging markedly on what caused MCS. Significantly they came from different fields — ‘36 specialists in allergy, 23 in occupational medicine, 20 in “clinical ecology,” and 10 in internal medicine and otolaryngology’ — and consequently lent a degree of legitimacy to the criteria (Bartha, Baumzweiger et al. 1999).

1. The symptoms are reproducible with [repeated chemical] exposure.
2. The condition is chronic.
3. Low levels of exposure [lower than previously or commonly tolerated] result in manifestations of the syndrome.
4. The symptoms improve or resolve when the incitants are removed.
5. Responses occur to multiple chemically unrelated substances.
6. [Added in 1999]: Symptoms involve multiple organ systems (Bartha, Baumzweiger et al. 1999).

There are also many terms used for this condition which are also contested. One of the most common apart from MCS is Environmental Illness (EI)⁴¹. Other terms coined particularly by opponents of a chemical causation have attempted to obscure a chemical or environmental causative model, for example Idiopathic Environmental Intolerances (IEI). The cabin fume controversy has resulted in another attempt to characterise this illness

⁴¹ MCS and EI are both used to represent this illness, though the preference in many forums including cabin fume debates is for MCS, thus I have used MCS except where some authors have used EI.

which incorporates the symptomology of those exposed to fumes and includes MCS under the term Aerotoxic Syndrome (Winder, Fonteyn et al. 2002).

The boundaries between the more accepted physical causal models — toxicology and allergy — and the psychological model are not necessarily distinct. Physical illness can cause psychological illness and psychological illness can cause physical illness. However, many opponents of an environmental/chemical basis for MCS have tended to emphasize a dichotomy, stressing the psychological as the primary cause of MCS. Those supporters of an environmental basis of MCS have often justified their position around this dichotomy. The polarity of debate, between physical and psychological, often couched in arguments of which side has the better science, may disadvantage those with MCS by leaving other options unexplored because these may ‘conflict or weaken positions assumed in the debate’ (Lax 1998, p. 726). This may include MCS advocates not wishing to be critical of those seen to represent the physical side of the debate, even if MCS patients are being exploited by some alternative practitioners, for example, charging patients for expensive treatments, yet refusing to advocate for patients in seeking Workers’ Compensation or disability benefits. Such concerns for profit above patient welfare may also apply to numerous companies that sell specialised MCS products such as dietary supplements and environmentally safe products.

The difficulty is discerning genuine advocates in a climate where MCS is under constant pressure from mainstream medicine (Lax 1998, p. 734). Lax argues that in contrast to a largely scientific issue, MCS is better viewed ‘as a struggle for the right to define legitimate knowledge about the condition within a specific context of unequal power relations and dynamics’ (1998, p. 726).

The Lay Perspective

The lay knowledge perspective explicitly incorporates the views of those affected by illness. This perspective is another means to understand illness, indeed all the previous perspectives rely to some degree on reporting of symptoms and circumstances surrounding

the illness. Lay knowledge is critical for those with illnesses that occur outside the widely accepted medical model as it provides a means to understand an illness that is not bound tightly to institutional concepts. Those with illnesses, such as MCS, that do not fit traditional institutional views have often experienced the marginalisation of their health problems and their views by these institutions. This inevitably leads to a confrontation between those with such illnesses and institutions in numerous forums (Crumpler 1994; Mathews 1998; Wright and Clarke 1999).

The Australian Senate Inquiry into the BAe 146 and inquiries in the UK and US into cabin air quality were in response to the challenge of lay knowledge in the form of aircraft crews seeking a safe workplace and recognition of their illnesses. As noted by Kroll-Smith and Floyd (1997, pp. 144-145), lay knowledge provides a justification to challenge existing practices and policies. Those with MCS/EI highlight the contradiction of societies that require a healthy workforce to generate capital yet also produce toxic compounds that damage health (Kroll-Smith and Ladd 1993, pp.24-25). Illness and disease are not simply medical issues: they are intimately tied into regulatory regimes, policies and laws. As lay knowledge expresses its concerns through unions, politicians, inquiries and the courts, its scope for influencing the debate increases. However, illnesses that are not amenable to a quick medical, lifestyle or technical fix face an ongoing struggle to achieve recognition, compensation and modifications to processes that generate exposures.

The above perspectives highlight not only the tensions surrounding medical debates about diagnosis but also the politics of illness. While some of these perspectives move beyond the individual, to the environment, it is perhaps the lay perspective that provides the greatest challenge to the corporate, regulatory, and political institutions which create and recreate the circumstances where chemical exposure occurs. Communication of the lay perspective is often, as is the case with the cabin fume controversy, aided by supportive unions, doctors and researchers.

The resources, influence and power of the chemical industry and associated organisations provide an ongoing challenge to the recognition of many health and environmentally

related issues. The cost of recognition of workplace and environmental health problems are a key driving force. Asbestos and tobacco corporations exercised considerable influence in slowing down the recognition, regulation and compensation of illness, chronic disease and disability. Strategies included public relations campaigns, political lobbying, medical research, and the stymieing of legislation and compensation.

International Debates on MCS: The International Program on Chemical Safety and Beyond

Corporations, in particular the chemical industry and its proxy organisations, have sought to marginalise a range of industry-generated health problems and continue to play a key role in shaping debate, policy, medical opinion, legislation and laws that relate to many health issues. The profit threat perceived by corporations should MCS be recognised as a work related illness means there

is a struggle for decisive influence on the definition of the illness, appropriate treatment and diagnostic measures, access to benefits and accommodations, and necessary preventive actions. Ascendant corporate power has allowed management to set important parameters of the discussion, constructing a framework to strongly influence the outcome (Lax 1998, p. 729).

A major struggle that highlights corporate influence in defining the illness is that involving the IPCS. The controversy surrounding a proposed name change to MCS arising from an IPCS workshop demonstrates the far reaching influence of corporations and their supporters. This is illustrative of the politics of MCS rather than simply medical opinion seeking more definitive explanatory models including that of causation, and highlights corporate ability to shape debate in many areas to meet their own objectives.

Setting out the chemical industry MCS agenda is a 1990 briefing paper on EI by the Chemical Manufactures Association (CMA), now known as the American Chemistry Council (ACC). First the CMA sets up an argument about how EI patients are ‘ill and

deserving of compassion, understanding and expert medical care’, but proceeds to undermine their claims of illness. It states the illness as a ‘legitimate disease is unproven’ and places the emphasis on psychological problems because these ‘patients generally lead troubled lives’ which is in turn linked to ‘psychosomatic illness’ and other symptoms ‘that do not fit any known medical disease’ (CMA 1990).

Second, the principal aim of the CMA paper is to argue against claims of an environmental/industry cause for this illness to avoid costs which would be imposed on business. To this end the CMA advocated a number of measures to reduce the acceptance of MCS as a legitimate disease in the media, legislature and courts. Measures advocated to deal with media coverage include:

- monitoring
- gathering of information
- ‘Identify medical personnel familiar with environmental illness who can speak as experts’ (The CMA paper noted a number of doctors and medical associations critical of an environmental basis of MCS such as the allergist Terr and the American Academy of Allergy and Immunology (AAAI)⁴²
- ‘Informally offer guidance and background materials to reporters, based on their degree of knowledge’ (CMA 1990)

The paper also advocated the formation of a coalition with industry sectors and other parties interested in ‘placing environmental illness in its proper perspective’. The coalition list is extensive and includes medical associations, manufacturers and users of pesticides, labour relations organisations, insurance companies, soap and detergent manufacturers, chambers of commerce, and the aerospace industry. Crucial amongst recommendations is a recognition of the importance of EI as a health issue and that it is dependent on doctors to gain legitimacy, noting that ‘should environmental illness arise as an issue, a coalition with the state medical associations is absolutely necessary’ (CMA 1990).

⁴² This organisation is also known as the American Academy of Allergy Asthma and Immunology but is more commonly referred to as the American Academy of Allergy and Immunology. I have chosen to use the more common usage form in this thesis.

One of the most influential chemical industry coalition organisations established to counter the health claims of people with MCS is the Environmental Sensitivities Research Institute (ESRI). This organisation, in essence a public relations (PR) firm, was established in 1995 by Ronald Gots, who became its Executive Director. Gots is a prolific writer on issues of MCS and a strong industry advocate opposed to MCS gaining wider legitimacy as an illness. The ESRI web site stated that the organisation is a

non-profit scientific and educational organisation. ESRI's mission is to support sound scientific and medical research into environmental intolerance issues, and to compile and disseminate information on those issues. ESRI is primarily sponsored by its member organizations. Membership is open to all who ... [comply] with the mission and objectives of the institute... and pay their requisite membership dues (ESRI 1998).

The organisation's fee paying members contribute \$5,000 or \$10,000 dollars annually. Members and the ESRI board of directors have included a large number of key chemical producing companies and associations such as Bayer, Amway, Colgate-Palmolive, DowElanco, Procter & Gamble, Rhone-Poulenc, Chemical Speciality Manufacturers Association, Responsible Industry for a Sound Environment and Cosmetic, Toiletry and Fragrance Association (McC Campbell 2000; Integrity in Science 2006). An MCS advocate organisation, MCS Referral and Resources, argues ESRI was founded to assist industries faced with litigation involving MCS. In spite of its claims ESRI has only recently provided research grants to study MCS (McC Campbell 2000). In 2005, research grants of up to \$25,000 were offered 'into the causes on [sic] EI/MCS, and/or the communication of research results about EI/MCS' (ESRI 2006). Thus, similar to the tobacco industry support of researchers, the ESRI funding also appears aimed at generating research favourable to industry. The communication aspect of research clearly indicates the public relations role of this organisation as have its many other campaigns.

ESRI ran a number of projects to undermine people with MCS. This has included advertisements in many US newspapers that were set out to appear to be legitimate

news stories. These advertisements stated MCS ‘exists only because a patient believes it does and because a doctor validates that belief’ (quoted in McCampbell 2000). ESRI has also worked secretly to get the American Academy of Family Physicians Foundation to endorse an anti-MCS brochure though the Foundation withdrew when ESRI would not attach its own name to the brochure (McCampbell 2000). The withdrawn brochure incorrectly claimed that MCS was not listed as a disability under the American Disabilities Act (ADA). Moreover, in 1997, the same year the brochure was produced, Gots, still the Executive Director of ESRI, stated in an article that ‘although not categorically noted to be a disability in the body of the law, the ADA does allow for the consideration of MCS as a disability on a case-by-case analysis that is applied to all other physical and mental impairments’ (quoted in McCampbell 2000). According to McCampbell ESRI was ‘attempting to mislead physicians and the public into believing that MCS is not a covered disability, while its executive director was warning an industry-oriented audience that MCS was a covered disability and offering suggestions for how to defend themselves against a claim’ (2000). Gots is also the director of the National Medical Advisory Service (NMAS), a for-profit organisation that provides medical ‘experts’ to back industry claims in the courts. The NMAS has the same office and fax number as ESRI and adopts the same stance on MCS.

In 1995, during one of the numerous cases Gots has testified in for corporate defendants, he stated that ‘MCS theory has been subjected to peer review evaluation and it has generally been rejected as “junk science”’ (Montague 1995). Gots is also on the advisory council of the Atlantic Legal Foundation (ALF), a conservative think tank that champions the rights of business in areas such as the environment, consumer rights and the courts. This organisation is the recipient of funding from numerous corporations such as DuPont, ARCO Chemical Co, Pfizer, Texaco and ExxonMobil, the manufacturer of Mobil Jet Oil. ExxonMobil donated \$20,000 to this organisation between 1998 and 2002 (Exxonsecrets). ExxonMobil donates millions of dollars to numerous organisations and politicians to champion its views on chemicals, regulation and the environment. One of this company’s major

projects has been the funding of anti-global warming think tanks and like minded organisations. Between 2000 and 2003 these organisations received more than \$8 million dollars from ExxonMobil (Anons 2005).

Increasingly international bodies, such as the IPCS, have been involved in shaping knowledge claims surrounding MCS. The IPCS Workshop, through a suggested name change, challenged the view of causation contained in the name MCS. Barrett⁴³ and Gots believe traditional definitions of MCS are misplaced because there are ‘no consistent characteristics, no uniform cause, and no objective or measurable features’ (Barrett and Gots 1998, p. 9). Consequently, they advocate abandoning the notion of causation present in the term MCS and prior definitions that suggest this approach, preferring the terminology put forward by the IPCS at an international Workshop in 1996. This workshop suggested replacing MCS with Idiopathic Environmental Intolerances (IEI). The Macquarie dictionary defines idiopathic as ‘of unknown cause, as a disease’ (Butler, Atkinson et al. 1991, p. 876). The term idiopathic is used in an attempt to place this illness outside models that seek a chemical or environmental explanation, ultimately shifting the debate onto the individual as both cause and site for intervention. For Barrett and Gots, the assumption that there is no ‘known’ etiology is used to implicate the individual as the primary causative mechanism.

Barrett and Gots make no mention of the resultant controversy surrounding the IPCS workshop but mention that the directors of the AAAI had adopted this definition in 1997 (Barrett and Gots 1998, p.9). This omission of the controversy and the mention of a professional body’s endorsement serve to legitimate IEI as a new unproblematic ‘correct’ definition and an apparently seamless apolitical issue. However Gots is very much bound up in the political controversy to marginalise arguments of an environmental causation for MCS suffers. He was invited to present the ‘US perspective’ at the IPCS workshop (Ashford and Miller 1998, p. 283)

⁴³ Steven Barrett is a retired psychiatrist and is chairman of the board at Quackwatch a website that expends many words supporting industry agendas Quackwatch, (2006). <http://www.quackwatch.com/>..

According to Staudenmayer the IPCS Workshop suggested three defining characteristics for this disorder, which he supported as one of the conference participants, saying that 'IEI places the burden of proof on EI advocates' (1999, p. 7). Staudenmayer is more candid in his account and discusses the 'campaign of resistance' by opponents of this definition, who argued that industry representatives present had significant influence in proceedings. He refers to a letter containing 81 signatures opposed to the findings of the IPCS workshop but argues only two, Howard Kipen and Claudia S. Miller, were present at the meeting. Interestingly he does not reference this letter or the responses, other than that they were published in the *Archives of Environmental Health* in 1996. Staudenmayer argues that it was 'not the influence of industry, but rather the lack of credibility of the arguments put forward by EI advocates' that did not provide a convincing alternative (Staudenmayer 1999, p. 7).

Critics of industry influence argue that four representatives of industry at the IPCS claimed to be NGOs but 'were full-time employees of BASF, Bayer, Monsanto, and Coca Cola — the first three claiming the name of an industry-funded science institute as their NGO affiliation (i.e., European Centre for Environment and Toxicology)' (Abrams, Anderson et al. 1996, p. 338). If we set aside the influence of industry for the moment Staudenmayer may be correct in positing 'a lack of credibility of the arguments' though his focus on MCS/EI advocates is misplaced. After all credibility is very much dependent on the context in which arguments are put forward in. However, Staudenmayer's narrow focus on 'arguments' ignores organisational influence in setting agendas. The pronouncements of organisations, particularly internationally recognised and respected organisations, impart legitimacy. Legitimacy is achieved in part because of the perceived objectivity of organisations in evaluating information. Consequently the history of an organisation is an important consideration in any evaluation of the way credibility is constructed.

The IPCS was established in 1980, located at the World Health Organisation (WHO) in Geneva and is sponsored by WHO, the International Labour Organisation (ILO) and the United Nations Environment Programme (UNEP). These sponsoring bodies are significant

international organisations in the areas respectively of health, labour and the environment. Association with these bodies can lend significant credibility.

As early as 1993 serious concerns about the integrity of the IPCS were raised by Professor Andrew Watterson who documented industry dominance of both task groups and the drafting of documents (Abrams, Anderson et al. 1996). Reviewing IPCS practices from 1982 to 1992 he found industry dominated the drafting of 135 documents. For example the first draft of the IPCS document on chlorofluorocarbon refrigerants was produced by the manufacturers (Hoechst and ICI) and both first and second drafts of a benomyl document were industry produced (Dupont). Of the 135 documents reviewed there was ‘on the task groups or present as observers only one nongovernment organization that was neither from industry nor from a professional medical group; industrial presence was significant’ (Abrams, Anderson et al. 1996, p. 338). The absence of non-government organisations is a serious omission in examining other views, particularly with regard to public health. This narrowing of interests involved in the consultation process results in a smaller amount of information available for the assessment process. This in turn leads to assumptions being made suggesting assessment was not objective and that conclusions lacked legitimacy.

IPCS credibility was found wanting by the US National Institute for Occupational Safety and Health (NIOSH). In 1993, NIOSH scientists criticised an expert panel overseeing an IPCS report on methylene chloride for failing to include opposing views. The report was based on manufacturers’ assessments of the chemical, such as ICI. As a result of this ‘error’ NIOSH decided to cease all collaboration with IPCS until its processes became more ‘objective’. Dr Richard Lemen, Acting Director of the NIOSH wrote to the IPCS which responded with a report to reconcile such criticisms stating that:

[an NGO’s] aims and activities shall be in conformity with the spirit, purposes, and principles of the Constitution of the WHO, shall centre on development work in health or health related fields, and shall be free from concerns which are primarily of a commercial or profit-making nature (emphasis in original) (quoted in Abrams, Anderson et al. 1996, p. 338).

Abrams et al requested that the 'IPCS report publicly on the complete extent of conflicts of interest of *all* members of IPCS expert scientific panels (i.e., participants, representatives, and observers, on all projects now under way' (Abrams, Anderson et al. 1996, p. 339).

A letter of response by Dr Michel Mercier the Director of the IPCS and sponsors of the IPCS attempted to dismiss concerns raised by the 81 signatories:

First and foremost, sound science and integrity are the goal and practice of IPCS and extensive measures have been adopted to ensure that this remains the case...The fact that there have been no improper influences must be readily apparent to and understood by anyone objectively reviewing the process (Mercier, Willis et al. 1996, p.341).

However, the letter does point out that recent attempts have been made to 'increase the transparency of our work' arising from external advice, such as the US State Department, and internal discussions from the Program Advisory Committee. Mercier et al in another two letters take pains to assert the objectivity and thorough review of scientific data conducted by the IPCS (Dayan 1996; Goldman, Huggett et al. 1996; Mercier, Willis et al. 1996). However, the responses tend to rely on broad generalisations and skate around many criticisms raised. The term 'sound science' is used to convey an image of a detached evaluation rather than the politics involved in research production, conclusions and evaluation.

Also criticised is the IPCS' role in the chrysotile asbestos review. Mercier et al claim that 'All assessment documents undergo a thorough, scientific multi-step peer-review process involving circulation of first drafts to over 150 contact points worldwide' (Mercier, Willis et al. 1996, p. 341). However, a number of reviewers have dropped out of this process. In 1993, an international body of occupational health scientists, Collegium Ramazzini, rejected a request to review a document on chrysotile asbestos by the IPCS because it was 'prepared by scientists with close ties to the asbestos industry' (Abrams, Anderson et al. 1996, p. 338). They wished to avoid association and the probability of being compromised (Castleman and Lemen 1998).

While largely ignoring the criticism in the letters of response it appears that IPCS has responded to this controversy, and apparently to the call by Abrams et al 'to conduct an expert, and impartial review' to ascertain if such a document would serve any purpose if published (Abrams, Anderson et al. 1996). Castleman and Leman have indicated that the third draft of the IPCS report on chrysotile asbestos has been sent to a less industry dominated scientific panel to write the final report (1998, p.2). However, these authors have implicated the ILO and WHO (IPCS sponsors) in producing reports that have negated public health concerns in preference to those of the asbestos industry. This industry favouritism, arising from industry and government demands, is perhaps not surprising given the global impact on policy that both these organisations have.

WHO has been placed under considerable pressure by industry and governments in other public health areas to adopt more industry friendly policy recommendations. A case involving WHO's Global Strategy on Diet, Nutrition and Physical Activity highlights the pressure it is subjected to. WHO published a report with the Food and Agriculture Organisation, known as Report 916, documenting health problems associated with salt, fat and sugar. There was intense industry lobbying and threats by the US government to withdraw funding from WHO. This was in spite of strong support by many countries including Britain. One of the most contested parts of the report was a recommendation that only 10 per cent of the average adult energy intake should be from added sugar (Revill and Harris 2004). A subsequent publication illustrated the success of this lobbying when WHO released its *Global Strategy on Diet, Physical Activity and Health* and made no reference to Report 916. In spite of considerable pressure from industry and the US, Britain and France helped prevent the sugar lobby from gaining NGO status at meetings (Revill 2004).

In light of the problems and changes implemented by IPCS, its credibility as a forum to evaluate scientific debates and publish information has been compromised. IPCS does not appear to be in a strong position to adjudicate on issues of credibility in light of its own claims and responses to review practices. IPCS supports and develops research that has downplayed the impact of hazards. Thus it appears more credible to proponents of minimal regulatory responses and less credible to those that seek tighter regulatory controls to

minimise the impact of hazards. Thus the letter by Abrams et al appears justified when it called on IPCS and its sponsors to:

Immediately halt work toward the issuance of reports on MCS. They should reconstitute the MCS panel exclusively with scientists who have published research (not merely opinion) on chemical sensitivity and related scientific issues and with doctors who have actual experience in managing patients with MCS. The IPCS and its U.N. sponsors should also assign NGO places to legitimate NGOs, and, to the fullest extent possible, should identify and exclude scientists with financial conflicts of interest (Abrams, Anderson et al. 1996, p. 339).

Spreading the word?

The term IES was proclaimed by some of the workshop participants as representing WHO's new position on a name. Following criticism the IPCS did issue a statement that WHO had not 'adopted nor endorsed a policy or scientific opinion on MCS' (Ashford and Miller 1998, p. 284). As a consequence of the mounting controversy, the IPCS limited the distribution of the final 'unedited' report, and included a number of acknowledgements and conditions, including:

several disclaimers, for example, that the document does not represent the decisions or stated policy of UNEP, ILO, or WHO; that it does not constitute a formal publication; and that it should not be reviewed, abstracted, or quoted without the written permission of the Director of the IPCS (Ashford and Miller 1998, p. 284).

Those supporting industry interests were not dissuaded by the IPCS' new found circumspection and published an anonymous paper from an industry sponsored conference outlining the 'consensus' achieved at the workshop (1996a). Ashford and Miller assert this publication is further evidence 'corrupting a process that was flawed from its conception' (1998, p. 285). The article was placed at the end of the conference papers lending greater legitimacy so it arguably serves as a conference summary. The conference *Annals of Multiple Sensitivities: State-of the Science Symposium* was co-sponsored by the NMAS

(and assisted by staff from ESRI), International Society of Regulatory Toxicology and Pharmacology, NIOSH and Johns Hopkins University. The conference prompted Montague to observe that NIOSH and Johns Hopkins University have allowed ‘themselves to become a vehicle for Dr. Gots’s political agenda...the symposium is weighted in favour of pro-industry, anti-consumer, anti-MCS-patient viewpoints’ (Montague 1995). There were no scholarships for MCS patients which meant they were effectively excluded due to a registration cost of \$650. The publication of the symposium and IPCS workshop ‘conclusions’ in the journal *Regulatory Toxicology and Pharmacology* was paid for by ‘a grant from the Environmental Sensitivities Research Institute’ and notes that the submissions were ‘peer-reviewed’ (1996). How an authorless workshop paper at odds with IPCS requirements, not to be reviewed, abstracted or quoted, was peer-reviewed is not explained. Nonetheless, the result of these publications was to lend further legitimacy to both symposium and the Workshop ‘consensus’.

Gots influence permeated the conference agenda and publications. His own article was predictable in its attacks on MCS and argued that ‘until the etiology is determined, a more descriptive and less categorical title for MCS and one which is less implicative of causation would be “environmentally associated symptoms” or Idiopathic Environmental Intolerances’ and referencing the IPCS (Gots 1996, p. S12). Gots also provided the ‘recommendations for a Name Change and Specific Conclusions’ from the ‘World Health Organisation Workshop on Multiple Chemical Sensitivities’ to the Ag-health Newsgroup of the UC Agricultural Health and Safety Centre at Davis, California which was also published in a Newsletter for chemical applicators and pesticide dealers, the *North Dakota Pesticide Quarterly* (1996b).

Another publication noted that although the major conclusions of the Workshop were not unanimous the working party ‘preferred the name “Idiopathic Environmental Intolerances”’ (Lessof 1997, p. 234). The author makes no mention of the subsequent controversy and casts the conference as a creditable attempt to examine ‘a range of views in order to consider all aspects of the subject’ (Lessof 1997, p. 233). He also claims that this report is ‘published’ by WHO even though there has been no formal publication to date. Such

political manoeuvring occurs not only via organisational associations but via linking research that supports a chemical bases for illness as ‘subjective’ where ‘objective features are rare’ (Lessof 1997, 234). However, Lessof does not appear to have met his own standards regarding objectivity.

In Australia, Robert Loblay claims a ‘recent report’ from IPCS supports his view that the ‘Current scientific consensus’ does not support a toxicological basis for MCS. He also mentions the report ‘recommended’ that the name MCS be changed to IEI (Loblay 1998, p. 63). To add to the gravitas of his statement Loblay noted in a footnote that IPCS was ‘operating under the auspices of the WHO, the International Labour Organisation and the UN Environment Program’ (Loblay 1998, p. 66). Loblay did not mention that no official report has been issued by IPCS, nor does he mention the controversy surrounding the IPCS draft recommendations. Loblay is extensively involved in lobbying authorities in Australia to minimise consideration of a chemical basis for MCS and other illnesses including Chronic Fatigue Syndrome (CFC).

Loblay is perhaps the key medical doctor in Australia that serves this gatekeeper role. Through his various professional positions he is able to stymie and marginalise the association of illness, disease and disability from chemical exposure. He was also a member of Ansett’s expert panel investigating BAe 146 aircraft as noted in Chapter 5, appeared before the Australian Senate Inquiry into BAe-146 aircraft and discounted the illnesses of aircraft crew including long term disability. He has also appeared as a witness in court cases for industry groups arguing against the recognition of people with MCS. These issues will be expanded further below.

Government authorities have also used the IPCS workshop report to undermine, although a little more subtly, arguments based on a chemical causation. United States government departments, via an Interagency Workgroup, produced a predecisional draft document examining MCS. The predecisional draft noted the essence of the controversy: that is, it arose following the IPCS workshop regarding the conclusions and recommendations, and that no final report has been issued. However, it gives greater emphasis to those very

workshop recommendations. The language of objective science is used with greater detail to justify the conference findings:

The recommendations of the workshop included the use of the descriptor IEI only after a thorough examination of patients, careful considerations of alternative explanations, and focused interdisciplinary approaches for the diagnosis and treatment of these patients (U.S. Federal Interagency Workgroup on MCS 1998, p. 49) .

The predecisional draft mentioned the sponsorship of the IPCS by WHO, ILO and UNEP (U.S. Federal Interagency Workgroup on MCS 1998, p. 48) but failed to mention that these organisations do not endorse the conclusions from the IPCS workshop, which consequently lends institutional legitimacy to the workshop. Nor does it mention that this Workshop's 17 participants' findings are not those of the IPCS or that two of the participants including the Workshop chair Dr. Howard Kipen were signatories to the letter signed by 81 scientists 'criticizing the IPCS and this workshop in particular for its chemical industry bias' (Donnay and Ziem 1998). Dr. Grace Ziem, one of the experts in MCS whose comments were sought by the Interagency Workgroup to provide an external peer review, noted that in spite of her submission there were few attempts to correct a number of omissions and errors.

The above discussion has highlighted a large number of industries, international organisations and researchers actively involved in marginalising MCS via a suggested name change. This has resulted in attempts to stymie the development of substantive policy and recognition of those people with this illness. What these efforts also demonstrate is the quest not only to influence key stakeholders but to garner institutional support in attempts at marginalising MCS. The attempted name change has largely not taken hold due to widespread opposition and general acceptance of the term MCS. There are organisations that still seek to justify a largely psychological explanatory model by continuing to misrepresent the case: for example the position statement of the AAAI heralds IEI as the new name for MCS. This organisation implies that it is sanctioned by the WHO and that there is broad institutional support. There was however, a failure to mention the resulting controversy and the position statement cited the authorless workshop conclusion in the

journal *Regulatory Toxicology and Pharmacology* and the Lessof article to support their claim for the new name (AAAAI 2006).

The equivalent body in Australia, the Australasian Society of Clinical Immunology and Allergy (ASCIA), has also used the term IEI though it also includes MCS and EI. The explanation tends to centre on people having psychological problems and focuses on symptom triggers such as smells, food additives and environmental chemicals rather than chemical exposures that could have precipitated the symptoms (ASCIA 2006). The references are dominated by those supporting this position including AAAI, allergists such as Terr, and psychiatrists such as Staudenmayer, and a link is given to Barrett's Quackwatch website (ASCIA 2006).

Medical Doctors as Advocates of Industry

The role of medical doctors in MCS debates is critical as they are able to lend legitimacy to various sides of the debate by appearing to be separate from industry concerns. As previously mentioned the ACC identified the key role of doctors and medical associations in their strategic planning. Often these industry aligned doctors are associated with 'independent' organisations and thus are able to generate greater authority to their claims. Some doctors have even established their own organisations, albeit with industry support, such as Ronald Got's ESRI and Steven Barrett, who has established numerous organisations including Quackwatch. Often such doctors and scientists are represented on many industry funded organisations; both Gots and Barrett have been on the board of the American Council of Science and Health (ACSH). As Beder notes the ACSH 'is one of the many corporate front groups which allow industry-funded experts to pose as independent scientists to promote corporate causes' (Beder 2000, p. 28). ACSH funding has been provided by food, chemical, pharmaceutical and oil corporations. These have included Nestlé, NutraSweet, Monsanto, Dow USA, Pfizer, Mobil, Exxon and ExxonMobil (Beder 2000, p. 28; 2006a).

The ACSH was established in 1978 and took an initial stance of independence from direct industry funding. The minutes of the March 1978 Board of Directors of the Manufacturers Chemists' Association (MCA)⁴⁴ documented comments of the director William J. Driver who stated that the president of the ASCH Elizabeth Whelan had founded a:

tax-exempt organisation composed of scientists whose viewpoints are more similar to those of business than dissimilar...ACSH is being pinched for funds, but in the interest of independence and credibility will not accept support from any chemical company or any company which could even remotely be concerned with the aims of the council (quoted in 2006a).

While direct sources of funding were to be avoided Driver added “‘Dr. Whelan would be happy to hear from’ MCA members who ‘are interested in the work of the council and know of possible sources of funds’” (quoted in 2006a). However, not long after ASCH was established all pretence of independence was abandoned and industry funding was accepted. As Whelan noted in a 1997 interview she decided to accept industry funding because she was already being called a ‘paid liar for industry’ (quoted in 2006a).

Not only are the ethics of ACSH questionable but so are some of their key associates. The ACSH has a range of professionals working for them though it does not directly employ many medical doctors. The importance of medical doctors to such organisations’ lobbying is crucial due to the key role they play in arbitrating health issues, particularly surrounding causation, as was noted by the CMA. Gilbert Ross, a medical doctor working for ACSH, has provided much needed support for industry with his publications documenting that ‘the arsenic in pressure-treated wood poses “no risk to human health”’ and ‘PCBs in fish “are not a cause of any health risk, including cancer”’ (quoted in Hogan 2005).

However, a *Mother Jones* article revealed that Gilbert Ross, prior to joining ACSH, was involved in a scheme that defrauded New York’s Medicaid program of around \$8 million and found to have perjured himself. Ross was sentenced to 46 months prison, fined \$40,000 for his role in the fraud and required to pay restitution \$85,137 (the amount was reduced from \$612,855 due to his lack of assets). Ross’ medical licence was revoked in 1995 and in

⁴⁴ The MCA later became the CMA and is now known as the ACC.

a 1997 decision by the US Department of Health and Human Services Ross was barred for 10 years from involvement in Medicare or Medicaid programs. This 1997 decision was affirmed by a judge who noted Ross was ‘an untrustworthy individual’ whose involvement in the fraud was ‘medically indefensible’ (quoted in Hogan 2005). After Ross left prison he applied for a job at ACSH, explained his criminal record and his lack of medical licence to Whelan, and was given the job. Ross was subsequently promoted in 1999 to Medical Director/Executive Director (Hogan 2005).

Whelan responded to the *Mother Jones* article with a strong defence of her appointment of Ross in 1998 and his subsequent promotion to Medical Director/ Executive Director, pointing out that Ross’s licence was reinstated in 2001 and that he had paid his debt to society. Whelan notes Ross ‘is a spokesman for ACSH on medical issues. He is invaluable ... [and] has tremendously advanced ACSH’s cause. He has become an indispensable member of the ACSH team’ (Whelan 2005). Ross has continued to support the ACSH industry position, notably in attempts to wind back EPA assessment of chemicals particularly on cancer policy (Ross 2006). Whelan on making initial inquiries into Ross’s offence was ‘fearing that it was some aspect of quackery’ (quoted in Rampton 2005). Rampton dryly notes ‘for Whelan, “quackery” (meaning disagreement with ACSH’s pro-pesticide, pro-junk food, pro-chemical industry arguments on health issues) is a worse crime than working for a scam clinic that submits false medical reports to the government to defraud taxpayers’ (2005).

Barrett has also published his anti-MCS position on the ACSH website. Here he focuses on psychological problems stating that ‘many MCS patients suffer from an emotional problem termed ‘somatisation disorder’’ (Barrett 1999). Barrett lists the qualifications of Gots and cites him in an attempt to bolster his arguments noting that the ‘ACSH scientific advisor Ronald E. Gots M.D., Ph.D president of the International Center for Toxicology and Medicine, in Rockville Maryland ... [concluded that] the diagnosis [of MCS] is far more disabling than the symptoms’ (Barrett 1999).

In conjunction with another organisation, Barrett founded the National Council Against Health Fraud (NCAHF) which has been involved in legal action against non-mainstream medical views in an attempt to gag his many critics. This type of legal action, termed Strategic Lawsuits Against Public Participation (SLAPP), is designed to intimidate those expressing alternative views. SLAPPs are widely used by industry and their supporters and have been documented since the 1970s. The SLAPP is used to deter citizens from influencing government policy around numerous social issues including health and the environment. Those using SLAPPs ‘cannot directly sue people for exercising their democratic right to participate in the political process, so they have to find technical legal grounds on which to bring cases. Such grounds include defamation, conspiracy, nuisance, invasion of privacy or interference with business or economic expectancy’ (Beder 2000, p. 64).

Barrett has brought many such SLAPPs including those against the lawyers that have defended people from his lawsuits. In recent years he has lost a number of these. Below some of the cases are examined to reveal not only scattergun attempts to dismiss views at odds with dominant industry positions, but also the economic gains to be made by those acting on behalf of industry. Also evident is the lack of expertise that many of these ‘experts’ have, not only in the specific cases but also in relation to their own qualifications. This in turn suggests a significant lack of credibility to comment on a range of matters including MCS.

Barrett claimed \$100,000 for damage against his reputation in the defamation suit *Stephen Barrett vs Darlene Sherrell and Phillip Heggen*. He was unsuccessful and his claim was dismissed (2002). Sherrell had published material on her website critical of Barrett and highlighting his association with ACSH claiming it was a ‘front group and mouthpiece for the food, chemical, sugar and drug industries’, and that he used ‘the “big lie” tactic himself, as do his associates’ (2002). Sherrell also highlighted his opposition to alternative therapies and defence of the nuclear industry, pesticides and other synthetic chemicals. Barrett claimed there were ‘hundreds’ of articles supporting the safety of fluoridated water but was unable to name any according to Sherrell; instead Barrett claimed such requests were

delusional. Another issue raised by Sherrell was Barrett's association with the American Medical Association to discredit the Chiropractic profession (2002).

In *National Council Against Health Fraud vs. King Bio Pharmaceuticals and others*, the NCAHF claimed King Bio, a homeopathic remedies supplier, sold products that were not effective and that their advertising was false and misleading (2001). The NCAHF lost the initial case and the appeal (2003). In the initial case the judge noted that Barrett was a psychiatrist who retired about 1993 and then allowed his medical licence to lapse. The court found that Barrett's purported expertise in US Food and Drug Administration (FDA) regulation 'is not apparent' moreover 'his professional continuing education experiences are outdated given that he has not had a current medical licence in over seven years'. The court found 'no sound basis to consider Dr. Barrett qualified as an expert on the issues he was offered to address'. The other expert testifying on behalf of NCAHF was Wallace Sampson, a retired medical doctor with a speciality in oncology, who offered testimony on 'scientific method generally... the nature of medical science and the nature of the information upon which much homeopathic science may be said to rest'. Sampson's testimony was quite general and focused on attacking homeopathic reference sources recognised by the FDA. The court noted he had very little experience in clinical research, research methodology and was not familiar with homeopathic professional organisations. The court noted that 'Dr. Sampson has relatively thin credentials to opine on the general questions of the proper standards for clinical or scientific research or other methods of obtaining valid evidence about the efficacy of drugs. The Court further finds that Dr. Sampson lacks experience in the field of homeopathic drugs, which renders this testimony of little or no weight in this case' (2001).

The court found both Sampson and Barrett 'are biased heavily in favour of the Plaintiff and the weight to be accorded their testimony is slight in any event. Both are long-time board members of the Plaintiff; Dr Barrett has served as its Chairman. Both participated in an application to the U.S. FDA during the early 1990s designed to restrict the sale of most homeopathic drugs' (2001). The court not only identified the wholesale opposition by these

doctors to alternative medicine but their personal economic benefits. Barrett testified to the court that his and Sampson's fees are paid by NCAHF. Consequently the judge concluded:

Based on this fact alone, the Court may infer that Dr. Barrett and Sampson are more likely to receive fees for testifying on behalf of NCAHF in future cases if the Plaintiff prevails in the instant action and thereby wins funds to enrich the litigation fund described by Dr. Barrett. It is apparent, therefore, that both men have a direct, personal financial interest in the outcome of this litigation. Based on all of these factors, Dr. Sampson and Dr. Barrett can be described as zealous advocates of the Plaintiff's position, and therefore not neutral or dispassionate witnesses or experts. In light of these affiliations and their orientation, it can fairly be said that Drs. Barrett and Sampson are themselves the client, and therefore their testimony should be accorded little, if any, credibility on that basis as well (2001).

The principal evidence offered by 'NCAHF was a collection of Internet web-page downloads from the Defendants' web-site... These documents established only what Defendants' claims were, not the alleged falsity of those claims. Plaintiff offered no evidence pertaining to the specific products in question' (2001). The court noted that the NCAHF attempted to place the burden of proof onto the 'defendant to prove that it was not violating the law' which the court rejected as 'unfair' (2001).

The NCAHF appealed and the Consumer Justice Centre (CJC) was allowed to file an *amicus curiae* brief to support NCAHF. The CJC attempted to shift NCAHF's original argument to one of unfair competition but this was rejected by the appeals court (2003). The appeal court noted the trial court had correctly found NCAHF had failed to prove their case and the 'witnesses who had no knowledge of, or experience with, King Bio's products, and who were found to be biased and unworthy of credibility' (2003).

The loss of court cases by those initiating SLAPPs is not uncommon; 77 per cent of those heard by courts are won by those being sued. What SLAPPs achieve is the deterrent factor; many of the people targeted are scared off with the threat of a SLAPP. Those challenging a

SLAPP will pay in time and money defending such actions which takes attention away from their focus on the controversy. Contesting a SLAPP also forces debate into the legal sphere and away from a public political debate where success may have a more far-reaching effect on public policy (Beder 2000, pp. 64-66).

The Language of Science and the Money of Industry

A similar strategy is used by industry funded organisations and their ‘experts’ in tort litigation which target cases perceived as a threat to industry interests. A common tool is the use of an amicus curiae brief to attack the credibility of scientific claims (Galbato 1998, pp. 274-278; Edmond and Mercer 2004a). This strategy has been assisted by the 1993 US Supreme Court case *Daubert v Merrell Dow* that has resulted in more restrictive criteria for the admissibility of scientific evidence. Many people seeking compensation for a range of injuries have had their cases challenged and dismissed by the Courts when industry sponsored organisations have tendered an amicus curiae brief in which experts claim a lack of adequate scientific evidence is presented by those seeking compensation for injury.

Among the numerous targets for this industry strategy are those people that develop MCS in the workplace (Galbato 1998). The case of *Theresa Canavan v Brigham and Women’s Hospital* demonstrates this line of attack by the resources and people marshalled to challenge one woman’s attempt to gain compensation for workplace injury and disability which included MCS. While her workplace compensated her for the symptom of sinusitis it rejected her disability claim. Her doctor testified in court that she developed MCS as a result of ‘chemical poisoning’ in the workplace and Canavan subsequently won that case. The hospital appealed on the grounds that her physician’s evidence did not meet the principles of scientific validity but the appeals court endorsed the original ruling. The case was appealed again and went to the Massachusetts Supreme Court where the Atlantic Legal Foundation (ALF) filed an amicus brief that had ‘the name of fifteen distinguished scientists’ attached, a number of which were also amici in the ALF brief filed in the *Daubert* case (Atlantic Legal Foundation). The scientists for the *Canavan* amicus brief

included Ronald Gots and James Watson who with Francis Crick won the Nobel Prize for discovering the structure of DNA.

The Massachusetts Supreme Court overturned the original case and it is worth examining the ALF amicus brief's arguments which were similar to the CMA amicus brief logged in this case. The essential AFL argument was a concern for scientific validity and the process scientists use to determine such valid knowledge. To support this argument the ALF amici curiae brief cited a previous Massachusetts case *Commonwealth v Lanigan* and quoted the *Daubert* case that stated that 'Scientific methodology today is based on generating hypotheses and testing them to see if they can be falsified' (quoted in Brief of Amici Curiae of Angell et al. 2000). Such simplistic formulations of the processes of science are at odds with the more complex reality of practices of science but are all too common in the legal sphere and are particularly apparent in the *Daubert* case (Edmond and Mercer 2004a, p. 242).

The brief goes on to say that an 'expert's opinion must "have a reliable basis in the knowledge and experience of his discipline"' (Brief of Amici Curiae of Angell et al. 2000). Since those who submitted the brief put themselves in the position of experts it follows that they also must subscribe to the principles of scientific methodology they purport and have a 'reliable basis' in making claims from within their discipline for their claims to have validity. Examinations of the reality of scientific practices reveals a considerably more messy and political process. For example Watson's role in undermining Rosalind Franklin's professional contribution to the development of the DNA model and his personal attacks against her as a stereotypical 'blue stocking' feminist served to justify Watson's use of her data without due credit (Sayre 1975).

In addition, Ronald Gots has, as previously discussed, significant political and economic interests with respect to marginalising MCS claims which have shaped the type of science he subscribes to, the arguments he runs and the organisations he operates or is affiliated to. Often legal commentators, while correctly problematising the difficulty of scientific knowledge claims relating to causation, and consequently the difficulty of people with

MCS seeking legal redress, do not give the same attention to the claims of industry and their amicus briefs (see Galbato 1998). However, what Galbato does identify is that while the US Fifth circuit courts have recognised ‘environmental illness’ as a disability under the Social Security Act, courts have rejected environmental illness arising from the workplace. The key issue for the courts is not existence but causation ‘when causation is not in controversy, scientific validity under *Daubert* will not necessarily block the admissibility of MCS testimony’ (Galbato 1998, p. 295). This appears to align with the long held view of industry that it is not important if a person is made ill or disabled but whether causation is attributed to industry action or lack thereof. For industry, costs that are born by the individual or government are preferable to costs imposed on industry.

The role of industry think tanks such as AFL and the Manhattan Institute and the court system is extensive. Both have claimed to have influenced the role of evidence introduction in the US and are involved in both legal commentary and the use of amicus briefs to champion industry arguments in strategic cases (Edmond and Mercer 2004a, pp. 244-246). A key person at the Manhattan Institute is Peter Huber, known widely for the popularisation of term ‘junk science’ (Huber 1991). Huber takes aim at many contested illnesses in the legal sphere including those involving clinical ecologists such as MCS. Huber adopts a range of strategies including using history to justify arguments of a largely psychological origin for MCS that predates modern industrial chemicals. For example, he cites Hippocrates’ use of the term hysteria to represent a range of ill defined medical complaints and a 1881 article dealing with neurasthenia which was a nervous condition with multiple symptoms (Huber 1991, pp. 107-108).

Later texts by Huber have also taken aim at clinical ecology and other contested illness but also serve more as rhetorical guides for the courts rather than addressing the processes of science and causation (Edmond and Mercer 1999). The term junk science with its caricatured image of science has found favour with judges and opponents of contested illnesses such as MCS. Edmond and Mercer have argued that the result of the *Daubert* decision is that it has provided a legal platform to exclude evidence which has been built on by subsequent cases ‘refined in corporate foundries’ and has resulted in ‘the apparent

convergence between *judicial* and *corporate* attitudes’ (Edmond and Mercer 2004a, pp. 251-252) While the majority of citations of Huber in the courts have been used to exclude evidence including that involving MCS, other citations have been used to include science deemed good as opposed to junk (Edmond and Mercer 2004b, pp. 218-224).

Gots’ ability to align with industry concerns and those of courts, via his interpretation of science and medicine, is now juxtaposed to another of his numerous enterprises. Gots was the founder and former medical director of Medical Claims Review Services (MCRS). This company provided ‘paper reviews’ to State Farm Insurance, the largest insurance company in the US. Paper reviews are external reviews of insurance claims by doctors and involve doctors examining the patient’s accident and medical reports but not the actual patient. State Farm argued that it used paper review for claims that were questionable; these numbered about 35,000 a year (Larson 2000). Such reviews are in essence explanations of causation and are instructive of the flexible position of industry advocates in relation to MCS and analogous to the role of industry amicus briefs.

John Larson on the NBC Dateline program investigated the paper review process and found serious problems with the processes including that doctors did not write or sign a large number of these reports (Larson 2000). Gots initially argued that while ‘someone else did the calligraphy’ doctors always read and checked all reports. Gots stated that ‘A doctor read every one’ and when asked if he read all reports Gots said ‘That’s right’ (quoted in Larson 2000). However, when asked about the claim that this was not the case according to a former MCRS doctor Gots then said that ‘It was certainly not standard practice [that a doctor did not read the reports]. It may, I can’t say that it, excuse me, never happened. But it was certainly not standard practice’. Under further questioning when asked by Larson whether this was 10-15 per cent Gots said ‘That would be my best guess. And it’s a guess at this point, that went out under our medical director’s signature, that had been reviewed by the nurse’ (quoted in Larson 2000). The result was that hundreds were not looked at by a doctor and these were used under the name of a doctor to deny medical claims.

A small sample of medical reports done by MCRS for State Farm was obtained by Larson and all 79 reports favoured State Farm. All these reports advocated either denying the claim or cutting back the benefit. Jack Mathus, a former State farm superintendent, stated the trend to use paper review to deny benefits was a 'company-wide program, and it is decisively and deliberately orchestrated' and that 'There's only one motivation for using a paper review. And that's to increase profits by reducing costs' (quoted in Larson 2000).

One of the people MCRS reviewed was Cindy Robinson who was injured in a car accident and required surgery for a herniated disk in her back. MCRS stated her injuries were 'minor' and were the result of 'work related activities'. Robinson pursued a law suit against State Farm who in turn organised another doctor to do a paper review. This time the doctor found that her injuries were the result of the accident and State Farm agreed to pay all her medical bills. Robinson continued the lawsuit because she felt it 'was too little too late' and eventually was awarded 10 million dollars in damages and the judge denied State Farm's request for a new trial. The judge termed Gots' company MCRS a 'completely bogus operation' that produced 'cookie cutter reports' and that State Farm was aware that these reports 'were not objective, but slanted to favour the denial or reduction of claims' (quoted in Larson 2000).

Of the 79 MCRS reports identified by NBC, State Farm claimed it subsequently paid most of them in full. Gots' company MCRS went out of business in 1995 but he still claimed his company was treated unfairly at the trial. He claimed his company was 'above standards in industry by far' and that other companies were worse as 'they don't even have doctors. They have all nurses or clerical people to do reviews' (quoted in Larson 2000). Gots' biased practices and bogus company clearly demonstrates an absence of ethical practice. His focus is on profiteering for himself and those corporations he represents at the expense of those injured and the wider public interest. His claim of MCRS industry superiority provides little reassurance. Rather than accepting responsibility he shows little regard for principled scientific or medical practice. Consequently his attempts through his various organisations, publications and ongoing role in the court system testifying on behalf of corporations against people with MCS lack any legitimacy. His actions also highlight

industry activities to minimise costs. Such cost minimisation strategies have less to do with identifying causation within areas of scientific or medical practice and more to do with providing a justification using the language of science and the money of industry to shift the blame onto the individual.

I will now examine the first workers compensation case in Australia relating to cabin fume exposure.

Workers Compensation and the BAe 146

Internationally there have been numerous legal cases in relation to the issue of health effects resulting from cabin fumes. In Australia, similar strategies are evident to those utilised in MCS (and State Farm) cases in the US. This includes shifting causation from a position of potential industry liability to one that attempts to locate responsibility onto the individual. Many aircraft crew have been unable to continue flying due to long term health effects that have included MCS. However, recognition by the courts of such health effects has been problematic.

In Australia Alysia Chew, who was employed as a flight attendant on BAe 146 aircraft, suffered a range of health complaints. Chew was employed by Ansett and East West Airlines between 1990 and October 1993 and has been unable to continue working in airlines due to illness. In the first workers compensation case for cabin fumes in Australia her symptoms were listed in the Compensation Court of NSW. These included

Headaches, sore throat, eye condition, nausea, breathing difficulties, chest tightness, fatigue, low white blood cell count, skin rash, sensitivity to petro-chemical substances, enlarged glands, sinusitis, recurrent pharyngitis, lethargy, post-viral syndrome precipitated by fume exposure, permanent reaction to chemical exposure (1999, p. 2).

Chew reported ongoing symptoms to physician Dr Tan on 22 June 1992 whose notes were summarised in the court judgment. These reported that she was 'ill following fumes

exposure on aircraft and the symptoms included giddiness, vomiting, difficulty breathing, sort chest (sic), sinus, sore throat and that morning coughed up phlegm and it looks like it had red, green and yellow bits through it' (1999, p. 2). She had also mentioned to the doctor that other flight attendants had similar symptoms. The doctor gave her a few days off work and she subsequently returned to work. In December 1992 Chew developed swollen glands in her neck and underarms. Following tests in January 1993, results found that she had glandular fever or Epstein Barr virus.

In October 1993 Chew was exposed to another onboard fume incident on a flight from Hobart to Sydney and stated that from the third row she could not see 'the last probably three to four rows of passengers and I alerted the purser who alerted the captain and we actually thought there was a fire in the toilet' but was not. Chew noted one passenger was 'gagging', the pilot ventilated the cabin but visibility was still 'very hazy'. The day's events were also confirmed by Magda Cotton who pointed out the plane stopped on the tarmac after taxiing 'so that the doors of the cabin could be opened to let out the smoke coming from the air-conditioning ducts' (1999, pp. pp. 2-3, 5). When Chew left the plane she was feeling very ill. This was the last time she worked on aircraft. Chew also stated that following her inflight exposures to fumes she developed problems with car exhausts, hair spray and perfume.

In court Chew's lawyers said there were two possible causal approaches to her disability both relating to cabin fume exposure.

The applicant alleges that TOCP as a toxic substance caused damage to the applicant's physiology which gave rise to the applicant's chronic ongoing symptoms and disabilities diagnosed by her doctors as "Multiple Chemical Sensitivity" ("MCS"). Alternatively the applicant alleges her symptoms and incapacity have resulted from aggravation of a condition of glandular fever or viral infection described as an Epstein Barr virus; that aggravation occurred over the period January 1992 until October 1993 and the effects of that aggravation are still present (1999, pp. pp. 1-2).

Judge Moran rejected the argument of MCS preferring the argument that she suffered aggravation of glandular fever or Epstein Barr. Moran agreed that the condition was ongoing and awarded compensation (1999, pp. pp. 10-13). Remaining unresolved was that many of her symptoms predated her diagnosis of a viral infection.

A key witness supporting Chew was Dr. Mark Donohue. He claimed that Chew had developed MCS and Chronic Fatigue Syndrome (CFS) as a result of her exposure to toxic chemicals at work. Other doctors for Chew included Dr. Fluher who identified Chemical Hypersensitivity as a result of toxic chemical exposure that also resulted in her developing CFS. Both Donohue and Fluher are general practitioners with an interest in environmental medicine. Dr Little, a specialist physician, also identified chemical sensitivity that has in turn resulted in CFS (1999, p. 6).

Chris Winder stated that Chew had developed MCS as a result of her work principally working on 'aircraft in which the engines or associated equipment leaked contaminants in to the passenger compartment' (quoted in 1999, pp. 7-8). Another witness for Chew was Dr Wakefield, a Professor of pathology and Director of Immunology and Immunopathology, Eastern Area Health Service, who said that 'her exposure to fumes in the aircraft cabin led to an aggravation, acceleration and exacerbation with deterioration of her disease (postviral fatigue)' and that this would 'preclude her from continuing with her pre-injury employment duties as a flight attendant on aircrafts where she will be exposed to petro-chemical fumes such as those emanating from synthetic oils used on aircrafts (sic) (quoted in 1999, pp. 6-7).

A witness for the airlines, R. J. Cain, an aircraft engineer, acknowledged the problem of oil entering in BAe 146 aircraft cabin and the occurrence of symptoms in people and that the filtration system introduced in October 1992 'was never to rectify the problem, it was to provide some relief to the problem' (1999, p. 4-5). He noted that there were approximately 128 reports made in the years 1996 to 1998 and also acknowledged that this problem occurred in Canada, Europe and the UK.

Another witness for the airlines, Dr. G. Crank, an organic chemist, reviewed other doctors' submissions to the case in addition to three reports from Dr. V. Vasak on tests carried out in 1992 and an Allied Signal Aerospace study in 1997 (see Chapter 3 for a discussion on the limitations of Vasak and Allied Signal reports). Crank acknowledged that Mobil Jet Oil II (MJO) contained the toxic substance tri-ortho-cresyl phosphate (TOCP) but noted that it was present as low as 0.03 per cent (see Chapter 4 for a discussion on the limitations of viewing toxicity of MJO too narrowly). Crank also claimed that there was no toxicity as a result of fumes entering an aircraft even when an aircraft is using air at 60 per cent fresh and 40 per cent recirculated. Such unqualified certainty that there was no toxicity does not appear 'scientifically' sustainable given the state of knowledge when Crank presented his evidence on the 15 and 16 December 1998. Later in 2000, van Netten pointed out there are many compounds that make up jet oils that have not been analysed and Mobil 'has a rough idea of what the composition is of their oils but does not have a clear picture of the different isomers' (quoted in SRRATRC 2000, p. 37). Nonetheless, Judge Moran accepted the opinion of Crank and dismissed the evidence of Winder because he did not consider the amount and extent of exposure 'but predetermined that there had been harmful exposure' (1999, p. 8). That Crank predetermined the safety of exposure and the aircraft was not in question.

Medical doctors that gave evidence for the airlines included Dr Robert Loblay, specialist physician and Senior Lecturer in immunology at the University of Sydney, Dr Pat Carroll, specialist physician, and Dr Julian Lee, thoracic physician. Lee stated he did not accept MCS as a recognised medical illness. This position was reiterated by Carroll, testifying on 16 December 1998, that he did not accept the concept and stated that 'where non clinicians support the claim they do so in contradiction to all published literature by scientific organisations' (quoted in 1999, p. 9) This is a curious statement given that clinicians from various disciplines and with differing views on symptomology and causation have been debating and publishing material on this illness from the late 1980s when the name MCS was first coined by Dr Mark Cullen (BESTCLSNRC 1992; Ashford and Miller 1998). The statement appears to mean that these doctors reject any physical causation. The implication

is that ‘valid’ science would make the problem simply disappear.⁴⁵ Therefore Carroll effectively seeks to deny those people not only the diagnosis of MCS but the lived experience of their physical symptoms.

The Consensus Statement by the Ansett Odour Committee and signed by Carroll and Loblay was submitted to the court. It is worth noting some of the content that was cited in the judgement.

The panel finds that the low levels of detected exposure to all the measured chemical contaminants are not a threat to the health of aircrew or passengers. In particular these pose no carcinogenic, mutagenic, teratogenic or cumulative toxicological hazard.

Contaminant levels were found to be well below the internationally accepted occupational health standards and cannot precipitate any chronic disorders.

The possibility that these odour exposure events could cause flight crew incapacitation was considered. All the measured levels were hundreds to thousands of times below those levels known to cause acute neurotoxic sequelae. The standard Smoke Removal Procedures were considered to provide a large margin of safety (quoted in 1999, pp. 8-9).

Here the Odour Committee is asserting health and safety, however, the previous discussion in Chapter 5 identified a number of limitations of this expert committee including industry dominance, and that employee and union members of this committee refused to sign the statement. Moreover, Chapter 5 also documented that in spite of initial claims to the contrary, by CASA and industry, CASA subsequently admitted there were ‘no worldwide standards for air quality in aircraft’ but under regulation FAR 25, ‘Crew and passenger

⁴⁵ Neither science nor medicine operates in isolation from the social context as many contested health issues evolve and change over many years. For example the eugenics movement was once viewed as both progressive and at the forefront of scientific practice with widespread industry support. This was in contrast to the more environmental philosophical position of social work which was viewed as non-scientific and the purview of ‘bleeding hearts’ Allen, R. F. (1987). *The Role of Experts in Scientific Controversy. Scientific Controversies: Case Studies in the Resolution and Closure of Disputes in Science and Technology*. H. T. J. Engelhardt and A. L. Caplan. Cambridge, Cambridge University Press: 169-202.

compartment air must be free from harmful or hazardous concentrations of gasses and vapours' (quoted in Australia Senate 1999a, pp. 38-39). Furthermore, the evidence of numerous cabin fume incidents on BAe 146 aircraft including pilot incapacity highlights the inadequacy of such procedures and claims. The evidence of Cotton documenting Chew's last working flight indicates the plane stopped after taxiing so that the doors could be opened to clear fumes, clearly the benefit of such procedures cannot be applied at altitude. Also telling was that during the flight Chew said the air remained 'very hazy'.

Loblay took issue, in testimony on 15 December 1998, with the doctors supporting Chew's case apart from Wakefield labelling them 'all adherents of the "Clinical Ecology" school of thought concerning "Multiple Chemical Sensitivity"' and claimed Donohue's report was not valid. He also raised the issue of medical research that suggested an 'individual's belief about the nature of an odour (e.g. that it is potentially harmful), based on what they are told by an authority figure, can modify their subsequent degree of sensitivity' (quoted in 1999, p. 9). Loblay rejected the label for Chew of MCS arguing 'she has a tendency to food intolerances' and stating her illness was a 'sensory phenomenon, rather than a "disease" process, and a diagnostic label of this kind creates quite the wrong impression in the mind of the patient'. Here Loblay imputes that psychological factors with the patient rather than a physical illness are the issue. However, Loblay agreed that the aggravation was more than likely due to her susceptibility but these were similar to statements made by Council for the airlines.

Loblay added, regarding MCS, that 'There is an emerging international consensus that this term should be abandoned altogether. Unfortunately, clinical ecologists have a vested interest in promoting its continued use' (1999, p. 10). Here he alludes to the suggested name change to IEI that arose from an IPCS Workshop, which Loblay wrote about earlier in the year and was discussed above (see Loblay 1998). This approach is similar to approaches by other 'experts' in the US; discredit professionals that support a MCS diagnosis, suggest a strong psychological component of those ill and disabled claiming MCS and seek institutional legitimacy from other bodies to support their claims. As the controversy surrounding the suggested name change for MCS in the IPCS Workshop

demonstrates, those with a concern for MCS or clinical ecology also want science and medicine not to be dominated by crude industry agendas that privilege corporate interests and corporate science above workers and public.

Personal Attacks at the BAe 146 Senate Inquiry

A number of doctors that appeared in the Chew case also appeared in the BAe 146 Senate Inquiry. It is worth examining some of the interactions between Loblay and other doctors that testified or made submissions to the inquiry, particularly Donohoe, as Loblay and Donohoe arguably represent the public and medical face of the two competing camps with respect to MCS debates in Australia (Donohoe 1998; Loblay 1998). This professional and personal tension between the two long predates the Senate BAe 146 Inquiry. Loblay's approach during testimony before the Senate Inquiry was to critique the chemical causation of illness and those medical doctors, researchers and aircraft crew who claimed a chemical causation. The personal and professional tensions clearly indicate the social and political processes involved in this debate.

Loblay noted that his invitation onto the Ansett expert panel arose after he contacted David Lewis, the Medical Director at Ansett, and provided him information about Donohoe. Loblay also noted that he did not accept any money for his panel membership as he did not wish to compromise his independence; however he made no such claim regarding his expert testimony at trial against aircraft crew on behalf of airlines that included Ansett. He also admitted that he had no experience with those aircraft crew that had been made ill on BAe 146 aircraft (Australia Senate 2000b, p. 101). The lack of knowledge has not precluded Loblay from making a range of statements both to the inquiry and courts. This lack of expertise and familiarity with aircraft crew is overcome by a preparedness to advocate on industries behalf and has similarities with those industry advocates discussed previously in the US, for example by Barrett.

During Loblay's appearance before the Inquiry he spent a large amount of time attacking the qualifications and assessments of doctors noting that Donohoe 'is not a mainstream

medical practitioner... his views are not considered to have much scientific validity within the mainstream speciality areas of medicine. This is common knowledge' (Australia Senate 2000b, p. 101) He then proceeded to attack Donohoe's submission to the Senate Inquiry and his practice and made personal attacks including claiming he used 'bogus' letters after his name. Nevertheless, when questioned by the Chair Senator Woodley whether Donohoe's MBBS was bogus, which were the only letters used by Donohoe in his submission, Loblay said no.

Donohoe had appeared prior to Loblay's testimony and noted that he was contacted in 1998 by David Lewis of Ansett and was invited to a meeting. He recalled that this was the first time that any company employees had attempted to get him to change his view stating 'I felt there was a threat – an implied threat more than a direct threat – that it would be in my interests to withdraw statements that I had made about safety on the jets and the health of the people I had seen who had been flying on those jets' (Australia Senate 2000b, p. 94). Donohoe had also stated that a judge said in a compensation court that he was deregistered and that he was not a credible person. The judge later contacted him and withdrew all comments in writing and claimed this was a result of comments made in the Ansett case. Donohoe also noted that people who hold the view that there are long term health effects have had their reputations damaged and that expert committees have excluded people that hold such views (Australia Senate 2000b, p. 94). Along with the aircraft crew Donohoe had treated he saw two passengers who became ill following travel on BAe 146 aircraft (Australia Senate 2000b, p. 96)

Loblay criticised Winder's and other submissions that argued the potential increased toxicity of chemicals at altitude due to the lower availability of oxygen using the example of carbon monoxide. Loblay agreed that carbon monoxide was more toxic at altitude but argued that using it as an example to suggest other chemicals are more toxic at altitude is misleading and 'arm waving pseudoscience' (Australia Senate 2000b, p. 102). He said if this was true there would be recommendations on medication at altitude. The following day Susan Brookes of the Flight Attendants Association of Australia (FAAA) challenged Loblay's claims pointing out that their training manual notes 'alcohol, nicotine and some

other drugs' are influenced by lower oxygen availability and that part of first aid training is to examine passengers for such effects (Australia Senate 2000c, p.160). Moreover, for researchers examining the possibility that chemicals from jet oil may have increased toxicity at lower levels of oxygen availability appears to be prudent, rather than being pseudoscience, given the risks to aircraft, crew and passengers.

Another doctor Loblay criticised both personally and professionally was Richard Teo. Loblay claimed that Teo's evoked response testing which examined altered brain functioning should be taken 'with a grain of salt' because of methodological problems. Loblay admitted that Teo's early neurotoxic testing on people exposed to solvents had shown that these people were 'abnormal' when compared to healthy people. This was when Teo was working at the same clinic as Loblay around 1994 (Australia Senate 2000b, pp.102-103). The key methodological problem for Loblay appears to be using the test on populations with less clearly defined exposures.

In Teo's submission he said that the two pilots and three flight attendants (it was 7 flight attendants by the time he appeared before the Senate Inquiry) had been assessed and all had indicated a significant dysfunction in their ability to process information (Australia Senate 1999e, p. 15). He noted that this was a significant flight safety risk which would be exacerbated with further exposure to BAe 146 environment. When Teo appeared before the inquiry he argued that Loblay's assertions were incorrect and that he was 'lying'. Teo said he had been examining the impact of chemical exposure on people's cognitive processes since 1980 (Australia Senate 2000b, pp. 108-110). Teo's research also included the impact of organophosphate exposure on brain function as did his PhD. His submission listing 46 publications and numerous conference presentations confirmed a considerable breadth of experience in this area with his publications dating back to 1979. One of these publications from 1993 included Loblay as co-author which might explain Loblay's qualification about Teo's early testing.

Regarding methodology Teo asserted that he took a detailed case history to narrow possibilities rather than eliminate all possibilities. He believed that because the people he

saw him came from a number of different flights all with impaired functioning that this presented a greater risk in terms of occupational health and safety. This he argued needed to be examined particularly given that it occurred in an aircraft. He also advocated a research project in which air quality and the health of the people flying should be monitored. Teo noted that those he had examined had exhibited problems for two years and that these people may continue to exhibit problems (Australia Senate 2000b, p. 110).

Loblay also attacked Dr Judy Ford personally and professionally; he had contacted and lodged a complaint with Ford's professional body (Australia Senate 2000b, p. 103). Ford had done genetic testing on five cabin crew and pilots of BAe 146 aircraft finding three people had significant exposure to chemical toxins whereas the other two did not reveal abnormal cells (Australia Senate 1999g, pp. 73-77).

Aircraft Crew vs. Industry Representatives

Another target for Loblay was the aircraft crew who documented their health problems to the Senate Inquiry. Loblay acknowledges air quality and fume issues on BAe 146 aircraft and irritant symptoms but has sought to shift the illnesses of the cabin crew from a systemic problem of chemical exposure to an individual psychological problem. He dismissed many of the symptoms of aircraft crew such as Judy Cullinane who made submissions labelling them 'non-specific'. Yet he also went on to stress other causative models rather than chemical toxicity and neurotoxicity. He argued that symptoms such as 'dizziness, inability to think clearly, pins and needles in the arms and legs and around the mouth, blurring of vision and tunnel vision' are symptoms of 'acute hyperventilation' (Australia Senate 2000b, p. 103). Loblay also introduced the term hysteria and acute anxiety to better explain the symptom of tunnel vision. Brendan Treston of the Flight Attendants Association of Australia pointed out while hysteria and hyperventilation may occur for some, his organisation had over 700 fume reports going back to the early 1990s. He argued that hyperventilation does not account for flight attendants vomiting blood, having ulcerations on their oesophagus or becoming stupefied over a considerable time period (Australia Senate 2000c, p. 160).

A number of aircraft crew made public and private submissions to the inquiry and it is worthwhile examining the health and safety problems they identify. Deborah Carter, a flight attendant on BAe 146 aircraft, had to leave her job in 1995 after 14 years due to illness resulting from fume exposure on this aircraft. The trigger for Carter was a particular fume incident on 14 November 1994 in which all flight attendants put on portable oxygen. Passengers were 'projectile vomiting' and very distressed. Her symptoms from this flight included 'burning eyes, nausea, headaches, sore throat, numbness down the right side of my body'. Two other flight attendants on this flight have also resigned due to illness.

Carter notes that she was ill for two years after the November incident and still has effects but obtained alternative employment in July 1996 (Australia Senate 1999h). Carter was rejected for medical compensation in 1995. One of the key reports rejecting her claim was done by Dr Pat Carroll who was a consultant for Queensland Workcover and Insurance Companies and later joined the Ansett Expert Committee and testified on behalf of Ansett at court. Carter made another attempt at medical compensation in 1997 following the return of dermatitis that she had developed previously following her exposure to fumes in November 1994. In a District Court of Queensland Appeal Carter requested the three year time limit for workers compensation be waved. She rejected the earlier medical assessments including Carroll's report for the Workers Compensation Review Board based on his examination of her on the 6 March 1995. Carroll's report of 21 April 1995, which was accepted by the compensation Tribunal, stated:

The issue of contamination of cabin air on the BAe 146 has been discussed and investigated at great length...No levels of any clinical significance have been found. The presenting features of the claimant are much more consistent with a viral illness. No toxic exposure causes this manifestation of symptoms. In particular, the skin rash is simply not compatible with toxic exposure and is compatible with a viral illness, particularly its resolving nature... Essentially there is no diagnosis (as multiple chemical sensitivity)...I am unable to find any supporting evidence for this plan (quoted in 2000).

Previously, in 1994, one of Carter's doctors, Dr Knowles, diagnosed 'recurrent pharyngitis and malaise' as a result of 'fumes in aircraft'. In 1995, Dr Terry diagnosed 'chemically induced erosive gastritis' as a result of occupational exposure to chemicals via inhalation and Dr Swain identified MCS as a result of 'exposure to noxious fumes in aircraft' (quoted in 2000). The Appeals court granted Carter leave to appeal noting that the Chew case and the reports submitted to the Senate Inquiry had brought up additional information that she was not aware of. The Appeal Court also noted that reports submitted to the Senate Inquiry documenting health, toxicological and BAe 146 seal problems occurred after Carroll's report. The Appeal Court noted this new information 'shows that the BAe 146-200 aircraft had a problem with oil seals, allowing toxic fumes to enter the cabin. Those fumes have been shown to cause long term health problems...If accepted, they tend to show that Dr Carroll's opinions about Ms Carter were wrong' (2000). The Appeal Court added that in the event another court takes a different view or fails to prove her case 'then consideration at least might be given to a reopening of the compensation claim' (2000).

Robin May, a pilot with 31 years' experience, was forced to leave work due to health effects from cabin fumes. She noted that in spite of the airlines having evidence of the hazard of fumes she and others were not told when they began being ill in 1993/1994. May has ongoing symptoms including severe nausea, chest pain, vertigo and skin irritations. In 1993 she had chest pain and tightness during take off and experienced nausea. Tests for heart problems showed no problems. Her pilot's licence was cancelled by CASA in February 1996 due to 'disabling chest pain' (Australia Senate 1999j, p. 43-45).

Judy Cullinane, a former flight attendant with Ansett, made a large and detailed submission to the Senate Inquiry and highlighted many problems with industry assertions (Australia Senate 2000n). She noted whilst flying on the same plane on 6-8 November 1997 she initially felt nausea and fatigue. Cullinane and other flight

attendants had a large amount of swelling and extreme tiredness. Just after take off on 8 November she felt a wave of heat from the top of her head to chest that was followed by intense pressure; other symptoms were nausea and tiredness. Cullinane then went to notify the crew but was unable to move or speak until the plane touched down and the symptoms slowly lifted. Cullinane was unable to continue working as a flight attendant due to a number of health complaints resulting from fume exposure including impaired memory, dermatitis, hair loss, lethargy and MCS. In 2002, Cullinane reached an out of court settlement with Ansett for an undisclosed amount (Stephens 2002).

Susan Michaelis, a former BAe 146 pilot for National Jet Systems (NJS), which are run on behalf of Qantas, made a submission to the inquiry outlining her experiences (Australia Senate 2000s, pp. 215-217). Michaelis recounted the increase in frequency and intensity of symptoms over time. These included ‘headaches, fatigue, nausea and nose throat and voice irritations’ (Australia Senate 2000s, p. 216). Michaelis also recounts the flight safety risk posed as the ‘symptoms frequently impaired my ability to operate the aircraft efficiently/safely’ (Australia Senate 2000s, p. 216). As noted in Chapter 5 the CASA Aviation Medical Office must have viewed flight safety as an issue with Michaelis because following a medical review they refused to issue her a medical certificate in 1999 leading to a loss of her pilot’s licence. Michaelis notes:

I am most concerned that the recognised issue of oil fumes has continued unresolved for so long with its obvious implications for ongoing crew ability to operate the aircraft safely and efficiently, when so frequently faced with symptoms associated with oil fumes, as well as the long term illnesses faced by many like myself, including other pilots.

I have now lost my health and career and find this an unacceptable loss. This problem has essentially been brushed under the carpet for too long and must be fixed before any more serious incidents occur, possibly again involving

incapacitation of one or both pilots and a possible tragic outcome (Australia Senate 2000s, p. 217).

Michaelis subsequently researched and wrote a number of articles dealing with cabin fumes and the risks posed. Many of them are addressed below.

Lesley Williams, a former BAe 146 flight attendant with NJS from July 1991 to October 1997, made a lengthy submission. She was forced to leave work due to illness and is no longer working as a flight attendant. Her symptoms included ‘very poor short-term memory, extreme fatigue out of all proportion to the length of shift, unrefreshing sleep (more like being unconscious), inability to read the newspaper (words above and below the line I was reading would jumble into it, making the sentence incomprehensible), chronic sore throat, chronic rhinitis, irregular heartbeats, and intermittent, painful, blistering facial skin rash’ (Australia Senate 2000t, p. 221). The latter she only recently attributed to fumes after observing ground engineers with similar symptoms and a friend after exposure to organophosphate sheep dip. She had also been diagnosed with MCS.

Williams flew almost exclusively one plane which ‘reeked all flight, every flight’ and was instructed to tell complaining passengers that the auxiliary power unit (APU) picked up the smell of oil. Williams also challenged UK Civil Aviation Authority claims that jet oil leaks only occur once in every 22,000 flights. Williams calculated that flying for a 2.5 year period crew and passengers were exposed on 621 days. If this is factored in terms of four sectors a day, one sector is one take off and one landing, she calculated 2277 exposures (Australia Senate 2000t, p. 221).

Richard Buncher, a former pilot on NJS, also made a submission to the Senate Inquiry as a result of his flight experiences. He had two periods flying BAe 146 aircraft during his 10 year career with NJS. It was during his second period between 1996 and 1999 that he suffered a range of symptoms including ‘severe and continuing headaches, continuous cough, skin irritation (particularly at the extremities), eye irritation and swelling, unreasonable and lasting fatigue’. He noted that symptoms such as headaches and fatigue were ongoing while other symptoms ceased when exposure ceased (Australia Senate

2000u, pp. 249-250). He also addressed flight safety stating that ‘I have no doubt that my in-flight performance was degraded by exposure to fumes’ (Australia Senate 2000u, p. 250). Buncher resigned from the company and stopped flying this aircraft type, to avoid ongoing exposure to fumes. He is still flying and is currently a Tactical Captain flying Learjets on Military Contract.

Frank Kolver, the Captain of the NJS BAe 146 aircraft, made a written submission and appeared before the Senate Inquiry. His experience along with another pilot affected by fumes on 10 July 1997 resulted in the Bureau of Air Safety Investigation (BASI) Incident Report and was one of the catalysts for the Senate Inquiry (BASI 1999). Kolver’s submission documents a number of symptoms following this incident including feeling like he had ‘a continuous hangover with a constant headache’ (Australia Senate 1999c, p. 3). He also felt a ‘strong pressure on top of his head’ and was dizzy (Australia Senate 1999c, p. 3). Whilst travelling in a car he became nauseous after 20 minutes and would have to stop. He was off work for two months and his condition slowly improved however when he returned to work he still often suffered headaches and pain in the temple area. Medical examinations, blood tests and a CT scan gave no indication of any problem.

Kolver was the subject of another fume event on 2 June 1999 when he had attempted to isolate the air supply ‘but we were unable to notice a difference or verify a source’ (Australia Senate 1999c, p. 4). At the end of the day Kolver had a headache and was nauseous ‘Later the same evening I became quite ill with severe headache and vomiting’ (Australia Senate 1999c, p. 4). He was off work for another 26 days with similar symptoms of headaches in the temple area, head pressure and feeling hungover. A further medical examination did not reveal the source of the headaches and he returned to flying.

In explaining why aircraft crew have greater symptoms than passengers, Loblay identified the spreading of a ‘belief system’ in a work population to explain why employees believed their symptoms were work related, ‘People’s beliefs often lead them to mistakenly attribute common symptoms or anxiety symptoms to toxic exposure when they are in an environment where they believe there are toxic chemicals’ (Australia Senate 2000b, pp

103-104). The greater time spent on fume prone aircraft by employees compared to passengers is overlooked by Loblay, nonetheless he is quick to claim others such as Donohoe ‘have no scientific basis’ (Australia Senate 2000b, p. 104).

Loblay also attempts to narrow discussion to normal conditions and claimed that ‘under normal cabin conditions, not when there is a leak’ it was unlikely that this could result in toxic effects (Australia Senate 2000b, 105). However, Loblay admitted he did not know the complete details regarding the 10 July 1997 BAe 146 incident. Loblay noted that he was not sure if the incident resulted from fumes but was confident enough to add,

As I said before, in circumstances where a person is exposed to a smell and believes that that smell might be toxic or dangerous, they can become acutely anxious, hyperventilate and then lose control of their faculties. The symptoms that were described in that particular case suggest to me that the pilot panicked (Australia Senate 2000b, p. 106).

Captain Kolver, rejected Loblay’s claims and pointed out that prior to the 10 July incident he had travelled on the same plane on 12, 19 and 20 June 1997 where crew could smell oil but there were no visible fumes which was the situation on 10 July. He had also submitted a Safety Occurrence Report on 12 June to the company and verbally told the Group Manager of Air Safety of his concerns who assured him that there was no problem (Australia Senate 2000c, pp. 146-148). That two pilots were affected suggests more than panic though this may also be reconciled under Loblay’s ‘belief system’ model. Loblay attempts to provide yet another rationale, that of medicine, to complement attempts by CASA and the aviation industry to discredit Kolver, other pilots, flight attendants and the initial BASI report.

When questioned before the Senate Inquiry about international aircraft fume incidents Loblay noted that there are only two places of concern but ‘I think that generally it is not’ (Australia Senate 2000b, p. 106). His lack of acknowledgment of the international issues is disingenuous given inquiries in the UK and US and the widely reported Swedish incident on the 19 November 1999. Also strange is that Loblay acknowledges that ‘it is a hazardous situation’ if people are not able to fly a plane ‘whether or not people are experiencing

irritancy or acute anxiety symptoms’, but his response including ideas on pilot training appear to tell aircraft crew to ignore health and safety information from those outside industry: ‘I think the sort of misinformation that has been circulated among staff, as a result of the activities of Dr Donohoe and colleagues, is endangering the situation more than would have been the case if people had a rather more sensible, down-to-earth approach’ (Australia Senate 2000b, p. 106). Here Loblay is essentially paraphrasing Gots in claiming the diagnosis of MCS is more harmful than the symptoms.

Ignoring the problem appears to be the basis of Loblay’s ‘down-to-earth’ approach. However this is unlikely to make it disappear instead it would disguise the problem leading to an increase in health problems and flight safety risk. Aircraft crew, as recorded by the Senate Inquiry report, noted the underreporting of cabin fume incidents due to fear of reprisal, concern for job security or being told by airline companies that there is no risk (Australia Senate 2000t; Australia Senate 2000u; SRRATRC 2000). As noted by Williams it is likely many pilots that have been through the period of industrial action know as the pilots’ dispute⁴⁶ would rather risk their health than threaten their livelihood. Also many may be suffering the ‘first subtle signs which I had – increased fatigue, occasional leg cramps, forgetfulness, etc. – without realising it to be a discrete illness with an insidious, progressive nature’ (Australia Senate 2000t, p. 227). A neuropsychological assessment of 6 flight attendants and two pilots from BAe 146 aircraft found a range of cognitive impairments. One of the most pronounced results was choice and reaction time impairments which were found in 87.5 per cent of crew and were suggestive of neurotoxic exposure (Coxon 2002).

Surveys of BAe 146 aircraft crew and Boeing 757 pilots have documented under reporting by aircraft crew of cabin fume incidents leading to less pressure on industry to redress these problems (Cox and Michaelis 2002; Michaelis 2003). Of 106 pilots that completed the survey 93 B757 pilots said they had experienced smoke and fume events and the number of events was estimated at over 1,660 but only 61 were logged as Air Safety Reports. The

⁴⁶ This industrial dispute started in 1989 and was an attempt to increase pay for pilots but was largely unsuccessful.

airline has the option of not sending these into the UK Civil Aviation Authority (CAA) unless the captain specifically requests this is done. Also of concern was that 96 pilots surveyed used oxygen only when the situation was really bad and fumes were visible (Michaelis 2003). A case study by two cabin crew members of a Boeing 727 documented a lack of reporting and data collection (Wright and Clarke 1999). These three surveys documented both short and long term health effects and further undermine the crude industry position couched in the language of science and medicine provided by Loblay. Continual denial of the problem allows industry to avoid responsibility and maintain aircrew and passenger ignorance about the seriousness of the problem.

Aircrew have also noted company attempts to discourage union surveys of fume incidents. An internal memorandum from NJS to all senior pilots, engineers and flight attendants documents attempts to discourage fume incident reporting to the FAAA (Australia Senate 2000g, pp. 230-231). Ronald Devine, a Training Captain for NJS, was observer on the 10 July 1997 BAe 146 aircraft incident, confirmed Kolver was having trouble and handed over controls to the First Officer. Devine also has had ongoing health problems since that incident. Devine stated that union survey forms were removed from crew pigeon holes by a 'Company representative' to prevent the survey (Devine 2000).

The Senate Inquiry report observed that Loblay had argued that 'there are no health effects as a result of exposure to fumes. Unfortunately, his evidence largely consisted largely of attacking the personal and professional integrity and status of other witnesses' and that he did not supply a written submission (SRRATRC 2000, p. 29). The Committee report was critical of the research cited by Loblay that the aircraft crews' 'non-specific' symptoms were present in 10 per cent of the population. This was because crew symptoms were present at higher levels than the general population (SRRATRC 2000, pp. 31-33).

The Committee did however not critique Loblay's many other assertions but cited his numerous claims in its final report. These included his claims locating the problem with the crews' 'belief system' suggesting that these were more psychological in nature and that exposure to cabin air could not be responsible for short or long term health problems

(SRRATRC 2000, pp. 31-33). Also included without Committee comment was criticism of Kolver including the suggestion that he panicked (SRRATRC 2000, p. 86). The report did not directly cite Loblay's personal attacks and at one level this may be justified as not airing unsupported claims however the omission of these comments and the responses from those he criticised arguably tends to raise the standing of the Loblay's information that was included in the final report. This in turn appeared to help justify the report's failure to acknowledge the impact of long term health effects and lack of a strong position emphasising the danger to flight safety.

The Senate report also neglected to note that Loblay had not examined or tested any of the crew members (SRRATRC 2000). The exception was Chew and this was done as part of his role as an expert witness for Ansett in the Chew case, but his role as an expert witness was not revealed in the Senate report even though the report cited an extract from the trial. The report did comment adversely on Carroll who had prepared a report on Deborah Carter, a former BAe 146 flight attendant, for a compensation tribunal and who subsequently became a consultant to Ansett: The 'Committee remains concerned at the possibility that proper procedural fairness has not been observed in these matters' (SRRATRC 2000, p. 108). However, the report did not mention that Carroll had also previously prepared a report for Chew's workers compensation assessment and then later testified at trial against Chew on behalf of Ansett.

John Woodley who chaired the Senate Inquiry acknowledged a number of limitations of the inquiry. One of Woodley's regrets was Loblay's attempts to mislead it noting that his evidence 'was dubious in the extreme' (Woodley 2005, p. 405). Woodley explained Loblay's appearance before the inquiry stating that Loblay had phoned a committee member and offered to give evidence but this was done without reference to himself the chair. Woodley noted Loblay 'gave his 'evidence' which consisted mostly of scandalous attacks on the other medical experts who gave, or were to give, evidence' and that aircrew were cast as being 'caught up in a kind of "mass hysteria"' (Woodley 2005, p. 405). Also noted was that Loblay did not reveal when he gave evidence 'that he had been a witness on behalf of insurance companies in a number of court cases dealing with compensation for

affected aircrew' (Woodley 2005, p. 406). Woodley further reiterated the Committee's comments on Carroll pointing to his conflict of interest in providing a report and testimony at the Queensland Compensation Tribunal then became a consultant to Ansett against the same person in a court case (Woodley 2005, p. 406).

Loblay's role in CFS is instructive as this is another illness that has been associated with chemical exposure. He was one of two convenors of a working group that developed CFS Clinical Practices guidelines for the Royal Australasian College of Physicians. These guidelines were published in a special supplement of the *Medical Journal of Australia* with funding from the Commonwealth Department of Health and Ageing (WGRACP 2002). The guidelines deal with a range of causative factors particularly viruses and psychological problems associated with this illness. The guidelines also acknowledged research that had implicated CFS with chemical exposure that included MCS, Gulf War Syndrome and Sick Building Syndrome though it pointed out that these were questionable clinical entities and beyond the scope of the guidelines (WGRACP 2002, p. S29). The report also documented poisoning from industrial solvents, pesticides and silicone breast implants that cause illness but these were demarcated from the guidelines because these only resembled CFS (WGRACP 2002, p. S32). The report details a range of strategies for doctors assessing this disability in the medicolegal sphere.

Forming an opinion about the level of disability is a usual requirement in medicolegal assessment. Since CFS is a subjective illness, initial evaluation relies on a systematic review of the patient's self-reported functional capacity and an assessment of whether this is accurate. Corroborating information may be obtained from a partner or other family member, and from other practitioners with detailed knowledge of the patient.

A doctor acting as an assessor or expert witness may be asked to provide an opinion on causation. Uncertainties regarding the aetiology and pathogenesis of CFS should be acknowledged, and conclusions about the role of infection, chemical exposure or the emotional demands of the

workplace should be appropriately tentative unless the clinical evidence is clear-cut and compelling (WGRACP 2002, pp. S46-S47).

Much of this is standard medical practice in diagnosing an illness however such practices were not followed by Loblay. In the Senate inquiry he made sweeping and categorical assessments about the pilots and flight attendants without examining them. Neither did he adequately consider chemical exposure. This was in contrast to the more considered opinion of other doctors that examined and assessed patients and made written and verbal submissions to the inquiry.

Another illustration of Loblay's influence is his appearance in key forums to critique research that is published linking chemical exposure to CFS and MCS. His comments are invariably a criticism of chemical associations. This has included editorials in the *Medical Journal of Australia* (Loblay 1995) and appearances on ABC radio's *Health Report* (ABC Radio 1995). In a more recent submission on MCS, which Loblay made to the Parliament of South Australia on behalf of the ASCIA, he offered strong criticism of clinical ecology/environmental medicine (Loblay 2004). While he acknowledged that many people with MCS have symptoms he again focused on the importance of psychological factors. The overall weighting Loblay gave was that MCS is psychological, pointing to a person's beliefs that 'can have a significant impact on the degree of concern, distress and disability experienced, and the extent of the avoidance measures adopted' (Loblay 2004). He also discussed the proposed name change to IEI without providing a context to this name but pointed out his current preference, "Intolerance to smells and fumes" (ISF) is a more straightforward descriptive term which does not carry inappropriate connotations of a serious disease process' (Loblay 2004).

Loblay, other allergists and 'experts' have used IEI and other terms such as 'Allergic to the 20 Century' (see Loblay 1993), to cloud and deny the seriousness of illness/chronic disease by locating the 'problem' with the individual or medical professionals who recognise MCS. The invention of new pejorative terms such as

ISF contributes to this process. This in turn serves to undermine recognition by the medical profession, regulators and government of people so affected. The focus on individuals tends to overshadow the workplaces and environments where health problems arise.

I will now briefly examine some of the research that has followed the Australian, UK and US inquiries that examined cabin fumes in particular that of the British Airline Pilots Association (BALPA) Conference.

Aviation Unions Driving Debate

The neglect by government, regulators, industry and key research bodies to meaningfully address the issue of cabin fumes has prompted increased efforts by a wide range of organisations and people seeking proper recognition and response to the cabin fume problem. Lord Paul Tyler who is Chair of the All Party Group on Pesticides and Organophosphates opened the BALPA *Contaminated Air Protection Conference* (CAPC) held in London on 20-21 April 2005. Many of the conference papers were subsequently published in the *Journal of Occupational Health and Safety – Australia and New Zealand*. This conference invited all major aircraft manufacturers, aviation oil producers, airlines and people involved in cabin air contamination. This was in contrast to an earlier industry conference, *The Building Research Establishment*, held in London in 2003 that reached the conclusion that there was no problem but had not invited ‘any union or independent medical or scientific opinion’ (Tyler 2005, p. 398).

There were a number of conspicuous absences from the BALPA conference. While the UK CAA and the Australian CASA did not present papers the FAA chief scientist presented a paper on cabin fume incidents. Noticeably absent from the conference proceedings was the Aerospace Medical Association which neither presented nor attended. In addition many airline medical departments, airlines and manufacturers failed to turn up to the conference. Exceptions included United Airlines, which was the first to install high-efficiency particulate filters into all its aircraft (Tyler 2005).

A paper to this conference by researchers from the Royal Australian Air Force (RAAF) documented bleed air contamination of military aircraft. One of the presenters Dr Bhupi Singh a Senior Research Officer in Aviation Medicine in the RAAF has also published research on cabin fumes which noted a number of health problems.

There is some evidence that continued exposure to small amounts of certain contaminants may produce chronic, long term, and irreversible damage to humans. Blood disorders, and damage to lungs, liver and kidney may occur.

Some toxins may be potentially carcinogenic (Singh 2004?).

He dismissed as inadequate terrestrial occupational exposure limits because, 'Aircrew members are required to perform complex tasks requiring high level cognitive skills, which may be much more sensitive to insult by hazardous contaminants in the smoke/fumes, such as Tri-Cresyl Phosphate' (Singh 2004?). Singh noted the high priority given by the Australian Defence Force to minimise or eliminate all workforce exposure to hazardous substances.

The numerous papers at this conference added to a significant body of work addressing such issues. Tyler highlighted three key issues: the fact that most fume events go unreported, the ongoing claim that cabin fumes are at too low a level to cause harm or long term health problems, and the failure to inform passengers. van Netten's article illustrated the way fume incidents are dismissed as anecdotal which results in underreporting because these incidents are not then recorded in a format that is regarded as scientific (van Netten 2005a). The article documents fume events on numerous aircraft types with the BAe 146 having the highest level of incidents. Also mentioned were attempts to prevent a key early article by van Netten from being published. The article *Air Quality and Health Effects Associated with the Operation of BAe 146-200 Aircraft* (van Netten 1998) was the subject of legal action to stop publication which was unsuccessful following legal negotiations. Such occurrences further highlight the widespread difficulties of those attempting to achieve recognition for this problem.

Many conference articles documented a range of health and safety problems for crew. A conference paper by Mohamed Abou-Donia, a Professor in the Department of Pharmacology and Cancer Biology at Duke University Medical Centre, provided a detailed assessment of organophosphorus compounds and their neurotoxic actions (Abou-Donia 2005). He discussed a range of neurotoxic actions including organophosphorus ester-induced delayed neurotoxicity (OPIDN) and organophosphorus ester-induced chronic neurotoxicity (OPICN). The latter has serious implications but results in less damage to the nervous system compared to OPIDN and has been associated with exposure by aircraft crew to jet oils and hydraulic oils.

The damage associated with OPICN is to the peripheral and central nervous systems which manifest as neurological and neurobehavioral abnormalities. The condition is produced by a large acutely toxic dose or long term low level doses of organophosphate compounds. In a study of blood from eight aircraft crew and eight controls it was concluded that there was evidence of neurological deficiency and that in the absence of other neurological causative agents was consistent with an organophosphate chemical exposure such as tricesyl phosphate. For those affected improvement is dependent on the extent of damage but when damage to the central nervous system is extensive there is likely to be an incurable loss of function (Abou-Donia 2005).

Respiratory physician Jonathan Burdon and thoracic physician Allan Glanville undertook a study of 14 aircraft crew. This revealed lung injury to all 10 flight attendants and 4 pilots that flew on the BAe 146 and that many 'abnormalities are irreversible' (Burdon and Glanville 2005, p. 454). They noted that the study took place well after exposure so that acute effects would have disappeared. They also acknowledged the limitations in a retrospective analysis and called on government and airlines to recognise the problem and undertake detailed studies of those exposed and those without symptoms.

Another study of 26 North American flight attendants examined after experiencing inflight exposure were tested for both neuropsychological evaluation and Positron Emission Tomography (PET) brain scans (Heuser, Aguilera et al. 2005). All 26 were diagnosed with

toxic encephalopathy following the neuropsychological examination and many demonstrated cognitive problems in relation to learning and reading. Five flight attendants were diagnosed with depression. The physical examination using Positron Emission Tomography (PET) found 9/26 were abnormal, 6/26 mildly abnormal and 11/26 were in the normal range. While acknowledging that cabin air was not examined during exposure events for the group in this paper it did suggest the development of a protocol for crew examinations following fume exposure.

Occupational and public health physician Andrew Harper undertook a self selected study that surveyed 39 pilots and 19 flight attendants flying on a range of aircraft from a number of countries (Harper 2005). The crew numbers were UK 51 per cent, Australia 37 per cent, US 10 per cent and Egypt 2 per cent. The BAe 146 was the most reported for fume events followed by Boeing 757, Airbus and MD 80 amongst a number of other aircraft types. The study documented exposure events from 1986 until 2005 with peak reporting occurring in 1998 and 1999. Most fume events occurred during take off and ascent and 40 per cent of those participating documented six or more exposures. Symptoms were similar to those previously mentioned including 'Feeling drunk as a skunk'; passengers were also affected. Flight safety concerns amongst crew included fear that one or both pilots would be affected. Reasons for not reporting fume events included concern for job security and harassment by employers with one crew member reporting that 'I was severely victimised by management'. This study also documented doctors' opinions that ranged from denial of toxic problem, bafflement and ignorance although some had still undertaken surgical measures, through to an acknowledgement of symptoms and illnesses resulting from fume exposure even when they 'cannot currently be fully explained, proved or disproved by the science of medicine' but nonetheless require further research (Harper 2005, pp.436-439).

Harper argued for a primary prevention model that eliminates exposure and improves safety practices. This includes timely medical assessment of affected crew, provision of medical treatment and the adoption of appropriate workplace management procedures for those exposed. All symptoms need to be addressed and for those disabled occupational rehabilitation should be provided. Acknowledging the political dimension and the

dominance of industry interests, Harper called for a preventive model rather than postponement because of incomplete knowledge. He also called on doctors not to rely on physical examination and laboratory tests as these are unlikely to provide a diagnosis for this condition. Rather he recommended a detailed occupational and medical history of the affected (Harper 2005, p. 439). A Perth medical doctor who had treated 39 crew members and one passenger since 1999 also stressed the importance of allowing the patient to tell their story as patient history 'is the cornerstone to diagnosis' (Somers 2005, p. 449).

The closing speech by the Secretary of the BALPA concluded that there is a workplace problem resulting in both 'short and long-term health effects...significant flight safety issues and unacceptable health problems in aircrew; and consideration should be given to passengers, who may also be suffering from similar symptoms' (McAuslan 2005, p.477). A number of key areas requiring action were suggested including design changes in aircraft and engines to stop leaks, and changes in aircraft environment systems so that do not rely on bleed air from engines. Importantly regulators need to enforce civil aviation legislation and 'the aviation industry needs to better comply with airworthiness standards for air quality, and stop this half-hearted interpretation of what they say' (McAuslan 2005, p. 476). McAuslan noted that there is a need for reporting systems that will prevent retribution to crew and that these need to be widely accessible. Also risk assessments from fumes need to factor in crew and public, and Occupational Health and Safety responsibilities acted on and developed so that responsibilities can be met which are not at present. Better systems need to be adopted to 'monitor, diagnose, treat, rehabilitate and compensate affected workers' (McAuslan 2005, p. 476).

Aviation Industry and its Supporters: Where to Now?

The aviation industry and its supporters are adept at dealing with crisis. They negate the history of incidents of fume contamination, crew illness and disability preferring instead to make calls for more research. Thus they maintain a focus on aviation economics above health and safety, which is effectively support for the status quo. For instance, Spengler, who was co-chair of the US National Research Council (NRC) 1986 Report and member of

the NRC 2002 Report, continues to downplay the health and safety impacts of cabin fumes and downplays the number of fume incidents in a similar manner to the NRC 2002 Report. He and his co-author go on to call for more comprehensive research to better understand the problem yet refer to the cabin fume issue as an 'occasional incident' (Spengler and Wilson 2003, p. 324). Such statements do not reflect the reality of the problem. Thus the call for more research appears more a rhetorical strategy to avoid more considered measures. They also argue that the animosity of pilot flight attendant unions and passenger associations, particularly against the FAA for failing to consider cabin air quality as important, has 'inhibited multiparty research efforts in the United States' (Spengler and Wilson 2003, p. 333). However, it has been the determination of aircraft crew and unions to draw attention to this issue that has compelled such attention.

The NRC 2002 Report also dismissed long term health problems including the descriptors MCS and Aerotoxic Syndrome because of a lack of evidence and called for more detailed data collection. However, its dismissal of the Australian Senate inquiry's recommendations focused on the inquiry's recommendation to recognise Aerotoxic Syndrome within appropriate codes to assist in expediting workers compensation. This was dismissed as contradicting its evidence summary. The report also quoted Loblay without referencing him when he stated that aircraft crew symptoms were non-specific and 'are present at any one time in 10 per cent of the population' but did not mention that the Senate Report had dismissed this claim (quoted in ACERRT 2002, p. 31).

The calculated marginalisation of health and safety, while designed to support government focus on economics and competition in airlines at the expense of safety and health considerations, is also limited in addressing the former. For example, of the three key airlines addressed in the Senate Inquiry, only Qantas/NJS remains, as Ansett went into receivership. This was due to a combination of problems: the grounding of Boeing 767s due to Ansett failing to carry out necessary maintenance, and financial mismanagement of the company that included a failure to replace old aircraft which meant the company needed to raise \$5 billion from shareholders. Prior to Ansett going into receivership, the then transport minister John Anderson stressed the importance of government 'privatising

aviation' and allowing airlines 'to make their own best judgements' and not wishing to be involved in 'pessimistic talk' about Ansett's precarious position. One financial manager described the role of some of Ansett's directors as 'reckless and incompetent' (ABC Television 2001b). A leaked internal audit report from CASA dated March 2001 concluded that CASA had not been aware for one and half years of the maintenance problem of the grounded Ansett 767s until informed by Ansett (Castle 2001, pp. 2-3).

Had CASA applied appropriate regulatory pressure for maintenance, Ansett directors may have acted to remedy the problem rather than simply siphoning profits without reinvesting in maintenance and aircraft. It also illustrates the lack of maintenance across Ansett's fleet including the BAe 146. This is further supported by an internal Ansett fax dated 26 June 1996 that noted Ansett was servicing the environmental control units of BAe 146 aircraft every 7000 hours instead of the recommended 5000 hours. Workshop reports also indicated that units of this service 'age are heavily contaminated with oily deposits' (Currie 1999). This may help explain why Ansett achieved the highest rate of cabin fume incidents internationally of all BAe 146 operators. Therefore, appropriate regulation may also have reduced the number of fume events experienced by this airline and prevented Ansett going into receivership with the resultant loss of jobs and investor money.

Ironically, it was Ansett that better addressed the concerns of the Senate Inquiry. Both Qantas and National Jet Systems (NJS) were far less cooperative, the chair of the inquiry noting that National Jet Systems was at times 'hostile' (Woodley 2005, p. 403). Qantas admitted that it takes primary responsibility for safety even for many of BAe 146 aircraft operated by NJS on its behalf (Australia Senate 2000b, p. 125). Thus the policies of NJS that impact on safety must also represent Qantas' position. It appears that Qantas/NJS has taken more primitive and hostile methods in dealing with this problem since the end of the Senate Inquiry, and following the failure of CASA and the ATSB to address this problem, by targeting the crew of aircraft. Senator Knowles stated that NJS,

solve the problem of air contamination by suspending or dismissing staff that complain of adverse events following exposure. It also appears that National Jet Systems place such enormous pressure on their crews to keep

their planes in the air at all costs that the crews themselves have been most reluctant to report faults that could ground a plane for any length of time. This has led to a culture of silence among most crews. They are now fearful of anyone going public because they have been threatened that they will all be sued (Australia Senate 2002c, p. 2134).

Aircraft crew members that have health problems have been dismissed even when they have been fit to fly - provided that they are no longer exposed to further fumes. Knowles read into the Hansard extracts from a doctor to whom NJS sent one pilot for review of symptoms. The doctor noted these were 'consistent with exposure to jet oil fumes and I note his reports consistently correlate with documented technical faults'. The doctor noted that the pilot had recovered from health effects and was fit to fly all aircraft types and 'the BAe 146 provided you can give assurances that there will be no further cabin air contamination' (quoted in Australia Senate 2002c, p. 2135). The doctor added,

If you cannot provide a safe working environment, then you will be placing him further at risk... If you cannot give assurances that there will be no cabin air contamination then it raises serious air safety issues for both your staff and passengers... I would consider that it is highly unlikely that he is alone, as a pilot, in his experience of the ill effects of leaked fumes. I hold some concern there may be underreporting of such incidents by pilots for a number of reasons... There needs to be some system for reporting incidents independent of the operator that protects both air safety and employee from fear of lack of job and/or licence (quoted in Australia Senate 2002c, p. 2135).

In letter of response to the pilot, NJS stated that while the problem was 'substantially under control I cannot be absolutely certain that the cabin air on this aircraft type [BAe 146] will never contain low levels of jet oil contamination' (quoted in Australia Senate 2002c, p. 2135). NJS offered him a position on a Dash 8 acknowledging, as Knowles put it, that 'they cannot control the air quality' (Australia Senate 2002c, p. 2135). In a letter to another crew member NJS said that,

While significant advances have been made in controlling the 146 cabin air quality issue, we cannot confidently and absolutely guarantee that no cabin contamination will occur on board a 146 aircraft. We are not prepared to risk compromising your health. Accordingly, the 146 flying option is no longer available to you. As a result, you are hereby notified that your employment is terminated due to redundancy of your position (quoted in Australia Senate 2002c, p. 2136)

These crew members had also raised their concerns with CASA and ATSB without success. The ATSB informed them that they could not investigate until after an accident (Australia Senate 2002c, p. 2134).

An appeal to the Industrial Relations Commission against NJS dismissing the BAe 146 pilot Nevan Pavlinovich was undertaken by the Australian Federation of Air Pilots (AFAP). Pavlinovich had been cleared as fit to fly by a medical doctor. The doctor also stated he could also fly the BAe 146 providing a safe working environment could be guaranteed. Laurie Cox, of the AFAP, noted that if the dismissal is upheld 'it's effectively giving the green light to the employer to say, look we can't do anything about not supplying a safe working environment'. He also added that 'If someone complains about having a medical problem associated with fumes escaping into the aircraft then that means it would immediately lead to their termination' (ABC News Online 2003b). The pilot lost his claim for unfair dismissal and was prepared to fund an appeal however the union was not prepared to join the appeal because according to Pavlinovich 'the pilots don't want me to appeal the decision' (ABC News Online 2003a). This suggests pilot concerns, including job security and fear of reprisals, may be guiding their decision not to rock the boat.

Meanwhile, ongoing incidents internationally indicate the situation is not under control and crew and passengers continued to be poisoned by oil fumes entering the cabin environment, in 2002 a BAe 146 QantasLink aircraft awaiting takeoff had to return and disembark passengers due to a fume problem (AAP 2002) and in January 2004 a Qantas Airbus A330-300 filled with fumes resulting in 9 people going to hospital as a result of exposure (AAP 2004). *The Sunday Times* reported in April 2005 on one of five flights that led to pilots

being ‘incapacitated’ following oil fume exposure in 2004. The mandatory occurrence report filed by the airline Flybe with the CAA documented both pilots being affected. The report stated that

During the cruise, the P2 (co-pilot) felt unwell (faint and breathless with shaking hands) and oxygen was administered for the last 20 minutes of the flight. The P1 (captain) also had a headache with flu symptoms and confirmed to be in a state of euphoria, although successfully landed the aircraft (quoted in Gadher 2005).

The CAA continue to claim that such contamination was not harmful to crew or passengers and the airline Flybe stated ‘We remain 100% confident the BAe 146 aircraft always meets and exceeds the relevant regulatory standards in the area of cabin air quality across our fleet’(quoted in Gadher 2005).

Summary

The preceding discussion has demonstrated a bias against recognition of long term health problems of those exposed to cabin fumes. The social and political determinants of illness, disease and disability have been obscured by claims that the problems rest with those individuals and doctors that assert such health problems. The examination of differing medical approaches to long term illnesses such as MCS associated with cabin fumes has identified that much of the language is better viewed in terms of a political and ideological struggle rather than disagreements over what constitutes good/bad science and medicine. This is particularly evident in the controversy surrounding the suggested name change from MCS to IEI at the IPCS Workshop. This clearly implicates international bodies such as the IPCS, the role of corporations and affiliated organisations such as the ESRI, and key medical doctors such as Gots in attempting to curtail terminology that suggests a chemical causation. The ongoing attempts by some doctors such as Loblay to introduce other names such as ISF serve to deny ‘a serious disease process’ and also add to a number of terms that are used to caricature the illness, those people suffering it and those who argue for a chemical causation. Such strategies also move attention away from the workplace and environment where those people first became ill.

The role of ACC, key corporations, numerous industry front groups and conservative think tanks in eliminating recognition of a chemical basis for illness such as MCS is truly expansive. Their ability to initiate SLAPPs to stymie debate, and amicus briefs by ‘reputable’ doctors/scientists claiming to be acting in the interests of good science, is not sustainable. The receptivity of courts to amicus briefs and their notions of what constitutes science as opposed to junk science appear to rest on corporate views rather than substantively addressing the complex reality of science. Similarly in Australia the Chew case had less to do with the complex reality of science of causation and more to do with politics.

The roles of Loblay and Carroll clearly demonstrate the political and economic forces operating in MCS debates. This included labelling Chew with a psychological disorder, discrediting those that argue for a chemical causation and seeking institutional legitimacy for claims by alluding to the suggested name change to IEI by the IPCS workshop. While the judge found that Chew’s viral condition was aggravated by fume exposure and granted compensation there was a major gap as it did not address the issue that her symptomology preceded the virus condition.

As discussed Loblay’s attempts to discredit those aircraft crew, doctors and researchers that asserted a chemical causation in the BAe 146 controversy under parliamentary privilege without a written submission to substantiate any of his claims clearly demonstrate a strong pro industry agenda. In contrast the lay knowledge of aircraft crew which helped establish this as an issue were far more credible in their accounts of the causes, symptoms and issues concerning cabin fumes. Those doctors, researchers and unions who documented the health and safety problems of cabin fumes have demonstrated that there are both short and long term health problems and flight safety problems and that these have been neglected.

In spite of ongoing incidents industry, regulators and industry aligned researchers continue to deny a safety and health problem. Calls for more research serve more as rhetorical devices to maintain the status quo while industry denials of health or safety problems go

hand in hand with the dismissal of aircraft crew who have had their health damaged by fume exposure.

Chapter 8: Conclusion

In this thesis I have examined a number of health and safety debates by various stakeholders within the cabin fume controversy. In Chapter 1, I explained my rationale and approach for investigating the cabin fume issue. My rationale was a concern for the health and safety of aircraft crew and passengers because their concerns were dismissed by regulators and the aviation industry. Another concern was institutional responses to occupational health and safety, and health issues on the periphery of accepted medical opinion such as Multiple Chemical Sensitivity (MCS). It became apparent that the issue of cabin fumes is an international problem and while the BAe 146 is the most fume prone aircraft many other aircraft have significant cabin fume problems including the McDonald Douglas MD-80, Airbus A320 and Boeing 737 and 757.

Chapter 2 explains my methodology. The interest based approach that I adopt draws on theoretical perspectives from science and technology studies and the sociology of medicine. I attempted to avoid the limitations of both constructivist and realist positions in justifying my interests position. This position is located towards the realist end of the constructivist realist continuum. This enabled the recognition of the constructed nature of knowledge claims and also allowed claims of bias and flawed assessment processes. A multi-level analysis was adopted. This entailed examining the micro level, namely the controversy surrounding BAe 146 cabin fume issue; the meso level, that is the role of institutions such as the Civil Aviation Safety Authority (CASA) and the Australian Transport Safety Bureau (ATSB); and the macro level, the social structure level that has established the 'rules'. This included examining deregulatory policy set in place by government and the role of economic considerations embedded in government policies and institutions that privilege costs to industry and industry assessments above both crew and passenger health and safety, and the safety of aircraft.

The interests position adopted in the study of cabin fumes highlighted the importance of a number of considerations that would benefit research in science and technology studies, medical sociology and occupational health and safety. This includes not privileging scientific and medical research claims above lay knowledge and recognising

lay knowledge can be superior to such research, and recognising research, policy and regulation are often biased against employee and public health and safety needs. Also research needs to critically examine stakeholder claims particularly industry and government claims. As this thesis has demonstrated they can be biased against employees and the public. The consideration of social structure in research as opposed to limited constructivist and poststructuralist theory allows a fuller understanding of how concepts of health and safety are established and maintained. Comparative analysis of inquiries is also a useful strategy in understanding the rationale for decisions and highlighting limitations. Finally, incorporating history in sociological analysis, particularly in linking case study material at the same level and at different levels of a controversy, provides a counter to simplistic health and safety arguments that ahistoricise events and research.

The interests approach adopted was used to examine often quite distinct claims regarding health and safety. These claims and their underpinning logic have demonstrated a number of failures. These include failures by the aviation industry, regulatory and investigative authorities and governments, which I argue amount to a bias, to acknowledge and proactively respond to this issue. The sum of these stakeholder biases helps explain the ‘creating of the conditions’ in which employees accept the damage to their health (Willis 1994, p. 155). To this the flying public can be added.

The examination of this controversy has demonstrated the great lengths that dominant stakeholders have gone to avoid acknowledgement of and responsibility for health problems and risks. Instead they continued to not only create but attempt to recreate the conditions in which employees and public accept damage to their health and the compromise of flight safety. The need for dominant stakeholders to recreate the conditions stems from the many aircraft crew deciding to fight against the denials of health and safety related problems by lobbying for inquiries, pressing for and undertaking publicly available research, legal action and media attention. Those researchers, doctors, journalists and politicians that have documented health problems have further contributed to the pressure.

The manufacturer of BAe 146 British Aerospace, now known as BAE Systems, was examined in Chapter 3. The discussion on BAE Systems documented a systematic marginalisation of health and safety issues by this company in three studies reviewed. Selective citation, omission of other studies and ignoring documented fume events by airlines were used to justify claims by BAE Systems that there is no toxicity associated with cabin air and no risk to flight safety. The studies demonstrated the alignment of industry interests between BAE Systems the airframe manufacturer, Allied Signal (now Honeywell) the manufacturer of the engines and Auxiliary Power Unit (APU) and Ansett/Qantas the operators. All attempted to limit claims of acute and chronic health issues and the claimed impact on aircraft safety.

The claimed inadequacies of scientific evidence and epidemiological studies, along with the classification of crew reports as anecdotal, have been cited as reasons for inaction. The lack of scientific evidence is not simply a product of the difficulty of the cabin fume problem but active industry involvement in not allowing the problem to be placed on a 'scientific' footing. This practice is evident in Australia and internationally as the analysis of BAE Systems and ExxonMobil has demonstrated. This has included not undertaking research including during actual fume events and not publishing research that should be publicly accessible.

When external research is undertaken existing conditions are altered and then data is interpreted to claim no health or safety problem. This has included changing the oil type from one that generated more health problems to one that generated fewer before the commencement of a research study undertaken by van Netten in Canada. In other research Alaskan Airlines changed procedures and materials before a study of cabin air by the National Institute for Occupational Health and Safety. This study was unable to identify the source of the problem. At one level this might be viewed as acknowledging the problem and trying to minimise health and safety risks however key industry players such as BAE Systems have largely continued to deny a safety or health problem. An exception was their acknowledgement, in March 2001, of a threat to flight safety following two UK pilots being affected by fumes on 5 November 2000. This appears more out of compulsion given it was contained in a BAE Systems Service Bulletin that was made mandatory by the UK CAA and later by CASA.

BAE Systems' efforts to minimise research that could lead to stronger regulatory measures have been extensive. Strategies included claiming the need for more research to identify the problem while failing to carry out research when recommended. A further example of this practice is evident in the Swedish incident. BAE Systems removed the engine from the BAe 146 aircraft involved in the Swedish 12 November 1999 incident then stripped the engine finding nothing significant. This was in contrast to the Swedish Board of Accident Investigation (SHK) that found problems in seals 1, 4, 5, and 9 indicating oil leaks had occurred and seal 2 had minor cracks. The plane was later flown over the same route and the air tested for contaminants. The SHK reported noted elevated levels of the total concentration of volatile organic compounds (TVOC) but could not specify the contaminant source. Both BAE Systems and SHK admitted this was done without the original engine which had been overhauled. This leaves the testing as little more than a public relations exercise than scientific research.

In 2004, the UK Air Accidents Investigation Branch found one of the main reasons for the lack of information about oil contaminants in cabin air was;

No comprehensive airborne analytical test programme had thus far been conducted on a particular aircraft which suffered from such an oil 'fumes' incident, where the aircraft remained in the same state as it was when the incident occurred. For example, with the subject (defective seal) engine still installed and with the same type of oil as was being used at the time of the incident (AAIB 2004, p. 31).

Inconclusive findings have been used by the aviation industry to deny a substantive problem and while introducing some changes, they have attempted to avoid more costly measures and regulatory intervention through diversionary practices and denial.

In Chapter 4, I examined the hazard posed by oils, in particular Mobil Jet Oil II (MJO), the oil used in BAe 146 aircraft in Australia. The operators of BAe 146 aircraft in Australia Qantas/NJS and Ansett all admitted to jet oil contaminating the cabin environment. These airlines also acknowledged short-term or acute effects from exposure but denied any long term health problem or safety problem with the aircraft.

The examination of jet oil debates found a strong dominance by oil industry research in the assessments of hazard posed and the publication of safety documents such as Material Safety Data Sheets (MSDS) and Material Safety Data Bulletins (MSDB). Guidelines for classifying hazardous substances by the National Occupational Health and Safety Commission (NOHSC) were not followed by ExxonMobil. This company used incorrect health and safety phrases on MSDS and MSDB, in particular using the phrases associated with Harmful rather than Toxic as was required. The role of NOHSC in this process was ineffectual at best.

ExxonMobil researchers and representatives to the Senate Inquiry have tended to argue that it was not possible for people in a workplace or the cabin environment to develop organophosphate-induced delayed neurotoxicity (OPIDN). OPIDN results in damage to the nervous system and is marked by symptoms of paralysis and loss of coordination. This approach served to downplay the effects of exposure that are less than those that required for OPIDN. Other strategies were to extrapolate from ingestion studies on rats and chickens to make claims of safety in workplace or cabin environment but these studies did not address inhalation. Oil industry researchers that have cited oil fume research used this to claim minimal risk from inhalation but this was a 1965 study on rabbits and hens. This study could not capture risks at altitude and the chemical changes that jet oil can experience due to burning or pyrolysis.

Many other factors undermine the claimed safety of MJO including the secrecy surrounding chemical makeup, which may include other ingredients that are more toxic than tri-ortho-cresyl phosphate (TOCP), one of the components within tricresyl phosphate (TCP) that has been a focus of researchers. Another issue undermining safety claims is the variability of batches of MJO suggesting the resulting chemical mixture is far from stable. A further indictment of the recent industry research and claims by ExxonMobil is the failure to review research literature on aircraft fume events and to take account of illness, disease and disability of aircrew exposed to oils in the cabin environment reported in the Senate Inquiry and media. The result is that ExxonMobil has consistently, over an extended period, offered a biased view of the hazard posed by MJO and downplayed the hazard of exposure in the cabin environment. Therefore I

argue that claims of the relative safety of this oil, and indeed other TCP based oils, within the aircraft cabin environment have little foundation.

In Chapter 5, I found that there was a shift following the deregulation of the airline industry, from a more precautionary model to one that is more reactive. Further, aviation research has tended to focus on accidents and has largely neglected the importance of incidents. The lack of attention given to fume incidents is particularly evident in the role of CASA and ATSB. Legislation relating to the cabin environment was used selectively or ignored by both agencies. Consequently both have failed in their duty of care to aircraft crew and passengers. Instead there has been an emphasis on economics at the expense of health and safety.

Both CASA and ATSB arguments are rife with contradictions and demonstrate a willingness to reinterpret events to justify their disregard of this issue. They attempted to rationalize the existing conditions that allow crew and passenger poisoning. Although at least some of the key personnel in the ATSB did take this issue seriously initially, this organisation has retreated from its early position. Both organisations have attempted to reinvent their positions as events have unfolded and continue to avoid proactive measures. Thus they appear functional to industry and government interests.

Latent factors were conspicuously absent from consideration of cabin fumes by CASA, ATSB, the UK Civil Aviation Authority (CAA), the US Federal Aviation Authority (FAA) and the aviation industry. This is despite their claimed acceptance of the Reason model.

The failures of CASA are not limited to the cabin fume issue but are systemic. A leaked internal audit report from CASA clearly documents a history of failure to take proactive measures. This report dated March 2001 made a number of conclusions:

Most facets of the aviation industry have applied past experience and incremental improvement to become well understood and documented. Australia's aviation safety regulator's surveillance of the industry has for too long been subject of management fads, each negating most of its 80 years of experience...The industry's level of compliance with safety

legislation is no longer actively being measured by CASA. If the safety regulator does not have this information, the industry has already achieved self-regulation (Castle 2001, p. 2).

Given their awareness of the cabin fume issue, only wilful neglect and incompetence can explain CASA's role. One month earlier, in February 2001, Mike Toller, the then head of CASA, stated in a press release that 'there is no self-regulation by any sector of aviation, and particularly not by any airline, large or small. There can only ever be one set of regulations, and therefore by definition one regulator' (quoted in Gibson 2001). The difficulty remains that while there may be one regulator, if it is not measuring safety compliance and acting on problems, it is by definition not regulating. This has been clearly demonstrated by the cabin fume issue. Even the collapse of Ansett can be viewed as a failure of CASA to regulate and a failure of the deregulatory policies of government which allow airlines to avoid their maintenance practices and duty of care to aircraft crew and passengers.

In Chapter 6, I analysed the scope and recommendations of the Australian Senate Inquiry and inquiries in the UK and the US that examined the cabin environment. The Chapter demonstrated that in the UK and the US the government inquiries omitted information, marginalised contrary views and constructed untenable conclusions from the large body of available information. I established that this reflected their biases against a more considered and proactive evaluation of health and safety issues. The Australian Inquiry was the most credible of the three because it acknowledged the short and medium-term health effects as well as the reports of aircraft crew, unions and the media which documented these problems. Even though the Inquiry failed to acknowledge long term health problems and the threat to flight safety posed by cabin fumes, that were clearly documented, these issues were addressed in the recommendations, which had a strong preventive focus. However, the Australian government has generally been unresponsive to these recommendations.

The UK Inquiry Report was a crude and reactive document with respect to cabin fumes. The Report attempted to exclude significant health and safety issues relying more on rhetoric than substance when finding no substantive health or safety issue. Instead the

Report tried to individualise a systemic problem with aircraft design and maintenance. Cabin fumes were reduced to individual fear and media generated panic. Both the UK and the US inquiries largely ignored or marginalised research and the reports of aircraft crew, unions and media.

The US Inquiry was a little more sophisticated and attempted to appear scientific in comparison to the UK Inquiry. However, it drew on research selectively and avoided documenting fume incidents to justify its failure to address the health and safety issues associated with cabin fumes. Consequently the US Inquiry like that of the UK was reactive and lacked integrity.

The UK Inquiry made recommendations on educating the public such as on Deep Vein Thrombosis (DVT) but did not make recommendations regarding cabin fumes which allowed the UK government to avoid addressing this issue. The US Inquiry did not make strong recommendations regarding cabin fumes, but offered more tangential recommendations and focused on other cabin contaminants such as ozone. The FAA response to recommendations was to establish fairly obscure processes that appear unlikely to address the problem in a substantive manner.

The issue of cabin fumes and the associated health effects has been known for many years by the regulatory and investigative establishment as well as the wider aviation industry. However, it was essentially a non-issue for those crew and passengers flying. Attempts have also been made to individualise the cabin fume problem to procedural failures on the part of the aircraft crew, individual susceptibility and even hysteria in order to deny short and long-term health problems including MCS.

In Chapter 7, I examined debates surrounding long term health problems associated with aircraft crew exposed to cabin fumes with a particular focus on MCS. The Chapter documented the considerable industry involvement and that of industry front organisations, such as the Environmental Sensitivities Research Institute (ESRI) and its founder Ronald Gots, in undermining a chemical exposure basis for MCS. Industry and their supporters argued that the problem lay with psychological problems of the individual. An analysis of the controversy surrounding the suggested name change at an

International Program on Chemical Safety (IPCS) Workshop illustrated the considerable range of resources accessible to industry and their allies. The suggested name change for MCS and other struggles in the media and courts demonstrated that MCS was the site of a political and ideological struggle rather than merely scientific or medical disagreements.

Some medical professional bodies, particularly those representing allergists, and doctors advocated the term Idiopathic Environmental Intolerance (IEI), inaccurately claiming it was endorsed by IPCS and the World Health Organisation. Using IEI and other suggested labels, such as Intolerance to Smells and Fumes (ISF), seeks to eliminate the notion of chemical exposure implicit in the name MCS, thus attempting to deny that people with MCS are experiencing a serious illness and disease process. Several of those arguing against a chemical exposure cause for MCS were found to have little basis for their arguments other than representing industry both for personal economic gain and limiting liability to industry. Their arguments have more to do with rhetoric and support for industry positions in the courts rather than science or medicine.

Allergy professional bodies such as the American Academy of Allergy Asthma and Immunology (AAAAI) and the Australasian Society of Clinical Immunology and Allergy (ASCIA) have acted as gatekeepers against the recognition of MCS. A key medical gatekeeper and allergist in Australia, Robert Loblay, has taken a strong stance against the chemical exposure mechanism for MCS and other illnesses arising from chemical exposure, such as Chronic Fatigue Syndrome (CFS). Loblay's role in the Senate Inquiry was one of attacking doctors and researchers and aircraft crew who asserted a chemical causation to explain illness, disease and disability. This was undertaken using parliamentary privilege and without supplying a written submission to support his unsubstantiated assertions. Moreover he did not examine aircraft crew except when testifying against them at court. The numerous doctors who examined crew and documented their health problems, including in written submissions to the Senate Inquiry, presented a more credible picture. This was because they built up a more complete understanding of what was going on that included patient history, symptomology and occupational history. Examinations and tests were conducted, but these were used to illuminate, not to undermine the patient and occupational history.

Importantly, the lay knowledge of the aircraft crew that documented the causes, symptoms and issues including short and long-term health problems and flight safety issues presented a very convincing case. In part because it filled an aviation industry created gap and also because it correlated with reports of both fumes and symptoms in aircraft nationally and internationally over a long period of time. These incidents have occurred in Australia, US, UK, Sweden, Canada and other countries and have resulted in a range of symptoms from acute and to chronic. Moreover, it was lay knowledge that has provided the impetus for inquiries and helped gain the attention of media and researchers.

Significant health problems of aircraft crew were examined. This included forced retirement of crew due to a range of health damage including lung damage, nervous system damage, persistent headaches, cognitive impairment, CFS and MCS. One crew member also documented a number of cancer cases among aircraft crew. In addition, flight safety risks from fumes such as impaired cognitive function were clearly apparent. Also documented was the widespread underreporting of health and safety concerns because of crew fear of reprisals, concern for job security, a lack of awareness of the issue because many crew were told by airline companies that there was no risk and active industry involvement at discouraging crew surveys. This discussion revealed an alarming picture of health and safety as a result of fume exposure.

The failures of government bodies and aviation industry documented in previous chapters have served to vindicate crew claims even further. The serious flaws in the rationale and arguments of those interests examined in this thesis who have denied a significant occupational health and safety problem, as well as a flight safety problem have served to further legitimate the reports of aircrew. Lay knowledge significantly outweighed the thin psychological arguments including panic and hysteria offered by industry representatives. The commonality of accounts from numerous countries of diverse symptoms, including long term disability, should be enough to demonstrate this is a serious occupational health and safety issue, as well as a flight safety issue.

Ultimately it has been lay knowledge of aircraft crew that has demonstrated an expertise that has exceeded the worth of much industry aligned research, inquires and claims of the aviation industry and government. Indeed evidence has existed for many decades both from crew and other sources of the health and safety hazard posed. The fallacious reasoning used to discount this knowledge particularly in light of the substantial body of evidence revealed in the Australian Senate Inquiry has further highlighted the corrupting processes that have sought to deny a serious health and safety issue.

Research, including papers to the British Airline Pilots Association (BALPA) conference in 2005, has continued to vindicate the health and safety claims of aircraft crew. However, the response by industry as evidenced by NJS/Qantas following the Senate Inquiry has been to terminate employees whose health has been compromised and replace them with new workers. Such practices have much in common with the Dickensian era when people were simply classed as expendable commodities, rather than today where such practices at least in many developed countries have supposedly been eliminated.

Part of the strategy that regulators, industry and their supporters have used are attempts to deny and avoid links to a history of fume events. Even the head of CASA, Mike Toller, sought to omit previous research in order to narrow responsibility down to aircraft crew. This thesis has established that cabin fumes are both a long term and widespread problem. Adverse health reactions to fumes have been documented for over 20 years. A publication by the US National Transport Safety Board (NTSB) in 1983 stated that oil can move into the cabin environment and have long lasting health effects.

There are instances in which chronic or repeated exposure may sensitize a person to certain chemicals so that concentrations in the ppb [parts per billion] range may later elicit an acute hypersensitivity type reaction (Wizniak 1983, p. 28).

Such comments from the NTSB predate MCS debates, and even the term MCS which was first coined in the late 1980s. This statement also predates the recent cabin fume controversies in Australia and other countries. Reactive and crude victim blaming approaches to cabin fumes have tended to avoid a history of symptoms both acute and

chronic. By removing the history of chemical exposure and illness, it becomes easier to situate psychological models of explanation in place. The above description appears to fit not only with the claims of aircraft crew but those many doctors and researchers who have attempted to explain cabin fume causation in chemical exposure terms. There is also a close similarity with the Ashford and Miller causative model for MCS that involves first, an initial loss of tolerance from an acute or chronic exposure to various types of chemicals, and second, subsequent responses to much lower levels of chemicals, foods and drugs.

This thesis has demonstrated the legitimacy of the aircraft crew illness, diseases and disability in contrast to the seriously flawed, tainted and by contrast illegitimate assertions of those that sought to undermine their claims. These crew health problems have been classified under a number of medical conditions by many professionals. Those who have listened to the crews and have acknowledged crew workplace experiences and symptomology have also a greater legitimacy than those adopting crude psychological labels that blame people for their workplace poisoning.

One group of professionals who are either followers of, or influenced by, the school of clinical ecology provided one of the earliest diagnoses of the health problems experienced by aircraft crew, namely MCS. These doctors' diagnoses of MCS linking crew symptomology with workplace exposure led to professional attacks both from within the medical community and externally from industry. This group also helped pave the way for other research that included documenting significant crew cognitive problems, lung damage and long term nervous system damage as a result of chemical exposure from jet oils. Thus, this case study has also legitimated both clinical ecology and the diagnosis of MCS. Studies that purport to dismiss MCS simply as a psychological problem without adequately considering chemical exposure and the source of such exposures are of questionable worth, other than as blunt rhetorical devices for industry and government to batter doctors and the people they support.

There are many thousands of people internationally who have been exposed to toxic chemicals and have subsequently developed health problems. Unfortunately industry, government, medical associations and doctors have, all too commonly, aligned to avoid

acknowledging the health problems, providing compensation and addressing the cause. Illness and workplace failures to acknowledge and fix the problem resulting in ongoing health problems may eventually cause psychological problems. Importantly, such psychological issues arise following illnesses from chemical exposure.

For example Boeing workers exposed to chemicals at a number of top secret facilities were diagnosed with MCS by doctors. Health problems included ‘nausea and nose bleeds to impaired vision and brain damage’ (Nelson and Worth 1994). However, instead of changing workplace conditions to prevent fume exposure to employees Boeing commissioned research. This Boeing-sponsored research identified psychological problems including ‘mass hysteria’ with employees. Boeing also exercised significant influence with local government authorities with the result that many workers were subsequently denied compensation (Nelson and Worth 1994). Claudia Sartain, known as Dea, got sick in 1988 along with many other Boeing workers who installed sheets containing phenol formaldehyde. Dea suffered a range of symptoms, saying she ‘felt dizzy, nauseous, my speech was impaired for hours’ and that ‘I started getting...depressed and moody. I was living off Tums and aspirin.’ She filed for workers compensation when no longer able to work, but these claims were subsequently challenged by Boeing which argued there was no ‘tangible link’ between the illnesses of employees and the chemicals (quoted in Worth 1994). Dea returned to work in October 1989 but was placed back working with the same material. Dea noted that ‘Women were having miscarriages all the time’ as one friend noted ‘She [Dea] got so tired of being sick’ and in January 1990 committed suicide (quoted in Worth 1994).

Science and medical research can be improved but this requires a commitment on the part of researchers not to align themselves with dominant government and industry objectives. However, such research while important is unlikely to provide an answer to the polarised cabin fume or MCS conflict whilst industry, supported by government, sets research priorities and omits and marginalises research that counters industry views. The discussion of the Australian Senate Inquiry, and the UK and US inquiries, clearly demonstrated politics and economic interests in marginalising health and safety, rather than simply revealing gaps in science and medicine.

Those flight crew and cabin crew who have suffered the effects of fume exposure, and have attempted to gain recognition of this issue and push for a solution to the problem, are acutely aware of the politics. Nonetheless, while this issue has now moved from a non issue to an ongoing controversy, the promise of scientific research is being used to diffuse growing opposition and ongoing fume events. This enables new ‘conditions’ of acceptance for health damage and compromised safety to be established in the workplace and public space of aircraft.

New research into the toxicity caused by cabin fumes began when the UK Committee on Toxicity was asked to investigate ten cabin fume incidents in 2005. One report documented ‘alarming cognitive failures’ in aircraft crew (Lean 2006). The resulting question is whether this will lead to acknowledgement and proactive measures or simply present an image that the problem is being ‘addressed’ by investigation without a substantive response, as has been the case with previous inquiries. The history of the cabin fume issue suggests the latter is the most likely outcome.

A number of filters and associated equipment are currently being investigated that may improve cabin air quality both in laboratories and inflight. However, given the precarious financial position of many airlines and their aims to extend the service life of planes and parts, the likelihood that such measures would be installed and maintained correctly is questionable, particularly when these new technologies are more expensive. While these technologies are not likely to eliminate cabin fumes, an electrodynamic bearing which reportedly will prevent nearly all oil contamination of cabin is undergoing development. Spengler and Wilson note that if these bearings were introduced into existing and future engines the high costs would ‘require reasons other than health concerns in the current financial and liability climate’ (Spengler and Wilson 2003, p 325). Neither of the authors views safety or health as significant issues with respect to cabin fumes and have sought to blame aviation unions for delaying more substantive research.

This thesis has argued that the reason that the cabin fume issue has received attention is due to the efforts of aircraft crew and unions. Industry and industry aligned researchers have contributed to obscuring rather than addressing the problem. The ongoing

complaints of aircraft crew, unions and media reports are indicative that aircraft crew and passenger poisoning continues.

Both the US and UK inquiries have dealt with a range of aircraft related hazards such as the spread of contagions, DVT, pesticide use on aircraft and ionising radiation exposure. A detailed sociological examination of these issues and their handling by these committees would contribute to a fuller understanding of the health and safety issues for crew and public. Given the systematic marginalisation of cabin fumes by these inquiries there is likelihood these other issues have been addressed in a manner that downplays their significance. Importantly, the role of cabin fumes should not be negated in such an evaluation as both these inquiries have used other cabin health issues to dismiss the importance of cabin contamination with oil. Further investigation is also needed on the many other aircraft that have a high number of fume events. Fume events, crew and passenger illness, and aircraft maintenance practices all need to be incorporated into any assessment. While the design of aircraft air-conditioning systems allows fumes to enter the cabin environment, poor maintenance practices appear as a major factor in accounting for higher numbers of fume incidents by some operators such as Ansett and Alaskan Airlines. The importance of aircraft maintenance practices was recognised by the Australian Senate Inquiry and incorporated in its recommendations.

Another area that would benefit from additional scrutiny is the absence of key occupational health and safety bodies in discussions over crew health and safety. Organisations such as NOHSC in Australia and the US and UK equivalents are conspicuously absent from debates regarding the health and safety of aircraft crew. This is due to FAA claiming exclusive jurisdiction in OHS. Similar jurisdictional processes are followed by aviation authorities in many other countries (Murawski 2005). This is compounded by a failure to develop equivalent OHS guidelines for cabin air quality by the FAA, CASA and CAA.

Even in areas where occupational health and safety bodies do have a role such as establishing guidelines for the production of MSDS sheets, there are inadequate safeguards. The examination of MSDS and MSDB produced by ExxonMobil, though small in number, suggests a failure of the NOHSC guidelines to make corporations

generate publications that are meaningful. That is, conveying a realistic picture of the health hazard posed for employees and medical professionals, instead of material that systematically and over a considerable period of time marginalises the health hazard posed. Therefore a broader enquiry into such publications would be a worthwhile avenue for additional research.

Had the cabin air intake system initially developed for jet aircraft remained in use, cabin fumes from aircraft jet engines would not occur. The original system, termed ram air, used by early jet aircraft, brought air into the aircraft via an air-scoop. Ram air is only susceptible to contaminants in the atmosphere because it does not pass through the engines. Cost saving measures heralded the use of bleed air which drew air from the engines prior to combustion that has led to cabin contamination by oils. The new Boeing 7E7, known as the 787, has developed an air supply system that is not dependent on bleed air, a decision apparently also based on economics (van Netten 2005b)⁴⁷. Whether a separate engine used for aircraft power on the ground, the APU, also now prevents fumes entering the cabin environment in the 787 is yet to be seen. The APU engine is associated with fumes entering the cabin environment on a number of fume prone aircraft including the BAe 146 and MD-80.

While economics can lead to developments in less damaging technologies, it is ultimately economics that have provided the justification either explicitly or implicitly for many of the assessments in the BAe 146 controversy that denied a health and safety problem. As Ralph Nader commented in his landmark book on the automobile industry *Unsafe at Any Speed*,

A great problem for contemporary life is how to control the power of economic interests which ignore the harmful effects of their applied science and technology...Our society's obligation to protect the 'body rights' of its citizens with the vigorous resolve and ample resources requires the precise, authoritative articulation and front-rank support which is being devoted to civil rights (Nader 1965, p. ix).

⁴⁷ This article by van Netten bears the same title to an article published in 2005 in the Journal of Occupational Health and Safety – Australia and New Zealand but has a number of changes.

Nader sought to highlight the built-in design faults and raise public awareness of the problems car manufacturers blamed driver negligence for. Manufacturers sought to avoid public scrutiny for their practices by not disclosing design information. Importantly, Nader sought to get the public involved and informed about this issue to apply the necessary pressure for change.

The claimed lack of science or causative model is not sufficient to deny health problems of crew and passengers. There are numerous instances in which causal paths are not understood but have resulted in an acknowledgment of the seriousness of the problem. An example is the expert panel that examined the cancer cluster in a Brisbane ABC studio following the development of breast cancer in twelve women over an 11 year period. The panel found the cancer cluster was the result of the studio environment even though the cause was not identified (2006b). However, this occurred only after a long and protracted struggle by the women who had rejected previous research that had discounted their concerns.

The case of the F111 aircraft maintenance workers who resealed fuel tanks and suffered the effects of fumes inside these tanks is another case where science could not answer all the questions. The Air Force acknowledged a number of failures including the low priority given to occupational medicine; contracting doctors being confined to the Medical Section and not examining the actual workplace; and the preference of the medical profession for demonstrated evidence via tests 'leading to a tendency to ignore reports of symptoms when tests proved negative' (RAAF 2001). The scope of occupational ill health was also addressed when the report noted that 'four times as many people die from diseases caused by exposure to hazardous substances in the workplace as die from traumatic injury on the job. The volume of occupationally caused ill health is of course much greater. The problem is insidious because the full effects of exposure often do not manifest themselves at the time, with the result that management and workers alike fail to have proper regard to the dangers' (RAAF 2001).

The case of cabin fumes on BAe 146 aircraft indicates that fume problems have been known for many years but key players that could alter this situation have continued to deny the problem. This is largely because of the perceived costs to change the situation.

Dr Richard Teo stated that ‘I would not fly on that plane [the BAe 146], I would take an alternative flight’ (Australia Senate 2000b, p. 110). The public, however, are not being informed about cabin fume issues by regulators or airlines and have to rely on the media. Nor is the public aware that many thousands of people that fly are being exposed to poisonous fumes every year. Many will likely go on to develop health problems similar to aircraft crew yet remain unaware of the cause. If an informed public follow Teo’s position the necessary pressure for action may be generated. It appears that only if this aircraft is grounded will there be the necessary impetus to develop a means to prevent fumes entering aircraft and provide the necessary imperative for other problematic aircraft to be dealt with.

Another means to generate the necessary political pressure is a major accident linked to cabin fumes. However, mistakes in communication or understanding and general cognitive problems that have been linked to aircraft crashes (see Cushing 1994) may be overlooked in terms of fume exposure and simply blamed on pilot error. Blaming crashes on pilot error is often one of the first responses of the aviation industry even before the examination of flight data recorders.

Regulators continue to deny health and safety problems and have not implemented programs to assess and monitor both cabin crew and flight crew. Where they have this has been done in a piecemeal manner. To provide a benchmark for some of the more quantifiable symptoms unions and crew could initiate an assessment program for existing and new crew members. This could include a range of tests such as lung and cognitive function tests. A clearly defined and conducted testing regime would provide a base benchmark. Nonetheless, crew histories of symptoms must be given a high priority as testing regimes have been and are likely to continue to be unable to quantify the range of illness, disease and disability experienced. Many contested illnesses and diseases such as MCS and CFS are reliant on the reporting of those people with such conditions. The lack of a widely accepted causative model is not sufficient to deny those affected people legitimacy particularly given much of the industry and medical opposition has more to do with ideology and economics than medicine.

In 2001, the Aviation Organophosphate Information Site (AOPIS) was established by pilots and cabin crew in Australia. This organisation now has over 1000 members in 14 countries and is involved in research, dissemination of information and lobbying for recognition of the hazards posed by cabin fumes. Their website (<http://www.aopis.org/>) documents research from academics, unions and former aircrew and aviation officials to provide a range of information to aircrew and public (APOIS 2006). Measures such as these serve to increase political pressure for reform. This organisation has also produced a DVD, *Aircraft Air Contamination: An Ongoing Health and Safety Issue*, documenting stories of aircraft crew and explaining the process of cabin fume contamination as well as health and safety dangers. This video can also be viewed online and another video is in the making called *Welcome Aboard Toxic Airlines* due for release in 2007.

Only through ongoing pressure, such as the international conferences organised by BALPA, is change likely. Much research has, and will likely be, targeted at identifying the toxic constituents in the air rather than addressing the problem or assisting those whose health has been damaged.

More research to identify the problem causing cabin fumes and symptoms is akin to researching the object hit by the Titanic before it sunk. A large amount of the research will remain industry driven and will serve to deny a serious problem through the use of diversionary science and medicine. The lack of clear findings from this type of research will lead to calls for more research and perpetuate the cycle rather than address how the problem of oil contamination can be prevented (in the case of the Titanic one option could have been preventing it from travelling at speed in far northern waters). Industry focused cabin fume research will simultaneously be used to marginalise aircraft crew ill health and disability and support claims of aircraft safety.

Research should target an engineering solution at the site of the problem such as engine seals leaking oil into the air conditioning systems and compelling new aircraft to use air that is not drawn from the jet engines, thereby stopping people coming into contact with oil fumes. Diligent maintenance is also necessary but a more proactive measure would be to develop a system that avoided bleed air from the jet engines. This would prevent cabin contamination due to maintenance failures and jet engine design flaws. Similarly

with regard to the APU the pathways that allow cabin contamination with oil will need to be addressed.

Unfortunately, there is little economic pressure on the aviation industry to innovate in this area. Changes that have been implemented on some existing aircraft, such as increased filtration, are relatively low cost but have proved ineffective at preventing fume incidents. The court system is also unlikely to generate significant pressure for change, in spite of some recognition of the problem, due to the dominance of industry and government views on long term ill health and disability.

Aircraft crew members and passengers made ill and disabled by unsafe fume prone aircraft need to be acknowledged, treated, and compensated. Crew should not be allowed to be used as expendable items to be blamed for their illnesses then cast aside when too ill only to be replaced by new crew to join the poisoning cycle. The BAe 146, the most dangerous fume prone aircraft, should be grounded internationally. This would put aircraft manufacturers and airlines on notice by applying a language they understand – that of economics. The BAe 146 aircraft, to paraphrase Nader, is an aircraft that is unsafe at any height. The evidence suggests that it is only a matter of time before a major accident occurs from fume exposure. Of course there is an alternative scenario that a major accident has already occurred as a result of fumes but blame has been placed somewhere else. The most likely place to lay the blame for airlines and regulators is the pilot in the event of his/her cognitive failure that leads to a crash and loss of life.

Appendix**Table 1 – Comparison of requirements of the List of Designated Hazardous Substances with Mobil Jet Oil II MSDS/MSDB**

Please see print copy for Table 1

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