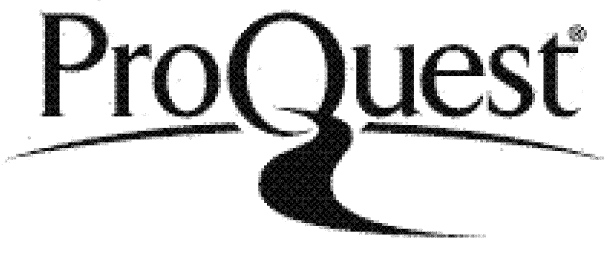
SCIENTIFIC EVIDENCE AND THE TOXIC TORT: A SOCIO-LEGAL STUDY OF THE ISSUES, EXPERT EVIDENCE AND JUDGMENT IN REAY AND HOPE v BRITISH NUCLEAR FUELS PLC.

Rebecca Jane Harrison.
Ph.D.
Law Department.
London School of Economics
and Political Science.



ProQuest LLC
789 East Eisenhower Parkway
P.O. Box 1346
Ann Arbor, MI 48106-1346

ABSTRACT

Providing a socio-legal analysis of the issues, expert evidence and judgment in **Reay and Hope v BNFL plc.**, the thesis offers an insight into the complexity of the toxic tort. Starting with an overview of the history of Sellafield, the thesis reflects on the scientific and epidemiological concerns surrounding the link between childhood cancer and nuclear installations. Drawing on scientific knowledge and epistemological considerations, the thesis moves on to the difficulties of verifying causation in science and the problems of establishing causation in law. Outlining the role of the expert witness and scientific expert evidence, the thesis proceeds with a case analysis, before broaching the thorny issue of judicial decision making and in particular, the difference between the 'discovery' and 'justification' process. Moving on to the Judgment in **Reay and Hope**, attention is given to the potential application of probability theory to the judicial decision making process.

Lasting just short of one hundred days and including the testimony of numerous scientific experts, **Reay and Hope** marked new ground in a number of ways; it was the first personal injury claim to test the concept of genetic damage from radiation; the only time that a Queen's Bench Division Judge had been allocated a full-time judicial assistant; and one of the first trials to endorse a satellite video link for examination of international expert witnesses. As far as judicial management is concerned, the case was a forerunner in having Counsels' Opening Statements in writing in advance of the trial, as well as having written daily submissions of key issues from plaintiffs and defendants upon conclusion of oral evidence.

The circumstances that led to the trial relate to events in excess of thirty to forty years ago when the fathers of Dorothy Reay and Viven Hope were employed by the Defendants and their predecessors (the United Kingdom Atomic Energy Authority) as fitters for the Sellafield Plant. Intrinsic to the litigation was whether paternal preconception irradiation caused or materially contributed to a predisposition to cancer leading to Dorothy's death from leukaemia and Vivien Hope's non-Hodgkin's lymphoma. As a consequence of the various statutory provisions, the Plaintiffs did not need to prove negligence on the part of the Defendants. In order to succeed the Plaintiffs had to prove on the balance of probabilities that radiation from Sellafield was a material contributory cause of the Plaintiffs' disease. The fundamental issue therefore was causation.

In addition to the case analysis, two pieces of empirical research were conducted for the purposes of this thesis. The first, a Social Survey (consisting of thirty four questions) was circulated to 160 members of the Academy of Experts (quantitative research); the second, a letter, involved written communication with sixty five Judges from the Queen's Bench Division of the High Court (qualitative research).

Underlying this socio-legal case analysis are fundamental questions with regard to existing legal principles, liability and judicial decision making.

CONTENTS

ABBREVIATIONS

A.B.C.C.	Atomic Bomb Casualty Commission
ALARA	As Low as Reasonably Achievable
ALARP	As Low as Reasonably Practicable
A.L.L.	Acute Lymphoblastic Leukaemia
A.E.A.	Atomic Energy Authority
B.E.I.R.	Biological Effect of Ionising Radiation
BMJ	British Medical Journal
BNFL	British Nuclear Fuels plc.
BPM	Best Practical Means
C.C.S.G.	Childhood Cancer Study Group
CLL	Chronic Lymphatic Leukaemia
CoMARE	Committee on Medical Aspects of Radiation in the Environment
DOE	Department of Environment
E.B.V.	Epstein Barr Virus
EURATOM	European Atomic Energy Community
F1	Children
F2	Grand Children
HSE	Health and Safety Executive
IAEA	International Atomic Energy Agency
I.C.R.P.	International Commission on Radiological Protection
L.E.T.	Linear Energy Transfer
MAFF	Ministry of Agricultural Fisheries and Food
MoD	Ministry of Defence
MRC	Medical Research Council
mSv	Millisievert
NAS	National Academy of Sciences
NBR	Natural Background Radiation
N.H.L.	Non-Hodgkin's Lymphoma
NII	HM Nuclear Installations Inspectorate
N.R.P.B.	National Radiological Protection Board
OSHA	US Occupational and Health Administration
P.C.	Probability of Causation
P.P.I.	Paternal Pre-conception Irradiation
R.B.E.	Relative Biological Effectiveness
RERF	Radiation Effects Research Foundation
R.R.	Relative Risk
S.E.A.M.	Sellafield Environmental Assessment Model
S.I.	International System of Units
Sv	Sievert
U.K.A.E.A.	United Kingdom Atomic Energy Authority
UNSCEAR	U.N. Scientific Committee on effects of Atomic Radiation

TABLE OF CASES

re "Agent Orange" Prod Liab. Litig., 565 F Supp. 1263 (E.N.D.Y 1983).
re Northern Dist. of Cal. "Dalkon Shield" IUD Prods. Liab. Liti., 526 F. Supp 887 (N.D. Cal 1981). vacated, 693 F. 2d 847 (9th Cir. 1982) cert. denied 103 S. Ct 817 (1983).
re "Three Mile Island" Litig., 557 F. Supp. 96 (M.D. PA 1982).
Rogers v. Secretary of State for the Home Office Department [1973] AC 388.
Sindell v. Abbott Labs 26 Cal 3d 588, 607 P 2d 924. 163 Cal Rptr 132 (1980).
Thorne v Worthing Skating Rink Co. (1877) 6 Ch. 415.
Wilsher v. Essex Health Authority [1987] QB 730, [1986] All ER 801, [1988] 2 WLR 557.
Wright v. Dunlop Rubber Co. Ltd (1972) KIR 255.

TABLE OF LEGISLATION

The Atomic Energy Act 1946

The Atomic Energy Act 1954

Civil Evidence Act 1968
Part 1.
s. 1(1)
s. 4(1)
s.18(5)

Civil Evidence Act 1972
s. 3
s. 4(1)
s. 5(3)

Civil Procedure Act 1997
(Chapter 12)
s. 1(1)
s. 1(2)

Court and Legal Services Act 1990
s.58

Criminal Law Act 1967
s.13
s.14

Fatal Accidents Act 1976

Law Reform (Miscellaneous Provisions Act) 1934

Limitation Act 1980
s.33(1)

Nuclear Installations (Licensing and Insurance) Act 1959

Nuclear Installations (Amendment) Act 1965

Radioactive Substances Act 1960

Rules of the Supreme Court
Order 25
r 8

Order 38
r 3
r 36
r 37
r 38
r 41

Order 45
r 5

US Atomic Energy Act 1946

INTERNATIONAL INSTRUMENTS

European Convention on Human Rights
Art. 10

PENDING LEGISLATION

Access to Justice Bill 1998

INTRODUCTION

Traditionally tort cases have been regarded as isolated disputes concerned with individual harm, where the law's role was simply to allocate losses between tortfeasor and victim according to principles of corrective justice[1]. In addition to notions of corrective justice however, damage prevention (through general deterrence) and the 'public law' function of the tort system have also been identified (Cane 1993). In world where risk assessment and cost benefit analysis play their part in determining the optimum level of any precautionary action taken at the bequest of the tortfeasor, the demands upon an already burdened civil justice system look set to grow.

Notwithstanding the problematic nature of the tort system as "too cumbersome, costly and haphazard" (Rosenberg 1984:854), the advent of the 'toxic tort[2]', has led to a fundamental challenge to the traditional basis of causation[3], where under negligence or strict liability, a toxic tort plaintiff (like all tort plaintiffs) must establish a causal connection between the tortious conduct and the loss for which recovery is sought. In terms of the 'but for' test, this means that the plaintiff must show on the balance of

---

1 Aristotle identified 'corrective justice' as: "The law never looks beyond the question, 'What damage was done?'' Consequently what the judge seeks to do is to redress the inequality, which in this kind of justice is identified with injustice" (Nichomachean Ethics, Book 5, Chapter 5, p.148 - J.A.K. Thomson (1971) Translation).

2 A cause of action which arises when a plaintiff has developed a disease following exposure to a toxic physical agent (chemical or in the form of energy).

3 See: Rosenberg 1984; Stapleton 1988; Hill 1991; Reece 1996.

probabilities that 'but for' the action of the defendants, the damage would not have occurred.

When applying the traditional 'balance of probability test' to a toxic tort, two potential problems arise. First, the test does not work where there are multiple or even alternative possible causes of a plaintiff's injury. Here the all or nothing approach, the preponderance of evidence rule, demands a degree of certainty in excess of fifty per cent in a area where estimates, probabilities and scientific uncertainty are the norm.

Second, difficulties occur in trying to establish the origin of the plaintiff's disease, in particular, the biological mechanism responsible for initiating or mobilising the illness. Here, nature, nurture and luck are called to account where often, as the link between smoking and lung cancer has proved, the exact causal mechanism remains elusive.

Underlying the basis of all toxic torts, distinct areas of scientific knowledge, grounded in an epistemological and procedural framework, provide the evidence upon which the expert offers his opinion. Whatever the discipline, be it genetics, epidemiology, dosimetry, radiobiology, a presumption exists that in addition to having a professional standing among his peers, the expert is also capable of being a competent expert witness. Therefore, implicit in expert testimony is the expectation that the scientific witness can cope with an adversarial system that on occasion, may seek to undermine both his integrity and his authority.

From a judicial perspective, the judge, in addition to decision maker, has the role of

arbitrator and case manager. Often however, because toxic torts involve large scale corporate activities which bring into being questions of accountability, the judge also has to balance, public and policy considerations. With the increasing interaction of science and law, the judge must also be aware of the 'account' of science which informs judicial decision making, and be able to differentiate between the substance of the evidence as it applies to the case, and the status of the scientific expert witness or corporate/governmental body represented by the expert.

Reay and Hope v British Nuclear Fuels plc. (BNFL), a highly complex toxic tort case, offered an opportunity to consider these issues within a wider socio-legal framework. In addition to the case analysis, the thesis also incorporates the findings from two empirical studies carried out for the purposes of this work. The first derives from a Social Survey conducted with members of the Academy of Experts. The second based on more qualitative research, involves members of the judiciary from the Queen's Bench Division of the High Court.

The basis of the case revolves around two families bringing claims against BNFL[4]. The first Plaintiff, Elizabeth Reay, was the mother of Dorothy Reay who was born in 1961 and died

---

[4] Today, British Nuclear Fuels plc is one of two organisations in the western world providing a complete fuel cycle service. BNFL's Head Office is located at Risley, near Warrington, Cheshire and the Company's production facilities are at Capenhurst, near Chester; Springfields, near Preston; Sellafield in Cumbria; and at Chapelcross, Dumfriesshire. The Atomic Energy Act 1971 transferred to BNFL the production and reprocessing sides of the nuclear industry from the United Kingdom Atomic Energy Authority (UKAEA) who had control of the sites, including Sellafield, from 1954.

from Leukaemia the following year aged 10 months. The second Plaintiff, Vivien Hope, was born in 1965. In 1988 she was diagnosed as suffering from non-Hodgkin's lymphoma (NHL), a disease with a similar aetiology to leukaemia. She has never made a complete recovery.

The first Plaintiff's claim was for damages under the now amended Fatal Accidents Act 1976[5], and also the Law Reform (Miscellaneous Provisions) Act 1934[6]. In addition, Elizabeth Reay claimed damages for injury to herself, and on behalf of the estate of her late husband, for injury to him. The claim for parental injury is based on trauma consequent on the conception, birth and death of a leukaemic child.

The second Plaintiff, Vivien Hope, claimed damages for past and future suffering and

---

[5] The Fatal Accidents Act 1976 provided that dependents could sue the wrongdoer for earnings and other monies that the fatally injured person might have expected to have received. Dependents were defined as husband, wife, parent, child, grandparent, grandchild, sister, brother, uncle or aunt. The law required some form of financial relationship with the deceased from which there was derived some benefits to the dependent. The 1976 Act dates back to the Fatal Accidents Act 1846, which also allowed Executors or administrators of the estate to bring an action on behalf of the dependents.

[6] Under the Law Reform (Miscellaneous) Provisions Act 1934 the deceased's administrator or representative may sue. The 1934 Act provides for the survival of a cause of action in certain torts. The Act embraced a 'loss of years' concept and damages were awarded on the basis of a claim for 'lost years'. Normally, where the injured party dies, the action must be brought within three years of death under the Limitation Act 1980. However, in the Reay and Hope case the Defendants did not plead the protection of limitation.

disability consequent upon her lymphoma.

As a consequence of the various statutory provisions dating back to the Atomic Energy Act 1946[7], including: The Atomic Energy Act 1954[8]; The Nuclear Installations (Licensing and Insurance) Act 1959[9]; The Nuclear Installations (Amendment) Act 1965[10], the Plaintiffs did not need to prove negligence on the part of the Defendants. In order to succeed the plaintiffs had to prove on the balance of probabilities that

---

7 The first statutory provision provided for the development of atomic energy and the control of such development but contained no statutory duty of care to the public.

8 This Act established an atomic energy authority for the United Kingdom (UKAEA), and made provision for its powers, duties, right and liabilities. Section 5(3) established the first statutory duty of care to the public which was absolute in character. The Act came into force on the 1st August 1954.

9 Although essentially concerned with the introduction of a system whereby persons or bodies other than the UKAEA might be licensed to instal or operate atomic energy plants. Section 4(1) substantially reproduced the absolute duty in the 1954 Act.

10 The 1965 Act was passed to give effect to a series of international conventions (the Paris Convention 1960, the Brussels Convention 1963 and the Vienna Convention 1963. Section 1 refined and developed the statutory duty while preserving its absolute character. It subdivided liability into firstly, an absolute duty upon the licensee to ensure that no occurrence involving nuclear matter caused injury to any person whether through radioactive properties alone or from a combination of radioactive and toxic, explosive or other hazardous properties. Secondly, no ionising radiations from anything "caused or suffered by the licensee to be on the site which is not nuclear matter" or from waste discharged on, or from the site, causing injury to any person. Statutory 1(4) applied that duty to the Authority (UKAEA).

radiation from Sellafield was a material contributory cause of the diseases contracted by the plaintiffs. The fundamental issue therefore was causation.

The novel feature of the **Reay and Hope** action was that both Plaintiffs based their case on **paternal** pre-conception irradiation (PPI), which they maintained, caused a predisposition to leukaemia and/or NHL in the next generation. This 'germ-line' hypothesis (frequently referred to as the 'Gardner hypothesis') is named after Professor M.J. Gardner, who was principal author of the study. An Epidemiologist[11], Professor Gardner was Head of the Medical Research Council, Epidemiological Unit, University of Southampton. This was the first time that a personal injury claim had tested the concept of genetic damage from radiation exposure.

As far as damages were concerned, these were agreed in advance of the trial. Subject to liability, £150,000 for Elizabeth Reay, and £125,000 for Vivien Hope.

The thesis is divided into five chapters. Chapter One reviews the history and background of the Sellafield plant. Chapter Two considers the construction of scientific knowledge and the problems of causation at both the scientific and legal level. Chapter Three looks at the role of the expert witness and scientific expert evidence. Chapter Four offers a

---

[11] Epidemiology is the field of public health that studies the incidence, distribution and aetiology of disease in human populations. An Epidemiologist therefore seeks to understand disease causation and by so doing prevent disease in groups and individuals. Increasingly, epidemiological findings are relied upon to assist the court in establishing whether exposure to a toxic agent caused the disease under consideration.

descriptive and analytical account of the case. Chapter Five presents a theoretical and empirical discussion of judicial decision making, before moving on to the **Reay and Hope v BNFL** Judgment.

Chapter One

Referring the reader to events prior to the Second World War, the first section charts the discovery of nuclear fission, the development of the atomic bomb, and the alliance that took place between the British, Canadian, and United States governments. Later, with the passing of the US Atomic Energy Act 1946, and the breakdown of Anglo-US-Canadian co-operation, the ending of further collaboration. Outlining the impact of the Atomic Energy Act 1946, the thesis explains how over a period of six years, three nuclear power plants (including Windscale, later known as Sellafield) were found, constructed and put into operation.

Documenting a number of incidents/accidents that have taken place at Sellafield, Sec 1(1) offers two observations in relation to **Reay and Hope.** First the circumstance of events correspond to a time when the fathers of Dorothy Reay (George Reay) and Vivien Hope (David Hope) were employed at Sellafield. Second and particularly relevant to the dosimetry part of the case, allegations made against the Defendants (BNFL) of a 'cavalier approach' with regard to radioactive discharges; inaccurate dose information; incomplete and/or inadequate records.

Moving on from the history of Sellafield, 1(2) considers the potential health effects of exposure to ionising radiation. Concentrating on cancer, this section outlines the full impact of exposure, and the effects of different forms of radiation at the biological level. Outlining the importance of international standards and in particular, the work of the International Commission on Radiological Protection (ICRP), the thesis reviews the principles underlying risk assessment and dose limitation, and the move by nuclear agencies towards a more financially orientated 'cost/ benefit' risk analysis. Without some appreciation of the potential health effects of ionising radiation it would be difficult to evaluate the significance of the estimated exposure levels received by George Reay and David Hope during their working life.

The final section of Chapter One (1.3), considers the controversy surrounding the link between childhood cancer and nuclear installations. Concentrating on the many epidemiological studies conducted during the 1980s as a consequence of the Yorkshire Television programme 'Windscale - the Nuclear Laundry', this section discusses some of the research findings in this country and abroad. For the first time scientific debate moved from questioning the existence of a cancer excess around Sellafield, to finding an explanation for the excess. The plaintiffs, relying on the epidemiological findings of the Gardner Report, based their claim on paternal preconception irradiation causing a mutation in the spermatagonia which in turn, via paternal sperm, caused a predisposition to leukaemia in Dorothy Reay and a predisposition to NHL in Vivien Hope. Epidemiology, and in particular the Gardner study were therefore central to the case.

Chapter Two

Having considered the background of Sellafield, and realized how divided scientific opinion remains over the potential health effects of low level ionising radiation and its relationship with childhood cancer, Chapter Two, adopting a more theoretical perspective, takes up some of the more fundamental issues raised in the previous chapter, with regard to scientific uncertainty.

Concentrating on the foundations upon which scientific knowledge is based, the first section (2.1), looks at the construction of scientific knowledge, its epistemology, and recent attempts to deconstruct scientific ideology. Referring to the philosophical challenge that has taken place, the thesis briefly considers the work of Karl Popper; Thomas Kuhn; Imre Lakatos and Paul Feyerabend. The deconstruction of scientific knowledge helps us first, to appreciate the basis upon which to challenge the cognitive authority of science, and second, particularly important with toxic tort cases such as **Reay and Hope,** to recognise the limitations of the practice of science, and the problems this creates for the establishment of causal relations.

The second section of this chapter (2.2), expanding on the work in the first, concentrates on scientific explanation and causal relations. Drawing on some of the methodological problems that exist within both epidemiology and science, this section highlights the uncertain nature of applied and quantitative research, and the potential difficulties this poses for personal injury claimants.

The final section of Chapter Two, extending on issues raised in 2(2), considers causation

in the law. Focusing on toxic torts, the issue of causation is perhaps one of the greatest difficulties to overcome. Under either negligence or strict liability (as with **Reay and Hope**), the plaintiff must establish the existence of a causal connection between the defendant's action (release of a toxic agent) and the loss (disease/mortality) upon which the plaintiffs base their claim. Unfortunately for the plaintiffs however, many claimants relying on the traditional basis of causation fail to establish causal relations. First the defendants may argue there is no proven biological causal mechanism. Second the defendants may contend, on the basis of probabilities, given life style and genetic factors, that the plaintiffs would have contracted the disease anyway. Third the defendants may contest on the basis of unassessability of contribution of risk. Fourthly, the defendants may suggest cumulative causation. Applying recent case law, this section proceeds by evaluating, and then challenging the traditional approach to causation. Moving on to alternatives such as 'loss of chance', the thesis supports the view that this could offer a more realistic framework upon which toxic tort plaintiffs, such as Elizabeth Reay and Viven Hope could mount their claim. Building on the theoretical discussion in previous sections, there is a rejection of the purely individualistic, non utilitarian view of the tort system.

Chapter Three

Chapter Three considers the role of the expert witness and scientific expert evidence. Incorporated throughout this chapter are findings from a Social Survey which was conducted via the Academy of Experts based at Gray's Inn. In total 160 scientific and

medical research experts were contacted for the purposes of this thesis[12]. The questionnaire involved a total of thirty four questions, with additional space for further information, should the expert so choose. In addition to evaluating the role and general experience of the scientific expert witness, the research was also interested in the experts' opinion of the judiciary. The results of these findings are disseminated throughout this chapter, and also Chapter Five, which looks specifically at the judiciary and judicial decision making.

Chapter Three, drawing on the work in Chapter One and Two, considers the expert within the dynamics of science/law interaction, and in particular, the problems of scientific knowledge (when presented as expert evidence) within an adversarial setting that often demands proof of specific causation. Section 3(1) begins by looking at the ambivalent role of the expert witness, and how increasingly, scientific experts are expected to be both good experts, and good witnesses. Required to cope with the legal deconstruction of their knowledge base, experts frequently find themselves accused of partisanship and bias.

Section 3(2) is exclusively concerned with scientific expert evidence, in particular, problems associated with the validity of scientific knowledge, including: poor methodology, novel or new areas of scientific research (as with the Gardner hypothesis in **Reay and Hope**), and misrepresented or fraudulent scientific claims. Underlying scientific evidence (as discussed in Chapter 2) is a knowledge base in a constant state of flux. The difficulty this poses for the plaintiff, seeking to prove their case on the balance

---

[12] In total there were 99 responses (62%), of which 7 (3%) were incorrectly completed.

of probabilities is often (as the testimony in **Reay and Hope** confirmed) experts hold contrary opinions and give contradictory evidence.

Chapter Four

Providing a descriptive and analytical account of **Reay and Hope**, Chapter Four (building on the work of previous chapters) brings together four complex areas of scientific expert evidence including: Occupational Dosimetry (4.2); Environmental Dosimetry (4.3); Epidemiology (4.4), and Genetics (4.5). Beginning with a synopsis of the **Reay and Hope** case (4.1), the purpose of Chapter Four is to provide a day by day account of events as they took place. Relying on the transcript of the trial, which lasted short of one hundred days, and included the evidence of numerous expert witnesses, the chapter highlights the role and contribution of the experts, as well as identifying some of the more important aspects of the trial, which led the presiding judge to his ultimate conclusion.

Drawing on every stage of the evidential process, the trial reveals a history of ongoing concerns expressed by the plaintiffs over: non-disclosure, misinformation, questions of neutrality and accountability, public health/safety and risk assessment. As far as the experts are concerned, allegations ranged from poor methodology to fraud and incompetence.

The complexity of the evidence, coupled with the politically sensitive nature of the subject matter, ensured a high level of public interest throughout the trial. In addition, specific

non-governmental organizations (NGOs)[13], smaller pressure groups[14], and others, including, nuclear workers and residents living near nuclear installations, had a particular interest in the judgment. As far as BNFL were concerned, they always encouraged acceptance of their operations, as well as nuclear power, and to this end embarked upon a marketing programme which included high profile advertising campaigns, local area financial support, and in-house experts giving some 400 talks a year to schools, businesses and local groups. To counter allegations that emerged from the case, and also deter any further attacks upon their already tarnished public image, BNFL were willing to spend huge unspecified amounts[15] to protect their name.

---

[13] NGOs included Greenpeace and Friends of the Earth Both organizations are international and high profile, and both employ professional staff at the scientific, media and legal level. In addition, these NGOs are not specific interest groups, they are concerned with global environmental issues.

[14] A particularly important and active pressure group involved directly with Sellafield is Cumbrian Opposed to a Radioactive Environment (CORE). CORE was originally formed in 1980 as the 'Barrow and District Action Group against the Impact of Nuclear Waste' to investigate potential health hazards with regard to the Sellafield site.

[15] BNFL secured the services of Freshfields Solicitors, Mr. K.S. Rokison QC and Mr. M. G. Spencer QC. Although not confirmed, it has been estimated that the case cost in excess of £20m. Mr. Justice French referring to the expense of the trial, said "it would need thousands of football pool wins to make any significant effect on the costs of this case" (Oral Judgment 8th October 1993 p.79A).

Chapter Five

Chapter Five is concerned with the process of decision making (5.1), the Reay and Hope Judgment (5.2), and the application of probability theory to future decision making (5.3). Concentrating on 'hard' or novel cases, where as with Reay and Hope, there are 'gaps in the law', Section 5(1) begins by considering the distinction between the 'discovery' and 'justification' process. Drawing on the observations of US and English judges including: Justice Cardozo; Justice Posner; Lord Radcliffe; Lord Devlin; Lord Denning and Lord Griffiths, the thesis considers the work of the Realist Movement, and their contribution to the internal reasoning behind judicial decision making.

As far as 'justification' of judgment is concerned, the doctorate draws on the findings of a second piece of empirical research carried out for the purposes of this thesis. This research involves contact by letter with all sixty five Queen's Bench Division (QBD) Judges[16]. Of those who responded (34 per cent), nearly all were willing to offer their views of the decision making process.

Section 5(2) concentrates on the Reay and Hope Judgment. Outlining the scientific framework upon which Mr. Justice French based his decision making, this section considers the management and supervision of the case, before moving on to an analysis of the Judgment.

Having identified a number of factors which emerged from the Judgment, Section 5(3)

---

[16] This was the total number of Queen's Bench Division Judges at the time of the research.

moves on to consider the viability of an alternative basis of decision making for particularly complex cases (such as toxic torts), where scientific expert evidence, and multiple witnesses are the norm. Section 5(3), identifies 'Bayes Theorem' (although generally associated with criminal cases) as a possible way forward in assisting judges and lawyers cope with toxic torts. Drawing on the many areas already discussed, Section 5(3) considers the potential of probability theory, and again, relying on the findings of the QBD research, speculates on whether 'Bayes Theorem' as an analytical tool, or as a foundation for decision making, has any future in the eyes of the judiciary.

Although Lord Woolf chose not to separate toxic torts for 'Specialist Area' consideration, many of the recommendations in Section IV of his Report[17] (Chapter 15, Medical Negligence; and Chapter 17, Multi Party Action) have application to, and implications for, the toxic tort. Consequently, as illustrated by the many issues raised in **Reay and Hope**, toxic torts cannot simply be incorporated into a general 'personal injury' categorization.

Many of the concerns highlighted by Lord Woolf over: cost; the difficulty of proving causation; the degree of public mistrust (which in the case of toxic torts may be levelled at corporations and/or public bodies); delays; problems of pre-litigation procedures; and the discovery process; have as much relevance to the toxic tort plaintiff, as to the medical negligence claimant. Moreover, because of the scientific complexity of the toxic tort, many of the recommendations in respect of specialised judicial lists, specially designated

---

[17] Access to Justice, Final Report to the Lord Chancellor on the Civil Justice System in England and Wales. July 1996.

courts, appropriate judicial training could be argued for. Further, because toxic torts depend upon the authority and integrity of the scientific expert witness, problems identified by Lord Woolf, including polarisation and allegations of partisanship are of particular concern.

Therefore, given the complexity of such claims, it seems appropriate that the toxic tort, in addition to being designated a 'specialist area', could also be included as a potential category for discussion in Chapter 17, Multi Party Action. Lord Woolf outlining his recommendations as regards multi party actions, identified the following objectives:

a) to provide access to justice where large numbers of people have been affected by another's conduct, but individual loss is so small that it makes an individual action economically unviable;

b) to provide expeditious, effective and proportionate methods of resolving cases, where individual damages are large enough to justify individual action but where the number of claimants and the nature of issues involved mean that the cases cannot be managed satisfactorily in accordance with normal procedures;

c) to achieve a balance between the normal rights of claimants and defendants, to pursue and defend cases individually, and the interests of a group of parties to litigate the action as a whole in an effective manner.

Currently Lord Woolf alludes in his chapter on 'Multi Party Claims' to concerns over complexity, intractability of intrinsic subject matter, major discovery problems, escalating use of experts, cost and delay - all problems highlighted by **Reay and Hope.**

At the time of writing, the White Paper, 'Modernising Justice', which deals with the planned reforms of the legal aid scheme, and the Access to Justice Bill (currently being

debated in Parliament) are under consideration. In the conclusion of this research therefore, the thesis in addition to bringing together all the socio-legal issues raised by **Reay and Hope** looks forward, and reflects upon the post-millennium future of the toxic tort.

1.1. THE HISTORY OF SELLAFIELD

The purpose of Chapter One is to provide some background to events leading to the Reay and Hope litigation. Divided into three sections, the first part considers the history of Sellafield and its development as a nuclear power station. The second documents the potential health effects associated with exposure to ionising radiation, and finally, section three discusses some of the scientific evidence as regards childhood cancer and nuclear installations.

Since 1945, the uncertainty surrounding nuclear power has developed into an anxiety deeply rooted within twentieth century culture. For many, the atomic bombings of Hiroshima and Nagasaki heralded the first realization of the immediate and long term effects of acute exposure to ionising radiation. Associated with the onset of cancer and a history of secrecy and misinformation, Sellafield, perhaps more than any other nuclear installation epitomizes the controversy surrounding nuclear power and the unseen, untouchable, insidious nature of chronic radioactive contamination.

Prelude to the Second World War

Prior to the Second World War, scientists had for many years wanted to tap into the huge store of energy locked up in the atom, however, it was not until 1939 says Jay (1954:3), that "the key to the lock was finally discovered in the form of nuclear fission"[1].

---

[1] When fissile materials such as uranium and plutonium are bombarded by neutrons, they split and release a huge amount of energy. Fission is therefore the splitting apart of a heavy atomic nucleus into two or more parts.

With the threat of war looming, scientists, aware of the potential of this new discovery had drawn the Government's attention to the effectiveness of nuclear power as a weapon of war, as a consequence, in April 1940 a committee[2] of scientists was set up under the Chairmanship of Sir G.P. Thompson.

The Committee was instructed to report on the feasibility of producing atomic bombs, having regard to two principal aims:

1. The nuclear data necessary for the development of an atomic weapon.
2. The most suitable method for the separation of uranium[3].

In 1941, the Committee hastily endorsed a feasibility study in conjunction with the Scientific Advisory Committee of the War Cabinet, and the Chiefs of Staff. In September of that year, the Prime Minister[4] asked Sir John Anderson[5], to undertake personal responsibility for the supervision of the project, with the direction of the work being entrusted to the newly created Department of Scientific and Industrial Research (DSIR)[6].

---

2 Originally under the Air Ministry and later under the Ministry of Aircraft Productions.

3 Uranium is the fundamental material in all atomic energy work, in particular uranium 238 (U238) and uranium 235 (U235).

4 Winston Churchill.

5 Later Lord Waverley responsible for the Waverley Committee which undertook an evaluation of the transfer of atomic energy from the Ministry of Supply after the war.

6 A newly created Directorate whose function was disguised under the name Directorate of Tube Alloys.

In the meantime, independent, parallel atomic research was also underway in the United States, leading to a collaboration between the British and American scientific community. In late 1942, for reason of efficiency, it was decided that the slow neutron[7] part of the British research should be transferred to the American team, which in turn, led to a further union in 1943, between the British and Canadian/French research establishments, under the direction of the National Research Council of Canada[8]. However, despite this new Anglo-Canadian/French alliance, both the American and British-Canadian research teams retained close working relationships, as a result, within a few months, further collaboration and consolidation was proposed, resulting in virtually all members of the slow neutron group being moved again, this time to Canada.

Later in the same year, after yet further discussions between Sir John Anderson, the American authorities, the Prime Minister and the President of the United States, it was decided for strategic, resource and security considerations to relocate the whole of the research and production of the atomic bomb to the U.S.A. (Jay 1954). Consequently, in 1943, the British research team moved en masse to the US, effectively putting a stop to any atomic energy research in the United Kingdom.

---

[7] There are thermal and fast reactors. In thermal reactors the neutrons are slowed down by means of a moderator (such as carbon or hydrogen) to a state of equilibrium with their surrounding matter. Fast reactors contain no such moderator.

[8] The Quebec Agreement (1943) enabled the UK to become involved in the Manhattan Project. It also laid down that the President would decide any sharing of post-war advantages. Subsequently, in September 1944, President Roosevelt and the Prime Minister signed the Hyde Park Aide-Memoir which promised full collaboration between the two countries in the development of nuclear technology.

Over the next three years, the success achieved by this scientific collaboration resulted in the translation of nuclear theory into engineering practice with the dropping of two atomic bombs on Japan in 1945[9]. However, despite this co-operation (and the fact that the basic physics of atomic energy had been published in the scientific journals of 1938-1939[10]), only the Americans completely understood the technical methods by which the bomb had been produced (as they had contributed the greater part of scientific expertise) and only they had the knowledge necessary for delivery of the bomb, as they had built the plant and equipment leading to its development.

In 1945, after the death of Roosevelt, the American Government under President Truman, decided to limit access to atomic research, thereby restricting the amount of information and knowledge available to other countries. In 1946, the American Congress passed the US Atomic Energy Act (the McMahon Act), which resulted in the breakdown of Anglo-US-Canadian atomic co-operation and ended further collaboration.

---

[9] Hiroshima 5th August 1945 (Uranium base) Nagasaki 9th August 1945 (Plutonium base).

[10] The results of splitting a uranium atom was discovered by two German scientists Otto Hahn and Fritz Strassman in 1938. Niels Bohr of Denmark and John Wheeler of Princeton published a theoretical explanation of the fission process in 1939. Meanwhile in Paris (1939) Joliot Curie's team showed that spare neutrons were also released making a chain reaction possible. In 1940 two Austrian physicists, Lisa Meitner and Otto Frisch wrote a memorandum explaining the physical properties of nuclear fission.

As a consequence of this incoming legislation and other factors[11], the Prime Minister informed the House of Commons in 1945 that the Government had decided to set up its own research and development establishment at Harwell, covering all aspects of atomic energy within the UK., including the manufacture of plutonium[12]. From that date, all work in this area was transferred from the DSIR to the Ministry of Supply.

Post Second World War

The Atomic Energy Bill was introduced into the House of Commons on the 1st May 1946, and became law on 6th November 1946. The Atomic Energy Act gave the Minister of Supply wide powers to produce, use and dispose of atomic energy and also carry out research into any matters connected with atomic energy. Further, it empowered the Minister of Supply to make an Order (if necessary) prohibiting any activities connected with the production and use of atomic energy except under licence. However, the Act did not set up a Government monopoly as such; in the beginning the Government tried unsuccessfully to induce and encourage commercial firms to get involved in both the building and operation of atomic energy plants (Arnold 1975).

---

[11] According to Arnold (1992) these factors included: the knowledge that there was no formal US commitment to defend the UK; the intensification of the Cold War; the failure of the two year discussions on international control of atomic energy. Later, in 1949, the detection (after testing) of the first Soviet bomb, and the 1950 Korean War, reaffirmed Attlee's belief that nuclear power was essential as a deterrent.

[12] Plutonium was first manufactured in a laboratory in 1941 by bombarding uranium with neutrons. In times of shortage of Uranium 235, plutonium can be recovered from the waste (spent fuel) of the nuclear reactors and mixed with ordinary uranium to make a fuel suitable for either power stations or nuclear weapons.

In early 1946, four key people responsible for the project were in place. Lord Portal of Hungerford, the wartime Chief of Air Staff accepted the position of atomic energy Controller in the Ministry of Supply; Dr. Cockcroft was appointed as Director of the research establishment at Harwell; Christopher Hinton[13] became Head of Production Organization, responsible for the design and building of the nuclear plants, and the last member of the team, William Penney was entrusted with the making and testing of the atomic bomb. In the opinion of some (Gowring 1974; Arnold 1992), the achievements of these men (and their establishments), has gone down in nuclear social history as one of the most successful (technically productive) post war team efforts of that period.

However of particular importance to the project during this period, were Hinton and his engineering colleagues. Hinton's instructions were to build factories capable of carrying out four main processes:

1. To extract uranium metal (U235[14]) from uranium ore (natural uranium).
2. To irradiate the uranium metal in piles (in order to get plutonium).
3. To extract plutonium from the irradiated uranium and refine it by means of chemical reprocessing.
4. To separate uranium 235 by diffusion.

---

[13] Hinton was a distinguished engineer who was lent from industry at the beginning of the war and by its end, was in charge of the building and operation of the Royal Ordnance Filling Factories. After the war he stayed on to run these factories down to a peacetime level, when he was invited to undertake responsibility for creating the new industry of atomic energy.

[14] Uranium-235 as a fissile material, will split in the right circumstances and promote a chain reaction.

In addition to building and constructing the factories, Hinton also had to take account of the geographical locations of the three sites, and the positioning of the headquarters[15]. Partly, this was to reduce vulnerability to the consequences of attack, but it was also to facilitate the appointment of contractors and design staff from any nearby existing heavy engineering and/or chemical industries.

Within six years says Arnold (1992:7), "men had been trained; sites found; a complex of factories designed, constructed and put into operation. There were plants to treat uranium ores, produce uranium metal and fabricate nuclear fuel elements; piles to produce plutonium; and chemical plants to produce irradiated fuel elements and extract and purify plutonium".

The first of these factories was based in Springfield, Lancashire, its task was to extract uranium from ore, to purify it and reduce it to metal. Following the completion of this process, the metal was cast into rods and encased in aluminium cans to form fuel elements.

In choosing the location for the second plant, Hinton opted for a relatively unpopulated area near Whitehaven which became known as the Windscale Works and was based near Sellafield in Cumberland. Prior to this, the land had been the home of a Second World War munitions factory and was at the time (1947), still owned by the Army. The nearby river Calder provided the necessary source of water for the plant and in addition, there

---

[15] The headquarters of the production organization was situated in Risley in Lancashire. From here the design, construction and operation of the three factories was planned.

were already existing railway sidings as well as office and service buildings. The factory occupied some 300 acres.

The third factory was based at Capenhurst near Chester[16]. The task for this plant was to enrich the uranium by increasing the proportion of fissile uranium (U-235). Enrichment had two purposes firstly, it allowed the recycling of depleted uranium (spent fuel) and secondly, high enrichment produced uranium suitable for both nuclear power stations and nuclear weapons.

In little more than six years since the original meeting of Cockcroft, Hinton and Penney, plutonium for the atomic bomb test had been delivered to Penney's staff. The first British nuclear device, code named Hurricane, was exploded on the Monte Bello Island off the north-west coast of Australia in October 1952.

In the early 1950s Churchill was persuaded that the work on nuclear energy should be transferred from the Ministry of Supply to a new body set up for the task. In April 1953, the Prime Minister appointed a committee to make its recommendations. In November 1953, the committee reported on 'The Future Organization of the United Kingdom Atomic Energy Project, and in 1954, the Atomic Energy Act created the United Kingdom Atomic Energy Authority. The White Paper stated:

> ....However crude and primitive our first nuclear power reactors may appear to future generations, we can look forward with confidence to the time when

---

[16] Mr. Harold Disney (rather than Hinton) was in charge of the design of the diffusion plant, part of which came into operation at Capenhurst.

> industrial power from the atom will be a major factor....Indeed, it is not too much to say that the exploitation of nuclear energy may come to be regarded as the most important step taken by man in the mastery of nature since the discovery of fire"[17]

Sellafield

Probably of all the sites in this country, Windscale[18] has proved the most controversial. Dominated by Pile 1 and 2, the first Pile (which began operation in October 1950) went critical in October 1951, the second Pile (which began operation in 1951) went critical the same year. Described by Hinton, as 'monuments to our initial ignorance', these events marked the beginning of a catalogue of incidents which have continued to undermine public confidence in nuclear safety.

Standing over 400 feet high, like vast chimney stacks, each pile contained a central core of graphite blocks with horizontally laid rows of approximately 170 tons of uranium metal held in some 70,000 aluminium cans (cartridges). The aim of the exercise was to transform the irritated uranium into plutonium. In addition to the two piles, there were also underwater storage facilities for the irradiated fuel discharged from the reactors (Pile Ponds), and de-canning sheds for stripping off the aluminium cans (in preparation for the separation of the irradiated uranium). Following de-canning, the chemical reprocessing plant (B204) continued the process of chemical separation and plutonium purification by isolating the plutonium, uranium and unwanted radioactive by-products.

---

[17] Cmnd. 8948 HMSO, November 1953.

[18] Hereafter Windscale will be referred to as Sellafield.

Because of the large amount of heat generated by this process, cold air[19] had to be blown over the reactors to keep them cool; it was then discharged through a filtered gallery built on top of the chimneys[20]. Known as the 'Cockcroft follies'[21], these filters were later found to be totally inadequate, releasing far greater levels of radioactive particles[22] into the environment than was ever realised or anticipated. In 1986, Dr. Derek Jakeman wrote to the British Medical Journal[23] outlining the full extent of these emissions:

> The release ...was substantial, consisting of thousands of millions of highly radioactive particles which were deposited within a few kilometres... predominately of long lived fission products...Large numbers of radioactive particles were found in gardens and homes, including the larders in Seascale. In 1955, when the particles were first found, only recently deposited activity was measured....no attempt was made to trace the full extent of the radioactivity within the local environment or the transfer to the food chain. A decision to monitor was not taken until July 1957, some three years after the particles were believed to have been released.

---

19 The air flow from each chimney stack was approximately one ton per second at a flow rate of 20 miles per hour.

20 The central core becomes intensely radioactive when running and the cool air discharged is therefore also radioactive. The reason for having the chimneys 400 feet high is to dilute any radioactivity before it reaches ground level.

21 Named after Sir John Cockcroft.

22 Including iodine, strontium and caesium. It was not until 1955 that the full extent of this long term leakage was realised, and only then by chance, when Dr. Derek Jakeman, a Windscale employee happened to take a Geiger counter to his Seascale home. Further details of this event came out in the trial, see Chapter 4(1) and 4(2) for additional information.

23 Jakeman, D. (1986),'New Estimates of Radioactive Discharges from Sellafield' British Medical Journal, 293:760.

He went on to say:

> ...levels of radioactivity in milk and other foods in the mid 1950s would have been extremely high at Seascale. They may have been more than ten times the maximum permissible levels in milk for one or two years....the cumulative dose received by children may have been in the region of 50mSv.....[this] probably represents the worst known example of exposure to radiation for members of the public from the operation of a nuclear plant.....for the group of children born in the 1950s, this dose could have exceeded that from natural background by a factor of 10.

The middle 1950s also saw the acknowledgement of another two major problems with regard to the design and construction of the Sellafield plant. The first concerned, what became known as 'Wigner energy'. Although it was recognized there was a growth of the graphite core upon irradiation, another phenomenon, 'Wigner energy' had not been realised. This related to a potential increase in energy (due to the displacement of atoms) when the graphite was bombarded by neutrons. Unless this energy was released therefore, it could accumulate in a spontaneous and potentially dangerous release of energy, perhaps seriously over-heating the reactor.

The second problem was burst fuel cartridges. According to Arnold (1992:34), if a can burst, and "the uranium metal was exposed, it would oxidise, releasing fission products into the coolant air stream, contaminating the pile and perhaps - unless removed - causing a fire in the channel". In addition to burst cartridges however, cans could also get displaced or damaged, creating an equally serious situation[24].

In one incident in 1955, part of a vital screening system which checked for burst cartridges inside the reactor was found to be sheared. According to Cutler and Edwards (1988:26),

---

[24] This is particularly relevant to the litigation. See Ch.4 for additional information.

this necessitated "two hundred and fifty one volunteers crawling into the core in relays" in order to rectify the situation. Thirteen discharged fuel elements (instead of falling into the discharge duct and being removed in the skips) had overshot and lodged in the air duct. Large quantities of uranium/uranium oxide ranging from 150-600 days old were found at ground level in, and around the local environment (Arnold, 1992).

The first major accident however, occurred at Sellafield in October 1957 when, as a consequence of a fire at the reactor core, an estimated three tonnes of uranium was set alight, which over a two day period, resulted in the dispersal of radioactive particles throughout England, Wales, Ireland and Northern Europe (Busby 1995). In the immediate aftermath of the accident, iodine-131; xenon 133; strontium-90; caesium-137 were identified as the main health concerns[25]. Subsequently however, in a number of ongoing reappraisals and reassessments between 1957-1988[26], other particles were also added to the list including: polonium-210; tellurium-132; ruthenium-106; tritium; cerium-144.

In reality the full impact of the health effects of the 1957 accident will probably never

---

[25] Command Papers include: Cmnd 302 (1957); Cmnd 338 (1957); Cmnd 342 (1958); Cmnd 471 (1958); Cmnd 1225 (1960).

[26] Beattie, 1963; Hill, 1965; Taylor, 1981; Chamberlain, 1986; Bobrow, 1986; Clark, 1988, 1989.

be known. What is clear, is that until Chernobyl in 1986[27], this incident was regarded as the worst nuclear accident in the world[28]. Arnold (1992:124), in her analysis of the accident identifies several "possible and cumulative causes":

> ...There were failures of knowledge and research, especially on graphite. The piles were used for purposes not envisaged when they were designed and lacked adequate instrumentation. There were deficiencies in staffing, organization, management and communications. The whole project was overloaded with too many urgent and competing demands - to expand and extend military production, develop new reactor types and support an arguably over-ambitious civil programme.

She goes on:

> ..It seems clear that we cannot say exactly what started the 1957 fire, various scientists hold differing views on the probable cause: some favouring graphite, some lithium-magnesium cartridges, some a uranium fuel element. From among the mass of data accumulated in the years after the accident, evidence can be found to support each of these. We may never know the answer, even when decommissioning of the pile is completed[29]. Whatever the initiating cause, the sequence of events in the pile core must have been highly complex and interactive.

During this period therefore, workers, their families and others from the local community were exposed to sources of environmental pollution emanating from the following areas:.

1. The Pile stacks themselves which carried to atmosphere the effluent cooling air together with radioactive gases and particles during the Pile operation.

---

[27] The worst accident to date occurred at Chernobyl, in the Ukraine on 26th April 1986. The reactor had no containment building and the fire burned for several days. Radioactive contamination was severe across Europe. The full health impact of this accident is still being assessed.

[28] A US nuclear incident (the Three Mile Island accident at Harrisburg, Pennsylvania in March 1979) was regarded as another major event. However, because of better containment, the radioactive discharges were minimal in comparison with the 1957 accident.

[29] As a consequence of the 1957 fire the original Piles are now redundant and in the process of being decommissioned.

2. The Pile Ponds in which irradiated fuel elements were stored underwater, resulting in corrosion and the consequent release of some of the content into the water.

3. The de-canning shed where operations involved raising the fuel cartridges thereby releasing radioactive droplets and gases into the atmosphere.

4. The chemical separation and plutonium purification plants in which uranium fuel was subjected to a number of chemical processes. Gaseous and other wastes were discharged to the atmosphere through a separate stack.

5. The fire in Pile No. 1 which lasted two days.... resulting in (a) uncontrolled release of gases and fine particles to the atmosphere, (b) run-off of contaminated water to Pile Ponds and via the run-off pipeline to the sea, (c) contamination of areas adjacent to the Pile building and areas surrounding the plant to distances of many kilometres[30].

In 1977, at the Windscale Inquiry[31], British Nuclear Fuels (BNFL) listed some 177 incidents which had taken place between 1950 and 1976. These included: "numerous spillages of plutonium and other radioactive materials, the contamination of many individual workers, and a series of fires, explosions and other mishaps" (Cutler and Edwards 1988:38). In addition to the inquiry, the Royal Commission on Environmental Pollution[32] had already notified the authorities of its concerns with regard to radwaste management:

> The Windscale plant deals routinely with highly radioactive and dangerous materials and ...incidents....inevitably occur...Nevertheless, it is important at such a plant that

---

30 Reay and Hope Judgment p.5-6.

31 The Windscale Inquiry was set up in 1977 under the Chairmanship of Mr. Justice Parker to consider the setting up of the Thermal Oxide Reprocessing Plant (THORP) at Sellafield. The inquiry sat for 100 days, during which time two issues dominated. First, the scientific justification for reprocessing, secondly, radiological protection of the general public and employees.

32 The Flowers Report 1976. Cmnd 6618.

> the highest standards of good housekeeping should be employed and we feel bound to say that we do not gain the impression that this was so at the time of our visit.

Further, and around the same time, excavation work at the site in 1976 revealed high levels of soil radiation as a consequence of a radioactive water leak from a concrete silo. The Nuclear Installation Inspectorate (NII) found that the leak may have started as far back as 1972. According to Cutler and Edwards (1988), and also May (1989), BNFL delayed informing the Energy Secretary of this incident for up to six weeks.

In 1981, the Health and Safety Executive (HSE)[33] pointed out that nearly half the incidents at all Britain's nuclear installations over the previous two years had taken place at Sellafield. In February 1986, Friends of the Earth (FOE) published an advertisement listing a total of 274 incidents at Sellafield between 1950-1986[34].

In the 1980s however, two events in particular galvanized public opinion with regard to health and safety concerns around Sellafield. The first concerned a Yorkshire Television programme entitled 'Windscale - the Nuclear Laundry' which was broadcast on the evening of the 1st November 1983 and confirmed the high levels of childhood leukaemia around the Sellafield site. Because of the serious nature of the claim, and prior to the evening broadcast, the Prime Minister, aware of the potential impact of the programme, on the afternoon of the 1st November 1983, assured the public that the issues raised would be examined. On the 2nd November 1983 therefore, Mrs Thatcher ordered an immediate

---

[33] HSE 'Windscale: The Management of Safety'.

[34] The Guardian, February (1986).

inquiry[35] which was announced that afternoon by the Secretary of State for the Environment.

The second incident, which occurred nine days after the programme, involved the contamination of four Greenpeace divers who were taking radioactive samples near the end of the Sellafield pipeline. The divers, who had been working from a dingy off the Cumbrian coast intended to block Sellafield's underwater discharge pipe into the Irish Sea. When they emerged from the water however, Greenpeace's Geiger counters revealed serious high levels of contamination. As a consequence of this incident BNFL initially closed the Seascale beach for twenty four hours. Notwithstanding these measures, subsequent analysis by the Department of Environment resulted in several miles of local beaches being closed for a further nine months, and food produce and marine life requiring constant monitoring.

In Parliament, the Secretary of State for the Environment announced his intention of referring the matter to the Director of Public Prosecutions (DPP). In August 1984, the DPP confirmed that BNFL were to be prosecuted on four counts under the Radioactive Substances Act 1960,s13(1) and the Nuclear Installations Act 1965,s4(6)[36]. In June 1985, the jury found BNFL guilty of failing to keep discharge records, failing to take all

---

[35] The Advisory Committee under its Chairman, Sir Douglas Black later published the Black Report, 'Investigation of the Possible Increased Incidence of Cancer in West Cumbria'.

[36] This was the first time in the history of the nuclear industry that criminal proceedings have been brought.

reasonable steps to minimise exposure of persons to radiation, failing to keep operational records, and failing to keep discharges to a minimum.

Since 1988, Sellafield has suffered a further series of incidents including radioactive discharge, fires, employee contamination and on one occasion the plant had to be put on amber alert[37] (May 1989). More recently (1990-1998), the Health and Safety Executive issued a number of statements concerning nuclear incidents at the Sellafield plant[38], including: radioactive discharges of ruthenium 106, plutonium[39], iodine-129; contamination of employees, wildlife, air, clean water, external plant walls, roofs, road surfaces; fires; failures of safety mechanisms such as cell shield doors, and on one occasion the plant was deemed sub-critical and shut down.

---

37 This indicates an emergency situation in which there is a threat to the whole plant.

38 'Statements of Nuclear Incidents' E:48:91; E2:92; E107:93; E1:93; E161:93; E142:94; E85:94; E36:94; E51:95; E100:95; E120:96; E169:96; E46:96; E1:96; E108:97; E67:98; E161:98.

39 Plutonium of all the substances released from Sellafield is probably one of the most long lasting and dangerous. With a half life of 24,000 years (the time for half the atoms to disintegrate), it is estimated that the total world (approximately thirty nations) inventory of plutonium, is about 1239 tonnes (Royal Society, 1998), of which 100 tonnes is in the UK.

Today, Sellafield still produces large quantities of high level[40], medium level[41] and low level[42] waste. Until recently Sellafield's radioactive disposal (as in the 1950s), included sea dumping[43] of radioactive waste through the great pipeline (two and half miles long) into the Irish Sea, and later, land burial[44] of waste at Drigg (south of Windscale) which has taken place since 1959. Currently the UK has a waste burden second only to the USA, which according to Blowers (1998:3) accounts for nearly 17% of the global total. Although twenty years ago, the Flowers Report (1976)[45] made it clear that any expansion of the nuclear programme should be dependant on safe containment of radioactive waste,

---

[40] High level (heat generating) waste are defined in the UK as those wastes in which the temperature may rise significantly as a result of their radioactivity.

[41] Intermediate (medium) level wastes are wastes which exceed the boundaries of low level waste, but which do not require heating to be taken into account in the design and storage of disposal facilities.

[42] Low level wastes, are wastes containing radioactive materials other than those acceptable for dustbin disposal (very low level). These may include combustible (packaging, safety clothing) or non combustible (redundant plant items).

[43] Sea dumping remained at the heart of both military and civil radwaste disposal policy until 1983. According to Elsworth (1990:299) the Irish Sea had a "quarter to one-third of a tonne of highly radioactive plutonium" pumped into it from Sellafield. In addition there was also sea-dumping of radioactive material wrapped in concrete or steel containers accounting for "67,337 tonnes of waste" dropped from the side of a ship.

[44] There are burial sites at Drigg (south of Windscale) where low level radioactive waste has been buried in shallow soil trenches since 1959.

[45] Royal Commission on Environmental Pollution (1976) Cmnd 6618.

there is still no decision on the best method of disposal[46], or where any potential repository should be based. Sellafield, although the favoured option by the nuclear industry was turned down by John Gummer, Secretary of State in 1997, in light of 'scientific uncertainties and technical deficiencies'.

Apart from being the main producer and storer of solid waste, Sellafield also gives rise to "the largest liquid and gaseous discharges of all British nuclear sites" (Berkhout 1991:134). According to Busby (1995), over sixty per cent of the total exposure dose from isotopic waste to the European community also comes from Sellafield.

For people living near any hazardous plant, the principal consideration is the risk to themselves and their families. As far as Sellafield is concerned, the main hazard for the local community and those employed by the nuclear industry is exposure to ionising radiation. Despite being one of the most regulated and controlled toxic substances worldwide, there are no guarantees that ionising radiation is safe, or that the current protection standards are adequate. As Caufield (1989:xii) says, "There are still unanswered questions about the genetic effects of radiation, about its behaviour at very low doses, and about its link to cancer".

---

[46] Consensus of opinion is concentrating on deep geological disposal, particularly for the longer-lived wastes.

1.2 POTENTIAL HEALTH EFFECTS RESULTING FROM EXPOSURE TO IONISING RADIATION

Although a naturally occurring phenomenon[47], ionising radiation, particularly from artificial sources such as nuclear power[48] probably engenders more fear than any other hazard in the environment. According to Professor Blowers (1998:1), the impact, whether it arises from deliberate, accidental or routine releases of radioactivity generates greater anxiety than "any other socially induced risk in the modern world". Increasingly regarded as a 'dread risk' (Slovic et al. 1980), radiation is perceived of as something insidious and invisible which, through pathways of water, atmosphere and the food chain pollutes the environment, covering wide areas and crossing all national boundaries.

In addition to the anxiety created by radioactivity however, McElveen and Eddy (1984:29) also identify cancer, "a disease characterized by the progressive and unrestrained growth of populations of abnormal cells, [as] ...probably the most feared disease". First and foremost this is because "cancer is frequently fatal, and when it is not, it requires aggressive and expensive therapy.... Second, over the last several decades, cancer has become an increasingly common cause of death and disease. Third, despite the expenditure of billions on research, the causes of cancer in humans are really not known, nor are the mechanisms by which cancer develops" (Ibid).

---

[47] Natural radiation includes cosmic rays from outer space, soils and rocks, and potassium in foods.

[48] Other artificial sources include medical, occupational and miscellaneous sources such as air travel, domestic smoke detectors, coal burning.

Notwithstanding the lack of consensus over the causes of cancer, most scientists acknowledge the potential carcinogenicity of high doses of ionising radiation[49]. When it comes to exposure at lower doses of radiation however, the data becomes more ambiguous with the immediate and long term effects of any correlation becoming less certain.

Therefore, while it is recognised that all doses of ionising radiation, however small, may represent a risk to health, radiation-dose limits at the lower end, are set according to what are deemed... a socially acceptable level of risk - "usually a probability of death in one year of between 1:100,000 and 1:1,000,000" (Berkhout 1991:3). In calculating levels of risk and probabilities, such assessments are compounded by problems of definition with

---

[49] All matter is made up of atoms. Each atom contains a nucleus consisting of protons and neutrons, around which revolve electrons. The electrons are negatively charged and move at high speeds. They are attracted to the protons which are positively charged. The neutrons are electrically neutral. Some nuclide are unstable, that is, they do not readily maintain their number of protons and neutrons in the nucleus. On losing protons, they are then converted into nuclide of a different element. Radioactive decay (radiation) is produced in the process of a nuclide making its transformation towards a more stable state. Ionisation is the process whereby, as a consequence of radioactive decay, there is a release of radioactive particles and electromagnetic waves which interact with matter in their path. It is this transfer of energy that cause damage. The main effect of this loss of energy is the disturbance of (negatively charged) electrons in the atoms of the substance in the path of the radiation. This disturbance may result in the atoms themselves losing electrons and becoming positive ions.

regard to radiation terms[50], concepts of dose[51] and spatial variations[52] . For this reason distinctions are made between non-stochastic effects[53], and stochastic effects[54] and somatic effects (on the individual) and genetic effects[55].

Therefore. while there is broad agreement that ionising radiation has the capacity to induce cancer, both the damage caused and the extent of the damage will depend upon the intensity and the type of radiation, as well as the time over which it was received.

---

50 Different types of unit are used to measure radiation and its effects. The quantity of radioactivity emitted = the becquerel (Bq) represents a direct measurement of the number of radioactive disintegrations per second. The biological effects produced on exposure to radiation at high levels = gray (Gy) (old unit = rads).
For low levels of radiation exposure the sievert (Sv) (which replaced the rem in 1977) is used. The Sv is a method by which the absorbed dose can be converted into a biological dose equivalent. A millisievert (mSv) is one thousandth of a sievert.

51 The "committed effective dose equivalent" is a composite figure in which all the doses from different types of radiation to different organs are combined. The "collective dose" is the individual dose equivalents and the number of individuals exposed. The "collective" dose commitment is the dose commitment multiplied by the number of individuals in the specified population.

52 Differences in geology, altitude, latitude can all affect background as well as manmade radiation levels.

53 For non-stochastic effects, a minimum radiation dose (threshold) has to be exceeded. Effects occur within days or weeks after exposure.

54 Stochastic effect of radiation are usually delayed and do not appear for several years. There is no threshold dose.

55 The hereditary or genetic effects of ionising radiation are those which, while not being expressed in the irradiated individual, are transmitted to his or her children through alternations in chromosomes within the genetic material.

Different forms of radiation (Alpha, Beta, Gamma, Neutron) have different abilities to travel and therefore different penetrative effects on the human body. Alpha emitting particles, although one of the least penetrative, poses particularly serious health risks if absorbed into the body through an open wound or inhaled, or swallowed. Beta particles, while a hundred times more penetrative than Alpha particles (like Alpha particles) can also be stopped by relatively thin layers of water, glass or metal, but again, can be hazardous if taken into the body. Gamma rays (electromagnetic energy waves at higher frequency than light or X-rays) in contrast to Alpha and Beta rays, go through almost anything before being absorbed and therefore, because of their particularly penetrative affect, require thick layers of lead or concrete to prevent serious health risk. Neutron rays unlike Alpha, Beta or Gamma radiation do not cause ionisation directly. Indirectly however, ionising may occur as a consequence of neutron particles colliding with other atoms causing the struck atom to disintegrate and release a host of radioisotopes into the atmosphere which may create a potentially lethal cocktail.

Therefore, the common factor with all radioactive material is that it is unstable, it decays (giving off alpha, beta or gamma radiation) and eventually becomes stable again[56] (thereby losing its harmful effects). However, it is the rate at which the different forms of radioactivity decays that is so important in respect of the human body. While some forms of radioactive material become harmless relatively quickly, other types take longer to

---

[56] See Footnote 49 for an explanation of the decaying process.

decay, thus remaining active for much longer periods[57]. An important consideration for long-lived materials is whether they become lodged in the human body or are rapidly excreted through normal biological processes. The amount of material received externally, in addition to the materials retained in the body represents the 'effective dose'[58]. The 'effective dose', the 'sievert'[59], is particularly relevant as a 'larger dose unit' in assessing 'acute' radiation biological damage (as for example in the case of Hiroshima or Nagasaki), but is not appropriate, for measuring exposure to individuals in non-acute circumstances. For this reason effects on individuals of non-acute exposure are usually measured in millisieverts (mSv), one thousandths of a sievert, and it is this lower level of exposure that is of primary concern at Sellafield.

In order to appreciate the impact of different doses of radiation on the whole body, Bertell (1985:42-43) identifies the probable health effects resulting from acute exposure to ionising radiation as:

(10 sievert and above) Immediate Death (Frying of the Brain).

---

[57] For instance Plutonium 239 has a half life of 24,400 years; Caesium 137 - 30 years; Iodine 131 - 2 hours.

[58] Effective dose is defined by the HSE (1992:15) as the "energy absorbed in body tissues, modified to allow for the different effect on the body of different kinds of radiation and for the different sensitivity of different organs of the body".

[59] The 'Sievert' is named after Rolf Sievert of Sweden, who in 1925 estimated the dose of Natural Background Radiation (NBR), that people were exposed to each year. This dose was reached without experimentation, or scientific evidence. On the basis of this figure, he later proposed that manmade radiation should be linked to levels of NBR radiation. A principle that has been followed ever since.

(6 to 10 sievert) Death: 10 Days
(weakness, nausea, vomiting and diarrhoea followed by apparent improvement. After several days; fever, diarrhoea, blood discharge from the bowels, haemorrhage of the larynx, trachea, bronchi or lungs, vomiting of blood and blood in the urine).

(2.5 to 6 sievert) Death: 50% Victims within 5 weeks
(nausea, vomiting, diarrhoea, epilation, weakness, malaise, vomiting of blood, bloody discharge from the bowels or kidneys, nose bleeding, bleeding from gums and genitals, subcutaneous bleeding, fever, inflammation of the pharynx and stomach, and menstrual abnormalities. Marked destruction of the bone marrow, lymph nodes and spleen causing decreases in blood cells especially granulocytes and thrombocytes).

At the non-acute level, effects on the body may not be immediately noticeable. The number of red and white blood cells may be reduced, damage to reproductive organs may occur. There may be premature aging, a shortened lifespan and genetic injury[60]. In contrast to immediate effects therefore, long term somatic/genetic effects are more difficult to determine, with some organs of the human body being more susceptible than others. For example, while the kidneys, bladder and cartilage in a healthy adult absorb relatively low amounts of radioactivity, the reproductive organs, liver, eyes and red bone marrow are more sensitive. Also, children, the elderly, those with an already compromised immune system and foetuses are always at greater risk. Bertell identifies the impact at lower levels of exposure as:

(1.5 to 2.5 sievert) Shortened Life Expectancy
(nausea and vomiting on the first day. Diarrhoea and probable skin burns. Apparent improvement for about two weeks thereafter. The healthy adult recovers to somewhat normal health in about three months. He or she may have permanent health damage, may develop cancer or benign tumours, and will probably have a shortened lifespan. Foetal or embryonic death if pregnant. Genetic and teratogenic effects. Possible sterility for up to

---

[60] The genetic material of the 46 chromosomes may be damaged by radiation. Experiments on fruit flies and mice have shown the development of abnormalities in the offspring of those exposed. See C.4(5) for further discussion.

three years).

(0.5 to 1.5 sievert) Shortened Life Expectancy
(less severe radiation and burns, spontaneous abortion or stillbirth if pregnant; long term, possible benign or malignant tumours, premature ageing, shortened lifespan, genetic damage).

(0.1 to 0.5 sievert) Risk of Tumours and Genetic Damage
(most people experience little or no immediate reaction. Sensitive individuals may experience radiation sickness; long term possible ageing, genetic effects and some risk of tumours).

(under 0.1 sievert) No immediate Health Effects
long term effect may include premature aging, some off spring mutation, risk of tumours later in life).

Appreciation of the hazards of radiation exposure can be traced back to the early pioneers in nuclear physics (and subsequent work) which highlighted concern over the effects of radiation caused to both radiographers and patients[61]. As a consequence of this recognition, the International Congress on Radiology was set up in 1925 with the aim of standardizing units and maximising doses of radiation. Today, every country with a nuclear industry has at least one regulatory agency overseeing radiological protection at national level, while at international level, the United Nations has a minimum of four agencies concerned with radiation exposure[62].

Central to international standards, and having primary importance however, the International Commission on Radiological Protection was set up in 1928 to make

---

[61] The first organization to consider evidence of damaging biological effects was the British X-ray and Radium Protection Committee (1921), which set standards for the protection of those employed in the medical application of X-rays and radium.

[62] The Scientific Committee on the Effects of Atomic Radiation, the World Health Organization, the International Atomic Energy Agency and the UN Environment Programme.

proposals, and offer advice, on risk assessment guidelines. Because of its autonomy from governments, and the international and professional standing of its membership, the ICRP's recommendations have always been relied on by the global scientific community. However, after the bombing of Hiroshima and Nagasaki, the ICRP really came into its own. From deciding risks of exposure on behalf of themselves and their colleagues, its remit extended to recommending standards for nuclear employees as well as the public at large. According to Caufield (1989), the aftermath of the Second World War therefore marked a watershed for the ICRP, from a body concerned with technical judgments, to one concerned with political judgment. The ICRP's risk assessment model derives from existing data and the expertise of their own membership (a select, self appointed body of fewer than 50 international scientists who are chosen from the ICRP's own sub-committees such as The International Congress of Radiology and other selected agencies[63]).

Since 1955 the ICRP has produced a number of recommendations regarding maximum permissible doses of radiation exposure to individuals and whole populations. In the beginning the ICRP calculated cancer deaths in excess of those which would have occurred anyway and identified permissible levels of dose to individuals based on background radiation levels. However, by the middle 1960s, after some criticism, the ICRP (1966:9) were making:

> .....the cautious assumption that any exposure to radiation may carry some risk for

---

[63] The environmental movement has continually questioned the closed membership of the ICRP, as well as their lack of public accountability. Of particular concern is the fact all members have a professional interest in supporting and promoting the use of nuclear technology.

the development of somatic effects, including leukaemia and other malignancies, and of hereditary effects. The assumption is made that, down to the lowest levels of the dose, the risk of increasing disease or disability increases with the dose accumulated by the individual. This assumption implies that there is no wholly "safe" dose of radiation. The Commission recognizes that this is a conservative assumption, and that some effects may require a minimum or threshold dose. However, in the absence of positive knowledge, the Commission believes that the policy of assuming a risk of injury at low doses is the most reasonable basis for radiation protection.

In the 1970s new theories on the aetiology of cancer[64] coupled with a growing rejection of an 'acceptable threshold dose' resulted in fundamental changes to the assessment of biological risk as a consequence of radiation exposure. The effect of this knowledge was twofold, first, it brought into being the concept of risk as regards radiation protection. Second, it resulted in a re-evaluation of existing quantitative regulations within a risk-benefit analysis. This process led to the publication of new recommendations by the ICRP (which still forms the basis of radiation protection today[65]), and have been adopted by the International Atomic Energy Agency (IAEA[66]), incorporated in a European Community Directive[67], and following National Radiological Protection Board (NRPB)

---

[64] In particular, somatic-cell mutation theory and microscopic cell damage and division to sensitive genetic material.

[65] The Radioactive Substances Act 1993 (which consolidated a number of amendments to the 1960 Act) made no references to the revised principles upon which the ICRP make their recommendations. However, various White Papers (Cmnd. 8607 & Cmnd 9852), in addition to the NRPB endorsed the 1977 and 1990 ICRP recommendations.

[66] IAEA, Basic Safety Standards for Radiation Protection, Vienna, IAEA Safety Series No. 9 (1982).

[67] Council Directive of 15 July 1980 amending the Directives laying down the basic safety standards for the health protection of the general public and workers against the dangers of ionising radiation. Off J Eur Communities, 23 No. L246 17-09-80.

advice[68], included in a Government White Paper on Radioactive Waste Management[69].

The principle upon which the ICRP recommendations are based, is that risks to individuals and to the general public should be kept to acceptable levels. In order to achieve this objective, ICRP recommend a system of dose limitation which has three main requirements:

(a) justification - no practice involving the use of radiation shall be adopted unless its introduction is judged to produce a net positive benefit;

(b) optimization - all exposures to ionising radiation shall be kept as low as reasonably achievable (ALARA), economic and social factors being taken into account; and

(c) dose limitation - the radiation dose to individuals shall not exceed the limits recommended by the International Commission on Radiological Protection. (ICRP:1977).

This system applies to all practices involving radiation exposure, with the exception that the quantitative dose limits do not apply to medical irradiation, exposure to natural background radiation or accident situations.

Although optimization of protection of the public has been identified as the requirement having paramount importance (NRPB 1977; Berkhout 1991; Mountfield 1991). Since

---

[68] NRPB, Recommendations of the International Commission on Radiological Protection (ICRP Publication 26): Statement by the NRPB on their acceptability for application in the UK. (1977). NRPB, The application of ICRP recommendations: Advice to the expert group reviewing the White Paper Cmnd. 884 "The control of radioactive wastes" (1978).

[69] Great Britain Command Paper: Cmnd 8607. Radioactive Waste Management (1982).

the publication of the ICRP recommendations, other factors have also been put forward with regard to the practical application of the ALARA principle, and the financial cost of protection[70] for public, and nuclear employees[71].

Mountfield (1991), in evaluating the cost-benefit analysis, wonders whether this balancing of the financial cost as against, protection of public (and the cost of further dose reduction), has resulted in an underlying acceptance by the ICRP, the nuclear industry and its regulatory body of what has been termed the de minimis approach[72] (Clark 1985; Lindell 1985); this approach correlates the level of risk, with level of dose. If the risk involved is regarded by the nuclear industry as trivial or negligible in proportion to the financial cost, then the risk will be tolerated. The adoption of this approach may help explain the gradually move in principle from: "exposure to ionising radiation shall be kept as low as reasonably achievable" (ALARA), to the more ambiguous "as low as reasonably

---

[70] Mr. David Alton when sitting on the Environmental Select Committee (13th May 1985) questioned Mr. C. Allday of BNFL with regard to information he and other committee members had received at the Sellafield Plant. Members were informed that it costs £1/4 billion to save two lives.

[71] NRPB, Cost-benefit analysis in the optimisation of protection of radiation workers. (1982) Clark, M.J. Optimisation of the radiological protection of the public. NRPB-R120 (1981). ICRP, Cost Benefit analysis in the optimisation of radiation protection. ICRP Publication 37. Ann ICRP. 10 No.2/3 (1983).

[72] Adapted from "de minimis non curat lex" (the law does not concern itself with trivialities) which in turn is possibly a corruption from "de minimis non curat practor" the prosecutor is not concerned with triviality.

practicable" (ALARP), to, by the "best practical means" (BPM)[73].

Critics of the ICRP argue that the assessment of risk and international protection standards should not reside in a small, non-elected group of scientists, who effectively disregard and marginalise any contrary scientific opinion. In a letter to a fellow ICRP member in 1971, Bo Lindel, the ICRP's then Vice Chairman acknowledged such criticisms when he said:

> We react like mechanical puppets or like insects shown a stimulus triggering reactions, when we are faced with statements or ideas which are not branded with the mark of the old truth. Should we not instead be curious and appreciative? News media in the USA and throughout the world are full of records of a debate which was started by insignificant contributors but has been carried on persistently by individuals such as Sternglass, Gofman and Tamplin[74]. In the ICRP records, these persons hardly exist and we have reacted in a very highbrow and rather a stupid way....Who are we that we can afford to smile at this from our lofty distance...To the outsider it looks like a well protected mafia of big power interests, operating without being scrutinized and criticized[75].

---

[73] ALARA, ALARP, BPM all relate to discharge limit requirements authorised by various bodies including: Department of Environment (DOE), Ministry of Agriculture, Fisheries and Food (MAFF) (under the Radioactive Substances Act 1960), and the ICRP/NRPB. According to the Environment Committee 1985-86 Report Vol 1, p. xxi these.... "serve no useful purpose either as a meaningful guide to the plant operator as to how much radioactivity can be routinely discharged to the environment, or as a discipline on the plant operators to keep discharges down".

[74] Lauriston Taylor one of the founders of the ICRP and an avid supporter of the radiation protection establishment dismissed dissenters such as Dr. E. Sternglass (University of Pittsburgh), Dr. John Gofman (Associate Director of the Lawrence Livermore Laboratory), Dr. Arthur Tamplin an associate of Dr. Gofman, as pseudo, one time scientists; no longer part of the radiation protection community.

[75] Cited by Caufield (1989:171). This letter from Lindel appears in S. Lauriston Taylor (1979) 'Organization for Radiation Protection' 10-389.

According to Caufield (1989:178), the public evaluates its own assessment of 'acceptable' risk upon the basis of its confidence in the nuclear authorities representing them. In the case of radiation protection standards she believes:

> .....public confidence in nuclear officialdom has been declining for the past 30 years, largely due to the public's repeated discoveries that it has been lied to. Lauriston Taylor's (ICRP) argument 'that at the time information was concealed or distorted, there were considered to be acceptable political or economic reasons to warrant it', offers no comfort to those who fear they that they are still not getting the whole story.

Currently, the ICRP recommends a maximum dose for members of the public (excluding Natural Background Radiation (NBR) and medical exposure) of 5 mSv per year (1977), which by 1985, had been reduced to 1 mSv per year[76]. The occupational recommended level is a maximum of 50 mSv per year[77]. Following revised estimates from the ICRP however, the Health and Safety Executive (HSE), acting on the advice of the NRPB recently published revised guidelines on dose limitation under which the doses received by workers should be "limited to 20 mSv per annum or less"(HSE:1992:21).

Today, the majority of risk estimates arrived at by the ICRP and other agencies depend on data from five problematic sources (Sumner 1987).

> The survivors of the Hiroshima and Nagasaki bombings which were collected from October 1950.
>
> Radiation in Medicine.

---

[76] However, it is permissible to use the dose limit of 5 mSv in a year for some years, provided that the average annual committed effective dose equivalent over a lifetime does not exceed 1 mSv a year.

[77] Exposure levels for radiation workers are based on the assumption that there is employee selection criteria for fit and healthy people able to withstand higher exposure rates. Further that workers know the risk they are taking.

Occupational Exposure.

Natural Background Radiation.

Chernobyl.

The A-Bomb Studies

It is difficult to estimate with any accuracy the total number of deaths that followed the dropping of the atomic bombs (Little Boy on Hiroshima on the 6th August 1945, and Fat Man, three days later on Nagasaki). What is clear, is that in addition to the chaos that one might expect from weapons of such destruction, early evaluation of the impact of the bombs was compounded by the various restrictions placed on investigations by the occupying forces. From 1945 until 1951, the General Headquarters of the Allied Forces also prohibited any publications, including the release of medical data, outside its own control. Therefore, figures in the first four days after the bombing of Hiroshima, of 118,661 people dead, and another 30,524 severely injured within 5 km of the centre of the explosion[78], must be taken on trust.

Further, despite early denials of long term radiation effects (Beral 1985; Busby 1995), by 1947, the US Government had designated 'Fishcake Castle' in Hiroshima as its headquarters for the Atomic Bomb Casualty Commission (ABCC). Set up in 1948 with the explicit aim of studying the effects of the bombing on survivors and their children, the ABCC still exists, now under a different name, the Radiation Effects Research Foundation

---

[78] Committee for the Compilation of Materials on Damaged Caused by the Atomic Bombs in Hiroshima and Nagasaki, 1981:113.

(RERF)[79].

Notwithstanding official restrictions and early denials however, other factors such as the lack of any systematic studies of survivors until five years after the bombings[80] also cast doubt on the accuracy of the records. As a consequence of this delay, several cases (particularly those involving genetic mutations resulting in possible spontaneous/deliberate abortions, stillbirths or infant deaths) may have been missed or omitted from the research altogether.

Another group, also suspected of being under-reported were exposed people, labelled by the derogatory term, 'hibakusha'[81]. Many A-bomb survivors, aware of growing discrimination, moved away from the area to avoid any stigma/shame to their relatives of having their name associated with any possible hereditary degeneration of the family line[82].

---

[79] Two scientists particularly involved with the ABCC Study from its inception were Professor J. Neel (from 1948) and Professor J. Schull (from 1950). Both men made a significant impact on the Court when they appeared as defendant expert witnesses in the Reay and Hope trial.

[80] Missing years are significant, particularly since 40% of the excess leukaemias and other cancers appeared in the first five years of exposure.

[81] Damaged bomb people.

[82] Moving from the bombed areas in the early days meant that the hibakusha could conceal any live births and/or subsequent infant deaths from the authorities.

To complicate the situation, other factors such as individual differences to exposure sensitivity; doses from fallout; the impact of increased radioactivity on natural background radiation (NBR) levels; and synergism (a joint or co-related action of two or more influences on the human body) were not included in the original research. Added to which, accurate patient records, access to trained medical personnel, and the procurement of any diagnostic equipment were fraught with difficulties in post-war Japan, casting yet further doubt on the reliability of the data.

Regardless of these uncertainties however, the A-bomb study is nonetheless regarded as one of the most comprehensive surveys of its type ever undertaken. Today, five decades later, results from the 41,000 Japanese survivors[83] are still relied on by the nuclear industry, nuclear agencies and the ICRP, as a primary research base for consideration in assessment of radiation protection standards.

Radiation in Medicine

There are four main uses of radiation:- Diagnostic radiology[84], Nuclear medicine[85], Dental radiography[86] Radiotherapy[87] (Sumner 1987:65). Patients receiving radiation for either

---

[83] Ackland, L. Radiation: how safe is safe? New Scientist 5th May 1993, 1873:34.

[84] X-ray pictures of various part of the body.

[85] The use of radionuclides for diagnosis.

[86] X-rays pictures of teeth.

[87] The use of ionising radiation in the treatment of cancer.

diagnosis or treatment form by far the largest component of artificial radiation to the general public accounting for between 87 per cent and 90 per cent of all non-NBR levels.

Although providing an essential data base on the biological effects of ionising radiation, some of the most valuable information, according to Caufield (1989:15) comes "from studies of large groups of people needlessly irradiated for minor problems". Among the various benign conditions treated with radiation between 1949-1960 were "ringworm, acne, birthmarks, bursitis, and sinusitis" (Caufield 1989:141).

One of the most influential studies highlighting the potential harmful effects of medical X-rays was a British survey of more than 14,000 people who were subjected to radiation treatment from the 1930s to the 1950s for ankylosing spondylitis[88]. Researchers found significant numbers of leukaemia deaths (60 as opposed to the 5.4 deaths expected in such a population), twice the number of lung cancer rates, and increased levels of stomach cancer (Caulfield 1989).

Women with benign gynaecological conditions were also subject to radiation treatment, with many dying later of leukaemia and cancer of the intestine[89]. Other studies, such as the one carried out by Alice Stewart in 1958[90] showed that babies whose mothers

---

[88] Although a painful spinal condition, ankylosing spondylitis is not fatal. Court Brown, W.M. & Doll, R. BMJ Vol 5474 (1965) 1327-1332.

[89] National Academy of Sciences (1977) Vol 1, 5.

[90] Stewart, A. 'A Survey of Childhood Malignancies', British Medical Journal (1958) 1 1495.

had pelvic X-rays while pregnant were also particularly vulnerable, suffering an increased risk of developing leukaemia later in life.

Today it is recognised that any X-ray taken for diagnostic purposes includes some risk of causing cancer. The BMA (1990) state that the average dose of X-ray used in diagnosis is about 0.7 mSv taken as the effective whole body dose. The risk of causing a fatal cancer in a man of 40 years on the basis of this dosage is estimated to be 1:250,000. However, according to Shrimpton et al. (1986), somebody having a barium meal procedure in which a patient swallows barium sulphate and is X-rayed as the sulphate moves through the stomach and intestine is at far greater risk (breast 2.25 mSv; lung 8.65 mSv; ovaries 3.60 mSv; red bone marrow 2.60 mSv).

When it comes radiation treatment, exposure will depend on diagnosis, disease, hospital, make of equipment, age of equipment. What is clear, is that radiation dosage used in radiotherapy is far higher than dosage used for diagnostic purposes. Often radiotherapy results in burning of the skin, nausea, loss of weight, hair loss, impaired fertility. A person subject to radiotherapy therefore, may well exceed all international dosimetry guidelines. Such doses are justified on the basis that both the doctor and patient agree that the benefits of high radiation exposure outweigh any potential risks involved.

Occupational Exposure

According to the Reich (1991:159), within most organizations, there is a gap between "potential problem discoverers and problem resolvers", with the result that both private

and public institutions (whether by accident or design) may delay discovery and response to toxic contamination of their workforce. Agreeing with the view of the US Occupational Safety and Health Administration that:

> The goals of occupational safety and health are not adequately served if employers do not fully share the available information on toxic materials and physical agents with employees.

and that:

> .....lack of information has too often meant that occupational diseases and methods for reducing exposure have been ignored and employees have been unable to protect themselves or obtain adequate information from their employers[91]

Reich goes on to highlight the closed policy of many corporations, and their reluctance to disclose any information about, or to their workforce, which may expose employers to financial liability.

Despite evidence dating back to the 1890s on the occupational risks of radiation exposure (uranium miners, radiologists, X-ray tube makers, scientists, doctors, radiation dial painters, military personnel[92]), the nuclear industry has been less than candid with employees over the possible long terms effects of radiation induced injury. Indeed, it was only in 1982 that BNFL conceded the setting up of a 'mortality' based Compensation

---

[91] US Occupational Safety and Health Administration 21 July 1978. 'Access to employee exposure and medical records'. Proposed Rule - Federal Register 43:31371.

[92] Studies include: NRPB (1976); Smith and Doll (1981); Aoyama et al. (1983); Mancuso, Kneale and Stewart (1977); Gofman (1979); Tolley et al. (1983); Beral et al. (1985); Darby, Doll and Pike 1985); Smith and Douglas (1986); Darby and Doll (1987).

Scheme for Radiation Linked Diseases[93], which in 1987, was finally extended to include non-fatal cases[94].

Notwithstanding the introduction of employee compensation schemes however, it is always possible to manipulate occupational data, thereby minimizing the full extent of occupational illness. In the opinion of Draper (1991:41), identifying a workers condition as arising from either personal habit or genetic disposition is increasingly relied on. Other practices include "highlighting smoking effects[95], excluding non-whites[96] and excluding old people[97] from cancer studies". By omitting these people from analysis, researchers are able

---

[93] BNFL set up the Compensation Scheme in 1982, and in 1987 at the same time as the Scheme was extended to include non-fatal cases, the UKAEA joined. In 1993 Nuclear Electric and Scottish Nuclear Ltd. joined. In 1994, the Ministry of Defence and the Atomic Weapons Establishment joined. Other associated companies linked to BNFL are also affiliated to the Scheme. Currently the main operators of the UK nuclear industry are members of the Compensation Scheme.

[94] Cancers now recognised under the Scheme include leukaemia (not Chronic lymphatic leukaemia - CLL), thyroid cancer, respiratory cancers, cancer of other tissues and skin cancer (not malignant melanoma).

[95] Smoking is held to be the cause for cancers rather than any occupational hazard. Exposure to a known occupational carcinogen is rejected even as confounding factor.

[96] Non-whites perform a higher proportion of hazardous jobs and in addition suffer from inequality in health care resulting in a higher cancer mortality (and illness) than whites.

[97] Exclusion of old people removes a large percentage of the working population who have been exposed for long periods and are therefore more likely to have cancer induced from occupational hazards.

to produce statistics which suggest a low level of occupational disease, birth defects and mortality emanating from the workplace environment.

According to Cutler (1988:56), the first official study of long term health effects of low level radiation for British nuclear workers (carried out by the NRPB in 1976), consciously left out of its calculations all workers between 1950 and 1974 who "had either departed from Sellafield to work elsewhere, ceased working because of illness, or retired". Cutler, goes on to say, "It was therefore obvious that the study was biased, as it excluded the very group of workers most likely to have suffered radiation's ill-effects: the sick and the old" (Ibid).

Later, the same study was re-visited by an independent advisor (Dr. Peter Smith) from the London School of Hygiene and Tropical Medicine[98]. In contrast to the NRPB's finding of 'a below average number of cancer deaths in the nuclear industry', Smith found there was a high rate of bone marrow cancer, leukaemia and bladder cancer among Sellafield workers, and further, that the risks seemed to increase in relation to the amount of radiation received. Often the time lag between radiation damage to a cell, and a detectable cancer, was more than fifteen years.

Natural Background Radiation

As far as NBR[99] is concerned, as much as 82-87 per cent of the average radiation dose

---

[98] Smith, P.G. & Douglas, A.J. (1986) 'Mortality of workers at the Sellafield plant of British Nuclear Fuels' British Medical Journal 293 845-854.

[99] Natural background radiation includes: Cosmic radiation, Gamma radiation, Radionuclides, Radon and its decay products.

comes from natural or background radiation, with the largest single amount, 55 per cent coming from radon. While there is no ongoing national monitoring of all radioactivity in the environment, it is known that NBR is widespread and may become assimilated in water supplies, soils, rocks, vegetation and foodstuffs[100].

Because NBR levels vary from district to district, certain areas have far higher levels of radiation than others. According to the HSE (1992), the UK's average exposure dose from all risks of natural background radiation is 2 mSv per year. However, in certain parts of the country such as Cornwall, Wales, the north of England and Scotland, this figure is considerably higher. In some instances where an area is above sea level (resulting in greater doses of cosmic radiation) and particularly where there are high concentrations of radioactive decay of uranium (resulting in radon gas), exposure may be as high as 20 mSv per annum.

Although NBR levels are measured across the country, there is no definitive dose estimate as such, rather information is collected from a variety of sources which together provide an average figure which should be taken into account, in addition to exposure from non-natural sources.

Chernobyl

The explosion at the Chernobyl nuclear power station in the Ukraine in April 1986, is

---

[100] All of which could equally be affected by discharges from nuclear power stations and other institutions such as hospitals which have radioactive waste.

generally regarded as the world's worst nuclear accident to date. Since the accident, data has been amassed on acute radiation effects, treatment of the severely exposed, emergency containment, and the importance of effective communication and management in critical situations.

As a consequence of Chernobyl's fallout, up to twenty countries, 2000 km away were affected by the radioactivity (including: tellurium-132, ruthenium-103, ruthenium 106, iodine-131. caesium-134 and caesium-137) emitted from the stricken plant. According to the Nuclear Energy Agency (1995), the long term health effects remain as uncertain now, as they were in 1987, when Dr. Robert Gale (a US scientist flown in to assist in the treatment of causalities) predicted an extra 60,000 cancer related deaths, 1000 birth defects, and 5000 cases of genetic abnormalities, with some 40 per cent of deaths occurring in the old Soviet Union. More recently, estimates of cancers generated by Chernobyl range from between 16,000 in the northern hemisphere (Sumner 1991:143), to 970,500 worldwide (Gofman 1990:36). Busby (1995) believes that until detailed results of environmental monitoring, radioactivity levels in foodstuffs and direct measurement of radioactivity in humans are available, it is impossible to make any accurate predictions of the number of terminal or other cancer worldwide.

Because of the uncertainty surrounding the health effects of low level radiation, and the ongoing scientific debate over what constitutes an acceptable/tolerable level of risk, many people says O'Riordan (1985:529), have developed a deeply held distrust of the nuclear industry which he identifies at two levels:

a) radioactivity is feared because it is simply not understood by most lay people; it cannot be seen, felt or smelt, it is known to be associated with cancer and other genetic diseases, and it is regarded as uncontrollable, insidious and potentially lethal to large number of entirely innocent and trusting people;

b) radioactivity is associated with a technology and an industry that appears remote, self confident, yet unaccountable. A substantial number of people are beginning to distrust "high" science, and technologies that seem too complicated as to be beyond the capacity of elected representatives to understand them and therefore be in a proper position to make sound and informed judgments about them. The public does not like to see political decisions in effect determined by non-accountable experts.

When the Yorkshire Television Programme was broadcast in the early 1980s, it confirmed what many residents and others suspected, that radioactive discharges from the Sellafield Plant were responsible for the childhood cancers. Since the documentary, a number of studies, initiated by the impact of the programme, have attempted to resolve the question of whether there is a causal connection between childhood leukaemia and nuclear installations. In the final section of this chapter therefore, attention will focus on the decade of scientific research, following the broadcast of the documentary in 1983, and delivery of the Reay and Hope Judgment in 1993.

1.3 CHILDHOOD CANCERS AND NUCLEAR INSTALLATIONS

Within three weeks of the broadcast of the Yorkshire Television programme 'Windscale - the Nuclear Laundry', the Government, under an avalanche of public, political and media pressure had set up an independent committee under the Chairmanship of Sir Douglas Black. The terms of reference for the inquiry were:

> To look into the recently published claims of an increased incidence of cancer in the vicinity of the Sellafield site:-
>
> i) examine the evidence concerning the alleged cluster of cancer cases in the village of Seascale;
>
> ii) consider the need for further research;
>
> iii) make recommendations[101].

Upon completion of the inquiry, the Black Advisory Group Report published in July 1984, confirmed the existence of an excess of childhood leukaemia in and around the village of Seascale[102], but, having established a "best estimate" of the average radiation dose received by a model population, did not support the view that the radiation released from Sellafield was responsible for the observed incidence of leukaemia in Seascale and its

---

[101] Report of the Independent Advisory Group 'Investigation of the Possible Increased Incidence of Cancer in West Cumbria' (1984) Ch.1(2) p.7.

[102] The Black report identified a total of 14 cases of leukaemia, eight cases of lymphoma, and ten cases of hempoietic cancers, all under the age of 25 years. This represented approximately a fourfold increase rate of leukaemia in people under 25 years in the district of Millom between 1968-1978, and a tenfold increase of leukaemia in the Seascale population aged under ten years of age.

neighbouring area[103]. However, the report did acknowledge there were:

> ..... uncertainties concerning the operation of the plant, which were highlighted in the Nuclear Installations Inspectorate of the November 1983 incident[104], and also problems attendant on the functioning of the plant.

Further, there were:

> ..... questions concerning the adequacy of the controls over present permitted levels of discharges; the quantitative assessment of apparent excesses of cancer; and possible genetic risks.

In addition the Committee:

> ..... found some evidence of lack of co-ordination between the various agencies with an interest in this industry and considering its impact on the health of the community[105].

With regard to further recommendations, the Black Committee proposed:

> A study of all children born since 1950 to mothers resident in Seascale at the time of the birth to examine incidence and mortality. (Birth Cohort Study).
>
> A study to examine the incidence of cancer amongst school children in Seascale. (School Cohort Study).
>
> A study to look at the records of those cases of leukaemia and lymphoma which have been diagnosed among young people up to the age of 25 resident in west Cumbria. These cases should then be compared with suitable controls in respect of

---

[103] The conclusions of the Black Committee were based on incorrect figures (supplied by the NRPB) which were later amended after new dose figures were presented by Dr. Jakeman, a UKAEA employee who had been based at Sellafield in the 1950s. See Ch.4(3) for a full assessment of the impact of this data.

[104] This refers to an incident identified earlier in the thesis Ch.1(1), in which high levels of radioactive contamination resulted in Greenpeace divers being contaminated, and several miles of local beaches being closed for nine months.

[105] Black Report, Chapter 6(13).

factors that could be relevant to the development of leukaemia and lymphoma (Case Control Study).

In addition to the epidemiological recommendations however, the Black Report also proposed the establishment of The Committee on Medical Aspects of Radiation in the Environment (COMARE), to investigate the release of radioactive discharges, and assess their impact on the local population.

The Gardner Research

As a consequence of the epidemiological recommendations of the Black Report, Professor Martin Gardner, Head of the Medical Research Council Environmental Epidemiological Unit, University of Southampton[106], was asked to undertake the three studies (Birth Cohort[107]; School Cohort[108]; Case Control Study[109]) in relation to the Sellafield excess.

---

[106] Professor Gardner was a member of Sir Douglas Black's Advisory Group, and later became a member of the Committee on the Medical Aspects of Radiation in the Environment (COMARE) which was also established on the recommendations of the Black report in 1985.

[107] Gardner, M.J. Hall, A.J. Downes, S. Terrell, J.D. 'Follow up study of children born to mothers resident in Seascale, west Cumbria' (Birth Cohort) British Medical Journal 1987; 295:822-7.

[108] Gardner, M.J. Hall, A.J. Downes, S. Terrell, J.D. 'Follow up study of children born elsewhere but attending schools in Seascale, west Cumbria' (Schools Cohort) British Medical Journal 1987; 295:819-21.

[109] Gardner, M.J. Snee, M.P. Hall, A.J. Powell C.A. Downes, S. Terrell, J.D. 'Results of case-control study of leukaemia and lymphoma among young people near Sellafield nuclear plant in west Cumbria' British Medical Journal 1990; 300:423-9.

The first study sought to identify all people born in Seascale since 1950 (attempting to trace anyone who had moved away from the area) to ascertain how many of them had developed cancer. The second study sought to identify all children born since 1950, who had attended school in Seascale, but had been born elsewhere, charting their development in a similar way to the first study. The third study, embarked over a six year period, to establish whether the excess of leukaemia and lymphoma diagnosed in children and young adults near Sellafield was associated with any particular characteristics related to the Plant. The study involved 97 people born within the west Cumbrian district, and diagnosed with either leukaemia or lymphoma before their 25th birthday between 1950-1985, and resident in west Cumbria at their time of diagnosis[110]. Factors taken into account included antenatal abdominal X-ray examinations, viral infections, lifestyles, proximity to Sellafield and employment risks of parents working at Sellafield.

In their first study of the children born in Seascale, Gardner et al. (1987a) found that the children were ten times more likely to develop leukaemia than the average, and three times more like to develop other cancers.

In their second study, Gardner et al. (1987b) found no increase in leukaemia (or other cancers) in those children who went to school in Seascale, but were born elsewhere.

In their third piece of research, Gardner et al. (1990), found that the risk of childhood

---

[110] The 97 cases (leukaemia 52; non-Hodgkin's lymphoma 22; Hodgkins disease 23) were compared with 1001 controls matched for sex and age, taken from the same birth registers as the cases.

leukaemia increased in relation to the fathers' exposure to external sources of ionising radiation, before the child was conceived. The report identified an eightfold increase, based on a recorded cumulative dose of 100 mSv (or 10 mSv or more in the six months before conception).

In his conclusion, Professor Gardner suggested that:

> The raised incidence of leukaemia and [to a lesser extent] non-Hodgkin's lymphoma among children near Sellafield was associated with paternal recorded external dose of whole body penetrating radiation during work at the Plant before conception (Gardner et al. 1990a:423).

The significance of the Gardner research cannot be overstated, not only did it confirm a link between the excess of childhood leukaemia and Sellafield, but it also established that children, whose fathers had worked at Sellafield before their conception, had a higher risk of developing leukaemia or NHL than the control group. It further showed that the risk increased with the fathers' preconception occupational radiation dose.

COMARE

In addition to the epidemiological recommendations, the Black Report also targeted radioactive discharges in the environment for special consideration. As a consequence, the Committee on the Medical Aspects of Radiation in the Environment was established in 1985, under the Chairmanship of Professor M. Bobrow[111]. COMARE was primarily concerned with radiation exposure of local people living near nuclear facilities in west

---

[111] Professor B. Bobrow was Prince Philip Professor of Paediatric Research at the United Medical and Dental Schools of Guy's and St. Thomas'.

Cumbria, Dounreay[112], Aldermaston and Burghfield[113].

In 1986, as a first priority however, COMARE were invited to consider the implications of the historic dosimetry data[114] (presented by Dr. Jakeman[115]), which had only come to light since the setting up of the Black Committee. As these figures had neither been submitted to the Black Committee, nor taken account of during preparation of the subsequent report, COMARE were asked to ascertain whether the new data affected the conclusions of the Black Report.

---

[112] Dounreay is the only other reprocessing plant in the UK.

[113] Both Aldermaston and Burghfield (in Berkshire), have Atomic Weapon Establishments in their locality. Although different from reprocessing plants such as Sellafield and Dounreay, both establishments are responsible for the release of radioactive material into the environment.

[114] Please refer to Footnote 23 p.27.

[115] In November 1984, NRPB were approached on a personal basis by Dr. D. Jakeman who between 1954 and 1956 had been an employee of UKAEA at their Sellafield site. During the period when the Black Inquiry was collecting evidence Dr. Jakeman had been abroad. It was not until his return to this country in 1984 that he was able to inform UKAEA, NRPB and BNFL that he had additional information. In 1985, Dr. Jakeman produced a report which contained his interpretation of the radioactive discharge figures.

COMARE, in their first report on Sellafield[116] acknowledged that:

> It is possible that important releases occurred in the past but went unrecorded or undetected by the rudimentary monitoring carried out in the early years. The events since the publication of the Black report increase our concern with this possibility, although it cannot be quantified. This emphasizes and underlines our concern regarding the uncertainty with regard to the validity of any conclusions[117].

Despite the uncertainties with regard to the undisclosed releases of radioactive discharges however, COMARE nonetheless concluded that the doses were "still well below those that would readily explain the observed cases of leukaemia in Seascale using conventional risk estimates" (Ibid). Therefore the fundamental conclusions of the Black Report remain unchanged.

In their second report[118], COMARE set out to investigate the possible increased incidence of leukaemia among young people living near the Dounreay nuclear establishment. As part of their remit, COMARE considered the authorised and accidental release of radioactive materials, chemicals, population effect, radiation dose, and occupational exposure.

Although the amount of radioactive material reprocessed is smaller than at Sellafield,

---

[116] 'The Implications of the new data on the releases from Sellafield in the 1950s for the conclusions of the Report on the Investigation of the Possible Increased Incidence of Cancer in west Cumbria' (1986) London: HMSO. (COMARE 1st Report)

[117] Ibid Ch.5(11) p.24.

[118] 'Investigation of the possible increased incidence of childhood cancer in young persons near the Dounreay nuclear establishment, Caithness, Scotland'. (1988) London: HMSO (COMARE 2nd Report).

Dounreay nonetheless offered an opportunity for independent and separate investigations of a similar environment. In addition to site similarities with Sellafield however, two studies (Heasman et al. 1986[119]; Darby et al. 1987[120]) also acknowledged an excess of childhood leukaemia around the Dounreay nuclear installation.

In 1988, COMARE submitted the findings of their 'Second Report', once again under the Chairmanship of Professor Martin Bobrow. In their conclusion, COMARE found evidence of a raised incidence of leukaemia among young people living in the vicinity of Dounreay, but as with Sellafield, stated that the radioactive discharges were insufficiently high to account for the leukaemia excess. Instead, COMARE indicated alternative explanations such as chemicals or viruses. They went on to acknowledge however:

> ....the evidence of a raised incidence of leukaemia near Dounreay, taken in conjunction with that relating to the area around Sellafield, tends to support the hypothesis that some features of the nuclear plants that we have examined leads to an increased risk of leukaemia in young people living in the vicinity of those plants. Conventional dose and risk estimates suggest that neither authorised not accidental discharges could be responsible. There are, however, uncertainties about dose and risk calculations, especially with respect to exposure of the foetus and small child, high LET[121] emission and prolonged low-level exposure[122].

---

[119] Heasman, M.A. Kemp, I.W. Urquhart, J.D. Black, R. 'Childhood leukaemia in northern Scotland' Lancet 1986 i:266.

[120] Darby, D.C. Doll, R. 'Fallout, radiation doses near Dounreay, and childhood leukaemia' British Medical Journal 1987 294: 603-7.

[121] Linear Energy Transfer (LET) is the rate at which a charged particle loses energy as it passes through matter.

[122] Ibid Ch.5(27).

In their third report[123], again under the Chairmanship of Professor Bobrow, COMARE examined additional data on childhood cancers, as well as leukaemias in the areas of Aldermaston and Burghfield. In considering the conclusions of their previous investigations at Sellafield and Dounreay, COMARE looked at other factors including chemical carcinogens, demographic phenomena, and viruses.

In their published report of 1989, COMARE concluded that there was a small but significant increased incidence of leukaemia and other cancers in children under the age of five living within 10km of nuclear establishments at Aldermaston and Burghfield. Despite this assertion however, COMARE went on to say, that in their opinion, neither the authorised nor accidental radioactive discharges were sufficiently high to account for the observed incidence of childhood cancer.

Having completed three reports at the request of the Government, COMARE concluded their investigation by saying:

> Our experience so far leads us to the conclusion that the distribution of cases of childhood leukaemia, or other childhood cancer, around individual nuclear installations cannot be seen in a proper context in the absence of comparable information about the general pattern, throughout the rest of the UK. We will therefore make recommendations for further work on the geographical distribution of childhood cancer on a nationwide basis and urge that high priority be given to their implementation[124].

---

[123] 'Report on the Incidence of Childhood Cancer in West Berkshire and North Hampshire area, in which are situated the Atomic Weapons Research Establishment, Aldermaston and the Royal Ordnance Factory, Burghfield' (1989) London: HMSO (COMARE 3rd Report).

[124] COMARE, 3rd Report, Ch.4(14).

Other Studies

Prompted by the findings of the Black Report, COMARE and the Gardner Study, other research was undertaken in the UK and abroad, to establish whether there was an association between paternal occupational irradiation and childhood leukaemia.

Dounreay

In Scotland, Urquhart et al. (1991[125]), did support the existence of an excess of childhood cancer, in particular, an excess of childhood leukaemia and non-Hodgkin's lymphoma near Dounreay. However, in their conclusions, the study made it clear that "the raised incidence of childhood leukaemia and non-Hodgkin's lymphoma around Dounreay cannot be explained by paternal occupation at Dounreay, or by paternal exposure to external ionising radiation before conception". The authors emphasised however, that the results of the study neither confirmed nor contradicted the findings of Gardner.

Kinlen et al, (1993a[126]), suggesting an alternative approach, proposed that the increase in childhood leukaemia in rural areas of Scotland may be associated with population mixing. Linked to Kinlen's hypothesis were other variables such as: infective agents; social class; density of children in the locality; and remoteness of the area. In a further study,

---

[125] Urquhart, J.D. Black, R.J. Muirhead, M.J. Sharp, L. Maxwell, M. Eden, O.B. Jones D.A. 'Case control study of leukaemia and non-Hodgkin's lymphoma in children in Caithness near the Dounreay nuclear installation'. British Medical Journal 1991 302: 687-92.

[126] Kinlen, L.J. O'Brien, F. Clarke, K. Balwill, A. Matthews, F. 'Rural Population mixing and childhood leukaemia: effects of the North Sea oil industry in Scotland, including the area near Dounreay nuclear site' British Medical Journal 1993 306: 743-8.

Kinlen et al. (1993b[127]) again failed to support the Gardner hypothesis, reiterating his earlier proposal that "an unidentified chemical leukaemogen and an (infective) epidemic promoted by unusual population mixing in an isolated area of high social class" were responsible for the excess.

Sellafield

McKinney et al. (1991[128]), in their study of west Cumbria, north Humberside and Gateshead reported an increased risk associated with fathers' exposure at work to ionising radiation and cancer in their children. Although the geographical area was wider than the Gardner study, it nonetheless had a large overlap with Gardner in terms of those exposed to radiation. Excluding the Gardner cases, the results showed a statistically significant excess, although the case numbers were small. The authors' concluded that their findings supported the hypothesis generated by the study of Gardner et al. that fathers' exposure to radiation before conception was causal.

Draper et al. (1993[129]), in line with other studies, confirmed the findings of the Black

---

[127] Kinlen, L.J. Clarke, K. Balkwill, A. 'Paternal preconceptual radiation exposure in the nuclear industry and leukaemia and non-Hodgkin's lymphoma in young people in Scotland'. British Medical Journal 1993 306: 1153-8.

[128] McKinney, P.A. Alexander, F.E. Cartwright, R.A. Parker, L. 'Parental occupations of children with leukaemia in west Cumbria, north Humberside, and Gateshead' British Medical Journal 1991 302: 681-7.

[129] Draper, G.J. Stiller, C.A. Cartwright, R.A. Craft, A.W. Vincent, T.J. 'Cancer in Cumbria and in the vicinity of the Sellafield nuclear installation, 1963-90' British Medical Journal 1993 306: 89-94.

Report that there was an excess of lymphoid leukaemia and non-Hodgkin's lymphoma among young people in Seascale, however, went on to say, they were unable to identify the cause of the excess. Their conclusions neither supported not detracted from the conclusions of Gardner et al.

In a further study by Kinlen (1993c[130]), this time concentrating on Seascale, he too confirmed the existence of an increased incidence of leukaemia and non-Hodgkin's lymphoma around the Sellafield plant. However, rejecting the Gardner hypothesis, and referring to his previous research at Dounreay (1993b), Kinlen again proposed the possibility of some unidentified carcinogen and infection, related to unusual population mixing as the most likely explanation.

The Health and Safety Executive (HSE) published their findings in October 1993[131], one week after delivery of the Judgment in Reay and Hope. The purpose of the study was to examine the Sellafield fathers' exposure to external radiation and a number of other employment factors not considered by Professor Gardner, including: internal radiation levels, suspect carcinogens and other mutagenic chemicals. In addition, fathers' job histories (where they worked, type of occupation, involvement in known radiation incidents) were also taken into account.

---

[130] Kinlen, L.J. 'Can paternal preconceptional radiation account for the increase of leukaemia and non-Hodgkin's lymphoma in Seascale?' British Medical Journal 1993 306: 1718-21.

[131] 'HSE Investigation of Leukaemia and other cancers in the children of male workers at Sellafield' 1993 London: HMSO.

Although two of the findings of the paper were subsequently reviewed after consultation with BNFL, the main conclusions of the study remain unchanged:

1. There is a clear distinction between the incidence of childhood leukaemia and non-Hodgkin's lymphoma in Seascale and elsewhere in west Cumbria.

2. The incidence in Seascale of these diseases in the children of Sellafield fathers being some 14 times the national average.

3. The strong association for the children of Seascale families between the fathers' cumulative preconception external radiation dose and the incidence of these diseases.

4. The concentration of the increased risk in the children of fathers who started work at Sellafield before 1965.

5. The absence for the non-Seascale subjects of an association with the fathers' 12-week preconception external radiation dose.

6. The absence of any positive association for cancers other than leukaemia and NHL.

7. The absence of any association with internal radiation dose.

8. The observation that the raised incidence in the children of Seascale fathers may, in some way, be associated with Seascale's unusually high proportion of in-comers, ie.non-Cumbrian born fathers.

Aldermaston and Burfield

Concern over what appeared to be an excess of childhood leukaemia in the local area of Aldermaston and Burfield had originally been identified by a Consultant Haematologist and her team at the Royal Berkshire Hospital in Reading. After contact with the London School of Hygiene and Tropical Medicine to investigate, preliminary findings[132]

[132] Barton CJ. Roman E. Ryder H. Watson A. Childhood Leukaemia in West Berkshire. Lancet 1985;i:217-8.

confirmed a small excess of childhood leukaemia. However, after completion of a more detailed report[133], it emerged that the cancer excess was confined to children under five years of age. The fathers, monitored for exposure to ionising radiation prior to conception, offered some support for the Gardner hypothesis.

International Studies

Outside the UK, and prompted by the British studies, researchers in other countries began to investigate the occurrence of cancer in the locality of nuclear installations. Their conclusions however did not support the findings of the British studies with the result that France (Viel et al. 1990; Hill et al. 1990[134]); Germany (Michaelis et al. 1992[135]); the United States (Clapp et al. 1987; Milham 1989; Goldsmith 1989; Hatch et al. 1990(a); Hatch et al. 1990(b); Shulman 1990; Hatch et al. 1991; Jablon et al. 1991[136]) and Canada (MaLaughlin et al. 1993[137]) failed to find a significant increase in childhood leukaemia near certain nuclear installations.

---

[133] Roman, E. Beral, V. Carpenter, L. Watson, A. Barton, C. Ryder, H. Aston, D.L. 'Childhood leukaemia in the West Berkshire and Basingstoke and North Hampshire District Health Authorities in relation to nuclear establishments in the vicinity' British Medical Journal 1987; 297; 603-7.

[134] La Hague nuclear waste reprocessing plant.

[135] The German study looked and the incidence of childhood malignancies in twenty areas in west Germany.

[136] In particular, Pilgrim (Massachusetts); Hanford (Washington); Tennessee; Three Mile Island.

[137] Ontario.

It has now been over a decade since James Cutler produced the Yorkshire Television Programme claiming a possible link between an excess of childhood leukaemia in the village of Seascale and the Sellafield Plant. When the documentary was originally shown in 1983, the experts were sceptical of the programme findings, effectively denying any excess of leukaemia or causal connection with Sellafield. Since that time, it has been accepted by the scientific community that there is a real excess of leukaemia and NHL in young people in Seascale. Further, not only are these excesses demonstrable over age ranges and geographical parameters, they are also persistent. Consequently, scientific debate has shifted from questioning the reality of these excesses, to finding an explanation for them.

Despite extensive research however, scientific opinion continues to be deeply divided over the causes of childhood cancer and its connection with nuclear installations. In order to understand why causation is so difficult to prove, and why there is such diversity of scientific opinion, it is necessary to appreciate how scientific knowledge is constructed, and the basis upon which scientists adhere to their rules of scientific method. Moving on, the next chapter will continue by focusing on the problems of cause and effect in science, and causation in law. As Loevinger (1995:187) rightly points out, "when causation is an issue, valid law requires valid science to reach a valid decision".

2.1 THE CONSTRUCTION OF SCIENTIFIC KNOWLEDGE AND THE CHALLENGE TO POSITIVISM

It is clear that scientific opinion continues to be deeply divided over the potential health implications of ionising radiation, and also the relationship between childhood cancer and nuclear installations. To understand the reasons behind such difference of opinion, it is necessary to widen our discussion to the foundations upon which scientific investigation and its quest for objective truth are based, and in so doing, examine how scientific knowledge is constructed. Moving on, attention will focus on the problems of establishing causation in science (2.2), to consideration of causation in the law (2.3).

Setting aside for a moment the philosophical arguments about whether objective truth exists, we are concerned here with what Casti (1989) refers to as scientific ideology. According to Casti (1989:13), scientific ideology "is a collection of beliefs and ideals about the practice of science that the scientific community clings to with universal tenacity". The practice of science consists of a recognised cognitive structure based on facts, hypothesis, experimentation, laws and theory which together, with the process of verification and peer review establishes an ideology of science. However, these are not the only factors identified by Casti, he also refers to science as a social activity, and one that "has standards for what constitutes 'good science' as determined by the norms of a particular community" (Ibid:57).

According to Ziman (1968:9), the goal of science is the achievement of "a consensus of rational opinion". With this aim in mind, scientific investigation, carried out by "our

recognized men of knowledge" (Barnes & Edge 1982:3) may be seen as the rational pursuit of objective truth which may, or may not be explained through the development and testing of hypotheses using proven experimental methods.

Today, the practice of science provides us with extensive knowledge of our world and universe, it offers both historical and future Insight as well as consideration of the present. However such knowledge is limited, what we desire to know is not only what happens, but why it happens. The recognition that there is a knowledge of what and a knowledge of why is implicit to the universal and essentialist belief that "science can provide explanations ... [and that]..... this is the primary goal of science" (Salmon 1984:3). A view supported by d'Espagnat (1979:158) when he said:

> Any successful theory..... is expected to make accurate predictions;
>
> Apart from experimental confirmation, however, something more is generally demanded of a theory. It is expected not only to determine the results of an experiment but also to provide some understanding of the physical events that are presumed to underlie the observed results. In other words, the theory should not only give the position of a pointer on a dial but also explain why the pointer takes up the position.

Fundamental to such beliefs, and part and parcel of this universal ideology is a rejection of any conflicting account of 'epistemology'. Underlying this view is a conviction of an omnipresent, absolute in science, when in reality, as Barnes and Edge (1982:3) point out:

> All the traditional conflicts of epistemology, between realism and instrumentalism, rationalism and empiricism, deductivism and inductivism, and many more, find expression in endless modifications and combinations, as competing accounts of science. And each account implies a different foundation for the credibility and authority of science.

In addition to epistemological conflict however, there is a recognition that the practice of science also involves personal choices and subjective value judgments, as a consequence says Jasanoff (1995:9), "individuals make decisions at the frontiers of established doctrine in accordance with their personal understanding of the existing tradition". Concurring with this view, Dunbar (1995) asserts that most scientists get their hypotheses from their own experience and from existing theoretical structures within their own discipline, in other words, scientists reflect their cultural milieu.

Notwithstanding this realization, many deconstuctionists (Merton 1973; Bloor 1976; Barnes 1974, 1977, 1982; Mulkay 1979, 1991; Hesse 1980; Collins 1981; Sharpin and Schaffer 1984; Lepenies, 1989; Wynne 1989) take as their starting point the assumption that science does represent 'objective knowledge' and that scientific thought is somehow more precise, more controlled, more rational than everyday thinking. Further, they acknowledge that the term 'science' has come to denote what Hamilton (1988:7) described as a "privileged realm of knowledge removed and seemingly sharply differentiated from other intellectual domains".

Moving on to challenging these assumptions, the authors go on to claim that scientific knowledge is culturally constructed; often corporately funded; a potential social tool for the benefit of powerful elites; and that it encompasses arbitrary compromises between conflicting beliefs systems. As a consequence, other interests (corporate, governmental, individual) are seen as encroaching on the quest for objective truth leading to the realisation

that there is no 'pure knowledge form' and that scientific ideology is qualified and conditional. Scientists it seems, are influenced by the same complex series of personal choices and subjective judgements as everybody else, which may explain, says Lovelock (1988), why happenings as important as a hole in the ozone layer were missed. In delivering the Schumacher Lecture, Lovelock comments:

> It is a scandal that the vast sums spent on expensive big science of satellite, balloon and aircraft measurement failed to predict or find the ozone hole. Worse than this, so sure were the computer programmers that they knew all that mattered about the stratosphere, they programmed the instruments aboard the satellite, that observed atmospheric ozone from above, to reject data that was substantially different from the model predictions. The instruments saw the hole, but those in charge of the experiment ignored it, saying in effect, 'Don't bother us with facts; our model knows best'[1].

This principle of selection also explains says Grayson (1995:vii), why frequently "scientists reach diametrically opposed conclusions based on identical data". Therefore says Beck (1995:119), if one poses an arbitrarily chosen question to a panel of scientific experts "one will be given fifteen different answers from five scientists". Beck goes on to say:

> This is neither by chance not by accident. It represents the state of science at the end of the twentieth century.....A different computer, a different institute, a different employer; a different reality (Ibid).

The Philosophical Challenge

Over the years various philosophers[2] have attempted to grapple with the problems of scientific ideology. For many however, the landmark of change came with the

---

[1] James Lovelock 'Stand up for Gaia'. Schumacher Lecture 1988. Reprinted by Resurgence (Ford House, Bideford, Devon).

[2] In particular, Popper (1959); Kuhn (1970); Feyerabend (1975); Lakatos (1976).

publication of Karl Popper's, The Logic of Scientific Discovery[3], in which Popper endeavoured to find a way of distinguishing between statements of science that had some external validity, and those based on pure belief. Popper realized that attempts to justify science through a process of induction (generalizations derived from observations) were inadequate. In place of induction therefore, he proposed that scientists generate hypotheses about the nature of the world, and then submit the hypothesis for rigorous testing. Accepting Popper's premise implies that scientific knowledge claims can never be proven or fully justified, they can only be refuted. Therefore, to be scientific, a hypothesis must be logically falsifiable.

Thus scientific progress rests on the notion of refutation, as Popper (1968:280) says:

> The advance of science is not due to the fact that more and more perceptual experiences accumulate in the course of time. Nor is it due to the fact that we are making even better use of our senses. Out of uninterrupted sense-experiences science cannot be distilled, no matter how industriously we gather and sort them. Bold ideas, unjustified anticipations, and speculative thought, are our only means for interpreting nature. And we must hazard them to win our prize. Those among us who are unwilling to expose their ideas to the hazard of refutation do not take part in the scientific game.

However, Popper warns against any idea of an ultimate explanation. For Popper, there can be no explanation which is not in need of further explanation. Popper makes it clear that the attainment of ultimate knowledge is in reality impossible, "The old ideal of episteme -

---

[3] Popper's views were first published in 1934, The Logic of Scientific Discovery (translated into English in 1959). However, Conjectures and Refutations (1963) is generally regarded as encapsulating the essentials of Popper's 'method of falsification'.

of absolutely certain, demonstrable knowledge - has proved to be an idol" (Ibid).

Thomas S. Kuhn

Later, in 1962, Kuhn's work entitled The Structure of Scientific Revolutions also had a profound effect, challenging the authoritative knowledge base of science. For Kuhn, our image of the rationality of science is affected by the history of science, in which an indoctrinated conservative, scientific elite guided by, and working within, an existing paradigm[3] carry out their puzzle-solving, the sum of which constitutes 'normal science'[4].

Kuhn's central thesis rests on the belief that advances in scientific knowledge comes not from scientific intellectual openness but from scientific intellectual closure. Normal scientific research, he argues, is guided by paradigms which are a series of related assumptions (theoretical, methodological and empirical) that are generally accepted by those working in a particular field of research, and includes beliefs, values and techniques. Therefore says Kuhn, most scientific research consists of attempts to solve problems without bringing into question its basic assumption. Thus scientists, accepting this framework reach internal agreements about what kind of problems, techniques and

---

[3] The notion of a 'paradigm' includes: Shared symbolic generalisations; Models; Values; Metaphysical principles; Exemplars (concrete problem situations). The paradigm represents the structured whole, and also guides the research activities of scientific community.

[4] Normal Science is according to Kuhn (1970:10), "research firmly based upon one or more past scientific achievements, achievements that some particular scientific community acknowledges for a time as supplying the foundation for its practice".

solutions are legitimate and by so doing establish a social network, which excludes from participation anyone who does not adopt or accept the framework.

From this perspective it is clear that for Kuhn, most scientific innovations are simply additions to, or relatively minor modification of existing paradigms which later become incorporated into scientific tradition for use by later generations of scientists.

However, a second much more radical kind of innovation can occur when one paradigm is replaced by another, this kind of intellectual transition can only take place by means of open rebellion and revolutionary transformation of the existing order. Such revolts are usually brought about by a loss of confidence in the existing paradigm which can no longer be reconciled with the cognitive hopes guiding normal science. Nonetheless, from such failures new rules do evolve, from which emerge the latest paradigm destined to become the next accepted orthodoxy in the field. Since such paradigms are regarded by Kuhn as being incommensurable, there is no rational 'scientific' basis for the change from one paradigm to another, rather revolution takes place within the social structure of the scientific community, or as Lakatos (1970:178) says, "In Kuhn's view scientific revolution is irrational, a matter for mob psychology". This is important, because as Hagstrom (1965) points out, science can be viewed as an exchange system in which gifts of information are exchanged for peer recognition. Therefore, says Mulkay (1991), the status and recognition of a scientist are dependent upon the new paradigm. A new paradigm thus offers work and opportunity as well as possible career enhancement, professional standing and recognition. In such circumstances the social control of the

scientific community is ensured by the demands and confines of the new paradigm.

Imre Lakatos

Lakatos' theory was formulated in an attempt to develop and improve upon Popper's account of falsification, while at the same time disassociating his own theory from what he believed to be Kuhn's socio-psychological approach.

Lakatos identified three aims for his model, first, to distinguish scientific from the non-scientific; second, to evaluate competing scientific research programmes; thirdly, to explain scientific change.

Deriving his work from the history of science, he represents this as a structured organic whole made up of sequences of theories welded together into a continuous scientific research programme. The purpose of the programme is to offer scientists guidance on which methodological principle to avoid abandoning (the negative heuristic), and which to pursue, thereby developing an increasingly sophisticated model (the positive heuristic). Underlying his theory is what he calls the 'hard core' (centre) of the programme which is made up of background information consisting of a number of theoretical assertions and assumptions.

Once established, the 'hard core' is sacrosanct and must be defended by a 'protective belt' made up of 'auxiliary hypotheses', the purpose of which is to be tested, refined or rejected. Thus in any piece of research, various auxiliary hypotheses will be added to, or rejected

from the research programme to accommodate new anomalies. Therefore, Lakatos was not against the use of ad hoc hypotheses[5], provided it contributed to the development and growth of the research.

In the opinion of Lakatos therefore, a scientist is free to make the best adjustments or modification to a theory he can by abandoning or removing assumptions or simply by ignoring unacceptable evidence. The most important thing is whether such intervention will lead to progressing the development of the research programme. Conflict between competing research theories thus stimulates scientific progress.

Because of the structural basis of Lakatos' work, he argues that there is no instant way of assessing the merits or otherwise of scientific research and any attempt to do this, is an example of utopian ideology. Lakatos goes on to condemn 'justifications' who want scientific theories to be proven, 'probabilists' who expect to instantly confirm a theory, and 'falsificationists' who immediately expect elimination on the basis of instant results.

Paul Feyerabend

For Feyerabend, there is no such thing as scientific method, it is he suggests, just one tradition among many. Science is therefore not 'privileged' in terms of method or results. Feyerabend, in his book Against Method, goes on to challenge any notion that there is a

[5] It is customary to assume that ad hoc hypotheses go beyond the available evidence, and further, that it must go beyond the evidence to be of value. Ad hoc hypotheses may be used to save a theory and may include any new idea which the scientist considers necessary for the progress of the research.

system of rules which guide scientists in the business of theory choice. In the opinion of Feyerabend, any attempt to adopt such rules or methodology would in fact impede scientific progress. Referring to history in support of his proposition, Feyerbend (1984:23) points out:

> The idea of a method that contains firm, unchanging, and absolutely binding principles for conducting the business of science meets considerably difficulty when confronted with the results of historical research. We find then, that there is not a single rule, however plausible, and however grounded in epistemology, that is not violated at some time or other.

For Feyerbend, methodology rests on social convention within the scientific community, rather than on any process of rational procedure.

Perhaps Newton-Smith (1981:1-2) summarized the situation when he wrote:

> The scientific community sees itself as the very paradigm of institutionalized rationality. It is taken to be in possession of something, the scientific method, which generates a "logic of justification". For Feyerabend, Kuhn and others, not only does scientific practice not live up to the image the community projects, it could not do so. For that image, it is said embodies untenable assumptions concerning the objectivity of truth, the role of evidence and the invariance of meanings.

At a time when the unforseen and unpredicted effects of technological and scientific advances are being realised, those responsible are being targeted at both the scientific and legal level. Public recognition that the practice of science is a process formulated on the basis of a false ideology, has brought into question the reliability, accountability and trustworthiness of the practice of science, resulting on occasion, in a disillusioned society re-examining the application of science based technologies. Increasingly aware of the fragility of scientific ideology, the public are demanding action to reduce what Bauer

(1969:18) has referred to, as the "unintended, unanticipated or undesirable" second order consequence. Therefore says Woolgar (1988:11), not only are the politics and impact of science under question, but also the validity of "the internal workings of science".

When applying this theoretical analysis to a complex toxic tort case like ***Reay and Hope v BNFL***, it becomes apparent how divided scientific opinion remains, and as will be shown later on in the thesis, how integral at foundational level, scientific ambiguity and uncertainty are. The deconstruction of scientific knowledge helps us in two ways, first, to appreciate the basis upon which to challenge the cognitive authority of science, and secondly, with the aid of this cognizance, to recognize the limitations of the practice of science. Epistemologically, this is not only important to our understanding of the nature of scientific inquiry, but also, scientific controversy. According to Wynne (1989:23), in a world where scientific claims and counter claims abound, the shifting and ever changing body of negotiated knowledge means that "science like life in general involves creating adequate conclusions from inadequate premises".

While social sciences, philosophy and history have done much to challenge the universality and construction of scientific knowledge, there still exists, an underlying assumption that scientific ideology offers a pure knowledge form; as Smith (1980:70) says, "many people both inside and outside the scientific community assume that the practice of science is equivalent to being rational. It is assumed that is, that if one wishes to know what is the case, then one must pursue a scientific procedure".

Moving on, and intrinsically linked to the scientific knowledge debate, is the issue of causal relations. In the next two sections therefore, attention will focus on the problems of establishing causation, from both a scientific and legal perspective.

2.2 SCIENTIFIC EXPLANATION AND THE PROBLEMS OF CAUSATION

Moving on from the philosophical and theoretical concerns that surround the foundation and construction of scientific knowledge, this section will concentrate on the problems of causal relations, in particular the scientific basis of causality and the difficulty this poses for the toxic tort case.

David Hume in *A Treatise of Human Nature* 1739 formulated what is regarded as the classic analysis of causation in which he argued (among other things) that a cause was an object precedent and contiguous to another. In an Abstract of that work, he wrote:

> Here is a billiard ball lying on the table, and another ball moving towards it with rapidity. They strike; the ball which was formally at rest now acquires a motion. This is as perfect an instance of the relations of cause and effect as any which we know either by sensation or reflection. Let us therefore examine it. It is evident that the two balls touched one another before the motion was communicated, and that there is no interval betwixt the shock and motion. ***Contiguity*** in time and place is therefore a requisite circumstance to the operation of all causes. It is evident, likewise, that the motion which was the cause is prior to the motion which was the effect. ***Priority*** in time is, therefore, another requisite circumstance in every cause. But this is not all. Let us try any other balls of the same kind in a like situation, and we shall always find that the impulse of the one produces motion in the other. Here therefore, is a third circumstance, viz., that of ***constant conjunction*** betwixt the cause and the effect. Every object like the cause produces always some object like the effect" (Hume "An Abstract of A Treaties of Human Nature" 1955:186-187)

Since the time of Hume the standard view of causality rests on the notion that there are "two or more distinct events that bear some sort of ***cause effect*** relation to one another" (Salmon 1984:137). Thus in everyday life we refer to situations in which one event (cause) is linked to another event (effect) by means of a causal process. While, as discussed in 2(1), deconstructionists may question the existence of causal laws (by acknowledging that nothing in nature is constant and everything is in a perpetual state of

flux), scientists nevertheless hold that some relationships do remain constant and that, depending on the "objects, events, conditions or other things at a given time" (Bohm 1984:2), causal laws (while not absolute) can and do exist.

In order to identify the existence of causal laws, certain well defined methods of scientific research have been established. As discussed in the previous section, in ideal circumstances they include the recognition of regular association of condition or events, the making of a workable hypotheses, the predicting of future effects, and the testing by observation or experiment of the hypotheses under question. However, not all hypotheses can be tested by controlled experimentation and where this is the case, identification of causal laws maybe be based on the possibility of some causal connection. According to Bohm (1984:12), "as long as these possibilities exist, progress can always be made in any science towards obtaining a progressively better understanding of the causal laws that apply in the field under investigation". For this reason the theory of probability (as applied by epidemiological and statistical research) aims to provide the objectivity needed when making approximate predictions in areas of uncertainty and also, helps establish whether there is a chance or causal connection.

In addition to causal laws therefore, laws of chance also contribute to the establishment of a particular theory surrounding a particular event, and in some situations, chance (as a consequence of some independent variable) may well provide an alternative explanation. Thus causal laws are only one part of the process. "The central problem in science, as in everyday life, is to differentiate between real causal effects and the spurious ones that are

due to confounding variables" (Dunbar 1995:15).

Currently, two distinct sets of guidelines (which have emerged over the years) assist the scientist (the Henle-Koch-Evans postulates) and the epidemiologist (Bradford Hill Criteria) in their quest to establish causal relations.

The Henle-Koch-Evans Postulates

The first set of criteria, the Henle-Koch-Evans (HKE) postulates[6] rest on ten factors, satisfaction of which say Foster, Bernstein and Huber (1993:7-8) provide compelling evidence of causation:

1. The disease is significantly more prevalent in those exposed to the hypothesized cause than in exposed controls.

2. Exposure is more frequent among those with the disease than in controls without the disease.

3. Prospective studies show a significantly higher incidence of disease in those exposed than in those not exposed.

4. Disease should follow exposure after an incubation period that tracks a log-normal curve.

5. Responses follow exposure along a logical biologic gradient from mild to severe.

6. Exposure triggers a measurable response (e.g. antibodies, cancer cells), with a high probability after exposure, or increases the number of responses if already present before exposure. This response pattern occurs infrequently or never in persons not exposed.

---

[6] HKE postulates were first proposed by Robert Koch (1843-1910) a bacteriologist and Nobel Prize winner. Some of these postulated were considered as early as 1840 by Koch's mentor Henle. They were later restated in 1976 by Evans, and are now referred to as the HKE postulates.

7. Experimental reproduction of the disease, in volunteers or laboratory experiments, or by controlled regulation of natural exposure, occurs more frequently in exposed animals or humans than those not exposed.

8. Elimination of the suspected agent (e.g. polluted water, removal of tar from cigarettes) decreases the incidence of the disease.

9. Modification of the host's response on exposure should decrease or eliminate the disease.

10. All of the relationships and findings should make scientific sense.

Notwithstanding the methodological usefulness of the HKE postulates, they nonetheless represent an 'ideal', a gold standard which often prove elusive if not impossible to achieve. Frequently, scientific evidence of causal relations is inconsistent and contradictory, yielding ambiguous results and divergent scientific opinion.

Because of the uncertainty of establishing the exact causal mechanism for cancer, three predominant theories have emerged. These include: the virus theory[7], pollutant theory[8] and psychosocial theory[9]. Other important factors in the development of cancer have also

---

[7] Viral infection may result in the virus DNA (deoxyribonucleic acid) taking over the function of normal healthy cells, which in turn may lead to cell changes and the start of cancer. Cervical cancer in particular has been linked to viral theory. The research evidence relied on for this is based only on animal experimentation.

[8] This second theory suggests a statistical relationship between certain types of cancer and environmental pollution, including poisons, chemicals, radiation, (cigarettes would also come under this category). There is says Rowe (1992:21) no empirical evidence to support this theory in relation to humans - "we only have unverified theoretical models".

[9] This third category relates strong emotion such as stress, tension, anxiety, negative attitudes to people who may become (as a consequence) cancer prone (Bahnson 1969, Redd & Jacobson 1988).

been identified as falling into three categories: nature, nurture and luck. "Nature relates to a person's genetic make-up at conception...Nurture relates to what people do or have done to them (in the womb, in childhood or in adult life)...Luck takes care of the remaining differences in outcome that both observation and theory lead us to expect" (Doll and Peto 1990:1203-1204).

Currently, no one mechanism has been identified as having dominance over another, nonetheless, in much the same way that John Snow established the causal relationship between cholera and sewage in water (by recognising that control of the harmful outcome did not necessarily depend on precise identification of the mechanism of harm), scientists have continued to reduce the incidence of cancer. For example the claim that "smoking causes lung cancer" is not based on any identified causal mechanism, despite this, progressive increases in the risk of lung cancer can now be avoided by people giving up cigarette smoking. In similar vein, circumstantial evidence based on research carried out in the chemical industry led to reduction of the incidence of bladder cancer, once the manufacture and use of 2-naphthylamine was stopped.

Because of the recognition of causal uncertainty, a variety of laboratory methods have been, and continue to be, developed in an attempt to identify which particular chemicals/ pollutant/factors are likely to cause disease. According to Doll and Peto (1990) however, the most favoured laboratory method are animal studies which have the advantage of providing information about toxic substances without exposing human subjects to harm.

In addition, because animal studies are more easily controlled than epidemiological studies, they also allow scientists to vary conditions of exposure at will.

The most direct approach in such experiments are "long term tests" where the chemical/ pollutants under investigation are given in high doses for a substantial part of the life span of the animal and "short term tests" which although similar, may only take days/weeks to complete as opposed to years.

Because no scientist fully understands the causal process involving toxins as either initiators or promoters of humans cancers, there are difficulties in quantifying or prioritising human risk of exposure based on laboratory data. While human experiments (skeletal/cataract/in vitro) offer direct evidence, extrapolation from animal studies to humans is fraught with difficulties. Such hypothesis and methodological difficulties that do exist however, become all the more apparent when transferred to an adversarial setting in which a toxic tort litigant seeks to prove that exposure to a particular pollutant resulted in a specific disease, birth defect or mortality. Often in such cases the plaintiffs rely on numerous animal studies in an attempt to show some sort of correlation between exposure and disease. For the results of these studies to be probative however, the assumption must be made:

1. that if a substance is toxic in various species of animal it must also be toxic in human beings;

and

2. that one can extrapolate from the higher and more toxic doses given to animals to the lower levels of exposure in humans being.

Unfortunately says Berger (1994:78), "while scientists are willing to make these assumptions, and animal studies are routinely used in risk assessment, a number of courts have rejected this evidence to prove causation on the grounds that the underlying premises cannot be confirmed". After all, while "quantitative extrapolations from animals to humans may..... be giving us approximate correct assessments of human risk. Conversely ..... they may suggest risks that are widely misleading in one or another direction" (Doll and Peto 1990:1216); a view supported by Higginson (1982:122) when he concluded:

> Today few experienced experimental oncologists would make any attempt to extrapolate mathematically the degree of human risk from animals.....Exact estimates as to the number of cases of cancer that might be expected to occur in man based on a single experiment are silly and simply ignore biological realities. The fact that no better methods exist does not make these statements any better or more valuable.

Identifying the different causes of cancer is further complicated by the additional factor that "some agents interact with others to produce effects that are much greater than the sum of the separate effects of the same two agents" (Doll and Peto 1990:1219). That synergism plays an important role in the development of cancer is not in doubt, what it means for research is that it is often impossible to maintain any categorical certainty in relation to the causes of cancer, and for this reason information that would allow a direct quantitative attribution of risk is also lacking and incomplete.

Epidemiological Research

In contrast to laboratory work, epidemiology concentrates on observations of the pattern of disease rather than on studies of particular toxins. Therefore, "epidemiology is concerned with the incidence of disease in populations and does not address the question

of the cause of an individual's disease..... [thus] epidemiology addresses whether an agent can cause a disease, not whether an agent did cause a plaintiff's disease" (Bailey et al. 1994:167).

Historically, epidemiology has played a significant part in cancer research by pinpointing risks associated with exposure to "combustion products of coal, sunlight, X-rays, asbestos and many chemical agents" (Doll and Peto 1990:1217). Unfortunately however, unless epidemiologists study reasonably large groups of people who have been subject to large doses of exposure over many years without effect, they cannot guarantee that those exposed to moderate levels will not also suffer some material effects. Other disadvantages in respect of epidemiological observation are:

1. Observation data may be open to misinterpretation.
2. The observation is limited to the conditions that actually occur at the time of the study.
3. Epidemiological research may not be able to detect the effect of a carcinogen until it has been used over many years.

On the positive side, epidemiologists study the impact of toxins on people directly (rather than animals) and try to determine what are the main causes of disease by looking at overall population trends (past and present). Further, epidemiologists have the advantage of being able to make use of their colleagues' laboratory work (which when used in conjunction with, or in combination with their own research may offer greater insight in terms of causal analysis then relying on laboratory studies or epidemiology alone).

Austin Bradford Hill in his classic work Principles of Medical Statistics[10], laid down what has become known as the Bradford Hill Criteria. The Bradford Hill Criteria represent the second set of guidelines. Relied on by epidemiologists in helping to ascertain the reliability of evidence as regards cause and effect, confirmation will depend upon a low probability of a chance finding, and the absence of confounding factors and flaws in methodology. If there is a finding in relation to chance of five per cent or less the conclusion reached by the study will usually be unassailable. If the study is designed to show a relative risk of disease consequent on exposure, then, provided that the lower confidence level is greater than a relative risk of 1[11], the study can be taken prima facie to show a causative link between the disease studied and the exposure of interest.

The Bradford Hill Criteria

Bradford Hill identified the following factors for consideration of a cause and effect relationship.

1. The strength of association (between exposure and disease) found by the study.
2. The consistency of association when compared with other studies. Is the finding confirmed by different persons, in different places, circumstances and times?
3. The specificity of the association with regard to groups, sites and types of disease.
4. The temporal relationship with regard to cause and effect. Which is the cart and which is the horse?

---

[10] In a celebrated lecture of 1965, Sir Bradford Hill proposed nine criteria to assist epidemiologists and others identify whether a reported association is causal or spurious. In 1971 he published his book Principles of Medical Statistics.

[11] A relative risk of 1, or close to 1, implies that exposure is only one factor of many contributing to the development of the disease.

5. The biological gradient in relation to the dose-response relationship. Is there a dose response relationship?

6. The biological plausibility of a causal link.

7. Coherence of evidence and the compatibility of a postulated cause with known facts.

8. Experimental evidence involved in the study.

9. Analogy (if available) to confirm findings.

To these nine points he added:

10. Animal experimentation. Extrapolation from animal to man must be done with caution.

Bradford Hill (1991:277) was however careful to point out that:

> Clearly none of these nine viewpoints can bring indisputable evidence for or against a cause-and-effect hypothesis and equally none can be required as a sine qua non. What they can do, with greater or less strength, is to help us to answer the fundamental question - is there any other way of explaining the set of facts before us, is there any other answer more likely than cause and effect?

Although it is not the purpose of an epidemiological study to establish or disprove specific causation, it does help to assess whether there is an association between a risk factor and an effect and whether the association occurs more frequently than would be expected by chance. If it does so, then the strength of the association may be assessed by statistical methods and the results be used as evidence either on their own, or as part of other relevant evidence in deciding the issue of causation.

Despite the problematic nature of causation with regard to applied science and epidemiological studies, personal injury claims still depend on establishing whether or not, on the balance of probabilities the substance emanating from a particular source

caused the illness, injury or condition. Therefore, it rests with the plaintiff to prove the existence of a causal link and to establish that the defendant's action was a material cause of the plaintiff's condition.

Moving on from the problems of scientific causation, the next section will concentrate on causation in the law, in particular, the tort system's capacity to deal effectively with personal injury cases, where the burden of proof of causation relies on scientific explanation and the preponderance of evidence rule.

2.3 CAUSATION IN THE LAW

When David Hume formulated his opinion that all reasoning concerning matter of fact seemed to be founded on the relation of cause and effect, he released the scientist from the historical constraints of metaphysical speculation, and in so doing, offered him an alternative to the notion of some unknown, unexplainable force or power. In effect say Hart and Honore' (1985:11) Hume told the scientist that "there was nothing in these notions, or in the idea of cause itself, over and above the generalizations and laws which it was his [the scientist's] business to discover".

Recently, challenges to the philosophical and procedural framework of science have furthered our understanding of the difficulties underlying the epistemology of science, the construction of scientific knowledge and causality in science. Moving on from issues relating to scientific ideology, the final section of this chapter will concentrate on causation in the law.

Generally supportive of Oliver Wendell Holmes' (1920) view that the law should derive its theory and legislative justification from science, law has increasingly relied upon scientific methodology for support of its claim to legal rationality (Smith and Wynne 1989). Today, reservations about the limits of rationalization and the problems this poses for science-law interaction, raises questions not only about the validity of scientific and legal analysis, but also law's deconstruction of scientific information. As Sales and Simon (1993:235) say, often:

> Scholars may have different theoretical and methodological orientations, existing

> research may not provide definitive answers, the same data can be interpreted in a variety of ways, the appropriateness of one sampling technique may be disputed, the appropriateness of the statistics may be open to question, and so forth.

The purpose of investigating causation in the law is say Hart and Honore'(1985:3), to "permit the clear formulation of constantly recurrent factors which count, though not conclusively, for and against decisions". At a time when no causal assertion in science is certain, and the intrinsic fragility of scientific knowledge is open to question, an understanding of the legal framework within which the traditional basis of causation resides seems all the more important.

In their monograph, **Causation and Law** (1985:10-11), Hart and Honore' acknowledge that the lawyer is primarily concerned "to make causal statements about particulars, to establish that on some particular occasion some particular occurrence was the effect or consequence of some other particular occurrence". Therefore, the lawyer is not interested in **discovering** connections, only in **applying** what are already accepted generalizations to particular cases. It is the role of science to construct theories, the lawyer's to establish particular events as causes. Thus lawyers when attempting to identify a causal connection question whether something "should be said to be the cause of something else, or only its 'occasion', 'a mere condition', or 'part of the circumstances' in which the cause operated" (Ibid). Causal questions therefore affect many different areas of law including criminal law, contract law and tort in helping to determine the existence and extent of liability or omission of harm.

Concentrating on personal injury claims, the issue of causation is perhaps one of the

greatest hurdles to overcome. In such claims, the defendant's negligence must be shown to have caused loss or damage[12], the establishment of which[13] (with proof of causation) will affirm the required link. More recently however, this traditional approach to causation, particularly with regard to toxic tort claims has become the subject of much criticism.

Traditionally, it has been customary over many years for the questions of causation to be considered in two stages. The first, the "but for" stage is concerned with whether loss would have occurred "but for" the relevant act or omission of the defendant. If the plaintiff is able to show on the balance of probabilities[14] that he would not have suffered the harm in question then factual causation may be proven. In the second stage, the court makes an assessment of whether the link between the conduct and the ensuing loss was sufficiently direct, proximate, foreseeable or alternatively remote, and whether as a consequence some subsequent event broke the chain of causation.

The separation of these two stages is however only figurative. As Honore' (1983:67) has said, they "are not taken literally. They do not refer to what is far or near in space and time. They are simply a shorthand used to denote all those considerations, causal or

---

[12] The loss or damage forms the 'gist of negligence' Stapleton, J. (1988) 104 LQR 213.

[13] The only exception to this requirement is in strict liability, industrial injury and war injury cases.

[14] This test dates back to 1571. **Newis v Lark** (1571) Plowd 403. According to Howarth (1995:95), the balance of probability of standard of proof requires the court to be indifferent between pro-plaintiff mistakes and pro-defendant mistakes, but it does not tell it to be indifferent about making mistakes in the first place.

other, which may make the connection between tortfeasor and the damage legally sufficient". Other factors relating to policy and personal responsibility have also been highlighted by Hart and Honore' as underlying many of the judgments of courts and of equal significance.

Markesinis and Deakin (1994) in their consideration of the problems of causation look to the burden of proof[15] required and ask whether the defendant may be liable, in the absence of conclusive proof, under the "but for test"[16]. By raising this question they draw attention to the problems facing a plaintiff trying to establish the necessary causal link in medical, industrial and environmental personal injury cases, and also (by implication) the tort system's capacity to deal effectively with "mass exposure cases"[17] (Rosenberg 1984:855) or "toxic torts"[18] (Day 1992:2). As Rosenberg rightly says, under either negligence or strict liability "mass exposure claimants, like all other tort plaintiffs, must establish the existence of a but-for, cause-in-fact relationship - a causal

---

[15] The burden of proof generally falls on the plaintiff. If the court cannot decide between the plaintiff's and the defendant's account of events. The defendant will win the case. Described in 1942 by Viscount Maugham as "an ancient rule founded on considerations of good sense [the rule] should not be departed from without good reason" **J. Constantine Steamship Line v Imperial Smelting Corp. Ltd** [1942] AC 154, 174.

[16] **Barnett v Chelsea and Kensington Hospital Management Committee** [1969] 1 QB 428.

[17] **Re: Northern Dist. of Cal. "Dalkon Shield" IUD Prods. Liab. Litig.,** 526 F. Supp. 887 (N.D. Cal 1981) vacated, 693 F. 2d 847 (9th Cir. 1982), cert. denied 103 S. Ct 817 (1983). **Re: "Agent Orange" Product Liab. Litig.,** 565 F Supp. 1263. (E.N.D.Y. 1983). **Re: "Three Mile Island" Litig.,** 557F. Supp. 96 (M.D. PA 1982).

[18] **Eckersley v Binnie** (unreported, CA 18 Feb. 1988, Lexis). **Merlin v British Nuclear Fuels Plc** [1993] All ER 711.

connection - between the defendant's tortious conduct and the loss for which recovery is sought" (Ibid). Unfortunately for the plaintiffs however, as discussed in 2(2), often identification of the exclusive toxic agent and/or the determining nature of the victim's disease, proves elusive.

For while the toxic tort defendant may admit to polluting the environment, the plaintiff, relying on the traditional tort approach may fail to establish causation. Firstly, the defendants may argue that the causal mechanism is unknown. Second, the defendants may suggest that the plaintiff would have contracted the disease (regardless of exposure) anyway. Thirdly, the defendants may contest on the basis of 'unassessibility' of contribution of risk[19], and fourthly, the defendants may suggest cumulative causation[20]. In mass tort cases there are also additional problems of multiple defendants[21].

Recently, in recognition of these problems, there have been a number of proposals put forward to resolve this situation including: reversal of proof in favour of the plaintiff[22], res ipsa loquitur, liability in proportion to major accountability, and the abandonment of the traditional approach to causation.

---

[19] See **McGhee v National Coal Board** 1 WLR 1.

[20] See **Wilsher v Essex Health Authority** [1988] 2 WLR 557,

[21] See **Sindell v Abbott Labs** 26 Cal 3d 588, 607 P 2d 924, 163 Cal Rptr 132 (1980). Each drug company in this case argued that the chances are it did not manufacture the drugs responsible for the personal injury.

[22] In 1978 the Royal Commission on Civil Liability and Compensation for Personal Injury considered this issue (Pearson Report, vol 1 p.285).

One case perhaps more than any other, has however focused attention on the limitations of the traditional approach to causation, while at the same time opening a window of opportunity in favour of the plaintiff. In **Hotson v. East Berkshire Area Health Authority**[23] the plaintiff was unable to establish, on the balance of probabilities, that the defendants' failure to treat him promptly, in breach of duty, would have reduced the injuries he sustained as a consequence of falling from a tree. The trial judge, Simon Brown J, found that there had always been a 75 per cent chance that the injuries would have resulted in his current disabilities anyway, but due to the defendants' carelessness, this had become a 100 per cent certainty. Therefore, even if the plaintiff failed to show that "but-for" the defendant's negligence he would be injury free, he could at least establish that he had lost a 25 per cent chance of avoiding his eventual permanent damage. The claim in **Hotson** was whether this could found a claim for damages. The trial judge[24] and the Court of Appeal[25] held that it could.

On appeal to the House of Lords[26] however, their Lordships in **Hotson**, reaffirmed the need to meet the 'but for' test, yet failed, in the opinion of some (Stapleton 1988; Scott 1992; Reece 1996), to properly consider or evaluate the alternative basis upon which the action was brought - loss of chance of avoiding outcome.

As a consequence of this, a number of academics (Stapleton 1988; Hill 1991; Scott

---

[23] [1987] 2 All ER 909 (hereafter the case will be referred to as **Hotson**).

[24] [1985] 3 All ER 167.

[25] [1987] 1 All ER 210

[26] [1987] AC 75, [1987] 2 All ER 909.

1992; Howarth 1995; Reece 1996) have sought further clarification on this issue. For while other legal systems appear to embrace loss of a chance doctrines[27], in England the idea has not been well received. Whereas loss of a chance is still recognised in contract law[28], in tort, says Howarth (1996:99), "although the question is still technically open, the door is rapidly closing".

According to Reece (1996:205), the theoretical base underlying this problem relates to the legal system's acceptance of scientific "universal determinism" dating back to the eighteenth century. While science has now started to question the legitimacy of this outdated theoretical perspective however[29], the assumptions underlying scientific determinism still remain deeply rooted and entrenched in respect of causation in the law. The burden and standard of proof, says Reece, were never intended for an indeterministic world.

In her article[30], Reece therefore adopts a philosophical analysis to elucidate her position, and thereby assist the reader to appreciate the difference between cases based on a

---

[27] In the US a number of jurisdictions have developed such doctrines. See **Herskovits v Group Health** 664 P 2nd 474 (Walsh 1983); **Deburkarte v Louvar** 393 NW 2d 131 (Iowa 1986); **Falcon v Memorial Hospital** 462 NW 2d 44 (Mich 1990). In France also the doctrine is well established see P. Malaurie and L. Aynes Cours De Droit Civil: Les Obligations Paris: Editions Cujas, 1994:135-136).

[28] **Chaplin v Hicks** [1911] 2 KB 786.

[29] Please refer to 2(1).

[30] Helen Reece (1996) Losses of Chances in the Law; 59 MLR 188.

deterministic (clear causation) foundation, and cases founded on a quasi deterministic (loss of chance) basis. In attempting to grapple with this issue, Reece, in considering quasi deterministic (loss of chance) cases, states that the traditional rules cannot be applied. The burden and standard of proof she says, are irrelevant when we are faced with a random event because neither side can prove or disprove causation on the balance of probabilities. For example, when confronted with a pollutant which is responsible for a random 10 per cent of cancers, it makes no sense "to ask whether it is more likely than not that the pollutant caused the plaintiff's cancer. The most that we can ever hope to know in this case is that there is a 10 per cent chance that the pollutant caused the cancer" (Reece 1996:205).

Linked to this philosophical position is the issue of what constitutes the 'gist of negligence'. Stapleton (1988[31]) looks at the question of what has in the past (loss or damage) and may in the future (loss of chance) be regraded as the essential and minimum requirements of actionable damage in the tort of negligence. In the second part of her analysis, Stapleton then goes on to consider the relationship between the reformulated damage (loss of chance of avoiding injury) and causation. She argues that such a departure would not violate the traditional approach and that the damage suffered by the plaintiff would still have to be 'more likely than not' caused by the defendant's breach.

Moving on, Stapleton goes on to consider possible wider applications of **Hotson** with regard to latent damage. Here, Stapleton is concerned with accelerated claims formulated in terms of loss of chance of avoiding outcome **before** onset of disease. This would mean

---

[31] Stapleton, J. 'Gist of Negligence' (1988) Part 1.

that observable manifestations of physical injury would not be necessary for a claim of negligence.

When analysing the injustice of the 'all or nothing' balance of probability test, Stapleton points out the unfairness to the plaintiff (who is unable to establish a causal connection between the defendants fault and the outcome) and indirectly, the failure of the law to protect the public through deterrence of present or future negligent activity on the part of the defendant.

Further says Stapleton, there are advantages to the loss of chance approach, including a more accurate valuation of the impact of the defendant's conduct (as the plaintiff would only recover a proportion of the cost to him of the full outcome). This is because each claim will have to address the exact nature of the interest which the defendant's fault has destroyed (which means the defendant only paying in proportion to the risk of his activity). Scott (1992) in supporting this proportionate approach recognises that statistics have long been utilized by the courts[32] and from a medical perspective, concurs with Stapleton's view that the implementation of the loss of chance doctrine would ensure justice to both parties.

Hill (1991) in criticising the loss of chance doctrine, considers the work of Stapleton and reflects on the House of Lords decision in **Hotson**, in particular their Lordships' failure to clarify the position with regard to this matter. In Hill's judgment, it should be for

---

[32] In terms of valuation of interest. To establish causation in the absence of better evidence. Contributory negligence.

Parliament to decide whether traditional rules are to be dispensed with and also, whether causal questions should be bypassed in favour of compensation for statistical chance.

In particular, Hill is critical of the fact that no distinction has been made between 'statistical' and 'personal' chance. A statistical chance can only be an assessment based on collected data of non-individual cases. A personal chance would be a chance that is peculiar to the individual and would therefore take account of that particular person's future circumstances and capacity to deal with a disease. It is Hill's view that loss of chance can only ever be realized in terms of 'personal chance' involving future hypothetical questions. Statistical chance, based on past fact, will not suffice. As far as Hill is concerned, the loss of chance doctrine is too radical and incorporates a fundamental change of policy which involves a new principle of recovery. As a consequence, Hill proposes the application of a policy orientated approach to the decision making process and thereby:

> in cases involving merely lost statistical chances, [where] the courts cannot determine which plaintiffs, if any, have suffered a personal loss. If, as a matter of policy, it is felt that the plaintiff ought to receive some financial help from the defendant as he might have suffered some personal loss - the plaintiff is 'innocent' whilst the defendant has been negligent and this is a way of being sure that everyone who has suffered a personal loss is compensated - then it should be recognised that policy, not logic, underlies the decision (Hill 1991:518).

For the present however, their Lordships in **Hotson** appear to have deliberately left open the question of whether 'loss of chance' may in the future form the gist of an action in negligence/personal injury claims. Possibly, this disregard was intentional in deference to

the decision of the House of Lords in **McGhee v. National Coal Board**[33] (discussed below) and in the knowledge that **Wilsher v. Essex Area Health Authority**[34] was shortly to be considered by their Lordships. Whatever the reason for their Lordships' lack of clarification, some academics (Stapleton 1988; Hill 1991) consider this was a missed opportunity which has resulted in continued uncertainty.

In **McGhee**[35], the plaintiff was employed at a brick kiln where he contracted dermatitis. There was no doubt that industrial dermatitis was caused by the brick dust and that as a consequence of this work, dust adhered to the plaintiff's skin resulting in the condition. Although no breach of duty by the defendant employers was established in respect of working conditions, the employers were held liable for failing to provide adequate washing facilities which resulted in the plaintiff having to bicycle home after work with his body still caked in brick dust. The question therefore was, whether the failure to provide showers caused or materially contributed to the dermatitis. The evidence did not show how the dermatitis began, but was in the opinion of their Lordships[36] sufficient to justify a conclusion that the defendant's failure to provide washing facilities made a material contribution to the onset of the dermatitis, although it may not have been the sole cause.

---

[33] [1972] 3 All ER 1008, [1973] 1 WLR 1, HL (hereafter the case will be referred to as **McGhee**).

[34] [1987] QB 730, [1986] 3 All ER 801, CA (hereafter, the case will be referred to as **Wilsher**).

[35] [1972] 3 All ER 1008, [1973] 1 WLR 1, HL.

[36] See per Lord Reid [1973] 1 WLR at 5, per Lord Wilberforce at 6, 7, per Lord Simon at 8, per Lord Salmon at 12.

What made this case remarkable however, was perhaps more to do with the passages in some of their Lordships' speeches than the decision itself. Lord Wilberforce's speech in particular has become the focus of much attention:

> ...it is a sound principle that where a person has, by breach of duty of care, created a risk, and injury occurs within the area of that risk, the loss should be borne by him unless he shows that it had some other cause. Secondly, from an evidential point of view, one may ask, why should a man who is able to show that his employer should have taken certain precautions, because without them there is a risk, or an added risk, of injury or disease, and who in fact sustains exactly that injury or disease, have to assume the burden of proving more: namely that it was the addition to the risk, caused by the breach of duty, which caused or materially contributed to the injury? In many cases of which the present is typical, this is impossible to prove, just because honest medical opinion cannot segregate the causes of an illness between compound causes[37].

Therefore, when considering the 'loss of chance' question in **Hotson**, Lord Mackay referred to **McGhee**, and the controversial proposition that where the defendants' failure had materially increased the risk for the plaintiff, then it was proper to treat such a material risk as equivalent to a material decrease in the chance of the plaintiff avoiding a particular outcome, at least, until **McGhee** had the opportunity to be reconsidered. Accordingly, Lord Mackay said that it would be:

> unwise to do more than say that unless and until this House departs from the decision **McGhee**, your Lordships cannot affirm the proposition that in no circumstances can evidence of loss of chance resulting from breach of duty of care found a successful claim in damages[38].

Commenting on the implications of this evidential gap for the plaintiff, Lord Wilberforce's speech (cited in **Hotson**) went on to say that "if one asks which of the parties, the workman or the employers, should suffer from this inherent evidential difficulty, the answer as a matter of policy or justice should be that it is the creator of the risk who, ex

---

[37] [1972] 3 All ER 1008 at 1012. 1 WLR 1 at 6.

[38] **Hotson** [1987] AC 75 at 916.

hypothesi, must be taken to have foreseen the possibility of damage, who should bear its consequences"[39].

More recently, in **Wilsher**, the House of Lords reaffirmed the strict application of the "but for test" (where the onus of proving causation on the balance of probabilities lies with the plaintiff being able to prove the existence of a causal link which in court is taken to mean more than 50 per cent probability). Therefore, mere proof that the defendants' breach **increased the risk** of injury is not sufficient. Where damage may have been caused by one or more of a number of factors, it is now necessary to prove affirmatively that at least one factor for which the defendant is liable made a **material contribution** to that injury.

In this case, the plaintiff, a premature baby who had suffered from most of the background afflictions that beset a premature baby, claimed damages in respect of retrolental fibroplasia (RLF), an incurable condition of the retina. In the plaintiff's case, this condition had resulted in total blindness in one eye and severely impaired vision in the other. The plaintiff argued that the defendants' fault had materially increased the risk of the outcome (a point disputed by the defendants). Accordingly, the plaintiff argued on the basis of **McGhee**, that if he could prove the defendants' negligence had increased the risk of the outcome, he had sufficiently established causation and the burden of proof would therefore shift to the defendant.

Lord Bridge, with whom other members of the House unanimously agreed, rejected the argument that **McGhee** had laid down some sort of esoteric principle of causation and

---

[39] **McGhee v National Coal Board** [1973] 1 WLR 1 at 6.

burden of proof. Thus the law as a consequence of **Wilsher,** now stands where it always has with the onus of proof on a balance of probabilities lying on the plaintiff, and that onus satisfied only if the plaintiff proves that the defendant's breach of duty made a material contribution to their injury.

What **Hotson** and **McGhee/Wilsher** all have in common is that under traditional rules the plaintiff would fail to establish on the balance of probabilities the necessary causal connection to allow for recovery. **Hotson,** in attempting to reformulate these orthodox rules offered their Lordships the opportunity of considering loss of chance as an alternative doctrine in respect of cumulative and multiple causation claims, or where the existence or establishment of a causal connection proved to be elusive. Increasingly in mass exposure and/or toxic claims, there is a reliance on complex scientific expert evidence where conflict of scientific opinion is divided over the specific causal agent. As Rosenberg (1984:851-852) says:

> Accidents in the course of the production, distribution, marketing, consumption, and disposal of toxic agents can have catastrophic consequences. Even a single instance of product defect, carelessness, or risk-taking may increase for thousands or even millions of people of one or more generations the dangers of contracting cancer or some other insidious disease. Ultimately, after a latency period that usually spans two or more decades, this disease risk will materialize and cause the disability or death of a significant portion of the exposed population.

The tort system's capacity to deal effectively with cases of this kind have been frustrated by the burden of proof of causation and the all or nothing approach of the "but-for" test where, under either negligence or strict liability, causation must be established on the balance of probabilities. Unfortunately, for mass exposure and/or toxic tort claimants, the generic character of the pollutant and its latency period often remain undetermined, as a consequence, the toxic agent is generally found not to exceed the background risk.

Another problem facing the plaintiff (discussed in the previous section) is the determining nature of the victim's disease. Rarely is one agent ever the exclusive source of a particular disease, and often, nature, nurture and environment all play their part in producing a synergistic effect. Therefore, while epidemiological studies may provide probabilities in respect of the incidence of disease, background risk and cumulative risk, because of our limited knowledge of the aetiology of disease, it is impossible to be more precise in relation to the exact casual mechanism involved. So although some employees have succeeded in identifying a particular toxin as the causative agent, these tend to be in cases where there are also rare pathological conditions[40]. Most third party claims remain conspicuous by their absence or fail on the basis of causation.

In modern industrial society where radioactive emissions or chemical discharges can have profound human and environmental consequences, the traditional view of the personal injury claim, perceived as it is, in purely individualistic terms (Chayes 1976), must be challenged. Any non-utilitarian view says Rosenberg (1988) is a misconception of the social function of the tort system and negates the collective interest that now exists in mass exposure or toxic tort cases. Today, deterrence, precaution and accountability are public issue concerns. For this reason, Reece (1996) and Stapleton (1988) among others, recognize that the conventional approach to causality, whether at theoretical or practical level, needs to be confronted. Loss of chance offers a real opportunity for claimants, and in so doing, encourages the development of a deterrent/optimal care

---

[40] Bladder cancer among workers in the rubber industry exposed to beta-naphthylamine has hinged upon judicial assessment of contradictory epidemiological evidence. See **Cassidy v Dunlop Rubber Co. Ltd** (1971) 11 KIR 311; **Wright v Dunlop Rubber Co. Ltd** (1972) 13 KIR 255.

culture, while at the same time ensuring that the defendants' are only liable in proportion to their tortious conduct and the plaintiff's injury[41].

Currently under traditional rules therefore, the issue of causation continues to be the football kicked around from one side to the other. What is being attempted is the resolution of uncertainties and what tilts the balance of probabilities in favour of the plaintiff or the defendant depends less on scientific truth, and more on the legal system's acceptance of a discredited deterministic philosophy which has its foundation in scientific ideology.

Having considered a few of the problems underlying the epistemology and construction of scientific knowledge, and discussed some of the issues with regard to scientific and legal causation, the next chapter will concentrate on expert evidence. In particular, the role of the scientist as expert witness. This is particularly important from a legal perspective for as Sales and Simon (1993:232) correctly point out, "scientifically compromised judgments presented in legal proceedings can be used by lawyers and judges to look to prior appellate [and first instance] decisions to support their conclusion about the validity of scientific testimony". Potentially therefore, any scientific opinion may gain legal acceptance, and by so doing take on precedential value in future cases.

---

[41] Presently, where the balance of probability exceeds 51% the defendant may find himself liable not only for the excess risk but also for the background risk.

3.1 THE EXPERT WITNESS

In the same way that notions of causation extend beyond narrow epistemological and disciplinary boundaries, scientific expert evidence goes beyond the realms of legal procedure to encompass scientific uncertainty and the dynamics of science/law interaction.

Although expert evidence has long been integral to the legal process, where says Schwarzer (1994:1), people "qualified by skill, knowledge, education or experience have been permitted to testify to help the trier of fact understand the evidence or determine a fact in issue", it is only with the advent of the toxic tort that cases coming before the courts have involved such complexity and scientific uncertainty. Notwithstanding that "courts are institutions established for the resolution of disputes, not arbiters of scientific truth" (Herman 1990:15), nonetheless as Freckelton (1987:174) points out, "law will always have difficulties in dealing with complex scientific evidence and new scientific techniques on the fringes of acceptance within the scientific community".

Indeed the problem this unfamiliar and often multifarious testimony poses for the judicial system has led some authorities to question the courts' competency to make reasoned decisions in light of such expert evidence. Recently, the Carnegie Commission on Science, Technology, and Government concluded that:

> The courts' ability to handle complex science-rich cases has recently been called into question, with widespread allegations that the judicial system is increasingly unable to manage and adjudicate science and technology issues. Critics have objected that judges cannot make appropriate decisions because they lack the technical training, that jurors do not comprehend the complexity of the evidence they are supposed to analyze, and that the expert witnesses on whom the system relies are mercenaries whose biased testimony frequently produces erroneous and inconsistent determinations. If these claims go unanswered, or are not dealt with, confidence in the judiciary will be undetermined as the public becomes convinced

that the courts as now constituted are incapable of correctly resolving some of the most pressing legal issues of our day[1].

In view of these concerns, the focus of this chapter will be on scientific expert evidence. In order to put the various issues into perspective however, 3(1) has been divided into two parts, the first discusses the role of the expert witness generally, the second, identifies relevant legislation and considers rules governing expert evidence, including, draft Civil Procedure Rules (1998), and proposals for an Experts' Protocol (1998)[2]. Moving on, Sec 3(2) examines issues related to scientific expert evidence specifically.

Incorporated throughout this chapter are the results of empirical research (carried out for the purposes of this thesis) from members of The Academy of Experts who, over the years, have become involved in complex litigation of a toxic tort or medical research nature[3]. The Questionnaire was delivered to Michael Cohen[4], Chairman of The

---

1 Carnegie Commission (1993) Final Report.

2 The draft Experts Protocol is a document generated by the Association of British Insurers and Law Society in consultation with The Lord Chancellor's Office.

3 In addition to incorporating the results of the research throughout Chapter 3, I have included some of the data in Chapter 5. Part of the questionnaire was concerned with expert opinion of the judiciary. Please see Chapter 5 for further information.

4 Michael Cohen LLB FIBA FClarb QDR FAE Barrister.

Academy of Experts[5] in May, 1997. Mr. Cohen kindly agreed to distribute the questionnaire to 160 of his membership[6] involved in scientific or medical experimentation.

The Expert Witness

Wigmore (1940) suggests putting the date of modern law expert evidence (as expressed in the dicta of Lord Mansfield in **Carter v Boehm**[7], and the decision of **Folkes v Chadd**[8]) as around the end of the eighteenth century. Concurring with this view, Jones (1994:58-59) agrees, "**Folkes v Chadd** was simply a formal admission of what was in fact already the day to day practice"; it thus legitimized the expert status of "a special sort of witness", and by so doing made expert evidence the exception to the opinion rule.

---

[5] The Academy of Experts is based at Gray's Inn London. The current President is The Rt Hon The Lord Howe of Aberavon CH QC. Vice Presidents: Daniel R. Fung QC.HH Judge Esyr Lewis QC. Anthony Scrivener QC. HE Judge Stephen Schwebel. Sir Donald Harrison MD MS FRCS FRCOphth (Hon) FRACS FRCSE FCM(SA) FACS FRCSI FRSM. Rodger Pannone MAE. Sir Francis McWilliams GBE BSc(Eng) F.Eng DCL.Prof. Pierre Lalive Lic. jur Lic.Litt(Geneva) Ph.D (Cantab).

[6] In total 160 questionnaires consisting of 34 questions were sent out to The Academy of Experts members. The response rate was 62% representing 99 replies, of which 7 (3%), were incorrectly completed, leaving 92 replies. Out of the 92 responses, 43 of the members (47%), chose to put additional comments on the back page of the questionnaire. All those taking part were involved in scientific and/or medical research at senior levels. Please refer to Appendix 1 for a copy of questionnaire and results.

[7] (1766) 3 Burr, 1905.

[8] (1782) 3 Doug. 157.

With regard to the role of an expert witness, Lord President Cooper expressed the view, this was to:

> ..furnish the judge or jury with the necessary scientific criteria for testing the accuracy of their conclusions, so as to enable the judge or jury to form their own independent judgment by the application of these criteria to the facts proved in evidence[9].

Despite such assertions however, historically there has always been ambivalence and judicial concern over the role of the expert witness. In 1873 the Master of the Rolls, Sir George Jessel observed:

> In matters of opinion I very much distrust expert evidence..... An expert is not like an ordinary witness, who hopes to get his expenses, but he is employed and paid in the sense of gain, being employed by the person who calls him.

He goes to say:

> Undoubtedly there is a natural bias to do something serviceable for those who employ you and adequately remunerate you. It is very natural, and it is so effectual that we constantly see persons, instead of considering themselves witnesses, rather consider themselves as paid agents of the person who employs them[10].

More recently, Cresswell J. said of an expert:

> An expert witness should provide independent assistance to the Court by way of objective unbiased opinion in relation to matters within his expertise... An expert witness in the High Court should never assume the role of advocate[11]

---

[9] **Davie v Edinburgh Corporation** [1953] SC 34 at 40.

[10] **Lord Abinger v Ashton** (1873) 17 LR Eq. 358 at 374.

[11] **National Justice Compania Naviera SA v Prudential Assurance Co. Ltd "The Ikarian Reefer"** [1993] 2 Lloyd's Rep. 68 at 81.

Today the importance of the expert witness cannot be under estimated, according to Freckelton (1987:3) "the influence of the expert is far-reaching and reminiscent of that of the mystics and village sages of former times". He goes on to say, that the courts willingess to embrace 'specialist expertise', 'latest scientific developments', and 'scientific claims' has resulted in a reliance and a dependency on the expert.

The challenge expert evidence poses for an already over burdened civil justice system are, as Lord Woolf acknowledges, problematic. In his Interim Report, **Access to Justice**[12], Lord Woolf observed that the expert witness was a prominent area of concern throughout the inquiry, and that as a professional body experts appeared to be one of the main areas of contention within the legal system. While acknowledging that criticism differed, depending on the type of proceedings under consideration, the general consensus was that:

> The need to engage experts was a source of excessive expense, delay and in some cases, increased complexity through the excessive or inappropriate use of experts. Concern was also expressed as to their failure to maintain their independence from the party by whom they had been instructed[13]

Further, there was a recognition that such problems had increased, particularly over the last decade.

In attempting to identify what factors underlie these difficulties, Lord Woolf began by outlining what he considered to be the function and role of the expert witness. In his opinion this was to:

---

[12] Access to Justice (1995) Interim Report to the Lord Chancellor on the Civil Justice System in England and Wales.

[13] Access to Justice (1995:181).

(a) assist a party to establish the facts and to assess the merits of a case and with its preparation;

(b) give to the court, as evidence, their expert opinion where opinion evidence apart from that of an expert would not be strictly admissible;

(c) give factual evidence on a subject, where because of their expertise, their evidence will have greater weight than that of an unqualified witness.

(d) conduct inquiries on behalf of the court and report to the court as to their findings;

and

(e) sit as assessors with judges to assist the court to understand the technical evidence which the court has to consider[14]

When considering the difference between an expert witness and "a good expert witness", Smith (1989:69) identifies communication skills and expertise as two of the more important criteria. However, Smith goes on to say "technical expertise in itself is certainly not sufficient for legal purposes which, whether in a written report or in oral testimony, require clarity and simplicity of expression, firmness with modesty, and an ability obviously more important with a jury - to couch technical statements in lay terms".

Other qualities identified by Reynolds and King (1992:26) which befit 'a good expert witness' include: "an analytical mind, objective judgment, recognition of the merits in alternative approaches, concise reporting, an interest in researching, patience, tact, the ability to negotiate, coolness under pressure, placidness, an ability not to be easily antagonized, realism, convincing credibility, relevant experience, thorough technical knowledge".

[14] Woolf, op cit. 181.

Therefore, what constitutes a "good expert witness" has evolved over many years as a result of: lawyers' experience, judicial observation and input, and an informal network of colleagues and recommendations from 'other' experts. Combined, all these factors have contributed to a perceived legal wisdom of what makes an expert 'a good witness'. Today, as Jones (1994:140) says, "lawyers' lists make it clear that they prefer people who are good experts and good witnesses".

Another factor in the evaluation of a "good expert witness" is the degree to which the lawyer can influence the expert witness in the course of his testimony. Often this will depend upon an element of witness subordination, as Smith and Wynne (1989:4) say:

> ..it is important to note that the legal process, and not the expert, defines the factual question which is relevant for the expert to answer. A 'good' expert therefore is someone who can subordinate his or her technical view of the relevant question".

Bennett and Feldman (1981:124) also highlight co-operation as an important factor, "the willingness of the witness to co-operate and his or her ability to respond to cues in the line of questioning".

Therefore says Green (1989:117) "experts who appear in court are at the end of a highly selective process", a selection process that involves "expert shopping" (Sales and Simon 1993:234) and has changed surprisingly little since 1877, when Sir George Jessel remarked that:

> A man may go, and does sometimes, to half-dozen experts. I have known it in cases of valuation within my own experience at the Bar. He takes their honest opinions, he finds three in favour and three against him; he says to the three in favour, will you be kind enough to give evidence?

> And he pays the three against him their fees and leaves them alone; the other side does the same. It may not be three out of six, it may be three out of fifty. I was told in one case, where a person wanted a certain thing done, that they went to sixty-eight people before they found one[15].

In addition to the selection of experts, and questions over renumeration, Freckelton (1987:124) highlights the potential bias of expert witnesses:

> Experts do not come into the court room as disinterested observers. They are generally sought out by one or other side in legal proceedings, requested to make a report to the legal representatives, paid for that and, if the report coincides with the arguments which the lawyers wish to put forward in the case, asked to testify. Experts are no more altruistic than lawyers. They expect remuneration and they receive it. Of necessity, this affects the relationship between the expert and the side for which he or she appears. There are all manner of pressures, albeit often subtle ones, that propel the expert in the direction of making findings which are acceptable to the side for which he or she initially prepares the report and then is asked to appear.

This concern with impartiality is also identified by Lord Woolf, in particular, he highlights the importance of expert witnesses being seen to be independent, as well as being free from the influence of partisan considerations. According to Lord Woolf (1995:182), many of the experts simply become an "effective weapon in the parties' arsenal of tactics", as a result, more often than not, there is:

(a) a polarisation of issues and unwillingness to concede issues from the start;

(b) insufficient observance of the confines of expert evidence and expansion into the realms of rival submissions; and

(c) insufficient willingness to strip out, agree or concede all but the essential issues following exchange of reports (Ibid).

In their submission to Lord Woolf, the Academy of Experts voiced their concerns over witness independence, highlighting two particular areas. Firstly, the "meeting of experts"

---

[15] Thorn v Worthing Skating Rink Co. (1877) 6 Ch. D. 415.

where experts are frequently instructed by lawyers not to agree to anything, or alternatively, only to agree subject to lawyers' approval. Secondly, the "exchange of experts' reports" where concealment appears to be the main requirement.

Lamenting the lack of witness independence, the Editor of the legal journal Counsel has been particularly scathing of expert testimony:

> Expert witnesses used to be genuinely independent experts. Men of outstanding eminence in their field. Today they are in practice hired guns; there is a new breed of litigation hangers on, whose main expertise is to draft reports which will conceal anything that might be to the disadvantage of their clients[16].

Notwithstanding the legitimacy of such views, it is important to remember that lawyers' bias in favour of their clients is "neither illegal nor immoral" (Sales & Simon 1993:234). As Saks (1993:5) says:

> The advocate's duty is to advance the most persuasive evidence and arguments on behalf of a client that can be done without perpetrating a fraud on the court. Presenting "biased" arguments and evidence in this endeavour not only is permitted, it generally is ethically required. This is part of what it means to be an advocate.

Therefore, while it is not permitted for lawyers to deliberately mislead the court they are not required to present the whole truth. As Sales and Simon (1993:234) remind us, "truth is supposed to emerge from the adversarial process, with each side presenting the strongest, biased case for their client".

Unfortunately, say Smith and Wynne (1989:30), this reliance on the adversarial process

---

[16] Editorial Counsel (1994).

to expose "which side of an expert disagreement is introducing covert, extraneous bias (including values and opinions) or incompetence" is itself now under scrutiny[17]. In addition to allegations of "artificial polarization" and concern over partisanship and remuneration, there is also the danger says Freckelton (1987:133) "that the expert can be manipulated into presenting a distorted account of evidence"; particularly since, as Jones (1994:13-14) points out, "the dynamics of advocacy are not so much concerned with the deconstruction of the other side's case as with destroying it altogether".

Presently any evaluation of an expert witness depends on his ability to persuade the court of the soundness of his opinion which according to Stuart Smith LJ:

> ..involves an examination of the reasons given for his opinions and the extent to which they are supported by the evidence. The Judge also has to decide what weight to attach to a witness's opinion by examining the internal consistency and logic of his evidence; the care with which he has considered the subject and presented his evidence; his precision and accuracy of thought as demonstrated by his answers; how he responds to searching and informed cross-examination and in particular the extent to which a witness faces up to and accepts the logic of a proposition put in cross-examination or is prepared to concede points that are seen to be correct; the extent to which a witness has conceived an opinion and is reluctant to re-examine it in the light of later evidence, or demonstrates a flexibility of mind which may involve changing or modifying opinions previously held; whether or not a witness is biased or lacks independence[18].

Thus, failure to live up to these expectations may find the expert's credibility as a witness challenged. One of the ways of achieving this is to attempt to destroy the experts' plausibility and believability. Witnesses may be portrayed as "evasive, unclear, rarely able to say anything without beating about the bush, and consistently not addressing the

---

[17] See Chapter 13 p.138 of Lord Woolf's Final Report on Access to Justice.

[18] **Loveday v Renton** [1990] 1 Med LR 177 at 125 per Stuart Smith LJ.

question" (Nyhart & Carrow, 1983:230). In addition, witnesses who appear uncertain, flustered or confused under cross-examination may "run the risk of being perceived as unprepared, careless, unprofessional or lacking in thoroughness" (Freckelton 1987:135). In the opinion of Jones (1994:149), some witnesses appear "too short winded, others are too opinionated, antagonistic, and chronic qualifiers"; if the expert is to be credible he must be none of these. Further, as expert testimony becomes increasingly relied upon, the quality of the testimony, and the skill of the witness are inevitably subject to harsher scrutiny and criticism by judiciary and lay public alike.

Linked to the notion of the 'credible witness' is the question of professional competence, which all too often, may be deliberately undermined by Counsel asking questions beyond the specialism of the witness, on occasion, leading to witness ridicule. Interestingly, of those members of the Academy of Experts who successfully completed the questionnaire[19], just over half (55%), found themselves being asked to give evidence in areas they considered beyond their specialism. A further 51% of the experts stated that their competency had been challenged, and over a quarter of these (26%), said they have been subjected to witness ridicule.

As a consequence, many experts "regard the adversarial system with distaste" (Smith 1989:71) as it appears to be a system that enables "barristers to win cases rather than uncover the truth" (Ibid). In addition, while many experts support the notion of expert

[19] Please refer to Footnote 6.

neutrality and consider themselves to be objective throughout proceedings, often, says Green (1989:121), "they are not seen in this way by others", instead they are portrayed as experts lacking professional integrity. Thus the Academy study found that a relatively high number (20%), of Academy of Expert members had their impartiality challenged under oath.

The inevitable result of such experiences is that many experts (in their submissions to the Woolf inquiry) drew attention to the difficulties and tensions which arise from the exigencies of litigation and expressed an unwillingness to appear as expert witnesses in future cases. Confirming a high level of negativity, the completed Academy questionnaire identified unrealistic deadlines and trial adjournment or delay, as particularly relevant in affecting the 'feel good' factor of the expert witness experience:

Questions	Yes
Are there unrealistic deadlines imposed on you?	52%
Have you ever incurred personal expenses as a consequence of trial alteration/adjournment or delay?	59%
Have you ever incurred any inconvenience as a consequence of trial alteration/adjournment or delay?	83%

Compounding the problem further, and acknowledged by the Academy of Experts as of additional concern, is the issue of professional negligence. The expert still owes a duty of care as a witness to his client to carry out his investigations with reasonable skill. If an expert is deemed to breach this duty of care he may well find himself liable for any losses

incurred as a consequence of his negligence[20].

Moving on to the 'Additional Comment' section of the questionnaire, 47% of the Academy of Expert members chose to make supplementary remarks related to their own experience. These comments are important for two reasons: first, because so many of the expert members chose to take advantage of the space provided to express their opinions; second, because many of the comments (in addition to reinforcing the views outlined in the main body of the questionnaire) also concur with the findings of Lord Woolf. In his Final Report (1997:143), Lord Woolf said:

> Contributions to the Inquiry from experts themselves suggest that there is a degree of uncertainty among them as to their duties, and a perceived conflict between their professional responsibilities and the demands of the client who is paying their fee. Experts would welcome some formal recognition of their role as advisors to the court rather than advocates of the parties.

On the basis of the following comments[21], Lord Woolf's assessment would seems to be correct:

"My main gripe is that solicitors (the vast majority) do not keep me in the picture with what is going on in the case and leave requests to the last minute".

"Unrealistic deadlines are invariably the fault of the solicitor who has been careless with the case".

---

[20] While it is very difficult to prove that the loss is due to the expert's negligence, the possibility is one recognized by the Academy of Experts who recommend that all expert witnesses take out professional insurance to cover both compensation and legal fees.

[21] This selection of 'Additional Comments' provides a good overview of many of the opinions expressed by the Academy of Expert members. For a full breakdown of comments, please see the Research Results presented in Appendix 1.

"Main problem is solicitors' poor communication skills and tendency to work at arms length by means of hastily dictated and sometimes convoluted letters. Few appreciate the fact that their work would be greatly eased if they brought experts in as quasi team members".

"The most negative aspect of being an expert witness is trying to receive payment - despite having an agreed timescale".

"Most lawyers use the expert merely as a 'tool' and do not accord sufficient respect or acknowledgement of years of experience and special training. Many lawyers devalue the 'expert system' by favouring amenable or prejudiced experts who approach a case not openly, but from a skewed 'frame of reference', this fans the adversarial flames and adds costs and time".

"Few lawyers have the courtesy to inform experts that a case has been settled and the file may be closed. Too many lawyers treat experts in an arrogant way".

Moving on, the following comments were particularly critical of 'the system', and again

appear to concur with the conclusions of Lord Woolf:

"In my field of personal injury litigation, there are some cases where it is necessary to delay settlement (final) for several years on account of the nature of the disability. But I believe that liability should be established as soon as possible to facilitate interim payments, based on professionally assessed needs".

"I believe the majority of cases take unnecessarily long to settle and that the emotional distress caused to the plaintiff and relatives is disproportionate to the financial gains. If at all possible the adversarial element and the number of experts should be reduced".

"The system of not knowing if or not you will be going to court until the very last minute is infuriating - surely someone can invest in a better system"

"I feel it would save a lot of time and effort (not to mention stress) if agreement could be reached in advance over which aspects of an expert's testimony were accepted and which were in contention. This would enable the experts to direct their time and efforts accordingly. Maybe a court appointed expert could adjudicate on such matters. I find it frustrating that well considered reports are sometimes not reviewed in sufficient depth prior to the start of proceedings".

"I have had solicitors asking me to alter my reports to present their clients in a more favourable light - asking to prepare a biased report".

Rules of Expert Evidence

Currently, in addition to the statutory provision as to the general admissibility of expert

evidence (Sec 3(1) of the Civil Evidence Act 1972[22]), there are also special provisions with regard to codes of procedure regulating expert evidence. The most important, Order 38 of the Rules of the Supreme Court (R.S.C) 1965[23].

As well as admissibility and procedural restrictions however, the courts also exercise control over the way expert evidence is given. According to Jones (1994:96) "the need to structure expert evidence stemmed from the real possibility that the expert would usurp the judicial role". Although there is no overall academic agreement on the classification of these rules, a certain consensus of opinion has emerged (Freckelton 1987; Robertson and Vignaux 1995). These include rules relating to qualifications[24], areas of expertise[25],

---

[22] Please refer to Appendix 2.

[23] R.S.C (Amendment) 1987 (S.I. 1987 No. 1423). Please see Appendix 3.

[24] With regard to qualification, it appears that expert witnesses must possess some specialized knowledge, skills, training or experience sufficient to enable them of offer information and opinion not generally available to members of the public (**R v Silverlock** [1894] 2 QB at 769 and 771). Sec. 4(1) Civil Evidence Act 1972 suggests that expertise must derive from knowledge and experience.

[25] According to Cross and Tapper (1995:557) areas of expertise have included "medical and scientific questions, the meaning of technical terms, questions of commercial practice or market value, the provision of a foreign system of law and the identity of a person's handwriting. These areas are in constant flux". Hodgkinson (1990:133) has suggested that the matter is, "at root, one of probative value".

hearsay[26], the common knowledge rule[27], the basis rules[28], and the ultimate issue

---

[26] The rule against hearsay evidence is one of the oldest and most complex in English law. For the application of the hearsay rule to written assertions see **Myers v DPP** [1965] AC 1001. For oral assertions see **R v Turner** [1975] QB 834. For conduct see **Li Shu-ling v R** [1988] AC 270. In addition, Part 1 of The Civil Evidence Act 1968 governs the admissibility of hearsay statements. The Civil Evidence Act 1972 and Rules 37 & 38 of the Supreme Court Practice do not accord any special relevance to the fact upon which the expert's opinion is based, whether they be hearsay or matter outside the expert's general professional knowledge and experience.

[27] According to Freckelton (1987) there are two approaches to common knowledge. The 'strict' exclusionary approach which propounds the view that the mere existence of an area of 'common knowledge' precludes any expert evidence on the topic, and the 'liberal' view, based on a 'need for assistance' concept in which the function of expert evidence is to render assistance, as and when required.

[28] The Basis rule is founded on the notion that expert opinions are excluded from evidence if their basis either is not admitted, or is not admissible in evidence. Murphy (1992) highlights the highly problematic nature of this rule, in particular the fact that an expert bases his opinion on many matters derived from his general knowledge; training and education; and professional experience. Much of the evidence available to the expert would clearly be based on experience and research that would, as a result of this rule potentially be inadmissible. The decision in **English Exporters (London) Ltd v Eldonwall Ltd** [1973] Ch 415 clearly shows that the expert cannot, by using underlying fact as the basis of his opinion, make those facts evidence in the case. This view was supported by **R v Abadom** [1983] 1 WLR 126.

rule[29].

In addition to having an understanding of the general principles of evidence however, all experts, say Reynolds and King (1992:120), also require "a working knowledge of the different categories and classifications of evidence so as to be able to distinguish which type of evidence is to be used". In their typology, Reynolds and King identify eight areas of evidence including: direct evidence[30], best evidence[31], real evidence[32], conclusive evidence[33], extrinsic evidence[34], indirect evidence[35], documentary evidence[36], and

---

[29] Historically it has been the rule at common law that no witness may give evidence on the ultimate issue of a case (**R v Wright** [1821] Russ. & Ry. 456). The ultimate issue rule has now been abandoned in England. In civil cases its abolition was recommended by Sec.3 Civil Evidence Act 1972.

[30] Direct evidence is the actual evidence of a fact. The evidence must be something the expert evidence personally experienced.

[31] This is the 'best' evidence that can be obtained to establish the basic facts from investigation, and, to give an opinion based on those facts.

[32] The real evidence is the object itself which is the subject matter of the dispute.

[33] Conclusive evidence is the most convincing evidence which is decisive in providing a fact of issue.

[34] Extrinsic evidence usually consists of oral evidence given in conjunction with written documentation (drawn from a source outside the documents) to explain the point in issue.

[35] Indirect evidence may be either hearsay or circumstantial.

[36] Documentary evidence is governed by Section 4(1) of the Civil Evidence Act 1968, and Rule 3 of Order 38 R.S.C.

prima facie evidence[37] (Ibid).

Moving on to the issue of judicial discretion to exclude evidence in civil proceedings, it would appear says Murphy (1992:24) that "no well defined exclusionary discretion can be demonstrated in respect of civil cases". Further says Tapper (1995:215), there is also an absence of "English cases asserting discretion to exclude pursuant to the fair trial categorisation". Despite this state of affairs, consideration has nevertheless been given to cases where evidence has been unlawfully obtained[38], and in cases where information has been withheld from the court[39].

Notwithstanding this ambiguity, Murphy (1992) nonetheless believes that some exclusionary discretion exists. Citing section 18(5) of the Civil Evidence Act 1968[40] as support for his view. This states:

> Nothing in this Act shall prejudice:-
>
> (a) any power of the court in any legal proceedings, to exclude evidence (whether by preventing questions from being put or otherwise) at its discretion.

Atiyah (1980:1249) similarly observes:

> Rules of procedure and evidence tend increasingly to be subject to discretion rather

---

[37] This is evidence which will establish whether or not there is a case to answer.

[38] **Ibrahim v R** [1914] AC 599 at 610, [1915-15] All ER Rep 874 at 178.
ITC Film Distributors v Video Exchange Ltd [1982] CH 431.
Helliwell v Piggott-Sims [1980] FSR 356 at 357.

[39] **D v NSPCC** [1978] AC 171 at 239.

[40] Reaffirmed by S.5(3) of the Civil Evidence Act 1972 which refers to "civil" rather than "legal" proceedings as in the earlier Act.

than fixed rule; and even where there are rules they tend increasingly to be of a prima facie nature, rules liable to be displaced where the court feel they may work injustice.

As far as the expert is concerned, says Freckelton (1987:248), there are "many circumstances in which professionals can find themselves in an embarrassing and awkward situation when asked as expert witnesses to disclose what has been said to them on the understanding that it would remain private and secret". He goes on to say that quite often, "disclosure can involve a conflict between the profession's code of ethics and the demands of the court system to have as much of the recent available evidence before it as possible". In addition, compliance with the order of the court could (at least in theory) result in sanctions and/or reprimands from ethical bodies together with loss of face among colleagues. In particularly sensitive cases this could endanger a relationship of trust that has been established or result in the withdrawal of research funding.

In sum, the position of the law appears to be that judicial discretion may exclude relevant evidence on grounds of public policy[41], vital interests of the state[42], and in certain cases where other (less serious) interests of the state may be challenged[43].

---

[41] Hennessy v Wright (1888) 21 QBD 509.
D v NSPCC [1978] AC 171.
R v Chief Constable of West Midlands, ex p. Wiley [1995] 1 AC 274.

[42] Duncan v Cammell Laird & Co. Ltd [1942] AC 624; 1942 1 All ER 587.
Rogers v Secretary of State for the Home Office Department [1973] AC 388.

[43] Alfred Crompton Amusement Machines Ltd v Customs and Excise Commrs. [1974] AC 405.
Conway v Rimmer [1968] AC 910.

Recent Developments

As a consequence of Lord Woolf's recommendations, Sec 1(1) of the Civil Procedures Act 1997 identifies certain 'rules and procedures', while Sec 2(1) & (2) outlines the composition of the Rules Committee, currently engaged in the preparation of the 'Draft Civil Procedure Rules', including those relating to expert evidence[44].

In addition to the Draft Civil Procedure Rules however, another proposal, a 'Draft Protocol of Best Practice in the Instruction and Use of Experts', is currently being formulated. This involves the Association of British Insurers, the Law Society and the Lord Chancellor's Department. The aim of the protocol is to help those who instruct and make use of expert evidence to do so:

> ...more effectively and efficiently. It is also intended to facilitate better communication and dealings between the expert and instructing party and more widely between opposing parties to a dispute[45].

Having reviewed some of the wider issues with regard to the role of the expert witness, the next section concentrates exclusively on 'Scientific Expert Evidence', highlighting particular concerns with regard to this area of expertise.

---

[44] Access to Justice: Civil Procedure Rule Committee. Draft Civil Procedure Rules. July, 1988. Part 32 'Experts and Assessors' has been included in Appendix 4.

[45] Draft Protocol of Best Practice in the Instruction and Use of Experts. Introduction. Please see Appendix 5. for further details of these proposals.

3.2 SCIENTIFIC EXPERT EVIDENCE

Moving on from some of the more general issues associated with the expert witness, this section will concentrate on scientific expert evidence, in particular, problems associated with the validity of scientific knowledge including: poor methodology, novel or new areas of scientific research, and misrepresented or fraudulent scientific claims.

Having read so far, it seems clear that scientific knowledge, based as it is on observations within a philosophical and procedural framework, experiences difficulties in dealing with cause and effect relationships. Therefore, the problem for the plaintiff (who depends upon the testimony of the scientific expert witness) is often radically different views of the hazard involved and divergent medical opinion of the impact of the toxin on human health. Fuelled by an adversarial process which seems to magnify these differences, the parties try to persuade the court to favour their interpretation. Thus the reality, says Oddie (1991:18) is that "Trial processes do not purport to be enquiries into the truth"; rather they are enquiries into whether a particular view of the matter (reconstructed for legal purposes) can be established or not.

Therefore, while the aim of an adversarial system may be to achieve just results, in fact, as Lord Woolf (1996:138) points out:

> All too often it [the adversarial system] is used by one party or the other to achieve something which is inconsistent with justice by taking advantage of the other side's lack of resources or ignorance of relevant fact or opinions. Expert evidence is one of the principal weapons used by litigators who adopt this approach.

Although Lord Woolf in his Final Report, did not designate toxic torts as a 'special

area[46]', there nonetheless exists some overlap with two designated 'specialist jurisdictions' (Medical Negligence and Multi-Party claims) in relation to scientific evidence. Of particular concern to Lord Woolf were problems related to partisanship and inequality of resources. As far as partisanship is concerned, Lord Woolf reiterated the findings of his Interim Report when he said:

> There is wide agreement that the expert's role should be that of an independent advisor to the court, and that lack of objectivity can be a serious problem[47].

In challenging inequality of resources, Lord Woolf pointed out that:

> One of the fundamental principles of my approach to civil justice is that there should, so far as possible, be a level playing field between litigants of unequal financial or other resources. A particular problem arises when one party, often the defendants or potential defendant, has an easily available source of expertise to which the other part does not have access[48].

When applying either partisanship or inequality of resources to toxic torts often (as in the **Reay and Hope** case) plaintiffs are faced with a 'David and Goliath' situation in which, 'in-house experts' and huge corporate resources ensure an unfair playing field from the start.

Having touched on a couple of the wider problems (partisianship and inequality of resources) with regard to scientific expert evidence, this section will move on to more specific concerns with regard to: qualifications; scientific methodology; new areas of

---

[46] Lord Woolf identified: Medical Negligence; Housing; Multi Party Actions; The Crown Office List; Specialist Jurisdictions.

[47] Final Report (1996:143).

[48] Final Report (1996:146).

science and scientific fraudulent claims.

Qualifications

From discussion in Sec 3(1), it is clear that an expert is a person who has knowledge not ordinarily possessed by the lay person. Historically therefore, the courts have permitted the expert to testify, where it is decided that specialized knowledge is relevant to a particular issue. In order to adduce the professional standing and reputation of the expert witness, it is customary for the expert, having taken the oath, to provide evidence on his own behalf, of his experience, professional achievements and qualifications for admissibility purposes.

The establishment of qualified experts, particularly in toxic tort cases, where causation is the issue, allows the court to attribute weight to the witnesses' opinion in areas of scientific uncertainty. Documented academic attainment therefore permits the court to assume the expert has sufficient understanding of his specialism to ascertain whether data or conclusions are valid, and further, that the data and/or conclusions can be applied to the facts of the case. As Marino and Marino (1995:9-10) say, "No expert should be permitted to testify regarding causality if the expert lacks academic attainment and actual experience of the appropriate type, and few experts should be permitted to testify if they possess only one such qualification".

When applying the expert's knowledge to a particular case, Marino and Marino (Ibid) go on to propose the utilisation of a basic framework which they suggest should be based on the following questions:

1. Does the expert's academic background indicate training in scientific methods and processes for inferring causality?

2. Has the witness demonstrated a familiarity with the scientific studies that embody the current scientific knowledge regarding the effects on living organisms produced by the toxin of interest?

Determining answers to these question will help the court decide firstly, whether the experts has sufficient understanding of the scientific principles involved in the toxin under consideration, and second, whether the expert can make relative evaluations in disciplinary areas overlapping their specific expertise, be it dosimetry, epidemiology or laboratory studies[49].

Methodological Problems (Applied Science and Epidemiology)

Because of the uncertainty over scientific knowledge discussed in Ch.2(1), and the problems of causation discussed in Ch.2(2), Gower (1997:18) believes we should not assume scientific experiments to be simple events, with clear beginning or endings. In his view, natural sciences are subject to "human interventions in a world of numerous conflicting influences and forces [which] have their origins in earlier related investigations and their termination in later explorations". Therefore:

> It is not surprising that the data produced in laboratories are sometimes unreliable, often contradictory, and always ambiguous. Experimental enquiries do have a life

[49] Often epidemiology and laboratory studies are conducted on the same toxin of interest. Therefore, geneticists and epidemiologists may rely on each others work to provide additional support for their own hypothesis. Statistics are also common to both areas, consequently, dose assessment and risk analysis may also be incorporated for evaluative purposes.

of their own, independent of any theories or hypotheses to which they may be relevant.

In similar vein, although epidemiological studies are useful because they focus on human health effects, nonetheless says Jasanoff (1995:120), they too often fall short of providing the level of proof required to establish causation:

> .....methodological defects render such studies unreliable or difficult to interpret. A common failing in epidemiological research is that studies are conducted on small population groups and hence may fail to detect a real, though infrequent correlation between exposure and illness.

Jasanoff goes on to say:

> Epidemiological studies may be inconclusive even if they show a statistically significant correlation between exposure and disease because of a failure to account for possible "confounding factors", that is, factors other than the alleged toxic exposure that could also have produced the observed effects.

Novel Areas of Scientific Expertise

Moving onto less established areas of science, the issue to be confronted is the basis upon which the courts allow new, novel[50] or controversial expert evidence. In two unreported cases[51], the Court of Appeal, while reaching no firm conclusions on the scientific validity of the evidence, admitted the testimony on the basis that the jury might find it of probative value.

---

[50] Novel refers to innovative or new evidence that is not established or necessarily accepted by the academic mainstream.

[51] R v McCrossen, unreported, 10th July 1991 CA Trans. No. 90/1256/Y2.
R v Mitchell, unreported, 26 March 1993 CA Trans. No. 82/2419/E2.

Acknowledging the difficulties of this area, Hodgkingson (1990:133-134), has suggested the following approach with regard to the admissibility of new areas of scientific expertise:

> i) The matter is, at root, one of probative value. Expert evidence is only admissible if the evidence of the particular expert is significantly probative of issues which the triers of fact would, left with the established facts and their own knowledge, be unable to determine because they are outside human experience.
>
> ii) The courts acknowledge a process over time by which particular scientific techniques become accepted, initially within the scientific community, and then by the courts. The two do not run hand in hand, both because the courts are not primarily a forum for the accreditation of the experimental sciences and because the legal process, entailing as it does a process of evidential proof makes additional demands upon a scientific discipline.
>
> iii) A discipline need not be accepted or rejected for evidential purposes. It may have a limited use in the court process, either because of its nature, or because of its limitations as compared with conventional evidential methods.
>
> iv) A scientific technique may be treated as admissible, but only subject to specific warnings to lay triers of fact as to the need for clearly understood and forensically unambiguous results.
>
> v) The courts may admit expert evidence in a field which is of doubtful susceptibility to expertise, if its findings can be put before the court in such a way that the court can itself analyze each element in the reasoning or calculation process.
>
> vi) The court will not generally compromise established evidential principles, which are themselves a safeguard of the reliability of the expert evidence to which they apply.

Until recently, other common law jurisdictions (for example the United States), introduced additional admissibility standards which exceeded the basic relevance requirement. The most established of these being the 'US Frye Test' which, as a consequence of this case, resulted in a 'general acceptance standard' which stated:

> Just when a scientific principle or discovery crosses the line between the experimental and demonstrable stages is difficult to define. Somewhere in this twilight zone the evidential forces of the principle must be recognised, and while courts will go a long way in admitting expert testimony deduced from a well-recognised scientific principle or discovery, the thing from which the deduction is

made must be sufficiently established to have gained general acceptance in the particular field in which it belongs[52].

The effect of **Frye v United States** was the potential rejection of any scientific evidence which was not sufficiently established, and had not gained general peer acceptance within the scientific community. The **Frye** test has therefore been the subject of much debate in the US, and other common law jurisdictions, and was not resolved until the 1993 case, **Daubert v Merrell Dow Pharmaceuticals Inc**[53].

In **Daubert v Merrell Dow Phamaceuticals Inc.**, the US Supreme Court took the view that **Frye** had been superseded by the US Federal Rules of Evidence. Rule 702 (which the court applied) was that novel evidence may be given if it will "assist the trier of fact to understand the evidence or to determine a fact in issue". The result of this decision was to abolish any admissibility standard and return to basic principles of relevance and probative value. In addition, the Supreme Court identified some important factors which they proposed for consideration on the scientific validity and relevance of any new scientific evidence. These include:

1. Whether the theory or technique can be, or has been tested.
2. Whether the technique has been published or subjected to peer review.
3. Whether actual or potential error rates have been considered.
4. Whether the technique is widely accepted within the relevant scientific community.

---

[52] **Frye v United States** (1923) 293 Fed. Rep. 1013 at 1014.

[53] **Daubert v Merrell Dow Pharmaceuticals Inc** (1993) 113 S Ct 2786.

Therefore, the importance of evidential rules in coping with areas of scientific uncertainty cannot be under estimated. As Clark (1981:81-83) reminds us:

> The data [scientific data] are always insufficient to dictate unambiguous conclusions...The debate therefore shifts from a preoccupation with the facts and their proof. It turns instead to the careful development of rules for the admissibility of legitimate evidence, and for the form of legitimate argument. Such rules are known to be fallible .....but fallibility is accepted as an inevitable consequence of our lack of omniscience. On the other hand, careful attention to developing mutually agreed-upon rules of evidence can create that essential willingness to proceed in the face of fallibility.... Perhaps most important formal rules of evidence constitute formal hypotheses on how we can best cope with the unknown.

While scientific ambiguity, and/or human fallibility may be accepted as an inevitable part of the scientific process, invalid or unreliable expert evidence nonetheless has serious implications for law.

This is particularly true of what Huber refers to, as 'junk science'. In the opinion of Huber (1991a:2), "Junk Science is the mirror image of real science, with much of the same form but none of the same substance". Huber (1991a:3), warns other common law jurisdictions to be wary of following the example of United States, "the legal establishment has adjusted rules of evidence accordingly, so that almost any self-styled scientist, no matter how strange or iconoclastic his views, will be welcome to testify in court. The same scientific questions are litigated again and again, in one courtroom after the next, so that error is almost inevitable".

What constitutes "good science" is however open to debate. According to Huber (1991a:215), it is to the lawyer's advantage to "maintain that science is unreliable, and to assert that nothing is really known for sure, and that no one outside the courtroom is

to be trusted". For Huber, good science is defined not by credentials but by consensus.

Fraudulent Scientific Evidence

Moving onto scientific misrepresentation/deception, in this instance, the issue is of concern not only to unwitting colleagues and the rest of the scientific community, but also to the legal system's reliance on expert witnesses, who may in good faith, refer to inaccurate/fraudulent data.

In this country the recent example of Dr. Malcolm Pearce, a senior consultant at St. George's Hospital in London shows the potential for such falsification of data[54]. In this case, three leading scientific journals including the British Medical Journal, the Lancet, and the British Journal of Obstetrics and Gynaecology, all published fraudulent papers by Pearce (one of which had been 'rubber stamped' and co-authored by Professor Chamberlain, President of the Royal College of Obstetricians and Gynaecologists). In evidence, Professor Chamberlain stated that the paper had been peer reviewed twice (medically and statistically); it never occurred to him that the paper was based on fraudulent claims. According to Lock (1995:1547-48) "the time has come for Britain to abandon its lax approach to scientific fraud", as well as the amateurism that permits publication of fraudulent research.

The difficulty of defining exactly what constitutes deception, fraud, misconduct or

[54] Dr. Malcolm Pearce was investigated and disciplined on the basis of alleged falsification of data on his research of a potential treatment for ectopic pregnancy.

unconscious behaviour is the subject of much national and international scientific debate. Related to this debate are issues of self-regulation, governmental intervention and judicial consideration. According to Grayson (1995:75), the United States is the only country that appears to be willing to confront this issue:

> Even the most cursory glance at the literature of scientific deception reveals a glaring discrepancy between the United States and the rest of the world. Although the American scientific community has demonstrated many of the characteristics of scientific conservatism, and has perhaps been forced to confront misconduct by the threat of legislative action, it has shown itself considerably more willing to admit that a problem exists than its counterparts elsewhere in the world. It has discussed the issues exhaustively, developed institutional procedures for investigating and disciplining misconduct, devised guidelines on ethical conduct, and addressed the educational needs of young scientists. Much of this has happened in the public domain, with the newspaper press playing a significant role. Elsewhere there is almost complete silence.

Savan (1988) believes that because research publication is so closely associated with an increase in salary, promotion, the achievement of academic tenure and research funding, the aspiring, as well as the established scientist is now under an intolerable pressure to publish, with research papers becoming an end, rather than a means. According to Grayson (1995:35), "scientists no longer publish predominantly to disseminate new knowledge - this function is increasingly carried out by informal means, either electronically or through face-to-face contacts at conferences - but to boost their curriculum vitae or the research ratings of their departments".

Thus internal dynamics and problems of the scientific academic world may indirectly impinge on the credibility of the expert witness. As Pugh and Day (1995:91) suggest "the lawyer should therefore not accept anything at face value.....Scientists, although in some ways quite scrupulous when it comes to drafting a report, can also be quite naive when it comes to accepting other people's work. The training of the lawyer to have an

enquiring mind and not to accept things at their face value is a real asset".

The problem that scientific evidence poses for the legal system has led to a realization that the legal community needs to become more sophisticated about the limitations of scientific knowledge, and correspondingly, scientific expert evidence. Perhaps, given the complexity of the matter, and the fact as Carson (1992:17) points out, the issues involved are so fundamental ie: "the nature of science, comparative methodologies, assessing degrees of expertise", it is not surprising there are problems.

In a toxic tort case, the plaintiff must establish that exposure to a toxin is sufficient (in the circumstances) to bring about the plaintiff's disease. According to Marino and Marino (1994:43), if the expert can demonstrate, on the basis of scientific research, and the evidence presented, that:

1. the plaintiff's disease can be caused by the toxin;
2. the doses of the toxic agent used in scientific studies involving the agent were comparable to the dose the plaintiff actually received; and
3. the plaintiff was exposed at levels substantially in excess of those experienced by ordinary members of the public.

then, in these ideal circumstances, the necessary conditions have been met. However, this assumes that the plaintiff has only been exposed to one risk factor, the toxic agent, for which the defendants are liable. In most situations however, other factors (as discussed in Chapter Two) play their role in contributing to the question of apportionment of cause.

Moving on to Chapter Four, it is clear that many of the concerns raised in this chapter with regard to the expert witness and scientific expert evidence unfolded during the **Reay and Hope** trial. Throughout the lawsuit, notions of the expert as a hired gun; lack of witness impartiality; claims of poor methodology; allegations of fraud, incompetence and bias emerged. Further, notwithstanding the novel and complex nature of the scientific evidence, and the public health importance of the issues under consideration, there was an unwillingness to embrace new ideas; thus scientific dogma[55] and the legal system's acceptance of scientific 'universal determinism'[56] prevailed. Other factors identified by Lord Woolf in his Final Report (1996), in particular, polarisation of issues and inequality of finances/resources vis-a-vis plaintiffs/defendants were also apparent from the start of **Reay and Hope** proceedings.

Because of the numerous expert witnesses that took part in the trial, Chapter Four begins by providing a brief synopsis of the case (4.1), before moving on to a more detailed examination of the experts and scientific expert evidence. Scientific areas relevant to the **Reay and Hope** case include: Occupational Dosimetry (4.2); Environmental Dosimetry (4.3); Epidemiology (4.4); and Genetics (4.5).

---

[55] Please refer to Chapter 2(1).

[56] Please refer to Chapter 2(3).

4.1 SYNOPSIS - REAY AND HOPE v BRITISH NUCLEAR FUELS PLC

Having laid the foundations of the case in Chapter One by providing the reader with a brief history and examination of the public health concerns that surround the Sellafield Plant, Chapter Two moved on to an exploration of science and consideration of the construction of scientific knowledge before tackling the thorny problem of scientific and legal causation - all issues which at root are fundamental to our understanding of the difficulties that so often best a toxic tort or multi-action claim where science and law interact and where, as Chapter Three illustrated expert evidence is increasingly relied upon to provide a beacon of light through the quagmire of scientific uncertainty.

Expanding on the research in these previous chapters, this part of the thesis will provide an analysis of **Reay v. British Nuclear Fuels plc; Hope v. British Nuclear Fuels plc.** Underlying this analysis is the proposition that rationalization on the basis of precise empirical questions, premised on the supposition that causal relations are only ever one dimensional is no longer tenable. This proposition challenges not only the neutrality and impartiality of the facts presented as objective, but equally the objectivity and application of the rule of law in attempting to resolve the issues appertaining to those facts. Beginning with a synopsis of the case therefore, the following sections of this chapter will provide an in depth and detailed account of the substantive evidence that led the presiding judge to his ultimate conclusion.

The trial of the cases of Elizabeth Reay and Vivien Hope, commenced in October 1992 and concluded at the end of June 1993 (with Judgment being given in October 1993)

was one of the most interesting trials in English civil law. The trial lasted short of one hundred days and included the evidence of some thirty one expert witnesses (out of a possible seventy experts who produced reports[1]). The trial broke new ground on two fronts; it was the first time in this country that a personal injury claim had tested the concept of genetic damage from radiation, and the only time in a civil trial that a judge (in this case Mr. Justice French) had been allocated a barrister (Mr. Philip Nicol-Gent) to act as a full-time judicial assistant. Further, this trial was one of the first to endorse a satellite video link for examination of expert witnesses pursuant to Order 38, Rule 3.

The basis of the action of Elizabeth Reay against the defendants British Nuclear Fuels plc (BNFL) was a claim for damages under the Fatal Accidents Acts and Law Reform (Miscellaneous Provisions) Act 1934 in respect of trauma consequent on conception, birth and death of her daughter Dorothy[2] from leukaemia. The second plaintiff, Vivien

---

[1] According to Martyn Day (who was also the Plaintiffs' Solicitor in **Reay and Hope**) there were a total of forty five expert witnesses who gave evidence (Pugh and Day 1995:111). Relying on the transcript of the trial however, only thirty one experts appeared in court to give oral evidence. Excluded from these figures are Professor Gardner who died in 1993; Professor Nomura who was ill; Dr. Inskip who made a signed declaration under oath. Other experts included Dr. B. Lambert (Advisor) and Professor Ehling who submitted evidence under the Civil Evidence Act.

[2] Dorothy Reay was born on 8th October 1961 and died of 'early B-cell acute lymphoblastic leukaemia 5' (All) on 2nd September 1962. Leukaemia is a form of cancer of the blood or haemopietic system.

Jane Hope[3] claimed damages against BNFL for past and future suffering and disability consequent upon her lymphoma.

The core issues before the court were whether the plaintiffs could prove that the cause or a material contributory cause of firstly, Dorothy Reay's death from leukaemia, and secondly, Vivien Hope's NHL was ionising radiation emitted by the activities carried out at Sellafield in Cumbria by the Defendants and their predecessors (the United Kingdom Atomic Energy Authority [UKAEA]). By reason of statutory provision the Plaintiffs did not need to prove negligence. It was common ground that section 5(3) of the Atomic Energy Authority Act 1954, imposed upon the defendants (as successors to the UKAEA) a statutory liability attaching from 1st August 1954[4]. The fundamental issue therefore was causation.

The plaintiffs based their case on paternal preconception irradiation (PPI); in particular, the work of Professor M. Gardner, Head of the Medical Research Council Environmental Epidemiological Unit, University of Southampton[5] who suggested that the raised

---

[3] Vivien Jane Hope was born on the 10th May 1965 and was diagnosed in June 1988 (at the age of 23 years) of having non-Hodgkins lymphoma (NHL) Burkitt's lymphoma. Lymphoma is also a form of cancer of the blood or haemopietic system.

[4] As discussed in the Introduction (p.5), Section 5(3) imposed a statutory liability to ensure that no ionising radiation from anything on any premise occupied by the defendants, or from any waste discharged (in whatever form) on or from any premises occupied by them causes any hurt to any person or any damage to any property, whether he or it is on any such premises or elsewhere.

[5] Referred to in Chapter 1(3).

incidence of leukaemia and (to a lesser extent) non-Hodgkin's lymphoma among children near Sellafield was associated with paternal recorded dose of whole body penetrating radiation during employment at the Sellafield Plant before conception[6]. The fathers of both Dorothy Reay and Vivien Hope worked for many years at the nuclear plant and both families lived in the vicinity. They alleged that their fathers' exposure to ionising radiation resulted in mutation in the spermatagonia which as a consequence, caused a pre-disposition to leukaemia and/or NHL in the next generation.

At the outset of the trial it was made clear by Counsel for the plaintiffs that these cases had nothing to do with current debate or concern surrounding the issue of nuclear power and that the events highlighted during the trial took place several decades before (Day 1, p.3). At the time the plaintiffs' claim, there were ineffective and defective procedures and practices in place which resulted in the exposure of workers and residents close to the plant to unacceptably high doses of radiation.

The dispute between the parties therefore centred on four main areas: occupational dose (4.2), environmental dose (4.3); the epidemiology (4.4) and the genetics (4.5).

4.2 The Occupational Dose

The doses of ionising radiation received by George Reay and David Hope in the course of their employment with BNFL were clearly fundamental for both the defendants and

---

[6] For a wider discussion of Professor Gardner's findings in the context of other research into childhood cancer and nuclear installations, please refer back to Chapter 1(3).

plaintiffs. As far as the plaintiffs were concerned the importance of the total paternal radiation dose lay firstly in their wish to show the doses were sufficient to cause male parental gonad damage, and secondly, to demonstrate there was some correlation between the total radiation dose received by both fathers and the incidence of the two diseases as regards wider epidemiological support.

The defendants by contrast hoped to prove that firstly, the doses received by the fathers were insufficient to cause the alleged damage, and secondly, that the alleged correlation between the radiation dose and incidence of disease did not exist.

Clearly the problem of establishing total occupational paternal radiation dose 30-40 years after the event would prove complex. In the end the figures agreed upon with regard to photon dose, neutron dose, the internal dose assessment and the totals of those assessments over an entire period of employment in respect of the plaintiffs, as well as an evaluation of Reay and Hope's preconception exposure period of six months, three months and two months, were only agreed after much discussion and compromise between the parties[7] and only then, after a total re-examination of the figures which was required as a consequence of inaccurate information provided by BNFL to Professor Gardner[8].

---

[7] See Ch.4(2) for a wider discussion and analysis of this issue.

[8] Further discussion on the reasons behind BNFL supplying inaccurate information to Professor Gardner will be discussed in 4(2).

The final figures[9] agreed upon by the plaintiffs and defendants were presented to the Court on the fifth day of the trial by Dr. Rex Strong (Head of Environmental and Personnel Protection at the Sellafield site of BNFL). Although Dr. Lambert and Dr. Dennis agreed the figures on behalf of the plaintiffs, they were fully aware of the reservations expressed by Dr. Strong that the dose figures:

> ...are intended to be used by epidemiologists in this litigation who have a technical appreciation of the scientific limitation of the data and who are prepared to accept them in this light as being indicative rather than definitive[10]

Therefore, it was accepted by both parties that the dose figures only represented the 'best possible estimates' and were not clear cut or conclusive in their application to the epidemiological and genetic evidence.

4.3 The Environmental Dose

This factor relates to the environmental dose[11] received by Vivien Hope and Dorothy Reay and their families, as well as other residents of Seascale. The importance of environmental dose is again linked to the Gardner study, where excesses of leukaemia and NHL were found in the vicinity of the Seascale village which is situated two miles from the Sellafield plant.

---

[9] The final figures will be discussed in greater detail in the following section.

[10] Dr. Rex Strong cited by Mr. Justice French Judgment p.19.

[11] Not to be confused with background radiation naturally present in the atmosphere.

The plaintiffs submitted that in addition to the occupational doses already referred to, the defendants were also responsible for emissions of radiation from the Sellafield plant. The effect of this extra exposure was to provide a 'second hit' opportunity in respect of the emerging cancers which, as a multifactorial disease often requires two events or 'hits' before the condition is fully realised. The plaintiffs maintained that this other element could have acted somatically on the foetus in utero or on the child after birth, contributing to the development of cancer. This is irrespective of whether the initiating cause was PPI or some other unknown factor. The plaintiffs however elected to call no evidence on this issue, relying instead on the cross examination of the witnesses called on behalf of the defendants.

In contrast to the plaintiffs, the defendants called three witnesses. The first Dr. S.R. Jones, was at the time employed by BNFL as Head of Environmental Studies at the Sellafield site[12]. Dr. Jones produced a mathematical model known as the Sellafield Environmental Assessment Model (SEAM). The aim of this model was to calculate the doses to the various members of the two families of concentrations of different radionuclides in the environment. The second witness was Dr. R.J. Dickinson who was employed by BNFL as Business Planning and Technical Appraisal Manager of the Magnox Division. The purpose of calling Dr. Dickinson was to confirm various aspects of authorization procedures in respect of the BNFL discharges. The third witness was Dr. J.W. Stather employed by the National Radiological Protection Board (NRPB) as Assistant

---

[12] Dr. S.R. Jones later became Director of Environmental Research at the Westlakes Research Institute and Corporate Advisor to BNFL. He is also a visiting professor at Liverpool University.

Director of the Environmental Measurements Department and the Non-ionising Radiation Department who, following the screening of the Yorkshire Television Programme "Windscale - the Nuclear Laundry"[13] was given responsibility by the NRPB for quantifying the dose assessment and radiation risk to children and young persons at Seascale and also for preparing a report for the Black Advisory group on the topic. His report to the Court was mainly to reiterate the findings he had made earlier and apply them to the Reay and Hope families.

4.4 The Epidemiology

The epidemiological evidence, in particular the study carried out by Professor Gardner and his team provided the foundation for the plaintiffs' case. As already discussed, Professor Gardner's 1990 study centred around an excess of leukaemia, NHL and other cancers in west Cumbria and in the neighbourhood of the Sellafield plant. The Gardner team examined cases occurring in young people born in the area and diagnosed there between 1950-1985 under the age of 25. An account of that study together with its findings were published in two papers in the British Medical Journal (BMJ)[14].

---

[13] See Ch. 1 for further details on this programme.

[14] Gardner, N.J. et al. British Medical Journal 300, 423-429 (1990). The first paper was headed "Results of case control study of leukaemia and lymphoma among young people near Sellafield nuclear plant in west Cumbria". The second paper was headed "Methods and basic data of case-control study of leukaemia and lymphomas among young people near Sellafield nuclear plant in west Cumbria".

Since its publication the Gardner report has been reworked by others[15] than Professor Gardner on no less than three occasions. Despite these changes however the Gardner report (with subsequent amendments) still remains central to the case[16].

The plaintiffs maintained that the Gardner Study demonstrated a significant association between the excess of leukaemias around Sellafield and PPI; that the data on which Gardner based his findings when re-analyzed continued to support that association; and that when the Bradford-Hill criteria (discussed in Chapter Two) are applied to the association, causation is proved on the balance of probabilities.

The defendants made it clear in their submission that it was for the plaintiffs to establish on the balance of probabilities that ionising radiation resulting from the operation of BNFL (or its predecessors - UKAEA[17]) at Sellafield was the cause, or a material contributory cause of the plaintiffs' diseases, it was not enough therefore to show that ionising radiation 'enhanced the risks' of those diseases. The defendants[18] went on to identify what they

---

[15] In particular Dr. Stephen Evans, Royal London Hospital who took over the work when Professor Gardner became ill and sadly died of lung cancer in January 1993.

[16] Witnesses called in respect of the plaintiffs include Dr. Stephen Evans (who recalculated the Gardner Study); Dr. K.J.Kopecky; Dr. E. Alberman; Professor D.C. Thomas; Professor D.A. Savitz; Professor N.E. Day.

[17] See Chapter 1(1) for more information on the history and background of Sellafield.

[18] Witnesses called on behalf of the defendants include: Dr. K. Macrae; Dr. R. Wakeford; Professor G. Howe; Professor A.C. Upton; Professor W.J. Schull; Professor B. Macmahon; Professor Sir Richard Doll.

regarded as methodological shortcomings in the Gardner Study. Included in their criticisms were: the small number of cancer cases involved in the study; the limited geographical location of the study; the concentration on the Seascale cases[19]; the inclusion of one particular case (the Bristol case) which they maintain should not have been included[20]; the inability of Gardner to explain the Seascale leukaemia and lymphoma excesses; the failure of the study to satisfy the Bradford Hill criteria. In their evidence the defendants relied on a number of epidemiological studies[21] discussed in greater detail in Chapter 4(4).

4.5 The Genetics

The plaintiffs maintained that although it was not necessary in law for them to prove either that the Gardner hypothesis was biologically possible or plausible (as their case relied on the epidemiological evidence and should therefore only be displaced by a clear demonstration that the cause and effect they claimed was impossible), the plaintiffs were nonetheless able to call experts to identify a probable biological mechanism whereby a plausible biological pathway could be identified, and where as a consequence radiation emitted by, or from the Sellafield Plant, could have caused or materially contributed to

---

[19] The issue of sub-group analyses (concentrating on those cases born and diagnosed in Seascale rather than examining all the cases diagnosed in west Cumbria) proved particularly contentious later on in the trial. For further discussion on this aspect please refer to 4(4).

[20] See Chapter 4(3) for a wider discussion of this issue.

[21] These will be considered in greater detail in Ch.4(4). Of particular importance are: Urquhart, (1991); Kinlen, (1991), (1993); Roman, (1993); Craft, (1993); Draper, (1993); Parker/Wakeford (1993).

one or both of the diseases. Therefore, in the opinion of the plaintiffs, irradiation of paternal gonads could cause a transferable mutation in the germ line which resulted in a predisposition to cancer (leukaemia and NHL) in the children. The only remaining issue was whether the numbers involved in the Seascale excess could also be explained by this predisposition.

In support of their case the plaintiffs began by calling Professor M.F. Greaves, Director of the Leukaemia Research Fund Centre at the Institute of Cancer Research. Professor Greaves supported the proposition that there was a plausible biological mechanism based on paternal irradiation and viruses which could explain the Seascale excess[22].

Developing their case further the plaintiffs then moved on to research data from mouse experiments and in particular, the work of Professor Nomura (Chairman of the Department of Radiation Biology, Osaka University, Japan). One of the central findings of Professor Nomura's work was an excess of tumours found in the offspring of mice that had been subjected to specific doses of ionising radiation[23]. Professor Nomura, although able to provide two written reports to the court, was unable to attend the trial due to ill health[24]. In order to overcome this problem the defendants did suggest the setting up

---

[22] The plaintiffs also called Professor J.C. Neil as further support.

[23] Nomura, T. "Quantitative Studies on Mutagenesis, Teratogenesis and Carcinogenesis in Mice" (1984) pp.27-34, JEMS, Mishima.

[24] Professor Nomura's evidence was therefore subject to a Civil Evidence Act Notice, allowable in circumstances where there are good reasons for non-attendance.

of a video link between London and Osaka, thereby enabling Professor Nomura to defend his studies in person[25]. However, in the event, given the circumstances and length of time anticipated for Professor Nomura's evidence, a London/Japan video link was not considered appropriate or realistic by the plaintiffs.

In addition, the plaintiffs relied on the evidence of Dr. Roger Cox (Head of the Biomedical Effects Department at the NRPB and Consultant to the United Nations Scientific Committee on the Effects of Atomic Radiation) who put forward three possible novel and speculative mechanisms[26]. Underlying Dr. Cox's evidence was the belief that the Gardner hypothesis could not be explained on the basis of conventional genetics, a view shared by Professor D.H. Wright, Chair of Pathology, Southampton; Professor M. Meuth, Chair of Radiology and Head of Section of Experimental Oncology, University of Utah; and Dr. J. Thacker, Head of DNA Repair and Mutagenesis Group at the Medical Research Council's Radiology Unit. These experts called on behalf of the plaintiffs, all agreed that too little was known about the mutation rates of complex illnesses such as cancer. It was therefore unacceptable to simply reject unconventional genetic data or conversely rely on conventional genetic data.

The defendants while not assuming any burden of proof, were keen to demonstrate the

---

[25] Having already made an order for examination of a witness in Canada via a video link pursuant to order 38 rule 3 which proved unnecessary, Mr. Justice French further agreed to support a video link from London to Japan.

[26] These include "transposons", telomere-like repeats" and "fragile sites", also "genomic imprinting". See Ch. 4(5) for more detail and explanation on this aspect of the case.

implausibility of the existence of a biological pathway whereby PPI could predispose the next generation to leukaemia and/or NHL. In submitting their evidence the defendants relied on three main areas of supportive research which included: the A-bomb studies, a rejection of the mouse data, and the absence of a heritable component in leukaemia. Important to the defendants' case was the evidence of Professor E.J. Hall; Dr. P Selby; Professor A.B. Dickinson; Professor J.V. Neel[27]; and Professor H.J. Evans; all renowned experts in their own area of genetics.

However of particular significance to the defendants (at this point of the trial) was the evidence of the mouse geneticist - Dr. P. Selby, on the work of Professor Nomura. Throughout his evidence which took two full days in chief, Dr. Selby alleged anomalies, inaccuracies and inconsistencies in the research of Professor Nomura resulting in his conclusion that the work could not be taken at face value and could not be relied on.

Having provided a brief synopsis of the case, the following sections will concentrate on an analysis of the expert evidence with regard to occupational and environmental dosimetry 4(2) and (3); epidemiology (4.4); and genetics 4(5). At the core of this chapter, as with previous ones, are the underlying concerns relating to epistemology; scientific uncertainty; scientific causation and causation in the law.

---

[27] Professor J.V. Neel gave evidence on the A-bomb studies (Day 55 and 56) and on the mouse data (Day 83).

4.2 OCCUPATIONAL DOSIMETRY

Moving on from the synopsis of the case, this section is concerned with occupational dosimetry[28] and in particular, whether the doses received by Reay and Hope were sufficient to cause male parental gonad damage. Intrinsic to this litigation therefore is not only the problem of establishing Reay and Hope's annual occupational dose so many years after the event, but also, the accuracy, reliability and foundation upon which such figures are based.

The purpose of measuring occupational dose is twofold, first it enables an individual who has been exposed to acute/chronic high doses of radiation to be withdrawn from a task or area. Second, it facilitates 'safe' occupational levels of radiation to be identified thereby ensuring employee dose recording and monitoring are kept within national and international guidelines. As a consequence, a worker's estimated life time exposure can be evaluated to ensure he does not exceed recommended safety levels.

In order to ascertain the occupational dose absorbed by George Reay and David Hope we are concerned with an exposure period of some fourteen years (beginning forty one years ago, and ending twenty seven years later). During this time Reay and Hope were employed as fitters at the Sellafield Plant, their duties involved the routine maintenance

---

[28] Occupational dosimetry comprises of 'external doses' from gamma and neutron radiation which can be measured by dose badges and other equipment, as well as 'internal doses' from alpha radionuclides via ingestion or inhalation pathways which rely on urine or faecal analysis. Both external and internal occupational doses have to be taken into account in any assessment of total occupational radiation dose.

and machinery. Both men worked on the piles (chimneys)[29], as well as in the d decanning areas[30] and both were exposed to high doses of radioactivity Day 1, p.6).

easuring the external occupational dose of workers employed at the Sellafield defendants relied on the use of film badges. Film badges were used because in the form of electromagnetic waves[31] will blacken or cloud over a phic film, and through means of calibration (measuring the level of radioactivity tensity of clouding) the amount of radiation can then be assessed. Further, it is ible applying this method, and using the same badge, to cover part of the film

---

[29] George Reay in particular worked on the pile roof. His job involved assisting in the removal of any burst cartridges (identified by the control room monitoring equipment detecting the release of radioactive gasses in the piles). During the removal of the necessary manhole covers and plugs (the biological shield to the core), Reay would find himself straddled at the top of a vertical void which would be streaming radioactive rays (neutrons and particles) before being lowered into the identified channel itself to specifically locate and dislodge the burst/leaking cartridge.

[30] Once dislodged the fuel cartridges would end up in the two pile ponds for approximately sixty to one hundred days 'cooling' before being decanned (the decanning bay was at the side of the ponds). The purpose of the decanning machine was to remove the aluminium cartridge cases from the uranium containing all the plutonium and other fission product. The fuel thereafter was despatched in sealed coffins to the separation plant. David Hope in particular spent 75% of his time in the ponds between 1956 until 1959. After promotion in 1959, 95% of his time was spent in the pond area. The ponds and the decanning bays were highly radioactive. Hope would often find himself wading into the water in the decanning section of the ponds and therefore subject to high doses of radiation.

[31] That is gamma and X-rays (photons), and particles such as beta particles or neutrons.

with a filter and in so doing, differentiate between different types of radiation.

Although the basic design of the film badge did not alter in this period[32], 1960 did see a change in the photographic film (from Ilford PM to Kodak RM) and filters (from lead/aluminium to tin/cadmium). It was as a consequence of these changes in the 1960s that what became known as "The Howells Factor" became identified by the plaintiffs' solicitors.

While going through the discovery documents, the plaintiffs' solicitors came across a report by Mr. Huw Howells, Head of Health and Safety at the Sellafield plant during the 1950s and 1960s. From the documents it was apparent that the managers of the plant were concerned by the disparity in recording as between the old Ilford film and newly introduced Kodak film and asked Mr. Howells to investigate. As a consequence of Mr. Howells' research it became clear that not only had the Ilford film been under-recording, in some instances by as much as 50 to 100 per cent, but also, the Kodak film in use at the time was possibly under-recording by up to 30 per cent[33].

Mr. Howells made a number of recommendations, the first related to the historic

---

[32] The film badge consisted of a 0.015 inch thick tin plate holder within which was wrapped photographic film. The holder had two open windows at the front and one similar window at the back corresponding with one of the two at the front. Inside in the unexposed area there were one or two filters.

[33] Two years after the Howells Report in 1962, a further report - the McKinnon Report concluded that the gamma recording on the Kodak RM film may have been actually over-recording. This was disputed at the time and the matter lay unresolved.

inaccuracy of workers' dose. He suggested that past employee records should not be altered, instead a note should be added to the employees' current records "giving a clear indication that the doses had been measured with the old Ilford film, and that a correction factor should be added to the Kodak badges in the future" (Hytner, Day 1, p.16). In respect of the possible under-recording of the Kodak film in use from 1960, Mr. Howells recommended investigations to find a suitable new filter. He pointed out that "the film badge is the prime arbiter of radiation control and while the accuracy of this is in doubt long-term exposure control is uncertain so that there is an urgency to exert considerable effort in solving this technical problem" (Ibid).

When going through the records of the late George Reay and David Hope it became clear to the plaintiffs' solicitors that the Dosimetry Service at Sellafield had only inserted their annual dosage; no amendment had ever been made to take account of the 'Howells Factor'. This meant that not only were the men exposed to far higher doses of radiation than was initially realised, but also, the whole basis of Gardner was now under question as the Gardner team had based their original research on inaccurate dose figures as supplied by BNFL. Because of this, the case fathers'[34] exposure levels were found to be higher than the control group, necessitating an entire re-working of the Gardner Study.

---

[34] Vivien Hope was not included in the original Gardner Study because she was born and brought up until the age of six in Drigg, two miles south of Seascale and therefore did not satisfy the criteria of being born and diagnosed in Seascale. Further, she was not diagnosed until 1988. The study period only went up to 1984.

Another problem identified by the plaintiffs' solicitors at this time related to the placement of employee film badges. Often, in addition to chest badges, certain workers were also issued with 'special' badges worn elsewhere[35]. Of significance to the plaintiffs' solicitors were the dose badges worn on the waist by Reay and Hope. Clearly waist badges could give a far more accurate reading in relation to the gonads and potential pre-conception dose than chest badges, this was another factor for consideration in the re-analysis.

As a consequence of these findings, Mr. Hytner QC in his opening statement on behalf of the plaintiffs, accused the defendants of having what he termed a 'cavalier approach'. Taking the issue further Mr. Hytner went on to say that:

> ...throughout this case, not only in relation to this [occupational dosimetry], but also in relation to other doses and other discharges, the Defendants do not appear to have taken with as much seriousness as befitted them the accuracy of the information they were passing on to others about dose.
>
> My Lord, they knew from their own safety expert that they had been under-recording doses, in the case of neutrons not recording them at all, and yet they gave inaccurate figures to Professor Gardner and they did not inform their workforce.
>
> My Lord, this is the first example of many we shall be coming to in the case where it can be shown that the Defendants either did not know what they were doing, where co-ordination in relation to discharges and exposure were inadequate, and they were somewhat cavalier in their approach to the accuracy of the information they gave others. (Day 1, p.17-18)

Although this assertion was both challenged and denied by Mr. Rokison QC on behalf of the defendants, it was nonetheless accepted that the occupational dosimetry figures were unreliable and inaccurate. Consequently a re-assessment of workers' occupational dose,

---

[35] In particular hand or waist.

in addition to a re-analysis of the Gardner Study was required.

The plaintiffs' solicitors having realised the enormity of the task ahead of them as well as the significance of their findings, contacted the NRPB (as an independent advisory body) to discuss the implications of this discovery, as well as request help with the occupational dose re-assessment. In response, Mr. G. Webb, Secretary of the NRPB contacted the plaintiffs' solicitors informing them that as two of their officers had already been instructed by BNFL (on the environmental dosimetry side of the case), the Board decided it would be inappropriate for another one of their officers to represent the plaintiffs' side. As far as the plaintiffs' solicitors were concerned this rejection confirmed their suspicions that the NRPB were not independent from BNFL, and that on this occasion, they were working against the public interest. NRPB's refusal was therefore viewed by the plaintiffs' solicitors as deliberately obstructive.

After further negotiation and discussion with the plaintiffs' solicitors the NRPB although still refusing to help directly, did finally recommend a retired expert named Dr. John Dennis who, prior to retirement had been a former employee of the NRPB. Despite this concession however the issue of the neutrality of the NRPB as an independent public body appeared open to question, particularly in light of evidence[36] given to the House of Commons Select Committee on Radioactive Waste where the NRPB identified their public role as one where:

---

[36] Webb, G.A.M. Hill, M.D. O'Riordan, M. Smith, H.and Shaw, K. "Radioactive Effluents and Solid Wastes: A Summary of NRPB Work on Standards, Assessments and Research" March 1985 pp.197-219.

(i) it provides guidance on the radiological protection **standards** to be applied;

(ii) it performs **assessments and predictive calculations,** using mathematical models of the potential risks to people;

(iii) it carries out **research** into environmental transfer processes and radiation dosimetry;

(iv) it provides **advice** to Government Departments, the nuclear industry, and other organisations, on radiological protection (Webb et al; 1985:198).

Aware of the implications and inequity of this situation, Mr. Hytner QC on behalf of the plaintiffs sought to elucidate the inherently problematic nature of NRPB's position when he said:

> The NRPB is a body independent of Government and industry, though lacking statutory powers similar to those of the Health and Safety Executive. Whilst it might be unjustifiably hurtful to suggest, using the language now in vogue in commercial circles, they are in bed with the defendants, it is the plaintiffs' case that partial explanations for some of the events with which we shall be dealing may be found in the fact that they are at least very close friends. Certainly NRPB have shown little enthusiasm to assist the plaintiffs in the fields of dosimetry in this litigation (Hytner: Day 1, p.22)

In the event and despite the issue of NRPB's neutrality and BNFL's public accountability, agreement was reached[37]. After two further exchange of expert reports, re-assessment of the external occupational doses were finalised by Day 4, and presented to the court on Day 5 by Dr. Rex Strong on behalf of the defendants[38], having been agreed by Dr. John

---

[37] The agreement consisted of an increase from the original 117 cases and controls that appeared in the Gardner Study to a total of 159 individuals (an additional 41 workers including Reay and Hope).

[38] Those involved in the reassessment on behalf of the defendants included Dr. R. Strong (BNFL); Mr. Harvey (Freelance Consultant); Dr. Avery and Mr. Gibson (UKAEA). The statement dated 5th November 1992 contained four tables. Table 1 set out the photon dose assessment; table 2 the neutron dose; table 3 the internal dose assessment and table 4 the totals of those assessments.

Dennis and Dr. Barry Lambert on behalf of the plaintiffs.

Taking account of overall occupational exposure, the plaintiffs assessed the actual total pre-conception doses as:

Reay - 709 mSv Hope - 294 mSv

These figures contrast sharply with the defendants' original figures of:

Reay - 384 mSv Hope - 160 mSv

or the defendants' amended figures of:

Reay - 639 mSv Hope - 246 mSv

(Hytner, Day 1,p.19).

Although Dr. Strong made it clear that the amended figures could only be regarded as joint 'best estimates' of the doses received and should therefore not be treated as definitive, there is no doubt that potential health effects[39] of exposure rates of between 600-700 mSv (0.5 to 1.5 sievert) could cause: long term, possible benign or malignant tumours; premature ageing; shortened lifespan; genetic damage; or, in the case of exposure levels of between 200-300 mSv (0.1 to 0.5 sieverts) premature ageing; genetic effects; and some risks of tumours (Bertell, 1985:42-43).

In addition to external occupational exposure, working at the plant also subjected employees such as Reay and Hope to the inhalation of radioactive particles in the air or through ingestion. Unfortunately, the 1950s and 1960s saw little monitoring of this

[39] See Chapter 1(2) for a wider discussion of the potential health effects of ionising radiation.

internal occupational exposure[40], it is for this reason that the plaintiffs, for the purposes of this issue alone, were willing to proceed on the basis of the defendants' alpha figures of between 0 and 1 mSv for Reay, and 0.85 for Hope.

Throughout this first part of the case the plaintiffs hoped to prove that the contribution of occupational exposure in relation to the total paternal doses was (a) sufficient to damage male parental gonads and (b) there was some correlation as between the dose amount and the incidence of the two diseases.

In their Opening therefore, the plaintiffs set out the history of the dose debate and the importance of the discovery process in highlighting the defendants' complacency and cavalier approach as regards their employees, government departments and the public. In particular, their failure to keep accurate records; inform their workforce of correct exposure levels; respond to recommendations from their own Health and Safety Advisor; provide accurate dosimetry figures to Professor Gardner.

In addition, Mr. Hytner pointed out that the defendants had been on terms which were too friendly with NRPB for each to fulfil their distinct and independent role with the result that there had been a failure to protect certain sections of the population, or inform them as to the full extent of their exposure levels. In the opinion of the plaintiffs therefore, the defendants' evidence should be treated with caution and suspicion.

---

[40] Post 1960s the traditional method for assessing the internal occupational dose would be through the monitoring of alpha of fission products in workers faeces or urine.

The defendants by contrast hoped to establish that the contribution of the occupational dose as regards the total paternal dose was (a) insufficient to cause the alleged damage to the gonads and further (b) that there was no correlation as between the amount of dose and the incidents of the two diseases.

In their Opening, Mr. Rokison QC on behalf of the defendants emphatically denied the plaintiffs' allegation of adopting a cavalier approach and made it clear that this assertion was resented by BNFL. In defending their position in respect of inadequate record keeping, Mr. Rokison said that "there had been the most exhaustive examination in the course of the discovery process and otherwise to seek out relevant records. It is perhaps not surprising that some potentially relevant records or other documents have not been located" (Rokison:Day 2, p.4).

On the issue of the 'Howells Factor', Dr. R. Strong on behalf of the defendants agreed under cross examination by Mr. Hytner QC that occupational doses in respect of 78 workers had gone up[41], and of that number 15 had gone up by more than 50 per cent, six by more than 100 per cent (Strong: Day 5,pp.5-6). Dr. Strong also agreed that had it not been for the discovery process in this litigation the historical information in respect of the 'Howells Factor' would not have come to his attention (Day 5, p.7). In challenging Mr. Hytner's cross examination of the defendants' witness on this matter, Mr. Rokison pointed out that occupational figures had now been agreed by the two parties and that bringing up this issue after agreement was simply perpetuating the prejudice already

[41] The dose of 15 workers also went down in relation to external doses.

exhibited in Mr. Hytner's Opening Statement, a view not wholly shared by Mr. Justice French who when asked to rule on this matter said, "the fact that cross-examination goes in some way to prejudice is no grounds for excluding it" (Day 5, p.11).

With regard to NRPB's relationship with BNFL, Dr. Stather on behalf of the defendants emphasised that the NRPB were an independent advisory body which despite having close working contact with individuals in BNFL, jealously guarded their independence (Stather: Day 7, p.73). Nonetheless, Dr. Stather did admit that as NRPB did not have expertise on discharges from nuclear sites, they had to rely on the operator to provide them with information (Day 7, p.74).

It is clear that a number of concerns relating to the trial process emerge from this part of the case. The first concerns the reliability and accuracy of the dose figures. Although Mr. Rokison on behalf of the defendants pointed out that a lot of work had been done in relation to the Reay and Hope cases in order to try and get the doses as precise as possible, it was acknowledged by both the plaintiffs and defendants that the occupational doses were subject to random error and therefore a degree of uncertainty. There were in total three separate analyses of dose. First there were the doses used by the Gardner team. Second there was a reassessment of doses done by Dr. Dennis as a consequence of the 'Howells Factor'. Third there was a re-analysis of the doses by Professor Stephen Evans and Professor Howe which formed the bases of the agreed statement presented to the court by Dr. Rex Strong on behalf of the defendants, as agreed by plaintiff experts, Dr. Dennis and Dr. Lambert.

Notwithstanding the uncertainty and unreliability of the figures, and the recognition by plaintiffs' Counsel that the occupational dose provided "the bedrock on which both sides' cases rested" (Hytner: Day 1, p.84), it is significant, as Mr. Rokison pointed out on behalf of the defendants, that the plaintiffs' experts made a number of concessions with regard to this issue (Day 2, p.6D). Possibly the reason behind these concessions can be explained by the second concern, inequality of resources, for while defendant experts had access to specialised manpower and unlimited resources, enabling analyses of enormous quantities of information relevant to the case, as well as having access to powerful computer software, such resources were clearly not available to the plaintiffs. (A situation recognized by Lord Woolf in his Final Report (1996:146) in which he acknowledged the importance of a level playing field between litigants to ensure a 'just' result).

In addition to the 'David and Goliath' component, an added resource pressure could also be found in the 'public purse factor'. Both plaintiffs and defendants were aware of the extra costs in money and time of delay, as Mr. Justice French said in his judgment:

> By far the largest element in computing the total paternal radiation dose received by individuals is the occupational dose ie that received while at work at the Sellafield plant. Had the occupational doses remained in contention it would have occupied the court for many weeks, even months[42]

Mr. Justice French, commending the occupational dose agreement, went on to say that with eminent good sense, the parties' settlement rendered any type of forensic exercise in respect of occupational dosimetry unnecessary.

---

[42] Judgment p.17.

Linked to the other issues, and of particular importance to the plaintiffs, is the third problem of securing the services of independent expert witnesses[43]. This proves difficult where corporations like BNFL and "close friends" like the NRPB have in-house experts that dominate the field under investigation making any independent expert opinion very difficult to obtain. On this issue, the plaintiffs' experts were few as a consequence of the stance adopted by the NRPB with the result that, upon reaching agreement with the defendants, the plaintiffs called no witnesses on their own account. This is despite Dr. Strong, on behalf of the defendants, playing down BNFL's responsibility over the 'Howells Factor' and denying any suggestion that BNFL were cavalier in their approach.

A final concern which emanated from the discovery process was the realisation that the plaintiffs' solicitors were possibly the only people who had actually studied BNFL's documents in any depth. The NRPB and other regulatory bodies, it seemed, accepted BNFL's historic dose assessments without challenge. This aspect perhaps more than any other highlights the public importance of toxic tort cases and again brings into question the traditional view of the tort of negligence, perceived as it is in purely individualistic terms, reiterating the point raised by Rosenberg (1984)[44], that any non-utilitarian view of toxic tort claims is a misconception of the social function of the tort system and negates the collective interest that now exists in such litigation.

Having reviewed the issues in respect of occupational dosimetry, the next section will

---

[43] Refer to Chapter 3 for a wider discussion on this issue.

[44] Please refer to Chapter 2(3).

move on to consider environmental dosimetry and the impact this has had on workers and local population around the Sellafield plant.

4.3 ENVIRONMENTAL DOSIMETRY

In addition to the occupational doses which were the subject of agreement between the parties, it was also necessary for the Court to hear evidence and submissions on the subject of environmental doses emitted by and from the Sellafield plant in respect of the plaintiffs, their families, and the local population as a consequence of the defendants' activities[45]. According to Mr. Hytner QC on behalf of the plaintiffs, it should be emphasised that not only were the Gardner excesses associated with paternal occupational dose, they were also heavily concentrated in the village of Seascale, two miles from the plant (Day 1, p.19).

Therefore the plaintiffs asserted (a) that environmental dose enhances the PPI received by way of occupational irradiation (b) that environmental dose augments the natural background radiation level providing a 'second hit' opportunity for cancer which, as a multifactorial disease may require one or two 'hits' before emerging and expressing itself. So, regardless of whether the initiating 'first hit' was PPI, or, some other unknown cause, environmental radioactive discharges emitted from the Sellafield plant could, in combination with natural background radiation levels, act somatically on the foetus in utero or on the child after it is born to cause/promote cancer at a later stage.

While the plaintiffs were not suggesting that environmental dose was enough on its own to cause the leukaemia and NHL of Dorothy Reay and Vivien Hope, they were proposing

---

[45] Environmental dose emitted from the Sellafield Plant is not to be confused with background radiation naturally present in the atmosphere for which the Defendants are not responsible.

a possible synergism, that is an inter-reaction with either occupational dose or some other factor. Thus despite the uncertainty over dose figures and the fact, as Mr. Hytner acknowledged, that it was impossible to gauge with any accuracy the extent of the Sellafield radioactive emissions over the years[46], it was nonetheless probable that the estimated environmental doses were considerably higher than those calculated by the defendants. Mr. Hytner went on to make it clear "that any uncertainty in relation to environmental dose rebounds to the disadvantage of the defendants, at whose door in any event blame for the uncertainty lies" (Day 1,p.21).

In his introduction to this part of the case, Mr. Hytner began by briefly outlining the historic roles of various bodies (the NRPB; the ICRP; the Black Committee; COMARE). However, of particular concern to the plaintiffs at this stage of proceedings were events ensuing the Yorkshire Television programme of 1983 and the setting up of the Black Committee of the same year.

As discussed in Chapter 1(3), the Black Committee were asked to consider exposure of children through the atmospheric discharges from the Sellafield piles and the great pipe into the Irish Sea. In order to complete this research, the Black Committee turned to the NRPB to carry out analyses of the radiation doses received by the Seascale children. Having accepted the defendants' estimates of the atmospheric discharges, the NRPB produced document R171 based on the information supplied from BNFL. This stated

---

[46] Specifically the relevant period up to 1962 in the case of Dorothy Reay and, 1988 in the case of Vivien Hope.

that the maximum dose to the children would be 5 mSv representing only 10 per cent of the doses they received from background radiation levels.

Therefore, while confirming the existence of an excess of childhood leukaemia in the village of Seascale, the report concluded that the 'best estimate' of the average radiation dose did not support the view that radiation from Sellafield was responsible for the observed excess of leukaemia. However, the Black Committee did recommend further research on this issue[47] and, in addition, the setting up of COMARE[48] to measure doses actually received by members of the public in west Cumbria and the relevant areas.

Two years after the publication of the Black Committee Report of 1984, COMARE reconsidered the Sellafield discharges of the 1950s, this time taking account of the allegations made by Dr. Derek Jakeman. Dr. Jakeman (who was abroad during the process of the Black inquiry) had, prior to his position with UKAEA, been employed as a scientist actively researching into radioactive emissions at the Sellafield plant during the 1950s.

Upon returning to the UK and having read the findings of the Black Committee Report and NRPB document R171, Dr. Jakeman challenged the low levels of radioactive emissions cited in both reports. Of particular concern were the underestimated uranium

---

[47] Culminating in the Gardner Study.

[48] COMARE was established in 1985. See Chapter 1(3) for more information on this development.

oxide levels[49] of 440 grams which formed part of the calculation of radiation dose received by people living in the local community as well as statistical errors in assessing the release from environmental monitoring data[50].

In an attempt to draw attention to this matter, Dr. Jakeman wrote to BNFL, the NRPB and the British Medical Journal, pointing out that:

> The release....was substantial, consisting of thousands of millions of highly radioactive particles (Jakeman 1986:760).

Dr. Jakeman went to say that despite large numbers of the radioactive particles being found in the gardens and homes of local residents in 1955, no attempt was made to trace the full extent of the radioactivity, or the impact on the foodchain until July 1957.

As a consequence of Dr. Jakeman's protestations, the 440 grams were increased by a factor of 45 over that in the NRPB R171 report to 20 kilograms[51]. Thus in a further report in 1986 (the R171 Addendum), the NRPB concluded that the 1950s overall discharge dose figures should be increased by ten per cent. Observations made by COMARE in consideration of the R171 Addendum said that:

---

[49] In order to identify particles of uranium oxide it is necessary to ascertain the levels of Ceasium 137 and Strontium 90, two isotopes produced during the changing of uranium to plutonium, as well as levels of plutonium around the local environment.

[50] This methodological flaw became known as "The Jakeman Factor", it includes: chemical analysis; measurement; interpretation of migrating and leaching (dissolving) of radioactive particles.

[51] This figure was a compromise between the figure of 12 kilograms put forward by or on behalf of the defendants, and 30 kilograms put forward by Dr. Jakeman.

> The way in which some of these data came to light is unsatisfactory and undermines our confidence in the adequacy and completeness of the available data. Although we accept that every reasonable effort has been made to ensure completeness of the information now available to us, we feel the monitoring programme and record keeping for the 1950s were such that we cannot be certain that all releases have been recognised (Day 1, p.23).

In support of this view and by way of illustration, the plaintiffs cited iodine, plutonium and argon 41 as examples where uncertainty over discharges still remain[52].

Iodine was highlighted because it only has a half life of eight days before being concentrated in the human thyroid. As a consequence no data exists on discharges of this period.

Plutonium[53] was specifically identified as during this time vast quantities of plutonium were released through the B204 stacks at the separation plant into the environment. Under cross-examination by Mr. Hytner on behalf of the plaintiffs, Professor S.R. Jones, an employee of BNFL and currently Director of Environmental Research at the Westlakes Research Institute[54] confirmed the fact that the B204 stacks had come on stream in 1952 and that in the twelve years prior to 1964 no specific monitoring of plutonium

---

[52] Other examples include polonium, caesium and strontium. The plaintiffs demonstrated identifiable flaws in the defendants methods of collecting and evaluating data (Hytner: Day 1,p.30).

[53] Plutonium is dangerous if inhaled or ingested either directly or through the food chain. Measuring the amount of plutonium at ground level also offers an indirect method of assessing the amount of uranium oxide in the atmosphere. In addition further external exposure comes from gamma radiation and other radionuclides.

[54] Westlakes Research Institute is funded by BNFL.

levels had ever been undertaken (Day 6 p.27F). As a consequence said Mr. Hytner, "we do not know the years when it was discharged, so who was breathing it in, who was ingesting it, nor do we know the wind conditions which may have caused it to be resuspended and when, so that it would be again inhaled or ingested by the population" (Day 11 p.21E). In the event BNFL accepted that the level of plutonium released by Sellafield was twenty times more than had previously been accepted by the company[55].

A third example of discharge uncertainty relates to Argon 41 which, although having a relatively short radioactive half life of 1.8 hours, can nonetheless be inhaled. Argon 41 was emitted between 1951 and 1957 without any monitoring and it was only with the publication of the R171 Addendum that the estimated Argon 41 figures, which appeared in the original R171 Report were revised and, as a consequence increased by 70 per cent. (Day 6, p.24H).

Underlying the problem of incomplete and inadequate data, Mr. Hytner was also keen to demonstrate the possibility that the defendants may have missed or failed to identify other unaccounted for radioactive discharges or releases. Referring to disclosure, and the fact that BNFL had agreed to supply all documentation by September 1991, Mr. Hytner pointed out that had it not been for Leigh Day Solicitors' Court Order for further

---

[55] As late as 1985, a paper by Professor Popplewell, 'Plutonium in Autopsy Tissues in Great Britain' to the NRPB found up to a six-fold increase in plutonium "body burden" in local inhabitants around Seascale.

discovery in 1992[56], discrepancies in the plutonium and other release figures would not have come to light at all. As far as the plaintiffs were concerned, this was a further example[57] of an occasion where discovery produced monitoring information which neither the defendants nor any other agency seemed aware of.

Another inconsistency that showed itself as a consequence of information supplied by BNFL related to historic discharge figures in respect of BNFL's 'discharge authorization application'. Plaintiffs' solicitors discovered that the historic figures that appeared in the Government application, did not correlate with the historic discharge figures produced for the Court by Professor Jones on behalf of BNFL. Dr. Dickinson, an employee responsible for authorization applications on behalf of the defendants was obliged to concede that certain factors had not been taken into account, and that this omission would make the emission figures for 1977-1987 appear four times lower than in fact they had been (Hytner Day 7, 64C).

Throughout this part of the case the plaintiffs made the tactical decision not to call any expert witnesses on their own behalf and instead to rely on the defendants' experts to highlight the fact that BNFL "never see their mistakes, they never apologise, they self justify" (Hytner: Day 11, p.1D). In their submission on environmental dose, Mr. Hytner

---

[56] The was the eighth Affidavit issued by Leigh Day Solicitors. The Affidavit set out their concerns with regard to the historic plutonium releases and specifically requested details in relation to B204, the plutonium separation plant.

[57] "The Howells Factor" identified in the previous section with regard to occupational dosimetry provided another such example.

on behalf of the plaintiffs, emphasized that BNFL made persistent errors due to complacency, over confidence and defensiveness (Day 11,p.10B), that the public and public bodies[58] had been misled (Day 11,p.22F), and that this careless (Day 11, p.73G) and cavalier approach in respect of unaccounted for emissions, as well as the extent of those emissions, would not have come to light had it not been for the documents disclosed on discovery.

As far as the defendants were concerned they called three expert witnesses, Professor S.R. Jones, Dr. R.J. Dickinson and Dr. J.W. Stather. Both Professor Jones and Dr. Dickinson were employed by BNFL, while Dr. Stather was employed by the NRPB.

Professor S.R. Jones, the defendants' primary witness at this point of the trial, produced a report dealing with radiation, dosimetry, natural radiation, discharges, radionuclides in the environment and environmental monitoring. In addition the report consisted of a description and evaluation of a mathematical model (the Sellafield Environmental Assessment Model [SEAM]), which Professor Jones had constructed in order to calculate the concentrations of a number of different radionuclides in the environment and also, the pathway of exposure as a result of discharges from the Sellafield plant to both the atmosphere and the sea. In total the work took four years to complete and was regarded by Professor Jones as thorough and comprehensive. Under examination by Mr. Rokison QC on behalf of the defendants, Professor Jones said:

I am very confident that what is in here [SEAM Model Report] is certainly the best

---

[58] Public bodies such as the NRPB and HMIP.

assessment that has yet been made of the historic discharges from the Sellafield site and, if you like, the history of radionuclide concentrations in the environment" (Day 6,p.3D).

This view however was not accepted by the plaintiffs who were keen to stress the unreliability of BNFL's past estimates in relation to radionuclide emissions and (as a consequence of BNFL's history) question the accuracy of Professor Jones' SEAM conclusions. Further, as pointed out in the plaintiffs' earlier submission, the NRPB, who supported the SEAM document, were in no position to independently assess the reliability of the original discharge figures supplied by BNFL, leaving unresolved many questions with regard to the composition and mathematical basis of the estimated emission figures.

Moving on, Professor Jones went on to say that he considered the model to be a cautious assessment of the discharge figures and had therefore overestimated rather than under estimated the dose figures involved. The aim of SEAM therefore was to put together the total data on emissions, environmental monitoring and internal monitoring in order to determine the doses in respect of the various members of the two families. In the opinion of the defendants, the exposure levels were small and constituted only a fraction of the amount that each member of the families would have received from background radiation.

The second witness called on environmental dosimetry was Dr. Dickinson. Dr. Dickinson was employed by the defendants in a planning and technical appraisal capacity and was therefore involved in the discharge authorization applications on behalf of BNFL. The purpose of calling Dr. Dickinson was threefold. First to refute any suggestions that BNFL had attempted to mislead NRPB, HMIP or the public at large. Second to refute any allegation that inaccurate information had been deliberately supplied to NRPB or HMIP.

Third to explain the discrepancy between Professor Jones' historic discharges figures, and the figures presented to the authorising department on behalf of BNFL[59].

The third witness called on this issue was Dr. Stather of the NRPB. Dr. Stather had been involved in the preparation of NRPB Report R171 on the dose assessments of children and young persons at Seascale for the Black advisory group. The purpose of calling Dr. Stather was to quantify the doses received by the relevant members of the Reay and Hope families and assess whether the radioactive material released into the environment was sufficient to augment the alleged PPI received by way of occupational radiation and/or sufficient to augment the background radiation level.

In addition, Dr. Stather was called by the defendants to confirm that the NRPB were an independent advisory body which despite having close working relationships with individuals at BNFL remained autonomous. Although confirming the existence of a professional relationship, Dr. Stather was willing to concede that the NRPB were wholly reliant on BNFL for discharge figures of radioactive emissions and that:

> ... we [NRPB] are not an organisation that can validate information on discharges that would be given to us by an operator. A regulator might be able to do that but we cannot do that. We do not have the expertise (Stather: Day 8, p. 84D).

Therefore, as far as the defendants were concerned the plaintiffs' case on environmental dosimetry could be broken down to three components. "First, they point to possible

---

[59] This inconsistency was reluctantly conceded by Dr. Dickinson, who admitted that 'an ordinary reader' (a member of the public) reading the application, could well have misinterpreted the figures as being four times lower than in fact they were.

incompleteness of records, particularly for the early years. Second, they point to errors made by BNFL or their predecessors in the past. Thirdly, they rely upon what they call the attitude and approach of BNFL" (Rokison: Day 11,p.36D).

On the first point Mr. Rokison on behalf of the defendants identified two possible reasons to account for incompleteness of records:

a) that monitoring in the early years was not as comprehensive as later years;

b) that extraordinary discharges went unnoticed or unrecorded.

In consideration of the early days of monitoring, Mr Rokison acknowledged that this was an area which had become more comprehensive, thorough and regular as time had moved on (Day 11p.36G). With regard to point b) and the possibility of unrecorded or unnoticed discharges, Mr. Rokison stated that "so far as extraordinary discharges are concerned, there is no reason to believe that all **significant** incidents were not recorded" (Day 11, p.37D).

On the second point concerning the alleged past errors made by BNFL and their predecessors, Mr. Rokison suggested that any such mistakes in the early days of operation of the Sellafield plant were perhaps to be expected, it was he said "not surprising that over a period of 40 years there may have been errors" (Day 11, p.37G).

With regard to the third point which dealt with the general attitude and approach of BNFL, Mr. Rokison, in his submission on environmental dosimetry dismissed this aspect as wholly irrelevant to the case (Day 11,p.39F). Mr. Rokison went on to say, that it was not surprising that out of thousands and thousands of documents the plaintiffs were able

to show "that someone at BNFL, in the past, may have been complacent or over-confident or defensive or over-sensitive, so what?" (Day 11,p.40A). Relying on the evidence of Professor Jones and Dr. Stather, Mr. Rokison pointed to the professionalism of the defendants' two experts as illustration of the competence that also exists in the nuclear industry.

As with the occupational dose, environmental dosimetry has raised a number of concerns. At root and fundamental to this part of the case is the question of monitoring and quantification of dose received by the relevant members of the Reay and Hope families as a result of the radioactive material released into the environment from the Sellafield plant. That is to say doses:

1. to Dorothy Reay's red bone marrow (a) from conception to birth and (b) from birth to date of diagnosis;

2. to Elizabeth Reay's ovaries down to Dorothy's conception;

3. to George Reay's testes down to the conception of Dorothy;

4. to Vivien Hope's lymphatic tissue (a) while in utero (b) from birth to 1988 (when her NHL was diagnosed);

5. to Monica Hope's ovaries down to Vivien's conception;

6. to David Hope's testes down to Vivien's conception[60].

As far as the defendants were concerned, Professor Jones' SEAM model produced the best assessment yet made of historic discharges from the Sellafield site which confirmed the exposure levels as being small, and constituting only a fraction of the amount of radioactive exposure that each member of the families would have received from

[60] Reay and Hope Judgment p. 29-30.

background radiation.

In respect of the plaintiffs Mr. Hytner maintained that:

1. The defendants had in the past been widely wrong in estimating their own emissions of radionuclides;

2. As with occupational dosimetry, the defendants' relationship with the NRPB was too friendly with the result that the NRPB were failing to fulfil their public function as a distinct and separate body. Further, NRPB were not in a position to independently validate BNFL's environmental discharge figures[61].

3. The defendants' cavalier approach to their duties resulted in a failure to inform the NRPB and the public of the full extent of the emissions;

4. As a consequence of these factors, the defendants' evidence on emissions should be treated with caution and indeed with suspicion.

Underlying the environmental dosimetry part of the case are many of the problems highlighted in the previous section. In particular, inequality of resources, lack of independent expertise, problems of public body regulation and accountability. In addition however, this section of the trial also reveals a tendency in the rhetoric and practice of law to treat the expert (in particular Professor S.R. Jones) as autonomous from the institutional setting (BNFL) of which he is a part[62], thereby confusing the credibility of the witness (as a representative of BNFL) with the credibility of the institution.

In the next section attention will focus on the epidemiological evidence and in particular,

---

[61] According to Dr. Stather the NRPB were not a regulator and therefore did not have the expertise to validate BNFL's figures.

[62] This issue will be considered further in Chapter 5(2) (analysis of the **Reay and Hope** Judgment).

the study carried out by Professor Gardner and his team which provided the foundation for the plaintiffs' case.

4.4 THE EPIDEMIOLOGICAL EVIDENCE

The Gardner study generated as a consequence of the observed excess of childhood leukaemia and lymphoma near the Sellafield nuclear plant was based on two hypotheses. First, that there was some causal connection between the childhood cancer excess and the geographical area, second that the increased rates of leukaemia and NHL were associated with some aspect of the Sellafield site.

To recapitulate, Gardner identified 97 cases of people aged under 25 years, born in west Cumbria Health Authority and diagnosed there between 1950-1985 as having leukaemia (52); non-Hodgkin's lymphoma (22) and Hodgkins disease (23) compared with 1001 controls matched for sex and date of birth taken from the same birth registers as the cases. Gardner used two groups of controls: area controls and local controls[63]. The area controls were 8 controls for every case drawn from west Cumbria. The local controls were 8 controls per case drawn from the same parish in which the mother was resident at birth[64].

Professor Gardner's epidemiological evidence was published in two concurrent papers in 1990. The first described the methodology and basic data of the case control study. The

---

[63] The aim of having area and local controls is to reduce the chance of bias.

[64] The reason for using 8 controls per case is to improve information about background factors which may prove relevant. Ideally it would of course be better to increase the number of cases, rather than the number of controls. Due to childhood leukaemia still being a relatively rare disease however the number of cases is limited.

second paper concluded that there was indeed a significant excess of leukaemias and NHL in the vicinity of Sellafield, and further that:

> The raised incidence of leukaemia particularly, and non-Hodgkin's lymphoma among children near Sellafield was associated with paternal employment and recorded external dose of whole body penetrating radiation during work at the plant before conception. The association can explain statistically the observed geographical excess. This result suggests an effect of ionising radiation on fathers that may be leukaemogenic in their offspring, though other, less likely, explanations are possible. There are important potential implications for radiobiology and for protection of radiation workers and their children (Gardner 1990a:423).

This was the first time since the Yorkshire Television Programme of 1983[65] that a correlation between exposure and disease had been confirmed. Prior to this, and throughout the 1980s, studies on the incidence of cancer around Cumbria and around nuclear installations had been undertaken and were progressing[66], however Gardner was the only study that had borne out COMARE's tentative hypothesis in their first report[67] that paternal preconception exposure **might** contribute to the childhood cancer excess.

In order to assess the validity of Professor Gardner's study, plaintiffs and defendants relied on the criteria devised by Professor Bradford Hill in 1965. Although I have referred to the nine points earlier on in the thesis[68], it is perhaps worth recapitulating on the detail

---

[65] For wider discussion of the Yorkshire Television Programme see Ch.1.

[66] Particularly: Tiplady (1981;1983), Alderson et al (1984); Cook-Mozaffari (1984); Craft & Birch (1983); Urquhart, Palmer and Cutler (1984); Palmer (1984); Gardner & Winter (1984a); For further, more detailed information please refer to Ch.1(3).

[67] COMARE (1986) 'The implications of the new data on the releases from Sellafield in the 1950s for the conclusions of the Report on the Incidence of a Possible Increased Incidence of Cancer in west Cumbria'.

[68] Please refer back to Ch.2(2).

of the Bradford Hill Criteria, particularly since they played such a significant and ultimately decisive role in Counsels' Opening; Closing Submission; and Mr. Justice French's ruling of the epidemiological evidence.

In summary, the Bradford Hill criteria considers the following as indicative of cause and effect:

1. Strength of association.
2. Biological gradient (dose-response relationship).
3. Temporal Relationships (does response follow dose).
4. Consistency with similar studies.
5. Biological plausibility (existence of a biological mechanism).
6. Coherence (compatibility of a case with the known facts).
7. Experimental evidence (relevant laboratory experiments).
8. Analogy (the production of similar results).
9. Specificity (alleged link between the disease and exposure of interest).

Before moving on to an evaluation of the more important parts of the epidemiological evidence however, this section will start by providing a necessarily detailed overview of the witnesses and issues involved. The importance of understanding the epidemiological evidence cannot be over stated. First, a descriptive account helps to provide a foundation upon which analysis can take place and second, such a framework prepares the reader for discussion of the rationale behind French J's ultimate decision.

In the first instance and having exchanged experts' reports[69], it appears initially there were only two concerns raised by the defendants in respect of Professor Gardner's methodology. The first related to the appropriateness of combining leukaemia and NHL

[69] Dr. Peter Smith, London School of Hygiene was the first expert commissioned by the defendants to assess the intrinsic and extrinsic validity of Gardner's 1990 report.

cases and controls[70]; the second concerned the number of hypotheses tested by Professor Gardner and the possibility that one of the hypotheses might appear statistically significant purely as a result of the random effect of chance.

In respect of the first point, the plaintiffs acknowledged that by themselves the NHL cases and controls were too small to be statistically significant. On the other hand, non-inclusion of the NHL cases and controls would result in the association between pre-conception exposure to radiation and leukaemia showing a stronger significance. As Mr. Hytner on behalf of the plaintiffs pointed out in his Opening, "it would therefore be surprising if this were to loom large as an issue in the case, as the Defendants, if they were to do so, would simply be trading a lessened certainty of cause and effect in the case of Vivien Hope[71] for an increased certainty in the case of Dorothy Reay[72] (Day 1, p.53).

On the second point, the plaintiffs accepted the general principle that where a number of hypotheses are chosen for a study there is a greater risk that one will appear statistically significant as a result of chance[73]. However, the plaintiffs rejected the notion that such

---

[70] The plaintiffs contended that leukaemia and NHL were one disease. The defendants contended that they were essentially different diseases of the haemopoietic system; the one originating from the bone marrow the other deriving from the lymphoid cells. Professor Greaves testified for the plaintiffs, Professor Catovsky for the defendants.

[71] Vivien Hope was diagnosed as suffering from non-Hodgkin's lymphoma in 1988.

[72] Dorothy Reay died of leukaemia in 1962 aged ten months.

[73] Where there are multiple hypotheses the study may becomes one of 'hypothesis generation' rather than 'hypothesis testing' which could undermine the results.

a mechanism was operating as regards the Gardner Study.

Notwithstanding the four aims of the study:

(1) to examine maternal exposure to medical X-rays and to infectious disease during pregnancy;

(2) to examine the geographical distribution at birth and in particular proximity to Sellafield;

(3) to examine habits that might have enhanced exposure to radionuclides released from Sellafield (for example, eating seafood, playing on the beach);

(4) to examine parental occupation especially employment at Sellafield and occupational radiation dose. (Hytner Day 1, p.55).

Mr Hytner pointed out there were only two hypotheses tested by Gardner: "first that the raised rates of leukaemia within the area were due to a high frequency of known causes of childhood leukaemia and lymphoma; and second, that the raised rates were associated with some aspect of the Sellafield plant..... Consequently, there was no "multiplicity" of hypotheses as suggested" (Day 1, p.54).

Moving on to the second exchange of reports, it emerged as a consequence of the discovery process that BNFL had supplied inaccurate dosimetry data to Professor Gardner, necessitating an entire re-working of the Gardner Study[74]. Unfortunately for the plaintiffs however, Professor Gardner had by this time become seriously ill[75] and was not in a position to undertake this exercise himself.

---

[74] Please refer to 4(2) for wider discussion of this issue.

[75] Professor Gardner died of lung cancer in January 1993.

Therefore, in light of Professor Gardner's illness and the fact that responsibility for the inaccurate information lay firmly with BNFL, the plaintiffs approached the defendants, hoping to agree as facts the raw data used by the Gardner team and contained in the study. Upon receiving the defendants' refusal to this proposal, the plaintiffs had no choice but to obtain Gardner's raw data from the Medical Research Council (MRC) at Southampton University and effectively re-run the study.

For the re-working of the Gardner Study, the plaintiffs' solicitors contracted Stephen Evans, Professor of Medical Statistics at London Hospital Medical College, University of London. Professor Evans produced a total of four reports, the first report involved a discussion of other studies. The second and third reports conducted a re-analysis of the data which Professor Gardner had used to produce his published work, in part reanalysed as a consequence of the revised doses. The fourth report commented on recent epidemiological studies that had come to prominence over the last year.

Before calling Professor Evans on the thirteenth day of the trial, a dictated statement dated 13th November 1992, served under the Civil Evidence Act was read out on behalf of Professor Gardner[76] dealing with a further three criticisms identified in the interim by Dr. Macrae on behalf of the defendants. The first issue concerned the misclassification of 21 cases and controls, representing 2.45 per cent of the total. This Professor Gardner dealt with by pointing out that the original information supplied by BNFL to the MRC unit was

[76] Professor Gardner was by this stage too ill to appear in court.

incomplete and/or inaccurate in respect of eighteen fathers[77], the other three misclassified fathers were the result of incomplete data necessitating further tracing information[78].

The second point raised by Dr. Macrae related to the exclusion of leukaemia and lymphoma cases born outside west Cumbria. On this point, Professor Gardner confirmed that while the aim of the original study had been to include all children diagnosed with leukaemia and lymphoma in and around the west Cumbrian area, the results of the Seascale Birth and Schools Cohort Study reported in 1987 showed clearly that the risk appeared to be confined to children born and diagnosed in west Cumbria. Accordingly, these cases were highlighted as of primary interest and published analysis focused on this area.

The third issue concerned the inclusion of what became known as the 'Bristol' Case. This case, said Dr. Macrae should not have been included in the analysis. Further, had this case been excluded, the statistical significance revealed in the study would not have appeared. In response, Professor Gardner pointed out that the aim of the case control study was only to include those cases diagnosed while resident in west Cumbria. In this instance the deceased had moved to Bristol University for a short period of time, having lived all his

---

[77] Of these eighteen fathers, sixteen did not appear in the original workforce data supplied by BNFL. The remaining two did appear in the data, but one was without initials, the other had a different surname spelling and date of birth than the information contained in Gardner's own files.

[78] The requirement of further tracing information is not uncommon. Most epidemiological studies have a few cases like this.

life in Seascale. Further he had registered his permanent address as being in west Cumbria and the same address appeared on his death certificate. As to whether exclusion of the Bristol case would affect the statistical significance of the study, Professor Gardner stated:

> Although the relative risks for the highest dose categories are consequently lowered, the majority in fact remain statistically significant with 95% confidence intervals[79].... Our interpretation of the results would hardly change from that published (Day 13, p.11D)[80].

The Plaintiffs' Expert Witnesses

Having read out the statement by Professor Gardner, Mr. Langstaff proceeded, on behalf of the plaintiffs to call Professor Evans to the witness box. In total Professor Evans spent almost two weeks giving evidence, during which time he not only reaffirmed the Gardner results but also strengthened them, particularly in relation to the dose - response relationship; the higher the exposure dose, the greater the risk of the offspring getting leukaemia. Professor Evans was also able to show that any possibility of the dose response relationship being simply a matter of chance had reduced from the 3-4% found by Gardner to 2-3% as a consequence of the revised dose figures.

When examined on the rigour of Professor Gardner's methodology, Professor Evans observed:

---

[79] 95% confidence interval is established by the exclusion of chance to a 95 per cent extent. This means a 95% certainty or 5 per cent (or less) if chance is considered.

[80] In the event, after a third re-analysis of Gardner, Professor Howe on behalf of the defendants confirmed Professor Gardner's view that exclusion of the Bristol case would have no impact on the original findings.

> The description of the methods of the study is one of the most extensive I have read in the scientific literature and has not to date been the subject of any major criticism in the scientific press (Day 13, p.49A).
>
> I consider that Professor Gardner has done as good a job as possible with the available material and I do not believe that there are any serious subjective biases in the occupational data derived from BNFL (Day 13, p.66E).

Although asked to comment on a range of studies, one theory which Professor Evans was examined and cross examined on later acquired particular importance for the defendants.

The 'Kinlen Hypothesis'[81] was based on a total of four studies[82] which looked at the relationship between clusters and viruses. According to this theory, children develop what Professor Kinlen has referred to as 'herd immunity'. This immunity protects families against certain viruses providing they remain within their own native environment. However, once they move to a new area, particularly a new town or village the defence of the herd immunity breaks down, leading to a greater likelihood of a predisposition to viral induced diseases. There are three elements to the Kinlen Hypothesis:

1. that influxes of population into rural and isolated areas are conducive to epidemics of certain infections;

2. that Sellafield and Dounreay are extreme examples of isolation and population influx;

3. that some unidentified virus (or viruses or other source of infection) can cause leukaemia and may well have caused the Seascale cluster without any causal contribution from Sellafield[83].

---

[81] The Kinlen hypothesis is referred to in Chapter 1(3).

[82] Kinlen, (1988); Kinlen, Hudson and Stiller (1991), Kinlen (1993); Kinlen, Dickson and Stiller (1995).

[83] Judgment p.13.

In response to this hypothesis Professor Evans expressed the view that had leukaemias and lymphomas been due to a virus he would have expected:

> ....to have found clusterings in space and time to be rather common. If we apply those sort of methodologies to other diseases that we know have a viral cause, we find that clusters are identified all over the place and we find that same sort of patterning even with such simple viruses as food poisoning (Day 14, p.55E).

Therefore Professor Evans rejected the Kinlen hypothesis as the primary or sole explanation for the excess[84]. In his conclusion, Professor Evans went on to say:

> The re-analysis confirms the overall conclusions of Gardner in regard to the case.....The most complete data with the agreed dose levels now shows firm evidence from both local and area controls that paternal radiation exposure is associated with childhood leukaemia (Day 14, p.68D).

Following Professor Evans' first appearance[85] in the witness box, the plaintiffs called two American experts, Scott Davis, Associate Professor, Department Epidemiology at the University of Washington, and Kenneth Kopecky, a biostatistician at the Fred Hutchinson Cancer Research Centre and Associate Professor in the University of Washington School of Public Health and Community Medicine.

Professor Scott Davis had since the 1980s focused his research on two principal areas of activity; first, the effects of radiation and second, the aetiology of leukaemia and lymphomas as a consequence of exposure. At the time of the trial Professor Davis' three research projects included: investigating the health effects of radioactive atmospheric

---

[84] The plaintiffs had not rejected the possibility that viruses in combination with preconception irradiation could be responsible for the excess.

[85] Professor Evans was called to the witness box twice.

discharges from Hanford nuclear facility; leukaemia excesses as a consequence of the Chernobyl accident, and analysis of clusters linked to Hodgkin's disease.

Professor Davis was commissioned to prepare three reports on behalf of the plaintiffs, his aim, to review and evaluate from an epidemiological perspective the "body of knowledge concerning a possible link between radiation exposure from nuclear power plants and the development of childhood leukaemia" (Day 19, p.4B).

The thrust of Professor Davis' evidence was that a number of studies, looking at the excess of cancers around nuclear power plants, gave strength to the view that the Seascale excess had not been caused by chance and further, that there was sufficient backing from other case-control studies to support Gardner. In his final assessment of the various studies[86], Professor Davis observed:

> As a group, the case-control studies reporting no association appear to be based on much poorer quality exposure information than those reporting an association (Day 20, p.63E).

In his concluding remarks, Professor Davis stated that he could find "no convincing evidence to refute the findings of Gardner" (Day 20, p.63G).

Moving on to the next witness, the plaintiffs called Dr. K.J. Kopecky[87]. Dr. Kopecky

---

[86] Studies included: Stewart/Keale (1970); Shu (1988); McKinney and Alexander (1991); Buckley 1989; Urquhart (1991); McLaughlin (1993); Roman II (1993); Kinlen 1993.

[87] As a biostatistician Dr.Kopecky was concerned with the statistical side of the review, whereas Professor Davis was concerned with the epidemiological aspects.

prepared three reports for the purposes of litigation in which he focused on the "statistical aspects of published reports concerning studies in humans of the effect of preconceptional irradiation of parents, and particularly the extent to which the currently available literature either supports or refutes the findings of Gardner" (Day 24,p.4Q).

In his overview of the published material, Dr. Kopecky was of the opinion that "taking this body of work as a whole.... the evidence [was] strongly suggestive of a link between preconception radiation exposure and childhood leukaemia" (Day 25, p.4F).

As regards the question of methodology, Dr. Kopecky informed Mr. Read on behalf of the plaintiffs that in his view:

> ...the methodology in the Gardner Study was of a very high calibre. I would say compared to other studies that I have read over the years in the epidemiological literature it ranks in the highest category in terms of the quality of the methodology. I think the authors are particularly to be applauded, at least from my point of view as a scientist, for having gone to such great lengths in a separate paper to lay out the methodology (Day 25, p.15A).

In addition to the array of epidemiological evidence that Professor Davis and Dr. Kopecky were asked to consider, one study of particular significance merits further comment. The aim of the A-bomb Study[88] led by Professor Neel and Professor Schull (both of whom were expert witnesses for the defendants) was to follow-up surviving Hiroshima and Nagasaki victims and their offspring in order to evaluate the effect of ionising radiation, somatically and genetically. The A-bomb Study is regarded as the largest cohort study of its kind ever conducted, it is generally recognised as being well executed and state of the art, developing as it has over time. Nonetheless, despite the general acceptance of the

---

[88] Some of the problems of the A-bomb Study were identified in Chapter 1(2).

A-bomb study, there are a number of anomalies which Mr. Hytner on behalf of the plaintiffs was keen to highlight, particularly in view of its contradiction of the Gardner findings. In his Opening Mr. Hytner pointed out that:

> Although the defendants rely heavily on the A-bomb data as not only being intrinsically reliable but also as being applicable to and setting apart the Gardner findings, it transpires that Profs. Neel and Schull themselves were not blind to the problems arising from what appeared to be bizarre results showing, as they did, a series of effects lower among those exposed to the blasts than among the unexposed cohort.
>
> Since it was recognised, as a matter of common sense and science, that this could not be so, the results were conveniently interpreted to make them correspond with the known reality of radiation effects - known that is, at the time (Hytner: Day 1, p. 61).

As far as Professor Davis and Dr. Kopecky were concerned, it was their shared view that whilst the A-bomb study results were incompatible with the Gardner study, the circumstances surrounding the A-bomb exposures were so different to those surrounding the exposure at Sellafield[89], that it should not be taken as being capable of contradicting the Gardner findings.

The next expert called to the witness box on behalf of the plaintiffs was Professor E. Alberman, a Clinical Epidemiologist with the Wolfson Institute of Preventive Medicine. Professor Alberman had also sat on COMARE III in 1988. The purpose of calling Professor Alberman was to deal with three assertions made by Professor Neel in relation to his A-bomb research:

a) that 'there is an irreconcilable conflict' between the Gardner hypothesis and the studies on the A-bomb survivors (Day 29, p.8F);

---

[89] In particular, acute v chronic irradiation, difference in dose levels, difference in population groups, difference in internal/external radiation exposure.

b) that the doses to the workers at Sellafield were far too low to bring about the observed cancer excesses in their children (Day 30, p.1C);

c) that it is acceptable to combine stillbirths, neonatal deaths and congenital malformations into a single endpoint - 'untoward pregnancy outcomes' for the purpose of deriving a genetic doubling dose[90] (Day 30, p.2D).

In concluding her evidence Professor Alberman said:

> In summary I must stand by my view that the evidence from the Japanese Atomic Bomb data does not provide convincing proof that exposure to low dose ionising radiation will not cause genetic damage (Day 30, p.17D).

In the opinion of Professor Alberman the findings of the A-Bomb data needed to be questioned more vigorously; there were she said, too many discrepancies which had been ignored for too long. Although not qualified to comment on genetic contradictions, her own conclusions as an epidemiologist in the international and national infant mortality field, highlighted the inconsistencies that existed between her own work and those of the A-bomb research.

Following Professor Alberman, Duncan Campbell Thomas[91], American Professor at USC School of Medicine, Los Angelos, California took the stand. Professor Thomas' principal areas of research included statistical methods in epidemiology; radiation carcinogenesis; cancer epidemiology; occupational and environmental health; genetic epidemiology. In total Professor Thomas was commissioned to prepare four reports with the aim of providing:

---

[90] This is the dose of ionising radiation which will produce the same number of genetic effects of a specified type as would result from 'spontaneous' mutations in each generation.

[91] Professor Thomas' academic training included mathematics, biostatistics and epidemiology.

> .....quantitative estimates of the probability that the diseases of....Dorothy Reay and Vivien Hope, were caused by their fathers' occupational radiation exposures at Sellafield...based on exposure-response data derived from the Gardner study (Day 32, p.4F)

When considering the methodology and practice of epidemiologists in general, Professor Thomas observed:

> In practice, conclusions about causality...are never based just on the study data but on its concordance with the world literature, biological plausibility, freedom from bias, and numerous other considerations. In other words, epidemiologists behave more like 'Bayesian' statisticians (Day 32, p.30D).

In recognising this practice, Professor Thomas was acknowledging the fact that an epidemiologist, like a Bayesian statistician[92], approaches his study in light of prior information and expectations. Adopting the Bayesian method therefore, an epidemiologist could assess the probability of the hypothesis first, and then move on to analysis of the data.

As far as the Gardner study was concerned a causal connection between paternal preconception irradiation and leukaemia was not established until the research data was revealed. Although not advocating the use of the Bayesian formula in any quantitative way, Professor Thomas did suggest that combining the 'probability causation'(PC) estimates and the frequentist approach[93], could help to provide further information on

---

[92] See Ch. 5(3) for wider discussion of Bayes' Theorem.

[93] The frequentists simply look at the data itself.

whether there is an association at all[94]. However, in assessing the magnitude of any association using this combined method, Professor Thomas did point out:

> PC estimates are inherently uncertain and there is no clearly accepted basis for allowing this uncertainty in reaching such judgments (Day 33, p.47A).

In considering the method and approach adopted by the Gardner study, Professor Thomas said "in general, the Gardner study appears to have been very well done" (Day 32, p.15A). He went on to say:

> In my view Gardner chose the most efficient design to achieve results (Day 32, p. 16F).

When examined by Mr. Langstaff on behalf of the plaintiffs, as to his opinion of the study, Professor Thomas said:

> In my opinion, the Gardner case-control study provides the most solid evidence on which to resolve the litigations concerning the childhood cancer cases in the vicinity of Sellafield (Day 32, p.19D).

In conclusion, Professor Thomas was of the view that the strength of the association as between paternal irradiation and the Seascale leukaemia excess was unlikely to be accounted for by chance. Thus preconception exposure acting in synergy with environmental radiation and/or viruses was the most probable explanation. Therefore, on the balance of probabilities he felt that the cases under consideration were cases where preconception irradiation had played a causative part. However, Professor Thomas went on to say that if the Gardner study had been a study in the absence of any other prior

---

[94] The defendants were keen to suggest that because the Gardner Study was the first study to come up with such a positive link, it must mean that the prior hypothesis was of very limited strength and therefore the paternal exposure results could not be taken as being causal without further support from other studies.

study considering preconception irradiation and its effects, he would not necessarily have come to this conclusion.

The next witness called by the plaintiff, was David Savitz, Department of Epidemiology, American Professor at North Carolina School of Public Health. For the purposes of litigation Professor Savitz prepared two reports dealing with an evaluation of "a number of studies relating to a sizable body of epidemiological research on preconceptional paternal exposure to chemical exposures in relation to childhood cancers" (Day 36, p.4C). The aim of Professor Savitz report was to interpret the data contained in the studies and in so doing provide a context for a broader array of research findings into which the Gardner study may or may not fit.

As a researcher primarily concerned with occupational and environmental epidemiology, Professor Savitz was able to confirm the usefulness of these studies in helping to determine the Gardner hypothesis by pointing out:

> Like all studies the Gardner study is not out there in isolation. There are other studies that I reviewed giving some sense of the underlying information base, the underlying information about whether environmental agents that the father is exposed to may in fact affect the health of his offspring (Day 36, p.4G).

In order to put Gardner into a wider context, Professor Savitz looked at the analogous situation of the chemical exposure of other workers, and the levels of leukaemias and additional cancers that affected their offspring. The intention of calling Professor Savitz was to show that evidence from non-radiation exposure, including some of Professor Savitz own research findings, supported the conclusions of Gardner. Thus if paternal germline damage could result from chemical exposure, it could also happen to workers exposed to

ionising radiation. Professor Savitz was able to confirm therefore that a sizable number of studies (at least ten) examining paternal employment and childhood cancer added support to the possible link between paternal preconception exposure and childhood cancer (Day 36, p. 24).

The final, and arguably the leading expert witness called by the plaintiffs on the epidemiological side of the case was N.E. Day, Professor of Public Health at the University of Cambridge. Professor Day's main area of interest included epidemiological methodology, statistics and cancer research. Professor Day prepared three reports on behalf of the plaintiffs. In his first report, Professor Day expressed the opinion that, on the balance of probabilities, a preconception radiation dose contributed substantially to the development of Dorothy Reay and Vivien Hope's malignancies. When asked by Mr. Langstaff whether he had modified his opinion as a consequence of additional information received since the completion of the first report, Professor Day replied:

> There has been a considerable amount of information which has become available which, on the whole, has tended to increase the strength of my belief that preconception irradiation played a part in producing the cluster and causing those haematological malignancies that were observed around Seascale (Day 40, p.3F).

In his second report, Professor Day looked at the strength of the association under the Bradford Hill Criteria, observing that:

> There is a great deal of support for the Gardner hypothesis from the geographical studies, the other case control studies, the Draper study[95], the animal

[95] Draper et al. (1993) 'Cancer in Cumbria and in the vicinity of the Sellafield nuclear installations 1963-90 BMJ 306:89-94.

> experiments of Nomura[96] and others and the analogous findings in other industries. The only negative evidence that truly stands out is that from the A-bomb data. It does not seem to me, for the reasons described above, that these data are strong enough to nullify not only all the supporting evidence but also the dose response relationship in Gardner's report, in a way that can only promote chance as the most likely explanation. Taking the evidence as a whole, there are considerable grounds for concluding that the observed association between preconception exposure to radiation and childhood cancer (Day 40, p.29B).

In his third report, Professor Day expressed his opinion as regards causation. Under cross-examination by Mr. Rokison on behalf of the defendants, Professor Day stated his belief that synergism in the form of environmental radiation and/or viruses could have interacted with paternal preconception irradiation and in so doing produced a causal effect. Professor Day went on to confirm his belief that the strength of the relationship for the Seascale cases (as between paternal irradiation and the level of leukaemias) was so great that it was unlikely to be accounted for by chance, and was therefore likely to be a cause or causes of the excess.

In his summary of the plaintiffs' interim submission of the epidemiological evidence Mr. Justice French said:

> The plaintiffs start their submission by saying that the Gardner Study demonstrates a significant association between the excess of leukaemias around Sellafield and PPI; that the data on which Gardner based his findings when reanalysed with additional data continue to support that association; and that when the Bradford Hill criteria are applied to the association causation is proved on the balance of probabilities. It is now unchallenged, they say, that there is indeed an excess of leukaemias and NHLs in Seascale though an issue remains how far the excess may spread, and to what degree, beyond Seascale. Of the presence of a 6-8 fold excess in Seascale there is no realistic doubt. The Gardner study is methodologically sound; there is

---

[96] See Nomura, I (1990) 'Of mice and men' Nature 345:671 and Nomura, T. 'Parental exposure to X-rays and chemicals induces heritable tumours and anomalies in mice'. Nature (1982) 296:575-7.

> no bias which affects the results and accordingly the P value can be interpreted as face value as excluding a chance association except by a freak[97].

The plaintiffs concluded their submission on epidemiology as follows:

> The Gardner report and its updated version remains centre stage. The defendants' own analysis confirms the high excess relative risk of leukaemia and NHL's in Seascale which is most unlikely to be explained by chance. The association with a high occupational dose has been unchallenged.

In the plaintiffs' opinion therefore:

> ...the challenge to the 'appropriateness' of the biological gradient has failed to erode the undoubted evidence of a suitable dose response indicative of causation. The result is that any explanation other than PPI has to explain that response; and the defendants' witnesses have failed to come up with a credible alternative explanation[98].

The Defendants' Expert Witnesses

As soon as Professor N. Day had completed his evidence on behalf of the plaintiffs, the defendants went straight into their evidence commencing with Dr. K.D. Macrae, Reader in Medical Statistics, Charing Cross and Westminster Medical School.

Dr. Macrae produced three reports based on his analysis of the Gardner Study. The first report looked at epidemiology and causation, the second considered leukaemia types and sub-types in the context of the Bradford Hill criteria, the third report dealt with other issues related to leukaemias.

Mr. Spencer QC on behalf of the defendants began his examination of Dr. Macrae by considering more general topics related to data bias; the concept of significance; multiple

---

[97] Judgment p.57-58.

[98] Judgment p.80-81.

hypotheses; what constitutes a true experiment; the appropriateness of relying on the Bradford Hill criteria; study designs in epidemiology.

Moving on to the Gardner Study specifically, Dr. Macrae was asked his view of a number of selected studies both inside and outside the UK which in the opinion of the defendants did not support the Gardner hypotheses. Dealing with the non UK studies first, Dr. Macrae confirmed his conclusions that:

> ..there is little, if any, supporting evidence from the systematic studies[99] conducted outside Britain for a raised risk of childhood leukaemia and NHL around nuclear sites (Day 45, p.7D).

Having received additional information on studies post-Gardner, and having considered UK and other studies together, Dr. Macrae was then asked by Mr. Spencer, his opinion on the validity of the Gardner hypothesis as regards cause and effect. In response Dr. Macrae commented:

> I start by being sceptical as to whether the Gardner Study itself has really established an association between pre-conception irradiation and childhood leukaemia or indeed NHL even more so. Because of the problems with the study I doubt the conclusions of the association in the study (Day 45, p.65C).

An area of particular concern to Dr. Macrae was the inclusion of the 'Bristol' case already discussed[100], and the exclusion, of what became known as the Edinburgh case[101].

---

[99] Including: Hill and Laplanche (1990) France; Jablon et al. (1991) US; Michaelis et al. (1992) West Germany.

[100] To recapitulate, this case concerned a young man who had resided in Seascale for most of his life. Upon taking up the offer of a place at Bristol University two months before he died, the deceased continued to register his permanent address as west Cumbria. Later the same address appeared on the death certificate. Gardner on the basis of this information concluded he was a resident of Seascale.

This second case was excluded from the Gardner study on the basis of failing to meet Gardner's methodological requirements of residency. Both cases, in the opinion of Dr. Macrae, cast doubt on the reliability of the study. Interestingly though, despite Dr. Macrae's criticism of Gardner, he seemed unable to make up his mind over the exclusion of the Edinburgh case. Under cross examination by Mr. Langstaff on Day 45[102] of the trial, Dr. Macrae said he would not have included the case, on Day 46[103] of the trial however, he said he would have included the case.

Earlier, when examined by defendants counsel as to whether criticism, particularly over the Bristol case, was not simply nitpicking (Day 45, p.31A), Dr. Macrae defended his opinion vigorously, castigating the fundamental bias of Professor Gardner's work, causing Mr. Justice French to ask whether Dr. Macrae was suggesting some sort of methodological malpractice on the part of Professor Gardner (Day 45, p. 32F).

Later, under cross examination on this same issue, Mr. Langstaff pointed out to Dr.

---

[101] This case concerned an Edinburgh student who was excluded from the Gardner Study because she was registered with a GP in Dorset for six years, and then registered in Edinburgh for three years prior to diagnosis. In total there was nine years non-registration in west Cumbria, therefore, she was regarded as non resident on the basis of the methodological criteria laid down by Gardner.

[102] Transcript: Day 45, p. 35D-E.

[103] Transcript: Day 46, p. 19C.

Macrae that two defendant experts, Professor Howe and Professor Doll[104] confirmed the study to be free from major potential bias, and that further, on re-analysis of the Gardner Study by Professor Howe, exclusion of the Bristol case was found to have no significant impact on the original findings. Notwithstanding this virtual professorial consensus at this time, Dr. Macrae remained dogmatic in his condemnation of Gardner's methodology.

The next witness called by the defendants was Dr. Richard Wakeford, Principal Research Scientist at British Nuclear Fuels. For the purposes of the case, Dr. Wakeford prepared three statements in which he identified his main area of interest as childhood leukaemia clusters around nuclear installations in the UK and overseas. Appertaining to these statements, Dr. Wakeford also submitted a draft copy of a new research project provisionally known as the Parker paper (later referred to as the Wakeford/Parker Study[105]) which allegedly demonstrated, in support of the defendants, that the Gardner hypothesis could not explain the childhood cancer excess observed in Seascale.

---

[104] Professor Doll confirmed the study to be free from major potential bias in his first report. Later in his second report Professor Doll did discuss the Bristol case, but still concluded that there was no substantial bias in the Gardner Study. Later, when Professor Doll was testifying however, he totally changed his position. See p.228-230 of this chapter for further details.

[105] This authors of the study are Parker, Craft, Smith, Dickinson and Wakeford (1993). For the convenience of the trial the study was referred to simply as the Wakeford/Parker study. In order to avoid any possible confusion I have continued to use the Wakeford/Parker abbreviation hereafter.

When examined on the funding status of the research[106], Dr. Wakeford, an employee and witness on behalf of the defendants, stated that the principal funding had come from the UK Co-ordinating Committee on Cancer Research (UKCC). However, clarifying the situation, Dr. Wakeford went on to concede that UKCC were in fact financed by the nuclear industry, including BNFL, the UK Atomic Energy Authority and the Central Electricity Generating Board who together provided a total of £3 million for distribution of projects under the auspices of UKCC. As a project satisfying the criteria laid down by the UKCC, the Wakeford/Parker study qualified for research funding.

Moving on to the findings of the paper, Dr. Wakeford confirmed that this latest study showed:

> ... that the suggestion that the paternal preconceptional doses of children born in Seascale are sufficient to explain the excess of childhood leukaemia cases in the village is incompatible with the absence of any indication of a similar excess in the much greater number of children with such doses born outside Seascale (Day 47, p. 20F).

In our opinion, said Dr. Wakeford:

> It is concluded that it is unlikely that the excess of childhood leukaemia in Seascale is due to paternal preconceptional radiation exposure and this must cast doubt on the direct causal interpretation of the statistical association between paternal preconceptional radiation exposure and childhood leukaemia reported by Gardner et al.
>
> The Seascale childhood leukaemia cluster remains an enigma (Day 47, p. 20G-H).

---

[106] Determining the funding status of research is important in assessing the neutrality and objectivity of the work.

Although Dr. Wakeford was essentially testifying on the findings of the new Wakeford/Parker study, it was open to the plaintiffs to cross examine Dr. Wakeford on other aspects of the case. Under cross examination by Mr. Langstaff, Dr. Wakeford conceded a number of points including: the excess of leukaemia and NHL was unlikely to be a chance phenomenon (Day 47, p.48A); it was not inappropriate to group together leukaemias and NHL (Day 47, p. 48B); the inclusion of the Bristol case on the basis of the death certificate address (as defined in Gardner's methodology paper) was appropriate.

When asked to provide a causal explanation for the Seascale excess, Dr. Wakeford proposed the idea of an occupational confounder[107], suggesting instead, that the excess might be due to the affected children being resident longer in Seascale and therefore more exposed to population mix and viral infection. Challenging this view as implausible, Mr. Langstaff on behalf of the plaintiffs, pointed out, that the 'case children' (whose fathers had high doses) were not employed at Sellafield, on average, any longer than the control group. Acknowledging this, Dr. Wakeford confirmed that he was only postulating a confounding factor as a possible explanation.

The next witness called by the defendants was Professor G. Howe, Director,

---

[107] Confounding factors are factors which have an apparent causal relevance where none exists. In this situation high occupational paternal dose could be irrelevant. What is relevant is that the fathers worked at the plant longer, and therefore exposed the case children to a greater number of viruses.

Epidemiological Unit, National Cancer Institute, Canada, and also Professor in the Department of Preventive Medicine and Biostatistics, University of Toronto. For the purposes of the case, Professor Howe prepared four reports underlying the question of "whether there was at least a 50% probability that Dorothy Reay's leukaemia had a causal link with PPI, and a similar question in relation to Vivien Hope's NHL" (Day 49, p. 8A).

Among other areas, incorporated into the four reports were issues of dose, causality, the role of chance, the Bradford Hill criteria, and comparisons with other studies. In concluding his report Professor Howe said:

> Thus, overall, the epidemiological evidence does not satisfy three important criteria of causality, namely strength of association, consistency, and overall existence of a dose-response relationship. I conclude that there is far from adequate support from the epidemiologic data for a causal association between paternal preconception radiation exposure and risk of leukaemia in offspring (Day 49, p. 7C).

In respect of NHL, Professor Howe concluded:

> ....there is no support from the epidemiologic data for a causal relationship between paternal preconception radiation exposure and increased risk of NHL (Day 49, p. 7F).

Interestingly in reaching his conclusions, Professor Howe not only dismissed the significance of Gardner's P values, but also challenged the weight of P values altogether. According to Professor Howe, epidemiologists place too much emphasis on the significance of P values, with the result, that a P value of a 5 per cent chance or less (or conversely a 95 per cent certainty) can lead to an incorrect interpretation of the figures as an indicator of causal association. In the opinion of Professor Howe, calculating a P value is only the first step on the way to determining causation. Referring to the Bradford Hill criteria as a more useful model for assessing adequate proof in terms of: consistency,

overall strength of association and overall existence of a dose response relationship, Professor Howe, applying the criteria to the Gardner Study stated that:

> ..... the probability of a causal association existing between paternal exposure and leukaemia risk is substantially less than 50 per cent (Day 49, p.42E)

When pressed on the exact percentage[108], Professor Howe seemed reluctant to quantify this in numeric terms as in his view it was:

> extremely difficult to place a specific number on one's beliefs because clearly this is a subjective process and we have to take account of evidence from a number of disciplines and from a number of studies, therefore we tend to use qualitative words to describe our beliefs (Day 49, p.43A).

Later, in challenging Professor Howe on this issue, Mr. Hytner, in his submission on behalf of the plaintiffs pointed out that:

> .....Professor Howe's results show prima facie an association between PPI and the Seascale excess to a very strong statistical significant degree (Day 89, p.17E).

Mr. Hytner went on to suggest that Professor Howe's refusal to accept the significance of Gardner's P values, and his own calculations of those P values[109], brought into question the whole significance of P values as an indicator of causal association, one is left with a situation said Mr. Hytner, where "the P value is meaningless" (Day 89, p.18A).

Moving on to the issue of combining leukaemia and NHL, Professor Howe said that he

---

[108] Professor Howe, although uncomfortable in putting forward a figure, suggested verbally, numerical values of between zero and 20% as the probable causal association existing between PPI and paternal exposure.

[109] Professor Howe initially accepted the findings of his own analysis of Gardner's P-values of a cause and effect association as a 'reasonable conclusion to come to'. Later, there was a 'change of tack' and Professor Howe refused to accept the significance of Gardner's P-values on the basis that the study was testing multiple hypotheses (Day 89, p.17E-F).

personally would have preferred to have conducted separate analyses, however, as a non-expert in the aetiologies of these diseases, he did not wish to be drawn into a debate on this issue (Day 50, p.56F).

As regards the Bristol case, Professor Howe agreed that although the inclusion of the case was largely insignificant to the results, he nonetheless felt that as a matter of principle this case should not have been included. Later under cross-examination by Mr. Langstaff on behalf of the plaintiffs, it was pointed out to Professor Howe that the death certificate certified residence in Seascale at the time of death and that accordingly it was appropriate for the Gardner team to have included the Bristol case. In response, Professor Howe stated that his knowledge was "based upon published papers which are not terribly adequate in this context" and that he would therefore prefer not to comment (Day 50, p. 36B).

Although as an epidemiologist Professor Howe was a highly respected expert witness, he nonetheless came across as being rather biased in his evidence against radiation, informing the court that despite prima facie evidence to the contrary, he unlike other experts in his field, immediately considered chemicals and not radiation to be the front runner in response to the 1983 screening of the Yorkshire Television programme Windscale - The Nuclear Laundry (Day 50, p. 14B).

Later, having also rejected synergism as a plausible explanation, Professor Howe was asked to provide some alternative solution for the excess. In response Professor Howe said:

> I cannot pretend that I can sit here and glibly explain it at all. I cannot. There are questions. There are difficulties (Day 51, p. 66D).

In the event Professor Howe came to the conclusion that the Seascale excess was due to a chance phenomenon[110], with an unknown Factor X (possibly socio-economic) contributing to the Seascale excess.

Following Professor Howe, Professor W.J. Schull was called to give evidence. Professor Schull along with Professor J. Neel (who also gave evidence on behalf of the defendants), are regarded as the two leading researchers in respect of the atomic bomb data. Both scientists went into the devastated Japanese towns after the bombings and both helped initiate research in to whether genetic damage had occurred to first generation offspring.

Professor Schull at the time of the trial was Director and Ashbel Smith Professor of Academic Medicine in the Graduate School of Biomedical Sciences, University of Texas. In addition, Professor Schull also held the Chair of Human Genetics in the School of Public Health and was Acting Director of the Medical Genetic Centre at the same School of Biomedical Sciences.

Although a geneticist, Professor Schull was called by the defendants to produce three reports concerned with epidemiology. In the first report, Professor Schull was asked to "consider specifically the cases of the two Plaintiffs, Vivien Hope and Dorothy Reay, and to focus on the findings on leukaemia and NHL from the bi-national studies of the survivors of the atomic bombings of the two towns" (Day 53, p.4D). In the second report, Professor Schull was concerned with the "adequacy of the Japanese data to

---

[110] Professor Howe was the only epidemiologist who came to this conclusion.

identify risk commensurate with that reported to be seen in the west Cumbrian study" (Day 53, p.58G-H). In the third report, Professor Schull, referring to his two earlier reports, concluded his evidence by offering his opinion on the statistical power of the Gardner Study in comparison with other epidemiological studies.

As far as the defendants were concerned, the A-bomb data represented the largest and most comprehensive epidemiological prospective cohort study ever conducted in relation to the effects of ionising radiation (both somatic and genetic) on a surviving population and their offspring. Professor Schull made it clear that most, if not all of what is known about biological consequences of human exposure to ionising radiation resulted from the atomic bomb studies, and that further, current legislation across the world stems from the experience of the A-bomb survivors (Day 53, p. 6A). In addition, the results of the studies have been closely scrutinised over a period of many years with international and national agencies assessing radiation risks and setting recommended limits of exposure on the basis of the research.

In the opinion of Professor Schull, the results of the Gardner study were statistically inconsistent with the results of the A-bomb studies, in particular the study of the first generation offspring. In concluding his evidence, Professor Schull said:

> Present scientific evidence provides no firm basis for assuming that preconception exposure to ionising radiation will increase an individual's risk of leukaemia or lymphoma, and there are many reasons to believe that it would not. However, even if it is assumed that preconception exposure entails some risk, there are no specific dose-related estimates that can be used to project the chance of occurrence of either leukaemia or lymphoma. Indeed, the experience of children conceived by the survivors of the atomic bombing of Hiroshima and Nagasaki, where the doses are better known, the sample size is much larger, and the surveillance has been more comprehensive, given risk estimates that do not differ significantly from zero. Under these circumstances it is my opinion that no

meaningful estimate can be made (Day 53, p. 58B-C).

Under cross examination by Mr. Hytner, Professor Schull was questioned on a number of areas which in the opinion of the plaintiffs highlighted shortcomings in the A-bomb studies including: loss of cases in the early period in the immediate aftermath of the bombings; disparity in lung cancer rates as between the exposed and non-exposed; problems of Down's syndrome frequency relative to exposure dose; the negative regression slope for leukaemia; the non-statistically significant increase in untoward pregnancy outcomes; differences in leukaemia and chromosome abnormalities rates as between Hiroshima and Nagasaki; apparent discrepancies between the A-bomb research and the Oxford Survey[111] in relation to in utero leukaemias; more malformations in the low dose group than the high dose group; inconsistent figures in respect of stillbirths and infant mortality rates as between the two cities; and inaccurate absorbed dose figures and risk estimates.

Before moving onto the defendants' challenge of these issues however, it is important to consider the evidence of Professor Neel. Professor Neel[112] (also acknowledged as one of the leading experts in this area) like Professor Schull was involved in initiating research into the effects of exposure to ionising radiation as a consequence of the dropping of the

---

[111] This showed a relationship between maternal X-rays and subsequent leukaemia in children.

[112] In addition to being a respected geneticist, Professor Neel also acted as consultant to the Radiation Effects Foundation, where as a young man in March 1947, he accepted the post of Acting Director of Field Studies under the earlier named Atomic Bomb Casualty Commission (ABCC). Prior to this, Professor Neel had been a commissioned officer assigned to the Medical Corps of the Manhattan Project.

Hiroshima and Nagasaki atomic bombs. Because of the joint collaboration of their research work, much of the evidence in respect of the somatic effects identified by Professor Schull and the genetic effects identified by Professor Neel were, for the purposes of the epidemiological section of the case, considered together.

Professor Neel, like Professor Schull's, prepared three reports for the court. Outlined in the first report were six general propositions[113] concerned with the genetic effects of ionising radiation. Included in the second report, were issues relating to the data collection in Hiroshima and Nagasaki during the past 40 years on the children of the survivors of the atomic bombings. In the third report, Professor Neel drew comparisons between the A-bomb data and the Sellafield data.

Corresponding to Professor Schull's examination, Professor Neel was also questioned on the shortcomings of the A-bomb data. In addition to the methodological weaknesses of the research, other factors relating to the applicability of the A-bomb data to the Sellafield situation were also highlighted by Mr. Hytner under cross examination. In particular, Mr. Hytner focused his attention on four concerns. Firstly, the problem of comparing chronic radiation (Sellafield), as against acute radiation (the A-bomb victims). Secondly, the existence of possible differences in susceptibility as between the Japanese population and those of England and Wales. Thirdly, whether the A-bomb survivors were subject to comparable environmental radiation exposure, which in the case of Sellafield, provided

---

[113] These include: universality of effect; the scattergun nature of radiation damage and the teratogenic effects; the mathematics of radiation response; the dose rate effect; sensitivity to radiation; The calculation of the doubling dose.

a second hit opportunity in promoting possible somatic and genetic leukaemogenic effects. Fourthly, whether there was any absence of viruses in Japan, present in Seascale, that could explain the inconsistency in the A-bomb/Gardner results. Also, Mr Hytner was keen to know why Professor Schull and Professor Neel had not addressed the issue of synergism in any of their written reports.

The defendants countered the plaintiffs' allegation of shortcomings in the A-bomb studies by submitting that the court should accept the reliability and thoroughness of the A-bomb research in comparison with other smaller studies examined throughout the trial. Moving on, the defendants maintained that the plaintiffs had not seriously challenged or damaged the international standing of the research, and that the plaintiffs' attempts to marginalise the A-bomb conclusions, in the end came down to two points. First, the loss of cases in the immediate aftermath of the bombings, and second, the fact that Japanese radiation doses had been acute whereas those at Sellafield were chronic. In respect of the first point, the defendants relied on the evidence of Professor Neel and Professor Schull to show there was absolutely no reason to believe there was any substantial loss of cases in the immediate aftermath of the bombings, although Professor Schull was willing to

concede that some cases could have been lost[114] in the ensuing years before 1948[115] (Day 89, p.48E).

On the second point, the defendants cited the opinion of Professor Neel and Schull, as well as producing statistics from various regulatory bodies to support their belief that acute radiation is more effective than chronic radiation. However, despite this evidence, there remains a general lack of consensus on this issue, leading French J. to conclude that chronic somatic irradiation was not more effective than acute radiation.

The other two matters raised by the plaintiffs and acknowledged by Mr. Justice French in his Judgement, concerned firstly, possible differences in susceptibility as between the Japanese populations and those of west Cumbria, and secondly, whether the A-bomb survivors were subject to comparable environmental radiation exposure and therefore, open to the possibility of a "second hit" opportunity as identified by the plaintiffs.

With regard to the first issue the defendants relied on the evidence of Professor Upton who had produced the international risk estimates on behalf of the ICRP. In the opinion

---

[114] Lost in the sense of mis-diagnosis, death on impact or non-diagnosis of leukaemia. In addition, there were in the opinion of the plaintiffs, unknown numbers of abortions because of the shame those exposed to the bombings suffered. The 'hibakusha' (bombed people) were stigmatised as likely to produce ill, deformed or dying offspring. Many denied being in Hiroshima or Nagasaki at the time of the bombings or concealed abortions, miscarriages or stillbirths to avoid such labelling.

[115] Official monitoring of the A-bomb survivors did not start until five years after the bombings. Prior to this only informal, therefore unreliable data was kept by the various bodies.

of Professor Upton, there was remarkable similarity, rather than difference between ethnic groups in respect of the carcinogenic effects of radiation observed in exposed populations. Notwithstanding the defendants' position on ethnicity, Professor Neel was willing to concede under cross examination by Mr. Hytner, the need for caution when extrapolating from one population group to another.

As far as the other factor was concerned, the defendants pointed out, there was no excess of leukaemia found in the offspring of survivors of the Hiroshima and Nagasaki bombings, suggesting, not an absence of possible 'second hit' opportunity factors, but instead, a clear demonstration that leukaemia in offspring was not measurably increased by the irradiation of parents.

When considering the absence of viruses in Japan that may be present in Seascale, the defendants maintained there was no evidence to suppose the existence, or conversely the non-existence of viruses in one place and not the other. The only virus actually identified by the plaintiffs, HTLV-1, is as widespread in western Japan as it is in Britain and was probably present in Hiroshima and Nagasaki at the time of the bombings. In conclusion say the defendants, any notion of interaction between PPI and viruses is simply speculation on the part of the plaintiffs.

In opposing this view the plaintiffs point to four areas of dissention in respect of the A-bomb evidence. Firstly, the numerous methodological problems that have now come to light as a consequence of the trial. Secondly, the uniqueness of the Sellafield situation and the Gardner Study. Thirdly, the dissimilar circumstances of the exposed populations in

respect of: radiation, dosimetry, data collection, ethnicity, culture, and socio-economic factors. Fourthly, the unwillingness of Professor Neel and Professor Schull to even consider the issue of synergism in their written reports. In conclusion say the plaintiffs, the A-bomb study offers no answer to the plaintiffs' case.

The next witness called on behalf of the defendants, was Professor A.C. Upton, who until his recent retirement in 1992, was Chairman of the Department of Environmental Medicine at New York University. In addition to holding this academic position however, Professor Upton was also Rear Admiral in the United States Public Health Service and Director of the National Cancer Institute. Further, Professor Upton served on the ICRP and was until recently, Chairman of the National Academy of Sciences-National Research Council, Advisory Committee on the Biological Effects of Ionising Radiation (BIER V).

For the purposes of the trial, Professor Upton prepared two reports. The first was concerned with:

> .....the extent to which the acute lymphatic leukaemia in the case of Dorothy Reay and the non-Hodgkin's lymphoma in the case of Vivien Jane Hope can be scientifically attributed to ionising radiation released from the Sellafield site (Day 57, p. 4G).

The second report considered the probability of causation and the way in which this concept has been used in relation to calculating the somatic risks from radiation.

In reaching his conclusions on the types and relative risks of leukaemia and lymphomas as a consequence of irradiation, Professor Upton looked at a number of studies adopting a variety of dose-response models. Included in his report were examples of research using

projection models; multiplicative models and linear-quadratic dose response models as a means of assessing risk and causation in relation to the two plaintiffs. In respect of Dorothy Reay, Professor Upton said:

> .....the radiation from Sellafield discharges can be considered negligible in terms of Dorothy Reay's overall risk of leukaemia (Day 57, p. 15F-G).

As regards the second plaintiff, Professor Upton stated:

> .....there was no firm evidence on which to implicate radiation as a causal factor and therefore there is no basis scientifically for attributing Vivien Hope's lymphoma to radiation received from the Sellafield discharges (Day 57, p.15H).

In the opinion of Professor Upton, there was no association between the development of leukaemia or lymphoma as a consequence of heritable genetic damage and pre-conception irradiation. In his closing paragraph, Professor Upton concluded:

> Whether the cancer in either of the two cases might be in any way attributable to paternal occupational irradiation is entirely conjectural at present. Without confirmatory epidemiological and experimental data, the hypothesis proposed by Gardner et al (1990) must remain highly questionable (Day 57, p. 19A).

Under cross examination by Mr. Read on behalf of the plaintiffs, Professor Upton confirmed his background to have originated in the field of pathology rather than epidemiology or statistics. Challenged on his reliance of two studies[116] in respect of his risk estimates for somatic leukaemia, Professor Upton confirmed the relatively sparse nature of supporting evidence in this field, and the fact that given the uncertain nature of existing dose-response models, particularly as regards very low levels of ionising radiation, there may be a need for departure from the standard risk models.

When examined on the two main studies for gauging somatic risk, Mr. Read pointed out

---

[116] The A-bomb Life Span Study and the Ankylosing Spondylitis Study. Please refer to Ch.1(2).

that there was an elevated risk for lymphomas in the case of the ankylosing spondylitis study and accordingly, an increased relative risk in respect of non-Hodgkin's lymphoma. As far as leukaemia was concerned, Professor Upton confirmed "a dramatic consistency, strong effects with a variety of studies" (Day 57, p. 27F).

Mr. Read then tackled Professor Upton on a number of studies[117] which he referred to in his report as providing backing for his opinion that the Gardner hypothesis was unlikely to be valid. Pointing to the various methodological problems that existed in relation to studies, Mr. Read highlighted the fact that none of these studies actually contradicted the findings of Gardner, they simply failed to support the research.

When asked by Mr. Read to explain the reason for the Seascale excess, Professor Upton admitted that it remained something of a conundrum. Referring to a constellation of causes, Professor Upton suggested parental smoking as one possible contributor to the Sellafield excess.

Following Professor Upton, the defendants called Brian MacMahon, Henry Pickering Walcott Professor of Epidemiology, Emeritus at the Harvard School of Public Health. Prior to Professor MacMahon giving evidence however, Mr. Rokison pointed out that unlike other expert witnesses, Professor MacMahon, due to ill health had been unable to keep up with recent developments in the case, as a consequence it was his intention to

---

[117] Including: McLauglin (1993); Cosgrove (1993); Jablon (1991); McKinney (1991); Yoshimoto (1990); Hill and Laplanche (1990).

limit his questioning, as far as possible, to clarifying matters with regard to Professor Macmahon's submitted reports.

For the purposes of the trial Professor MacMahon prepared three reports concerned with the topic of: epidemiology; relevant studies in relation to leukaemia and NHL; and clustering of childhood cancer around nuclear facilities.

In conclusion Professor MacMahon confirmed his opinion that:

> None of the reported individual clusters of childhood leukaemia and or lymphoma around nuclear facilities holds up convincingly as a biologically meaningful cluster; with the possible exception of the cluster in Seascale, all appear to result from artificial boundary manipulation and/or chance. None, including that at Seascale, can be convincingly linked to the facility. The cases at Seascale are of unknown origin. The idea that these cases result from exposure to radioactive discharges from Sellafield is not consistent with current knowledge of the relationship between radiation exposure and leukaemia risk (Black, 1984; COMARE, 1986) (Day 58, p. 28B-C).

Although Professor Macmahon, author of the seminal text on epidemiology was seen by the defendants as a key witness - the American equivalent of Professor Sir Richard Doll, he was by this stage still convalescing, and therefore, unable to completely come to terms with evidence post-Howe.

The final witness called on behalf of the defendants was Professor Sir Richard Doll, Emeritus Professor at Oxford University, Consultant in Epidemiology to the NRPB and Honourary Member of the Imperial Cancer Research Fund. Professor Doll is regarded as one of the most eminent authorities in epidemiological research and was responsible, along with Sir Bradford Hill for identifying the correlation between smoking and lung cancer.

For the purposes of the trial Professor Doll prepared five reports concerned with the principles, methodology, and interpretation of epidemiology. In particular, Professor Doll looked at causal relationships, leukaemias and occupational hazards, before considering the excess of childhood leukaemias around nuclear power stations specifically. In his evaluation of Gardner, Professor Doll considered, and analyzed a number of studies[118].

Upon examination by Mr. Rokison QC on behalf of the defendants, Professor Doll confirmed his opinion that:

> In the light of all the evidence the idea that occupational exposure to ionising radiation was the cause of the increased incidence of leukaemia in the children of Sellafield workers cannot be sustained (Day 60, p.42H).

In relation to the individual cases, Professor Doll said of Vivien Hope:

> None of her past history provides any reason to think her cancer was attributable in any way to the operation of the nuclear plant in Sellafield. First there is nothing to suggest that residents of Cumbria experienced any greater risk of developing any type of cancer than people resident elsewhere in Britain, unless they were born in Seascale (Day 60 p.48C).

As far as Dorothy Reay was concerned, Professor Doll said:

> An increased incidence of acute leukaemia has been observed in children born in Seascale between 1955 and 1986, but there is no evidence of an increased risk in infants born elsewhere in Cumbria and birth in Whitehaven per se provides no reason to link the development of the disease with the operation of the Sellafield plant (Day 60, p. 49E).

Although confirming his earlier opinion that the Gardner Report was a properly conducted study (Day 61, p.10D), Professor Doll did, nonetheless identify three major flaws with

---

[118] Including: Darby (1987); Cook-Mozaffari (1987); Shu (1988); Yoshimoto (1988); Buckley (1989); Mole (1990); Draper (1991); Urquhart (1991); Michaelis (1992); McLaughlin (1993); Roman II (1993); Kinlen (1993).

regard to Gardner's methodology. The first concerned the number of hypotheses tested by Gardner, which, in the opinion of Professor Doll amounted to several. The second, concerned Gardner's lack of recognition as regards sub-group analysis in the presentation of his results, the third related to the inclusion of the Bristol case discussed earlier on in the trial.

With regard to the first point, Mr. Hytner QC on behalf of the plaintiffs, asked Professor Doll whether the number of hypotheses were particularly important as a criticism of Gardner. Replying, Professor Doll explained, the number of hypotheses were only significant in relation to the interpretation of the P value. While not crucial therefore, he did regard it as something that needed to be borne in mind when considering whether the results were a chance finding or not.

Moving on to the second point, Professor Doll made it clear that he thought his criticism regarding sub-group analyses to be a far more serious flaw in the study. Under earlier examination by Mr. Rokison on behalf of the defendants, Professor Doll had stated:

> What I lay more store on really is the concentration on cases born in and diagnosed in Seascale rather than an examination of all the Seascale cluster and although there is no way of proving this, and indeed I think Dr. Inskip has denied it, it does seem to me that there is a possibility that this report was focused on the particular small group on which it was focused because of the findings as they were doing the study. To me a more natural study would have been one that took in all the cases that were reported in the Seascale cluster (Day 60, p. 29H-30A)

At this stage of the proceedings, the defendants' counsel did not seek clarification of the implication behind Professor Doll's allegation, relying instead on Mr. Rokison to point out to Professor Doll:

> To be fair, and you may be aware of that, this was in a sense only regarded

> as the first stage of the study and I think the intention remains to complete the study by looking at all cases that were diagnosed in west Cumbria as recommended by Black (Day 60, p.30 A-B).

Under cross examination by Mr. Hytner however, clarification of Professor Doll's words was sought. Having confirmed that Professor Doll was referring to the case-control study, Mr. Hytner went to ask:

> What you are suggesting there is that as they were doing the case control study, because of the findings in that study and the findings that were coming out of the study they began to focus on the Seascale births because they thought that would produce the more significant result. Is that your suggestion? (Day 61, p.12H-13A).

In an attempt to avoid any misunderstanding Mr. Hytner reiterated his question:

> Again, so that there can be absolutely no doubt and to avoid any misunderstanding, this is not a suggestion really but it is an allegation of fact. Your allegation or suggestion or imputation is not that they exercised judgement in some way which you disagree with but that factually they made this decision to focus on births in west Cumbria after they knew the details of dose?
> (Day 61, p.14D).

Repeating the question for a third time, Mr. Hytner said:

> Sir Richard, the allegation which you say has been denied by Hazel Inskip was not simply that they focused on births and diagnosis in west Cumbria because that has not only been admitted, if you like to use the word, but asserted positively and explained by Professor Gardner and Dr. Inskip. What is said which she denied, and that which you have said again in the witness box today, **is that they focused on births and diagnosis in west Cumbria as a result of the information that was coming to them from the case-control study, including dose?** (Day 61, p. 14E-F).

The allegation that Professor Doll appeared to be making related to Professor Gardner's decision to concentrate solely on those born and diagnosed with leukaemias and lymphomas in Seascale, west Cumbria, as against all those born with cancer in Cumbria as a whole. Gardner had stated in his study that he had taken this decision as a consequence of his research in 1987, which showed that those born in the area were at

particular risk. Professor Doll seemed to be suggesting that the Gardner team had knowledge of additional information and dose data before making the decision to concentrate solely on those born and diagnosed in west Cumbria, the implication being that Gardner had deliberately set the parameters of his own study to ensure that the results were as strong as possible. In other words, the Gardner Study, five years work, was meaningless. Professor Gardner had not only misrepresented but also manipulated his own results.

This attempt by Professor Doll to discredit the professional reputation and standing of Professor Gardner, particularly in light of his recent early death from lung cancer, seemed to the plaintiffs quite extraordinary. Professor Gardner was after all one of the country's most highly regarded and respected epidemiologists, he was viewed by his colleagues and other epidemiologists as a man of honesty and integrity and was the first epidemiologist in this country to be awarded the prestigious Bradford Hill medal, given posthumously by the Royal Statistical Society for Professor Gardner's "outstanding contributions to the application of medical statistics, especially in the study of occupational and environmental hazards, and for the excellence of his expository writing on the use of statistics in medical research" (The Royal Statistical Society 1994:5).

To avoid any misunderstanding of the serious nature of this allegation therefore, Mr Hytner again asked Professor Doll whether he fully appreciated the factual criticism he was making of Professor Gardner. It was at this point of the trial however, that Professor Doll's allegation was to prove all the more revealing in light of further cross examination by Mr.

Hytner with regard to Professor Gardner's statement[119].

This statement, dated 13th November 1992 was taken under oath at Professor Gardner's home, at a time, when he was terminally ill. The statement, required by the plaintiffs had been made in response to similar, earlier criticisms, identified by Dr. Macrae on behalf of the defendants[120]. Of particular importance to Professor Doll's allegation, was the second point raised by Professor Gardner, this concerned the exclusion of leukaemia and lymphomas cases born outside west Cumbria, the statement stated:

> The case-control study was planned during the mid 1980s with the aim of including all children diagnosed with leukaemia or lymphoma in west Cumbria. The results of the Seascale birth and schools cohort studies reported in 1987 showed that the risk appeared to be confined to children born there and so these cases were of primary interest. The published analysis, therefore, focused on those both born and diagnosed in west Cumbria. It has always been the intention to present findings for the six cases of leukaemia and eight cases of lymphoma born elsewhere. These cases, however, are more relevant to the assessment of such factors as X-rays or mother's age than to the Sellafield geographical and occupational environment before birth or at a young age (Day 13, p.9E-G).

In addition to Professor Gardner's statement, Dr. Inskip had also prepared a confirmatory declaration which asserted:

> Although not included in the first analysis, it is still the intention to examine those cases born outside west Cumbria. The main reason for excluding them from the published paper was that the risk appeared to be confined to those born in the area (Day 13, p. 7E).

---

[119] This statement was given under the terms of the Civil Evidence Act as a consequence of Professor Gardner's illness. The statement was made under oath to Mr. L.L. Blake, Treasury Solicitor.

[120] For a wider discussion of Professor Macrae's criticisms and Professor Gardner's response (dictated statement served under the Civil Evidence Act), see p.193-195 of this section.

When asked by Mr. Hytner whether Professor Doll appreciated that the factual criticism he was making had been denied by both Professor Gardner and Dr. Inskip, Professor Doll admitted he had not in fact read Professor Gardner's statement, although, he did confirm seeing the statement by Dr. Inskip. The plaintiffs' legal team, astonished by this revelation, referred Professor Doll to the relevant section in his bundle of documents. Professor Doll was then asked by Mr. Hytner if he wanted time to read Professor Gardner's entire statement in order to put the matter in context. Agreeing to this suggestion, Mr. Justice French adjourned the hearing for twenty minutes to allow Professor Doll time to read Professor Gardner's statement.

Upon returning to the witness box, Mr. Hytner asked Professor Doll whether he wished to maintain or withdraw his criticism of Professor Gardner. Professor Doll confirmed his wish to maintain his position.

In order to avoid any possible misunderstanding, and also, to clarify Professor Doll's position with regard to this allegation, Mr. Hytner cited two examples of separate situations:

Situation No. 1.
The epidemiological group decide, without knowledge of exposure risks or doses, to concentrate on cases born in and diagnosed in west Cumbria. They do a study on that group and publish the findings of that study.

Situation No. 2.
...they do the same thing but, before making the switch, they know the dose records and exposure risks of the cases (Day 61,p.22D).

Mr Hytner then asked Professor Doll which situation applied to Professor Gardner.

Confirming there would be no criticism in respect of the methodological approach adopted in situation one, Professor Doll cited situation two as the most relevant with regard to Professor Gardner.

Alluding to earlier observations Professor Doll had made of the Gardner study[121], Mr. Hytner referred Professor Doll to relevant passages in his correspondence with Dr. Berry:

> I have at last found time to study Martin Gardner's articles with the attention they deserve - and, frankly, I found them very good (Day 61, p. 27D)

Later in the correspondence and, notwithstanding initial concerns expressed by Professor Doll over multiple hypotheses and weakness of conclusions, Mr. Hytner pointed out that Professor Doll had decided that these concerns:

> ..... turned out to be irrelevant in respect of the major finding (Day 61, p. 27D-E).

In conclusion, Professor Doll stated:

> In summary, I have no methodological reasons for doubting the validity of the radiation findings. They are, however, both statistically weak because of the small numbers and biologically surprising. I assess the results as good grounds for formulating a hypothesis that has to be tested by other data (Day 61, p.27H).

When asked by Mr. Hytner how he reconciled this view of the Gardner study, with the hardened one he now adopted, Professor Doll replied, that his view had only hardened on the basis of further information.

At times, throughout his cross examination with Mr. Hytner, Professor Doll appeared to become confused and uncertain of exactly what he was saying. Perhaps, because of

---

[121] These observations were made in a letter to Dr. Berry.

Professor Sir Richard Doll's international standing and reputation, the allegation made against his colleague seems all the more serious. Not only did Professor Doll make the allegation in the first place, but he compounded the accusation by initially not reading, and then, rejecting Professor Gardner's statement, given under oath, weeks before his death. Intentional or not, this attack was made in the knowledge that Professor Gardner could not personally refute the allegation, and also, that any charge of this nature would impact heavily on Professor Gardner's professional integrity and competence. Interestingly, prior to Professor Gardner's death, Professor Doll had a period of two years in which he could have challenged him on his findings, it seems surprising therefore that such an accusation could have been made, so soon after Professor Gardner's death, in open court.

Colleagues working with Professor Gardner were in no doubt that the written statement, read on Professor Gardner's behalf, did not have the weight or impact of a personal court appearance. Nonetheless, despite this view, associates felt duty bound not to ally themselves with one side or the other. Appearing in court on behalf of the plaintiffs could not only compromise MRC's neutrality and independence, it could also put at risk future research funding. In considering the ethical and moral conflict facing epidemiologists, and the authors of the Gardner study in particular, Nilstun and Inskip believe:

> .....that to have maintained independence in this particular case was ethically justified. However, if not only the Plaintiffs, but also the workers at nuclear plants would have benefited substantially, our analysis would lead us to the conclusion that the epidemiologists should have served as expert witnesses (Nilstun and Inskip 1996:127).

In addition to the attack on Professor Gardner however, it should not be forgotten that Professor Doll also cast aspersions on the honesty and integrity of Dr Inskip herself. In rejecting her confirmatory statement, Professor Doll was by implication suggesting that Dr. Inskip had deliberately misled the Court, an opinion he later qualified and finally retracted.

In his Closing Submission on behalf of the plaintiffs. Mr. Hytner said that this episode had been a painful one, he went on to say that:

> Our case is that Professor Doll never really intended to make this allegation at all. Our case is that it was a statement he made under examination-in-chief, that it was a rash comment, that he said it at a time during evidence when he himself was confessed to being confused during the course of his evidence. Your Lordship will remember that he also made a suggestion against Dr. Inskip, which he retracted - he plainly didn't intend to make it. Indeed it was odd if your Lordship is considering the whole of the circumstances of how this statement came to be made. My Lord, we recall Mr. Rokison in re-examination, when he brought Professor Doll back to the comment on Dr. Inskip, saying, "Well you brought it on yourself," which seemed to suggest that it was something he had said which was contrary to something else he had said.
>
> My Lord, what we then say is that when brought face to face with what he had said, he was, like so many witnesses in the witness box, under pressure, reluctant to admit he had made a mistake (Day 89, p.26B-D).

Summarized below are eight of Bradford Hill's criteria identified by Mr. Justice French in his ruling, as representative of the plaintiffs' and defendants' epidemiological evidence:

(i) STRENGTH OF ASSOCIATION

Plaintiffs

The Gardner study demonstrates a significant association between the excess of leukaemias around Sellafield and PPI; the data on which Gardner based his findings when re-analyzed with additional data continue to support that association (Judgement, p. 31F).
The strength of association is therefore established.

Defendants
The Defendants submit that as a consequence of adjustments needed for multiple hypotheses and second, the sub-group analysis identified by Professor Doll, the criterion of strength of association could not be regarded as having been satisfied.

(ii) CONSISTENCY

Plaintiffs
The Plaintiffs identified two areas of consistency, the first, the operation of a genetic element in leukaemia, the second, consistency with other studies. On the first point, both Professor Schull and Professor Doll on behalf of the defendants conceded the existence of a genetic component in certain leukaemias. On the second point, the Plaintiffs, while acknowledging the variety of opinion as regards consistency for Gardner, highlighted the unique nature of the Gardner Study, in particular, an unusually extensive high socio-economic group in the population; considerable rural isolation, and high atmospheric discharges of radioactive material from Sellafield. In the opinion of the Plaintiffs there was no study, at the present time that could compare with Gardner. Citing studies (McLaughlin (Ontario 1992), Parker/Wakeford (west Cumbria 1993), Roman II 1993) in support of the Gardner hypothesis, they state that the A-bomb study is not sufficiently reliable nor the conditions sufficiently similar for the data to be applied to Sellafield.

Defendants
The Defendants contend that all the evidence points to the conclusion that this criterion was satisfied neither in relation to the Gardner hypothesis of causal association between PPI and leukaemia/NHL, nor in relation to the hypothesis of synergism or interaction between PPI and some unidentified further "factor X"
(Judgment, p.43E-F).

(iii) EXISTENCE OF A DOSE/RESPONSE RELATIONSHIP (Biological Gradient)

Plaintiffs
The strength of association is established. The 'point estimate' of the risk is indicative of a true causal relationship. If the dose repones and PPI are not the cause of the excess then, whatever the cause, it must mimic the dose-response relationship. This consideration makes anything other than an occupational exposure closely related to dose very unlikely.

Defendants
On the latest analysis carried out with reference to the agreed figures, there is no biological gradient or relevant dose response relationship apparent whether one has regard to the total or to the six month doses. On the contrary, any positive association is limited to the few cases in the highest dose category with no evidence of any increase relative risk in relation to total doses of less than 100 mSv (Judgment, p.46F-H).

(iv) ANALOGY

Plaintiffs
While not of crucial importance, Analogy does provide supporting evidence for the Gardner hypothesis. Professor Savitz dealt with relevant research on chemicals and the key features of his evidence lay in identifying trends, confirmed by recent studies, that certain forms of paternal exposure to occupational factors (in particular chemical exposures) may cause cancers including leukaemias in offspring.

Defendants
Nobody has placed very much reliance on Analogy. Dr. Savitz himself introduced reservations as to what analogous studies actually showed. No study shows a clear association (Rokison, Closing Submission, Day 87, p.60G).

(v) SPECIFICITY

Plaintiffs
Though this criterion is of little assistance because it cannot be proven categorically that radiation causes a specific disease, research on the incidence of NHL and a variety of leukaemias does support the Gardner hypothesis that the scattergun effect of radiation can produce a variety of leukaemias somatically. Data for Seascale reflects this variety of leukaemias.

Defendants
The Defendants maintain that the Plaintiffs' case in relation to specificity is odd. On the one hand, the plaintiffs recognise the criterion to be of little assistance, on the other, instead of complying with the demands of Specificity and attempting to identify specific diseases caused by radiation, the Plaintiffs reverse the requirement for specificity and counter with the scattergun effect of radiation. In so doing the plaintiffs are acknowledging that specificity cannot be established.

(vi) TEMPORAL ASSOCIATION

Plaintiffs
The Plaintiffs submit that there can be no dispute that this requirement is satisfied, since exposure preceded disease.

Defendants
Temporal association is generally taken to mean simply that the postulated cause must precede the postulated event which it causes and that is a necessary prerequisite and everybody agrees that is satisfied (Rokison, Closing Submission, Day 87, p.61E).

(vii) EXPERIMENT

Plaintiffs
Not relevant to this case.

Defendants
It was not suggested that there was any experimental or semi-experimental data which had any relevance to the Gardner hypothesis or to the plaintiffs' synergy theory.

(viii) BIOLOGICAL PLAUSIBILITY

Plaintiffs
The Plaintiffs submit that the evidence received from the epidemiologists (before hearing the genetic evidence) to be unanimous, namely that far from being implausible, the germline mechanism for radiation-induced leukaemia had been demonstrated (Judgment, p.34B).

Defendants
The Defendants do not contend that the Gardner hypothesis, with or without the alleged synergism or interaction with an unidentified factor X, is biologically impossible in the sense that a germline mutation may, in a rare case lead to the development of leukaemias in offspring. They do, however, contend that it is completely implausible as an explanation of the Seascale cluster, in that the relative risk is quantitatively quite out of line with human experience and is inconsistent with the results of the A-bomb data (Judgment, p.47D-F).

The final section of Chapter Four is concerned with genetics and the mechanism that explains how a mutation can be transferred to the next generation, and also, how it can do so at sufficient frequency to account for the Seascale excess.

4.5 The Genetics

Although the plaintiffs' case remained one of epidemiology, they nonetheless called experts to demonstrate the plausibility of a biological mechanism which could firstly, explain how the mutation could be transferred through the paternal germline and secondly, account for the scale of the Seascale excess.

In their interim submission on this subject, the plaintiffs contend that where, as with the Gardner study, the epidemiology is strong, the evidence could only be displaced by a clear demonstration that the causal relationship which they assert is untenable. As knowledge of the causes of cancer are still far from complete, plausibility of a genetic component is, say the plaintiffs, quite impossible to disprove. While not suggesting any formal shift of the burden of proof, the plaintiffs submit that ultimately the defendants will have to concede to the existence of a biological mechanism. Therefore as Mr. Justice French pointed out[122], what effectively separates the two parties has less to do with the plausibility of a biological mechanism and more to do with whether the biological mechanism could explain the excess of leukaemia and lymphomas around the Sellafield plant.

Prior to calling the first witness on the sixty third day of the trial however, Mr. Hytner drew the court's attention to some procedural matters that had arisen in the interim. Of particular concern at this stage of the proceedings was the attendance of Professor T. Nomura on behalf of the plaintiffs.

---

[122] Judgment p.126.

Professor Nomura, Chairman of the Department of Radiation Biology, Faculty of Medicine, Osaka University, Japan, had over a period of thirty years, focused his research almost exclusively on in-utero and transgeneration carcinogenesis, teratogenesis and mutagenesis.

Professor Nomura's research concentrated on analysing the genetic impact of exposure to various mutagens and carcinogens, including radiation in the offspring of mice. In reaching his conclusion that parental exposure to ionising radiation could significantly increase the incidence of tumours in offspring, he believed his work clearly demonstrated the plausibility of a genetic mechanism which could predispose children to cancer as a result off radiation-induced mutations in their fathers' germ cells.

Acknowledging that such effects had not been detected in the offspring of atomic bomb survivors, Professor Nomura suggested three possible causes for the apparent discrepancy which he identified as: "different germ cell susceptibility to leukaemia-causing mutations in Japanese and English people; different germ cell stages exposed in the two populations; and different postnatal tumour promoting environments" (Nomura, 1990:671). Believing his work could reconcile the differences between the A-bomb and Sellafield population studies, Professor Nomura stated his view that the Gardner study demonstrated in humans, what his experiments had shown in mice. Thus, the Gardner study accorded with his own findings that it was possible for leukaemia and other cancers to be induced genetically by the irradiation of the fathers' sperm/spermatogonia[123].

[123] Male seeds and immature male germ cells.

As far as Professor Nomura's testimony was concerned however, Mr. Hytner identified two problems that had arisen in respect of Professor Nomura's attendance at court. Firstly, he had received notification (confirmed by fax on Day 63) that as a Government employee, Professor Nomura was not permitted to take time off work to give evidence. Secondly, acknowledging receipt of a subsequent fax, Mr. Hytner drew the court's attention to a medical certificate indicating that Professor Nomura was unwell and therefore unable to travel. According to the certificate, recovery was not expected for several months.

In view of Professor Nomura's non-attendance at court, Mr. Hytner proposed submitting his testimony under the Civil Evidence Act[124]. Aware that Professor Nomura's evidence would carry far less weight than if he was able to attend in person, Mr. Hytner declared his intention of relying on other witnesses, called on behalf of the plaintiffs, to comment on Professor Nomura's findings.

The Plaintiffs' Expert Witnesses

The first witness called by the plaintiffs was Professor M.F. Greaves, Director of the Leukaemia Research Fund Centre at the Institute of Cancer Research. For the purposes of the litigation, Professor Greaves prepared four reports concerned with: the nature of leukaemias and NHLs and the mutations involved in them; the inheritance of leukaemias and NHLs; the aetiology of leukaemia and NHL; and the aetiology of the diseases of the

[124] Professor Nomura's evidence was formally submitted to the court on 4th May 1993 (Day 75 of the trial), when Dr. Cox (NRPB) was giving evidence on behalf of the plaintiffs (Day 75, p.5E-F).

two Plaintiffs.

Throughout his examination by Mr. Hytner, Professor Greaves maintained his opinion as a biologist, that the pathological division between leukaemia and NHL was blurred; a situation which occurs where there is considerable overlap between two categories of blood cell cancers. Further, recent work carried out by Professor Greaves and others in the 1980s, purported the now accepted view, that lymphomas can in fact evolve into leukaemias, thus supporting Professor Greaves' opinion that they can be part of the same disease.

Moving on to the mutations that are involved in leukaemias and NHLs, Professor Greaves corroborated the consensus view that disorders arise from a single cell and therefore result in monoclonal[125] diseases. When considering the gene mutations involved in cancer, Professor Greaves explained that gene mutations may be the result of complete or partial deletion of a gene, extra copies of a gene, rearrangement of genes or other mechanisms leading to gene mutations.

With regard to the inheritance of leukaemia and NHL, Professor Greaves affirmed his

---

[125] Monoclonal means that only the daughter cell of the mutated cell is defective. The daughter cells of other stem cells remain directly unaffected by the mutation, although indirectly the normal functioning of other cells may be upset. In contrast to monoclonal diseases are multiclonal diseases such as parasitic and bacterial infections where multiple cells are affected.

belief that both leukaemia and NHL could arise somatically and be inherited. Citing examples such as Bloom's Syndrome[126]; Ataxia Telangiectasia[127]; Duncan's Syndrome[128] and Li Fraumeni Syndrome[129], Professor Greaves suggested that Li Fraumeni syndrome provided the clearest example of a mutant gene that could both predispose and give rise to leukaemia in the offspring of those inheriting the mutation. Referring to studies[130] that observed a familial pattern of inheritance, Professor Greaves agreed with Mr. Hytner that a number of those reports identified two possible interpretations of the evidence as being: "inheritance and/or some common exposure within a household" (Greaves Day 63, 35B).

Following on from inheritance, Mr. Hytner asked Professor Greaves about gene-mouse experimentation, in particular whether genes that had been implanted into a mouse (a

---

[126] Bloom's syndrome is thought to be caused by a mutated gene which results in a defect in the protein that connects DNA.

[127] Ataxia telangiectasia is thought to be caused by a mutated gene (as yet unknown), that is linked to a protein function in the embryo.

[128] Duncan's syndrome is caused by a defect in the immune system which has the effect of predisposing the person to variety of tumours including lymphomas.

[129] Li Fraumeni Syndrome is a familial syndrome in which a number of cancers appear at increased frequency. The particular gene involved is the p53 gene. The loss or deletion of this tumour suppressor gene or anti-oncogene may give rise to leukaemia or other cancers as its function is to control dividing and growth.

[130] Studies include: Nomura (1986); Draper (1989); Narod et al. (1991); Yoshimoto et al. (1991); Kaye et al. (1991); Felix (1992).

transgenic mouse) would, once inserted into the germline as a dominant oncogene[131] (in this case one involving human leukaemia) result in offspring becoming susceptible to leukaemia and lymphoma. In response, Professor Greaves affirmed that "those mice born of that fertilised egg and their subsequent offspring can be very susceptible to leukaemia and lymphoma" (Greaves: Day 63, p. 35E). Professor Greaves went on to say that both dominant oncogenes and suppressor anti-oncogenes had been successfully used in such experiments.

When asked whether he had conducted any such experiments himself, Professor Greaves confirmed that he had been involved in one set of experiments with one particular gene in transgenesis, and that there were perhaps ten to twenty laboratories worldwide involved in similar research.

Before moving on to the aetiology of leukaemias and NHLs, Mr. Hytner wondered whether Professor Greaves had reached any firm conclusions about the Seascale excess prior to the publication of the Gardner study. Responding that he had suggested (not concluded) in a letter to the Lancet Medical Journal that "paternal mutations should be considered as an important possible contributor" to the leukaemia excess (Greaves: Day 63, p.38C-D), Professor Greaves agreed that prior to publication of the Gardner study, he had recognised the plausibility of a biological mechanism.

In respect of the aetiology of leukaemias and NHLs, Professor Greaves acknowledged

---

[131] A dominant oncogene is a gene which encourages dividing activity and leads to uncontrolled growth.

various suggested causes of the two diseases including: radiation, the HTLV-1 and EBV[132] viruses, chemicals, socio-economic factors, drugs and electro-magnetic fields. In the opinion of Professor Greaves, the virus theory, in particular the Kinlen hypothesis[133] that childhood leukaemia may be due to an abnormal and/or rare response to a common infection had some validity. However, Professor Greaves made it clear that he parted company with Professor Kinlen over the particular virus responsible. According to Professor Greaves, it could be any one of a number of viruses, known or unknown, or it could be bacteria. Further, he did not accept that viruses working on their own could account for the level of the excess found at Sellafield.

With regard to the relevance of socio-economic factors, again Professor Kinlen and Professor Greaves arrived at different, although not dissimilar conclusions on the basis of their research. In contrast to Professor Kinlen's United Kingdom located studies which looked at the operation of a viral mechanism in high socio-economic rural communities, Professor Greaves investigated different ethnic and geographical communities across the world. On the basis of his observations he concluded, that with socio-economic development, there was an elevated risk of childhood leukaemia, and the risk was an increased risk of the order of a ten-fold increase. Linked to infection and patterns of exposure to viruses therefore, were environmental factors related to: hygiene, smaller

---

[132] The Epstein Barr (EBV) virus has been particularly associated with part of the causal mechanism (along with malaria as a crucial co-factor) in Burkitt's lymphoma in Africa. More recently EBV has also been implicated with non-Hodgkin's lymphoma.

[133] See Ch.4(4) for a wider discussion of the Kinlen hypothesis.

family size, occupancy of houses and lower population density impacting with other factors.

Moving on to the aetiology of leukaemias in relation to synergy between radiation and viruses, Professor Greaves said he endorsed what most biologists would have predicted, synergy is a powerful factor in both human and animal cancer. Referring to the work of Dr. Berns in Holland, Professor Greaves explained that Dr. Berns had carried out synergistic experiments with inherited genes and other agents (chemicals, viruses) to establish whether this combination would produce a greatly increased rate of leukaemia and lymphoma. As a consequence of such experimentation, synergy between inherited genes/chemicals and inherited genes/viruses translated into a 20-fold increase.

Asked to explain the apparent absence of any observed synergistic effects in Japan between the A-bomb and other factors such as viruses, Professor Greaves said that in contrast to the defendants' experts (Professor Schull and Professor Kinlen), he had no knowledge of the prevalence of the HTLV-1 virus[134] in Japan prior to 1961. In any event, he rejected any notion that there was one definitive virus responsible for childhood leukaemia, or the view that all viruses acted in the same way. Whatever the underlying reason, it was Professor Greaves' conviction that a vital component of synergy was missing.

---

[134] Professor Greaves also argued that only a small number of people who are infected with HTLV-1 actually develop the disease. The Japanese estimate suggest one in one thousand. Therefore only a small number of cases of leukaemia due to HTLV-1 virus would be evident over the subsequent 50 years in Hiroshima and Nagasaki.

Citing the findings of the Gardner study and the conclusions of the Parker/Wakeford study in support of his opinion that some additional factor, other than paternal mutations was present at Seascale, Professor Greaves provided two specific examples of synergy - the papilloma virus and bracken[135] in relation to animals, and environmental radiation in relation to humans.

Acknowledging the fact that evidence had already been given in respect of environmental radiation being associated with, and/or causing a percentage of childhood leukaemias, Professor Greaves declared that although he preferred the virus option, he had no quarrel with the view that synergy combined with PPI could in principle account for the Seascale excess.

Following Professor Greaves, the plaintiffs called Professor D.H. Wright, Chair of Pathology at Southampton Hospital. For the purposes of the court, Professor Wright prepared two reports in which he considered the heterogeneity of leukaemia sub-types and known causes of leukaemia and NHL.

In respect of the first point, Professor Wright stated that in his opinion both leukaemia and NHL were derived from immature cells of the lymphoid system, and therefore had common aetiologies. Referring to his experience as a clinician and pathologist, Professor Wright agreed there were certain lymphomas and leukaemias where the dividing line was

---

[135] 'Papilloma bovine virus' and 'bracken fern' are the subject of a study carried by Dr. Ruth Jarrett which brought together biological and epidemiological studies to show that a combination of exposures to bracken and the virus accounted for the high frequency of cancer in cattle.

so narrow as to be almost indistinguishable. Elaborating on the similarity, Professor Wright cited the example of a patient who enters one door of a hospital and has a lymph node biopsy done and is diagnosed with a lymphoma. The following day, the same patient enters the identical hospital by another door, and has a blood count and marrow examination done, on the second occasion, the patient is diagnosed with leukaemia.

With regard to the causes of leukaemia, Professor Wright said he concurred with the view of Professor Greaves and others, that inherited gene line mutation could give rise to different types of cancer. However, Professor Wright also pointed out, in the case of an inherited gene mutation which was present in every living cell, that the resulting disease, be it leukaemia or lymphoma was dependent upon the **nature of the co-factor** (whether it be viruses, PPI, or chemicals) as well as the **number of hits** (first, second, third) acting in synergy with the mutation.

The next witness called by the plaintiffs was Professor J.C. Neil, Chair of Veterinary Pathology, University of Glasgow. Professor Neil had since 1974 been involved in the study of retroviruses[136] and was widely regarded in the field of virology.

According to Professor Neil, it was possible for cancer-inducing viruses to invade the nucleus of the cell in two ways. In the first instance, the virus could integrate into the host DNA[137] **directly** with the result that the gene may become inactivated and/or

---

[136] A retroviruses is a subdivision of viruses.

[137] The nucleus of every cell contain a molecule of acid, deoxyribonucleic acid (DNA).

damaged, impairing or abolishing its function. Alternatively, a virus could **indirectly** affect the DNA by altering the expression of a cellular gene by virtue of the information which the virus brought in. Therefore without integrating into the DNA directly, the virus could replicate the DNA and affect the proliferation of the cell. Also, again indirectly, the virus could affect other cells which do not contain the virus, causing them too to proliferate.

Under examination by Mr. Hytner, Professor Neil affirmed the existence of a wide diversity of viral agents known to be associated with cancers in animal and man. Professor Neil confirmed that by far the largest, most diverse, and best known group were retroviruses, which had been implicated with cancers, particularly leukaemia since 1908.

As far as viruses/retroviruses are concerned they may be endogenous[138] or exogenous[139], the latter being regarded as unstable and potentially cancer-inducing. When asked by Mr. Hytner which explicit viruses had been implicated in human populations, Professor Neil cited EBV (an exogenous virus), HTLV-1 and HIV[140] (two

---

[138] An endogenous virus/retrovirus is one that is inherited in the germline. According to Professor Neil they are regarded as very stable elements in DNA and are not thought to be harmful or cause any known diseases.

[139] Exogenous viruses/retroviruses have an external origin and are implicated in the spread of infections involved with cancer.

[140] B cell lymphomas are relatively common in AIDS patients so it would appear that HIV may directly promote tumours. Indirectly however, because the viral genome is not generally found in the tumour cell, this suggests one of two possibilities. The first mechanism said Professor Neil, is through impairment of the host's immune system. The second, by the virus affecting the B cells and causing them to proliferate.

exogenous retroviruses). However, he also said that in his opinion, it was unlikely that these were the only viruses/retroviruses implicated in human cancer.

Developing this point further Professor Neil went on to say:

> The acceleration phenomenon appears to depend on the capacity of the virus to activate cellular genes which act synergistically with the inherited oncogene to reveal the fully malignant phenotype (Day 69, p.20B).

Notwithstanding the fact that human viruses are efficient carcinogens in their own right, they nonetheless all require co-factors[141], acting in synergy in order to be effective, to date, there have been no human cases[142] of a virus operating on its own.

Later, when asked under cross-examination about the relevance of co-factors in relation to leukaemia and NHL, Professor Neil reiterated the conclusions of his report, that in his judgment:

> .....it is quite conceivable that a virus could interact with preconception paternal exposure to radiation to induce leukaemia and lymphomas of diverse types (Day 70, p.32H).

Following Professor Neil, the plaintiffs called another three genetic experts[143] to

---

[141] Such as chemicals, drugs, irradiation, socio-economic factors.

[142] Professor Neil did express the view that a feline leukaemia virus might be able to act on its own in respect of cats. However, this is a particularly potent virus which often results in the death of the host.

[143] Professor Meuth; Dr. Thacker; Dr. Cox.

demonstrate to the court firstly, how little is actually known about the mutation rates of complex illnesses such as cancer. Secondly, to identify various mechanisms recently implicated in the onset of tumours. Thirdly to show how problematic it is to rely on conventional genetics when analysing the plausibility of the Gardner hypothesis.

The first expert, Professor M. Meuth, Chair of Radiology, Head of Experimental Oncology, University of Utah, described his area of interest as genome instability and oncology, specifically, the role of unstable regions of DNA[144] in cancer. Professor Meuth's primary aim therefore, was to understand the "chromosomal rearrangements between mutations that occur particularly in tumour cells and ultimately to define the mechanism underlying their formation" (Day 71, p.4A).

Agreeing with Mr. Hytner that his interest in the genetic effects of radiation developed as a consequence of the now widely accepted view of the seriously disruptive effects of radiation on chromosome structure, Professor Meuth confirmed:

> These research interests have led me and my collaborators to make comprehensive

[144] These are sequences of DNA which have a high frequency of breakage and are prone to re-arrange or change their orientation. These may include structures such a 'telomores' (TLRs are ends of chromosomes), or, 'fragile sites' known as transposons (of which there are large numbers in the genomes of all mammalian cells). Because of their chromosomal locations damage is more likely.

analyses of the molecular basis of spontaneous[145] and radiation induced mutations in model cell culture systems (ie experimental systems using animal cells) (Meuth Day 71, p. 7F).

Having established Professor Meuth's main area of interest, Mr. Hytner proceeded to question Professor Meuth on the estimated number of 'radiation induced' mutations that occur. Commenting that it was difficult to provide exact numbers, Professor Meuth did confirm that 'some' mutations were believed to be due to environmental radiation, while others were known to result from deamination[146] (chemical processes).

Moving on to experimentation, Professor Meuth affirmed his belief that radiation does increase mutations. Referring to his experiments with hamster cells in which he compared the frequency of mutations induced by gamma radiation with those that occur spontaneously[147], Professor Meuth said he discovered significant differences between the spontaneous and radiation induced mutations. One particularly unusual type of mutation, discovered after irradiation, was the multiple mutations found in localised regions of the affected gene which could, as a consequence of a defective repair mechanism lead to "double strand breaks in the DNA, and subsequently either to the

---

[145] Spontaneous has two meanings in this context. Firstly, as something which occurs within the cell without any outside influences. Secondly, as something that occurs due to causes. Recently the term 'spontaneous mutation' has been used where environmental agents have impacted on cellular processes and cellular metabolism, altering the basis of the DNA structure with the result, that there is a change in the nucleotide sequence.

[146] A chemical process which involves the removal of one more amino groups from a molecule.

[147] In respect of Professor Meuth's research, 'spontaneous' means no known selective damaging agent was applied to the cells.

formation of deletions or more complex type rearrangement of DNA" (Meuth Day 71, p.14G). In particular, these double strand breaks could also lead to the rearrangement and inactivation of adjacent genes.

Professor Meuth went on to propose two explanations for multiple mutations as a consequence of ionising radiation. Firstly, a mutator gene which had the effect of increasing the rate of mutations throughout the genome. Secondly, a defective DNA repair mechanism, which as a result of exposure may become 'error prone'.

Questioned by Mr. Hytner as to whether there was any human experimental support for the hamster cell experiments, Professor Meuth said that while further experimentation was under way, the work of Dr. J. B. Little at Harvard Medical School, was able to provide further evidence for 'inducible mutator genes' resulting from irradiation. Asked by Mr. Justice French to confirm that "these are genes which produce non-targeted (random) mutations throughout the genome in irradiated cells many generations after the original exposure" (Day 71, p.18H), Professor Meuth confirmed this to be correct. Clarifying this point further, Professor Meuth explained, if such mutator genes occurred in the germline, it could produce sperm with mutations over many months and over many cell generations.

Confirming his work involved relatively small numbers, and presently only dealt with acute as opposed to chronic radiation, Professor Meuth reiterated his observation that on the basis of his research:

> A recurrent feature of many lymphoproliferative disorder is the presence of non-random chromosomal rearrangements (i.e. chromosomal rearrangements which are consistently of a certain type). There is good evidence that at least some of these

rearrangements may be the result of aberrant joining of unlinked DNA fragments (e.g. fragments which have arisen as a result of radiation-induced breaks in the DNA) (Meuth:Day 71, p.25F).

In summarizing his position Professor Meuth said:

i) Ionising radiation significantly increases the frequency of complex rearrangements in somatic cells. These have not been detected among spontaneous mutants. Insofar as some of these complex rearrangements involve small regions of DNA, it is perfectly possible that they are capable of being inherited.

ii) Recent work suggests that inducible responses, that is the mutator genes, could directly increase the level of DNA instability for prolonged period. The induction of such mutator genes in spermatogonial stem cells could lead to the accumulations of mutations in mature sperm long after exposure. Mutator genes would also have significant effects on somatic cells.

iii) There is clear evidence of an interrelationship between the pathways involved in processing of antibodies and the repair of radiation-induced damage. This increases the risk of non-random rearrangements in somatic cells (B and T cell lineages) leading to activation of oncogenes (initiation of cancer) (Meuth: Day 71, p.27H-28E).

The next witness called by the Plaintiffs was Dr. John Thacker, Head of the DNA Repair and Mutagenesis Group at the Medical Research Council's Radiobiology Unit. For the purposes of the court Dr. Thacker prepared two reports concerned with the apparent discrepancy between the 'genetic risk estimates' calculated from the A-bomb survivors and the mouse data, in comparison with the 'risk estimates' implied by the Gardner study[148]. In his assessment, Dr. Thacker addressed two main points. Firstly, the dose effect in respect of acute v chronic irradiation. Secondly, the variation in the radiosensitivity of certain genes. Acknowledging that scientists did not understand the the full genetic and biological consequences of radiation exposure and that further analysis

[148] The 'genetic risk estimates' derived from the atomic bomb and mouse data imply that the doses received by the fathers in the Gardner study were insufficient to account for the leukaemia excess.

of radiation-induced mutations in the human genome was needed, Dr. Thacker stated:

> Two of the mainstays of current radiation risk estimates for genetic effects are the human atomic bomb data and the experimental mouse gene mutation frequencies. I believe that the above analyses show that neither of these data sets can be used straightforwardly to predict the outcome of specific mutagenic or carcinogenic effects of radiation; to do this we need specific information on both the genes (and chromosomal regions) involved and the relative effectiveness of the doses and dose rates experienced (Day 73, p. 31B).

> .....we will not understand the potential mutagenic and carcinogenic consequences of radiation exposure until we have thoroughly analyzed radiation induced mutation at representative sites in the human genome (Day 73, p. 37D).

Referring to the inadequacy of the mouse data in respect of the 'specific locus test'[149] to detect mutations, and the 'indirect doubling dose method'[150] to assess risk, Dr. Thacker confirmed that it was very difficult to extrapolate risk estimates from mice to men.

---

[149] A system of murine (mouse) experiments to detect recessive (double chromosome) mutations in offspring. Originally pioneered by Professor Russell (1954), he identified seven specific loci (genes) which when mutated, gave rise to six specific 'coat' variations and one 'short ear' variation from the norm. When the 'test' mouse was subsequently mated with a 'normal' parent who was also irradiated, the consequences were observed in the offspring and the 'normal' (now irradiated) parent. Later the 'specific locus test' was extended to dominant (single chromosome) skeletal and cataract mutations.

[150] The data from the experiments with mice can be used to estimate radiation induced genetic risk in humans. The 'indirect doubling dose method' is doubling the amount of radiation it would take to double the spontaneous mutation frequency. This is done by observing mutation rates in future generations and then working backwards to estimate risk in first generations.
An alternative is 'the direct method' of risk assessment pioneered by Professor Ehling and developed by Dr. Selby, which makes an estimate of human damage in the first generation based on experimental damage in the first generation directly.

Under cross examination by Mr. Rokison on behalf of the defendants, Dr. Thacker provided a number of reasons for his opinion on this matter including:

1. There is no proof that the sensitivity of the human and mouse genome is equal.

2. The 'specific locus experiments' preclude analysis of more than a few genes.

3. There are no large scale studies of mice.

4. The genetic endpoint in respect of mice 'coat colour' and ' short ears' are not the same as the endpoint of leukaemia and lymphomas cited in the Gardner study.

5. More recent studies at a molecular level show that radiation induces a much higher frequency of complex rearrangements.

6. The atomic bomb and mouse data are based on 'acute' high doses not 'chronic' low doses of radiation.

Following Dr. Thacker, the plaintiffs called Dr. Roger Cox, Head of the Biomedical Effects Department, National Radiological Protection Board. For the purposes of the court Dr. Cox prepared three reports concerned with the "possible germline mechanisms that can influence the appearance of cancer in human families and populations [when placed in the context of] possible associations between paternal radiation exposure at Sellafield and the increased leukaemia incidence in the offspring of exposed workers" (Day 73, p.1H-2A).

Confirming that there was now unambiguous evidence from clinical, epidemiological, cytogenetic[151], and molecular studies within human population, that individuals and families carry mutations in germ cells which could predispose them to the development of cancer[152], Dr. Cox went on to explain that the same genes may also give rise to non-

[151] Study of chromosomes.

[152] Transgeneration carcinogenesis.

inheritable (sporadically) arising tumours.

Moving on to the work and competence of Professor Nomura, Dr. Cox confirmed that in his judgment Professor Nomura was a competent worker. Asked by Mr. Hytner whether he had any concerns over Professor Nomura's recent research, Dr. Cox admitted to having a number of reservations with regard to the design of the study.

Under cross examination by Mr. Rokison, Mr. Justice French intervened to ask Dr. Cox his opinion of the international standing of Professor Nomura. In response Dr. Cox replied:

> He is a well recognised mouse geneticist, my Lord. Certainly this is a contentious area and there is a good deal of dispute amongst the mouse geneticists and people like me, if you like, who are somewhat on the edge of it but interested in cancer. I would say that I would regard him as competent. This is a study that has caused problems. On the other hand the study that Professor Nomura did which I am not so familiar with, which was with congenital malformations, also raised a great deal of contention at the time it was published but was then subsequently repeated by others, notably Dr. Lyon at the Radiobiology Unit. I would have the same problem really commenting on the standing of many people. He is a well recognised worker (Day 75, p.49F-H).

Dr. Cox confirmed that as yet there had been no attempt to replicate Professor Nomura's studies, reiterating the point that "it is not that people had tried to do it and failed. As far as I am aware nobody has actually repeated his study" (Day 75, p. 50C).

When asked by Mr. Hytner his opinion of the Gardner hypothesis in conjunction with the findings of Professor Nomura, Dr. Cox replied:

> The Sellafield findings are, in part, qualitatively supported by the data from Nomura's mouse studies but neither study can be easily reconciled with current views on germ cell mutagenesis...To different degrees both studies demand a

> radiation mutagenesis mechanism that generates high frequency germ cell events relatively specific to tumourgenesis, ie certain tumour associated genes of DNA sequences are preferentially damaged. Further to this, in order to explain the absence of such mutations in Japanese children whose parents received higher doses than the Sellafield fathers it is also necessary to postulate the existence of genetic factors of ethnic origin and/or the involvement of unconventional genetic mechanisms that might have unusual properties with regard to dose and dose-rate effects (Day 75, p.9C-D).

Dr. Cox went on to say however, that despite the limited knowledge on the mechanisms involved and their relationships to leukaemutagenesis, it was not possible to preclude any strictly scientific judgment "on the specific probability of a causal relationship between doses to the fathers and leukaemia in their offspring. I suggest such a causal relationship should not be excluded on mechanistic grounds" (Day 75, p.29B).

The final witness due to be called on behalf of the plaintiffs was Professor U.H. Ehling[153] who along with others in his field, is acknowledged as one of the main figures in mouse genetics. Prior to the trial, Professor Ehling had written a review article setting out all the uncertainties as regards mouse genetics. In the build up to the exchange of reports in June 1992, having originally agreed to submit a report, Professor Ehling instead submitted his article as evidence. Shortly before Professor Ehling was due to appear in court however, the defendants decided to agree the article and not challenge Professor Ehling's evidence, negating any need therefore for the plaintiffs to call him as a

---

[153] Professor Ehling developed the 'direct' method of risk assessment which was later developed by Dr. Selby. This method, in contrast to the 'indirect doubling dose' method, does not double the spontaneous dose rate in order to assess risk in respect of the mutation rate in offspring.

witness[154]. As a consequence Professor Ehling's evidence was submitted under the Civil Evidence Act.

From the unchallenged evidence[155] of Professor Ehling, Mr. Justice French gleaned the following information[156]:

a) There is no proof that the radiosensitivity of the human and mouse genome is equal.

b) There is no proof that the genes selected in these [mouse] experiments are representative of the whole mouse genome.

c) It is meaningless to determine an average mutation rate for all genes.

d) Extrapolation from mouse to man should be based on the same endpoints.

e) The skeletal method is less reliable than the cataract[157].

f) An integral component of the 'direct method' is the incidence of multifactorial disease.

Having completed their evidence in respect of the genetics part of the case, the plaintiffs concluded in respect of:

---

[154] Professor Ehling did assist the Plaintiffs' legal team later on the trial however (when Dr. Selby was challenging the competence of Professor Nomura).

[155] Although originally agreeing not to challenge Professor Ehling's evidence and allowing it stand on its own, the defendants later disagreed with the plaintiffs interpretation of the review article and challenged it in their Closing Submission. A point highlighted by Mr. Hytner in his Closing Submission on behalf of the plaintiffs (Day 89, p. 61E-F).

[156] Judgment p.132.

[157] His Lordship is refering to the 'specific locus test'. See Footnote 149 for more information on this.

Dorothy Reay:

She was part of the Seascale excess.

Her father, George Reay's dose was extremely high and in light of Dorothy's age at onset, the most likely explanation for her leukaemia was her father's PPI.

There is no evidence of interaction or synergism with other factors.

The second hit would have occurred as a consequence of a 'spontaneous mutation'.

Vivien Hope:

Although deemed by the defendants 'not to be part of the Seascale excess', she should for all practical purposes of the litigation be included: her father was exposed to high doses of radiation and therefore subject to PPI; Vivien was born only a few miles away from Seascale; she lived at Seascale from the age of six (until her lymphoma was diagnosed at 23); she worked at Sellafield.

A plausible explanation in Vivien Hope's case is that she inherited a predisposition to virally induced Burkitt's lymphoma; when exposed later in life to the virus she therefore contracted NHL. In addition, a further hit (second or third) was environmental radiation from Sellafield to which she had been exposed for 23 years.

The Defendants' Expert Witnesses

In order to counter the plaintiffs' claim of a plausible biological mechanism which could firstly, account for paternal germline mutation and secondly, explain the frequency of the Seascale excess, the defendants' experts concentrated on the following areas:

1. The plausibility of a biological mechanism in respect of paternal germline mutation and the Seascale excess.

2. The heritability of leukaemia and NHL.

3. The level of radiation exposure received by the parents.

The first witness called by the defendants was Professor E.J. Hall, Chair in Radiation Oncology and Radiology, Columbia University. For the purposes of the litigation Professor Hall prepared three reports concerned with:

> ...what is known about the interaction of ionising radiation with biological material, and the radiobiological principles that have emerged concerning the effects of radiation quality and radiation dose-rate. The purpose of this report

..... to arrive at a comment on the feasibility of the Gardner hypothesis, namely that paternal exposure to radiation over a period of time may lead to leukaemia or lymphoma in the offspring (Hall:Day 77, p.6H-7A).

In reaching his conclusion that the Gardner hypothesis was highly unlikely, Professor Hall stated his opinion that there was insufficient knowledge about radiation induced cancer or leukaemia inherited through the germline. Any information that does exist in relation to biological dose rates or mutation rates are based on the A-bomb data which contradicted the Gardner findings. According to Professor Hall, the hypothesis inherent in the Gardner report "namely that leukaemia may be induced in offspring by paternal irradiation by being transmitted via the germ cells represents a mechanism unknown to conventional radiation biology" (Day 77,p. 25A-B). Further said Professor Hall, if radiation induced mutations were to be propagated through the paternal germline, a whole range of other genetic defects would be expected:

> Leukaemia alone, in the absence of a whole spectrum of other malignancies and mutations leading to structural deformation, is difficult to imagine (Day 77, p.27D).

Albeit, as Professor Hall explained, the A-bomb data itself did not reveal any radiation induced tumours not seen before.

When asked by Mr. Rokison on behalf of the defendants, whether paternal preconception irradiation offered a plausible explanation for the Seascale excess from a genetic perspective, Professor Hall agreed it was theoretically plausible:

> I think one has to say that it is theoretically plausible because, on the one hand, we know that radiation induces mutations, and, on the other hand, we know that leukaemia has some familial trait, though weak, and those two things put together, I think it would not be fair or reasonable to not concede it was theoretically plausible (Day 77, p.39D-E).

Under cross examination by Mr. Hytner on behalf of the plaintiffs, Professor Hall was asked to confirm his input (along with others) into the BIER V Report, in particular Chapter Three, 'The Mechanisms of Cancer' which stated:

1. The effects of radiation and chemical carcinogens which lead to cancer are dose dependent and generally irreversible.
2. The carcinogenic process is dependent on cell proliferation.
3. The changes that initiate carcinogenesis in a cell are passed on to daughter cells.
4. The subsequent events in carcinogenesis can be profoundly influenced by various non-carcinogenic factors.
5. Tumours tend to become increasingly malignant with time through the stepwise outgrowth of progressively more malignant subpopulation of tumour cells.
6. A synergistic interaction between the initiating effects of radiation (or various chemicals) and specific promoting agents is now known to occur in many different organs and cell systems (Day 77, p. 58D-G).

Confirming that he had considerable input into this chapter, Professor Hall acknowledged that an initiating event, such as a mutation, could pass through the germline and upon exposure to a second event, express itself in a particular endpoint. Professor Hall also agreed with Mr. Hytner, that it was important not to be unduly sceptical about scientific thesis that had the support of other experimental data.

The next witness called by the Defendants was Dr. Paul Selby, Senior Research Scientist in the Biology Division of Oak Ridge National Laboratory[158], Tennessee. For the purposes of the court Dr. Selby prepared two reports which firstly, provided a detailed synopsis of his experience[159] and research interests, and secondly, considered the

---

[158] Oak Ridge National Laboratory is an outgrowth of the Manhattan Project which developed as a consequence of World War II.

[159] Dr. Selby worked with Professor Russell who developed the original 'specific locus test', and later with Professor Ehling who pioneered the direct method of risk assessment. Dr. Selby went on to develop the work of Professor Ehling.

Gardner hypothesis and the work of Professor Nomura.

In respect of the work of Professor Gardner, Dr. Selby concluded:

> It thus appears that Gardner's hypothesis has no biological plausibility and simply resulted from a correlation, based on small numbers, that gave a significant result when, in reality no real difference existed. In view of the profound implications of the Gardner hypothesis to the uses of nuclear energy, and even to the uses of diagnostic and therapeutic radiation (especially when that hypothesis is extended to the view that 10 mSv has a serious heritable genetic effect), it is unfortunate that the authors did not give more attention to assessing the plausibility of the hypothesis before alarming the public (Day 78, p. 50E-F).

Although not an epidemiologist, Dr. Selby went onto say:

> ...it is extraordinarily unlikely that the acute leukaemia in the Reay child or the non-Hodgkin's lymphoma in the Hope child had any relationship at all to the preconception radiation exposure of their parents. Had the radiation exposure of either or both their parents been responsible for these kinds of diseases, there should have been an epidemic of all kinds of genetic disorder in the communities where the fathers lived who worked at Sellafield. Such epidemics should also be apparent throughout the world around all nuclear plants.. (Day 78, p.53G).

With regard to work of Professor Nomura, Dr. Selby was less circumspect, resorting to adverbs like "falsely" and adjectives like "preposterous", "misleading" and "amazing". Indeed so serious were the allegations in respect of Professor Nomura's professional integrity and competence[160], Mr Hytner intervened during Mr. Spencer's examination of Dr. Selby, to draw his Lordship's attention to the fact that Dr. Selby's criticisms went far beyond those identified in his reports.

In light of Dr. Selby's condemnation of Professor Nomura's methodology and

---

[160] At one point in his second report, Dr. Selby suggested that Professor Nomura did not know the difference between spermatogonia and spermatozoa.

interpretation of results, Mr. Spencer suggested to his Lordship, a 'reading day' the following Monday[161], to give the plaintiffs' legal team extra time to consult with Professor Nomura. In rejecting this suggestion Mr. Hytner said:

> My Lord, I am not accustomed to walking into an elephant trap, particularly when it is signposted and uncovered. The situation is very simple, as my learned friend knows. We have had, I won't say sprung on us, that is pejorative, we have been confronted today with highly detailed evidence which has not appeared in any of Dr. Selby's reports. (Day 79, p.97A-B)

Reminding his Lordship of the two affidavits and one medical report relating to Professor Nomura's non-attendance, Mr. Hytner went to say:

> My Lord the situation is that the original reports were obtained with some difficulty. It entailed two solicitors, one with scientific qualifications, flying to Japan and having an all day interview with Professor Nomura, when copious notes were taken. My Lord, he asked for the report to be written, or a draft to be written from those notes for him to correct. My Lord the draft was sent to him; he corrected it. My Lord, we anticipate that if any attempt was made now to send the whole of two days' transcripts, or certainly a full day's transcript by fax, to Professor Nomura over the weekend it would entail, as your Lordship now appreciates, Professor Nomura waltzing from report to report on his own, through the transcript, trying to work out precisely what it was that is being said against him. It then entails him writing copious instructions.
>
> My Lord, if that were done by Monday I hope your Lordship appreciates that in the time I would have to consider the instructions any cross-examination of mine would be a floundering one. My Lord, it would then give the Defendants the opportunity to say, "Well Dr. Selby was cross-examined and his evidence stood up". My Lord I do not propose to fall into that trap (Day 79, p97.D-F).

Over the weekend contact was finally made with Professor Nomura, resulting in over forty pages of faxed material (Day 82, p.1E-F). In the event however, and despite the assistance of Professor Ehling on the Sunday, the task proved too difficult. Time

---

[161] Mr. Spencer suggested on Friday afternoon (Day 79), having Monday (Day 80), as the 'reading day' in order to facilitate the plaintiffs' solicitors communication with Professor Nomura. The plaintiffs would therefore have three days, instead of two, to address any criticisms by Dr. Selby.

limitation, cost and language difficulties led the plaintiffs' legal team to make the tactical decision not to challenge Dr. Selby on Professor Nomura's work. Under cross-examination on the Monday therefore, Mr. Hytner stayed clear of any reference to the serious allegations made by Dr. Selby[162].

Instead, throughout his cross-examination, Mr. Hytner concentrated on undermining Dr. Selby's self confidence by challenging the many criticisms he made in respect of Professor Gardner, other geneticists and public bodies. Mr Hytner pointed out to Dr. Selby that many of the witnesses he castigated were in fact "scientists at the top of their professions and highly respected in their field" (Day 80, p.10B).

Beginning with Professor Gardner, Mr. Hytner asked Dr Selby how a geneticist could be so critical of an epidemiologist. Acknowledging that he had not trained as an epidemiologist, Dr. Selby qualified the statement by informing the court that neither was he a novice when it came to statistics. In Dr. Selby's opinion the Gardner results should not have been published until the Gardner team had "deeply consulted" with geneticists involved with risk. Reminded by Mr. Hytner that this was an **epidemiological** study set up publicly (by a public body) to look into an association between an excess of leukaemias and a nuclear installation, Mr. Hytner went on to explain that in common with other studies, the findings were published and not suppressed. Perhaps, implied Mr. Hytner, Dr. Selby did not give credence to epidemiological studies per se, particularly if they conflicted with his own opinions on genetic risk.

---

[162] A point taken up by Mr. Rokison in his Closing Submission on behalf of the defendants (Day 87 p.13H).

Moving onto the two divided camps that exist in the world of genetic risk assessment, Mr. Hytner referred specifically to the 'direct' method of calculating risk developed by Dr. Selby, and supported by UNSCEAR[163], and the 'indirect' doubling dose method of risk calculation supported by the BEIR V Committee[164], appointed by the Academy of Sciences. Which camp, asked Mr. Hytner should an epidemiologist like Professor Gardner support?. Admitting that both methods had problems, and that neither method would ever be completely free of assumptions (Day 80, p.24D), Dr. Selby agreed that risk estimates were poor if you needed a precise answer.

Mr. Hytner then put a number of questions to Dr. Selby including:

- Do you accept the proposition that mutations are induced by radiation?
- Is radiation effective at causing deletions and rearrangements?
- Can mutations be transmitted through the germline?
- Can large chromosomal changes be passed through the germline?
- Do you agree that there is no proof that the radiosensitivity of the human and mouse genomes are equal?
- Is it questionable whether the genes selected in the specific locus and direct experiments are representative of the whole mouse genome?
- Is it true that specific locus experiments cannot be used to determine the magnitude of damage that would be encountered in the first generation.
- Wherever possible extrapolation from mouse to man should be based on experimental results using the same genetic endpoint in mouse and man?
- A better experimental data base needs to be compiled for the direct estimation of genetic risk?

---

[163] United Nations Scientific Committee on the Effects of Atomic Radiation.

[164] Committee on the Biological Effects of Ionising Radiation.

Suprisingly Dr. Selby's response to all the above questions was affirmative. Therefore while not intending to offer any support to the plaintiffs' case, his answers (at the very least) revealed certain inconsistencies in his thinking.

Moving on to Professor Nomura, although Mr. Hytner chose not to challenge Dr. Selby directly on his opinion of Professor Nomura's integrity and competence, he did point out some anomalies in relation to Dr. Selby's attitude to Professor Nomura.

For the purposes of the court Professor Nomura prepared three reports, the first was sent to Dr Selby for comment in June 1992, the second in September 1992; the third in December 1992. According to Dr. Selby's testimony, upon receipt of the second report in September 1992, he was aware of Professor Nomura's incompetence as regards methodology and interpretation of results and yet, in February 1993 Dr. Selby participated in the writing of a two papers which treated Professor Nomura's data and results with due academic regard. In response Dr. Selby said:

> Regardless of the state of erosion of my confidence in the work of Professor Nomura, my Lord, the results still are in the literature and of interest. They remain of interest and I feel that both of the publications, the one that is in press and I hope mine will be published, shed important alternative view in regard to positions that Professor Nomura has taken. But they do not at all get into the question of questioning his competence. They question very strongly his interpretation of data. It would be up to others whether or not they would draw from that that his competence was in question (Day 80, p.50A-B).

When asked by Mr Hytner whether having publicly castigated the reputation of Professor Nomura in open court, he should not also alert the editors of respective journals to the incompetence of Professor Nomura's work, Dr Selby said he saw no reason to personally write to them.

Finally, Mr Hytner asked Dr. Selby why, when Professor Nomura's research had been under the spotlight for over twenty years, other scientists had not also condemned his findings and further, why numerous eminent scientists had allowed their names to be incorporated into his research, thereby endorsing his work. Mr. Hytner went on to point out that Professor Nomura had published articles, in many cases, very prestigious journals, in other cases reasonably prestigious journals, and that it was unlikely that peer reviewers, knowing the controversial nature of his work would be hoodwinked by the data. In response, Dr. Selby said firstly, scientists do not like to criticize other scientists. Secondly, it was possible that many of the eminent scientists mentioned by Professor Nomura were not actually endorsing his work. Thirdly, many peer reviewers do not take their job as seriously as they might, agreeing with the hypothesis put forward by Mr. Hytner, that they were careless and not as competent as they should be (Day 80, p.57B).

In conclusion said Mr. Hytner "It really does appear to be the case, does it not, Dr. Selby, of "Everybody's out of step except Johnny"?.

On the eighty second day of the trial, Mr. Spencer called A.B. Rickinson, Professor of Cancer Studies and Head of Cancer Research Campaign Laboratories at the University of Birmingham.

Throughout his professional career, Professor Rickinson had worked on the Epstein Barr Virus and on the pathogenesis of tumours associated with that condition, in particular Burkitt's lymphoma, which he had studied for over twenty years. The aim of Professor Rickinson's report was to comment on the diagnosis of Burkitt's lymphoma in respect of

Vivien Hope.

According to his testimony, lymphoma is a malignancy identifiable through a characteristic marker on the surface of the tumour cells. The malignancy derives from a specific set of chromosomal translocations which affect the immune system from a very young age (childhood). Professor Rickinson believes the translocation to be a somatic event which occurs by reason of errors in the normal development process. He considered an inherited predisposition to such a translocation to be unlikely. Burkitt's lymphoma, although occurring worldwide is most commonly found in equatorial Africa and New Guinea where it is the commonest childhood cancer.

Moving on, Professor Rickinson confirmed the predisposing role of malaria for Burkitt's lymphoma and also explained how in HIV patients, one of the common manifestations of AIDS, before the onset of other symptoms, is Burkitt's lymphoma. As far as Epstein Barr is concerned, as many as fifteen to twenty per cent of cases were found to be virus positive[165]. In the case of Vivien Hope however, neither malaria nor HIV were found to be predisposing factors, further she was found to be negative in respect of the Epstein Barr virus.

In reaching his conclusion that it was unlikely that radiation damaged the paternal genetic information thereby altering the risk for Bukitt's lymphoma in subsequent children, Professor Rickinson highlighted the complexity of determining how Burkitt's lymphoma

---

[165] With the Epstein Barr virus, genetic material actually exists within the tumour cells.

arises in EBV immune individuals. Under cross examination by Mr. Hytner, Professor Rickinson proffered the view that where there was no EBV virus, another virus, a surrogate may be responsible.

Following Professor Rickinson, Mr. Rokison briefly recalled Professor Neel[166] who had, since his previous appearance in court, produced a fourth report. According to the Defendants, this report was required as a consequence of a number of important scientific and other developments, in particular the Kinlen findings, and the fact that Professor Neel believed that the Plaintiffs' case had changed from one of parental preconception radiation alone, to the inclusion of a potential co-factor (Factor X).

Having taken Professor Neel through some areas of his first three reports again, Mr. Rokison them moved onto radiation as a co-factor, and the findings of the Kinlen (1993 Seascale) study which concluded that paternal preconceptional radiation could not explain the excess of leukaemia and NHL in the area. Asked to comment on his opinion of these findings, Professor Neel confirmed his concurrence with Professor Kinlen's view; he saw no reason for introducing radiation as an explanation for the Seascale cluster.

The final witness in the case was Professor H.J. Evans called on behalf of the defendants. For the purposes of the court Professor Evans prepared two reports related to his work over the past twenty two years with studies looking directly or indirectly (in a supervisory capacity) into the effects of radiation and chemical mutagens in inducing chromosome

[166] Professor Neel had given evidence earlier on in the trial (Day 55).

damage in blood cells of exposed individuals, occupationally exposed personnel or cancer patients. In particular, Professor Evans was interested in studies on the blood cells of patients with leukaemia or lymphoma. In reaching his conclusion that:

> ...on the basis of the overall evidence I consider it highly unlikely that the recorded levels of radiation exposure received by the male parents of leukaemic children born to Sellafield workers is in any way responsible for the development of leukaemia/lymphoma in offspring (Day 84, p.4D-E).

Professor Evans went on to suggest that instead he considered it:

> ...highly likely that the observed leukaemias and lymphomas, including those of the Reay and Hope families, are as a consequence of somatic mutations arising post-natally from natural unknown causes (Day 84, p. 4G).

While some witnesses accepted the existence of a heritable (non-syndrome[167]) component for leukaemia, Professor Evans rejected this view on the basis that firstly, there

[167] Professor Evans accepted the mechanism of inheritance in respect of known syndromes including: Li Fraumeni; Bloom's syndrome; Ataxia telangiectasia; Duncan's syndrome.

were no leukaemia families[168]. Secondly, on the findings of the Draper study[169], and thirdly, the fact that no identical twins had been observed with leukaemia[170]. According to Professor Evans, the wealth of evidence on the heritability of leukaemia and NHL based on observations of the population, in particular, twins, siblings and other relatives, established no reason to believe in the existence of a gene or genes which pass through the germline and give rise specifically to leukaemia/NHL.

In their submission on the genetics parts of the case, the defendants maintained that the plaintiffs had failed to demonstrate the operation of any preconceptional causal mechanism that could explain the Seascale excess. Further, the plaintiffs had been

---

[168] Over the last thirty years, as a consequence of improved treatment, a significant number of children with leukaemia have survived and gone on to have children themselves. Where parents who have had leukaemia have children, the question remained whether the parent would pass on a predisposition to leukaemia through the germline to their offspring.

[169] The Draper (January 1993 Cumbria/Seascale) study reappraised the possible excess of leukaemia and lymphoma around the vicinity of Seascale to determine any excess from 1984-1990. Draper confirmed the incidence of leukaemia and NHL in young people aged 0-24 in Seascale to be higher than expected on the basis of either national rates or those of the surrounding area. However, of the forty children in the study with a parent who had leukaemia it would be expected that based on the Mendelian principle, at least half (20) would inherit the relevant gene. In fact children of survivors show no cases among 40 children born to parents who had leukaemia and none to parents with NHL. The observation, according to Professor Evans is that "you don't see leukaemia in offspring" (Day 85, p.46).

[170] All information indicates that in the few cases of concordance between identical twins with leukaemia, the mutation is not inherited, but is caused by events in utero ie: a chromosomal rearrangement in one twin which is passed to the other via a shared blood system.

unable to undermine the results from the A-bomb studies or account for the complete absence of a non-syndromic heritable component in leukaemia and NHL.

The Defendants went on to say, that in respect of the two cases before the court, there was no justification for suggesting that Dorothy Reay's leukaemia was in any way connected causally with her father's occupational PPI. What was more likely, and a factor that had not received proper consideration throughout the trial was the association between maternal age and the risk of leukaemia. Dorothy Reay's mother was over the age of 40 years and therefore, at four times the average risk of having a leukaemic child.

As to Vivien Hope, it should be remembered said the defendants, that the plaintiffs' case was based on the excess relative risk for those born and diagnosed within Seascale. Vivien Hope was born in Drigg and moved to Seascale aged six, accordingly, she did not qualify for inclusion. Again, Vivien Hope suffered from NHL; there had been no positive association with NHL and PPI either inside or outside Seascale. Therefore, regardless of the plaintiffs' contention that leukaemia and NHL are so similar that they can be combined together, leukaemia and NHL have different aetiologies and different ages at onset, they are not variations of the same disease and Vivien Hope's NHL is distinct from Dorothy Reay's leukaemia.

The fact that the genetic material of the forty-six chromosomes may be damaged by radiation was not at issue, what was at issue, and is alleged by the plaintiffs was that a predisposition to leukaemia can be transferred through the paternal germline at a frequency that can explain the Seascale excess. The genetics evidence was relevant

therefore not only as part of the Bradford Hill criteria, but also as an issue of causation.

Throughout this part of the trial the plaintiffs found themselves challenging the traditional basis of genetics, in particular: the 'non-syndrome' heritable component for leukaemia; the reliability of the animal data; and the findings of the A-bomb studies. Further assert the plaintiffs, while conventional mutation genetics may suggest the Gardner hypothesis to be implausible, recent research has highlighted the lack of scientific consensus over genetic mechanisms generally, and specifically, those related to cancer and the role of co-factors.

Having reviewed the scientific expert evidence in the case a number of issues, identified in Chapter Four, arise from the **Reay and Hope** trial:

AREAS OF SCIENTIFIC UNCERTAINTY THAT EMERGED DURING THE TRIAL

OCCUPATIONAL DOSIMETRY 4(2): the Howells' Factor; the three separate analyses of occupational dose (Professor Gardner; Dr. Dennis; Professor S.J. Evans and Professor G. Howe).

ENVIRONMENTAL DOSIMETRY 4(3): the Jakeman Factor; the R171 Addendum (NRPB); the SEAM Model; anomalies between the historic discharge figures produced for the Court by Professor S.R. Jones and those for a discharge authorization application (for the same period) produced by Dr. R.J. Dickinson.

EPIDEMIOLOGY 4(4):

Expert Opinion of the Gardner Study

Good Quality Research (Professor S.J. Evans; Professor S. Davis; Dr. K. Kopecky; Professor E. Alberman; Professor D.C. Thomas; Professor D. Savits; Professor N.E. Day.
Methodologically Flawed (Dr. K. D. Macrae; Dr. R. Wakeford; Professor G. Howe; Professor W.J. Schull; Professor J. Neel; Professor A. Upton; Professor B. Macmahon; Sir R. Doll).

Expert Opinion of the A-bomb Research
Good Quality Research (Professor W. Schull; Professor J. Neel).
Methodologically Inconsistent (Professor E. Alberman).
Incompatible with the Gardner Research (Professor S. Davis; Dr. K. Kopecky; Professor E. Alberman; Professor N.E. Day).

GENETICS 4(5):

Gardner's Study Biologically Plausible (Professor M. Greaves; Professor Meuth; Professor D.H. Wright; Professor J. C. Neil).
Gardner's Study Biologically Implausible (Professor E. Hall; Dr. P. Selby; Professor H.J. Evans).
Rejection of Conventional Genetics to explain the Gardner Research (Professor M. Meuth; Dr. John Thacker; Dr. Roger Cox; Professor Ehling).
Synergism (Gardner Hypothesis plus Co-factor) (Professor M. Greaves; Professor D.H. Wright; Professor J.C. Neil).
Viruses Responsible for Seascale Excess (Professor R. Rickinson; Professor J. Neel).
Expert Opinion of the validity of Professor Nomura Research (Dr. Roger Cox).
Expert Opinion of the invalidity of Professor Nomura's Research (Dr. Selby).

ALLEGATIONS OF MANIPULATION OF RESULTS (POSSIBLE FRAUD)
Professor R. Doll suggested Professor M. Gardner had deliberately manipulated his results, notwithstanding Professor Gardner's denial, taken under oath, weeks before his death.

ALLEGATIONS OF FALSE STATEMENT
Professor R. Doll accused Dr. H. Inskip of making a false declaration under oath which he later retracted.

ALLEGATIONS OF INCOMPETENCE
Dr. P. Selby castigated the reputation and standing of Professor Nomura in the strongest possible terms, then proceeded to accuse other colleagues of incompetence.

NOVEL/NEW AREAS OF RESEARCH
Professor Gardner's research.
Professor Nomura's research.

LACK OF WITNESS NEUTRALITY/HIRED GUNS
Allegations by the plaintiffs that there was a lack of witness independence by the NRPB (particularly in respect of the occupational dosimetry evidence).
In-house and other nuclear industry experts were only available to BNFL.

INEQUALITY OF RESOURCES/FINANCES
This was a classic example of a 'David and Goliath' situation in which BNFL Plc had access to unlimited resources and funds not available to the two plaintiffs. According to Lord

SIGNIFICANCE OF DISCOVERY PROCESS

Without disclosure of 'The Howells Factor', the inaccuracy of the occupational dose figures would have not have come to light.

Although BNFL agreed to supply all documentation by September 1991, only upon further Discovery in 1992 did the discrepancy in plutonium and other discharge figures (released into the environment) become apparent.

5.1 Judicial Decision Making

Moving on from the complex area of expert evidence, the main focus of this chapter is judicial decision making, in particular an analysis of the 'discovery' and 'justification' process whereby Mr. Justice French reached his ultimate conclusion in favour of the defendants that on the balance of probabilities PPI was not a material contributory cause of the Seascale excess or, it must follow, the leukaemia of Dorothy Reay or, the NHL of Vivien Hope. In the conclusion of his judgment, his Lordship divided the case into two parts. The first was concerned with whether the Gardner study established a statistically significant association between PPI and the excess of leukaemia found around the Sellafield site; the second, whether on the basis of the evidence and the Bradford Hill criteria, the association was causal. Incorporated into the analysis is due regard to the observations of Day & Pugh (1995) and Miller (1997) that his Lordship's decision had little to do with law or legal reasoning. Developing this point further, I will explore what factors appear to have influenced his decision, and whether the Bradford Hill criteria is an appropriate foundation upon which to base a judicial judgment.

Before embarking on the case itself however (5.2), I will begin with an examination of the components involved in judicial decision making. Implicit in consideration of this matter is a rejection of the notion that the 'judicial discovery' process is beyond the realms of legal analysis, and with it, any assumption that such exploration should be left to the domain of Psychology. Moving on (5.3), discussion will focus on the benefits or not, of rationalising judicial decision making through the implementation of applied probabilistic reasoning. In order to evaluate current opinion on these issues, primary research is presented from High Court Judges (Queen's Bench Division), and once again, members

of the Academy of Experts.

Contemporary understanding of legal reasoning (Wasserstron 1961; MacCormick 1978; Alexy 1989; Bengeotxea 1993; Anderson 1997) is based on the notion that there is a distinction between 'how a judge reaches his decision' and 'how a judge justifies his decision'. According to this view, legal reasoning[1]: the independent, logical, rational and objective nature of the process is 'judicial justification'. Whereas, the 'discovery' process, which explains how a judge reaches his decision[2] (the difficult to control, unconscious, non-rational, non-logical, subjective, value based, intuitive part of decision making) has increasingly moved into the domain of Psychology.

While some legal theorists (Twining 1973; Wroblewski 1992) continue to support the need for a more acceptable distinct psychological theory to assist law in determining what factors and considerations influence the judicial decision making process, others, in particular Anderson (1997), believe that Psychologists have failed to take the mantle offered to them. Consequently, there is a growing demand for academic lawyers and legal theorists to re-assert control of this knowledge base and in so doing recognise that both discovery and justification are a continuation of the same process; it is only through such realisation that judgments, particularly in 'hard cases'[3] (which arise as a consequence of

---

1 Positivists define legal reasoning as a rational, objective, impartial process based on deductive analysis.

2 Supported by the Realist movements in America and Scandinavia; particularly popular in the 1960s.

3 See Dworkin's essay 'Hard Cases' which appeared in Taking Rights Seriously (1978 ed) Ch.4.

gaps in the law) can be understood.

According to Peczenik (1989:24) gaps in the law occur where:

1) the established law does not regulate a given case (an insufficiency gap[4]);

2) the established law regulates the case in a logically inconsistent way (an inconsistency gap[5]);

3) the established law regulates the case in a vague or ambiguous manner (an indeterminacy gap[6])

4) the established law regulates the case in a morally unacceptable way (an axiological gap[7])

Implicit in Peczenik's analysis is the belief that, as a consequence of gaps in the law, discretion, value judgments and other factors inevitably impact on judicial understanding; interpretation of evidence; and decision making; a view supported by others (Kriele 1965; Esser 1972; Larenz 1983), including Alexy (1989), who was particularly concerned with the legitimacy of judicial discretion when deciding between two competing solutions.

Underlying concerns of judicial decision making lie two opposing theoretical perspectives. The first, legal positivism rests on the notion that law is based on a structure of rules which determines how law operates, procedures work and decisions are made. Having rules thus ensures that the decision making process is predictable, orderly, consistent and non-

---

[4] Insufficient gaps result from the fact that the literal text of the statute does not regulate a given case.

[5] An inconsistency gap may occur as a consequence of logical inconsistency of a legal norm established as part of legal tradition.

[6] Indeterminacy gaps result from vagueness or ambiguity of the legal norm.

[7] Axiological gaps occur when the established law regulates a given case in a morally unacceptable way.

arbitrary. Constraining the judiciary in this way therefore minimises the potential for judicial discretion, and guarantees as Dicey (1939:202) says "the absolute supremacy or predominance of regular law as opposed to the influence of arbitrary power, and excludes the existence of arbitrariness, or prerogative, or even wide discretionary authority". Embracing positivism therefore encompasses legal autonomy and universality.

In the opinion of Sunstein (1996:111-115) therefore, rules:

- minimise the informational and political cost of reaching decisions in particular cases;
- are impersonal and blind; they promote equal treatment and reduce the likelihood of bias and arbitrariness;
- serve appropriately to embolden and to constrain decision makers in particular cases;
- promote predicability and planning for private actors, legislators and others;
- increase visibility and accountability;

The second theoretical perspective is based on American, Scandinavian and German Realism. The underlying basis of realist philosophy is the subjugation of rules. Rules in this context are therefore only one of many elements such as: the judge's idiosyncrasies, background, prejudice, political leanings, relationships with counsel, all factors which could potentially affect the outcome of a case.

Acknowledging the work of the American Realist movement, Anderson, (1997) reminds the reader of the contribution jurists such as Holmes (1841-1935); Frank (1889-1957); Gray (1839-1915); Llewellyn (1893-1962) have made to unravelling the judicial discovery process. Rejecting the notion that American Realism was simply a response/rejection of positivism, Anderson (1997:10) believes that the Realists came closest to identifying the actual processes involved: "puzzling; hunching, intuiting; the checking and testing of a solution, judging and deciding, and presenting the judgment".

Anderson goes on to attribute to the movement a credible account of the illusionary and mythical nature of formalism.

In contrast to American Realism, the Scandinavian Realists (Hagerstron (1868-1939), Olivercrona (1897-1980), Ross (1899-1979) stressed the psychological impact of adherence to normative rules and considered the influence such rules had on judicial behaviour. Issues identified include: the impact of legal ritualism (Hagerstrom); the potential abuse of judicial power (Olivecrona); and the reality of legal prediction (Ross).

In similar vein, the German 'Free Law' (Freirechtslehre) school which developed at the the same time as the American and Scandinavian movements also stressed the indeterminacy of legal rules and the creativity of the judiciary. Of particular interest to the German realists was the importance of acknowledging and responding to the developing role of the judge. Although not as widely known as either the American or Scandinavian movements, the German school emphasized the need for judicial control and restraint, and in so doing, complemented the work of the behaviourist sociological orientated American school, and the psychological orientated Scandinavian school.

Notwithstanding the opinion of Cotterrell (1989), that legal realism has been effectively marginalised in Britain, he nonetheless acknowledges the valuable service they performed in demonstrating the problematic nature of normative legal theory, and in highlighting some very real concerns with regard to judicial decision making.

Some judges, aware of the 'personal element' and discretionary nature involved in the judicial making process have publicly voiced their concerns. Cardozo, (1921:9-10) arguably one of America's greatest judges observed:

> The work of deciding cases goes on every day in hundreds of courts throughout the land. Any judge, one might suppose, would find it easy to describe the process which he had followed a thousand times and more. Nothing could be farther from the truth. Let some intelligent layman ask him to explain: he will not go very far before taking refuse in the excuse that the language of craftsmen is unintelligible to those untutored in the craft. Such an excuse may cover with a semblance of respectability an otherwise ignominious retreat. It will hardly serve to still the pricks of curiosity and conscious. In moments of introspection, when there is no longer a necessity of putting off with a show of wisdom the uninitiated interlocutor, the troublesome problem will recur, and press for a solution. What is it I do when I decide a case? To what source of information do I appeal for guidance? In what proportions do I permit them to contribute to the result? In what proportions ought they to contribute? If a precedent is applicable, when do I refuse to follow it? If no precedent is applicable, how do I reach a rule that will make a precedent for the future? If I am seeking logical consistency, the symmetry of the legal structure, how far shall I seek it? At what point shall the quest be halted by some discrepant custom, by some consideration of the social welfare, by my own or the common standards of justice and morals?

Judge Jerome Frank, an American Realist and highly regarded federal judge, also drew attention to the multitude of elusive factors that exist and are involved in judicial decision making. In Frank's opinion, prejudices, whether they are "racial, religious, political, or economic... Unconscious biases..plus or minus reactions to women, or unmarried women, or redhaired women or brunettes, or men with deep voices or high pitched voices, or fidgety men, or men who wear thick eyeglasses, or those who have pronounced gestures or nervous tics - biases of which no one can be aware" (Frank 1949:xiii), all such 'elusive factors' may impact on the judge and ultimately affect his decision making.

Concurring with these sentiments, Judge Richard Posner (1990:189) made the following observation:

> It is a mistake to take at face value descriptions of judges as engaged always in a search for 'the' correct answer, rather than as exercising discretion under the influence of personal values and preferences determined by temperament and selective life experiences.

In this country, judges such as Lord Radcliffe (1968:212) have written about the "inescapable personal element in the judicial decision", while Lord Devlin (1978:511) recognised that "the judge who is confident that he has no prejudices at all is almost certain to be a bad judge".

Lord Denning also acknowledged the existence of judicial discretion, but tempered his view by stressing the importance of policy considerations:

> The truth is the that the law is uncertain. It does not cover all the situations which may arise. Time and again practitioners are faced with new situations, where the decision may go either way. No one can tell what the law is until the courts decide it. The judges do every day make law, though it is almost heresy to say so. If the truth is recognised then we may hope to escape from the dead hand of the past and consciously mould new principles to meet the needs of the present[8]

Later, Lord Denning M.R., as he was by then, reiterated this point in somewhat bolder terms in **Dutton v Bognor Regis U.D.C.**[9] when he observed:

> This case is entirely novel.....
>
> In previous times, when faced with a new problem, the judges have not openly asked themselves the question: what is the best policy for the law to adopt? But the question has always been there in the background. It has been concealed behind such questions as: Was the defendants under any duty to the plaintiff? Was the relationship between them sufficiently proximate? Was the injury direct

---

[8] 'The Reform of Equity' in C.J. Hamson (ed.) Law Reform and Law-Making (1953:31).

[9] [1972] 2 W.L.R. 299 at 313.

or indirect? Was it foreseeable, or not? Was it too remote? and so forth.....

Nowadays we direct ourselves to considerations of policy...

What are the considerations of policy here?

In addition to recognising the realist perspective and policy considerations, Professor Griffith reminds us that the judicial role is also political, one of maintaining the status quo:

> The principal function of the judiciary is to support the institutions of Government as established by law. To expect a judge to advocate radical change is absurd. The confusion arises when it is pretended that judges are somehow neutral in the conflicts between those who challenge existing institutions and those who control those institutions (Griffith (1991:329).

Whatever the reality of decision making, there is no doubt says Sunstein (1996:136) that "reason giving is prized in law". Increasingly however, as the decisionmaker becomes less constrained by normative rules, certain cases, particularly those involving complex scientific expert evidence are demanding alterative models of decision making. In particular, models that offer greater insight into judicial discovery and justification processes.

In order to understand the reasoning element underlying judicial decisions the remainder of this section will concentrate on providing a more in depth analysis of the distinction between the 'discovery' and 'justification' process.

The Discovery Process

Included in the realists critique of legal formalism is a rejection of the idea:

- that judges use deductive techniques to decide cases;
- that judges' legal opinions are accurate descriptions of how judges reach decisions;
- that legal certainty and predictability are ideals that judges should strive to reach (Anderson 1996:3).

Thus the notion that "the judge begins with some rule or principle of law as his premise, applies this premise to the facts, and arrives at his decision" (Frank 1949:101) constitutes nothing more than dogma. Judicial decision making is neither neutral, objective nor rational; any view to the contrary, say the realists, simply masks the reality.

According to Anderson (1996:6), five elements can be identified in mainstream Realists writings including:

1. brooding and puzzling about the facts of a case;
2. achieving a tentative hunch or intuition about what is just in the case;
3. checking or testing the hunch or intuition against both the relevant laws and legal principles and against what is considered to be the wise solution in this case and other similar cases that may arise in the future;
4. reaching a judgment, decision or solution;
5. presenting or expounding the judgment, decision or solution in the time honoured fashion.

Most cases in Frank's opinion however, are reached by a method of backwards reasoning, "backwards from conclusions tentatively formulated" (Frank 1949:101).

Taking on board the realists' perspective and his own belief that there are no set patterns to judgments, Lee (1989:42) considers that the assumed structure, where: "the facts are set out, the legal issue is pinpointed, the previous law is explored, any 'policy' arguments are summarily treated, the law is applied to the facts, the conclusion is reached and an order is made" to be an over simplification. In reality says Lee, "judges might well reach a conclusion intuitively and then work backwards to provide a justification. Occasionally,

in so doing they might change their minds. They will also sometimes respond to drafts of their colleagues' judgments. [What is] clear, is that judges sometimes feel the need to give their conclusion without simultaneously providing the reasons" (Ibid). Quite often therefore, judgments are made which appear remarkably thin on case-law and remarkably fulsome in their treatment of facts. Perhaps as Lee (1989:43) suggests, when judges attempt to rationalize their hunches, they find previous case-law does not easily support their views. Judges therefore become convinced of a result of a case, before having worked out, how to justify their conclusion. Reminding the reader that the rationalisation for the justification of a judgment, is not the same as the thought processes involved in making the decision, Lee's contention is that the judges could formulate their judgment to accord more closely with their reasoning processes if they were more open about the various factors that influenced their decision making.

Bell also talks about the inadequacy of the deductive model of legal reasoning, and explains why many consider decision-making to be nothing more than 'hunching'. According to Bell, underlying such criticisms are concerns that the decision maker has too much individual power and is effectively unaccountable to the universal audience. After all, says Bell (1986:63), "Lawyers' concerns for legal stability, order, and coherence, may be shared less by the wider community [the universal audience] which is interested in justice in particular cases". Also, the values which are perpetuated by the legal community may fail to correspond to the expectations of the wider community. While the concept of legal reasoning may not embrace a system of "cadi-justice" therefore, it nonetheless attempts to hide the fact "that in easy cases, judges are carrying out particular political policies, and in hard cases, they are making value judgments" (Ibid:64).

According to Tamanaha (1997:182) to function as a judge, "the judge must internalise (and therefore accept, though not necessarily consciously) a great deal of the norms applicable to the practice of judging". Some of these are expected and encouraged, such as a proper judicial disposition in court; following the law; the style of judicial writing; and so forth. Other factors involved in the decision making process however, may result in cynicism, or a flouting of legal norms. No matter how rigid and uncompromising the norms, the potential attitude of the judge cannot be disregarded. Referring to the work of Kenneth Vines (1969), Tamanaha concurs with the view that judges may be divided into three categories: the law interpreter (who strictly interprets the law); the law maker (who believes that law making is an inevitable part of interpreting the law); and the pragmatist (who believes that there are elements of both interpretation and law making in judicial decisions). According to the findings of the Vines' study, supported by the work of Wold (1974), judges have different perceptions of their decision making role and are unclear over exactly what processes are involved.

From the above discussion therefore, it would appear that hunching, insights, brooding, intuition, puzzling, potential bias and prejudice are all factors contributing to the judicial discovery process. In addition says Anderson (1996:2), other influences such as "mood, personality, background, education and experience" are just as important.

Moving on to determining the grounds for the weighting of a legal decision, Burton (1994:35) presents what he refers to as his "good faith thesis" (how judges should and do adjudicate) and his "permissible discretion thesis" (Ibid:107) (judicial discretion, if exercised in good faith is compatible with the legitimacy of adjudication in a constitutional

democracy). For Burton, the aim of his project is "to develop and defend a practicable and attractive ethic of judging in a judicious spirit" (Ibid:xvi). In order to do this Burton considers both the reasons for the decision, and the reasoning process in judicial decision making. Each reason (legal standard or concrete reason for action) is thus weighed and compared with other competing reasons. Facts however are not weighed, therefore, for the purposes of analysis, consideration of legal reasons need to be separated from the facts. When this has been achieved, all the relevant reasons in a case must be identified and assigned a weight (out of a possible 100 units for instance, weight could be distributed 10-30-10-30-20); from the point of allocation, no new reason can be entered into the model.

Burton stresses that weighting is a qualitative exercise, therefore the process of assigning the appropriate weight is an act of balancing. According to Burton, "we should conceive of the grounds of weight as a ring of relevant reasons impinging on a decision, not a linear regress in search of a result-determining foundation " (Ibid:61). With the ebb and flow of weights however, there is always the possibility of multiple outcomes. In spite of this potential, Burton believes that a judge in good faith will be constrained by both 'action threshold' and 'congeries of reason' which will help him to determine the appropriate weighting distribution, and in so doing, force an ongoing review of the total.

While assessment and weighting of the various elements is clearly important to decision making, it is also true that the precise determinants of the weighting criteria are not specified in advance, consequently, there is ambiguity and uncertainty over exactly what factors in the totality of the circumstances are attributed with what weight.

According to Sunstein, while it may be possible for a judge to assign and stipulate some weighting in advance, these factors will not be exhaustive, "no predetermined list of factors can be exhaustive" (Sunstein 1996:29), therefore, Sustein considers any advance weighting criteria difficult to implement as often, weighting of factors can only be determined once the context of the controversy has been put into perspective, and the dispute has started to unravel.

In addition to problems with regard to the discovery process, the ideal judicial balancing act also demands that the judge adopt the role of the umpire or referee. While presiding over the contest therefore, the judge should try to be as even handed as possible and ensure the contest is fair to both sides. In order to do this "judges have to receive and assess information, to calculate according to paradigms that have a high probability of giving the right answer, to modify the paradigms when evidence or reasoning shows that the paradigm as previously used sometimes gives the wrong answer" (Schweers Cook & Levi 1990:301). Unfortunately therefore, it appears lawyers (like scientists before them) have accepted the premise that they can add to, or modify existing paradigms without necessarily questioning the basic assumptions underlying law's foundation. The result for law, as for science (Kuhn 1963) - the endorsement of a framework with fundamental faults, where any additions or modifications are merely incorporated into the system for acceptance by future generations. It is only with a loss of confidence in the paradigm therefore, that transformation and overthrow of the existing order can take place.

Justification

Moving on to the justification process, Perry (1976) and Perelman (1979) have both suggested that legal justification involves convincing others of the rightness of one's conclusions. In order to do this it is necessary for the judge to provide an explanation which is more favourable to his conclusion than against it. Justification may therefore be considered as an appeal to reasonable people "the universal audience" (Olbrechts-Tyteca 1968:31), as well as an appeal to the "legal audience" [judges, practitioners, commentators, teachers, and students of law] (Bell 1986:53). To do this successfully however, the judge must also incorporate into his decision making his rationale for not supporting the losing party. Counsel may then have the job of translating and explaining the judgment (through solicitors) to their respective clients. The ultimate test for rationality says Bell (Ibid:60), is "whether, within a framework, an argument is capable of providing a justification for a decision according to law".

MacCormick's (1978) explanation of judicial decision making is heavily influenced by the realist movement. Acknowledging the distinction between discovery and justification (1978:16), MacCormick proceeds to separate the two stages. Drawing an analogy between science and law, MacCormick refers to Archimedes' discovery of specific gravity as a later justified "flash of insight". Identifying a similar process in legal discovery, MacComick seems to be suggesting that judges also experience similar flashes of insight, which again have to be justified. Concentrating on the justification process, MacCormick believes that the 'discovery' process should be left to the domain of Psychologists. As far as the 'justification' process is concerned, MacCormick divides this into two types: first order justification (where on the basis of deductive reasoning, decisions are justified if they

evolve from a major premise formulating a valid rule of law, and a minor premise (consisting of proven facts based on relevant legal procedures and rules of evidence). Second order justification entails testing rival universal norms in order to ascertain which one is legally valid.

Where in litigation deductive justification is not possible, MacCormick identifies three potential problematic areas: relevancy (dissension over which legal rule is relevant); interpretation (where the words of a statute are ambiguous); classification (where the court has to decide whether the facts fit into the rule). Reasoning in relation to these particular problems are however limited by requirements of consistency, coherence and consequences[10]. Only if a ruling satisfies all these requirements will it be regarded as legally justified.

In addition to the limitations of consistency, coherence and consequence, judicial decisions also have to fulfil a set of general conditions, including: public good, corrective justice, common sense and convenience. Therefore, judges should only make rulings on the basis of corrective justice, public good, community common sense, if they are authorised by analogy (in the form of other case law), or have support from existing legal principles.

Alexy (1989) places his analysis of justification firmly in the context of the wider community, in particular, the 'grounds of legitimacy' of judicial decision making in

---

[10] MacCormick regarded reasoning as consequentionalist (not utilitarian). Reasoning must however comply with legal principles to be justified.

situations where the decision maker has discretion[11]. According to Alexy, the application of law allows for value judgments in such situations, the question that concerns him is whether such value judgments can be rationally justifiable. In contemplating this question, Alexy invites the reader to consider whether the decision maker should be guided by the "value judgments of the community at large or of a specific group" (Ibid:10), or, should the decision maker have recourse to the "inner evaluative coherence of the legal order" (Ibid:11) or perhaps, appeal to some "objective order of values" (Ibid:12). Ultimately, says Alexy what is required is a model which takes account of commonly held values, as well as the results of prior legal discussion. Linked to this model is a criteria of correctness which is the means by which evaluation of the legal assertions are rationally justified.

According to Peczenik (1989:336-339), certain methods of judicial justification are discernable, they include the following:

1. The 'pseudo justification method':
i) where extremely brief reasons are given for the decision;
ii) or, where the justification for the decision remains unclear.

2. 'The simple subsumption method', where the court presents the decision as a logical consequence of a general rule and some facts.

3. 'The fact-stating method' , where there are statements concerning facts, but neither value judgments nor norms.

4. 'The dialogue method'. Where the court proffers reasons for and against the decision (including facts, norms, and often general value judgments).

5. 'The sophisticated subsumption method' (or scientific method), where the court proffers reasons for and against the decision, including facts and value judgments -

[11] Where legal norms, doctrines or precedents do not dictate an obvious answer.

> then modifies these reasons in such a way, that the decision becomes a logical conclusion of them.

In order to ensure coherence of judicial decision making however, all decisions have to be both extensive and of general application. Peczenik (Ibid:342) justifies this requirement on the basis that firstly, "modern society is no longer orientated towards [simply] obeying judgments.....The parties rather wish to have immediate access to general and extensive reasons, answering the question why the court has decided in a certain way". Secondly, democracy requires that a judge, particularly in a hard case, fulfils his decision making function with due regard to both the wording and spirit of the law. In order to do this the judge must provide extensive and general justification for his decision. Thirdly, "an extensively and generally justified decision directly fulfils the demand of intersubjective testability.....In other words, one knows on which grounds one may criticise it [the decision]. Testability promotes objectivity of the decision, and thus legal certainty". Fourthly, "a decision gains a strong position as a precedent, if it is justified in an extensive manner, facilitating its criticism and yet not proved wrong. At the same time, a highly general character of the justification makes the precedent widely applicable" ensuring uniformity, coherence, predictability and fixity of the law. Finally, an extensive and general justification "helps the parties to decide whether to appeal against the decision". It also increases their chance of obtaining a change of decision, should such a move be justifiable.

Cardozo (1921:162) appreciating the complex nature of judicial decision making, said of a judge:

> He must balance all his ingredients, his philosophy, his logic, his analogies, his history, his customs, his sense of right, and all the rest, and adding a little here and taking out there, must determine as

wisely as he can, which weight shall top the scales.

Comparing the role of the judge to that of a spectator, watching an "unpredictable daily drama with an ever changing cast of characters" (Pannick 1987:199), Pannick reminds us of the burdensome responsibilities a judge has to discharge. Lee (1989:195) in similar vein, sees the reality of judicial law making as existing somewhere between a 'nightmare and a noble dream'. Presenting judges as well meaning individuals from similar backgrounds, Lee informs the reader that judges disagree over their decision making role, disagree over pre-existing law, and disagree over the future development of law in a given area.

Today, judges still appear to have different opinions of their decision making role, although some judges are far more approachable on this topic than others. Of the sixty five Queen's Bench Division Judges contacted for the purposes of this thesis, 34 per cent responded[12]. While some judges were clearly concerned over recent proposals for a more rationalized and accountable judiciary[13] (particularly in cases involving highly controversial scientific expert evidence), a few had no doubts about the wisdom of Cardozo's balanced approach:

> In most general terms, I would put myself somewhere between Cardozo and the 'some academics [who] would like to take this process a stage further' to whom you refer. Decision making is an interesting process especially in the judicial field. Is it possible to make decisions which are themselves not the product of one's own prejudices derived from family, school and working environment? Why does Judge A decide a case one way and Judge B the opposite way? I remain to be convinced that there is a mechanistic tool that can remove 'subjective' reasoning processes and which would provide a more just conclusion to cases.

---

[12] See Appendix 6 for a copy of the letter sent to Judges.

[13] Additional evidence on the changing role of judicial decision making will be presented from judges and expert witnesses in Section 5.3.

Other judges had no doubts:

> I declare myself to be a Cardozo man. If humans acted rationally, it is scarcely to be contemplated that our civilisation would require a system of law. Rationality is surely the antithesis of human behaviour in which law has a proper role to fulfil.
>
> The traditional view of a judge's approach to decision making, as expressed by Cardozo, remains as true today as it was then.
>
> I do not think I could fault or improve on Cardozo.

Certain judges while not disagreeing with the views of Cardozo, nonetheless felt other factors were equally important:

> I certainly seek to use my commonsense.

Other members of the judiciary however, were rather more circumspect, reflecting on past judicial experience:

> ....I call to mind the wise words of Lord Mansfield -"Give your judgment but not your reasons; the first may be right the second will almost certainly be wrong."

Only one judge, of those commenting on their views of judicial decision making, completely dismissed the relevancy of such analysis, when he wrote:

> I cannot relate what you say in your letter of the 9th December to the day to day realities of work in the courts, and I do not believe that this sort of 'research' has any practical value[14].

In America, the problem that unfamiliar, often highly complex scientific evidence poses for the judiciary has led some US authorities to question the courts' competency to deal effectively with cases of this kind[15]. Disillusionment over the legal system's ability to handle

---

[14] This was the only Judge who responded in this manner.

[15] The Carnegie Commission on Science Technology. Final Report, (1993).

complex litigation has therefore resulted in many commentators questioning the legitimacy of the whole legal process. As Jasanoff (1995:5) points out, these "technically illiterate factfinders, who understand neither the substance nor the methods of science, are increasingly called upon to discriminate among sophisticated technical arguments", where often the perceived credibility and authority of the expert, rather than the substance of the evidence, is what informs judicial decision making. Green (1989:107), found that many cases in this country were only "resolved when a judge was satisfied that some point was scored by one expert over another - and that needn't mean the judge understood the point". Therefore the account of science which informs judicial decision making is constructed from a model that assumes the scientific detail to be of less significance than other more irrelevant issues determined throughout the trial.

Law as a form of ideology therefore encourages public belief in the existence of a judiciary which is rational, objective and neutral, on the premise that issues that come before a court can be broken down into precise empirical questions which can be answered through a process of deductive analysis, based on a system of unilinear causal relations. Legal positivism/formalism thus assumes that the traditional approach provides the only rigorous and disciplined means of resolving complex scientific disputes. In reality what is taking place is a process of judicial redefinition (Horowitz 1977), which artificially fragments and distorts the issue under consideration. To put this differently, while judicial processing may seek to exclude wider social and political concerns from the decision maker's role, this is not possible. Accepting this judicial fiction merely allows 'certain' important and relevant facts to be omitted, disregarded or ignored by the judge, and as with the ***Reay and Hope***

Judgment, tilts the balance significantly in favour of one side. In addition, any attempt to reduce complex, often undecided issues of science and technology to the soluble, does not address the nature of the problem itself.

Having laid the foundations of judicial decision making, the next section will concentrate on the Judgment in the case.

5.2 The Judgment

In delivering his judgment on the 8th October 1993, Mr. Justice French reminded the Court that these actions had arisen as a consequence of two tragedies. The first concerned Elizabeth Reay who claimed against the defendants, British Nuclear Fuels plc, damages under the Fatal Accidents Acts and Law Reform (Miscellaneous Provisions) Act 1934 in respect of the trauma consequent on the conception, birth and death of her daughter, Dorothy from early acute lymphatic leukaemia (All). The second, Vivien Jane Hope, claimed damages against the same defendants for past and future suffering and disability consequent upon her non-Hodgkin's lymphoma (NHL) diagnosed at the age of 23 years. The sole concern of the Court therefore was whether the Plaintiffs could prove that the cause or a material contributory cause of Dorothy Reay's death and Vivien Hope's lymphoma was ionising radiation emitted by the activities carried on at Sellafield by the Defendants or their predecessors.

Informing the Court of the novel feature of this action as regards paternal preconception irradiation (PPI), his Lordship proceeded to expound the Plaintiffs' view that PPI was responsible for causing a mutation in the spermatagonia which in turn, via paternal sperm, caused a predisposition to leukaemia and/or NHL in the next generation. Known as the 'germline' hypothesis' and derived from the work of its principal author, Professor Martin Gardner, the epidemiological study thus provided the foundation for the plaintiffs' case.

Reaffirming there was no question in this action as to whether the defendants or their predecessors were negligent, His Lordship reiterated the fact that the effect of the Atomic

Energy Authority Act 1954 was to impose upon the defendants, as successors to the United Kingdom Atomic Energy Authority statutory liability:

> It shall be the duty of the Authority to secure that no ionising radiations from anything on any premises occupied by them, or from waste discharged (in whatever form) on or from any premises occupied by them, cause any hurt to any person or any damage to any property, whether he or it is on any such premises or elsewhere (Section 5(3).

It was also common ground that by virtue of the legislation this statutory liability attached only from 1st August 1954.

The dispute between the parties therefore centred on four main issues:

1. The doses of ionising radiation received by George Reay and David Hope in the course of their respective employments;

2. The doses of ionising radiation received by members of the two families and others from radiation in the environment insofar as such radiation was caused by emissions from the Sellafield plant.

3. Whether the Gardner Study in its context, can prove, on the balance of probabilities:

   a) the existence of a statistical significant association between PPI of fathers working at Sellafield and an excess of leukaemia and/or NHL;

   b) the establishment of a causal association in the light of all the evidence and in particular, when regard is given to the Bradford Hill criteria.

4. Whether there exists a plausible or reasonably possible biological pathway by which radiation emitted by, or from the Sellafield plant could have caused or materially contributed to the two diseases.

For the purposes of the conclusion of his judgment however, his Lordship divided the case into two parts. The first was concerned with whether the Gardner study established a statistically significant association between PPI and the excess of leukaemia around the Sellafield nuclear plant. The second, whether on the basis of the evidence and the

Bradford Hill criteria, the association was causal.

The Gardner Study

Of the Defendants' criticisms of the study, his Lordship enumerated:

- the small number of children suffering from leukaemia/NHL;

- prior identification of the leukaemia excess by Yorkshire Television and the Birth and School Cohort study;

- Gardner's decision [alleged by Professor Macrae and Professor Doll] to limit the study and cases to those born and diagnosed in Seascale ***after*** collection of data had begun;

- Gardner's decision to include the 'Bristol' case contrary to the rules of the study;

- insufficient tracing of certain fathers, which although statistically insignificant was not corrected until after publication of the Gardner study.

- the fact, in the opinion of the Defendants, the Gardner study had more than one hypothesis.

Acknowledging the validity of all these criticisms to a greater or lesser extent, his Lordship qualified this assertion by saying:

> .....that is not to say that the Gardner study is valueless or that no association is shown between employment at Sellafield of fathers receiving PPI of 100 mSv or more or that the authors' claim "this result suggests an effect of ionising radiation on fathers that may be leukaemogenic in their offspring" is to be disregarded[16].

The Bradford Hill Criteria

Moving on to the Bradford Hill criteria, described by his Lordship "as an attempt to systemize common sense", Mr. Justice French proceeded to apply the epidemiological

[16] Judgment p.193-194.

model for utilisation in his Judgment[17].

In respect of:

(i) ***Strength of Association***
My conclusion is that though an arithmetically strong prima facie association is shown to exist, considerable reserve is necessary before placing reliance on it.

ii) ***Consistency***
This criterion requires that there be studies demonstrating similar results in comparable circumstances.....A great number of studies were reviewed in the course of the evidence, none of which, in my judgment, fulfilled the above requirement.

iii) ***Existence of a dose response relationship***
In my judgment, the data, while not inconsistent with a dose response in the form of a biological gradient fall short of demonstrating that such a response is present.

iv) ***Analogy***
The parties are in agreement that this criterion is inherently of little importance..... I conclude that some, though very little, weight can be attributed to this criterion or to the evidence by which the plaintiffs seek to prove fulfilment.

v) ***Specificity***
In my judgment this criterion affords the plaintiffs little assistance.

vi) ***Temporal Association***
There can be no dispute that PPI preceded the leukaemias in offspring. This essential criterion is satisfied.

vii) ***Experiment***
There was no suggestion that any human experimental data which bore on the issues in this case was known to exist.

viii) ***Biological Plausibility***
This criterion was considered, first by epidemiology, secondly, in the genetic aspect of biology. In addressing this criterion two questions arise: First, have leukaemias and/or lymphomas a heritable component apart from syndromes? Secondly, if so can the Gardner hypothesis plausibly explain the Seascale excess.

For the purposes of my judgment I am content to assume that there is a heritable component for the two diseases but that it is very small.

---

[17] Judgment P.193-198.

> In my judgment [Plaintiffs' witnesses] do indeed show that a causal relationship between PPI and leukaemia in F1 [offspring] should not be excluded on purely mechanistic grounds, though clearly, a great deal more research is necessary. What they do not do in my judgment, is to show that, in light of current knowledge, the Seascale cluster is capable of being explained numerically by the biological mechanism which are the subject matter of their research.

From the above commentary, it seems clear the process by which Mr. Justice French reached his ultimate conclusion in this case does not appear markedly different in approach from that adopted by the scientific community. Particularly relevant as the main focus of his judgment, was his Lordship's evaluation and weighting of the scientific evidence, which in the opinion of some (Day 1995; Miller 1997) had little to do with legal reasoning. Perhaps not surprisingly therefore, a few scientists (Stather 1993; Doll 1994) have subsequently expressed their approval of Mr. Justice French's conclusion that PPI was not a material contributory cause of the Seascale excess. Notwithstanding some scientific support for his Lordship's decision, a number of socio-legal concerns emerge from the **Reay and Hope** Judgment.

Before embarking on a comprehensive analysis of the judgment however, a few observations are necessary in respect of the more unusual aspects of the proceedings. To reiterate, this case marked new ground in three ways: it was the first time that a personal injury claim had tested the concept of genetic damage from radiation; the only time in a civil trial that a judge had been allocated a named judicial assistant; one of the first trials in this country to endorse a satellite video link for the examination of expert witnesses. Moving on to the proceedings themselves, his Lordship established early in 1992 his preference for having the Opening Statements in writing, in advance of the trial, rather than given orally by Counsel as was the norm. Further, and again unusually in this regard,

Mr. Justice French requested written submissions from defendants and plaintiffs outlining key issues as each expert concluded his evidence. Interestingly, at a more general level, his Lordship seemed to adopt an almost inquisitorial approach throughout the proceedings; judicially pro-active, particularly in the early days of the trial, his Lordship frequently intervened (during the examination and cross examination of witnesses) to accommodate the complexity of the scientific evidence.

Applying a pragmatic approach to his managerial and supervisory role therefore, Mr. Justice French identified and stipulated pre-trial procedures that would assist him in the effective management of the trial. According to the Manual for Complex Litigation (1995:15[18]) effective judicial supervision includes:

- A judge being active in identifying and anticipating potential problems before they arise rather than waiting passively for problems to be presented by counsel.
- The judge's involvement not being limited to procedural matters, but also dealing with substantive issues as they arise in order to make an informed ruling.
- The judge deciding disputes promptly. Delayed ruling may be costly and burdensome for litigants and will often delay other litigation events.
- The judge periodically monitoring the progress of the litigation to ensure that schedules are being followed.
- The judge being carefully prepared. Heavy handed case management by an unprepared judge may often be counterproductive, while an early display of careful preparation set the proper tone and can enhance the judge's credibility and effectiveness with counsel.

---

[18] This is a US Manual produced for high ranking Judges by the Federal Judicial Center. A lower level equivalent in England and Wales is The County Court Bench Book, published by the Judicial Studies Board. There is no equivalent to the US Manual published in this country for High Court Judges and above.

From the case analysis it would seem that Mr. Justice French complied with the majority of these recommendations in that he:

- Prepared his reading of the issues in advance of the trial.
- Attempted to identify and anticipate potential problems with regard to witnesses, reports, timetabling.
- Kept pace with the day to day reading of various reports and counsels' written submissions.
- Enhanced his own understanding of the issues by being pro-active in seeking greater clarification from witnesses.
- Regularly monitored and reviewed timing schedules.
- Paid due regard to Court time and costs, but was never obstructive where an adjournment proved necessary.
- Adopted a courteous and respectful manner towards expert witnesses and counsel and was never heavy handed in approach.
- Delivered his Judgment as quickly as possible, given the complexity of the case.

Having established that the trial was well managed, and that Mr. Justice French was prepared to use his discretion to adapt and modify existing procedural rules to fit the needs of the case, the thesis now moves on to consider the reasoning behind the Judgment, and in particular, his Lordship's handling of the substantive issues raised, and his decision not to apply the same innovative and creative approach to his decision making.

In his introduction, his Lordship emphasised that ***Reay and Hope*** was not directly involved with current wider concerns surrounding nuclear power and nuclear processes. Events in the case he said, had taken place 30 to 40 years ago when methods then in practice had long since discontinued. Reminding the court that during the 1940s it was considered

necessary for the United Kingdom to have ready available sources of plutonium in order to fulfil the country's requirements for nuclear weapons, his Lordship emphasized that the the construction of Sellafield was considered a priority. Referring to the pioneering spirit of the late 1940s, and the fact that Pile No. 1 started operating soon after design and construction in October 1950, while Pile No. 2 was working by June 1951. Mr. Justice French acknowledged these events as a "brilliant technical achievement"[19]

French, J. then provided a brief description of the Piles, made reference to the 1957 'Windscale fire', and explained how sources of environmental contamination during the working period of the Piles, and for a few years after closure of the Piles, continued at Sellafield. Moving on, his Lordship highlighted the reasons for the contamination:

> 1. The Piles themselves and in particular the output from the Pile stacks carried to atmosphere the effluent cooling air together with radioactive gases and particles produced during the Pile operation. This inevitably included large quantities of radioactive argon derived from the argon gas naturally present in air.
>
> 2. The Pile Ponds in which irradiated fuel elements were stored under water resulting in corrosion and the consequent release of some of the contents into the water. Gas evolution and spray from wind action were thought to be mechanisms for the release of radioactive substances to the environment and not only in the immediate vicinity of the site.
>
> 3. The de-canning shed where operations involved raising the fuel cartridges, stripping off the aluminium cans and separating out the irradiated uranium which contained plutonium and radioactive by-products. This operation released radioactive droplets and gases.
>
> 4. The chemical separation and plutonium purification plants in which the uranium fuel was subjected to a number of chemical processes resulting in the isolation of plutonium, uranium and unwanted radioactive by-products. Most of the radioactive products and by-products were stored either on or off site but low level liquid wastes were discharged to the atmosphere through a separate stack (the

[19] Judgment p.5.

reprocessing stack). Low level solid wastes were stored off-site at Drigg or incinerated on site.

5. The fire in Pile No. 1 which lasted two days (in early October 1957) and resulted in the (a) uncontrolled release of gases and fine particles to the atmosphere, (b) run-off of contaminated water to the Pile Ponds and via the run-off pipe line to the sea, (c) contamination of areas adjacent to the Pile building and areas surrounding the plant to distances of many kilometres[20]

Although his Lordship did not expound on the working history of George Reay and David Hope, it is clear from the transcript that both men were exposed to high doses of occupational exposure. As fitters, Reay was involved in the removal/recovery of burst cartridges from the core, while Hope was involved in lowering experimental cartridges down to the core. Such procedures required the men to lift the roof manhole cover, thereby exposing a concrete plug in the biological shield of the core. In order to carry out their duties, both men had to straddle the access holes from the pile roof to the roof core, with their gonads suffering direct exposure. In addition to this work, both men were also employed in the heavily radioactive pond and bay areas. Only later was it realized how radioactive the water was.

Despite evidence from the Plaintiffs with regard to a 'cavalier approach' in respect of radioactive emissions, his Lordship was keen to play down the significance of any present day concerns in relation to Sellafield, asserting[21]:

.....this case is not, at least directly, concerned with the current wider pubic

---

[20] Judgment p.9-10.

[21] Judgment p.4-5.

> interest in the merits or demerits, environmental or otherwise of nuclear power and nuclear process;

and:

> .....evidence regarding radiation doses received by Mr. Reay and Mr. Hope before conception of their respective daughters Dorothy and Vivien and by others may have little bearing on conditions at Sellafield or at other plants at the present day".

In choosing to reject many of the wider implications of the Gardner Study for present and future workers; their families; and local residents; Mr. Justice French removed any hope that **Reay and Hope**, a test case, could fulfil the goals identified by Rosenberg (1984:851), of contributing towards a more 'public law vision of the tort system' where "maximizing social welfare and protecting individual entitlement" co-exist. Acknowledging Rosenberg's 'utilitarian rights based model' would have allowed the judge to consider issues of accountability; pollution deterrence; and in light of such novel scientific evidence, adoption of a more precautionary approach, redefined for toxic tort purposes - "prudent action in advance of scientific certainty"[22] (Attfield 1994:152). In the event however, his Lordship opted for traditionalism and orthodoxy over innnovation.

---

[22] There is, at present, no comprehensive or definitive definition of the precautionary principle. The Hon. Mrs Justice Smith in her Judgment, **R v Secretary of State for Trade and Industry, ex parte Duddridge and others** QBD October 3, 1994 acknowledged that over the years the 'expression' had been used in a number of international declarations, conventions and treaties (p.7), and that it appeared to be a policy intended to protect the environment. However, Mrs Justice Smith went on to say it "is not intended to apply to damage to health caused by environmental factors unless those factors are or might in themselves be damaging to the environment in the long term" p.20.

There are three main areas that will be examined (all covered in greater depth earlier on in the thesis) which provide a framework upon which to evaluate and consider the Judgment[23], and in so doing integrate the various strands of the research together. The headings include:

- Science and Science/Law Interaction
- Causation
- Expert Evidence
  (ie: Occupational/Environmental Dosimetry; Epidemiology and Genetics).

Science and Law Interaction

From the case analysis it seems that Mr. Justice French was willing to accept the inter-disciplinary approach of science and law, and Vanyo's (1974:57) assertion that "they both involve rules of some sort; they both involve data or facts of some sort; and they both reach conclusions based on analytical reasoning". This is why for many (Sive 1974; Smith 1989; Jones 1994) lawyers' perception of science is of a universal, ideal 'pure' knowledge form (supremely rational, open-minded, emotionally detached, objective and neutral[24]). As a consequence, say Wynne and Smith (1989), many judicial fact finders increasingly rely upon scientific expertise to assist them in their ultimate decision making. Although science and law remain separate disciplines, one of the consequence of this professional alliance is the potential deconstruction of both areas distinctive knowledge base, with "s ience as a body of knowledge and law as a body of knowledge becoming blurred as the practices of science and law each intrude one upon the other" Jones (1994:270).

---

[23] When analysing the Judgment, none of the detail that emerged from the transcripts (discussed in Ch.4) will be reviewed in any depth.

[24] Please refer to Ch.2.

Simply acknowledging this increasing interaction of science and law however, does not confront the main issue - whose account of science informs judicial decision making? As Green (1989:113) points out, most "legal institutions are staffed by non-scientists, non-engineers and non-doctors" yet all too often, lawyers are called upon, and expected to resolve, complex scientific questions for which they have little or no training. Despite this lack of scientific knowledge, Green goes on to say that most legal professionals do not perceive this as a problem, they simply "construct a model of scientific knowledge which allows for an account of the science-law interaction in which non specialists understanding of specific issues is sufficient for the resolution of all legal problems" (Ibid).

While Mr. Justice French made a serious effort to clarify and comprehend the scientific evidence, as well as cope with the complexities of the arguments, his Lordship nonetheless accepted without question the interpretive framework upon which science is based, and further, proceeded to utilise scientific methodology for his own decision making purposes.

Unlike the courts in the US which have attempted to identify defined boundary lines between judging the process (judicially acceptable) and judging the basis of scientific knowledge (judicially unacceptable), the English courts have always accepted the legitimacy and authority of scientific knowledge. Regarding science as a joint ally in the shared project of truth finding, law has assimilated its defintion of scientific methodology (rationality, objectivity, neutrality) and utilised it for its own purposes. When Mr. Justice French omitted from consideration any wider concerns with regard to the basis of scientific evidence, he did so in the belief that certain facts could therefore be fragmented and separated for resolution, exclusively by reference to empiricism.

When comparing legal v scientific standards of proof there are two juxtaposing positions. The first that the legal standards of proof need not be as rigorous as the scientific standards (Miller 1987); the other, that the standard of proof in the courtroom is more rigorous than those exercised by the scientific community (Levin 1987). Under traditional tort doctrine, the civil burden of proof requires the plaintiff to establish a 51 per cent tilt in his favour to succeed on the balance of probabilities. In contrast, the epidemiological standard of proof is determined by calculating the statistical significance of the P-value, which in this case was identified by Gardner as having a 5 per cent probability (95% certainty) that any association was due to chance. Forming only one part of the Bradford Hill criteria therefore, the strength of the association, along with consistency, evidence of a dose response relationship, analogy, specificity, temporal association, experiment and biological plausibility make up the guidelines laid down by Bradford Hill, with the aim of assisting epidemiologists, and in this case Mr. Justice French establish causation.

Although it may have been pragmatic for Mr. Justice French to have utilised the Bradford Hill criteria, there is no way of knowing the legal reasoning behind his decision. Unfortunately, the all important 'judicial discovery process', discussed in 5(1), remains an elusive element. Whether the cumulative effect of attempting to combine the balance of probabilities, with guidelines laid down by the Bradford Hill criteria, raised the overall standard of proof in this case, remains an open question. While probability theory may offer a prescriptive way of assessing such judicial uncertainties in the future (a point considered in greater detail in the next section), it presupposes a subjective prior probability model, and knowledge of judicial calculation of the probability of compound

events (Manansky 1997). Without more information therefore, it is virtually impossible to determine the weighting basis upon which Mr. Justice French reached his conclusion.

From discussion of this part of the Judgment, certain criticisms can be made:

1. The Judge appears to have accepted without question the interpretive framework upon which science is based.

2. His Lordship accepted the existence of a methodological alliance between science and law which allowed him to blur the boundaries of scientific and legal decision making.

3. French, J. applied and utilised a scientifically constructed model to justify his decision.

Causation

The issue of causation continues to be a major problem for any toxic tort plaintiff relying on the traditional basis of causation. In recognition of this fact, legal academics and lawyers are currently in debate over the all or nothing approach of the 'but for' test, the 'loss of chance' question and where the burden of proof should lie.

Mr. Hytner on behalf of the plaintiffs cited **Bonnington Castings Ltd v Wardlow**[25], and **McGhee v National Coal Board**[26] in support of his assertion that, provided the factor responsible for the illness made a material contribution to the disease, or materially contributed to the risk of the disease and was not de minimis, the defendants were liable. The only way the Defendants could escape liability therefore, is if it could be shown that PPI was so overwhelmingly trivial post August 1954, as to be of minimal significance, as:

---

[25] [1956] 1 All ER 615, [1956] AC 613.

[26] [1972] 3 All ER 1008, [1973] 1 WLR 1 HL.

> Prior to 1954 there was no statutory duty and the Minister of Supply, succeeded by the Lord President of the Council, was liable for any breach of common-law duties (Day 90, p. 28G-H).

Not surprisingly therefore, the plaintiffs rejected the more recent case, **Hotson v East Berkshire Area Health Authority**[27] in which the House of Lords reasserted the authority of the all or nothing approach of the but for test, whereby an increase in risk was deemed insufficient to amount to causation[28].

Relying on **Bonnington; McGhee** and other cases such as **Wilsher v Essex Area Health Authority**[29] (which in the opinion of the plaintiffs, upheld that part of the **McGhee** case which equated increase risk with causation) for their Closing Submission, Mr. Hytner went on to highlight the impossible task of plaintiffs proving, on the balance of probabilities, which particular photon or alpha particle may be responsible for which mutation causing leukaemia:

> My Lord, the interesting thing is this, that photons are continually reaching the body from the background radiation for which the Defendants are certainly not responsible. How could we possibly prove, even if PPI is a cause of the Seascale excess, that Vivien Hope's NHL wasn't initiated or promoted eventually by a proton of gamma from outer space, background radiation having nothing to do with Sellafield? How do we know that Dorothy Reay was not one of those

---

[27] [1987] AC 750, [1987] 2 All ER 909 HL.

[28] As discussed in Ch.2(3), despite this ruling, the court left open the question of whether 'loss of chance' might in the future form an action in the tort of negligence, Lord MacKay in his speech said, "I consider it would be unwise in the present case to lay down as a rule that a plaintiff could never succeed by proving a loss of chance" **Hotson v East Berkshire Area Health Authority** [1987] 2 All ER 909 HL at 477.

[29] [1988] 1 All ER 871, [1988] AC 1074 HL.

unfortunate infants of whom there clearly are many whose childhood leukaemia is indeed caused by background radiation?

If this point is in fact a valid one, no Plaintiff could every prove a case. It would be quite impossible because if you don't know which photon or which alpha particle caused the damage, caused the mutation, all these millions that are passing through the body, it doesn't matter what statistical evidence you produce to show likelihood, you have got to prove this one (Day 90, p.39A-D).

Citing Lord Bridge in **Wilsher**[30] in support of his assertion that a judge is therefore entitled to draw inferences from the evidence, Mr. Hytner continued:

> But where the layman is told by the doctors that the longer the brick dust remains on the body, the greater the risk of dermatitis, although the doctors cannot identify the process of causation scientifically, there seems to be nothing irrational in drawing inferences, as a matter of common sense, that the consecutive period when brick dust remained on the body, probably contributed cumulatively to the causation of dermatitis. **I believe that a process of inferential reasoning on these general lines underlies the decision of the majority in McGhee's case.**

The defendants challenged the plaintiffs' interpretation of **McGhee**, as well as the interpretation which had been placed on **McGhee** by the Court of Appeal in **Wilsher**, in particular, the majority judgment of Lord Justice Mustill and Lord Justice Glidewell expressed by Mustill, L.J. in the following terms:

> If it is an established fact that conduct of a particular kind creates a risk that injury will be caused to another or increases an existing risk that injury will ensue; and if the two parties stand in such a relationship that the one party owes a duty not to conduct himself in that way; and if the first party does conduct himself in that way; and if the other party does suffer injury of the kind to which the risk is related; then the first party is taken to have caused the injury by his breach of duty, **even though the existence and extent of the contribution made by the breach cannot be ascertained**[31].

---

[30] Ibid at 1088 B.

[31] [1988] AC 1074 HL at 771.

From the viewpoint of the Defendants, any attempt to extract some esoteric principle from **McGhee** was fruitless and misguided; the Court had simply been adopting a pragmatic approach to the facts of the case, and on this occasion, the majority concluded that it was a legitimate inference of those facts that the defendants' negligence had materially contributed to the plaintiff's injury.

Clearly, Mr. Justice French could have raised some of these issues in his judgment and/or made reference to the various authorities cited by the plaintiffs and defendants. In particular, he could have offered his opinion on judicial inference of inconclusive scientific and medical evidence, and referred to the problems of general v specific causation.

The uniqueness of **Reay and Hope** offered his Lordship the opportunity to contribute to the debate on the problems of causation and also, as part of his written judgment, to have identified some wider issues underlying this area from a legal perspective. Because he chose to present his Judgment solely on the basis of empirical facts and scientific criteria, very little law was actually considered. Yet according to MacCormick (1978:103), "legal decisions must make sense in the world and they must also make sense in the context of the legal system. In our problem cases, they must be based on rulings which make sense in the context of the legal system".

Expert Evidence

From discussion of experts witnesses in Ch.3, it would seem, despite statutory and other regulatory authority, there remain a number of ambiguities and uncertainties surrounding judicial interpretation of expert evidence, including: perceived level of witness

competence, witness credibility, potential bias of witnesses, court presentation of witnesses. In addition however, other factors such as the death of a primary witness, in this case, Professor Martin Gardner, and the non-attendance of Professor Nomura, may also have impacted on his Lordship's decision making. Commenting on Professor Nomura's absence, Mr Justice French said[32] "It was unfortunate..... that he [Professor Nomura] was unable to defend his studies in person or even, it would seem, via a satellite video link between London and Osaka".

With regard to the experts who did attend the trial, their areas of expertise (already broken down for the purposes of the trial and case analysis) remain, Occupational and Environmental Dosimetry, Epidemiology and Genetics.

Occupational Dosimetry

In respect of internal and external Occupational Dosimetry, figures were only achieved after a compromise between Plaintiffs and Defendants. The agreement, subsequently presented to the court, on day five of the trial by Dr. Rex Strong on behalf of BNFL, was referred to by his Lordship in his Judgment[33]:

> By far the largest element in computing the total paternal radiation dose received by individuals is the occupational dose ie. that received while at work at the Sellafield plant. Had the occupational doses remained in contention it would have occupied the court for many weeks, even months. It would have involved to a very much greater extent than is now necessary an examination of basic nuclear physics, of the various types of radiation, of the impact of those types of radiation on the human body, and of varying impact of those types of radiation on different parts of the body. It would have involved detailed evidence as to the nature of the

---

[32] Judgment p.207.

[33] Judgment p.17.

> operations carried on at Sellafield, the times spent by the workers concerned at various locations on the site, the amounts of radiation to which they were subject at the various locations, the nature and effectiveness of protective measures taken and the effectiveness or otherwise of methods designed to record doses to the workers. All this would have been in the context that the majority of the events in question took place 30 to 40 years ago.
>
> As matters have turned out however the parties, with eminent good sense, have rendered a forensic exercise of the sort outlined unnecessary.

Mr. Justice French went on to say however:

> I shall make one further observation regarding Dr. Strong's agreed statement. He ends it with an express reservation that the dose figures as agreed "are intended to be used by epidemiologists in this litigation, who have a technical appreciation of the scientific limitations of the data and who are prepared to accept them in this light as being indicative rather than definitive[34].

Three factors arise from this part of the trial. Firstly, despite the 'agreement' reached by the parties there remains uncertainty over the reliability of the figures. Secondly, most of the problems relating to occupational dosimetry[35] only emerged as a consequence of the discovery process (the Howells factor) and would have remained hidden, had it not been for the litigation. Thirdly, the Plaintiffs' made serious allegations against a public body (the NRPB), raising serious concerns over their neutrality and relationship with in-house experts and affiliated bodies whose expertise dominates the field under investigation; particularly significant, given that the plaintiffs called no witnesses on their own behalf after settlement of the 'agreement'.

Clearly all these matters are of public concern, and again bring us back to the private v public law debate discussed earlier on in the thesis. Had the traditional tort approach

---

[34] Judgment p.19

[35] Discussed in Chapter 4(2).

been questioned, perhaps his Lordship would have been less concerned with when the 'parties reached an agreement', and rather more, with the serious public health and policy issues that emerged as a consequence of the 'agreement'.

Environmental Dosimetry

A number of issues arise from the environmental dosimetry[36] part of the case, not least the 'Jakeman factor' which resulted in releases of uranium oxide levels being increased from 440 grams to 20 kilograms. Other discharges, including iodine, argon 41, polonium, caesium, strontium were also highlighted by the plaintiffs as providing other examples where incomplete or inadequate data existed with regard to radioactive discharges and releases. Here again, discovery produced information that neither the defendants nor any other monitoring agency seemed aware of.

As with occupational dosimetry, the plaintiffs called no witnesses on their own account, relying instead on cross examination to highlight the persistent errors, over confidence and defensiveness of the defendants, as well as the cavalier approach they adopted towards radioactive emissions. The plaintiffs further allege attempts by the Defendants to "rubbish" the reputation of Dr. Jakeman (as a result of his whistle-blowing activities) and again made reference to the fact that the NRPB were "too friendly" with the NRPB to fulfil its independent monitoring role, thereby safeguarding the public interest.

In preparation for, and also to counter such allegations, the Defendants' devised the Sellafield Environmental Assessment Model (SEAM) in order to calculate the

---

[36] See Ch.4(3) for a more detailed discussion of this area.

concentrations of different radionuclides in the environment. According to Professor Jones, SEAM provided one of the most comprehensive mathematical models yet devised to assess historic discharges from the Sellafield site.

Mr. Justice French took on board many of the plaintiffs' concerns, when he said:

> To these and other arguments advanced by Mr. Hytner I have given careful consideration. I can well see that from the plaintiffs' viewpoint there were good grounds for initial suspicion in a number of respects. Having heard Professor Jones [BNFL] and Dr. Stather [NRPB] I did feel that they displayed a measure of defensiveness perhaps, due in part at least, to Mr. Hytner's and Mr. Read's fair but searching cross examination. Also, I think it probable that the defendants, like any undertaker whose activities may cause pollution, would prefer uncomfortable facts to be presented in their most favourable light.

His Lordship went onto say:

> ....That said, the probity and competence of Professor Jones, and Dr. Stather are beyond question. I am satisfied that I can rely on the evidence to the extent that they were doing their honest and expert best to put the full picture regarding environmental dose before the court. While by no means all emission of radionuclides have been accounted for, let alone recorded, I have sufficient confidence in Professor Jones' SEAM model and in his evidence[37]

In the same way that his Lordship concentrated on the 'agreement' rather than the substance of the evidence with regard to occupational dosimetry, he appears to have repeated the same error of judgment in respect of environmental dosimetry. Professor Jones' expertise provided a prime example of a situation in which he, as the scientist was distinguished from BNFL as an institution. In his Judgment, Mr. Justice French acknowledged that not all emissions had been either accounted for, or recorded, ignoring this point further, he went on to say that he nonetheless found the "probity and competence" of Professor Jones to be "beyond question". There are clearly two different

---

[37] Judgement p.27-28.

issues here, one dealing with Professor Jones' competence to formulate mathematical historic assessment models, the other, the fact that the defendants repeatedly failed to account for, or record, emissions of radionuclides released into the environment.

What emerges from analysis of the environmental dosimetry evidence is the ongoing uncertainty over discharge figures. Many (Busby 1994; Gould and Gouldman 1990; Sutcliffe 1987; Bertell 1986; Sternglass 1981) believe that the true emission figures (then as now) are in fact far higher than appreciated, or admitted to, and that the nuclear industry, and BNFL in particular, have a vested interest in being economical with the truth. Although Mr. Justice French was aware of these ongoing evidential inconsistencies and also, Dr. Stather's concession under cross examination that the NRPB did not, and do not, have the expertise to validate discharge figures given to them by BNFL, his Lordship appears to have disregarded these factors in favour of his opinion and evaluation of Professor Jones' and Dr Stather's court presentation as expert witnesses, rather than confront the issues raised. (Coincidentally, referring to the Academy of Expert research, judicial reliance on 'presentation' of evidence rather than 'evidential content' was identified by 68 per cent of members as an area of major concern[38]).

Epidemiology

Epidemiological studies are notoriously subject to methodological problems, incomplete or unreliable data and are more concerned with general rather than specific causation. As a consequence of such scientific uncertainty says Jasanoff (1996:405), judges often become adept at the boundary work of decision making, a process which subjectively

[38] Please see Ch.5(3) for further information.

allows them "to demarcate credible witnesses from unreliable ones"; junk science from mainstream science (Huber 1991); plausible theories from implausible ones. Whether one accepts or rejects the legitimacy of such boundary work, it is important because, as Hoffman (1984) observes, scientific and legal approaches to assessing evidence are, and should remain, distinct entities.

Unlike Judge Weinstein in the Agent Orange litigation, Mr. Justice French did not ponder on jurisprudential and evidential questions surrounding the general, rather than specific aims of epidemiology, nor whether weaker evidential standards were more appropriate for epidemiological evidence. What Mr. Justice French does appear to have done, is accept what Wynne (1989:47) has referred as "the social negotiation of scientific consensus" which as Chapter Two illustrated, presumes the existence of a recognized authority of scientific knowledge, reinforced by the assumption that courts are capable of determining what constitutes legitimate scientific expert opinion. On this occasion however, epidemiology did not simply assist the decision maker, it also provided the methodological foundation and justification for the judgment.

Acknowledging the role of epidemiological research as providing an assessment of the probability:

(a) that there is an association between the exposure of interest and the disease of interest;
(b) that the association, if any, is causal;

His Lordship reiterated the fact that in this case, the exposure of interest was ionising

radiation and the disease of interest was cancer of the blood. Reminding the court that Dorothy Reay's cancer was leukaemia while Vivien Hope's cancer was NHL, Mr. Justice French proceeded to outline certain considerations:

(i) whether the exposure of interest was causally connected with both forms of cancer;
(ii) whether both forms of cancer should properly be regarded as one disease of interest in assessing the probabilities of causation;
(iii) if not, what the probabilities are, applying the same methods of assessment to each, that leukaemia on the one hand and NHL on the other hand were casually connected with the exposure of interest.

Accepting the epidemiological evidence as providing the foundation of the plaintiffs' case, his Lordship went on to conclude that if, on the evidence before him "no reasonably possible or plausible route or pathway had been shown by which radiation emitted by the defendants could have caused one or both of the diseases, [it] would clearly be a very important matter to put in the scales when deciding whether one or both cases were proved"[39]. Where one or several epidemiologists or other scientists find an association, or do not find an association, or are able or unable to establish causation, then such a finding would, as Mr. Justice French commented "be most helpful to the judge[40]. Despite offering some judicial assistance however, expert epidemiological opinion remains divided and contenious, to quote Sales and Simon (1993:235) once again:

> ...Scholars may have different theoretical and methodological orientations, existing research may not provide definitive answers, the same data can be interpreted in a variety of ways, the appropriateness of one sampling technique may be disputed, the appropriateness of the statistics chosen may be open to question, and so forth.

---

[39] Judgment p. 34.

[40] Judgment p. 35.

Referring to the common problems of bias and boundary tightening associated with case control and cohort studies, his Lordship identified the Bristol case, multiple hypotheses and sub-groups analyses as particular methodological weaknesses alleged by the defendants in respect of the Gardner study. Mr. Justice French quoted directly from Professor Doll's conclusions:

> I have previously concluded that the observations of an excess number of cases of leukaemia and non-Hodgkin's lymphoma in Seascale was not the result of paternal preconceptional irradiation but could most reasonably be explained by a combination of chance and the effect of the sort of socio-demographic factors described by Kinlen and that the statistical association with paternal preconception irradiation found by Gardner et al (1990) was probably due to a combination of chance and the post hoc selection of an atypical subgroup of the young people who developed leukaemia in West Cumbria for concentrated study. The new evidence that has become available supports this conclusion".

His Lordship went on to say:

> This is a conclusion which, on the evidence as a whole, seems to me no less plausible than the Gardner hypothesis[41]

Although Mr. Justice French doubted whether any epidemiological study had been subject to so lengthy or so rigorous examination as the Gardner study had undergone during the trial, and recognised that under similar scrutiny no "epidemiological study would emerged unscathed[42]", his Lordship does not appear to have applied the same rigorous standards demanded of the Gardner study to either the A-bomb research[43] or the Kinlen hypothesis, both of which were severely criticised for methodological inconsistencies and unreliable or contradictory conclusions.

---

[41] Judgment p.208-209.

[42] Judgment p.194.

[43] The A-bomb studies were equally important to the epidemiological and genetics evidence.

Given his Lordship's disinclination to apply comparative evidential standards, or consider important evidential questions that emerged as a consequence of these methodological inconsistencies, it is perhaps not surprising that Mr. Justice French also chose to ignore the words of Professor Macmahon[44], when he said:

> Rarely can we be certain that a causal relationship exists, but by assembling evidence from any different angles we may build a body of support sufficient to convince most reasonable people that it is more prudent to act as though an association were causal than to assume that it is not. The point in the accumulation of evidence at which this decision is reached depends in considerable part on the consequences of the alternative actions to be taken as a result of the judgment (Day 58, p.11E-F).

In blurring the boundaries of scientific and legal decision making, Mr. Justice French demonstrated the inherent difficulties of ruling on conflicting epidemiological evidence. The question of "whose knowledge should count as valid, and according to what criteria", are identified by Jasanoff (1993:19) as pertinent considerations when addressing the reconstruction and redefinition of scientific knowledge within a legal context.

Genetics

In his introduction to the genetics evidence, his Lordship reiterated the fact that the plaintiffs' case is:

> .....that the epidemiological evidence is very strong and could only be displaced by a demonstration that the cause and effect they assert is impossible[45]

---

[44] Judgment p.35.

[45] Judgment p.118.

Reminding the Court that the Plaintiffs were not suggesting any formal transfer of the general burden of proof to the defendants and that this remained with the Plaintiffs, his Lordship proceeded to outline the plaintiffs' allegation that qualitatively it had been proved that a pre-disposition to leukaemia could be transferred through the paternal germline.

The Defendants, again while not assuming any burden of proof, were concerned to demonstrate that the existence of any mechanism whereby PPI could pre-dispose to leukaemias in offspring was highly implausible.

Outlining the main focus of the genetics evidence as establishing:

> .....whether there exists a plausible or reasonably possible biological pathway or mechanism by which radiation emitted by or from the Sellafield plant could have caused or materially contributed to one or both of the two disease[46].

His Lordship identified two central questions:

> a) whether or not irradiation of paternal gonads **can** cause a predisposition to leukaemia and/or NHL in children; and/or:
>
> b) can do so having regard to the doses of radiation received by the fathers in these cases.

Explaining the importance of biological plausibility, his Lordship went on to say:

> If the alleged causal connection is biologically impossible as regards one or both diseases then, no matter what the statistics purport to show, the claim or claims, as the case may be, cannot succeed. Equally if the alleged causal connection is widely implausible in respect of one or both diseases that must have a bearing on the weight to be given to the statistical probabilities of the matter. Conversely, if a plausible biological mechanism exists, that helps the plaintiffs' case by fulfilling one of the Bradford Hill criteria (Ibid).

---

[46] Judgment p.7-8.

Pointing out the importance of the genetics evidence in helping to establish both biological plausibility and the issue of causation, Mr. Justice French identified risk estimates (derived from human, animal, and human cell in vitro data) and advances in medical knowledge as fundamental in establishing whether leukaemia and or lymphomas have a heritable component (apart from syndromes related) and if so, whether the Gardner hypothesis could plausibly explain the Seascale excess.

Accepting the consensus of expert opinion that in the main there was a 'small non-syndrome' heritable component. Mr. Justice French stated:

> For the purposes of this Judgment I am content to assume that there is a heritable component for the two diseases but that it is very small[47]

Referring to the inconsistencies that exist between the A-bomb data and the Gardner study, his Lordship reminded the Court that both national and international agencies had relied on the A-bomb data for purposes of risk assessment and radiological protection standards over many years. Commenting that these nuclear agencies would not have taken this action if it had been unsafe to do so, his Lordship went onto to say:

> In my judgment they [the Plaintiffs] do indeed show that a causal relationship between PPI and leukaemias in F1 [off spring] should not be excluded on purely mechanistic grounds, though clearly, a great deal more research is necessary. What they do not do in my judgment, is to show that, in light of current knowledge the Seascale cluster is capable of being explained numerically by the biological mechanisms which are the subject of their research[48]

---

[47] Judgment p. 200.

[48] Judgment p.205.

Moving on, his Lordship made reference to the novel features of the evidence and the Plaintiffs' claim that "in terms of human experience and studies, the Seascale phenomenon is probably unique"[49]. He referred to the work of Professor Meuth who pointed out that the scientific community were failing to take account of important genetic factors when making risk estimates; Dr. Cox who identified certain unconventional mechanisms to explain the biological mechanism; and Dr. Thacker who said "we will not understand the potential mutagenic and carcinogenic consequences of radiation exposure until we have thoroughly analyzed radiation-induced mutation at representative sites in the human genome"[50]. There is no doubt that, as with that the link between smoking and lung cancer, the biological mechanism responsible for PPI remains at the cutting edge of scientific research and, in the opinion of his Lordship therefore, "speculative".

In rejecting the opinion of Professor Day with regard to the limitations of the A-bomb data in respect of dose assessment; variation of population sensitivity and composition; differences in exposure levels; and the fact that synergism was not considered a relevant factor for inclusion in the A-bomb data; his Lordship also by implication, rejected the evidence of Professor Neil, who illustrated the problems of relying on conventional genetics, and Dr. Thacker, who as well as identifying the differences between animal and human data outlined above, also drew the Courts' attention to the differences between acute v chronic radiation exposure.

---

[49] Judgment p. 206.

[50] His Lordship cited Dr Thacker's comments made on Day 73, p. 31B of the proceedings.

Concerned over the non-attendance of Professor Nomura and the Plaintiffs' thwarted attempts to make contact, his Lordship appears to have disregarded the observations made by Dr. Cox in his evidence, that (as yet) nobody had actually repeated Professor Nomura's study (Day 75, p.50C) and further that, Professor Nomura was a well known and internationally recognised mouse geneticist (Day 75, p. 49F-H). Relying instead on the scathing professional and personal attack made by Dr. Selby, his Lordship said of Professor Nomura:

> The defendants devoted a great deal of time and expertise on a detailed critique of Professor Nomura's studies with a view to demonstrating their unreliability. Professor Nomura himself was unable to attend the hearing because of illness and the Japanese government's refusal to permit him to leave Japan. He did grapple with some of the criticisms in supplementary written reports. A sufficient number of unanswered or insufficiently answered criticisms remained, however, for me to feel unable to place reliance on Professor Nomura's studies as lending support to the Gardner hypothesis. Nor am I impressed by the studies on which he relied as supporting his own results[51].

Currently, much of the accepted wisdom over genetic research is under review. Genetics as a discipline has moved from a letter in the journal Nature by Watson and Crick in April 1953, to the discovery of the genetic code; it is virtually impossible to predict with any certainty what will happen in molecular biology over the next decade. Despite conceding to the existence of a 'small' genetic component, his Lordship seemed unable or, unwilling, to embrace the developing world of genetics.

In addition to problems of new, novel, or unconventional scientific evidence however, many members of the Academy of Experts also expressed concern over judicial

[51] Judgment p. 206.

understanding of **traditional** scientific evidence. Of those who took part in the Survey[52], the following views were fairly representative[53]:

> .....My main comment would be the apparent lack of understanding of technical issues by the judge, which impeded clear resolution of often complex problems.
>
> The knowledge of judges varies considerably; some know the subject very well and giving evidence is easy, other have no idea about the subject and therefore do not understand the complexities of detailed expert evidence
>
> I think that judges may be influenced by a well written report where ethical explanations are rendered comprehensible insofar that when he has to recap he will refer to the report that he finds easiest to read and is most likely to answer the question that it in his mind.
>
> [Regardless of expert evidence] The bias of the judge is still evident in some cases to the point that it is visible to all in the court.

Judgment Conclusion

Like the Agent Orange case, **Reay & Hope** was not a traditional tort action, subject to qualitative and quantitative difference therefore, alternative approaches to the decision making process should have been considered. All toxic tort disputes, by their nature, involve complex injuries, time scales and evidence. Consequently, presiding judges, as part of their understanding process, need to embrace not only the limits of scientific theory and methodology, but also some basic assumptions with regard to tort law. Some legal theorists (Rosenberg 1984; Schuck 1987; Reece 1996), while still believing that toxic torts remain essentially 'tort disputes', also recognise the unique and distinctive character of these claims and the need to have new models to represent them. In

---

[52] Further details of this survey may be found in Ch.3.

[53] See Ch.3 and Ch.5(3) for further discussion of this research

addition to greater scientific epistemological awareness therefore, judges need to question the whole legitimacy of relying on the traditional tort approach to resolve cases of this complexity.

In the US, toxic tort development has already resulted in an undermining of the traditional basis of tort. As Schuck (1987:12) points out:

> 1. Tort law and moved from an individualistic grounding toward a more collective one.
>
> 2. The criteria for evaluating the parties' behaviour has moved from moral categories to more functional ones. Evaluations of conduct based on fault, specific causation and corrective justice norms have increasingly given way to considerations of compensation, deterrence, and administrative efficiency.
>
> 3. Today's judge does not simply decide between competing proofs and legal theories offered by the parties; he or she is also widely expected to administer large scale litigation with an eye to achieving broad social purposes.

The unique features of **Reay and Hope** fit neatly into this broader paradigm and could have provided a basic foundation upon which his Lordship could have built. Instead, Mr. Justice French chose to apply a scientific and factual framework upon which to base his decision, thereby omitting from consideration any other factors outside the strict, narrow parameters defined by him.

From the Judgment analysis therefore a number of factors emerge:

1. Mr. Justice French failed to take advantage of, or alternatively chose not to proceed with the wide discretionary powers he had to be innovative. His Lordship was unwilling to consider any alternative to the traditional 'individualistically orientated' tort approach.

2. The Judge accepted without question the interpretive framework upon which science is based, and allowed his own subjective evaluation of what constituted legitimate scientific authority to impact on his decision making.

3. His Lordship assumed the existence of a close methodological alliance between science and law, and in so doing utilised a scientifically constructed model to not only assist, but also justify his decision making.

4. Mr. Justice French made no mention of cited authority, and made no attempt to grapple with important evidential and jurisprudential questions surrounding toxic torts and ***Reay and Hope*** in particular. In addition to cited authority, his lordship could have expanded on the difficulties of scientific causation v legal causation; traditional standards of proof; the preponderance rule; loss of opportunity; public v private law; the dilemma of the toxic tort; probability theory and evidential uncertainty[54].

Before embarking on any definitive conclusions with regard to this case however, 5(3) will consider whether the implementation of some form of applied probabilistic reasoning would be a way forward in assisting the judiciary and others, in their understanding of the processes involved. Drawing on legal scholarship, and research discussed earlier on in the thesis[55], this section will evaluate the viability of applied probabilistic theory, in particular Bayes' theorem, to 'hard' cases such as ***Reay and Hope.***

---

[54] Please refer to Chapter 2(3) for further discussion on this issue.

[55] Queen's Bench Division judiciary. Academy of Expert members.

5.3 THE APPLICATION OF PROBABILITY THEORY TO JUDICIAL DECISION MAKING

Having looked at some of the problems with regard to judicial decision making, and considered the **Reay and Hope** judgment in particular, the thesis will concentrate on whether the application of some alternative method of judicial reasoning would be more appropriate in cases involving highly complex scientific expert evidence and whether, in the final anaylsis, this approach would benefit the toxic tort.

Although generally associated with criminal cases[56], Bayes Theorem is seen as a possible way forward in assisting lawyers, legal academics and others to confront some of the more general problems raised in this chapter with regard to judicial decision making. In addition to evaluating current academic thinking on this issue however (Fienberg 1989; Aitken and Stoney 1991; Schum 1994; Aitkin 1995; Robertson and Vignaux 1995), this section will also incorporate empirical research from the judiciary, and from members of the Academy of Experts to assess the viability, and potential benefit of applying probabilistic reasoning to the decision making process.

For Holmes writing in the 1890s there was no doubt that a judge of the future should be a man of statistics, in his opinion therefore, an ideal system of law should draw its theoretical and legislative justifications from scientific methodology. Yet, notwithstanding the potential for the realisation of this ideal, there are, and remain, major obstacles to its fulfilment. Twenty years ago, Loevinger (1974:15) observed, "few lawyers have even a vague impression of the basic principles of statistics, sampling methods, or probability

---

[56] See Footnote 63 (p.339) for case details.

theory". Twenty years on, Loevinger (1995) is still highlighting the lack of statistical training in legal education, and reminding the legal establishment of the radical changes that have taken place in the fields of science and technology.

Brennan (1989) too acknowledges this development, but also draws our attention to the parallel growth of scientific expert evidence and the toxic tort. Reminding the reader that judges are use to thinking about causation in terms of "mechanistic causal chains" (while scientists rely on "probabilistic evidence of causation and statistical proof of proposition"[57]), Brennan says it is possible for the judge to misinterpret the hypothesis for causal proposition, or alternatively, to reject statistical evidence which may prove/disprove a particular hypothesis.

Increasingly, as ***Reay and Hope*** shows, judges are called upon to decide cases on the basis of highly complex (often contradictory) disparate pieces of scientific evidence where each piece of evidence (within its own academic discipline) may adopt a different or contrary perspective. For this reason, many academics (Bring and Aitken 1996; Schum 1994; Robertson and Vignaux 1995) believe that the application of statistical and probabilistic reasoning to the judicial decision making process would not only assist the judiciary (and other factfinders) in their understanding of the scientific evidence, but also offer an alternative to the top-down decision model (Michon and Pakes 1995) utilised by many judges in their decision making.

---

[57] Probabilistic evidence relies on hypothesis building and hypotheses testing using statistics.

However, while recognising the potential benefits of an increased use of statistical probabilistic reasoning in the courtroom, certain legal scholars such as Bring and Aitken (1996:134) claim that "the analytical framework proposed by statisticians does not adequately represent the reasoning needed in court" and further says Pakes (1996:148), "that judicial decision making is not quite like decision making when betting". Others, in particular legal educationalists (Twining 1984; Binder & Bergman 1984), suggest that law schools should simply do more to develop a special awareness of the evaluation of evidence, appreciating perhaps, as Jeremy Bentham (1748-1832)[58] and John Henry Wigmore (1863-1943)[59] before them, the methodological gap that exists with regard to the decision making process, and the fact that "most decisions in court are taken under uncertainty" (Bring and Aitken 1996:134) where "conclusive evidence is either in very short supply or is quite impossible to obtain" (Schum 1994:1-2).

Although the concept of probability dates back to the gambling days of 1645 (Todhunter 1865), as early as 1665 the German mathematician, Leibniz, had already proposed a probability calculus specifically for legal reasoning. Later in an attempt to utilize probabilistic reasoning more fully "clerics, merchants, historians, and others" (Schum 1994:37) also aspired to apply probability theory to their daily working lives.

Notwithstanding the various unsuccessful attempts by mathematicians (Leibniz 1665;

---

[58] See Bentham J. (1839) 5 Vol. Rationale of Judicial Evidence,

[59] See Wigmore J.H. (1937) The Science of Judicial Proof: As Given by Logic, Psychology, and General Experience, and Illustrated in Judicial Trials.

Condorcet 1785; Wigmore 1937) to systemize legal reasoning into a coherent analytical method for drawing inferences from a mass of evidence, the claim suggests Balding (1994) that probability theory offers insights crucial to sensible reasoning, particularly about scientific evidence, has not gone away.

An eighteenth century clergyman and mathematician, the Reverend Thomas Bayes is generally credited with the establishment of a particular approach, which although not accepted by the legal establishment, and still regarded as highly controversial, has increasingly over the last decade, become a source of academic and judicial debate, as well as a major discussion topic at international conferences, and in papers/journals evaluating the use of probability reasoning in courts (Schum 1994). Before moving on to Bayes Theorem itself however, I will briefly reiterate some of the more important reasons for the possible implementation of applied probabilistic reasoning to judicial decision making.

The judicial decision making process particularly in 'hard' cases', without recourse to Bayes' theorem or other heuristics, is by its very nature probabilistic, therefore, as has been shown in 5(1) and 5(2), open to criticisms of subjective evaluation. Consequently, allegations, ill-founded or not, of judicial inconsistencies, judicial bias, judicial incompetence, political or public policy considerations overriding public perceptions of equity and justice; all rest with the failure of the judiciary to first, explain the reasoning behind their decision making (the discovery process) and second, to justify their decision in line with their reasoning, as part of that legal process.

Because scientific expert opinion seldom provides a definitive answer, and each item of

evidence contributes to the 'probability assessment' (judicial hypothesis) in favour of one side or the other, the fact that the probity value of the evidence, in addition to some ill considered and irrational factors, discussed in 5(1), may also come into play, needs to be confronted. These factors it seems may contribute as much to the judge's understanding/misunderstanding, interpretation/ misinterpretation of the evidence, as his character, education, politics and religious beliefs. Further, judicial perception of the scientific witness (whether the expert is seen as credible and/or experienced) depends as much on the status of university/institution the expert is associated with as his age, gender, ethnic origin, court presentation, confidence and general disposition.

In order to help the judge in his understanding of the scientific evidence, as well as to prevent as many of these subjective 'irrational' unquantifiable factors as possible from influencing the decision maker, probability theory is seen as a way forward. Not only could it assist the fact finder in focusing more fully on the evidence in hand, but also offer an opportunity (combining the discovery process and justification) for the judgment to become more accessible to other jurists, legal academics and members of the public. For the first time, the 'world at large' may be able to understand and systematically follow the logic (the 'workings out') behind the conclusion of these scientifically complex cases, and in so doing, open the judgment to the type of rigorous scrutiny that is now expected in a democratic society where the boundaries of private and public law are becomingly increasingly blurred.

Despite the legal establishment's unwillingness to embrace change in this area, there has been a growth in the use of statistical information in courts. In part this increase has

occurred as a consequence of scientific development (particularly in areas such as forensic and genetic evidence). In addition, more technological advances, particularly in information technology has also heralded a massive shift in thinking with regard to the use and presentation of statistical data in the courtroom.

Today, statistical expertise is no longer confined to those with a degree in statistics. Many professionals in medicine, science, and social science receive formal training in statistical analysis and methodology as part of their education, and depend on theories of probability and applied statistics in the utilisation and presentation of their work. Because of this continued growth in the application of statistical methodology, it is not unreasonable to propose (from a longer term perspective) the inclusion of statistics as a core component within a wider LLB programme, or more immediately, the implementation of statistical training for judges, as part of their ongoing educational process.

Moving on to probability theory and Bayes Theorem in particular, it is worth reiterating a couple of general points for consideration. Probability say Robertson and Vignaux (1995:14) is "a rational measure of the degree of belief in the truth of an assertion based on information. The hypothesis, assertion, or premise is itself either true or false. .....Our degree of belief about the truth of the assertion is measured by our assessment of its probability". Therefore, probability is a quantitative measure[60] that allows us to assess, on the basis of probability, whether a particular hypothesis is true or false. The

---

[60] Probability takes values between 0-1. A probability of 0 = (on the basis of the information) the hypothesis is false/impossible. A probability of 1 = (on the basis of the information) the hypothesis is true/possible. Most assessment of probabilities however, fall somewhere between 0-1.

value of any assessment will of course depend on the quality of the information available. If a coin is thrown into the air, it is probable that it will come down heads. It is equally probable however, that it will come down tails. There are two possibilities for any outcome in this situation - heads/tails. The hypothesis is that it has one chance in two of coming down heads. The probability of it coming down heads may be quantified as $1 \div 2 = 0.5$.

In the Bayesian approach however, probabilities represent subjective degrees of belief, rather than objective facts. Bayes' theory therefore starts with the factfinder's subjective prior knowledge (perhaps based on pre-trial case reading) which allows the judge to form a hypothesis, expressed as quantitative odds in favour of one side. This is known as 'prior odds' (assessment without evidence). The odds are obtained by dividing the probability that the hypothesis is true by the probability that it is false ie: the judge 's hypothesis is that the Defendants have a 80% chance of winning their case, while the plaintiffs have only a 20% chance. Thus:

Prior odds = Defendants 80%
Plaintiffs 20%

= Prior odds are 4 in favour of Defendants

New pieces of expert evidence (E1, E2, E3, E4) presented to the court however, offer the judge the opportunity to revise his prior hypothesis (based on no evidence) and turn them into posterior odds (final proposition based on evidence). To do this, the judge

evaluates the likelihood ratio of the evidence[61], assigning to each piece of evidence a value (anything from 0 to infinity) which is then multiplied by the prior odds, to give the final posterior odds (the final proposition), in favour of one side or the other. Thus:

Prior odds (Defendant/Plaintiff) x LR (E1, E2, E3, E4) = Posterior odds.

In order to make the likelihood ratio more accessible, Evett (1991) has proposed the setting up of a verbal scale[62] which allows the factfinder to translate the LR of the evidence into words. In the opinion of Redmayne (1997), this approach has certain advantages in offering some level of consistency between cases, and also making the presentation of complex scientific evidence more comprehensible.

Currently much of the criticism of Bayes' Theorem is based on its application and use in

---

[61] The likelihood ratio (LR) compares one hypothesis to another and is defined as the probability of the data under the first hypothesis divided by the probability of the data under the second hypothesis.

[62] 'See Evett, 'Interpretation: A Personal Odyssey' in Aitken and Stoney (eds): The Use of Statistics in Forensic Science (Ellis Horwood: Chichester 1991) in which he suggests the following correlation:

Likelihood ratio	Evidence strength
1 - 33	Weak
33 - 100	Fair
100 - 330	Good
330 - 1000	Strong
1000+	Very strong

criminal cases[63]. Most of this debate however, has been orientated towards jurors interpretation of DNA and other forensic evidence, rather than judicial rationalisation of scientific evidence. Clearly, while there is some overlap of methodology (regardless of whether the case be civil or criminal), this chapter is more concerned with the potential impact of Bayes' theorem on the judiciary, and in particular, whether it offers a way forward to a more coherent and consistent system of decision making[64]. Outlined below are the views of academics[65], Queen's Bench Division Judges, and members of the Academy of Experts.

Legal and Socio-legal Theorists

For Allen (1997:255) 'statistical' formalism may reduce the potential for "whim - caprice - bias"....and "the influence of the darker side of human decision", it could also offer law ("which deals with the most profound issues of life"), the opportunity for the decision maker to become more predictable and correct. Alternatively says Allen (Ibid), there is another strand to legal history which illustrates "the role of judgment in legal affairs, and

---

[63] See R v Deen The Times, 10th Jan 1994; R v Dalby (unreported, CA no, 94/2819/W2 (1995); R v Adams [1996] 2 Cr App R 467; R v Doheny, R v Adams The Times, 14th August 1996; US v Shonubi (Court of Appeals): 998 F.2d; 1993 US App; 895 F Supp 460 1995 US Dist.

[64] For a full account of some of the main arguments on this issue see 'Bayesianism and Judicial Proof' Special Issue International Journal of Evidence and Proof 1997.

[65] Although many of the academics referred to in this section are lawyers, others included in this debate are more socio-legal, with backgrounds in the social sciences, in particular, Sociology and Criminology.

speaks unashamedly of ideas, no matter how ill defined, like justice, equity and fairness. These two strands of thought are in a curious relationship. Both strive for very similar goals, claiming correct decisions under the rule of law as their primary objective".

In concluding his preliminary inquiry into 'Rationality, algorithms and judicial proof', Allen (1997), a Bayesian sceptic, does not deny the potential use of Bayes' theorem as an analytical tool. However, in identifying its main problem as 'computational complexity', Allen, is particularly concerned with the updating of 'prior probability' (as each new piece of evidence emerges) and also with ascertaining the basis upon which the LR of the 'evidence reformulation' is founded, tested and validated. Further, he is interested in knowing how any new theories (that may emerge during deliberations) are incorporated into the overall calculation.

In light of these uncertainties Allen (1997:271) concludes, that problems facing a judge at trial are far too complex to be left to Bayesian analysis:

> ...The law has to decide at the moment in question; it cannot suspend belief while a long run of tests is completed. Convergence to the truth based on a series of experiments is not feasible for the law. People's rights, obligations and resources are conditioned upon the outcome of trials. Society would not function if relatively quick answers to legal questions were not forthcoming (Allen 1997:272).

A point not lost on McEwan (1996:153) who, in consideration of the application of Bayes, and the recognition that decision making inevitably involves some assessment of probability, views the prospect of judges "improvising their way through the statistical minefield" as something to be avoided. McEwan goes on to point out a common judicial

objection to statistics enshrined in the notion that "Things happen or they don't, they don't probably happen".

Bring (1997:292), like Allen (1997), acknowledges the fact that Bayes' theorem may be a helpful analytical tool, but proposes confining its use to legal scholars. Concluding that it would "only be of limited use for factfinders in real court cases", he too identifies problems of assessment, updating of a prior probability, and errors in decision making. Drawing our attention to the possible loss of public confidence in the legal system, and the fact that 'the mere appearance of justice' may elude factfinders, Bring believes that factfinders have neither the expertise, nor the time to master the intricacies of probability theory.

Callen (1997:296) sees the advantage of a formal computational system, but argues that such systems cannot accurately represent the complexity of human decision making. Agreeing with the views of Ligertswood (1997) and Stein (1997), Callen regards any potential application of probability theory (which is dependent on values and judgment) as incomplete. From this perspective says Callen, Bayesian analysis rests on impossible fact finding assumptions, which it neither acknowledges nor confronts. Bayes' theory therefore provides no answer to the question of 'prior odds', and simply leaves the factfinder relying on some other means (subjective, and as yet unexplained) to determine the initial mathematical level to apply.

Fienberg et al.(1995:7) too recognises the statistical complexity of probability theory and the fact that statistical evidence may obscure certain issues, particularly where "limited

familiarity may lead the judge...to misunderstand statistical evidence". However, in contrast to the views of Allen 1997; McEwan 1996; Bring 1997; Callen 1997; Fienberg has no problems in declaring the usefulness of probability theory for evidentiary purposes. Highlighting the importance of statistical education for factfinders, Fienberg (1997:310) reminds the reader that "Probability has served as a language that scientists and others have found to be not only helpful but crucial to the advancement of their enterprises".

Carriquiry (1997:299), a Bayesian enthusiast, believes that much of the misunderstanding that exists between the Bayesiosceptics and the Bayesian supporters is based on the fact that they "seem to be talking past each other, without listening to what the other side is saying". In Carriquiry's opinion,"there can be no Bayesian analysis without a healthy dose of judgment.....judgment and probabilistic formulations complement each other, and both are fundamental components of the process of decision making" (Ibid).

For Friedman (1997), the complexity of Bayes' Theorem is not the issue 'the world is a complex place'. The flexibility of the Bayesian approach means it can take into account as much complexity as its user can handle. As far as Friedman is concerned, most of the computational problems identified by Allen and others may not be as difficult as claimed, as in his opinion, pure computational precision is not necessary to make the Bayesian system work. In proposing the adoption of the Bayesian approach, particularly for analytical purposes, Friedman (1997:289), like Kaye and Balding (1995), believes "that probability analysis can help "observers - lawyers, courts and especially scholars - think about the probative value of evidence".

Agreeing with many of the limitations identified by the Bayesiansceptics, Michon believes that unless statistical evidence has a significant analytical role in a case, there is no substantial reason to make an explicit presentation of probability theory. What is needed is "a revision of court procedures, on the basis of research that will take into account the cognitive abilities and limitations of factfinders who, after all are human" (Michon 1997:334).

Kaye (1997:314) in his paper focuses on the 'burden of persuasion' and the completeness, generality, and utility of probabilistic theory when applied to civil and criminal cases - a dichotomy he finds useful. In Kaye's (Ibid) opinion "The mathematical properties of decision rules have little or nothing to do with the hoary debate over law versus equity, rules versus principles, or the like". For Kaye, no 'tension between algorithms and judgment' arises from dissecting or appraising a legal standard that requires judgment to apply..... [Therefore].... "The mathematics does not diminish the importance of the judgment, but directs attention to how it should be applied".

Lempert (1997), also a Bayesian enthusiast, considers the positive contribution of the Bayesian approach in understanding both evidence and proof. Respecting the normative, analytical and logical role of the theorem, Lempert believes that Bayes also provides the factfinder with a framework for making sense of statistical evidence.

From the above discussion, it would seem there are two bodies of academic opinion on the future role of Bayes' theory as regards judicial decision making. Many Bayesiansceptics while not wholly embracing the theorem therefore, nonetheless unite with

Bayesian enthusiasts in supporting the analytical basis of the Bayesian approach, and the contribution it could make to the decision making process. Underlying this debate is a recognition of the ongoing concerns with the current system. For Allen therefore (1997:343):

> Little could be more challenging, and perhaps nothing, within law more important. At the core of a society dedicated to civil peace through the rule of law must be found rational decision making. Rational decision making - deliberate, disinterested, informed, open-minded - forms the bedrock of a just society.

Moving on to the opinions of the judiciary, Judge Weinstein (who in addition to presiding over the **Agent Orange**[66] trial, also presided over **Shonubi**[67]), embarked on what McEwan (1996:150) has described "an extraordinarily detailed analysis of law and theory in order to justify the use of less familiar methods of proof". Recognising that relying on heuristics may lead to the exclusion of other, equally relevant information, Judge

---

[66] Judge Weinstein was responsible for the lengthy pre-trial negotiations in the Agent Orange case (re Agent Orange Product Liability Litigation, 611 F. Supp. (D.N.Y. 1985). Of particular significance was his handling of the 350 veterans who had 'opted out' of joining the wider class action covered by the settlement. Appraising the evidence himself, he dismissed the plaintiffs' epidemiological evidence, as not strong enough to support their claims, and also rejected the animal data supplied by the plaintiffs as insufficient to establish causation. Although some of Judge Weinstein rulings remain highly controversial, he is credited with having "judge centred vision, presenting a classic instance of occasional influence of academic theories on judicial decisions" (Schuck 1987:270).

[67] US v Shonubi (Court of Appeals): 998 F.2d; 1993 US App. Referred for sentence: 895 F. Supp 460; 1995 US Dist. In brief, Mr. Shonubi was convicted of smuggling heroin to the US. In order to determine sentence, the court needed to ascertain how much heroin he had smuggled on previous occasions.

Weinstein made the decision in ***Shonubi*** to incorporate Bayes' theorem into his reasoning process. Describing it as a "helpful description of appropriate legal fact-finding techniques"(Ibid:25), the judge reminded the court that what he, and others (Bell 1996; Anderson 1997) had referred to as the judicial hunch "is generally based on evidence and experience, albeit with the inferential chain unstated" (Ibid:22). Accepting Holmes' (1871:540) notion that "Judges know how to decide a good deal earlier than they know why", Judge Weinstein therefore subscribes to the view that, although the judicial 'hunching' process is not as defined as Bayesian analysis, factfinders intuitively engage in ongoing re-evaluation of the LR during the course of the trial.

Judiciary

As far the English judiciary are concerned, of those Queen's Bench Division Judges who responded to the survey (34%), nearly all expressed their confidence in, and their support for traditional decision making practice. However, a few judges (a representative sample of which are outlined below) did offer their views on the potential application of probabilistic reasoning to the decision making process and whether the Bayesian approach had any merit, either as an analytical tool or as a basis for decision making.

One judge in his acknowledgment clearly differentiated the dual roles of Bayes' theorem firstly, as an analytical tool, secondly, as a possible alternative to 'classic judicial judgment'. In his view:

> There are two entirely different versions of probability which come the court's way and which are not always distinguished. One is evaluation of stochastic probability on the basis of expert evidence - for example, in order to determine whether it is

epidemiologically likely that a particular effect has been the product of a particular event. Here the judge has to absorb often conflicting scientific evaluations in order to form his or her own. The exercise is complicated by the fact that not all experts are equally candid or dispassionate, and that a few are mere partisans. So part of the judicial task is to try to discern the reliable from the unreliable expert - a task made even more difficult by the fact that from time to time an expert who is a well-known hired gun may in this one case be right, as a stopped clock is right twice a day.

The other, the classic judicial judgement, concerns whether an account given to the court is more probably than not true. Here life and literature alike demonstrate that the objective probability that something would have occurred is a thoroughly unreliable guide to whether it did. The improbable, sometimes the inconceivable regularly happen. When was the last time you gave or heard an account which began: 'You're not going to believe this'?

Sir Ashley Bramall QC once represented a west London landlord called Jankovitch who was always litigating against his tenants and who finally believed that he had got a cast-iron case for possession against one of them who had quite clearly abandoned the letting. At court, where Bramall represented the landlord, the tenant turned up with a hilariously improbable story of (as I dimly recall it now) having got lost on the way to a wedding and turned up weeks later on the other side of the country. Judge Baxter, an excellent and experienced judge, accepting his story - Like the theologian', he said, 'credo quia non possibile'. The capacity to base judgment on experience and understanding and not to be tied to mere probabilism is, I think, one of the most important judicial functions.

Another judge in consideration of this issue pointed out that "the complexity of expert evidence is nothing new. Judges in the last century would have heard evidence on e.g. human pathology and engineering construction". Moving on, he questioned whether there was really such a distinction between the traditionally accepted view of judicial decision making, and applied probabilistic reasoning:

If a Judge is unfamiliar with a particular technique or methodology then it has always been the task of the advocates with the expert to enlighten him. They are usually, successful. In deciding which evidence they prefer on the balance of probabilities they may well be applying "probabilistic reasoning" but if they are not one and the same, then I am afraid the law only permits the judges to apply the former.

Certain judges while acknowledging 'on occasion' judicial unfamiliarity with statistical information, also recognised the potential pitfalls of judges assuming any such expertise in their own right:

> I agree that many Judges (but not all) are unfamiliar with methods of statistical analysis.....but it would be a bold Judge who used his own expertise, because he would, in effect, be giving evidence to himself without the parties having an opportunity to challenge it.

Further, as one judge pointed out, while applied probabilistic reasoning may:

> ....be a useful tool... there is no single method which should be regarded as a universal touchstone for reaching the correct decision in every case.

In addition to responding to the survey, one member of the judiciary attached an unrevised judgment - ***Keating v Sheffield Health Authority*** which he had recently delivered. As with ***Reay and Hope***, the case involved an array of complex scientific and medical expert evidence, concerning the alleged medical negligence of a cardiac surgeon. In his reference to this case, the judge acknowledged "the conflict in methodology between the judicial 'balance of probabilities' and assessment based on medical probability".

Agreeing with the proposition that 'the distinction between law and science is becoming increasing blurred', the judge accepted that:

> .....what the medical profession requires for proof of theory may well differ from the lawyers - especially in the field of civil law where the balance of probabilities suffices.

However, he went on to suggest, that applied probabilistic reasoning was not a way forward in solving this problem, and further, that legal academics may be lacking sufficient

insight of the decision making process to offer a solution:

> ....Academics have a valuable role to play in challenging the judicial process of decision making, but do not have the necessary access to everyday events to enable them to make a sound judgment of resolution of factual conflict. Dare a judge to say of academics that they [the academics] are 'not in touch'?

Another judge in his reply highlighted the type of attitude that many legal theorists would like to see Bayes' Theorem address, when he referred to the comments of Lord Mansfield - "Give your judgment but not your reasons"[68]. He went on to say however:

> Additionally by nature I dislike abstractions creeping into the judicial process. When I make up my mind, I take a number of different factors into account and use a number of different thought processes without stopping too long to try and analyze those processes or to christen them at some intellectual font.

Others in the judiciary likened probability theory to nothing more than using one's commonsense:

> If by applied probabilistic reasoning you mean exercising one's commonsense, we are left with a distinction not a difference.

When considering the practicability of moving to a 'statistically based probabilistic reasoning' process the following judge provided examples to illustrate his point:

> An obvious example of a straightforward use of statistical material is actuarial evidence. Such evidence is regularly used by Courts in the larger personal injury claims. I believe that in South Africa, actuarial evidence in all such cases is required. Actuaries are not cheap. They need time to prepare reports. Is it to be suggested that all plaintiffs in all cases, where actuarial evidence would be admissible, should

---

[68] I have already referred to this comment in Ch.5(2).

be required to employ them? Or are we to say that you get a different quality of justice depending upon the monetary value of your claim?

Sometimes experts seek to give more evidence than they can competently do.....The Court of Appeal considered this in a case called Auty v National Coal Board in which I was involved. There, Lord Oilver said that the evidence of the actuary on this topic was about as reliable as, but less entertaining than, that of an astrologer. Therefore, the fact that an expert gives evidence is not always of assistance. In our adversarial system, each side will have an expert who will say different things. Maybe it is suggested that the Court itself should appoint its own expert, or the Judge seek advice from someone, or perhaps the probabilistic experts think they should be experts and judges as well?

Commenting on the move to involve judges in more specialised forms of decision making, one judge wondered who would benefit from such a change:

As it happens I have just completed a case featuring a strong conflict as to the propriety of undertaking a novel type of surgery, in its turn depending substantially upon a reading of the contemporaneous radiological evidence. Inevitably there was some attempt to make me into a pro tem radiologist so as to determine the significance of the scans and x-rays. Authority and inclination happily coincided to make me focus solely upon a finding as to whether the Defendant surgeon's contemporaneous assessment could be justified as falling with the ambit of accepted and reasonable clinical practice - did he have a respectable justification for his opinion, not whether he was probably right?

.....a Judge is expected to be able to assess evidence and apply the law to it, there his expertise ends however tempting it may be to pontificate on other subjects.

He went on to consider whose interest would be served by the possible implementation of such a theorem, and further how decisions could be justified to parties, the public and the Court of Appeal?

Concurring with this view there was support for the believe that as far as the decision making process is concerned:

> It is no part of a Judge's function to seek to become an expert himself. The judge has to decide which expert's conclusions he/she prefers bearing in mind the burden and standard of proof.

Adopting a rather different approach one member of the judiciary saw no great distinction in the aims and objectives of law and science, and therefore had no problem with statistical analysis contributing to the decision making process:

> I don't recognise law and science as belonging to different categories. Both are quests for the truth, and the law has no choice but to embrace in its quest, all that is sound in science, maths and statistics. The difficulty, of course, is to separate what is sound from what is dross. But exactly the same difficulty attends the receiving of non-expert evidence.

As to applying probabilistic reasoning to the judicial decision making process, the judge in question doubted:

> ....whether its principles ought to be permitted to control the judicial process - contribute to it, yes.

Pointing out that judges (and traditional decision making) have always been part of our system of justice, another judge seemed particularly wary of change. Recognising the difference of opinion amongst experts, particularly with regard to the presentation of statistical evidence in court, this judge rejected any proposal which might seek to replace current judicial practice with scientists/scientific methodology, as too radical. In his opinion, such views were potentially "dangerous":

> ..... as scientists only too often disagree with one another and do not have the experience of evaluating evidence that judges have.

In contrast to the majority of legal theorists who found some merit in the application of Bayes' theorem for analytical purposes, most judges who took part in this research remain staunch supporters of what one respondent referred to as "classic judicial judgment". On one level therefore, such sentiment may be seen as offering some support for the Bayesiansceptics; on the other, such views may denote a rejection of the whole notion of 'judicial proof'.

Although, there is no definitive account of the elements involved in decision making, most judges appear to take comfort in the ambiguous nature of the task entrusted to them. With more 'hard' cases coming before the courts however, and the boundaries of public and private law under challenge, it remains to be seen, particularly in this new era of openness and accountability, how long the judiciary can continue to ignore their critics.

The Academy of Experts

Moving on to members of the Academy of Experts, and the survey discussed in Ch.3[69], a wholly different picture emerges. In contrast to the judges and Bayesiansceptics, the

---

[69] This research forms part of the 'Expert Witness Questionnaire' referred to in Ch.3. To reiterate, the research comprised of a six page booklet made up of 34 questions, sent out to 160 scientific and medical experts - all members of 'The Academy of Experts' based in Gray's Inn. In total there was a 62% repones rate. Of the 99 returned questionnaires, 7% were incorrectly completed = 93 correctly completed. 47% of the 92 chose to make additional comments on the back page of the questionnaire.

majority of the experts were unanimous in their support for the implementation of applied probabilities reasoning to the decision making process[70]. Of those who responded:

48% of the experts had experience of judicial misunderstanding of their evidence;

and:

68% of the experts found in their experience judges relying more on presentation of evidence rather than content.

Because of their experience, and the potential for misunderstanding/misinterpretation of complex scientific evidence:

52% of the experts thought that judges ***should*** adopt applied probabilistic reasoning to both their evaluation of the evidence, and to their judgment.

and:

59% of the experts who responded, wanted judicially appointed scientific advisor/s to sit with the judge.

Most experts considered the appointment of a scientific advisor to be a useful addition to the judicial process, although only 34% of experts, believed some form of statistical training would make any difference to the present situation.

Friedman (1997:350) in his article 'Towards a (Bayesian) Convergence?' points out that the Bayesian approach does not have to be seen in purely in numerification terms. What Bayes offers is a set of constraints or guidelines which may be expressed in the following statement:

1. All other things being equal, the more probable a proposition appears without consideration of a given body of evidence, the more probable it will appear upon consideration of that evidence.

---

[70] Questions 27 - 31 of the Questionnaire.

2. All other things being equal, the more probable it appears that a given body of evidence would arise given the truth of a proposition, the more probable the proposition will appear given the body of evidence.

3. All other things being equal, the less probable it appears that a given body of evidence would arise given the falsity of a proposition, the more probable the proposition will appear given the body of evidence.

Most legal academics, judges and experts, would not I submit, deny the 'logical validity' of any of these propositions. For 'hard' cases, involving highly complex scientific evidence therefore, Bayes offers a way forward, particularly as a framework and analystical model in addressing many of the criticisms identified in this chapter.

6.1 CONCLUSION

The Judgment of **Reay and Hope v BNFL** in October 1993 marked the end of one of the most interesting and complex toxic tort trials in English law. Lasting short of one hundred days and including the testimony of thirty one scientific expert witnesses, out of total of seventy who produced reports, the trial marked new ground in a number of ways; it was the first personal injury claim to test the concept of genetic damage from radiation; the only time that a Queen's Bench Division Judge had been allocated a full-time judicial assistant; and one of the first trials to endorse a satellite video link for examination of expert witnesses pursuant to Order 38, Rule 3. Moving on to judicial management, the case was a forerunner in having Counsels' Opening Statements in writing in advance of the trial and having written daily submissions from both Plaintiffs and Defendants of key issues upon conclusion of oral evidence.

The circumstances that led to the trial relate to events in excess of thirty to forty years ago when the fathers of Dorothy Reay and Vivien Hope were employed by the Defendants and their predecessors (the United Kingdom Atomic Energy Authority) as fitters for the Sellafield plant. During the time that George Reay and David Hope were employed at Sellafield, they were involved in the routine maintenance of plant machinery including the piles, pond and decanning areas. Intrinsic to the litigation was whether paternal preconception irradiation (resulting in a mutation in the spermatagonia which via paternal sperm) caused, or materially contributed to a predisposition to cancer, leading to Dorothy Reay's death from leukaemia and Vivien Hope's NHL.

The first Plaintiff, Elizabeth Reay, mother of Dorothy Reay who died when she was 10

months, based her claim for damages of £150,000 under the now repealed Fatal Accidents Act 1976 and also the Law Reform (Miscellaneous Provisions) Act 1934. In addition, Elizabeth Reay claimed damages for injury to herself, and on behalf of the estate of her late husband, for injury to him. The second Plaintiff, Vivien Hope was born in 1965; in 1988 she was diagnosed as suffering from non-Hodgkin's lymphoma. Vivien Hope claimed damages of £125,000 for past and future suffering and disability consequent upon her lymphoma.

As a consequence of the various statutory provisions dating back to the Atomic Energy Act 1946; the Atomic Energy Act 1954; The Nuclear Installations (Licensing and Insurance) Act 1958; The Nuclear Installations (Amendment) Act 1965; the Plaintiffs did not need to prove negligence on the part of the Defendants. It was also common ground that by virtue of the legislation this statutory liability attached only from 1st August 1954. In order to succeed the Plaintiffs had to prove on the balance of probabilities that radiation from Sellafield was a material contributory cause of the Plaintiffs' diseases. The fundamental issue therefore was causation.

The Plaintiffs based their claim on the work of Professor M. Gardner, who until his death in 1993 was Head of the Medical Research Council, Epidemiological Unit, University of Southampton. Professor Gardner's epidemiological evidence was published in two concurrent papers in 1990. The first described the methodology and basic data of the case control study. The second, concluded there was a significant excess of leukaemia and NHL in the vicinity of Sellafield, and further that:

> The raised incidence of leukaemia particularly, and non-Hodgkin's lymphoma among children near Sellafield was associated with paternal employment and

> recorded external dose of whole body penetrating radiation during the work at the plant before conception. The association can explain statistically the observed geographical excess. The result suggests an effect of ionising radiation on fathers that may be leukaemogenic in their offspring, though other, less likely, explanations are possible. There are important potential implications for radiobiology and for protection of radiation workers and their children (Gardner 1990a:423).

Prior to the publication of Professor Gardner's 1990 study, the Yorkshire Television Programme 'Windscale the Nuclear Laundry' (1983); the Black Advisory Group Report (1984); the establishment in 1985 of the Committee on the Medical Aspects of Radiation in the Environment (COMARE), their subsequent reports (1986); (1988); (1989); Gardner's (School Cohort) Study 1987; had all confirmed a raised incidence of leukaemia around nuclear power plants and an increased risk of leukaemia/NHL in young people living near nuclear facilities.

Despite confirmation by the scientific community of an excess of leukaemia/NHL in young people around Sellafield, and the fact these excesses proved persistent over time, geographical parameters, and age ranges, scientists still remain deeply divided over the cause of childhood cancer and its connection with nuclear installations.

The dispute between the parties centred on four main issues:

1. The doses of ionising radiation received by George Reay and David Hope in the course of their employment (Occupational Dosimetry).

2. The doses of ionising radiation received by members of the two families and others from radiation in the environment (Environmental Dosimetry).

3. Whether the Gardner study, in its context, can prove on the balance of probabilities, first that there is an association between PPI of fathers working at Sellafield and leukaemia and/or NHL in F1 [offspring], and secondly that such association is causal of the diseases (Epidemiology).

4. Whether there exist a plausible or reasonably possible pathway or mechanism by which radiation emitted from the Sellafield plant could have caused or materially contributed to one or both of the two diseases (Genetics)[1].

In reaching his conclusion, Mr. Justice French declared:

> In my Judgment...on the evidence before me, the scales tilt decisively in favour of the defendants and that the plaintiffs therefore have failed to satisfy me on the balance of probabilities that PPI was a material contributory cause of the Seascale excess, or it must follow, of
> a) the leukaemia of Dorothy Reay or
> b) the NHL of Vivien Hope[2]

While any toxic tort claim brought in negligence or in breach of statutory duty poses problems of causation, **Reay and Hope**, a particularly complex case, offers a prime example of an action in which highly complicated cutting edge science provided the basis for litigation. **Reay and Hope** gave us an insight into a future in which manmade disasters; environmental wrongdoing; human distortions of the natural world impact upon our lives. Thus as potential victims and future plaintiffs we look to the civil justice system to represent and compensate us, and in so doing, expect the law to live up to the principles, identified by Lord Woolf (1995) of justice and fairness. Unfortunately for the plaintiff however, society still relies on a tort system which according to Rosenberg (1984:854) is "too cumbersome, costly and haphazard". For many (Rosenberg 1984; Stapleton 1988; Hill 1991; Scott 1992; Howarth 1995; Reece 1996) therefore, the tort system's capacity to deal effectively with such action is now open to question.

Under traditional tort doctrine recovery depends upon a preponderance of evidence rule which imposes upon the plaintiff an 'all or nothing' burden of proof in excess of 50

---

[1] Judgment p.5-6.

[2] Judgment p.209

percent. The judge for his part has to decide on the balance of probabilities, a conclusive presumption in favour of one party or the other. Once described as an "ancient rule founded on considerations of good sense"[3] the burden of proof is neither rational nor equitable in resolving the causal indeterminacy underlying most toxic torts. Like **Reay and Hope**, many such actions rely on evidence at the frontiers of scientific knowledge, in many instances therefore the most that can be established is that exposure to a pollutant increased the risk to the plaintiff of contracting the disease.

In contrast to the "eclectic array of wrongs" (Parascandola 1997:147) covered by 'common' tort law, toxic torts are more specialised (hazardous substances; environmental pollutants; toxins) and share a number of similar characteristics (multi-science uncertainty; mass exposure; multiparty action). As far as personal injuries are concerned, toxic torts often involve some form of birth defect; chronic disease or mortality. Perhaps of all diseases however cancer is the most common; described by Weinberg (1998:1) as the enemy within, he says of the disease:

> Cancer wreaks havoc in almost every part of the human body. Tumours strike the brain and the gut, muscles and bones. Some grow slowly; others are more aggressive and expand quickly. Their presence in human tissues signals chaos and a breakdown of normal function. Cancer brings unwelcome change to a biological machine that is perfect, marvellously beautiful and complex beyond measure.

A socio-legal analysis of the **Reay and Hope** trial thus afforded an opportunity to examine

---

[3] **Joseph Constantine Steamship Line v Imperial Smelting Corporation Ltd** [1942] AC 154, 174 per Viscount Maugham.

in depth some of the multi-disciplinary issues arising from the litigation[4]. In addition however, evaluation of the case also allowed for two pieces of empirical research involving members of the Academy of Experts (quantitative research) and judges from the Queen's Bench Division of the High Court (qualitative research). In assessing current opinion on expert witnesses; scientific evidence; judicial decision making; and the potential use of applied probabilistic reasoning; the thesis was able to draw upon years of courtroom experience and in so doing, consider the development of science/law interaction from a practical and theoretical perspective.

In considering the complexity of science/law interaction, some academics (Foster, Berstein and Huber 1993) believe the legal community, and judges in particular, need to become more sophisticated and adept in appraising scientific evidence. Jasanoff (1995:5) while concurring with this view, also postulates that legal professionals need to improve their understanding of science per se, commenting that judges and lawyers "know on average very little about social organisation and processes of science, still less about basic scientific concepts such as "statistical significance", and almost nothing about the substantive content of particular scientific fields". The effect of this state of affairs is that judges "who understand neither the substance not the methods of science, are increasingly called upon to discriminate among sophisticated technical arguments" (Ibid). Without adequately trained judges, fact and reason thus become prey to the manipulative dynamics of an adversarial system in which misunderstanding and misinterpretation rule the day. The result is, says Jasanoff:

---

[4] Including philosophy of science; critical legal theory; dosimetry; epidemiology; genetics; probability theory.

> Cross examination and the legal rules of evidence operate only as recipes for obfuscation (Ibid).

Further, where scientific evidence is new, novel or does not fit into existing paradigms, the views of the scientific community differ sharply from those of the legal professionals;

> If we [scientists] are forced to a premature opinion on a scientific question, we are bound to give the Scottish verdict Not Proven (Ziman 1968:14-15).

In contrast to scientific incertitude however, the law must take a firm position. Within legal constraints and the laws of evidence, the law must tease, goad, pressure the witness and ultimately decide; no matter how undeveloped the science, no matter how biased the testimony.

Issues, Evidence and Judgment

In light of these wider considerations the thesis sought to elicit greater understanding of the issues, evidence and judgment in the **Reay and Hope** case. Starting with epistemology and the work of the deconstructionists, it emerged that science is not based on objective truth but is qualified and conditional involving socially constructed and culturally determined judgments. Therefore, when embarking upon a toxic tort case such as **Reay and Hope**, the cognitive authority of science needs to be challenged. Lawyers, like everybody else it seems, must learn to appreciate the limitations of the practice of science; as Midgley (1992) points out science does not have a claim on omnicompetence.

Moving on to scientific causal relations it appears, despite well defined methods of scientific research, there are questions about the nature and basis of scientific methodology

which still remain problematic, as Gower (1997:18) says:

> We may still be debating important details about how the methods and logic of science work. We may even still be debating some issues of principle. But this does not in itself show the project is misconceived; it may instead be a project where both principles and details are immensely difficult to make explicit.

Currently no scientist or epidemiologist would suggest that the HKE Postulates or the Bradford Hill criteria represent the definitive guidelines upon which either group base their claims. Nor would any scientist or epidemiologist necessarily reject Gower's assertion that the scientific method has no clear beginning or ending:

> Experiments are not simple events with clear beginnings and ends; they are human interventions in a world of numerous conflicting influences and forces, and have their origins in earlier related investigations and their termination in later explorations (Ibid).

Science as we now know is in constant state of flux, frequently therefore, scientific evidence of causal relations is inconsistent and contradictory, yielding ambiguous results and divergent scientific opinion.

As far as causation in the law is concerned, this is probably one of the greatest difficulties for the plaintiff to overcome. The but for, cause in fact relationship between the tortfeasor's action and plaintiff's loss remains elusive. While Hotson[5] offered a window of opportunity in respect of loss of chance, the door is closing; scientific determinism remains deeply entrenched within legal dogma. As McGhee[6]/Wilsher[7] has now

---

[5] Hotson v East Berkshire AHA [1985] 3 All ER 167, [1987] AC 75, [1987] 2 All ER 909.

[6] McGhee v NCB [1972] 3 All ER 1008, [1973] 1 WLR 1.

[7] Wilsher v Essex Hath Authority [1987] QB 730, [1986] All ER 801, [1988] 2 WLR 557.

established, the law as a consequence of **Wilsher** stands where it always did with the onus of proof on a balance of probabilities lying with the plaintiff, and that onus satisfied only if the plaintiff proves that the defendant's breach made a material contribution to their injury.

When discussing the role of the expert witness it is clear that the specialist needs to be a 'good expert' and a 'good expert witness'. Implicit in this requirement are notions of witness selection; witness subordination; witness co-operation and remuneration. As far as Lord Woolf is concerned: potential bias; polarisation; lack of witness independence; expense and delay are all prime concerns. In addition, the credibility of the witness must be assured, he must appear unflustered, certain and competent. Moving on to scientific expert evidence, it seems that partisanship and inequality of resources are particularly associated with the toxic tort. Thus in-house experts, corporate funds and what Lord Woolf described as 'an unlevel playing field' are specific concerns for the would be plaintiff.

When analysing the testimony in **Reay and Hope** similar evidential difficulties emerged. Particular problems related to discovery; misinformation; partisanship; lack of witness independence; and a disregard for new areas of science. In addition, allegations of: poor methodology; manipulation of results; false statement and incompetence were also levelled by one side or the other.

---

[7] **Wilsher v Essex Hath Authority** [1987] QB 730, [1986] All ER 801, [1988] 2 WLR 557.

Interestingly many of the evidential issues that arose in the trial were also identified by members of the Academy of Experts. The quantitative research thus provided an alternative means of establishing some of the major concerns underlying scientific evidence. Other more general areas that stand out for special consideration include: challenges to the competency of the witness; unrealistic deadlines; witnesses being asked to give evidence beyond their specialism; personal expense/inconvenience as a consequence of trial adjournment/delay.

Moving on to judicial decision making and the **Reay and Hope** Judgment, it appears that rationalisation for justification of a judgment is not the same as the thought processes involved in making a decision. Thus if the 'world at large' is to understand how a judgment has been reached, a distinction needs to be made between the 'discovery' and 'justification' process. Peczenik (1989) identifies public accountability; democracy; testability and uniformity as primary motivations for such a dichotomy.

From the second piece of empirical research, it emerged that many of the Queen's Bench Division judges contacted for the purposes of the thesis, supported Cardozo's view, that decision making rests on a balance of ingredients including: philosophy, analogy, background and sense of right. However, any belief in a judiciary which is rational, objective, neutral and makes decisions on the basis of legal positivism/formalism may as the Realist movement suggest, be open to question.

In considering the Judgment of **Reay and Hope**, it seems Mr. Justice French took advantage of the wide discretionary powers he had to adapt his managerial and

supervisory style to the needs of the case, and yet failed to apply the same innovative and pragmatic approach to his decision making. In my opinion therefore:

> His Lordship did not consider the application of a more utilitarian rights based model despite public health and environmental concerns that emerged as a consequence of the discovery process. Concentrating on individual rights, Mr Justice French missed a golden opportunity of challenging traditional tort dogma and embracing wider legal concerns that emerged during the trial.
>
> French, J. did not refer to any case law in his Judgment and made no contribution to the wider debate on toxic torts and the problem of causation. Unlike Judge Weinstein in **Agent Orange**[8] he did not ponder on jurisprudential and evidential questions underlying traditional tort doctrine.
>
> Mr. Justice French accepted without question the interpretive framework upon which science is based and in so doing, assumed the existence of a methodological alliance between science and law which allowed him to blur the boundaries of scientific and legal decision making. Taking this to its ultimate conclusion, he then applied and utilised a scientifically constructed model to justify his decision making.
>
> His Lordship rejected all novel or new areas of scientific research and in so doing locked himself into existing scientific paradigms.
>
> Mr Justice French, on occasion, seemed more impressed with the presentation of evidence, rather than the evidential content.

When attempting to analyze the **Reay and Hope** Judgment, one is stuck by the lack of available information from which a legal evaluation of the ruling can be made. In light of increasing allegations of judicial inconsistency, judicial bias, political or policy considerations overriding public perception of equity and justice, there is growing demand for 'judicial proof' of decision making.

With the development of statistical analysis in the courtroom, Bayes' Theorem, a

---

[8] re **'Agent Orange'** 565 F Supp. 1263 (E.N.D.Y 1983).

quantitative measure that allows the factfinder to assess (on the basis of probability theory) whether a particular hypothesis is true or false, has been proposed as a way forward. In advocating adoption of the Bayesian approach supporters believe that probability analysis can help judges, lawyers and scholars think about the probative value of evidence. Offering both a framework for decision making and an analytical tool, Judges from the Queen's Bench Division of the High Court were asked their opinion on the potential application of probabilistic reasoning to the decision making process, and whether the Bayesian approach had any merit. In contrast to the many legal theorists who found value in the application of Bayes' Theorem, the majority of judges remained staunch supporters of what Mr. Justice Sedley referred to as "classic judicial judgment". Perhaps unsurprisingly members of the Academy of Experts concurred with the findings of Bayesian enthusiasts in supporting the implementation of applied probabilistic reasoning for decision making purposes.

What emerges from the case analysis is how involved, problematic and complex toxic torts are. **Reay and Hope**, a land mark case, was decided at a time when the whole civil justice system was under review and when funding for such cases was also under threat. Legal aid funded, **Reay and Hope** is probably one of the last cases of its kind to qualify[9].

The Lord Chancellor concurring with the findings of Lord Woolf's Final Report (1996), said of the civil justice system:

---

[9] **Reay and Hope** qualified under the Legal Aid Act 1988. Between 1991/2 and 1997/8 civil and family legal aid expenditure rose from £330m to £634m. Legal aid in civil cases is as a consequence under review. See Access to Justice Bill 1998 discussed below (p.367).

> The civil law tends to be accessible only to those who can afford to pay the high and unpredictable costs which accompany litigation; or to those who are so poor they qualify financially for legal aid. A large part of the community feels unable to turn to the law for assistance or remedies. Part of the problem is that the services and remedies sought from the justice system are often disproportionate to the issue at stake. At the moment, too many services and remedies are simply too expensive for those who might want to use them[10] .

With this view in mind and looking to the future, Lord Irvine of Lairg in **Modernising Justice** went on to identify 'social welfare cases'; 'other cases of fundamental importance' (children; protecting people from violence) and **'cases involving a wider public interest'** (those likely to produce real benefits for a significant number of other people, or which raise an important legal issue; and those challenging the actions, or failure to act, of public bodies) as having greatest priority[11]. As far as funding assessment is concerned, he said this should aim to consider three questions:

1) Would another type of service be a better way of dealing with the case?

2) Could the applicant fund the case in some other way?

3) Do the merits of the case itself, in the context of the Government's priorities and available resources, justify public funding?

In answering the third of these questions his Lordship proposed the following criteria:

> The legal strength of the case and the prospects of a successful outcome.
>
> The importance and potential benefit to the assisted person, and the likely cost.
>
> The wider public interest (as defined in 3.7 Modernising Justice).

---

[10] Modernising Justice (1998) p.7.

[11] Paragraph 3.7 Modernising Justice p.28.

The availability of resources and the likely demands of those resources.

The provisions of the Access to Justice Bill 1998[12] forming part of a wider programme of legal reforms outlined in Modernising Justice proposes (in relation to civil matters[13]) the establishment of a Community Legal Service (CLS), run by a Legal Services Commission (CLS). Under a Funding Code drawn up by the Commission and approved by the Lord Chancellor, a criteria explaining the funding of individual cases is to be publicly available. Under Part 1: Clause 7 (which also gives effect to Schedule 2 and excludes from the scope of the CLS Fund specific types of services[14]) the Lord Chancellor may amend the Schedule (subject to affirmative resolution procedures[15]). In addition, the Lord Chancellor may issue directions to the Commission authorising it to provide services within excluded categories in exceptional circumstances. For example, the Lord Chancellor may direct that a personal injury case (generally excluded under Schedule 2 as appropriate for conditional fees) suitable for funding by the CLS where exceptionally high investigative or overall costs are likely to be necessary, or where issues of wider public interest are involved. Although public funding is still theoretically possible therefore, it seems unlikely (given the complexity

---

[12] Introduced in the House of Lords 2nd December 1998, the Bill is currently in its Third Reading.

[13] The Bill replaces legal aid services for both civil and criminal services. The Community Legal Services Commission will replace legal aid in civil and family cases.

[14] In addition to other exclusions under Schedule 2, only basic information and advice will be available for disputes involving allegations of negligent damage to property or the person (personal injury), apart from clinical negligence.

[15] Clause 23(3).

of the toxic tort) that cases such as ***Reay and Hope*** will qualify for future legal aid.

As far as 'conditional fee agreements' are concerned, Section 58 of the Courts and Legal Services Act 1990 sanction such arrangements. Conditional fee agreements allow clients to agree with their lawyers that the lawyer will not receive all or part of the usual fees or expenses if the case is lost; but that, if it is won, the client will pay an uplift (success fee) to the solicitor in addition to the usual fee. In July 1995, conditional fee agreements were allowed for a limited range of cases including personal injury. Unfortunately for the potential plaintiff however, conditional fees are not as simple as they first appear. To begin with the plaintiff may have to make disbursements (to cover medical or other expert reports, court fees or enquiry agent's fees) which may involve significant costs before a lawyer can make an informed decision about the prospects of success. Secondly the plaintiff is obliged to take out an insurance policy to cover himself for up to £100,000 of the other side's costs, payable if the plaintiff loses. Thirdly the insurance scheme "Accident Line Protect" will only apply to personal injury cases other than those involving medical negligence[16]. Fourthly in order to qualify for such an insurance policy, plaintiffs' solicitors must be a member of the Law Society's Accident Line Scheme which means they must have at least one member of their firm on the Law Society Personal Injury Panel.

---

[16] Currently medical negligence cases are thought to be excluded on the basis of complexity of scientific evidence and uncertainty of outcome. Although under review, it is possible that toxic torts may well find themselves excluded for similar reasons.

Interestingly the recent test case of lung cancer victims v tobacco companies has cast doubt on the success of conditional fee arrangements for toxic tort plaintiffs who fail to qualify for public funding under either the current system[17], or as envisaged in the Access to Justice Bill 1998. Unfortunately for the claimant, under traditional tort doctrine, the generic character of the pollutant, its latency period, and the fact that synergism often remains undetermined has serious risk implications for any would be solicitor taking on such litigation. The main concerns that emerge from the case include:

Claims of Champerty The Defendants' **Imperial Tobacco/ Gallaher Group** claimed that the common law misdemeanour of champerty (maintenance) should apply to the case. Although abolished by the Criminal Law Act 1967 s.13, it is still regarded as against public policy (s.14).

Payment of Costs The Plaintiffs sought a ruling on whether the solicitors/Plaintiffs would be liable for any costs against the companies and wanted an Order to debar the tobacco companies from trying to recover costs from the lawyers/Plaintiffs involved, should the plaintiffs lose. The Defendants challenged this Order on the basis that it was neither necessary nor appropriate and would fetter the Courts' discretion over costs. Mr. Justice Wright identified "the advertised willingness of the solicitors to conduct the litigation" as the stimulus that ultimately led the plaintiffs to instruct Leigh Day to bring proceedings on their behalf. As a consequence of the costs issue, it is alleged the solicitors were coerced into a private arrangement with the tobacco companies barring the firms from further action against the tobacco companies for a period of ten years.

---

[17] In January 1995 the Legal Aid Board made a limited grant of legal aid for a full review of merits, quantum and the total likely costs involved in pursuing an action against the tobacco companies. In July 1996 all the applications were refused, the refusal was expressed to be "on the merits". In 1996, after legal aid refusal, Leigh Day & Co. offered to fund the claims against the tobacco companies on behalf of a number of lung cancer sufferers under a conditional fee agreement. In so doing Leigh Day joined two other firms Irwin Mitchell & Co. and Bindman and Partners (Bindman and Partners later dropped out).

Implementation of a Gagging Order An Order made by Mr. Justice Popplewell gagging the lawyers from making statements to the media was upheld, despite, in the opinion of the plaintiffs, this 'gag' constituting a breach of the right of free speech as guaranteed under the European Convention on Human Rights[18].

Judicial Discretion and the Limitation Act The Limitation Act 1980 requires plaintiffs to being actions within three years. Thirty six of the fifty two lung cancer victims commenced their actions more than three years after their diagnosis of lung cancer, so technically could have been excluded. However Sec. 33 of the Act allows the Judge to exercise discretion and permit cases to proceed if he believes this would be in the interests of justice. In making this decision the Judge will consider certain factors including:

a) Length of delay and reasons why the plaintiffs did not sue earlier.
b) Unfairness to Defendants because of lost evidence.
c) Defendants role in creating delay.
d) Strength of overall case.

One of the main factors to be taken into account when considering an application under s.33 is the extent to which the Plaintiff will be prejudiced by the operation of the time-bar (if a direction under s.33(1) is not made). Referring to **Dale v British Coal Corporation**[19] and **Forbes v Wandsworth**[20] Mr. Justice Wright said:

> The prospects of success include not only the Plaintiff's chances of being able to establish his primary case on liability, but also the quantum of any likely recovery having regard both to the extent of his injuries and the extent to which any damages otherwise recoverable may fail to be reduced as a result of any allegation of contributory negligence which appear on the face of it to be open to the Defendants[21].

---

[18] Article 10: Freedom of Expression.

[19] **Dale v British Coal Corp** [1992] PIQR 373 at P. 380-381.

[20] **Forbes v Wandsworth HA** [1997] QB 402 at p.417 E per Stuart Smith L.J.

[21] Judgment Handed Down 9th February 1998. Case Number S97/113-116 **Hodgson & Ors v Imperial Tobacco Ltd & Ors.**

Mr. Justice Wright declined the request of eight of the lead plaintiffs to pursue claims outside the time limit. He went on to say "taking a broad view, it seems to me plainly legitimate to say that the prospects of success in this litigation on behalf of any plaintiff is by no means self evident".

In light of Mr. Justice Wright's comments and discussion with their clients, Leigh Day & Co. issued a statement saying that forty six of the fifty two clients had decided to abandon all claims against the Defendants and that they, Leigh Day and Irwin Mitchell had decided not to continue with the litigation. The remaining plaintiffs at the time of writing are still considering their position.

In his ***Keynote Address*** to the Solicitors' Annual Conference (1997:7)[22], Lord Irvine of Lairg in optimistic tone, said of the conditional fee arrangement:

> Excluding claims for money or damages from legal aid will put those on low incomes, as well as those on middle or higher incomes, on equal footing - taking forward a civil case will depend on whether or not it has merit to persuade a lawyer to handle it on a "no win, no fee" basis. The decision whether or not to go ahead with any particular case will depend on its strength, not on the financial resources of the client.

Other alternatives to conditional fee arrangements were proposed by the Bar (Contingency Legal Aid Fund) and Law Society (Conditional Legal Aid Fund). Both proposed fund operated schemes on the basis that clients winning cases would be obliged to pay into a central fund a percentage of the damages received. The funds would then

---

[22] The Keynote Address was given in Cardiff on the 18th October 1997. For a full copy of the text, please see Appendix 7.

be used to meet the cost of clients losing cases and possibly the administration costs of the fund itself. In response to these proposals his Lordship said "I cannot conceal from you that I doubt whether a Contingency Legal Aid Fund points the way forward" (Ibid)

Lord Woolf M.R. in his 'Samuel Gee Lecture' delivered to the Royal College of Physicians[23], compared the present civil justice system to a diseased organ:

> There are plenty of other diseases to which the system is prone, including the lack of certainty as to what will be the consequences of becoming involved in litigation, the fact that it fails to allow for the inequalities in resources of the parties and it is excessively adversarial.

According to Parascandola (1997:147) "We currently live in a world of silent risks caused by invisible agents acting through mechanisms poorly understood". Thus expansion of the toxic tort will continue to preoccupy lawyers, judges, scholars, policy makers, and the 'world at large' who although concerned with the deficiencies of the present system, are equally concerned by access to a just settlement in any future system.

Identifying problems of the American toxic tort, Brennan (1989) highlights the adversarial process, polarisation of views, the 'hired gun' phenomenon, the complexity of scientific evidence, judicial misunderstanding of evidence, and the problem of causation as particular obstacles for the toxic tort litigant. In discussing the need for reform, Brennan proposes:

a) modification of existing rules and procedures;

---

[23] Lord Woolf MR gave the Samuel Gee Lecture on Tuesday 13th May 1997. For a full copy of the lecture please see Appendix 8.

b) the introduction of 'science panels';

In modifying existing rules and procedures, Brennan suggests the role of the judge should become more active and less passive; that Special Masters[24] in the US [or Court Assessors[25] in this country] could assist at pre-trial and procedure level[26]. As far as expert witnesses are concerned, he suggests more innovative evidential rules which in turn allow for greater judicial discretion; and finally (supported by Lord Woolf and still highly controversial) the use of court appointed experts.

The 'science panel' proposed by Brennan involves a panel of scientists assisted by lawyers and concerned citizens who adjudicate on specific questions of causation and formulate a consensus opinion on the causal dispute under question. The 'science panel' emerges from a Toxic Substances Board, "the role of the Board is to provide a source of unbiased expert opinion that help the court consider toxic causation [thereby leaving] the deterrence and compensation [element] primarily in the hands of the courts" (Ibid:71). The Board would therefore assist the courts understand the causal connection without supplanting the role

---

[24] The role of Special Master in the US is to provide advice and guidance as well as assist the judge in the handling of complex scientific and technical issues.

[25] Lord Woolf in his Final Report (1996) suggests the appointment of Court Assessor to sit with the judge during the trial. According to Lord Woolf, the appointment of a Court Assessor would ensure judicial understanding of the issues throughout the trial and be particularly helpful in cases where there is an array of complex scientific expert evidence.

[26] Special Masters appointed under Federal Rule of Civil Procedure 53 have already "assisted courts with asbestos litigation, hazardous waste site litigation and Dalkon Shield litigation" (Brennan 1989:6).

of judge or jury.

Although not all Brennan's ideas would adapt for English law purposes, many of his proposals do receive general support from Lord Woolf, in particular: court appointed experts; court assessors; a less adversarial approach; more judicial education. However, if a serious attempt is to be made to resolve the ongoing problems of the toxic tort plaintiff, perhaps as Armstrong (1995:99) suggests, the distinction between areas of private law and public law needs to be reconsidered:

> The existence of the private conflict becomes an opportunity to clarify and determine the standards by which society governs itself. Those standards include the Rule of Law, the maintenance of which transcends the interests of the private parties in order to achieve justice for those who are never involved in actual proceedings.

Taking this a stage further, it is clear the establishment of causal relations remains an impossible hurdle for the toxic tort plaintiff to overcome. While legal principles, liability and judicial decision making stay unchanged, it is difficult to see how recent proposals recommended by Lord Woolf or Lord Irvine will impact upon the plight of these claims. In the meantime, increasing hazards, greater scientific complexity and growing environmental awareness suggest a public willingness to embark upon civil action[27]. Therefore, it is perhaps ironic that despite the best intentions and highest aims from some of the most outstanding legal minds of our age, toxic tort plaintiffs look set to remain both victims of their personal injury and the civil justice system post millennium.

---

[27] Victims embark upon civil action from an individual and utilitarian perspective (ie: deterrence, public interest and environmental protection).

GLOSSARY OF TERMS

ABSORBED DOSE	Quantity of energy imparted by ionising radiation to unit mass such as tissue.
ALLELES	Alternative forms of gene.
ALPHA PARTICLE	A charged particle which is emitted during the radioactive decay of some radionuclides; it consists of two protons and two neutrons and has a net charge of +2. It is a high linear energy transfer radiation.
ARGON	This is a beta emitting radionuclide with a half life of approximately two hours.
ATOM	Smallest portion of an element that can combine chemically with other atoms.
ATOMIC NUCLEUS	The central part of an atom at which the positive nucleus and, therefore, the number of electrons in the atom associated with that nucleus.
BECQUEREL	The Standard International (SI) Unit for the number of nuclear disintegrations taking place per second in a quantity of radionuclide containing matter.
BETA PARTICLE	A negatively charged electron or a positively charged positron emitted from a nucleus in certain types of radioactive disintegrations.
CAESIUM 134	This is a beta and gamma emitting radionuclide with a half life of about 2 years.
CAESIUM 137	This is a beta emitting radionuclide with a half life of approximately 30 years.
CASE CONTROL STUDY	A type of epidemiological study in which the occurrence of possible explanatory factors for a disease is compared between those with the disease (cases), and a representative sample of non-cases (controls) from the same population.
CANCER	A disease characterised by the proliferation of cells leading to local growth (tumour), to local invasion and to metastasis.
CARCINOGEN	A substance which causes cancer.

CARCINOMA	A cancer arising from epithelial tissues. Most human cancers are carcinomas.
CELL	The basic unit which makes up all living organisms.
CHROMOSOME	A threadlike structure in the nucleus carrying the genetic information arranged in a linear sequence. It is composed of a DNA molecule.
CONFIDENCE LEVEL	A 95% confidence level is a range of values that has a 95% chance of containing the true value; it provides an indication of the precision of the estimates odds ratio.
COLLECTIVE EFFECTIVE DOSE	The quantity used to express the total radiation exposure to all the organs and tissues of the body in a group of individuals. It is obtained by multiplying the mean effective dose by the number of people exposed to a given source of radiation.
COHORT	A team commonly used in epidemiological studies to denote a group of subjects with some common feature such as residence or place of work.
COOLING PONDS	Area of the Sellafield site where newly arrived fuel rods are stored under water to allow the decay of volatile isotopes. The rods produce considerable heat which is removed by a flow of cooling water through the ponds.
CONTAMINATE	Radioactive material in particulate, gaseous or liquid form present in places where it should not be.
COSMIC RAYS	High energy extra -terrestrial ionising radiation. Mostly absorbed by the earth's atmosphere.
CRITICAL GROUP	A defined group of people who receive more radiation from a given source than the average population.
CRITICAL ORGAN	The organs and tissues of the body have varying degrees of radiosensitivity to ionising radiation. For the purposes of radiation protection, it is necessary to consider the radiosensitivity with respect to specific effects as well as to the dose received.

CURIE (Ci)	The old unit of radioactivity (the number of nuclear disintegrations per second occurring. The curie has now been superseded under the SI system by the becquerel (Bq), equal to one disintegration per second.
DECANNING	The first process in the cycle of nuclear fuel reprocessing in which the casing is separated from the fuel.
DECAY	The process by which radionuclides change from one atom to another emitting ionising radiation as they do so.
DELETION	Usually a chromosome abberation in which a proportion of a chromosome is lost. May also refer to loss of any DNA segment.
DNA	Deoxyribonucleic acid. The molecule that controls the structure and function of cells and is the material of inheritance.
DISCHARGES	The release of liquid effluent from an industrial site.
DOSEMETER	An instrument which measures radiation doses or dose rates.
DOUBLING DOSE	The radiation dose that would double spontaneous mutation rates. It is used for estimates of genetic risks from ionising radiation.
EFFECTIVE DOSE	The quantity derived from equivalent dose to represent the combinations of doses to different organs and tissues.
EFFECTIVE HALF LIFE	The half life for the quantity of a radioactive substance in the body.
EMBRYO	The young organism arising from the fertilised egg cell.
EMISSIONS	The release of a gaseous effluent from an industrial plant.
ENZYME	A protein which is the product of an enzyme-coding gene. Enzymes speed up, enable or control chemical reactions in living systems without being used up in the reactions.
EXTERNAL RADIATION DOSE	Dose which is received by an individual as a result of exposure to sources of radiation from outside the body.

FACTOR	A variable the values of which fall into or have been allocated to discrete categories (eg place of residence, date of birth).
FALL-OUT	The transfer of radionuclides produced by nuclear weapons from the atmosphere to earth.
FAST BREEDER REACTOR	A type of nuclear power reactor which produces more fissionable material than it consumes.
FILM BADGE	One of the devices used for estimating external radiation dose. It consists of a photographic film in a holder and is normally worn on the front of the body. Processing of the film allows estimation of the dose received by the wearer.
FISSION	The splitting of a nucleus into two or more fragments. The process may be spontaneous or may be induced. Only certain nuclides, all of them very heavy, can fission. The energy manifests itself in heat which is harnessed in power reactors, or in shock when harnessed in weapons.
FISSION PRODUCTS	The material fragments resulting from fission of a heavy nucleus.
GAMMA-RAYS	Photons emitted from the nucleus of a radionuclide during radioactive decay.
GAS COOLED REACTOR	A nuclear reactor which uses gas, usually carbon dioxide, to cool the pile. In Britain these reactors use "magnox" fuel.
GENE	A unit of inheritance; a specific sequence of bases along the DNA molecule.
GENE POOL	The sum total of the genes in a breeding population.
GENETIC DISEASE	Any genetically conditioned disorder ultimately caused by a particular gene-determined defect.
GENOME	The entire repertoire of genes in a cell in an organism.
GONAD	A reproductive organ (ovary in females and testis in the males) in which gametes (ova and sperm) are produced.

GRAY	The Standard International (SI) Unit of absorbed dose on ionising radiation. 1 Gy = 1 joule of energy absorbed per kilogram of matter such as body tissue.
HALF-LIFE	The time for the activity of a radionuclide to decay to half its original value.
HIGH LET RADIATION	A type of ionising radiation that leaves a high average density of energy deposition along the tracks that it produces in tissues, for example alpha particles, neutrons. It is usually more damaging to body tissue than is low LET type of radiation.
INTERACTION	Difference in the effects of one or more explanatory variables.
INTERNAL RADIATION DOSE	Dose which is received by an individual as a result of radioactive material inside the body.
IN VITRO	Studies carried out on material from an animal under artificially controlled conditions.
IN VIVO	Studies carried out in the intact animal.
IODINE-131	A beta and gamma emitting radionuclide with a half-life of about 8 days. It accumulates in the thyroid.
IONISING RADIATION	Radiation that can deliver energy in a form capable of removing electrons from atoms and turning them into ions.
IRRADIATED	Having been exposed to radiation. In the context of the Piles it is usually the neutron bombardment which is the most significant.
ISOTOPE	Forms of an element having the same atomic number (number of proteins) but different atomic mass (number of neutrons + proteins).
LEUKAEMIA	Cancer of the white blood cells. Leukaemias can be derived from the myeloid or lymphoid series. The cells infiltrate the bone marrow, the blood stream and other organs, eg: liver, spleen, kidneys.

LINEAR ENERGY TRANSFER	A measure of the density of energy deposition in the tracks of ionising radiation. See High and Low LET.
LOW LET RADIATION	A type of radiation that leaves a low average density of energy deposition along the tracks that it produces in tissues, for example gamma rays, X-rays, beta particles. It is usually less damaging to biological tissue than his high LET radiation.
LYMPHOID TISSUE AND LYMPHATIC ORGANS	The organs and tissues of the body containing appreciable numbers of lymphocytes, for example lymph nodes, thymus, spleen, tonsils.
LYMPHOMA	A tumour of the lymphoid tissue.
MAGNOX	A type of nuclear fuel which is encased in a Magnesium alloy. It is also the name given to the gas cooled reactors using the fuel.
MALIGNANCY	The essential property of cancer cells which is demonstrated by their ability to proliferate indefinitely to invade surrounding tissue and to metastasize to other organs.
METASTASIS	The spread of cells from a primary tumour to a non-contiguous site, usually via the blood stream or lymphatics with the establishment of a second growth.
MILLISIEVERT	mSv: A unit of equivalent dose and effective dose.
MITOSIS	Somatic cell division. The division of a nucleus following replication of the chromosomes so that the resulting daughter nuclei have the same number of chromosomes as the parent nucleus.
MOLECULE	A collection of atoms bound into a well defined unit forming a stable chemical compound.
MULTISTAGE CARCINO-GENESIS	The development of tumours is regarded as a multistage process in which at least three separated sequential processes, initiation, promotion and progression, have been described.
MUTAGEN	Mutation inducing agent: these can be physical or chemical.

MUTANT	Any allele (alternative form of gene); or an individual carrying such an allele.
MUTATION	A permanent heritable change in the amount or structure of the genetic material in an organism, resulting in a change in the characteristic of the organism. The alterations may involve a single gene, a block of genes, or a whole chromosome. A mutation in the germ cells in sexually reproducing organisms may be transmitted to the offspring. A mutation that occurs in somatic cells may be transferred to descendent daughter cells within the organism.
MUTATION RATE	The rate at which mutations occur at a given locus.
NATURAL RADIATION	Natural radiation pervades the whole environment. Radiation reaches the earth from outer space. The earth itself contains radionuclides and natural radionuclides are present in the food we eat and in some of the elements in our body. Everyone is exposed to such radiation, which is frequently referred to as background radiation. The principal sources are: Cosmic rays; Terrestrial gamma rays; Radon decay products; Internal radiation.
NHL	Non-Hodgkin's Lymphoma (blood disease involving a tumour of the lymphoid tissue).
NUCLEUS	The central part of an atom.
NUCLIDE	An individual species of atom characterised by its mass number, atomic number and the energy state of its nucleus.
ONCOGENE	A gene whose protein product may be involved in processes leading to transformation of a normal cell to a malignant state. It can either be an altered normal gene, or a normal gene incorporated into a virus which then causes transformation when the virus infects the cell.
OXIDE FUEL	Nuclear fuel consisting of pellets of Uranium oxide. Used in Advanced Gas Cooled Reactors and Water Cooled Reactors.
PHOTON	A quantum of electromagnetic radiation, regarded as a particle with zero rest mass and charge.
PILE	The name given to the part of a nuclear reactor which contains the fuel and their moderating systems.

PLUTONIUM

An actinade that can exist in several different isotopic forms. The principal isotopes, together with their main decay pathway are as follows
Plutonium-238: An alpha emitting radionuclide with a half-life of about 86 years.
Plutonium-239: An alpha emitting radionuclide with a half-life of about 24,000 years.
Plutonium 240: An alpha emitting radionuclide with a half-life of about 6,600 years.
Plutonium-241: A beta emitting radionuclide with a half-life of about 13 years and which decays as an alpha emitter.
Plutonium-242: An alpha emitting radionuclide with a half-life of about 379,000 years.

POINT MUTATION

A mutation that is specifically localised on a chromosome.

PRESSURISED WATER REACTOR

A type of nuclear power plant which has a pile cooled by water kept under pressure.

PROMOTION (TUMOUR)

The ill understood and protracted process whereby initiated cells undergo clonal expansion to form visible tumours. The mechanism involved are diverse but, in different contexts, include sustained tissue damage and cycles of cell distribution and regeneration, immune suppression, hormonal imbalance, alterations in intercellular contacts and release of cells from normal growth control. Specific agents have been characterised but their mode of action is unclear.

PROTON

An elementary particle with a positive electric charge.

QUALITY FACTOR

The factor by which absorbed dose of a given radiation is multiplied in order to obtain its dose equivalent for radiation protection purposes.

RAD

The old unit of absorbed dose of ionising radiation.
100 rad = 1 gray.

RADIATION

In this context, usually shorthand for 'ionising radiation'.
Forms of energy (sub-atomic particles or electromagnetic waves) which can propagate through space, and causes radiation damage by ionisation, in its interaction with matter.

RADIATION DOSE	A general term, often shortened to 'dose', for a measure of exposure to ionising radiation.
RADIATION WORKER	A person working with radioactive materials. Often used to mean classified person.
RADIOACTIVE HALF-LIFE	The time taken for the activity of a radionuclide to lose half its value by decay.
RADIOACTIVITY	A property of radionuclides of spontaneously emitting ionising radiation.
RADIOISOTOPE	An isotope of an element whose nucleus is unstable and undergoes spontaneous decay.
RADIONUCLIDE	An unstable nuclide that emits ionising radiation.
RADON	A naturally occurring radioactive gas which is one of the decay products of uranium. Radiation from radon accounts for the majority of the annual dose received by the average member of the UK population, at around 50% of the total.
RED BONE MARROW	The component of marrow which contains the bulk of the stem cells from which blood cells are formed.
RELATIVE BIOLOGICAL EFFECTIVENESS	(RBE) A quantity describing the relative effect of various types of radiation on tissues. In radiobiology it is defined as the ratio of a dose of reference radiation required to produce an identical biological end point to the dose of the radiation being tested when all the physical and biological variables, other than the radiation quality, are kept as constant as possible.
RELATIVE RISK	The probability that an event will occur.
REM	The old unit of dose equivalent. The absorbed dose (rad), is multiplied by the Quality Factor for the particular type of radiation. 100 rem = 1 sievert.
REPROCESSING	A process, the purpose of which is to extract Uranium and Plutonium from spent fuel.

RETROVIRUS	A virus in which the genome comprises RNA.
RNA	(Ribonucleic acid) RNA governs all protein manufacture. It differs from DNA by having extra -OH group on the ribose sugar and although, it too has four nitrogenous basis, it contains uracil instead of thymine as well as adenine, cytosine and guanine. It can exist in both single and double stranded forms and it governs all protein manufacture.
SARCOMA	Tumour developing in the connected tissues of bones and muscles.
SELLAFIELD SITE	The composite name given to the BNFL site in West Cumbria which includes the Windscale nuclear fuel reprocessing facility and the Calder Hall nuclear reactor.
SIEVERT	The name for the SI unit of dose equivalent.
SOMATIC CELLS	All cell types in an individual other than those which are, or give rise to germ cells.
SOMATIC EFFECTS	The effects of radiation on the body of the person or animal exposed (as opposed to genetic effects).
SPERMATOGIUM	The sequence of events from stem cell spermatogonia to mature spermatozoa.
STACKS	Tall ventilation chimneys from the Windscale piles on the Sellafield site; they contain filers to remove particulates.
STATISTICALLY SIGNIFICANT	Shown by statistical testing to be unlikely to have arisen by chance.
STEM CELLS	Cells that can produce either undifferentiated it partially specialised) or differentiated (if fully specialised) cells.
STOCHASTIC EFFECTS	Those radiation effects (such as cancer induction) where it is the probability of the effect occurring which depends on the dose, rather than the severity of the effects.
STRONTIUM-89	A beta emitting radionuclide with a half-life of about 50 days. It is

	chemically similar to calcium and tends to concentrate in bone.
STRONTIUM-90	A beta emitting radionuclide with a half-life of about 28 years. It is similar to calcium and tend to concentrate in bone.
STUDY POPULATION	All the subjects included in the study. This may include cases and controls.
THORPE	Thermal Oxide Reprocessing Plant. A plant for the purpose of reprocessing enriched Uranium oxide; fuel used by Advanced Gas Cooled reactors and Water Cooled Reactors.
TOXIN	A general term for a chemical agent, often of biological origin, but not always) which can cause injury or disease.
TRANSGENIC MOUSE	A mouse that has had a foreign gene introduced by means of gene transfer techniques in all of their cells. New information is then passed on through the germline of the adult.
TRITIUM	A radioactive isotope of hydrogen. It emits low energy beta radiation and has a radioactive half-life of 12.3 years.
TUMOUR	A swelling or growth. It usually implied a collection of cells. A tumour may be benign (ie cells do not invade or metastasize) or malignant.
TUMOUR SUPPRESSOR GENE	A gene whose continued expression is thought to be essential for normal growth and differentiation of cells. Many tumour suppressor genes probably exist. Deletion or suppression of such genes lead to tumour development. They are recessive at the level of individual cells which means that both alleles must be inactivated before a tumour develops.
URANIUM	A naturally occurring element with atomic number 92. It is present in nature as two isotopes uranium 235 and uranium 238.
VARIABLE	A quantity that varies. Any attribute, phenomenon or event that can have different values.

VIRUS	Any of the infections, sub-cellular and ultra-microscopic particles representing potentially pathogenic agents, whose replication in the cell and transmission by infection results in characteristic reactions of the host cells and host individuals. Viruses are independent genetic systems which possess an evolutionary history of their own. They use the synthetic machinery of living cells to direct the synthesis of specialised particles which contain the viral genome and transfer it to other cells.
WHOLE BODY DOSE	A term used to represent dose from approximately uniform irradiation of an individual, and to distinguish it from dose to particular body organs and tissues.
WINDSCALE PLANT	The nuclear fuel reprocessing facility situated within the Sellafield site.
X-RAYS	A type of electromagnetic radiation whose photons have energy lower than most of gamma-rays but higher than that of ultra-violet light. Most X-rays are not of sufficient energy to cause ionisation.
ZIRCONIUM-95	This is a beta emitting radionuclide with a half-life of about 65 days.

GLOSSARY REFERENCES

Committee on Medical Aspects of Radiation in the Environment.
Health and Safety Executive.
Last, J.M. (1988) A Dictionary of Epidemiology, Oxford University Press.
National Radiological Protection.
Transcript of Reay and Hope v BNFL; Trial and Judgment: Days 1-90: Notes of J.L. Harpham Ltd. Official Shorthand Writers, 55 Queen Street, Sheffield SI 2DX.

BIBLIOGRAPHY

Ackland L. Radiation: how safe is safe? New Scientist 5th May (1993) 1873:34.

Aitken, C.G.G. (1995) Statistics and the Evaluation of Evidence or Forensic Science. Chichester: John Wiley and Sons.

Aitken, C.G.G. Stoney, D.A. (1991) The use of Statistics in Forensic Science. Chichester: John Wiley and Sons.

Alderson, M.R. Ashwood, F.L. Cook-Mozaffari 'Mortality and Cancer Registration on the vicinity of nuclear installations in England and Wales'. Submissions to Black Advisory Group (1984) (SDB 596/H24).

Alexy, R. (1989) A Theory of Legal Argumentation: The Theory of Rational Discourse as Theory of Legal Justification. Oxford: Clarendon Press.

Allen, R.'The nature of judicial proof'. Cardozo Law Review 13 (1989):373-387.

Allen, R.J. 'Rationality, algorithms and judicial proof: a preliminary inquiry' The International Journal of Evidence and Proof (1997) 1: Special Issue.

Anderson, B. (1996) "Discovery" in Legal Decision-Making. Dordrecht: Kluwer Academic Publishers.

Aoyama, T. et al. (1983) 'Mortality study of Japanese technologists'. Biological Effects of Low-Level Radiation - Proceedings of a Symposium Venice April 1993. IAEA.

Armstrong, A. (1995) 'Making Tracks' in A.A.S. Zuckerman & Ross Cranston (eds.) Reform of Civil Procedure: Essay on 'Access to Justice'. Oxford: Clarendon Press.

Arnold, L. (1975) The Birth of the UK Atomic Energy Authority. Atom 224 July 1975.

Arnold, L. (1992) Windscale 1957: Anatomy of a Nuclear Accident. London: Macmillan.

Atiyah P.S. 'From Principles to Pragmatism: Changes in the Function of the Judicial Process and Law' (1980) 65(5) Iowa Law Review 1249.

Attfield, R. (1994) 'The Precautionary Principle and Moral Values' in T. O'Riordan and J. Cameron (edn.) Interpreting the Precautionary Principle. London: Earthscan Publications Ltd.

Bahnson, C.B.'Psychophysiological Complementarity in Malignancies' Annals of the New York Academy of Sciences (1969) 164(2): 319-333.

Bailey, L.A. Gordis, L. Green, M. (1994) "Reference Guide on Epidemiology" in Reference Manual on Scientific Evidence. Federal Judicial Center. Washington: US Government Printing Office.

Barnes, B. (1974) Scientific Knowledge and Sociological Theory. London: Routledge and Kegan Paul.

Barnes, B. (1977) Interests and the Growth of Knowledge. London: Routledge and Kegan Paul.

Barnes, B. (1982) T.S. Kuhn and Social Science. London: Macmillan.

Barnes, B. Edge, D. (1982) Science in Context. Milton Keynes: The Open University Press.

Barton, C.J. Roman, E. Ryder, H. Watson, A. 'Childhood leukaemia in west Berkshire'. Lancet 1985 ii:1248-9.

Bauer, R.A. et al (1969) Second Order Consequences: A Methodological Essay on the Impact of Technology. Cambridge. MIT Press.

Bayles, M.D. (1990) Procedural Justice. Dordrecht: Kluwer Academic Publishers.

Beattie, J.R. (1993) 'An assessment of environmental hazard from fission product releases' Culcheth. UKAEA AHSB(S) R64.

Beck, U. (1995) Ecological Politics in an Age of Risk. Cambridge: Polity Press.

Bell, J. (1986) 'The Acceptability of Legal Arguments' in N.MacCormick and P. Birks The Legal Mind: Essay for Tony Honore. Oxford: Clarendon Press.

Bengeotxea, J. (1993) The Legal Reasoning of the European Court of Justice. Oxford: Clarendon Press.

Bennett W.I. Feldman (1981) Reconstructing Reality in the Courtroom. London. Tavistock.

Bentham, J. (1839) The Rationale of Judicial Evidence (Bowring ed.) Edinburgh. William Tait.

Beral, V. et al 'Mortality of employees of the United Kingdom Atomic Energy Authority 1946-1979'. British Medical Journal (1985) 291 440-447.

Berger, M.A. (1994) "Evidential Framework" in Reference Manual on Scientific Evidence. Federal Judicial Center. Washington: US Government Printing Office.

Berkhout, F. (1991) Radioactive Waste: Politics and Technology. London: Routledge.

Bertell, R (1985) No Immediate Danger: Prognosis for Radioactive Earth. London: The Women's Press Ltd.

Binder, D. Bergman, P. (1984) Fact Investigation: From Hypothesis to Proof. St. Paul, MN: West Publishing.

Black, RJ. Urquhart, J.D. Kendrick, SW. Bunch, KJ. Warner, J. Jones, DA. 'Incidence of leukaemia and other cancers in birth and schools cohorts in the Dounreay area' British Medical Journal (1992) 304:1401-5.

Bloor, D. (1976) Knowledge and Social Imagery. London: Routledge and Kegan Paul.

Blowers, A. (1998) 'Nuclear Waste and Landscape of Risk' Paper delivered at the 13th Low Level Radiation and Health Conference. University of Greenwich, July 1998.

Blowers, A. (1998) 'Radioactive Waste - an Inescapable Legacy' Paper: Low Level Radiation and Health Conference, University of Greenwich. London.

Bobrow, M. (1996) 'The Implications of New Data on the Releases from Sellafield in the 1950s for the Conclusions of the Report on the Investigations of the Possible Increased Incidence of Cancer in West Cumbria: First Report COMARE. London: HMSO.

Bohm, D. (1984) Causality and Chance in Modern Physics. London: Routledge & Kegan Paul.

BMA (1990 ed.) The BMA Guide to Living with Risk. Middlesex: Penguin Books.

Bradford Hill A. Hill I.D. (1991) 12th ed. Principles of Medical Statistics. London. Edward Arnold.

Brennan, T.A. 'Helping Courts with Toxic Torts: Some Proposals Regarding Alternative Methods for Presenting and Assessing Scientific Evidence in Common Law Courts' University of Pittsburgh Law Review Vol 51 (1989) No. 1

Bring, J. Aitken, C.G.G. 'United States v Shonubi and the use of Statistics in Court'. Expert Evidence Vol. 4. No. 4. July (1996).

Bring, J. 'Bayes on Trial' The International Journal of Evidence and Proof (1997) 1 Special Edition.

Buckley, J.D. Robinson, L.L. Swotinsky, R. et al.'Occupational Exposures of Parents of Children with Acute Non-lymphocytic Leukaemia: A Report from the Children's Cancer Study Group' Cancer Res. (1989) 49:4030-4037.

Burton, S.J. (1994) Judging in Good Faith. Cambridge University Press.

Busby, C. (1995) Wings of Death: Nuclear Pollution and Human Health. Aberystwyth: Green Audit.

Callen, C.R. 'Computation and juridical proof' The International Journal of Evidence and Proof (1997) 1 Special Issue.

Cane, P. (1993) 5th edn.Atiyah's Accidents, Compensation and the Law. London: Butterworths.

Cardozo, B.N. (1921) The Nature of the Judicial Process 178. Yale: University Press.

Carnegie Commission on Science, Technology, & Government, Science and Technology in Judicial Decision Making: Creating Opportunities and Meeting Challenges 11 (1993).

Carriquiry, A.L. 'Bayesian legal decision making: impossible task?' The International Journal of Evidence and Proof (1997) 1 Special Issue.

Carson, D.'Expert Evidence in the Courts'. Expert Evidence (1992) Vol. 1 No.1 13-19.

Casti, J.L. (1989) Paradigms Lost: Images of Man in the Mirrors of Science. London: Sphere Books.

Caufield, C. (1989) Multiple Exposures: Chronicles of the Radiation Age. London: Secker and Warburg.

Chamberlain, A.C. 'Environmental impact of particles emitted from Windscale piles, 1954-7. AERE R 12163 April (1986).

Clapp, R.W. Cobb, S. Chan, CK. Walker, B (Junior). 'Leukaemia near Massachusetts nuclear power plant'. Lancet (1987) ii:1324-5.

Clark, M.J. (1981) 'Optimisation of the radiological protection of the public'. NRPB-R120.

Clarke, R.H. (1985) Radiological Protection aspects of exemption levels in the nuclear fuel cycle, in Interface Questions in Nuclear Health and Safety, Proceedings of NEA Seminar 16-18 April 1985, Paris: OECD pp. 234-245.

Clarke, R.H. 'The 1957 Windscale accident revisited' International Conference on the Medical Basis for Radiation Accident Preparedness - II Clinical Experience and Follow-up since 1979: Oak Ridge, Tennessee, 20-22 October 1988.

Clark, R.H. 'Current radiation risk estimates and implications for the health consequences of the Windscale, TMI and Chernobyl accidents', UKAEA Conference on Medical Response to Effects of Ionising Radiation: London 28-30 June 1989.

Clark, W.C. (1981) Witches, Floods and Wonder Drugs: Historical Perspectives on Risk Management (RR 81-3) (Laxenburg, Austria: International Institute for Applied Systems Analysis, March 1981.

Collins, H.M. Knowledge and Controversy: Studies of Modern Natural Science, Social Studies of Science (1981) 11 (Special Issue) 3-15.

Cook-Mozaffari, P. (1984) 'Deaths from cancer in South Coastal Cumbria (Copeland District). Submission to Black Advisory Group (SDB 587/H12).

Cook-Mozaffari, P.J. Ashwood, F.L. Vincent, T. Forman, D. Alderson, M. (1987) 'Cancer Incidence and mortality in the vicinity of nuclear installations, England and Wales 1950-80 London: HMSO.

Cook-Mozaffari, P. Darby, S. Doll, R. 'Cancer near potential sites of nuclear installations'. Lancet (1989) ii:1145-7.

Committee for Compilation of Materials on Damage Caused by the Atomic Bombs in Hiroshima and Nagasaki. (1981) Hiroshima and Nagasaki: The Physical, Medical and Social Effects of the Atomic Bombings. London: Hutchinson.

Committee on Medical Aspects of Radiation in the Environment (1986). 'The implications of the new data on the releases from Sellafield in the 1950s for the conclusions of the report on the investigation of the possible increased incidence of cancer in west Cumbria'. London: HMSO (COMARE 1st Report).

Committee on Medical Aspects of Radiation in the Environment (1988). 'Investigation of the possible increased incidence of childhood cancer in young persons near the Dounreay nuclear establishment, Caithness Scotland': London: HMSO (COMARE 2nd Report).

Committee in Medical Aspects of Radiation in the Environment (1989). 'Investigation of the possible increased incidence of childhood cancer in the West Berkshire and North Hampshire area, in which are situated the Atomic Weapons Research Establishment, Aldermaston, and the Royal Ordnance Factory, Burghfield': London: HMSO (COMARE 3rd Report).

Cosgrove, G.E. Selby, P.B. Upton, A.C. Mitchell, T.J. Steele, M.H.Russell, W.I. 'Lifespan and autopsy findings in the first generation offspring of x-irradiated mice'. Mutat Res (1993) 319:71-79.

Cotterrell, R. (1989) The Politics of Jurisprudence. London: Butterworths.

Counsel (1994) Editorial.

Court Brown, W. M. Doll, R British Medical Journal (1965) 1327-1332.

Craft, A.W. Birch, J.M. 'Childhood cancer in Cumbria. Lancet (1983) i:1299.

Craft, A.W. et al. Epidemiolog. Community Health (1993) 47:109-115.

Cutler, J. & Edwards, R.(1988) Britain's Nuclear Nightmare. London: Sphere Books.

Darby, S.C. Doll, R. Pike, R. 'Mortality of Employees of the United Kingdom Atomic Energy Authority 1946-79' British Medical Journal (1985) 291 672.

Darby, S.C. 'Epidemiological Evaluation of Radiation Risk using Populations Exposed at High Doses'. Health Physics (1986) 51, 269-281.

Darby, S.C. Doll, R. Gill, S.K. Smith, P.G.'Long-term mortality after a single treatment course with X-rays in patients treated for Ankylosing Spondylitis'. Journal of the National Cancer Institute (1987) 75:1-21.

Darby, S.C. Doll, R. 'Occupation Epidemiology: Problems in reaching an overview' Proceedings of the British Nuclear Energy Society on 'Health Effects of Low Dose Ionising Radiation - Recent Advances and their implications 11-14 May 1987.

Darby, DC. Doll, R. 'Fallout, radiation doses near Dounreay, and childhood leukaemia'. British Medical Journal (1987) 294:603-7.

d'Espagnat, B. "The Quantum Theory and Reality". Scientific America (1979) 241 No. 5 November:158-181.

Devlin, Lord 'Judges, Government and Policies' 41 MLR (1978).

Dicey, A.V. (1939 9th edn.) Introduction to the Study of the Law of the Constitution. ed. E.C.S. Wade. London: Macmillan.

Doll, R. Peto, R. (1990) The Causes of Cancer: Quantitative Estimates of Avoidable Risks of Cancer in the United States Today. Oxford: Oxford University Press.

Draper, G.J. (1991) The geographical epidemiology of childhood leukaemia and non-Hodgkins lymphomas in Great Britain 1966-83. London: HMSO.

Draper, G.J. Stiller, C.A. Cartwright, R.A. Craft, A.W. Vincent, T.J. 'Cancer in Cumbria and in the vicinity of the Sellafield nuclear installations, 1963-90'. British Medical Journal (1993) 306:89-94.

Dunbar, R. (1995) The Trouble with Science. London: Faber and Faber.

Dworkin, R.M. (1978) Taking Rights Seriously. London: Duckworth.

Elsworth, M. (1990) A Dictionary of the Environment. London: Paladin.

Environmental Select Committee (1985) 'Radioactive Waste' Minutes of Evidence. London: HMSO.

Esser, J. (1972) Vorverstandnis und Methodenwahl in der Rechtsfindung. Frankfurt a. M.

Evett, I.W. (1991) 'Interpretation: a personal odyssey' in Aitken, C.G.G. and Stoney, D.A. (eds) The Use of Statistics in Forensic Science. Chichester: Ellis Horswood.

Feyerabend, P. (1984) Against Method. London: Verso.

Fienberg, S.E. (1989) The Evolving Role of Statistical Assessments as Evidence in the Courts. New York: Springer-Verlag.

Fienberg, S.E. Krislov, S.H. Straf, M.L. 'Understanding and Evaluating Statistical Evidence in Litigation'. Jurimetrics (1995) No. 36, 1-32.

Finkelstein, M.O. Levin, B. (1990) Statistics for Lawyers. New York: Springer-Verlag.

Forman, D. Cook-Mozaffari, P. Darby, S. Davey, G. Stratton, I. Doll, R. Pike, M. 'Cancer near nuclear installations'. Nature (1987) 329:499-505.

Foster, K.R. Bernstein, D.E. Huber, P.W. (1993) Phantom Risk: Scientific Inference and the Law. Cambridge, Mass. The MIT Press.

Frank, J. (1949) Law and the Modern Mind. London: Stevens and Stevens.

Freckleton I.R. (1987) The Trial of the Expert: A Study of Expert Evidence and Forensic Experts. Melbourne. Oxford University Press.

Friedman, R.D. 'Answering the Bayesioskeptical challenge' The International Journal of Evidence and Proof (1997) 1 Special Issue.

Gardner, M.J. Winter, P.D.'Mortality in Cumberland during 1959-78 with reference to cancer in young people around Windscale'. Lancet (1984) i:216-217.

(a) Gardner, M.J. Hall, A.J. Downes, S. Terrell, J.D. 'Follow up study of children born to mothers resident in Seascale, west Cumbria' (Birth Cohort). British Medical Journal (1987) 295:822-7.

(b) Gardner, M.J. Hall, A.J. Downes, S. Terrell, J.D. 'Follow up study of children born elsewhere but attending schools in Seascale, west Cumbria' (Schools Cohort). British Medical Journal (1987) 295:819-21.

Gardner, M.J. 'Review of reported increases of childhood cancer rates in the vicinity of nuclear installations in the United Kingdom'. Journal of the Royal Statistical Society [Series A] (1989) 152:307-25.

(a) Gardner, M.J. Snee, M.P. Hall, A.J. Powell, C.A. Downes, S. Terrell, J.D. 'Results of case control study of leukaemia and lymphoma among young people near Sellafield nuclear plant in west Cumbria'. British Medical Journal (1990) 300:423-9.

(b) Gardner, M.J. Hall, A.J. Snee, M.P. Downes, S. Powell, C.A. Terrell, J.D. 'Methods and basic data of case control study of leukaemia and lymphoma among young people near Sellafield nuclear plant in west Cumbria'. British Medical Journal (1990) 300:429-34.

(a) Gardner, M.J. 'Childhood cancer and nuclear installations' Public Health (1991) 105:277-8.

(b) Gardner, M.J. 'Father's occupational exposure to radiation and the raised level of childhood leukaemia near the Sellafield Nuclear Plant'. Environmental Health Perspective (1991) 94:5-7.

(a) Gardner, M.J. 'Paternal occupations of children with leukaemia'. British Medical Journal (1992) 305:715. (Correction to preceding chapter).

(b) Gardner, M.J. 'Leukaemia in children and paternal radiation exposure at the Sellafield nuclear site'. J Natl Cancer Inst Monogr (1992) 12:133-5.

Gofman, J.W. 'The Question of Radiation Causation of Cancer in Hanford Workers' Health Physics (1979) 37 617-639.

Gofman, J.W. (1990) Radiation Induced Cancer from Low Dose Exposure: An Independent Analysis. San Francisco: Committee for Nuclear Responsibility.

Goldsmith, J.R. 'Childhood leukaemia mortality before 1970 among populations near two United States nuclear installations'. Lancet (1989)i:793.

Gould, J.M. Gouldman, B.A. (1990) Deadly Deceit: Low Level Radiation; High Level Cover-up. New York: Four Walls Eight Windows.

Government White Paper on Radioactive Waste Management. Cmnd. 8607 (1982) London: HMSO.

Gower, B. (1997) Scientific Method: An Historical and Philosophical Introduction. London: Routledge.

Gowing, M. (1974) Independence and Deterrence: Britain and Atomic Energy 1945 1952 (2 Vol.) London: Macmillan.

Grayson, L. (1995) Scientific Deception: An Overview and Guide to the Literature of Misconduct and Fraud in Scientific Research. London. The British Library.

Green J. (1989) Industrial Ill Health, Expertise and the Law in Smith R. Wynne B. Expert Evidence: Interpreting Science in the Law. London. Routledge.

Griffith, J.A. G.(1991 2 edn.) The Politics of the Judiciary. London: Fontana.

Guardian FOE Advertisement: List of Sellafield Incidents between 1950-1986. Feb. 1986.

Hagstrom, W.O. (1965) The Scientific Community. New York: Basic Books.

Hamilton, P. (1988) (Editors Forward) cited in S. Woolgar (edn.) Science - the very idea. London and New York: Tavistock Publications.

Hart, H.L.A. Honore' A. (1985 2nd ed.) Causation in the Law. Oxford: Clarendon Press.

(a) Hatch, M.C. Beyea, J. Nieves, J.W. Susser, M. 'Cancer near the Three Mile Island nuclear plant; radiation emissions'. Am J Epidemiology (1990) 132:397.

(b) Hatch, M. Susser, M. 'Background radiation and childhood cancers within 10 miles of a United States nuclear plant'. Int J Epidemiology (1990) 19:546.

Hatch, M.C. Wallanstein, S. Beyea, J. Nieves, J.W. Susser, M. 'Cancer rates after the Three Mile Island nuclear accident and proximity of residence to the plant'. Am J Public Health (1991) 81:719.

Health and Safety Executive (1993) Investigation of Leukaemia and other cancers in the children of male workers at Sellafield. London: HMSO.

Heasman, M.A. Kemp, I.W. Urquhart, J.D. Black, R. 'Childhood Leukaemia in Northern Scotland'. Lancet (1986)i:266.

Herman, R. 'Allowing Jurors to Decide: Evidence Review' National Law Journal July 30 1990.

Hesse, M. (1980) Revolutions and Reconstructions in the Philosophy of Science. Brighton: Harvester.

Higginson, J. Formaldehyde: Review of Scientific Basis of EPA's Risk Assessment, 97th Cong., 2d sess., (1982) H-165,p.122.

Hill, C. Laplanche, A. 'Overall mortality and cancer mortality around French nuclear sites'. Nature (1990) 347:755.

Hill, C.R. 'Polonium-210 in man' Nature (1965) Lond CCV111.

Hill, T. 'A Loss Chance for Compensation in Tort of Negligence by the House of Lords' 54 MLR (1991) 511.

HMSO (1952) Harwell: The British Atomic Energy Establishment. London.

HMSO (November 1957) Accident at Windscale No. 1 Pile on 10th Oct. 1957. Cmnd. 302. London.

HMSO (December 1957) Report of the Committee appointed by the Prime Minister to examine the Organisation of Certain parts of the UKAEA. Cmnd 338. London.

HMSO (January 1958) Report of the Committee appointed by the Prime Minister to examine the Organisation for Control of Health and Safety in the UKAEA. Cmnd 342. London.

HMSO (July 1958) Final Report of the Committee appointed by the Prime Minister to make a Technical Evaluation of Information Relating to the Design and Operation of the Windscale Piles, and to Review the Factors Involved in the Controlled Release of Wigner Energy. Cmnd 471. London.

HMSO (December 1960) The Hazards to Man of Nuclear and Allied Radiations: A Second Report to the Medical Research Council. Cmnd 1225. London.

HMSO (1976) Nuclear Power in the Environment, Royal Commission on Environmental Pollution. Sixth Report, Cmnd. 6618. London.

HMSO (1978) The Windscale Inquiry. Report by the Hon. Mr. Justice Parker. Vol. 1 London.

Hodgkinson T. (1990) Expert Evidence Law and Practice. London. Sweet & Maxwell.

Hoffman, R. 'The use of epidemiologic data in the courts' Am J. Epidem. (1984) 120:190-202.

Holmes, O.W. (1920) Learning and Science: Speech 1895 in Collected Legal Papers New York. Harcourt: Brace and Co.

Holmes, O.W. (1920) Law in Science, Science in Law: Address 1889 in Collected Legal Papers 210-244. New York: Harcourt Brace and Co.

Holmes, O.W. (1871) Book Review American Law Review 5:539.

Honore' A. "Causation and Remoteness of Damage" in A. Tunc (ed.) Int. Encl. Comp.L (1983).

Howarth, D. (1995) Textbook on Tort. London: Butterworths.

HSE (1981) Windscale: The Management of Safety. London: HMSO.

HSE (1992) The Tolerability of Risk from Nuclear Power Stations. London: HMSO.

(a) Huber, P.W. (1991) Galileo's Revenge: Junk Science in the Courtroom. New York. Basic Books.

(b) Huber, P.W. Medical Experts and the Ghost of Galileo. Law and Contemporary Problems (1991) 54, 119.

Hume, D. (1955) An Inquiry Concerning Human Understanding. Indianapolis, Ind: Bobbs-Merrill contains "An Abstract of A Treatise of Human Nature".

IAEA. Basic Safety Standards for Radiation Protection. IAEA Safety Series No.9 (1982).

International Commission on Radiological Protection (1966) The Evaluation of Risks from Radiation. ICRP Publication 9. Oxford: Pergamon Press.

International Commission on Radiological Protection (1977) Recommendations of the ICRP. ICRP Publication 26. Oxford: Pergamon Press.

International Commission on Radiological Protection (1977) ICRP Publication 27, Annals of the ICRP 1977, 1 (4):1.

International Commission on Radiological Protection (1983) Cost Benefit Analysis in the Optimization of Radiation Protection. ICRP Publication 37. Oxford: Pergamon Press.

Jablon, S. Hrubec, Z. Boice, J.D (Jnr). 'Cancer in populations living near nuclear facilities: a survey of mortality nationwide and incidence in two states'. JAMA (1991) 265:1403.

Jakeman, D. 'New Estimates of Radioactive Discharges from Sellafield', British Medical Journal (1986) 293:760.

Jasanoff, S. (1995) Science at the Bar: Law, Science and Technology in America. Massachusetts: Harvard University Press.

Jasanoff, S. 'Beyond Epistemology: Relativism and Engagement in the Politics of Science' Social Studies of Science(1996) 26:393-418.

Jay, K. (1954) Britain's Atomic Factories: The Story of Atomic Energy Production in Britain. Division of Atomic Energy: Ministry of Supply.

Jones C.A. (1994) Expert Witnesses: Science Medicine and the Practice of Law. Oxford. Clarendon Press.

Kaye, D.H. Balding D.J. in Allen et al 'Probability and proof in ***State v Skipper***: an internet exchange' (1995) Jurimetrics 35.

Kaye, D.H. 'Statistical decision theory and the burdens of persuasion: completeness, generality and utility' The International Journal of Evidence and Proof (1997) 1 Special Issue.

Kaye, S.A. Robison, L.L. Smithson, W.A. Gunderson, P. King, F.L. Neglia, J.P. 'Maternal Reproductive history and birth characteristics in childhood acute leukaemia' Cancer (1991) 68: 1351-5.

Kinlen, L. Evidence for an infective cause of childhood leukaemia: Comparison of a Scottish new town with nuclear reprocessing sites in Britain. Lancet (1988) ii:1323-1327.

Kinlen, L.J. Hudson, C.M. Stiller, C.A. 'Contacts between adults as evidence for an infective origin of childhood leukaemia: An explanation for the excess near nuclear establishments in west Berkshire'? Br. J. Cancer (1991) 64:549-554.

(a) Kinlen, L.J. O'Brien, F. Clarke, K. Balwill, A. Matthews, F. 'Rural population mixing and childhood leukaemia: effects of the North Sea oil industry in Scotland, including the area near Dounreay nuclear site' British Medical Journal (1993) 306:743-748.

(b) Kinlen, L.J. Clark, K. Balkwill, A. 'Paternal preconceptual radiation exposure in the nuclear industry and leukaemia and non-Hodgkin's lymphoma in young people in Scotland'. British Medical Journal (1993) 306:1153-8.

(c) Kinlen, L.J. 'Can paternal preconceptional radiation account for the increase of leukaemia and non-Hodgkin's lymphoma in Seascale?' British Medical Journal (1993) 306:1718-21.

Kinlen, L.J. Dickson, M. Stiller, C.A. 'Childhood leukaemia and non-Hodgkin's lymphoma near large rural construction sites with a comparison with Sellafield nuclear site'. British Medical Journal (1995) 310:763-768.

Koehler, J.J. (1992) Probabilities in the courtroom: An evaluation of the objectives and policies, in Kagehiro, D.K. and Laufer, W.S. Handbook of Psychology and Law. New York: Springer-Verlag.

Kriele, M (1979) Recht und praktische Vernunft. Gottingen: Vandenhoeck and Ruprecht.

Kuhn, T. (1970) The Structure of Scientific Revolution. Chicago: The University of Chicago.

Lakatos, I. (1970) 'Falsification and the Methodology of Scientific Research Programmes' in I.Lakatos and A. Musgrave eds. Criticism and the Growth of Knowledge. Cambridge: Cambridge University Press.

Larenz, K. (1983) Methodenlehre der Rechtswissenschaft. Berlin: Springer.

Last, J.M. (1988) A Dictionary of Epidemiology, 2nd ed. Oxford: Oxford University Press.

Lee, S. (1989) Judging Judges. London: Faber and Faber.

Lempert, R. 'Of flutes, oboes and the as if world of evidence law' The International Journal of Evidence and Proof (1997) 1 Special Issue.

Lepenies, W. (1989) 'The direction of the discipline: the future of the universities', Comparative Criticism 11:00-00.

Lindell, B. (1985) Concepts of Collective Dose in Radiological Protection. Paris: OEDC.

Ligertwood, A. 'Bayesians and the world out there' The International Journal of Evidence and Proof (1997) 1 Special Issue.

Lock, S. 'Lessons from the Pearce Affair: Handling Scientific Fraud' British Medical Journal (1995) 310 1547-48.

Loevinger L. (1974) Jurimetrics: 'Science In Law' in Thomas, W.A. Scientists in the Legal System: Tolerated Meddlers or Essential Contributors: Michigan: Ann Arbor Science Publishing Inc.

Loevinger, L. (1995) 'Science as Evidence' Jurimetrics 35 2 153-89.

Lord Chancellor's Department 'Moderning Justice' December 1998.

Lovelock, J. 'Stand up for Gaia'. Schumacher Lecture 1988. Reprinted by Resurgence, Ford House, Bideford, Devon.

MacCormick, N. (1978) Legal Reasoning and Legal Theory. Oxford: Clarendon Press.

Mancuso, T. Stewart, A. Kneale G. 'Radiation Exposures of Hanford Workers Dying from Cancer and Other Causes' Health Physics (1977) 33(5) 369-384.

Marino, A.A. Marino, L.E. (1995) 'The Scientific Basis of Causality in Toxic Tort Cases' Dayton Law Review 21 1-62.

Markesinis B.S. Deakin S.F. (1994 3rd ed.) Tort Law. Oxford: Clarendon Press.

May, J. (1989) Three Greenpeace Book of the Nuclear Age: The Hidden History, The Human Cost. London: Victor Gollancz Ltd.

McElveen J.C. Eddy P.S. 'Cancer and Toxic Substances: The Problem of Causation and the Use of Epidemiology' Cleveland State Law Review (1994) Vol. 33: 1-29.

McEwan, J. 'Hypothetical or actual fact? Common sense and probability as evidence in U.S. v Shonubi'. Expert Evidence Vol. 4. No. 4. July 1996.

McKinney, P.A. Alexander, F.E. Cartwright, R.A. Parker, L. 'Parental occupations of children with leukaemia in west Cumbria, north Humberside, and Gateshead'. British Medical Journal (1991) 302:681-687.

McLaughlin, J.R. King, W.D. Anderson, T.W. Clark, A.E. Ashmore, J.P. 'Paternal Radiation exposure and leukaemia in offspring: the Ontario case-control study'. British Medical Journal (1993) 307.

McLean I. 'The Judicial Balancing Act'. Expert Evidence Vol 4 No. 1 September 1995.

Merton, R. (1973) The Sociology of Science. Chicago: University of Chicago Press.

Michaelis, J. Keller, B. Haaf, G. Kaatsch, P. 'Incidence of childhood malignancies in the vicinity of West German nuclear power plants'. Cancer Causes and Control (1992) 3:255.

Michon, J. Pakes, F.J. (1995) 'Judical decision-making: a theoretical perspective' in Bull, R. and Carson, D. (eds) Handbook of Psychology in Legal Contexts. Chichester: J. Riley. pp.509-25.

Michon, J. (1996) What did Shonubi swallow? Expert Evidence Vol. 4 No. 4. July 1996.

Michon, J.A. 'The time has come to put this debate aside and move on to other matters' The International Journal of Evidence and Proof (1997) 1 Special Issue.

Midgley, M. (1992) 'Can Science save its Soul' New Scientist 1 Aug. No. 1832.

Milham, S. (Jnr). 'Childhood leukaemia mortality before 1970 among populations near two United States nuclear installations'. Lancet (1989) i:1443.

Miller, C.E. 'Radiological Risk and Civil Liability: A Review of Recent Developments in the United Kingdom' (1997) in Robert Baldwin, Law and Uncertainty: Risks and Legal Process. Kluwer Law International.

Mills, J.L. (1993) 'Spermicides and Birth Defects' in K.R. Foster, D.E. Bernstein, Peter W. Huber (eds) Phantom Risk: Scientific Inference and the Law. Cambridge, Massachusetts: The MIT Press.

Mole, R.H. 'Leukaemia and lymphoma among young people near Sellafield' British Medical Journal (1990) 300:878.

Mountfield, P.R. (1991) World Nuclear Power. London: Routledge.

Mulkay, M. (1979) Science and the Sociology of Knowledge. London: George Allen and Unwin.

Mulkay, M. (1991) Sociology of Science: A Sociological Pilgrimage. Milton Keynes, Open University Press. Paper entitled: Norms and Ideology (1976).

Murphy P. (1992) A Practical Approach to Evidence. London. Blackstone Press Ltd.

Narod, S.A. Stiller, C. Lenoir, G.M. 'An estimate of the heritable fraction of childhood cancer' Br. J. Cancer (1991) 63:993-9.

National Academy of Sciences (1977) Vol. 1, 5.

Newton-Smith, W.H. (1981) The Rationality of Science. London: Routledge and Kegan Paul.

Nilstun, T. Inskip H.M. 'Epidemiology in the courtroom: analysis of ethical conflict'. The Science of the Total Environment (1996) 184: 123-127.

Nomura, T. 'Parental exposure to X-rays and chemicals induces heritable tumours and anomalies in mice'. Nature (1982) 296:575-577.

Nomura, T. 'Quantitative Studies on Metagenesis Teratogenesis and Carcinogenesis in Mice' (1984) 27-34 JEMS, Mishima.

Nomura T. (1986) 'Further studies on x-rays and chemically induced germ-line alternations' causing tumours and malformations in mice' in C. Ramel. B. Lambert. J. Magnusson edn.Genetic Toxicology of Environment Chemicals Part B: Genetic Effects and Applied Mutagenesis: New York: Alan R. Liss.

Nomura, I. 'Of mice and men'? Nature (1990) 345:671.

NRPB (1977) Recommendations of the International Commission on Radiological Protection. (ICRP Publication 26) Statement by the NRPB on their acceptability for application in the UK. London: HMSO.

NRPB (1978) The Application of ICRP Recommendations: Advice to the expert group reviewing the White Paper (Cmnd. 884) The Control of Radioactive Waste.

NRPB (1982) Cost Benefit Analysis in the Optimisation of Protection of Radiation Workers. London: HMSO.

NRPB (1983) An Assessment of the Radiological Impact of the Windscale Fire October 1957 (M.J. Crick and G.S. Linsley) NRPB R 135 Addendum.

NRPB R171 (1984) Stather, J.R. Wrixon, A.D. Simmonds, J.R. "The risks of leukaemias and other cancers in Seascale from radiation exposure". London: HMSO.

NRPB R171 (Addendum) 1986 London: HMSO.

Nyhart J.D. Carrow M.M. (1983) Law and Science in Collaboration. Massachusetts. Lexington Books.

Oddie, C. (His Honour Judge), Chairman, (1991) Science and the Administration of Justice. London: Justice.

Off. J. Eur. Communities. 23 No. L246 (17th September 1980).

O'Riordan, T. (1985) 'Radioactive Waste Disposal: Public Attitudes and Political Consequences' Memorandum submitted to the House of Commons. First Report from the Environment Committee Radioactive Waste 1986 2:529 London: HMSO.

Pakes, F.J. 'Shonubi: On the value of 'missing' evidence'. Expert Evidence Vol. 4 No. 4. July 1996.

Palmer, M.K. (1984) 'Death from cancer at ages under 25 in 5 coastal parishes compared with the rest of Millom Rural District, 1963-80. Submission to Black Advisory Group (SDB 588/H28).

Parascandola, M. 'Cancer, Individuals and Toxic Torts' Journal of Applied Philosophy (1997) Vol 14, No.2:147-157.

Parker, L. Craft, A.W. Smith, J. Dickinson, H. Wakeford, R. Binks, K. McElvenney, D. Scott, L. Slovak, A. 'Geographical distribution of preconceptional radiation doses to fathers employed at the Sellafield nuclear installation, west Cumbria'. British Medical Journal (1993) 307:966-971.

Peczenik, A (1989) On Law and Reason. Dordrecht: Kluwer Academic Publishers.

Perelman, C. (1976) Logique Juridique: Dalloz: Paris.

Perelman, C. Olbrechts-Tyteca, L. (1968) The New Rhetoric: University of Notre Dame Press.

Perry, T. (1976) Moral Reasoning and Truth. Oxford: Clarendon Press.

Popper, K.K. (1968) The Logic of Scientific Discovery. London: Hutchinson.

Posner, R. (1990) The Problems of Jurisprudence. Cambridge, Mass: Harvard University Press.

Pugh, C. Day, D. (1992) Toxic Torts. London: Cameron May.

Pugh, C. Day, M. (1995) Pollution and Personal Injury: Toxic Torts II. London. Cameron May.

Radcliffe, Lord (1968) Not in Feather Beds. London: Hamish Hamilton.

Redd, W.H. Jacobson, P.B. (1988) 'Emotions and Cancer: New Perspectives on an Old Question' Cancer 62: 1871-1879.

Redmayne, M. 'Presenting Probabilities in Court: The DNA Experience'The International Journal of Evidence and Proof (1997) Vol.1 No.4.

Reece, H. 'Losses of Chances in the Law' (1996) 59 MLR 188.

Reich, M.R. (1991) Toxic Politics: Responding to Chemical Disasters. New York: Cornell University Press.

Reynolds, M.P. King, P.S. (1992) The Expert Witness and his Evidence. Oxford. Blackwell Scientific Publications.

Robertson, B. Vignaux, G.A.(1995) Interpreting Evidence: Evaluating Forensic Science in the Courtroom. Chichester: John Wiley & Sons.

Roman, E. Watson, A. Beral, V. Buckle, S. Bull, D. Baker, K. Ryder, H. Barton, C. 'Case-control study of leukaemia and non-Hodgkin's lymphoma among children aged 0-4 years living in west Berkshire and north Hampshire health districts'. British Medical Journal (1993) 306:615-21.

Rosenberg, D. 'The Causal Connection in Mass Exposure Cases: A "Public Law" Vision of the Tort System' (1984) 97 Harvard Law Review 849.

Rowe, W.D. (1992) "Risk Analysis: A Tool for Policy Decisions" ed. by M. Waterstone in Risk and Society: The Interaction of Science, Technology and Public Policy. London: Kluwer Academic Publishers.

Royal Commission on Civil Liability and Compensation for Personal Injury (1978) (Pearson Report Vol. 1) Cmnd. 7054.

Royal Commission on Environmental Pollution (RCEP) 'Flowers Report' (1976) Nuclear Power and the Environment, Sixth Report, Cmnd 6618, London: HMSO.

Royal Society (1998) Management of Separated Plutonium. London.

Saks M.J. (1993) Improving APA Science Transaction Amicos Briefs. Law and Human Behaviour.

Sales, B.D. Simon, L. 'Institutional Constraints on the Ethics of Expert Testimony' Ethics and Behaviour (1993) 3 (3 & 4).

Salmon, W.C. (1984) Scientific Explanation and the Causal Structure of the World. Princeton: Princeton University Press.

Savan, B. (1988) 'Getting into Print' in The Myth of Objectivity in Scientific Research. Montreal. CBC Enterprises 109-27.

Schuck, P.H. (1987) Agent Orgrane on Trial: Mass Toxic Disasters in the Courts. Cambridge, Massachusetts: Harvard University Press.

Schum, D.A. (1994) Evidential Foundations of Probabilistic Reasoning. Chichester: John Wiley & Sons.

Schwartzer W. W. (1994) Reference Manual on Scientific Evidence: Introduction. Federal Judicial Center, Washington: US Printing Office.

Schweers Cook, K. Levi, M. (1990) The Limits of Rationality. London: University of Chicago Press.

Scott, W. 'Causation in Medico-Legal Practice: A Doctor's Approach to the "Lost Opportunity" Cases' (1992) 55 MLR 521.

Shapin, S. Schaffer, S. (1984) Leviathan and the Airpump: Hobbes, Boyle, and the Experimental Life. Princeton: Princeton University Press.

Shrimpton, P.C. Wall, B.F. Jones, D.G. Fisher, E.S. Hillier, M.C. Kendall, G.M. Harrison R. 'Doses to patients from routine diagnostic X-ray examinations in England'. British Journal of Radiology (1986) 59 749-758.

Shu, X.O. Gao, Y.T. Brinton, L.A. Linet, M.S. Tu, J.T. Zheng, W. Fraumeni, J.F. 'A population based case control study of childhood leukaemia in Shanghai. Cancer (1988) 62:635.

Shulman, S. 'Cancer around nuclear plant'. Nature (1990) 347:604-5.

Slovic, P. Feschoff, B. Lichtenstein, S. (1980) 'Understanding Perceived Risk' in R. Schwing and W. Albers eds. Societal Risk Assessment: How Safe is Safe? New York. Plenium Press.

Smith, P.G. 'Comments on the case-control study of Gardner et al of leukaemia and lymphoma among young people in west Cumbria'. Hygiene and Communicable Disease (1990) 65:1-6.

Smith, P.G. Douglas, A.J. 'Mortality of workers at the Sellafield plant of BNFL. British Medical Journal (1986) 293 845-854.

Smith, P.G. and Doll, R. 'Mortality from cancer and causes among British radiologists' British Journal of Radiology (1981) 54 194-198.

Smith, R. (1989) Forensic Pathology, Scientific Expertise and the Criminal Law in Smith, R. Wynne, B. (edn.) Expert Evidence: Interpreting Science in the Law, London: Routledge.

Smith, R. Wynne, B. (1989) Expert Evidence: Interpreting Science in the Law. London. Routledge.

Stapleton, J. 'The Gist of Negligence - Part 1: Minimum Actionable Damage' (1988) 104 LQR 213.

Stapleton, J. 'The Gist of Negligence - Part II The Relationship between "Damage" and Causation' (1988) 104 LQR 389.

Stein, A. 'Judicial Fact-finding and the Bayesian Method: The Case for Deeper Scepticism about their Combination'. The International Journal of Evidence and Proof (1996)1 Issue 1.

Stein, A. 'Bayesioskepticism justified' The International Journal of Evidence and Proof (1997) 1 Special Issue.

Sternglass, E.J. (1981) Secret Fallout. New York: McGraw Hill.

Stewart, A.M. Webb, J.W. Giles, B.D. and Hewitt, D. (1956) Malignant disease in childhood and diagnosis irradiation in utero. Lancet ii 447-448.

Stewart A. 'Survey of Childhood Malignancies' British Medical Journal (1958) 1 1495.

Stewart, A.M. Kneale G.W.' Radiation dose effects in relation to obstetric X-rays and childhood cancers'. Lancet (1970) i:1185.

Sumner, D (1987) Radiation Risks: An Evaluation. Glasgow: The Tarragon Press.

Sunstein, C.R. (1996) Legal Reasoning and Political Conflict. New York: Oxford University Press.

Sutcliffe, C. (1987) The Dangers of Low Level Radiation. Aldershot: Avebury.

Tamanaha, B.Z. (1997) Realistic Socio-legal Theory: Pragmatism and a Social Theory of Law. Oxford: Clarendon Press.

Tapper C. (1995) Cross and Tapper on Evidence. London. Butterworths.

Taylor, Lauriston S. (1979) Organization for Radiation Protection. Washington: US Department of Energy.

Taylor, P.J.(1981) The Windscale Fire, October 1957: Report for the Union of Concerned Scientists. Cambridge, Mass.

The Royal Statistical Society News. '1997 Medal Awards' September 1997.

Tiplady, P. (1981; 1983) 'Leukaemia and other Cancers in Cumbria: Submissions to Black Advisory Group Appendix A SDB 254/16.

Todhuner, I. [1865] 1965 A History of the Mathematical Theory of Probability: From the time of Pascal to that of Laplace: New York Chelsea Publishing.

Tolley H.D. et al. 'A Further Update of the Analysis of Mortality of Workers in a Nuclear Facility' Radiation Research (1983) 95 211-213.

Transcript of Trial: Days 1-90: From the Notes of J.L. Harpham Ltd. Official Shorthand Writers, 55 Queen Street, Sheffield S1 2DX.

Twining, W. (1984) Taking Facts Seriously. Journal of Legal Education No. 34: 22-42.

Urquhart, J. Palmer, M. Cutler, J. 'Cancer in Cumbria: the Windscale connection'. Lancet (1984) i:217-218.

Urquhart, J.D. Black, R.J. Muirhead, M.J. Sharp, L. Maxwell, M. Eden, O.B. Jones, D.A. 'Case-control study of leukaemia and non-hodgkin's lymphoma in children in Caithness near the Dounreay nuclear installations'. British Medical Journal (1991) 302:687-92.

US Occupational and Health Administration 21 July 1978 ' Access to employee and medical records' Proposed Rule - Federal Register 43:31371.

Viel, J.F. Richardson, S.T. 'Childhood leukaemia round La Hague nuclear waste reprocessing plant'. British Medical Journal (1990) 300:580.

Vines, K.N. (1969) 'The Judicial Role in the American States' in J.B. Grossman and J. Tanehaus (edn) Frontiers of Judicial Research. New York: John Wiley.

Wasserstrom, R. (1961) The Judicial Decision. Oxford: Oxford University Press.

Webb, G.A.M. Hill, M.D. O'Riordan, M. Smith, H. Shaw, K. "Radioactive Effluents and Solid Wastes: A Summary of NRPB Work on Standards, Assessments and Research. House of Commons Select Committee, The Environment Committee, 15th May 1985.

Weinberg, R. (1998) One Renegade Cell: The Quest for the Origins of Cancer. London: Weidenfeld & Nicolson.

Wigmore, J.H. (1937) The Science of Judicial Proof: As Given by Logic, Psychology and General Experience and Illustrated in Judicial Trials. 3rd edn. Boston: Little Brown & Co.

Wigmore J.H. (1940) On Evidence: A Treatise on the Anglo-American System in Trials at Common Law (1983) Boston: Little Brown & Co.

Wold, J.T. 'Political Orientations, Social Backgrounds , and Role Perceptions of State Supreme Court Judges' Western Political Quarterly (1974) 27:237-48.

Woolf, The Right Honourable the Lord (1995) Access to Justice: Interim Report to the Lord Chancellor on the Civil Justice System in England and Wales. London. Lord Chancellor's Department.

Woolf, The Right Honourable the Lord MR (1996) Access to Justice: Final Report to the Lord Chancellor on the Civil Justice System in England and Wales. London: The Stationary Office.

Woolgar, S. (1988) Science - the very idea. London and New York: Tavistock Publications.

Wroblewski, J. (1992) 'The Judicial Application of Law' ed. Z. Bankowski and N. MacCormick. Dordrect: Kluwer Academic Publishers.

Wynne, B. Establishing the Rules of Laws: Constructing Expert Authority in Smith, R. & Wynne, B. (1989) Expert Evidence: Interpreting Science in the Law. London: Routledge.

Yoshimoto, Y. Neel, J.V. Schull W.J. Kato, H. Soda, M. Eto, R. Mabuchi, K. 'The frequency of malignant tumours during the first two decades of life in the offspring of atomic bomb survivors. Am. J. Hum. Genet. (1990) 46:1041-1052.

Yoshimoto, Y. Mabuchi, K. 'Mortality and cancer risk among offspring (F1) of atomic bomb survivors' J. Radiat. Res. (1991) suppl:294-300.

Ziman, J. (1968) Public Knowledge: An Essay concerning the Social Dimensions of Science. Cambridge: Cambridge University Press.

APPENDIX ONE

THE

ACADEMY OF EXPERTS

MEMBERSHIP

QUESTIONNAIRE

the
UNIVERSITY
of
GREENWICH

the UNIVERSITY of GREENWICH

26th May 1997

Dear Member,

The purpose of this questionnaire is to gain some understanding of your background as an expert witness. In total there are thirty four questions centred around the experience of scientific, medical and technical experts as well as a final section that evaluates membership opinion of judicial decision making.

The questionnaire has been designed by a Senior Lecturer at the University of Greenwich, who is also a researcher at the London School of Economics and Political Science in her final year of a doctoral thesis in law under the supervision of Professor Carol Harlow. In addition to providing empirical data for the thesis however, the questionnaire will also, on completion of the doctorate form the basis of membership information for The Academy of Experts who will have access to the findings for their own purposes. Further information on the project may be obtained from your Chairman, Mr. M. Cohen.

In order to ensure as higher response rate as possible, it would be appreciated if you could complete the profile specification and questionnaire by ticking the appropriate answers and returning the booklet in the prepaid envelope as soon as possible (ideally within the next six weeks).

All the information provided will of course be kept confidential, and in order to safeguard anonymity, names and occupational details have not been included in the questionnaire.

I look forward to receiving your response and would like to take this opportunity of thanking you in advance for your assistance.

Yours sincerely,

Rebecca Harrison.

Avery Hill Campus
Southwood Site
Avery Hill Road. Eltham
London SE9 2UG
Telephone: +44 (0)181-331 8000

PROFILE SPECIFICATION

(Please answer the following questions before completing the questionnaire)

QUALIFICATIONS:

_____
_____
_____

PROFESSIONAL TITLE:

_____
_____
_____

GENDER: a) Male ( )
b) Female ( )

ETHNICITY:

a) European White ( )
b) European Black ( )
c) European Other ( )
d) Asian Chinese ( )
e) South Asian ( )
f) Commonwealth White ( )
g) Commonwealth Black ( )
h) American Black ( )
i) American White ( )
j) Middle Eastern ( )
k) Other ( )

AGE:

a) Under 35 years ( )
b) 35 to 55 years ( )
c) 55 to 63 years ( )
d) Over 63 years ( )

Is English your first language? Yes ( )
No ( )

If not, are you fluent in English?
Yes ( )
No ( )

ROLE OF EXPERT WITNESS

(Please answer all questions by ticking the most appropriate box)

1) Has a solicitor ever prepared you in advance for a case with regard to the following?

	a). Yes, completely	b). Yes, partly	c). Not at all
- Rules of evidence	( )	( )	( )
- Oral testimony	( )	( )	( )
- Written reports	( )	( )	( )
- Cross examination	( )	( )	( )
- Media attention	( )	( )	( )
- Adjournment/delay of case	( )	( )	( )
- Legal terminology/jargon	( )	( )	( )
- Meeting of experts	( )	( )	( )

---

2) Have you ever been sent on a training course to prepare you for the role of expert witness?

a). Yes ( )
b). No ( )

---

3) Would you describe your area of research as:

a). New/novel ( )
b). Established ( )
c). Controversial ( )

---

4) Have you, in your role as an expert witness, ever been subjected to (what you considered to be) witness ridicule?

a). Often ( )
b). On occasion ( )
c). Never ( )

---

5) Have you ever experienced a conflict of interest during a trial?

a). Often ( )
b). On Occasion ( )
c). Never ( )

---

6) Have you at any point in your experience as an expert witness felt your professional competence was being challenged?

a). Often ( )
b). On occasion ( )
c). Never ( )

EXPERIENCE OF BEING AN EXPERT WITNESS

7) In your experience as an expert witness does the solicitor generally make you feel part of the team?

a). Yes, usually ( )
b). Sometimes ( )
c). Rarely ( )
d). Never ( )

---

8) In your experience as an expert witness do you think there are unrealistic deadlines imposed on you?

a). Yes ( )
b). No ( )

---

9) In general do you think there are too many meetings with:

Solicitors	a). Yes	( )	b). On occasion	( )	c). No	( )
Other Experts	b). Yes	( )	b). On occasion	( )	c). No	( )

---

10) Has your scientific/medical/technical research ever been misrepresented by Counsel?

a). Often ( )
b). On occasion ( )
c). Never ( )

---

11) Have you ever been asked to give evidence on an area which was beyond your specialism?

a). Yes ( )
b). No ( )

---

12) Have you ever incurred any personal expense as a consequence of trial alteration/adjournment/delay?

a). Yes ( )
b). No ( )

---

13) Have you ever incurred any inconvenience as a consequence of trial alteration/adjournment/delay?

a). Yes ( )
b). No ( )

---

14) In your experience, do you find the system of 'booking' expert witness time in advance to be an effective and reliable indicator of the time you actually spend in court?

a). Yes ( )
b). No ( )

---

15) Has the impartiality of your evidence ever been challenged under cross-examination?

a). Yes ( )
b). No ( )

---

16) Has your evidence ever broken down under cross-examination?

a). Often ( )
b). On Occasion ( )
c). Never

17) Would you describe your experience as an expert witness as:

a). Positive, on the whole ( )
b). Mixed ( )
c). Negative, on the whole ( )

---

18) Has opposing Counsel ever suggested that your research is based on any of the following?

- Fraud a). Yes ( ) b). No ( )
- Misrepresentation of data a). Yes ( ) b). No ( )
- Poor methodology a). Yes ( ) b). No ( )
- Misinterpretation of data a). Yes ( ) b). No ( )
- Junk science a). Yes ( ) b). No ( )
- Pseudo science a). Yes ( ) b). No ( )
- Deception a). Yes ( ) b). No ( )

---

19) In your opinion, has your evidence ever been unnecessary or inappropriate to a case?

a). Often ( )
b). On occasion ( )
c). Never ( )

---

20) Have you ever given expert evidence via live video links or satellite?

a). Often ( )
b). On Occasion ( )
c). Never ( )

---

21) In your experience as an expert witness, have you ever suffered from what you perceived to be age discrimination in respect of being considered either too young or too old?

a). Often ( )
b). On Occasion ( )
c). Never ( )

---

22) How many times have you given written evidence as an expert witness?

a). 1-5 times ( )
b). 5-10 times ( )
c). Over 10 times ( )

---

23) How many times have you given oral evidence as an expert witness?

a). 1-5 times ( )
b). 5-10 times ( )
c). Over 10 times ( )

---

24) Over how many years have you been an expert witness?

a). 1-5 years ( )
b). 5-10 years ( )
c). Over 10 years ( )

EXPERIENCE OF JUDICIARY

25) In general (in your experience as an expert witness) have you found the judiciary to be:

	a). Often	b). On occasion	c). Never
- Helpful	( )	( )	( )
- Patient	( )	( )	( )
- Balanced	( )	( )	( )
- Disrespectful	( )	( )	( )
- Courteous	( )	( )	( )
- Intimidating	( )	( )	( )
- Rude	( )	( )	( )

---

26) Has a judge ever suggested that you have adopted a partisan approach when presenting evidence?

a). Often ( )
b). On Occasion ( )
c). Never ( )

---

27) Has a judge (in your opinion) ever misunderstood the point of your evidence?

a). Often ( )
b). On occasion ( )
c). Never ( )

---

28) As scientific, medical and technical expert evidence often relies on statistically based methodology, do you consider that your evidence would be more accessible if judges were given some form of statistical training?

a). Yes ( )
b). No ( )

---

29) In your experience as an expert witness, do you think a judge (when basing his decision on the balance of probabilities) should adopt applied probabilistic reasoning (statistically based formulation) to his evaluation and judgment of the case?

a). Yes, where appropriate ( )
b). No, not necessary ( )

---

30) In your experience have you found that judges rely more on presentation of evidence rather than content?

a). Yes ( )
b). Sometimes ( )
c). Never ( )

---

31) As a expert witness, would you support proposals for a judicially appointed scientific advisor to sit with the judge in order to facilitate better judicial understanding of the evidence?

a). Yes ( )
b). No ( )

---

32) Do you agree with Lord Woolf that court appointed expert witnesses would increase the independence of experts and reduce the potential for partisanship?

a). Yes ( )
b). No, not necessarily ( )

33) In your opinion, and on balance, do you think that the engagement of a court appointed expert witness may help to reduce any of the-following:

- unnecessary polarisation of issues	a). Yes ( )	b). No ( )
- unnecessary expense	a). Yes ( )	b). No ( )
- unnecessary delay	a). Yes ( )	b). No ( )
- unnecessary complexity	a). Yes ( )	b). No ( )

---

34) Based on your experience, do you consider that a High Court Judge sitting alone can gain sufficient comprehension and understanding of scientific evidence to be able to resolve complex cases based on the testimony of opposing expert witnesses?

a). Yes, usually ( )
b). No, never ( )
c). Possibly ( )

Based on your experience as an expert witness, please use the space provided for any additional comments you you would like to make:

Thank you for taking the time to complete this questionnaire.

Expert Witness Questionnaire

RESULTS

160 sent out
99 returned = 62% response rate
92 of the 99 correctly completed = 93%
7 incorrectly completed (7% not incorporated into final figures)
43 out of the 92 responses (47%) chose to make additional comments on the back page of the questionnaire.

Gender

Male	78
Female	14

Ethnicity

a. European white	91
b. European white	0
c. European other	0
d. Asian Chinese	0
e. South Asian	1
f. Commonwealth white	0
g. Commonwealth black	0
h. American black	0
i. Americna white	0
j. Middle Eastern	0
k Other	0

Age

a. Under 35 years	0
b. 35 to 55 years	55
c. 55 to 63 years	22
d. over 63 years	15

Is English you first language?

yes	91
no	1

Professional Title of Experts

3 x Chartered Civil and Structural Engineers.
7 x Chartered Civil Engineers.
1 x Computer and Automation Consultant.
2 x Consultant Clinical Neuro Psychologists.
5 x Consultants.
1 x Consultant Anaesthetist.
2 x Consultants Accident and Emergency Medicine.
1 x Consultant Chartered Engineer and Surveyor.
1 x Consultant Child Neurologist.
1 x Consultant Ear Nose and Throat Surgeon.
1 x Consultant in Disability Therapy.
6 x Consultant Engineers.
1 x Consultant Geo-technical Engineer.
1 x Consultant Industrial Microbiologist.
4 x Consultant Mechanical Engineers.
1 x Consultant Neurologist.
1 x Consultant Occupational and Aviation Medicine.
1 x Consultant Occupational Physician and Toxicologist.
1 x Consultant Osteopath.
2 x Consultant Orthopaedic Surgeons and Traumatologists.
4 x Consultant Orthopaedic Surgeons.
1 x Consultant Otolaryngologist.
2 x Consultant Paediatrician.
1 x Consultant Pharmacologist.
1 x Consultant Plastic Surgeon.
1 x Consultant Plastic and Hand Surgeon.
1 x Consultant Surgeon.
1 x Consultant Surgeon and Professor of Colo-Rectol Surgery.
2 x Consultant Trichologists.
1 x Director of Operations and Nursing.
12 x Doctors.
1 x Electrical Scientist.
1 x European Engineer.
1 x Forensic Consultant Engineer.
1 x Independent Medical Practitioner/Forensic Physician.
1 x Independent Consultant in Occupational Health and Safety Management.
2 x Nursing Consultants.
3 x Occupational Therapists.
1 x Orthopaedic Consultant.
1 x Paediatric Nursing Consultant.
1 x Physiotherapist.
1 x Professor and Head of the Univ. Dept. of Surgery (Univ. of Birmingham).
1 x Professor of Medicine.
1 x Professor of Reconstructive Surgery.
2 x Registered General Nurses.
1 x Senior Contracts Manager.
1 x Senior Scientist.
2 x Specialist Speech and Language Therapist.

1. Has a solicitor prepared you in advance for the following?

	Yes	Partly	No
Rules of Ev.	16	29	47
Oral Test.	16	31	45
Written Rep.	23	39	30
Cross Exam.	4	26	62
Media Att.	10	10	72
Adj/Delay	12	26	54
Legal Term	15	26	51
Meet of Expert.	20	31	41

2. Have you ever been given training as an expert witness?

yes	53
no	39

3. Would you describe your area of research as:

a. new/novel	10
b. established	72
c. controversial	10

4. Have you ever been subjected to witness ridicule?

often	1
on occasion	23
never	68

5. Have you ever experience a conflict of interests in a trial?

often	1
on occasion	14
never	77

6. Has your competency ever been challenged?

often	4
on occasion	43
never	45

7.In your experience as an expert witness does the solicitor generally make you feel part of the team?

a. yes, usually	56
b. sometimes	26
c. rarely	9
d. never	1

8. Are there unrealistic deadlines imposed on you?

yes	48
no	44

9. Are there too many meetings?

yes	1
on occasion	12
no	79

10. Has you scientific/medical/technical research ever been misrepresented by Counsel?

a. often	2
b. on occasion	23
c. never	67

11. Have you ever been asked to give evidence which was beyond your specialism?

yes	51
no	41

12. Have you ever incurred personal expenses as a consequence of trial alteration/adjournment or delay?

yes	54
no	38

13. Have you ever incurred any inconvenience as a consequence of trial/adjournment or delay?

yes	76
no	16

14. Is booking expert witness time in advance an effective and reliable indicator of the time spent in court?

yes	15
no	77

15. Has the impartiality of your evidence every been challenged under cross examination?

yes	18
no	74

16. Has you evidence every been broken down under cross examination?

often	0
on occasion	10
never	82

17. Would you describe your experience as an expert witness as:

a. positive, on the whole	66
b. mixed	17
c. negative, on the whole	9

18. Has opposing counsel every suggested that your research was based on any of the following:

	Yes	No
Fraud	0	92
Misrep.	5	87
Poor Method.	10	82
Misinterp.	16	76
Junk Sc.	0	92
Pseudo Sc.	4	88
Deception	0	92

19. In you opinion has you evidence ever been unnecessary or inappropriate to a case?

often	0
on occasion	31
never	61

20. Have you every given expert evidence via life video links or satellite?

often	1
on occasion	3
never	88

21. Have you ever suffered from age discrimination?

often	3
on occasion	7
never	82

22. How many times have you given written evidence?

1-5	4
5-10	10
over 10 times	78

23. How many times have you given oral evidence?

1-5	29
5-10	16
over 10 times	4

24. Over how many years have you been an expert witness?

1-5	20
5-10	27
over 10 years	45

25. In general (in your experience as an expert witness) have you found the judiciary to be:

	a. often	b. on occasion	c. never
Helpful	65	24	3
Patient	66	25	1
Balanced	69	22	1
Disrespectful	4	16	72
Courteous	75	15	2
Intimidating	4	37	51
Rude	1	20	71

26. Has a judge every suggested that you have adopted a partisan approach when presenting evidence?

a. often	0
b. on occasion	4
c. never	88

27. Has a judge (in you opinion) ever misunderstood the point of your evidence?

a. often	2
b. on occasion	42
c. never	48

28. Should judges have some form of statistical training?

yes	34
no	58

29. Should judges adopt applied probabilistic reasoning to his evaluation and judgement of the evidence in a case?

yes	48
no	44

30. In your experience have you found that judges rely more on presentation of evidence rather than content?

a. yes	9
b. sometimes	54
c. never	29

31. Should there be a judicially appointed scientific advisor to sit with a judge?

yes	54
no	38

32. Do you agree that court appointed experts would reduce the likelihood of partisanship?

yes	37
no	55

33. In your opinion, and on balance, do you think that the engagement of a court appointed expert witness may help to reduce any of the following:

	yes	no
unnecessary polarisation of issues	55	37
unnecessary expense	52	40
unnecessary delay	51	41
unnecessary complexity	47	45

34. Based on your experience, do you consider that a High Court Judge sitting alone can again sufficient comprehension and understanding of scientific evidence to be able to resolve complex cases based on the testimony of opposing expert witnesses?

a. yes, usually	51
b. no, never	2
c. possibly	39

ADDITIONAL COMMENTS BY EXPERT WITNESSES

Solicitors

"It is unreasonable for solicitors to ask for ones availability to attend court and then to ignore it by issuing a subpoena. This is high handed and unfair and an abuse of the subpoena system".

"My main gripe is that solicitors (the vast majority) do not keep me in the picture with what is going on in the case and leave all requests to the last minute".

"Unrealistic deadlines are invariably the fault of the solicitor who has been careless with the case".

"More use could be made of discussion with the expert from the other side - with the notable exception of 'experts' who are known to be partisan - biased - not many, but they do exist".

"Those who instruct experts should recognise experts absolute impartiality
They should also be more efficient so that last minute settlement or adjournment becomes unnecessary"

"I feel it would save a lot of time and effort (not to mention stress) if agreement could be reached in advance over which aspects of an expert's testimony were accepted and which were in contention. This would enable the experts to direct their time and efforts accordingly. May be a court appointed expert could adjudicate on such matter.
I find it frustrating that well considered reports are sometimes not reviewed in sufficient depth prior to the start of proceedings".

"Main problem is solicitors poor communication skills and tendency to work at arms length by means of hastily dictated and sometimes convoluted letters. Few appreciate the fact that their work would be greatly eased if they brought experts in as quasi team members".

"I have had solicitors asking me to alter my reports to present their client in a more favourable light - asking to prepare a biased report".

"1.Statements of Claims/Pleadings should not be solely drafted by Solicitor/Counsel.
2. Solicitors should appoint experts as soon as issues are clear.
3. Solicitors should advise experts of likely court requirements of experts ie: when they will be required and not leave it vague for the experts to assume.
4. Solicitors should make more effort to pay experts fees on agreed timescales".

"Lack of payment for cancellation of cases (through settlement of case) [is] often a problem".

"Patients cannot be fitted in at short notice for major surgery. NHS annual leave is needed to attend court and cancellation of operating lists and clinics [are] not recognised by [the] legal profession; loss of private earnings (as on annual NHS leave) not recompensed".

"Mostly a report is all that is required from medical specialists and one does not know in most cases what the solicitor does with the report. It is sometimes obvious, because I am asked to refer to other's reports, where mine is the one the solicitor has chosen to present to counsel. Also, universally I have been asked about availability in the next 6-9 months for 3 cases - but often one hears nothing more after sending the report and often one has to 'chase' the solicitor to pay for the report".

"Most instructing solicitors, in my experience, have 'bland' perceptions of the role of certain professional groups. Such perceptions are simplistic and unsophisticated - ie: a psychologist - and beyond this there is little appreciation of speciality
eg: Educational Psychologist, Clinical Psychologist etc.".

"The most negative aspect of being an expert witness is trying to receive payment - despite having an agreed timescale".

Lawyers

"What really would solve many disputes is, the parties getting together, if necessary with experts and not resorting to law. Many lawyers and insurers create the case, where none should exist in the first place".

"Most lawyers/insurers use the expert merely as a 'tool' and do not accord sufficient respect or acknowledgement of years of experience and special training. Many lawyers/insurers devalue the 'expert system' by favouring amenable or prejudiced experts who approach a case not openly but from a skewed 'frame of reference', this fans the adversarial flames and adds to costs and time.
Few lawyers have the courtesy to inform experts that a case has been settled and the file may be closed. Too many lawyers treat experts in an arrogant way".

"There is an immediate requirement for ongoing education for Barristers and QC's".

Judges

"As a technical expert I believe that I have a duty to make my reports 'user friendly' and that I must try to explain things so that lay people can understand. Padding and prolix discussion of non relevant issues are also to be avoided. A report usually gets read by severally highly paid people who need to understand it before a judge ever sees it and clarity saves time and money.

I think that judges may be influenced by a well written report where technical explanations are rendered comprehensible insofar that when he has to recap he will refer to the report that he finds easiest to read and is most likely to answer the question that is in his mind. The other thing that I would say to you is concerning court training. Expert witnesses do not get the opportunity to give evidence in court often enough to acquire proficiency by this alone. Training in procedure, cross examination and general bearing is essential".

"By and large my experience has been positive. My main comment would be the apparent lack of understanding of technical issues by the judge, which impeded clear resolution of often complex problems".

"Despite denial to the contrary, the pervasive and perverting influence of Freemasonry is all too evident when medical cases come to trial".

"Judges are highly analytical and reasoning and are quite capable of assimilating complex arguments and drawing appropriate conclusions".

"The knowledge of judges varies considerably; some know the subject very well and giving evidence is easy, others have no idea about the subject and therefore do not understand the complexities of detailed expert evidence. I doubt if they would take kindly to having an advisor sitting next to them.
The bias of the judge is still evident in some cases to the point that it is visible to all in the court. This does not help to create an image of the law being impartial.
A lot of time is wasted either for a court to become available or counsel having last minute conferences related to potential settlement of a claim".

Experts

"The expert should be skilled at presenting his arguments clearly and enable the Judge to understand the technical issues".

"Medical issues are less clear ie: more subjective than some technical specialities".

"There is a difference between a person that has expertise and a competent expert witness. The former can damage a case by their evidence because of arrogance, lack of objectivity and intolerance of others. None of these are necessarily partisan but, in some respects they are worse. As a relatively young expert, I consider this criticism to be particularly appropriate to the 'older end'. Perhaps they should accept that their intellectual powers are fading, and pass the stress and skill that typifies expert work to those at the peak of their intellect, rather then saturated with experience".

"In my experience an expert can only demand the respect deserved by making it clear to all concerned that the main concern is truth - whoever is paying?"

"In my opinion, it is essential for expert witnesses to be accredited members of the Academy of Experts to signify their standing as professional expert witnesses in their respective fields".

"There needs to be much more respect for expert time and availability for court attendance by listing officers and some judges".

"The biggest problem experts face is getting issues to the stage whereby a judge can understand them; some issues are technically too complex for the court and should have a technical assessor".

"Each [expert] operates to a quite different perspective/paradigm. A Court [appointed] official might well need to identify an appropriate expert but might well encounter considerable difficulties in finding/locating or even assembling a panel to give a balanced view in a given situation".

"Most expert witness reports do not get to trial as a good expert should advise his appointing solicitor if a case has little or no chance of success".

[When distinguishing between expert evidence on liability and quantum] "In my experience [liability] is more controversial than [quantum] where my opinion has usually been accepted".

Woolf Proposals

"I thoroughly support the Woolf proposals but a professional register of accredited experts has to be developed against criteria set by the Lord Chancellor's Dept. and professional bodies"

"In my field the use of court appointed experts is likely to result in injustice. This is because many "experts" only ever practice in one area of the profession and have little appreciation of how the other side operates. The safeguard against opinions formulated by such experts is the appointment of experts who have experience which is broad enough yet 'expert' enough to see the wider picture. An expert with apparently appropriate credentials often has little appreciation of overall matters".

"Re: proposal for 'court appointed witnesses' - it would be interesting to learn from where a court (circuit area) would find the appropriate expert of a given expertise - and thence - the method proposed for selection and appointment".

"I think Lord Woolf's proposals show a naive faith in the impartiality of a medical expert without a legal training".

"I have seen the French system in operation. Here the case was 'tried' effectively by four experts judiciaries appointed by the Judge. I seldom saw the latter during a case which lasted 11 years in the Tribunal de Commerce de Paris. I have to say that I had no more confidence in these court appointed experts, in fact less, than I did in the judges before whom I testified in Canada. I though that the latter had a very good grasp of complex technical issues."

"I approve of the Woolf proposals to have court appointed experts as undoubtedly the present adversarial system does lure a small number of 'experts' to be less than impartial. The problem will be how to make available and vet/accredit a list of suitably impartial expert 'experts'".

Discrimination

"I feel at times discriminated against due to my sex".

System

"The system of not knowing if or not you will be going to court until the very last minute is infuriating - surely someone can invest a better system".

"In my field of personal injury litigation, there are some cases where it is necessary to delay settlement (final) for several years on account of the nature of the disability. But I believe that liability should be established as soon as possible to facilitate interim payments, based on professionally assessed needs.
I believe the majority of cases take unnecessarily long to settle and that the emotional distress caused to the plaintiff and relatives is disproportionate to the financial gains. If at all possible the adversarial element and the number of experts should be reduced".

Legal Aid

"Too many cases are not rejected by the Legal Aid Board because there is no case. Experts should be able to do a rapid adjudicating process to dismiss more cases getting aid".

"There should be a clear understanding by solicitors that the contract to prepare a report is with them, not with the Legal Aid Board. There should be no delay in agreeing payment on the grounds that the fee has to be agreed".

"I think there should be a more efficient system whereby the Legal Aid Board would be able to consider cases (particularly medical ones) in more detail, and exclude those that have no possible justification for proceeding further".

APPENDIX TWO

CIVIL EVIDENCE ACT 1972

(c. 30)

An Act to make, for civil proceedings in England and Wales, pro- 6100
vision as to the admissibility in evidence of statements of opinion and the reception of expert evidence; and to facilitate proof in such proceedings of any law other than that of England and Wales.

[12th June 1972]

Application of Part I of Civil Evidence Act 1968 to statements of opinion

1.—(1) Subject to the provisions of this section, Part I (hearsay evi- 6101
dence) of the Civil Evidence Act 1968, except section 5 (statements produced by computers) shall apply in relation to statements of opinion as it applies in relation to statements of fact, subject to the necessary modifications and in particular the modification that any reference to a fact stated in a statement shall be construed as a reference to a matter dealt with therein.

(2) Section 4 (admissibility of certain records) of the Civil Evidence Act 1968, as applied by subsection (1) above, shall not render admissible in any civil proceedings a statement of opinion contained in a record unless that statement would be admissible in those proceedings if made in the course of giving oral evidence by the person who originally supplied the information from which the record was compiled: but where a statement of opinion contained in a record deals with a matter on which the person who originally supplied the information from which the record was compiled is (or would if living be) qualified to give oral expert evidence, the said section 4, as applied by subsection (1) above, shall have effect in relation to that statement as if so much of subsection (1) of that section as requires personal knowledge on the part of that person were omitted.

Rules of court with respect to expert reports and oral expert evidence

2.—(1) If and so far as rules of court so provide, subsection (2) of sec- 6102
tion 2 of the Civil Evidence Act 1968 (which imposes restrictions on the giving of a statement in evidence by virtue of that section on behalf of a party who has called or intends to call as a witness the maker of the statement) shall not apply to statements (whether of fact or opinion) contained in expert reports.

(2) In so far as they relate to statements (whether of fact or opinion) contained in expert reports, rules of court made in pursuance of subsection (1) of section 8 of the Civil Evidence Act 1968 as to the procedure to be followed and the other conditions to be fulfilled before a statement can be given in evidence in civil proceedings by virtue of section 2 of that Act (admissibility of out-of-court statements) shall not be subject to the requirements of subsection (2) of the said section 8 (which specifies certain matters of procedure for which provision must ordinarily be made by rules of court made in pursuance of the said subsection (1)).

(3) Notwithstanding any enactment or rule of law by virtue of which documents prepared for the purpose of pending or contemplated civil proceedings or in connection with the obtaining or giving of legal advice are

in certain circumstances privileged from disclosure, provision may be made by rules of court—

(*a*) for enabling the court in any civil proceedings to direct, with respect to medical matters or matters of any other class which may be specified in the direction, that the parties or some of them shall each by such date as may be so specified (or such later date as may be permitted or agreed in accordance with the rules) disclose to the other or others in the form of one or more expert reports the expert evidence on matters of that class which he proposes to adduce as part of his case at the trial; and

(*b*) for prohibiting a party who fails to comply with a direction given in any such proceedings under rules of court made by virtue of paragraph (*a*) above from adducing in evidence by virtue of section 2 of the Civil Evidence Act 1968 (admissibility of out-of-court statements) except with the leave of the court, any statement (whether of fact or opinion) contained in any expert report whatsoever in so far as that statement deals with matters of any class specified in the direction.

(4) Provision may be made by rules of court as to the conditions subject to which oral expert evidence may be given in civil proceedings.

(5) Without prejudice to the generality of subsection (4) above, rules of court made in pursuance of that subsection may make provision for prohibiting a party who fails to comply with a direction given as mentioned in subsection (3)(*b*) above from adducing, except with the leave of the court, any oral expert evidence whatsoever with respect to matters of any class specified in the direction.

(6) Any rules of court made in pursuance of this section may make different provisions for different classes of cases, for expert reports dealing with matters of different classes, and for other different circumstances.

(7) References in this section to an expert report are references to a written report by a person dealing wholly or mainly with matters on which he is (or would if living be) qualified to give expert evidence.

(8) Nothing in the foregoing provisions of this section shall prejudice the generality of section 75 of the County Courts Act 1984, section 144 of the Magistrates' Courts Act 1980 or any other enactment conferring power to make rules of court; and nothing in section 75(2) of the County Courts Act 1984 or any other enactment restricting the matters with respect to which rules of court may be made shall prejudice the making of rules of court in pursuance of this section or the operation of any rules of court so made.

Amended by M.C.A. 1980, s.154 and Sched. 7, S.C.A. 1981, s.152(4) and Sched. 7 and by County Courts Act 1984, s.148(1) and Sched. 2.

Admissibility of expert opinion and certain expressions of non-expert opinion

6103 3.—(1) Subject to any rules of court made in pursuance of Part I of the Civil Evidence Act 1968 or this Act, where a person is called as a witness in any civil proceedings, his opinion on any relevant matter on which he is qualified to give expert evidence shall be admissible in evidence.

(2) It is hereby declared that where a person is called as a witness in any civil proceedings, a statement of opinion by him on any relevant matter on which he is not qualified to give expert evidence, if made as a way of conveying relevant facts personally perceived by him, is admissible as evidence of what he perceived.

(3) In this section "relevant matter" includes an issue in the proceedings in question.

Evidence of foreign law

4.—(1) It is hereby declared that in civil proceedings a person who is 6104
suitably qualified to do so on account of his knowledge or experience is competent to give expert evidence as to the law of any country or territory outside the United Kingdom, or of any part of the United Kingdom other than England and Wales, irrespective of whether he has acted or is entitled to act as a legal practitioner there.

(2) Where any question as to the law of any country or territory outside the United Kingdom, or of any part of the United Kingdom other than England and Wales, with respect to any matter has been determined (whether before or after the passing of this Act) in any such proceedings (not being proceedings before a court which can take judicial notice of the law of that country, territory or part with respect to that matter)—

(*a*) any finding made or decision given on that question in the first-mentioned proceedings shall, if reported or recorded in citable form, be admissible in evidence for the purpose of proving the law of that country, territory or part with respect to that matter; and

(*b*) if that finding or decision, as so reported or recorded, is adduced for that purpose, the law of that country, territory or part with respect to that matter shall be taken to be in accordance with that finding or decision unless the contrary is proved:

Provided that paragraph (*b*) above shall not apply in the case of a finding or decision which conflicts with another finding or decision on the same question adduced by virtue of this subsection in the same proceedings.

(3) Except with the leave of the court, a party to any civil proceedings shall not be permitted to adduce any such finding or decision as is mentioned in subsection (2) above by virtue of that subsection unless he has in accordance with rules of court given to every other party to the proceedings notice that he intends to do so.

(4) The proceedings referred to in subsection (2) above are the following, whether civil or criminal, namely—

(*a*) proceedings at first instance in any of the following courts, namely the High Court, the Crown Court, a court of quarter sessions, the Court of Chancery of the county palatine of Lancaster and the Court of Chancery of the county palatine of Durham;

(*b*) appeals arising out of any such proceedings as are mentioned in paragraph (*a*) above;

(*c*) proceedings before the Judicial Committee of the Privy Council on appeal (whether to Her Majesty in Council or to the Judicial Committee as such) from any decision of any court outside the United Kingdom.

(5) For the purposes of this section a finding or decision on any such question as is mentioned in subsection (2) above shall be taken to be reported or recorded in citable form if, but only if, it is reported or recorded in writing in a report, transcript or other document which, if that question had been a question as to the law of England and Wales, could be cited as an authority in legal proceedings in England and Wales.

Interpretation, application to arbitrations, etc., and savings

5.—(1) In this Act "civil proceedings" and "court" have the meanings 6105
assigned by section 18(1) and (2) of the Civil Evidence Act 1968.

(2) Subsections (3) and (4) of section 10 of the Civil Evidence Act 1968 shall apply for the purposes of the application of sections 2 and 4 of this Act in relation to any such civil proceedings as are mentioned in section

18(1)(*a*) and (*b*) of that Act (that is to say civil proceedings before a tribunal other than one of the ordinary courts of law, being proceedings in relation to which the strict rules of evidence apply, and an arbitration or reference, whether under an enactment or not) as they apply for the purposes of the application of Part I of that Act in relation to any such civil proceedings.

(3) Nothing in this Act shall prejudice—

(*a*) any power of a court, in any civil proceedings, to exclude evidence (whether by preventing questions from being put or otherwise) at its discretion; or

(*b*) the operation of any agreement (whenever made) between the parties to any civil proceedings as to the evidence which is to be admissible (whether generally or for any particular purpose) in those proceedings.

Short title, extent and commencement

6106 6.—(1) This Act may be cited as the Civil Evidence Act 1972.

(2) This Act shall not extend to Scotland or Northern Ireland.

(3) This Act, except sections 1 and 4(2) to (5) shall come into force on 1st January 1973, and sections 1 and 4(2) to (5) shall come into force on such day as the Lord Chancellor may by order made by statutory instrument appoint; and different days may be so appointed for different purposes or for the same purposes in relation to different courts or proceedings or otherwise in relation to different circumstances.

APPENDIX THREE

EVIDENCE

I. GENERAL RULES

General rule: witnesses to be examined orally (O.38, r.1)

38/1 1. Subject to the provisions of these rules and of the Civil Evidence Act 1968 and the Civil Evidence Act 1972, and any other enactment relating to evidence, any fact required to be proved at the trial of any action begun by writ by the evidence of witnesses shall be proved by the examination of the witnesses orally and in open Court.

This rule was taken from the former O.37, r.1, as amended by R.S.C. (No.3) 1937 and R.S.C. (Summons for Directions) 1954.

Amended by R.S.C. (Amendment) 1969 (S.I. 1969 No.1105) and by R.S.C. (Amendment No.4) 1979 (S.I. 1979 No.1512).

38/1/1 **Effect of rule**—This refers to a general rule of the law of evidence, but is of limited application. It does not apply to any motion, petition or summons (r.2(3)) or any other proceeding except an action commenced by writ, and it does not apply to any interlocutory proceeding in such an action, but only to the trial, though it also applies to trials of issues or questions of fact or law, references, inquiries and assessments of damages (r.8). It only applies to evidence of fact, not opinion, and it only provides that where a fact is to be proved by the evidence of witnesses they shall be examined orally and in open Court.

Pursuant to S.C.A. 1981, s.87, r.2(1) of the present Order enables the Court to order that the affidavit of any witness may be read at the trial if in the circumstances of the case it thinks it reasonable so to order, r. 2A allows for the proof of a witness, exchanged under the rule to be treated as the evidence in chief of the witness provided directions to that effect have been given by the Master or Judge, and r.3 enables the Court to order that evidence of any particular *fact* may be given at the trial in such manner as it directs. The Civil Evidence Act 1968, Vol.2, Pt.18, para.6080, and rr.20–33, enable hearsay evidence to be adduced in civil proceedings under certain conditions. See also O.25, rr.2 and 3, which call upon the Court on the hearing of the summons for directions, to exercise its powers, for the purpose of saving costs, under the Civil Evidence Act 1968 or the Civil Evidence Act 1972 and the rules of the Order. See also O.26 which enables the Court to allow the administration of interrogatories to the parties as to facts in issue, and enables the and enables the answers to be put in evidence and O.39 under which evidence on oath may in special cases be taken before an examiner and put in at the trial. Agreements may also be made as to the mode of giving evidence (O.25, r.4 and see "Affidavit evidence by agreement," para.38/2/5). In Admiralty, see O.75 rr.21(8) 30, 31, 41(6) 42(3).

Accordingly the effect of the present rule is merely that, subject to the above limitations, the evidence of witnesses at a trial is to be given by their examination orally and in open Court.

A party has the right to choose which witnesses to call and in what order (*Briscoe* v. *Briscoe* [1968] P.501; [1966] 1 All E.R. 465). In civil proceedings, the trial Judge has no power to dictate to a litigant what evidence he should tender (*Tay Bok Choon* v. *Tahansan SDN BHD* [1987] 1 W.L.R. 413, P.C.).

Since there is no property in a witness of fact, nor in an expert witness as to the facts he has observed and his own independent opinion on them, it is the duty of a witness to come to Court and give evidence in so far as he is directed by the Judge to do so, and therefore a contract by which a witness binds himself not to give such evidence before the Court is contrary to public policy and will not be enforced by the Court (*Harmony Shipping Co. S.A.* v. *Saudi Europe Line Ltd.* [1979] 1 W.L.R. 1380; [1979] 3 All E.R. 177, *per* Lord Denning M.R.).

38/1/2 **Oaths and solemn affirmations**—The Oaths Act 1978 consolidated the Oaths Act 1909 and the Oaths Acts 1888–1977, which were repealed, see Vol. 2, para.6166.

The form and manner in which any oath may be administered in England and Wales and in the United Kingdom generally are governed by the Oaths Act 1978, which also validates oaths administered in a form and manner other than that prescribed by law or to a person who at the time of taking it had no religious belief.

The Oaths Act 1978 also governs the form of a solemn affirmation and the circumstances in which a person who objects to being sworn may be permitted to make his solemn affirmation instead of taking an oath, or in relation to a person to whom it is not reasonably practicable

the particular circumstances of the case, and it need not have taken place [illegible] of the statement. Where the statement has been made, it may later be accepted or adopted in circumstances which recognised the gravity and importance of the truth being asserted on the particular occasion, and therefore the subsequent acknowledgment of the truth of what had been said amounts to a sufficient acknowledgment: *R.* v. *Governor of Pentonville Prison, ex p. Singh* [1981] 1 W.L.R. 1031; [1981] 3 All E.R. 23, D.C.

Examination of witnesses

38/1/3 **Examination-in-chief**—In examination-in-chief, leading questions may not as a rule be put, but the Court has a discretion to relax the rule so far as justice may require. A witness may refresh his memory by referring to any writing made by himself at the time of the transaction about which he is being examined, or at any subsequent time if the Court considers it was then fresh in his memory, or even if made by another person if read within such time by the witness, and if when he read it he knew it to be correct. A Judge in his discretion may permit a witness, who had begun to give evidence, to refresh his memory from a statement made nearer the time of the events in question even though it was not strictly a contemporaneous record provided he was satisfied that 1) the witness due to the lapse of time could not now recall the entails of the events, 2) the statement represented his memory of those events at the time, 3) he had not read it before coming into the witness box, and 4) the statement was not referred to by the witness again (*R.* v. *Da Silva, The Times*, August 17, 1989). And an expert witness may refresh his memory by reference to professional treatises. But any such writing or treatise must be shown to the adverse party if he requires it, and he may cross-examine upon it. The evidence in chief must be confined to facts within the witness's own knowledge, except where he is called as an expert on questions on which expert evidence is admissible, *e.g.* handwriting, science, or trade. By the Criminal Procedure Act 1865, s.3 (applied in Civil Evidence Act 1968), "a party producing a witness shall not be allowed to impeach his credit by general evidence of bad character, but he may, in case the witness shall in the opinion of the judge prove adverse, contradict him by other evidence, or by leave of the judge prove that he has made at other times a statement inconsistent with his present testimony, but before such last-mentioned proof can be given the circumstances of the supposed statement, sufficient to designate the particular reason, must be mentioned to the witness and he must be asked whether or not he made such statement." The discretion of the Judge under this section is absolute and without appeal (*Rice* v. *Howard* (1886) 16 Q.B.D. 681; *R.* v. *Francis* (1913) 29 T.L.R. 188). It is entirely in the discretion of the Court whether a party who calls his opponent may treat him as hostile (*Price* v. *Manning* (1889) 42 Ch.D. 372, C.A.). As to admissibility of evidence of telephone conversations, see *Jacobi* v. *Jacobi and Solomon* [1994] 1 All E.R. 67.

Counsel has a discretion to call such witnesses as he pleases and in the order that he chooses, and the Court should not overbear that discretion, *e.g.* by insisting that the party or a particular witness should be called before another witness (*Briscoe* v. *Briscoe* [1968] P.501, C.A.) but although where this has happened, the appellate Court will not readily find that what was wrongly done was done without ill-effect, still it will examine the irregularity to see whether any prejudice or even possibility of prejudice has been occasioned to the person who has been wrongly compelled to call witnesses in a different order from that which he intended and wanted (*Barnes* v. *B.P.C. (Business Forms) Ltd.* [1975] 1 W.L.R. 1565; [1976] 1 All E.R. 237).

38/1/4 **Cross-examination**—There is no right to cross-examine a witness called merely to prove documents without being sworn either to prove or identify them, nor a witness sworn by mistake and not examined in chief to any material extent before the mistake is discovered. But if a witness is intentionally called and sworn he may be cross-examined, though not yet examined in chief. A witness called and examined by the Court may, if the Court permits, be cross-examined (*Coulson* v. *Disborough* [1894] 2 Q.B. 316, but as to this case see *Re Enoch and Zaretzky, Bock & Co.'s Arbitration* [1910] 1 K.B. 327, C.A.). Attesting witnesses to a will or deed may be cross-examined by the party calling them, as they are witnesses of the Court (*Jones* v. *Jones* (1908) 24 T.L.R. 839; *Oakes* v. *Uzzell* [1932] P.19). If a plaintiff in libel is put in the box simply for cross-examination, he cannot be cross-examined to credit: see *Bracegirdle* v. *Bailey* (1859) 1 F. & F. 536; *Hobbs* v. *Tinling* [1929] 2 K.B. 1, p.12, C.A.

In cross-examination leading questions may in general be put, and the right to cross-examination is not limited by the examination-in-chief but extends to the whole of the issues in the action but the answers of a witness respecting any fact irrelevant to the issues may not be contradicted except his answer to the question whether he has been previously convicted. The Judge may disallow vexatious questions irrelevant to the issue. The conviction of a criminal offence (s.25 of the Common Law Procedure Act 1854, re-enacted in Criminal Procedure Act 1865, s.6, and *R.* v. *Baker* [1895] 1 Q.B. 797, p.800 except of course for "spent" criminal offences under the Rehabilitation of Offenders Act 1974) or to any question tending to show partiality on the part of the witness if he denies the facts suggested may be put to him by way of cross-examination as to credit (*Att.-Gen.* v. *Hitchcock* (1847) 1 Ex. 91). The previous inconsistent or contradictory statement made by a witness in previous civil proceedings or a

direct oral evidence by him would be admissible (Civil Evidence Act 1968, s.3, see Vol 2 P 18). Previous statements in writing need not be produced unless required by the Judge, but if the witness is to be contradicted by the writing his attention must be drawn to the parts to be used for that purpose (Common Law Procedure Act 1854, re-enacted in Criminal Procedure Act 1865, s.5 and applied in Criminal Evidence Act 1968). A witness is not compellable to answer any question tending to expose him to any kind of criminal offence or penalty. The Judge decides as to the tendency of any question to incriminate the witness (*Ex p. Reynolds* (1882) 29 Ch.D. 294, C.A.).

A co-defendant not interested in a question between the plaintiff and his co-defendant is not entitled to cross-examine such co-defendant (*Re Wagstaff* (1907) 96 L.T. 605). Evidence given by one party affecting another party in the same litigation cannot be made admissible against such party unless there be a right to cross-examine. The evidence of a respondent cannot be used against a co-respondent after refusal of leave to cross-examine (*Allen* v. *Allen* [1894] P.248).

Re-examination—There is a right to re-examine to explain answers given in cross-examination.

38/1/5 **Exclusion of witness from the Court**—On the application of either party the Court may at any time order all witnesses on both sides, other than the one under examination, to withdraw, and not to leave the Court again after giving evidence so as to communicate with other witnesses before they give evidence. (This practice was approved in *Re Nightingale, Green* v. *Nightingale* [1975] 1 W.L.R. 80.) The order is discretionary, and notwithstanding *Outram* v. *Outram* [1877] W.N. 75, and *Penniman* v. *Hill* (1876) 24 W.R. 245, should not generally include the parties.

The practice relating to the exclusion of witnesses from the Court "does not apply and never has applied to the parties themselves or their solicitors or their expert witnesses. They are never excluded from the court" (*per* Sir John Arnold P. in *Tomlinson* v. *Tomlinson* [1980] 1 W.L.R. 322, p.327; [1980] 1 All E.R. 593, p.596.

38/1/6 **Witness called by Judge**—The Judge may call a witness whom neither party proposes to call, and may examine him himself; but since such witness is not the witness of either party, neither has the right to cross-examine him, though the Judge would usually allow either, or (possibly) both parties to do so (*Fallon* v. *Calvert* [1960] 2 Q.B. 201; [1960] 1 All E.R. 281, C.A.; *Re Enoch and Zaretzky, Bock & Co.'s Arbitration* [1910] 1 K.B. 327, C.A., ling dictum of Esher M.R., in *Coulson* v. *Disborough* [1894] 2 Q.B. 316).

In committal proceedings for contempt of Court, which are of a quasi-criminal character, the Court has power to issue a subpoena of its own motion upon a witness to attend to give evidence or produce documents (*Yianni* v. *Yianni* [1966] 1 W.L.R. 120; [1966] 1 All E.R. 231).

38/1/7 **Rebutting evidence**—The Judge at the trial has a discretion to allow the plaintiff to adduce rebutting evidence: (1) in answer to evidence of the defendant in support of an issue the proof of which lay upon him (*Williams* v. *Davies* (1883) 1 Cr. & M. 464; *Wright* v. *Wilson* (1850) 9 C.B. 650; *Penn* v. *Jack* (1866) L.R. 2 Eq. 314); and the plaintiff does not lose his right to have such discretion exercised in his favour by not giving evidence in the first instance to rebut the plea set up by the defendant, although the nature of the defence was disclosed by the cross-examination of the plaintiff's witnesses (*Shaw* v. *Beck* (1853) 8 Exch. 392); (2) when the plaintiff has been taken by surprise, or the evidence is contradictory (*Bigsby* v. *Dickinson* (1876) 4 Ch.D. 24; *Budd* v. *Davison* (1881) 29 W.R. 192; *Rogers* v. *Manley* (1880) 42 L.T. 584). But on the trial of a claim and counterclaim, the issues on each being identical, the plaintiff was not allowed, after the evidence on the claim was closed, to call further evidence in answer to defendant's evidence in support of counterclaim (*Green* v. *Sevin* (1879) 13 Ch.D. 589, 597). *Cf.* also *Barker* v. *Furlong* [1891] 2 Ch. 172.

38/1/8 **Defendant's evidence**—If a Judge is prepared to decide in favour of defendant or respondent without hearing his evidence, his counsel may insist on the evidence being first heard, but if he does not, the C.A. may allow the evidence to be taken before reversing the decision (*Ex p. Jacobson* (1883) 22 Ch.D 312); or the case may be sent back by the House of Lords to take the defendant's evidence (*Singer Co.* v. *Wilson* (1865) 3 App. Cas. 376).

Evidence as to costs—Evidence will not be admitted after judgment for the purpose of influencing the costs (*Mayor of Bristol* v. *G. W. Ry.* [1916] W.N. 47); *cf. Millensted* v. *Grosvenor House Ltd.* [1937] 1 K.B. 717, C.A. (statement as to payment into Court). But in non-money claims, in respect of which payment into Court under O.22 is inappropriate, evidence of an offer to settle made before the trial in a letter marked "without prejudice" as to the issue of costs, may be admitted and will be given the same consequences as a payment in under O.22 exceeding the amount recovered (See O.22, r.14 and O.62, r.9(*d*), *Cutts* v. *Head* [1981] 1 All E.R. 597, C.A., applying *Calderbank* v. *Calderbank* [1976] Fam. 93; [1975] 3 All E.R. 333, and *Computer Machinery Co.* v. *Drescher* [1983] 1 W.L.R. 1379; [1983] 3 All E.R. 153).

proved by the attesting witness (*Re Rice's Estate* (1855) ...) but where the parties interested are before the Court it is not necessary to prove by the attesting witness any instrument to the validity of which attestation is not requisite, and such instrument may be proved by admission or otherwise as if there had been no attesting witness there (s.26 of the C.L.P.A. 1854; *Worthington* v. *Moore* (1891) 64 L.T. 338). The signature of a transferor was allowed to be proved by a person who knew the handwriting, though the transferor and an attesting witness were available (*Clarence Hotel (Ilfracombe) Ltd.* (1902) 54 S.J. 117).

Use of an interpreter—See *Re Trepca Mines Ltd.* [1960] 1 W.L.R. 24; [1959] 2 All E.R. 798. The proceedings of the Court must be in English and a lay litigant has no legal right to open his case through an interpreter (*ibid*). But the Court has a discretion to allow a foreign litigant to address the Court through an interpreter and to refuse to allow the evidence in English to be translated (*In the Estate of Fuld, decd.(No.2)* [1965] 1 W.L.R. 1336; [1965] 2 All E.R. 657).

Privilege of witness—The mere statement by a witness of his belief that his answer to a question will tend to criminate him is not sufficient to excuse him, but the Court must see from the circumstances of the case and the nature of the evidence required, that there is reasonable ground to apprehend danger to the witness from his being compelled to answer (*Ex p. Reynolds* (1882) 20 Ch.D. 294). 38/1/10

Evidence (Foreign Dominions and Colonial Documents) Act 1933—See nn. under r.10, as to proof by production of foreign registers under this Act.

Recording apparatus—As to admission of evidence of interview recorded without 38/1/11
knowledge of one party, see *H. Parker Ltd.* v. *Mason* [1940] 2 K.B. 580, C.A.; and as to the right of a witness to refresh his memory by reference to a tape recording made by him at the time, *R.* v. *Mills* [1962] 1 W.L.R. 1152; [1962] 3 All E.R. 298, C.C.A. A recording made by mechanical means without human intervention is in the nature of real evidence and is admissible evidence, *e.g.* tape recordings (*R.* v. *Maqsud Ali* [1966] 1 Q.B. 688; [1965] 2 All E.R. 464); and radar recordings of echoes of ships in collision (*The Statue of Liberty* [1968] 2 All E.R. 195).

Notes of evidence given in other proceedings—*e.g.* notes taken by justices' or coroners' clerk. As to the extent to which they can be used, see *Brinckley* v. *Brinckley* [1965] P.75; [1963] 1 All E.R. 493. See Civil Evidence Act 1968, s.4.

Unstamped document—By the Stamp Act 1891, s.14(4) unless the duty and penalty are 38/1/12
paid at the trial under s.14(1) an instrument "(specified in the First Schedule) executed in any part of the United Kingdom or relating, wheresoever executed, to any property situate, or to any matter or thing or to be done in any part of the United Kingdom shall not, except in criminal proceedings, be given in evidence or be available for any purpose whatsoever, unless it be duly stamped in accordance with the law in force at the time when it was first executed."

Notwithstanding the words "be given in evidence or be available for any purpose whatever," an insufficiently stamped promissory note may be handed to a witness to challenge his recollections (*Birchall* v. *Bullough* [1896] 1 Q.B. 325).

Evidence by affidavit (O.38, r.2)

2.—(1) The Court may, at or before the trial of an action begun by writ, 38/2
order that the affidavit of any witness may be read at the trial if in the circumstances of the case it thinks it reasonable so to order.

(2) An order under paragraph (1) may be made on such terms as to the filing and giving of copies of the affidavits and as to the production of the deponents for cross-examination as the Court thinks fit but, subject to any such terms and to any subsequent order of the Court, the deponents shall not be subject to cross-examination and need not attend the trial for the purpose.

(3) In any cause or matter begun by originating summons, originating motion or petition, and on any application made by summons or motion, evidence may be given by affidavit unless in the case of any such cause, matter or application any provision of these rules otherwise provides or the Court otherwise directs, but the Court may, on the application of any party, order the attendance for cross-examination of the person making any such affidavit, and where, after such an order has been made, the person in question does not attend, his affidavit shall not be used as evidence without the leave of the Court.

terms as the Court shall think just, written statements of the oral evidence which the party intends to lead on any issues of fact to be decided at the trial.

(3) Directions given under paragraph (2) may—

(*a*) make different provision with regard to different issues of fact or different witnesses;

(*b*) require any written statement served to be signed by the intended witness;

(*c*) require that statements be filed with the Court.

(4) Subject to paragraph (6), where the party serving a statement under paragraph (2) does not call the witness to whose evidence it relates no other party may put the statement in evidence at the trial.

(5) Subject to paragraph (6) and unless the Court otherwise orders where the party serving the statement does call such a witness at the trial—

(*a*) the party may not without the consent of the other parties or the leave of the Court lead evidence from that witness the substance of which is not included in the statement served, except in relation to new matters which have arisen in the course of the trial;

(*b*) the Court may, on such terms as it thinks fit, direct that the statement served, or part of it, shall stand as the evidence in chief of the witness or part of such evidence;

(*c*) whether or not the statement or any part of it is referred to during the evidence in chief of the witness, any party may put the statement or any part of it in cross-examination of that witness.

(6) Where any statement served is one to which the Civil Evidence Acts 1968 and 1972 apply, paragraphs (4) and (5) shall take effect subject to the provisions of those Acts and Parts III and IV of this Order. The service of a statement pursuant to a direction given under paragraph (2) shall not, unless expressly so stated by the party serving the same, be treated as a notice under the said Acts.

(7) Where a party fails to comply with a direction given under paragraph (2) he shall not be entitled to adduce evidence to which such direction related without the leave of the Court.

(8) Nothing in this rule shall deprive any party of his right to treat any communication as privileged or make admissible evidence otherwise inadmissible.

Added by R.S.C. (Amendment No. 2) 1986 (S.I. 1986 No. 1187).
Amended by R.S.C. (Amendment) 1988 (S.I. 1988 No. 1340).

38/2A/1 **Scope and operation of this rule** – This rule makes an enormous and notable advance towards the open system of pre-trial procedure. It empowers the High Court to direct any party at any stage of the proceedings to serve on the other parties the written statements of the oral evidence which that party intends to lead on any issues of fact to be decided at the trial.

However, the rule specifically provides in para. (8) that it will not "deprive any party of the right to treat any communication as privileged, or make admissible evidence otherwise inadmissible." This provision makes it abundantly clear that the rule stops far short of affecting the substantive rights of the parties. The validity of this rule was unsuccessfully challenged in *Comfort Hotels Ltd.* v. *Wembley Stadium Ltd.* [1988] 1 W.L.R. 872 in which Hoffmann J. held that the rule was entirely procedural.

38/2A/2 It embodies a fundamental innovation in the law and practice relating to the identity of the intended trial witnesses of the parties and relating to the confidentiality of their statements or "proofs" of evidence. It provides a radical alteration to the manner of eliciting the evidence in chief of witnesses at the trial by their oral examination in open Court, as provided by r.1 above. Above all it greatly improves the pre-trial process by providing the machinery for enabling all the parties to know before the trial precisely what facts are intended to be proved at the trial, and by whom, and thereby it reduces delay, costs and the opportunity for procedural technicalities and obstruction towards the trial.

aimed at accelerating the process and reducing costs in the High Court;

(2) the elimination of any element of "surprise" before or at the trial as to the witnesses each party intends to call at the trial or as to the substance of their evidence. The parties will no longer be able to spring or to be exposed to surprises as to the trial witnesses or their evidence, but will be required to "place their cards on the table";

(3) the promotion of a fair settlement between the parties. With all or substantially all the factual evidence before them, subject to cross-examination, the parties will be able to make a more realistic appraisal of the strengths and weaknesses of their own and each other's cases, which should contribute towards the fair and expeditious disposal of the proceedings by settlement or otherwise;

(4) the avoidance of a trial, thereby saving a great deal of wasteful time, effort and cost on the part of the practitioners, the judiciary and the Court staff, as well as the parties and their witnesses;

(5) the identification of the real issues and the elimination of unnecessary issues;

(6) the encouragement of the parties to make admission of facts, which they are often reluctant to do;

(7) the reduction in the number of pre-trial applications, such as for further and better particulars of pleadings or for further discovery of documents or for interrogatories;

(8) the provision of the framework whereby routine and evidence-in-chief can be given in summary form, see para. 5(*b*).

(9) the improvement of the process of cross-examination;

(10) the concentration of both the parties and the trial Judge on the real matters in controversy between the parties;

38/2A/3 As in the case of pre-trial disclosure of expert evidence (see para. 38/35/2), so in the case of the pre-trial service of witnesses' statements under this rule, the machinery is intended to be operated on the basis of fairness and mutuality as between the parties, so that neither party should be able or be allowed to operate such machinery to obtain an unfair or undue advantage over any other party, as for example, by obtaining the statements of the witnesses of the opposite party before the trial without *at the same time* serving the statement of their own witness on that party. The rule is designed to provide for the simultaneous exchange of the witnesses' statements on the parties on or before a fixed date which may be called "the exchange date." This general rule of practice may no doubt be subject to variation according to the special circumstances of any particular case, but always the paramount consideration will be to maintain fairness and impartiality. It will be in very special circumstances that the Court will give a direction, not for the simultaneous exchange of witnesses' statements by the parties, but for the sequential service by one party on the other of his witnesses' statements to be followed at a later date by the service by that other party of his witnesses' statement (see *Kirby* v. *British Rail Engineering Ltd.* [1983] 1 W.L.R. 1165; [1983] 3 All E.R. 147, C.A. sequential service of experts' reports).

38/2A/4 Under this rule, the prior consent of the parties is not required to empower the Court to give a direction under para. (2) for the service of witnesses' statements. Nevertheless, every encouragement will be given by the Court to the parties to agree between themselves to serve witnesses' statements on each other, and if required, the direction of the Court will recite that it is made by consent.

This rule applies to any "cause or matter." It empowers the Court to order the service of witnesses' statements, not only as between the plaintiff and the defendant on both the claim and counterclaim (if any) but also as between the plaintiff and each of two or more defendants, and further as between two or more defendants themselves, whether or not a contribution notice has been served by one of them on the other or others. The rule also applies to third party proceedings, not only as between the defendant and the third party and any subsequent parties but also as between the plaintiff and the third party and any subsequent parties on the same basis which enables the Court to give directions for the discovery of documents between them, or on which they may interrogate each other (*Eden* v. *Weardale* (1887) 34 Ch.D. 223, 35 Ch.D. 287, and see para. 16/1/23).

38/2A/5 **Directions for service of witnesses' statements**—The direction of the Court under para. (2) for the pre-trial service by the parties of the witnesses' statement may be made "at any stage" of the proceedings to which the rule applies but will normally be made on the hearing of the application or summons for directions. In the conduct of Official Referees' business under O.36, r.6(2), the Court will nevertheless give such a direction, but it will provide that it should take effect on or before a specified date by which time the pleadings will have been closed and discovery completed. A party may include in the application or summons for directions a specific application for a direction under para. (2), but in the absence of such an application, the Court may nevertheless give such a direction. If the date of trial of an action has been or is being fixed the Court will ordinarily allow a reasonable margin of time, say, six to ten weeks before that date before which the direction under para. (2) should take effect. If no date of trial has been fixed, the Court and the parties will use their best endeavors to estimate that date, so as to provide for pre-trial service of the witnesses' statements of the parties, since this is one of the cardinal objectives of the rule.

which was added by R.S.C. (Summons for Directions) 1954, and as to para.(3) from the former O.38, r.1.

The order is usually made on the hearing of the summons for directions or on application by notice under it. The rule is of especial value where the witness is abroad, or the evidence will not be contested. A draft of the proposed affidavit should be submitted for the consideration of the other side before the application, unless it is clear what it will contain. It is not practicable to make such an order where the evidence will be strongly contested and the credibility depends on the Court's view of the witness (*e.g.* the evidence of an eye-witness in a running-down action, or of witnesses in an action for rectification where there is little documentary evidence—*Bonhote* v. *Henderson* [1895] 1 Ch. 742; *Constantinidi* v. *Ralli* [1935] Ch. 427). The fact that an affidavit has been used on an interlocutory application gives no right to read it at the trial (*Perkins* v. *Slater* (1876) 1 Ch.D. 83; *Blackburn Union* v. *Brooks* (1877) 7 Ch.D. 68).

38/2/2 **Adjourned summons**—On an adjourned summons evidence filed after the time fixed by the Master for filing evidence will not be admitted without leave, which may be obtained at the hearing without formal application; *secus*, where no time has been fixed (*Re Chiffers* (1888) 36 W.R. 806).

Construction—In the case of an O.S. for construction or other relief it is sufficient for the affidavit to state who are the trustees or executors and beneficiaries without stating (except if requisite for explanation) devolution of their title. This does not apply where applications deal with a fund in Court or appointment of trustees or a vesting order or where devolution of the title or the trusteeship is an issue (Direction of Judges of Ch.D., February, 1944).

Notice of motion—Affidavits filed prior to amendment of a notice of motion may be read at the hearing without leave (*Re King & Co.'s Trade Mark* [1892] 2 Ch. 462).

Persons other than deponents may in special circumstances be called on the hearing of a motion: thus arbitrators were allowed to give evidence on a motion to set aside an award where the Court could not ascertain the facts from the affidavits (*Leiserach* v. *Schalit* [1934] 2 K.B. 353).

38/2/3 **Cross-examination upon affidavit**—When an affidavit has once been filed by one party, the opposite party is entitled to use statements therein as admissions by deponent.

The practice in bankruptcy is different, and such an affidavit if not used by deponent cannot be treated as an admission by him (*Re Cohen* [1924] 2 Ch. 515, following *Ex p.* [illegible] (1882) 20 Ch.D. 126).

The affidavit may be allowed to be used in Court though the cross-examination is pending (*Lewis* v. *James* (1887) 32 Ch.D. 326, p.331).

The Court may refuse to act on an affidavit where the deponent cannot be cross-examined (*Shea* v. *Green* (1886) 2 T.L.R. 533; and see *The Parisian* (1887) 13 P.D. 16); and if the deponent does not attend for cross-examination where notice to cross-examine has been given the affidavit cannot be read in his absence without leave (see O.38, r.1). This rule applies in bankruptcy (*Re Bottomley* (1915) 84 L.J.K.B. 1020).

Cross-examination on affidavits filed on a summons under the Companies Act 1948, [illegible] will not be ordered to be taken in Court except under special circumstances (*Re Faure Electric, etc., Co.* (1888) 58 L.T. 42).

There can be no cross-examination under para.(3) on an affidavit showing cause against a garnishee order *nisi* (*Jeffris* v. *Tomlinson* (1887) 3 T.L.R. 193); nor on an affidavit disclosing the names of the persons constituting a firm under O.81, r.2 (*Abrahams* v. *Dunlop Pneumatic Tyre Co.* [1905] 1 K.B. 46, C.A.).

There is a discretion to order cross-examination of a deponent after his affidavit has been used (*Strauss* v. *Goldschmidt* (1892) 8 T.L.R. 239).

A dependent cannot be cross-examined on an affidavit claiming diplomatic immunity [illegible] confirmed by the Att.-Gen. (*Engelke* v. *Musmann* [1928] A.C. 433).

The Court will, if necessary, make an order for cross-examination of a foreign witness resident out of the jurisdiction (*Strauss* v. *Goldschmidt* (1892) 8 T.L.R. 239).

Where there is a question of motive or of good faith of deponent, the Court ought not to be asked to act without cross-examination, see *Re Smith and Fawcett* [1942] Ch. 304, C.A.

In proceedings by originating summons, *e.g.* for maintenance under M.C.A. 1973, s.27, a party cannot be denied the right to cross-examine the opposite party or his witness upon his affidavit, at any rate where such affidavit has been read to the Court, and so incidentally in such proceedings there is no room for a submission of "no case to answer" (*Lindicall* v. *Lindwall* [1967] 1 W.L.R. 143; [1967] 1 All E.R. 470, C.A.). On the other hand, a party is not bound to cross-examine the opposite party or his witness upon their affidavits, and the Court may form its view without hearing such cross-examination (*Re D. B. Brace, ex p. The Debtor* v. *H. Gabriel* [1966] 1 W.L.R. 595; [1966] 2 All E.R. 38, C.A.).

Cross-examination on an affidavit will not generally be allowed on matters extraneous to the question in the particular proceedings in which the affidavit was filed (*Re SBA Properties Ltd.* [1967] 1 W.L.R. 799; [1967] 2 All E.R. 615).

There is a discretion as to ordering cross-examination on affidavits filed on interlocutory applications (see para. (3)). [illegible]

[illegible] interlocutory injunctions [illegible] *[illegible] International (Mayfair) Ltd.* [1971] F.S.R. 300; [1972] R.P.C. 237.

Where an affidavit has been made pursuant to an Anton Piller order "it cannot be right to allow a plaintiff the opportunity of a roving cross-examination merely because the plaintiffs harbour suspicion that the person sought be made the subject of the order has not been merely open in his disclosure" (*per* Peter Gibson J. quoted by Falconer J. in *CBS U.K. Ltd.* v. *Perry* [1985] F.S.R. 421).

In contempt proceedings, where a deponent has made an affidavit, he may be cross-examined upon that affidavit. Only very exceptionally should a Judge refuse an application to cross-examine, *e.g.*, where cross-examination would be for a collateral purpose (*Coinmatic Products U.K. Ltd.* v. *Hawkex Plastics Ltd.* [1971] 2 Q.B. 67; [1971] 1 All E.R. 1141).

In proceedings under para.(3) *i.e.* in any cause or matter begun by originating summons, originating motion or petition, and on any application made by summons or motion, the Court, at any rate in bankruptcy proceedings, has a discretion to order the debtor to attend for cross-examination upon his affidavit. Moreover, in such proceedings, where a person who has made an affidavit with a view to its being given in evidence has been ordered to attend for cross-examination but fails to do so, the Court has a discretion whether or not to admit or exclude such an affidavit from being used as evidence, but such discretion should usually be exercised, not at any stage before the trial or hearing, but only at the stage of the trial or hearing itself of the cause, matter or application, for such discretion should be exercised in the light of all the circumstances known to the Court when the affidavit is sought to be read, including the evidence of other witnesses (*Re a Debtor (No. 2283 of 1976)* [1978] 1 W.L.R. 1512; [1979] 1 All E.R. 434, C.A.).

Before whom conducted—The Court may order the dependent to be cross-examined either before itself or before an examiner. For cross-examination of the deponent of his affidavit see para. 3. 38/2/4

In the Q.B.D., in proceedings in Chambers, the cross-examination is in most cases ordered to be held before the Master or Judge.

In Ch.D. a procedure was introduced to avoid a summons. See *Practice Direction* [1969] 1 W.L.R. 983; [1969] 2 All E.R. 736 (revoked now by [1987] 1 W.L.R. 93), and Ch.M.P.F. [illegible] 55, Vol. 2, Pt.2, para.534.

As to examination before a Master in the Ch.D., see O.32, r.15.

As to cross-examination before an examiner, see O.39, r.4.

Solicitors Act 1974—As to practice and form of affidavit on application to the committee, see Vol. 2, Pt.11, "Solicitors."

Affidavit evidence by agreement—It is still open to the parties to agree that affidavit evidence shall be admitted at the trial, and indeed they ought to be encouraged to do so, whenever this is practicable (see O.25, r.4) but it may be such an agreement will only be effective if it is recorded in the order on the summons for directions (O.25, r.4). 38/2/5

Cross-examination in Ch.D.—Under the former practice, which still prevails in the Ch.D. a deponent might be cross-examined on an affidavit in support of a claim in proceedings under an administration decree (*Cast* v. *Poyser* (1856) 3 Sm. & G. 369); or on an affidavit verifying accounts (*Re Lord* (1866) L.R. 2 Eq. 605; and see *Meacham* v. *Cooper* (1873) L.R. 16 Eq. 102); on an affidavit in support of an application for leave to amend (*Catholic Publishing Co.* v. *Wyman* (1863) 11 W.R. 399) only, however, under special circumstances, where such affidavit is necessary (see *Conybeare* v. *Lewis* (1880) 29 W.R. 391); and generally on affidavits used on interlocutory applications. But where a motion is ordered to stand over to the hearing there can be no cross-examination on an affidavit used on the motion, though the plaintiff has given notice of intention to use it at the hearing of the action (*Singer* v. *Audsley* (1872) L.R. 13 Eq. 401; *Hooper* v. *Campbell* (1865) 13 W.R. 1003); and there can be no cross-examination on an affidavit of documents (*Manby* v. *Bewicke* (*No.2*) (1857) 8 De G.M. & G. 470; *Hall* v. *Truman* (1885) 29 Ch.D. 307); nor on a merely formal affidavit, *e.g.* an affidavit proving service (*National Provident, etc., Assn.* v. *Carstairs* (1863) 11 W.R. 866). 38/2/6

Urgent cases—In urgent cases, *e.g.* on motions for or to dissolve injunctions, the hearing should not be postponed for the purpose of cross-examining a deponent (*Normanville* v. *Stanning* (1853) 10 Ha., App. XX; *Bright* v. *Spratt* [1874] W.N. 72); and where from death, illness, or absence abroad, the dependent cannot be produced for cross-examination, his affidavit will be allowed to be read, for what it is worth (*Braithwaite* v. *Kearns* (1865) 34 Beav. 202; *Ridley* v. *Ridley* (1865) 34 Beav. 329; *Davies* v. *Otty* 13 W.R. 484; *Abadom* v. *Abadom* 24 Beav. 243; *Morley* v. *Morley* 5 De G.M. & G. 610) see Civil Evidence Act 1968, s.2, Vol. 2, Pt.18. 38/2/7

Admiralty—See O.75, rr.21, 33, 38, 40.

Exchange of witnesses' statements (O.38, r.2A)

2A.—(1) 38/2A

(2) At any stage in any cause or matter, the Court may, if it thinks fit for the purpose of disposing fairly and expeditiously of the cause or matter [illegible]

The 'normal' order in all divisions of the High Court is for the exchange of proofs of oral evidence of witnesses with such variations as might be appropriate under this rule. But where the application for such exchange is opposed, the Master's discretion is unfettered. (Re Lord Saunders and Partners (a firm) v. Eastglen Ltd., The Times, July 28, 1989.) A major consideration which the Court might like to consider is the objection of any party to the giving of such a direction by claiming the right to privilege to withhold from disclosing the statements of the witnesses and even their names (see "Saving for right of privilege," para. 38/2A/11).

Under para. (2), the Court is empowered to direct the parties to exchange their witnesses' statements of fact "if it thinks fit" to do so for the purpose of disposing fairly and expeditiously of the cause or matter and saving costs. Ordinarily, the parties or one of them will apply for such a direction, though in the absence of any such application, it is common practice for the Court to inquire of the parties whether they have any objection to such a direction being given. Even if the parties do raise such objection, the Court may nevertheless give the appropriate direction, if he thinks fit to do so, irrespective of the views of the parties, although it will take into account the grounds of objection advanced by them.

The appropriate Court to give a direction under para. (2) is, in the first instance, the Master in the Queen's Bench and Chancery Divisions, the Patents Judge in patent actions, the Commercial Judge in commercial actions, the Admiralty Registrar in admiralty actions and the allocated Official Referee in Official Referees' business.

The Vice-Chancellor gave the following Practice Direction on January 23, 1989:

1. Henceforward on the hearing of the summons for directions the Master will normally make an order under R.S.C., O.38, r.2A for the exchange of witness statements of all oral evidence which any party intends to lead at the trial. The order will specify the day on which such exchange is to be made. Any party who objects to the making of such order or desires a modified order for such exchange must specifically raise the point for decision on the summons for directions.

2. Henceforward on issuing the summons for directions a complete set of pleadings must be lodged.

38/2A/6 The direction given by the Court under para. (2) may make different provisions with regard to different issues of fact or different witnesses (para. 3(*a*)). It may require any witness statement served to be signed by the intended witness (para. 3(*b*)), and it may direct that the witnesses' statements be filed with the Court (para. 3(*c*)). The direction may therefore be either in general form, applying to all the witnesses as to fact of the parties, or in specific form, specifying the issues of fact or the witness to whom, it will apply.

As already stated (see para. 38/2A/3), save in exceptional circumstances the direction given by the Court under para. (2) will be for the exchange between the parties of the witness statements of the witnesses. This may take the form that the parties "do mutually serve on each other the statements of the witnesses as to fact within days or by the day of " (see Practice Form No. 51A, Vol. 2, para. 251),

or perhaps more simply "statements of witnesses of fact [*if a direction is given under para. (5)(b) of the rule,*] to serve as evidence in chief to be exchanged by [*specifying the date*]."

If a party should fail to serve the statement of a witness pursuant to the direction given by the Court under para. (2) whether it be in the general or specific form, he will not be entitled to adduce evidence to which such direction relates without the leave of the Court (para. (7)). In other words, the failure to serve the statement of a witness as directed by the Court will result in the defaulting party being unable to call that witness at the trial or indeed to adduce any evidence to which such direction related, except with the leave of the Court.

Such leave will ordinarily be granted only on terms, which may well be stringent, *e.g.* that after new evidence has been given, the other party should be entitled, if he so wishes, to an adjournment of the trial in order to consider such evidence and that the party in default should pay the costs of and occasioned by the adjournment in any event, possibly even on an indemnity basis.

38/2A/7 **Contents of witnesses' statements**—The overriding features of the written statements of the witness which may be served pursuant to the direction of the Court under para. (2) are:—

(1) that they are intended for use at the trial itself, and

(2) that they relate to issues of fact to be adduced at the trial.

Accordingly, the written statement of such a witness must contain only such material facts as the witness is able to prove of his own knowledge (*cf.* O.41, r. 5(1) as to the contents of an affidavit). The written statement of the witness is the equivalent of the oral evidence which that witness will give if called, in his evidence in chief at the trial. Indeed, the trial Judge may direct that the statement served or part of it should stand as the evidence in chief of that witness or part of it (para. 5(*b*) *cf.* O.38, r.43, putting expert reports in evidence). Like the oral evidence of the trial witness, the written statement served must be full and complete; it must be "the truth, the whole truth and nothing but the truth." It must be emphasised that the party serving the witness statement may not lead evidence from his witness, the substance of which is not included in the statement served, except as to new matter or with the consent of [illegible] inadmissible evidence [illegible] statement of information or belief even if the grounds and reasons thereof are given (see O.41, r. 5(2) as to the contents of affidavits for interlocutory proceedings). Unless so stated by the party serving it, the written statement of the witness will not be treated as evidence under the rules relating to hearsay evidence (para. (6) and see O.38 Pt.III). In the Official Referees' Courts, the general practice is that any objection as to the admissibility of all or part of a witness statement will normally be heard after the witness has produced his statement and sworn to its truth.

Like the oral evidence of the trial witness, a written statement must not contain any expressions of opinion, but be confined only to matters of fact. Unless so stated by the party serving it, the written statement will not be treated as an expert report under the rules relating to expert evidence (para. (6) and see O.38, Pt. IV).

The written statement of a witness should not seek to anticipate the evidence of a witness of the opposite party and to contradict it or otherwise to deal with it. It is not the function of the written statement of a witness to answer questions that may be put in cross-examination, but only to answer questions as would be asked in his examination in chief. However the witness statement should contain all the evidence which he might be expected to give were he to be examined orally at the trial.

38/2A/8 **Form of witnesses' statements**—The statement should be expressed in the first person and it should state

(1) the full name of the witness;

(2) his place of residence or if he is making the statement in his professional business or other occupational capacity, the address at which he works, the position he holds and the name of his firm or employer;

(3) his occupation, or if he has none, his description;

(4) the fact that he is a party to the proceedings or is the employee of such a party.

The statement of the witness should represent his evidence in chief and should be treated as if he was giving evidence in the witness box. It should be stated in a clear straightforward narrative form, and should use the language of the witness, his *ipsissima verba*. For the sake of clarity it should follow the chronological sequence of the events or matter dealt with. For the sake of easy and ready reference, it should be divided into paragraphs numbered consecutively, each paragraph being as far as possible confined to a distinct portion of his evidence. If the statement contains dates, sums or other numbers, they should be expressed in figures and not in words.

The statement should be on paper complying with the requirement of O.66, r.1 and should be fully legible. It should normally be typed double spaced on one side of the paper only. Before it is used at the trial, it should be paginated either individually as a separate statement or as one of several statements contained in a file. If it mentions any document or documents, the reference to each of them should, where possible, be given in the margin.

The statement must be signed by the witness if so required by the Court (see para. 3(*b*)) but even without such a requirement it is obviously sensible that the statement should be signed by him and dated. It may be desirable for the signature of the witness to be witnessed by a responsible person who should state his name, address and occupation and verify by his own signature the fact that the witness signed the statement in his presence.

If the Court so requires the written statement of the witness must be filed with the Court (para. 3(*c*)). The statements should therefore not be bound with thick plastic strips or anything else which would hamper filing. The filing of these statements will enable the trial Judge to read them before the trial, and if he does so, he will no doubt announce that fact at the beginning of the trial. When reading the statement, whether before or at the trial, the trial Judge will also no doubt exclude from his mind any objectionable matter contained in the statement, such as hearsay evidence or expression of opinion.

38/2A/9 **Amendment of witnesses' statements**—The written statement of a witness served pursuant to the direction of the Court under para. (2) constitutes "a document" in the proceedings, and falls within the amending power of the Court under O.20, r.8(1). The amending power is likely to be exercised only in exceptional circumstances. The time for the witness to alter or withdraw part of his statement may best be left to when he comes to be asked about it in the witness box. Equally, any argument that the statement of a witness contains inadmissible evidence or other objectionable material should be left to be heard after the witness has produced it at the trial, as is the practice before Official Referees, rather than dealt with by way of a prior application to compel the statement to be amended.

38/2A/10 **Supplementary statements of witnesses**—Although there is no express provision to this effect, the Court has power, if it thinks fit to do so, to direct that a further written statement of a witness be served supplementary to that already served. The better practice is that the evidence dealing with or contradicting any statements made by witnesses of the opposite party should be given orally rather than be dealt with by way of a supplementary statement. A supplementary statement may be allowed to be served to give the witness of a party the opportunity to [illegible] in his own statement or to answer the statement of the opposite party.

*other statements of the witnesses between the parties, whether pursuant to the direction under para. (2), or by consent, the trial itself remains an oral, public trial. The written statement of a witness is not in itself evidence of the case. The trial Judge may, on such terms as he thinks fit, direct that the statement of the witness should stand as the evidence in chief of that witness or part of such evidence (para. (5)(*b*)); indeed such a direction may be given at an earlier stage, *e.g.* at the time of giving the direction for the exchange of witnesses' statements. Whether the statement of the witness is directed to stand as his evidence in chief or his testimony is elicited orally at the trial, he will be subject to oral cross-examination by the opposite party under O.38, r.1 who will have the advantage that he will have known in advance what the witness was going to say in his evidence in chief (see Jacob, *op. cit.*). In the absence of such a direction, the party calling the witness must elicit his evidence by his own examination-in-chief in the ordinary way under O.38, r.1.

Where the party serving the statement of a witness under para. (2), does not call that witness at the trial, no other party may put that statement in evidence at the trial (para. (4)). Whether or not the content of the statement of any party thereof may be used or referred to at the trial will of course depend upon whether or not the trial Judge thinks fit to allow or does allow such use or reference to be made.

Where the party serving the written statement of a witness under para. (2) does call the witness at the trial, he must confine the evidence-in-chief to the substance of what is contained in the statement, and he must not lead, and will not be allowed to lead, evidence from him the substance of which is not included in the statement (para. 5(*a*)) unless (i) the other parties consent, or (ii) such additional evidence relates to new matters which have arisen in the course of the trial (*ibid*) or (iii) the Court grants leave on appropriate terms which may be stringent. Unless the Court otherwise orders, he will of course not be able to lead evidence from the witness which differs from or contradicts the contents of that statement.

Witness statements which have been exchanged under O.38, r.2A are not put in evidence by the fact of exchange but remain confidential until the witness makes the statement public by verifying it on oath in the witness box or the party who served the statement waives the privilege. In opening, counsel should not refer to such statement, nor should a witness called by an opposing party be cross-examined by reference to a statement of another witness who might or might not be called by that opposing party or someone other than the party on whose behalf the cross-examination is being conducted. Cross-examining counsel may, however, put to an opposing witness a statement taken on behalf of the cross-examiner's own client, but by so doing he waives his client's privilege in the statement. If he puts to an opposing witness only a small part of his own client's statement, he will thereby entitle his opponent to re-examine that witness on the whole of the statement unless he has agreed with opposing counsel that only part of a statement may be put to a witness without the whole being opened up for re-examination or by cross-examining counsel preparing written questions to be handed to the witness either in the witness box or several days previously (*Fairfield-Mayhey Ltd.* v. *Shell UK Ltd.* [1989] 1 All E.R. 576).

38/2A/12 **Saving of right to privilege**—Para. (8) expressly preserves the right of every party to withhold from disclosure any communication on the grounds of privilege. It is, of course, plain that the statement or "proof" of the evidence of a witness is a communication to which such right extends, since it will have been obtained by the solicitor for the party in his professional capacity for the purpose of pending or contemplated civil proceedings or in connection with the obtaining or giving of legal advice and is protected from disclosure on the ground of legal professional privilege (see para. 38/35/1, *below* relating to the privilege from disclosure of experts' reports). This right clearly also extends to the names or other identities of the witnesses who have made statements or given "proofs" of their evidence to or for the purposes of the solicitor for a party acting in his professional capacity (see "Disclosing names of witnesses etc.," para. 18/12/44), whom the party does not intend to call to give evidence at the trial.

38/2A/13 **Saving for admissibility of evidence**—Para. (8) expressly provides that nothing in rule 2A will make admissible evidence otherwise inadmissible. There is accordingly an obligation on the parties preparing the witnesses' statements to be served pursuant to para. (2) always to ensure that they contain no inadmissible evidence. This means that they must take care to omit any hearsay evidence, or statements of information and belief even if the grounds and sources thereof are given or any expression of opinion, or any matter which is scandalous, irrelevant or otherwise oppressive (see O.41, r.6). If the statement of a witness should by chance contain any such material, it should be corrected as soon as possible (see para. 38/2A/9), or otherwise the opposite party may apply to strike out such material, and in appropriate cases, for the service of a fresh statement (*ibid*).

38/2A/14 **Availability of witness statements**—Solicitors should bring to Court extra copies of witness statements so that they can be made available to the Press and members of the public as the evidence in the case was in the public domain (*Practice Statement: Commercial Court Notices*, *The Times*, August 23, 1989). Other divisions of the High Court may decide to allow [illegible]

1.—(1) Without prejudice to rule 2, the Court may, at or before the trial of any action, order that evidence of any particular fact shall be given at the trial in such manner as may be specified by the order.

(2) The power conferred by paragraph (1) extends in particular to ordering that evidence of any particular fact may be given at the trial—

(*a*) by statement on oath of information or belief, or

(*b*) by the production of documents or entries in books, or

(*c*) by copies of documents or entries in books, or

(*d*) in the case of a fact which is or was a matter of common knowledge either generally or in a particular district, by the production of a specified newspaper which contains a statement of that fact.

38/3/1 **Effect of rule**—This rule was taken from the former O.37, r.1C. The order is usually made on the hearing of the summons for directions or an application to restore under it.

Limitation of expert evidence (O.38, r.4)

38/4 4. The Court may, at or before the trial of any action, order that the number of medical or other expert witnesses who may be called at the trial shall be limited as specified by the order.

38/4/1 **Effect of rule**—Formerly O.37, r.10. The order is usually made on the hearing of the summons for directions but see in relation to automatic directions in personal injury actions, O.25, r.8(1)(*c*). This rule itself gives no power to order the exchange of reports of medical or other expert witnesses (*Worrall* v. *Reich* [1955] 1 Q.B. 296; [1955] 1 All E.R. 363) but this is subject to O.38, r.37 see now Civil Evidence Act 1972 and Part IV of this Order "Expert Evidence". The usual form of order is "that medical reports be agreed if possible, and if they are not agreed the medical evidence be limited to [one or two] witnesses on each side" and an order in similar terms is usually made in regard to other expert evidence, limiting the evidence to one witness on each side (or two if experts are to be called in more than one field of specialised knowledge). Some difficulty is caused in limiting fairly the expert evidence where the action is by a layman against a person who proposes to call his expert employees to give evidence partly of fact, as well as an independent expert. In *Taylor* v. *Greening & Sons, Ltd.* (1956)(unrep.) the Court of Appeal on June 15, 1956, made an order for directions as follows: "A report by an engineer be agreed if possible, and if not agreed, the expert evidence be limited to two independent witnesses for each party: provided always that either party may call additional expert witnesses (who may be in the employment of or otherwise connected with such party) but such witness or witnesses shall not qualify on taxation for payment as experts."

Where one party desires to call only one expert witness and the other party desires to call three, an order limiting such evidence to one witness on each side would be proper, though possibly unnecessary, since the making or refusal of an order limiting the number of expert witnesses is not conclusive on the question whether it is reasonable or not to call the specified number of such witnesses and does not fetter the discretion of the Taxing Master whose duty it is to determine the matter (*Attwell* v. *Ministry of Public Building and Works* [1969] 1 W.L.R. 1974, [1969] 3 All E.R. 196).

The power to limit the *number* of expert witnesses does not extend to excluding expert evidence altogether (*Sullivan* v. *West Yorkshire Passenger Transport Executive* [1985] 2 All E.R. 134, C.A.).

38/4/2 **Expert witnesses**—Their function is (*inter alia*) to explain words, or terms of science or art appearing on the documents which have to be construed by the Court, to give expert assistance to the Court, *e.g.* as to the laws of science, or the working of a technical process or system) or to inform the Court as to the state of public knowledge with regard to the matters before it: see *Grosfield & Sons Ltd.* v. *Techno-Chemical Laboratories Ltd.* (1913) 29 T.L.R. 379; *Badische Celanese Ltd.* v. *Courtaulds Ltd.* (1935) 152 L.T. 537, H.L. "The opinion of scientific men upon proven facts may be given by men of science within their own science" (*United States Shipping Board* v. *Ship St. Albans* [1931] A.C. 632, P.C., in which the evidence of a land surveyor to deduce the position of the vessels from three photographs of a collision at sea taken from a passing vessel was not accepted). In no case is it competent for them to express their opinion upon any of the issues, whether of law or fact, which the Court or a jury has to determine (*per* Neville J. in *Grosfield & Sons* v. *Techno-Chemical Laboratories Ltd.* (1913) 29 T.L.R. 379). Thus, in a patent action, an expert witness is not entitled to say what the specifi[illegible]

alteration is obvious, that being a question for the Court (per Lord Tomlin in *British Celanese Ltd. v. Courtaulds Ltd.* above, p.543). As to admissibility of expert evidence on the question whether or not concealment or non-disclosure of a fact is material to the making of a policy of insurance, see *Locker and Woolf, Ltd. v. Western Australian Insurance Co. Ltd.* (1935) 153 L.T. 334.

Expert witnesses are entitled at the trial to refer to documents consisting of summaries of the results of research into the drug alleged to have caused the injuries complained of and articles and letters about the drug published in medical journals, and they may do so as part of the body of their expertise and if they do so, the Court would have to admit such documents in evidence, in the sense of reading them and giving the factual assertions in them such weight as is thought fit, and indeed if an expert refers to the results of research published by a reputable authority in a reputable journal, the Court will ordinarily regard those results as supporting any inferences fairly to be drawn from them, unless or until a different approach is shown to be correct (*H. v. Schering Chemicals Ltd.* [1983] 1 W.L.R. 143; [1983] 1 All E.R. 849).

Expert witnesses when giving evidence at trial are entitled to draw on and rely on materials produced by others in the area in which the experts have their expertise, *e.g.* statistical records compiled by the Home Office, since subject to limitations, their evidence is not subject to the rule against hearsay evidence in the same way as that of witnesses of fact (*R. v. Abadom* [1983] 1 W.L.R. 126; [1983] 1 All E.R. 364).

Expert evidence as to foreign law may be given by a person who is otherwise suitably qualified to do so on account of his knowledge or experience, irrespective of whether he has acted or is entitled to act as a legal practitioner in the country or territory of that law (Civil Evidence Act 1972, s.4(1) see Vol 2, Pt.18, para.6100).

As to proof of foreign law, see *De Beeche v. South American Stores Ltd. and Chilian Stores Ltd.* [1935] A.C. 148; *St. Pierre v. South American Stores (Gath and Chaves) Ltd.* [1937] 3 All E.R. 349, C.A.; *Rendal (A/S) v. Arcos Ltd.* [1937] 3 All E.R. 577, pp.582, 583, H.L.

The general rule of law that there is no property in a witness of fact applies also to an expert witness and therefore subject to the limitation that such a witness cannot give evidence as to communications, arising in the course of his being instructed by one party, which are protected by legal professional privilege, an expert witness who has been consulted by one side and has given his opinion to that side, can thereafter be consulted and if necessary subpoenaed by the other side to give his opinion on the facts of the case (*Harmony Shipping Co. S.A. v. Saudi Europe Line Ltd.* [1979] 1 W.L.R. 1380; [1979] 3 All E.R. 177, C.A.). It is however clearly undesirable that expert witnesses should be involved with both sides (*third party*, Waller L.J.).

The Court has the power to direct that expert evidence be called after all other evidence has been heard (*Alpina Zurich Insurance Co. v. Bain Clarkson, The Times*, January 23, 1989). Copies of an expert's evidence should be disclosed and not the bare bones of his report. Hence a covering letter containing matter which is material to the report and its conclusions should be disclosed as the party calling the expert has a duty to disclose the substance of his evidence. (*Kenning v. Eve Construction, The Times*, November 29, 1989).

In Admiralty actions, the following *Practice Direction* as to the Evidence of Expert Witnesses issued by the President will apply [1968] 1 W.L.R. 312; [1968] 1 All E.R. 447.

Where a party intends to adduce expert evidence, he should produce to the other party his expert's statement of proposed evidence, together with any reports, plans, models, calculations, etc., relevant to it, for agreement if possible. Failing such agreement, the other party should deliver to the first party a written statement setting out particulars of the matters not agreed. Where both parties intend to adduce expert evidence, each should follow this procedure. Failure by any party to follow this procedure may result in a special order as to costs.

For the appointment of a Court expert, see O.40.

Limitation of plans, etc. in evidence (O.38, r.5)

38/5 5. Unless, at or before the trial, the Court for special reasons otherwise orders, no plan, photograph or model shall be receivable in evidence at the trial of an action unless at least 10 days before the commencement of the trial the parties, other than the party producing it, have been given an opportunity to inspect it and to agree to the admission thereof without further proof.

38/5/1 **Effect of rule**—This rule was taken from the former O.37, r.11). See in relation to automatic directions in personal injury actions, O.25, r.8(1)(*d*).

Care must be taken at a trial to ensure that no plan, photograph or model shall be received in evidence, unless the parties, other than the party producing it, have been given an opportunity to inspect and agree it or the Judge for special reasons makes an order or direction that it may be received. In the event of the Judge making such an order or direction the Associate must include it in the Certificate for the information of the Taxing Master.

An application to produce a plan, photograph or model [illegible]

(and identifying what is to be produced and stating that in the opinion of the deponent, the document, plan or film, etc. is relevant to an issue in the action and to the *bona fides* of the other party and specifying the special reasons relied upon for seeking non-disclosure. *McGuinness v. Kellog Co. of Great Britain* [1988] 1 W.L.R. 913; [1988] 2 All E.R. 1, C.A.).

Revocation or variation of orders under rules 2 to 5 (O.38, r.6)

6. Any order under rules 2 to 5 (including an order made on appeal) may, on sufficient cause being shown, be revoked or varied by a subsequent order of the Court made at or before the trial. 38/6

Substituted by R.S.C. (Amendment) 1974 (S.I. 1974 No.295). This rule reproduces the former r.7.

Evidence of finding on foreign law (O.38, r.7)

7.—(1) A party to any cause or matter who intends to adduce in evidence a finding or decision on a question of foreign law by virtue of section 4(2) of the Civil Evidence Act 1972 shall— 38/7

(*a*) in the case of an action to which Order 25, rule 1, applies, within 14 days after the pleadings in the action are deemed to be closed, and

(*b*) in the case of any other cause or matter, within 21 days after the date on which an appointment for the first hearing of the cause or matter is obtained,

or in either case, within such other period as the Court may specify, serve notice of his intention on every other party to the proceedings.

(2) The notice shall specify the question on which the finding or decision was given or made and specify the document in which it is reported or recorded in citable form.

(3) In any cause or matter in which evidence may be given by affidavit, an affidavit specifying the matters contained in paragraph (2) shall constitute notice under paragraph (1) if served within the period mentioned in that paragraph.

Added by R.S.C. (Amendment) 1974 (S.I. 1974 No. 295).

38/7/1 **Operation of rule**—The object of s.4 is to avoid the need to prove as a fact a question of foreign law with respect to any matter in subsequent proceedings where that question has already been the subject of a finding or decision contained in a judgment of the High Court or in a judgment on appeal therefrom, where such judgment is in a citable form. The need for that section arises from the fact that the finding or decision of the English Court as to what is the foreign law on a particular question or matter is essentially a finding of fact in the particular action in which it is made and can have no probative value in any other action, and therefore if the same question with respect to the same matter were to arise in a subsequent action, it would have to be proved afresh in that action.

The party intending to adduce such finding or decision in evidence in subsequent proceedings must, however, comply with the machinery and requirements of this rule. For this purpose, he must serve notice of his intention on every other party to the proceedings and such notice must comply with the requirements (*a*) as to time, and (*b*) as to content. As to time, the notice must be served in an action begun by writ within 14 days after the close of pleadings (para.1(*a*)) and in any other proceedings, within 21 days after the date on which the appointment for the first hearing of the action is obtained (para.1(*b*)). As to content, the notice must specify the question on which the finding or decision was given or made, and must also specify the document in which it is reported or recorded in citable form (para. 2).

In any cause or matter in which evidence may be given by affidavit, an affidavit specifying the matters required to be contained in the requisite notice shall constitute the requisite notice if served within the periods above mentioned (para. (3)). It would seem that in interlocutory matters, as for example, on an application to set aside the service of the writ out of the jurisdiction, an affidavit specifying the requisite matters will constitute the requisite notice to adduce in evidence the finding or decision on the question of the foreign law relied on.

A finding or decision on any question of foreign law will be treated as reported or recorded [illegible]

(Civil Evidence Act 1972).

It should be noted that the foreign law with respect to any matter will not be taken to be in accordance with the finding or decision specified in the notice served under this rule if it conflicts with another finding or decision on the same question adduced by the service of the requisite notice under this rule in the same proceedings (see proviso to s.4(2) of the Civil Evidence Act 1972, Vol. 2, para.6104). Moreover, a party who fails to serve the requisite notice under this rule will be precluded from adducing in evidence the finding or decision on which he relies except with the leave of the Court (see s.4(3)).

On the other hand, there is nothing to prevent a party from calling expert evidence of foreign law to show that the foreign law on the question on which the finding or decision relied on has been repealed or abrogated, changed or modified or that the foreign law is contrary to that finding or decision.

Application to trials of issues, references, etc. (O.38, r.8)

38/8 8. The foregoing rules of this Order (other than rule 2A) shall apply to trials of issues or questions of fact or law, references, inquiries and assessments of damages as they apply to the trial of actions.

Amended by R.S.C. (Amendment No. 2) 1986 (S.I. 1986 No. 1187).

38/8/1 **Effect of rule**—This rule was taken from the former O.37, r.2. It is particularly important to note that as to assessments of damages the evidence of the witnesses must be proved by their examination orally and in open Court, save in the case in which some other mode of proof is allowed by order or is otherwise admissible (see rr.2 and 3, and rr.20 *et seq.*).

Depositions: when receivable in evidence at trial (O.38, r.9)

38/9 9.—(1) No deposition taken in any cause or matter shall be received in evidence at the trial of the cause or matter unless—

(*a*) the deposition was taken in pursuance of an order under Order 39, rule 1, and

(*b*) either the party against whom the evidence is offered consents or it is proved to the satisfaction of the Court that the deponent is dead, or beyond the jurisdiction of the Court or unable from sickness or other infirmity to attend the trial.

(2) A party intending to use any deposition in evidence at the trial of a cause or matter must, a reasonable time before the trial, give notice of his intention to do so to the other party.

(3) A deposition purporting to be signed by the person before whom it was taken shall be receivable in evidence without proof of the signature being the signature of that person.

38/9/1 **Effect of rule**—This rule was taken from the former O.37, rr.18 and 24.

Depositions taken before an examiner under O.39, r.1, do not *per se* become evidence in the case. (*Fisher* v. *C. H. T. Ltd.* [1965] 1 W.L.R. 1093; [1965] 2 All E.R. 601). The party at whose instance the evidence was taken before the trial is not bound to put that evidence in at the trial, but he or any other party may, and if he so wishes, must do so, and then the whole deposition becomes evidence (*ibid.*). He must bespeak an office copy (see rule 10) and give reasonable notice of his intention to do so (para.(2)).

Court documents admissible or receivable in evidence (O.38, r.10)

38/10 10.—(1) Office copies of writs, records, pleadings and documents filed in the High Court shall be admissible in evidence in any cause or matter and between all parties to the same extent as the original would be admissible.

(2) Without prejudice to the provisions of any enactment, every document purporting to be sealed with the seal of any office or department of the Supreme Court shall be received in evidence without further proof, and any document purporting to be so sealed and to be a copy of a document filed in, or issued out of, that office or department shall be deemed to be an office copy of that document without further proof unless the contrary is shown.

former O.61, r.7. The present rule is in general terms and [illegible] seal of "any office or department of the Supreme Court," and this would include Chambers or the Admiralty Registry or the District Registries.

38/10/2 **Certification of documents for use abroad**—The practice is as follows:

(1) When a certified copy of a judgment, order or any other filed document is required for use in a foreign or Commonwealth Court the applicant shall bespeak the certified copy from the department having the custody of the document, explaining the purpose for which the document is required.

(2) The certified copy will normally be issued bearing the name of the officer of the Court having custody of the document and authenticated by one of the Masters of the Supreme Court.

(3) Further authentication, e.g. by one of Her Majesty's Justices of the Supreme Court of Judicature, or the Lord Chancellor, will no longer be available except where the applicant is able to satisfy the Practice Master that the foreign Court or authority for which the document is required, will not accept as sufficient the copy certified as in para.2 above.

Practice Directions (Documents for Use Abroad: Q.B.D. and Ch.D.) [1971] 1 W.L.R. 604; [1971] 2 All E.R. 160).

See M.P.D. No.16B, Vol.2, Pt.3A, para.717.

This practice applies in the Q.B.D. and the Ch.D. and will presumably be followed in the Family Division. By virtue of O.63, r.11, it will also be followed in the District Registries.

38/10/3 **Certified copies for use in the Republic of Eire**—See n. Republic of Ireland under O.71, r.14.

Certified copies for use in Belgium and France—Belgium—By Art. 1 of an Agreement between H.M. Government in Great Britain and the Belgian Government, made in Brussels, December 21, 1928, it is provided that copies or extracts from judgments, decrees, orders and other judicial proceedings in any Courts of justice in Great Britain and Northern Ireland, and affidavits, pleadings or other documents filed or deposited in any such Court, shall not require legalisation in order to be accepted as authentic in Belgium provided that they bear *prima facie* evidence of authenticity and are certified, in accordance with the Agreement, to be in conformity with the original.

France—Art. 1 of an Agreement between H.M. Government in the U.K. and the Government of the French Republic, made in Paris, April 3, 1937, provides to the same effect in regard to France (including Algeria).

The Certificate for use in the Central Office is in the following form and is signed by the Senior Master or his deputy:

"I HEREBY CERTIFY that the Office Copy document hereto annexed is in conformity with the original thereof filed or deposited in the Central Office of the Supreme Court of Judicature in England.

"Dated this day of , 19 .

"Senior Master of the Supreme Court of Judicature in England."

38/10/4 **Legalisation of foreign public documents**—For the extent to which the requirement of "legalisation" of foreign public documents has been abolished, see the Convention (Treaty Series No.32 Cmnd.2617 (1965)) which came into force on January 24, 1965.

Admissibility abroad of entries in British registers—The above agreements also extend to the use in Belgium and France of copies of entries in registers kept in Great Britain and Northern Ireland, relating to civil status (births, marriages, divorces, deaths, adoptions) and also of certificates issued by the Patent Office in London relating to British patents, designs and trade marks.

38/10/5 **Admissibility in England of entries in foreign registers**—The converse case (namely the use in the United Kingdom of certified entries in foreign public registers) is provided for by the Evidence (Foreign, Dominion and Colonial Documents) Act 1933, and the Oaths and Evidence (Overseas Authorities and Countries) Act 1963, which enables Orders in Council to be made applying these Acts to entries in particular registers of particular countries authenticated in manner provided in the Orders. Under the Act of 1933, Orders have been made applying the Act to certain registers of certain countries—namely Belgium—(S.R. & O. 1933 No.383); Canada—all provinces except Ontario, New Brunswick and Alberta (S.I. 1962 No.2046); France—(S.R. & O. 1937 No. 515); Australia—(S.R. & O. 1938 No.739); New Zealand—(S.I. 1959 No.1306); Bahamas—(S.I. 1961 No.2041); Barbados—(S.I. 1962 No.641); Bermuda—(S.I. 1961 No.2042); British Antarctic—(S.I. 1962 No.2605); British Guiana—(S.I. 1961 No.2043); British Honduras—(S.I. 1961 No.2044); Dominica—(S.I. 1961 No.2045); Falkland Islands—(S.I. 1962 No.2607); Fiji—(S.I. 1961 No.2046); Gibraltar—(S.I. 1961 No.2047); Hong Kong—(S.I. 1962 No.642); Jamaica—(S.I. 1962 No.643); Mauritius—(S.I. 1961 No.2048); Montserrat—(S.I. 1962 No.644); St. Helena—(S.I. 1961 No.2049); Sarawak—(S.I. 1961 No.2050); Seychelles—(S.I. 1962 No. 2608); Sierra Leone—

(S.I. 1965 No.1720); Basutoland—(S.I. 1965 No. 1719); Grenada—(S.I. 1966 No ...); Kenya—(S.I. 1965 No. 1712); Saint Lucia—(S.I. 1965 No. 1721); Turks and Caicos Islands—(S.I. 1966 No. 83).

Under the Act of 1963, Orders have been made applying the Act to certain registers of the following countries, namely Denmark—(S.I. 1969 No.144), Italy—(S.I. 1969 No.145), the United States of America—(S.I. 1969 No.146), the Republic of Ireland—(S.I. 19.. No.1059), the Netherlands—(S.I. 1970 No.284), specified public registers of the Federal Republic of Germany and Land Berlin (West Berlin)—(S.I. 1970 No.819), Luxembourg—(S.I. 1972 No.116).

Evidence of consent of new trustee to act (O.38, r.11)

38/11 11. A document purporting to contain the written consent of a person to act as trustee and to bear his signature verified by some other person shall be evidence of such consent.

38/11/1 **Effect of rule**—This rule was taken from the former O.38, r.19A.

The sealed consent of the Public Trustee to act is accepted without verification or affidavit of fitness.

In the Court of Protection, the practice is similar to that provided by this rule.

For forms, see Ch.M.P.F. 31, Vol.2, Pt.2.

38/11/2 **Affidavit of fitness of new trustee**—This should show something as to the position of the proposed trustees in respect of their pecuniary means (*per* Kay J., *Re Castle Sterry's Trust* [1888] W.N. 179). In *Re Smith's Policy Trusts* [1894] W.N. 68, Kekewich J., held that an affidavit stating that the proposed trustees were persons of good credit was sufficient as to their pecuniary means. One affidavit only is as a rule required (see *Re Arden* [1887] W.N. 166).

Evidence at trial may be used in subsequent proceedings (O.38, r.12)

38/12 12. Any evidence taken at the trial of any cause or matter may be used in any subsequent proceedings in that cause or matter.

38/12/1 **Effect of rule**—This rule was taken from the former O.37, r.25. An undertaking that an affidavit shall not be used at the hearing does not preclude its being used on an inquiry in Chambers (*Jenners* v. *Morris* (1862) 10 W.R. 640).

Order to produce document at proceeding other than trial (O.38, r.13)

38/13 13. At any stage in a cause or matter the Court may order any person to attend any proceedings in the cause or matter and produce any document to be specified or described in the order, the production of which appears to the Court to be necessary for the purpose of that proceeding.

(2) No person shall be compelled by an order under paragraph (1) to produce any document at a proceeding in a cause or matter which he could not be compelled to produce at the trial of that cause or matter.

38/13/1 **Effect of rule**—This rule was taken from the former O.37, r.7.

This rule does not enable an order to be made for the inspection of documents in the hands of persons not parties (*Straker* v. *Reynolds* (1889) 22 Q.B.D. 262) nor does it confer any additional right of discovery against such persons: the object of the rule is to enable an order to be made at any stage of a proceeding, but it can only be made for purposes of a particular proceeding (*Elder* v. *Carter* (1890) 25 Q.B.D. 194; *O'Shea* v. *Wood* [1891] P. 237, p.286; *Pritchard* v. *Macfarlane* [1891] 2 Q.B. 241; *Penn-Texas Corp.* v. *Murat Anstalt* [1964] 1 Q.B. 40; [1963] 1 All E.R. 258, C.A.; *Penn-Texas Corp.* v. *Murat Anstalt (No. 2)* [1964] 2 Q.B. 647; [1964] 2 All E.R. 594, C.A.; *Central News Co.* v. *Eastern Telegraph Co.* (1884) 53 L.J.Q.B. 236).

The order has the effect of a subpoena *duces tecum*. The order can be made *ex parte* (*Re S...* [1891] 1 Ch. 323; *Zumbech* v. *Biggs* (1900) 48 W.R. 507). The party on whom the order is made may on attending with the documents raise any legal objection to production (*Re S...* (1891)).

In an action against a married woman, the solicitor to the trustees of the settlement was held bound to produce it, as the defendant could not object to such production (*B...* v. *Tanner* (1885) 16 Q.B.D. 1).

In personal injury actions, a different rule applies, see O.24, r.7A.

Copies of entries in bankers' books—Subject to the following requirements, a copy of an entry in a banker's book shall be received in all legal proceedings as prima facie evidence of such entry (s.3): legal proceeding means any civil or criminal proceeding or inquiry in which evidence is or may be given and includes an arbitration (s.10). Proof is required that the book was at the time of entry one of the ordinary books of the bank, in its custody, and the entry made in the ordinary course of business. The proof may be given orally or by affidavit by a partner or officer of the bank; (*b*) that the copy is correct. This proof may be given in the same manner by the person who examined the copy (ss.4, 5). Such person need not be an officer of the bank; the proof may be given by any person who has examined the copy with the original entry (*R.* v. *Allbut* (1911) 75 J.P. 112). The bank need not produce the original books if ss.2–5 are complied with. Evidence under the Act is prima facie evidence against all the world (*London and Westminster Bank* v. *Button* (1907) 51 S.J. 466).

Inspection of books—Where before the Act a party had a right to issue a subpoena *duces tecum*, he can now obtain an order for inspection and leave to take copies of entries (see s.7 and *Re Marshfield* (1886) 32 Ch.D. 499). 38/13/3

Banking account of person not a party—If it is proved to the satisfaction of the Court that a banking account, nominally that of a person not a party, is really that of a party, or that the party is so closely connected with it that items in it would be evidence against him at the trial, then the Court in its discretion may order inspection before trial, but great care must be taken in exercising this jurisdiction, and the order ought not to be made without notice to the person (*S. Staffordshire Tramways Co.* v. *Ebbsmith* [1895] 2 Q.B. 669; *Ironmonger* v. *...* (1928) 44 T.L.R. 579). "When an account is the account of a person who has nothing to do with the litigation, the Court ought to look to the effect in practice of such an order on the rights of third parties, and to take care that this section is not made a means of oppression" (*per* Lindley M.R., *Pollock* v. *Garle* [1898] 1 Ch. (1898) p.5). See *L'Amie* v. *Wilson* [1907] 2 I.R. 130.

Save in exceptional circumstances, the Court should not require a foreigner who is not a party to the action, and in particular a foreign bank, to produce a subpoena and order under the Bankers' Books Evidence Act 1879 documents outside the jurisdiction concerning business transacted outside it (*MacKinnon* v. *Donaldson, Lufkin and Jenrette Securities Corp.* [1986] Ch. 482; [1986] 1 All E.R. 653 (New York Bank), following *R.* v. *Grossman* (1981) 73 Cr.App.R. 302 (Isle of Man branch of Barclays Bank)). Orders under the Act concerning documents outside the jurisdiction are so unusual that they should ordinarily be made on notice to the bank (*ibid*).

Privilege—Where the application is to inspect the books of the banker of a party to the litigation, the latter may successfully claim protection for such of the entries sought to be inspected as would be protected if in the possession of the party, provided he claims that protection in an affidavit of discovery in proper form and on adequate grounds (*Waterhouse* v. *Barker* [1924] 2 K.B. 759): thus the order was refused as to entries which the party swore would tend to incriminate him (*ibid.*) or were not relevant (*S. Staffordshire Tramways Co.* v. *Ebbsmith* [1895] 2 Q.B. 669) and the affidavit is conclusive and cannot be contradicted (*Parnell* v. *Wood* (1892)). The Act does not take away any ground of privilege from, nor does it extend the right to discovery against, a party, but it gives a right to discovery of documents not in possession of the party (*Perry* v. *Phosphor Bronze Co.* (1895) 71 L.T. 854). 38/13/4

Books to which Act applies—The Act applies to books in the custody or control of the successors to the bank, by whom the entries in the books were originally made (*Asylum for Idiots* v. *Handyside* (1906) 22 T.L.R. 573 C.A.). 38/13/5

A book is "used in the ordinary business of the bank" within s.9 of the Act, though it may not be in daily use, if it is kept by the bank, so that they may have it in case it is desired to refer to it S.C.).

Bankers' books include a record of a customer's transactions and details of cheques recorded by a bank on microfilm, and accordingly such microfilm may be used for the purposes of proving banking transactions in legal proceedings in accordance with the Act (*Barker* v. *Wilson* [1980] 1 W.L.R. 884; [1980] 2 All E.R. 81, D.C.); but the term does not extend to include letters contained in a bank correspondence file and as such are not admissible under the Act (see *R.* v. *Dadson* (1983) 127 S.J. 396; (1983) 77 Cr.App.R. 291, C.A.). Paid cheques and paying-in slips retained by a bank after the conclusion of the transaction to which they related are not "bankers' books" within the meaning of the 1879 Act as amended by the Banking Act 1979 (*Williams* v. *Williams* [1988] Q.B. 161, C.A.).

There is jurisdiction to make an order in case of bankers in Scotland or N. Ireland (*Kissam* v. *Link* [1896] 1 Q.B. 574).

Practice on application—The practice in Ch.D. is to apply at Chambers and in Q.B.D. to a Master on an affidavit of facts (as to whether this is necessary in all cases, see *Arnott* v. *Hayes* (1887) 36 Ch.D. 731, p.736). The affidavit should state (1) the nature of the proceedings (2) necessity for the inspection and for the copies, showing that the entries of which inspection is sought will be admissible in evidence at the trial of the action (*Howard* v. *Beall* (1889) 23 Q.B.D. 2) and (3) the period over which it is proposed that the inspection should 38/13/6

137).

38/13/7 **The order**—*The order should, as far as possible, be limited to the entries which may be wanted at the hearing, but should be sufficiently wide to enable the applicant to get copies of the requisite entries (Arnott v. Hayes (1887) 36 Ch.D. 731, p.738). Provided that the entries would have been admissible in evidence prior to the Act, an order may be made for inspection and copies under s.7, although the accounts are kept in the names of other persons besides the parties to the action (Howard v. Beall (1889) 23 Q.B.D. 1). And see S. Staffordshire Tramways Co. v. Ebbsmith* [1895] 2 Q.B. 669.

38/13/8 **Criminal proceedings**—In criminal proceedings the order is made by the Judge in Chambers, and drawn up at the Crown Office.

In proceedings for criminal libel, defendants, who proposed to plead justification were refused an order for inspection of the account of the person alleged to be libelled (*R* v. *Bate* (1913) 29 T.L.R. 635).

Court-martial—Orders have been made by the Judge in Chambers for production of bankers' books before a court-martial.

Statutory "direction"—A direction by a state official made under a statutory authority requires proof pursuant to Documentary Evidence Act 1868 (*Tyrrell* v. *Cole* [1919] W.N. 19

II. WRITS OF SUBPOENA

Part II was added by R.S.C. (Amendment) 1969 (S.I. 1969 No. 1105).

Form and issue of writ of subpoena (O.38, r.14)

38/14 14.—(1) A writ of subpoena must be in Form No.28, 29, or 30 in Appendix A, whichever is appropriate.

(2) Issue of a writ of subpoena takes place upon its being sealed by an officer of the office out of which it is issued.

(3) Where a writ of subpoena is to be issued in a cause or matter which is not proceeding in a District Registry, the appropriate office for the issue of the writ is the Central Office or, if the cause or matter has been set down for trial outside the Royal Courts of Justice, either the Central Office or the registry for the district comprising the city or town at which the cause or matter has been set down for trial.

(4) Where a writ of subpoena is to be issued in a cause or matter which is proceeding in a District Registry, the appropriate office for the issue of the writ is—

(*a*) the registry, or

(*b*) if the cause or matter has been set down for trial at a city or town not comprised in the district of that registry, either that registry or the registry for the district comprising that city or town, or

(*c*) if the cause or matter has been set down for trial at the Royal Courts of Justice, either the Central Office or the registry in which the cause or matter is proceeding.

(5) Before a writ of subpoena is issued a praecipe for the issue of the writ must be filed in the office out of which the writ is to issue; and the praecipe must contain the name and address of the party issuing the writ, if he is acting in person, or the name or firm and business address of that party's solicitor and also (if the solicitor is the agent of another) the name or firm and business address of his principal.

This rule was amended by R.S.C. (Amendment No.5) 1971 (S.I. 1971 No.1955)

(O.38, r.15)

15. The names of two or more persons may be included in one writ of subpoena ad testificandum. 38/15

Amendment of writ of subpoena (O.38, r.16)

16. Where there is a mistake in any person's name or address in a writ of subpoena, then, if the writ has not been served, the party by whom the writ was issued may have the writ re-sealed in correct form by filing a second praecipe under rule 14(5) indorsed with the words "Amended and re-sealed." 38/16

Service of writ of subpoena (O.38, r.17)

17. A writ of subpoena must be served personally and, subject to rule 19, the service shall not be valid unless effected within 12 weeks after the date of issue of the writ and not less than four days or such other period as the Court may fix, before the day on which attendance before the Court is required. 38/17

Amended by R.S.C. (Amendment No.2) 1980 (S.I. 1980 No.1010).

Duration of writ of subpoena (O.38, r.18)

18. Subject to rule 19, a writ of subpoena continues to have effect until the conclusion of the trial at which the attendance of the witness is required. 38/18

Writ of subpoena in aid of inferior Court or tribunal (O.38, r.19)

19.—(1) The office of the Supreme Court out of which a writ of subpoena ad testificandum or a writ of subpoena duces tecum in aid of an inferior Court or tribunal may be issued is the Crown Office, and no order of the Court for the issue of such a writ is necessary. 38/19

(2) A writ of subpoena in aid of an inferior Court or tribunal continues to have effect until the disposal of the proceedings before that Court or tribunal at which the attendance of the witness is required.

(3) A writ of subpoena issued in aid of an inferior Court or tribunal must be served personally.

(4) Unless a writ of subpoena issued in aid of an inferior Court or tribunal is duly served on the person to whom it is directed not less than 4 days, or such other period as the Court may fix, before the day on which the attendance of that person before the Court or tribunal is required by the writ that person shall not be liable to any penalty or process for failing to obey the writ.

(5) An application to set aside a writ of subpoena issued in aid of an inferior Court or tribunal may be heard by a Master of the Queen's Bench Division.

Scope of rules 14–19—Rules 14–18 replaced the former O.37, rr.26–27A and 29–31A with a few minor amendments, and r.19 replaced the former O.59, r.43(2). They constitute together with O.32, r.7) a self-contained code relating to writs of subpoena, and prescribe the practice as to form and issue, amendment, service and duration. They apply to both writs of subpoena *ad testificandum*, and subpoena *duces tecum*. They also provide the machinery for enforcing the attendance of witnesses to testify or to produce documents at the trial of actions in the High Court in London or at a trial centre outside London, and in aid of inferior courts and tribunals. For enforcing the attendance of witnesses in Chancery Chambers, see O.32, r.7. 38/14–19/1

Forms of writs of subpoena—These must be in Form 28, 29 or 30 in App.A. (see Vol.2, Pt.2) whichever is appropriate, with such variations as the circumstances of the particular case require (O.1, r.9). The same forms are to be used whether the writ of subpoena is to compel the witness to testify or to produce documents or both. 38/14–19/2

A writ of subpoena *ad testificandum* may include the names of two or more persons, and a

separate fee is payable for each witness whose name is included. If the names of the witnesses cannot be given at the time of issue, it is the practice to issue the subpoena subject to requiring their insertion, with a note in the margin of the writ limiting the number of witnesses according to the fee on the praecipe. When names have been inserted no other names can be substituted (*Re Taylor* [1912] A.C. 347).

38/14–19/3 **Subpoena duces tecum**—There is no provision authorising the inclusion of more than one person in a writ of subpoena *duces tecum*. A separate writ of subpoena is therefore required for each witness whose attendance to produce documents is being enforced.

A subpoena *duces tecum* need not, before it is actually issued, specify the documents to be brought: it is sufficient if they are inserted afterwards with reasonable distinctiveness (*Scott v. I. R. C.* [1963] 1 W.L.R. 112; [1963] 1 All E.R. 68n.). But if a witness, served with a subpoena in a general form, admits that he has in his possession the documents thereby referred to, he must produce them (*Lee* v. *Angas* (1866) L.R. 2 Eq. 59; and see *Re Emma Silver Mining Co.* (1875) L.R. 10 Ch. 194, where the company was ordered on motion to produce its books on the cross-examination of its secretary on his affidavit).

It should be observed that the prescribed form of a subpoena *duces tecum* appears to embody a subpoena *ad testificandum* as well and therefore if it is desired for any proper purpose to limit the subpoena simply to compel the production of specified documents, that part of the prescribed form which requires the person served to attend the trial and testify should be deleted.

Although films and tape recordings may be "documents" so far as discovery is concerned, a subpoena *duces tecum* is in itself the apt instrument for compelling their production at the trial. The Court has an inherent jurisdiction to make orders for the production and playing of tape recordings and for the production and showing of cinematograph films, and the Court may make an order requiring the witness to provide not only tape recordings and films but also the apparatus to operate them, and may further order them to be played over or shown at such place as may be most convenient. The application for such an order must, however, be made on notice to the witness who may object thereto, and the Court has jurisdiction to refuse to make an order if it thinks it would be oppressive, unreasonable or otherwise improper to be ordered and the costs are in the discretion of the Court (*Senior* v. *Holdsworth, ex p. Independent Television News Ltd.* [1976] Q.B. 23; [1975] 2 All E.R. 1009, C.A.).

Where there is disobedience to a subpoena *duces tecum*, the Court has jurisdiction to enforce obedience by committal, even though the disobedience is not wilful (*R.* v. *Daye* [1908] 2 K.B. 333). But a secretary of a company cannot be committed for disobedience to a subpoena to produce its books when the books have been taken out of his possession by resolution of the directors (*R* v. *Stuart* (1886) 2 T.L.R. 244), but see *Re Emma Silver Mining Co.*; as to directors, see *Re Maville Hose* [1939] Ch. 32.

As to the right of a servant to refuse to produce documents without the authorisation of his master, see *Eccles & Co.* v. *Louisville and Nashville Ry.* [1912] 1 K.B. 135, C.A.

The fact that a banker has received a document upon the terms that it shall not be delivered up, except with the consent of the depositors, is no answer to a subpoena *duces tecum* requiring the banker to produce the document (*R.* v. *Daye* [1908] 2 K.B. 333).

Application for subpoena *duces tecum* to officers of a bank for production of their books refused, as being a matter to be left for determination of the judge at the trial (*Parnell* v. *Bland* [1892] P. 137). For practice under the Bankers' Books Evidence Act, see paras.38/13/2 *et seq.*

A partner of a defendant is, under a subpoena *duces tecum*, compellable to produce his copy of a partnership deed, copies of which have to be signed and retained by each partner (*Forster* v. *Samuel* [1913] 3 K.B. 706).

As to production of documents kept by the Registrar of Companies, see the Companies Act.

The issue of the writ where it is sought to examine medical records of a party or of a witness was serious matter and not a step to be taken lightly. Inquiries should first be taken to ascertain whether the required evidence could be made available by other means. Where the documents were protected by privilege the consent of the person concerned should first be sought. It is wrong on receipt of the writ to send the documents to the solicitors who issued the writ. The writ compels the person to whom it is addressed to attend the court. If he is unable to do so, the guidance of the court should be sought. *Re SI. (A minor) (Wardship: Medical Evidence)* (1987) 2 F.L.R. 412.

38/14–19/4 **Issue of writ of subpoena**—Before a subpoena may be issued, a *praecipe* duly completed must first be filed in the office from which it is to issue.

Any party may issue a subpoena for the examination of witnesses or for the production of documents by him, at any stage, without the leave of the Court, *i.e.* subpoenas issue as of course without order, for attendance for trial before a Judge or Official Referee or Master to whom an action or question is referred by order (O.36, rr. 3 and 11) including assessment of damages (O.37, rr.1 and 4).

On the other hand, subpoenas may not issue to compel the attendance of a witness for the purpose of proceedings in Chambers, except with leave; in the case of proceedings before a Judge, or Master or Registrar, by a note from the Judge, Master or Registrar, as the case may be (see O.32, r.7).

[illegible] in the Court of Appeal [illegible] of the Central Office.

In committal proceedings for contempt of Court, which partake of a quasi-criminal character, the Court has power to issue a subpoena of its own motion (*Yianni* v. *Yianni* [1966] 1 W.L.R. 120; [1966] 1 All E.R. 231).

38/14–19/5 *Arbitration*—For attendance before an arbitrator or umpire on a reference by submission out of Court, subpoena issues as of course without order (Arbitration Act 1950, s.12, Vol.2, p.18).

For attendance before an Official or Special Referee or Master, to whom a question has been referred by order for inquiry or report, or the action referred for trial, under O.36, subpoena issues without order.

Application of Arbitration Act to prior enactments as to arbitration—S.31(1) of Arb. Act 1950, applies to all prior or subsequent enactments as to arbitration.

The appointment of an arbitrator under the Lands Clauses Consolidation Act 1845, is by s.18 of that Act "deemed a submission to arbitration." Subpoena therefore issues as of course. If under s.68 of the Act a party elected to have the compensation assessed by a jury, and the sheriff declined to summon the witnesses, subpoena issued as of course.

Appointment of an arbitrator under the Local Government Act 1972, is deemed to be a submission, and subpoena issues as of course.

Acquisition of Land Act 1982; *Law of Property Act* 1925, s.84—By order of L.C.J. and M.R. writs of subpoena for attendance before an official arbitrator under above Acts issued as of course and in addition to the official title of proceedings should bear the heading "and In the Matter of the Arbitration Act 1950."

38/14–19/6 *Channel Islands and Isle of Man*—The S.C.A. 1981, s.36 does not apply as they are not part of the U.K. See Interpretation Act 1978, Sched. 1; *Re Brown* (1864) 33 L.J.Q.B. 193; *Dutton* v. *Farmer* (1851) 6 Exch. Rep. 242. Process in a civil or commercial matter can now be served in the Channel Islands, see *Practice Note (Channel Islands)* (1961) 105 S.J. 288.

The Summary Jurisdiction (Process) Act 1881 was applied to the Isle of Man by the Summary Jurisdiction Process (Isle of Man) Order, 1928 (S.R. & O. 1928, No. 377). It follows therefore that a Crown Office subpoena in a criminal matter runs to the Isle of Man.

Companies Act 1985—A witness summoned under s.561 must be served with a summons and not with a subpoena (*Re Westmoreland Co.* (1892) 66 L.T. 52). Order should not normally be made on a director to produce documents held by the company (*Re Maville Hose* [1938] W.N. 281).

No process for compelling production of any document kept by the Registrar may issue without leave of the Court (s.710(1)). Application is made *ex parte* to Master in Ch.D. and Q.B.D. A Chancery Master usually requires to see an opinion of counsel in support.

38/14–19/7 *Comptroller of patents*—Subpoena issues from the Central Office as of course, to compel the attendance of witnesses before the comptroller of patents, who, in this respect, is in the same position as an Official Referee.

Conduct money—As to tender of conduct money, see S.C.A. 1981, s.36(4). This is a condition pre-requisite to proceedings against a person who defaults in complying with a subpoena.

Examiner—The attendance of an affidavit witness for cross-examination may (when once the order for cross-examination has been obtained) be compelled by subpoena under this rule without order.

Unless a subpoena is issued, the attendance of a witness before an examiner cannot be compelled on motion (*Stuart* v. *Balkis Co.* (1884) 32 W.R. 676) and as a matter of practice a subpoena before an examiner, directed to the witness to be examined, issues as of course without order under this rule.

Medical Act 1956—Pursuant to Schedule 4, para.5(1) writs of subpoena are issued out of the Central Office.

Subpoenas may be issued for attendance before Disciplinary Committee under the Provisions Supplementary to Medicine Act 1960 (see 2nd Sched., Part II, para.2, of that Act).

Nurses (Amendment) Act 1961—Subpoenas may be issued under s.9.

38/14–19/8 *Solicitors Act 1974—applications under*—See rules printed in [1932] W.N. p. 333 Misc.). For the purpose of an application before the Committee of the Incorporated Law Society to strike the name of a solicitor off the Roll of Solicitors or to require a solicitor to answer allegations contained in an affidavit, writs of subpoena *ad testificandum* and *duces tecum* may, pursuant to s.46(11) of the 1974 Act, be issued out of the Central Office. Forms of subpoena, App. to rules printed [1932] W.N. p.333 (Misc.) and [1939] W.N. 123 (Misc.). An order for substituted service by registered post of the *subpoena* may be obtained in Chambers. See Vol.2, Pt.11.

Witness in Eire—The High Court has no power to issue a subpoena.

Act 1854, the Scottish Court issues a warrant of citation and under s.67 of the Judicature (Northern Ireland) Act 1978, the Court of Northern Ireland issues a subpoena. These processes are served (by serving a copy and producing the original) on the witness in England. For procedure where the witness disobeys warrant or subpoena, see s.3 of the Act.

Witness in Scotland or N. Ireland required in England—See S.C.A. 1981, s.36, as to issue of subpoena by leave where witness is in Scotland or N. Ireland. This section applies to attendance before an O.R. or arbitrator on reference under an order.

Application in Chancery and Q.B. *ex parte* in Chambers without summons (in practice to a Master except in commercial cases); on affidavit stating reasons order indorsed on affidavit. In Fam.D. *ex parte* to Registrar on affidavit. The order is not drawn up.

38/14–19/9 **Service of subpoena**—Personal service is necessary, though substituted service may be ordered. Where a witness persistently refused admission to her house for the purpose of service, the Judge ordered substituted service by post (*Dyson* v. *Forster* (1908) (unrep.), Jelf J. in Chambers, February 7, 1908).

As regards the time of service, particular attention must be paid to the amendment of r.17 which clearly requires that the subpoena must be served, not only *within* 12 weeks of its issue but also, not less than four days or such other period as the Court may fix before the day on which attendance before the Court is required.

Duration of subpoena—The subpoena continues to have effect until the conclusion of the trial at which the attendance of the witness was required. Where the trial is abortive, *e.g.* where the jury disagrees, *semble* fresh subpoenas would have to be issued; but not so where the trial is adjourned.

38/14–19/10 **Subpoenas in aid of inferior Court or tribunal**—Such subpoenas are issued out of the Crown Office, as of course, no order is necessary (r.19 and see *Soul* v. *Inland Revenue Commissioners* [1963] 1 W.L.R. 112; [1963] 1 All E.R. 68n., C.A.).

A subpoena can generally be issued out of the Crown Office to aid an inferior tribunal in the following circumstances, namely where the inferior tribunal (1) is recognised by law; (2) is acting judicially or quasi-judicially; (3) is acting upon evidence, although that evidence need not be on oath, and (4) has insufficient power of its own to compel the attendance of witnesses or the production of documents; *Currie* v. *The Chief Constable of Surrey* [1982] 1 W.L.R. 215; [1982] 1 All E.R. 89 (subpoenas issued to compel witnesses other than police officers, to attend and give evidence at a police disciplinary hearing conducted under the Police (Discipline) Regulations 1977).

Para. (2) of r.19 states the duration of the writ of subpoena issued in aid of an inferior Court or tribunal in much the same way as in the case of a trial (r.18).

Para. (4) of r.19 is designed to mitigate the inconvenience that may be caused by the service of a Crown Office subpoena so near the date on which the witness is required to attend as to preclude an application being made to set it aside.

Para. (5) of r.19 changes the practice as to setting aside a Crown Office subpoena issued in aid of an inferior Court or tribunal by conferring this jurisdiction on a Master of the Q.B.D. An application to set aside any other subpoena issued out of the Crown Office must still be made to a Divisional Court. It is made by two clear days' notice of motion.

38/14–19/11 **Setting aside subpoenas**—Applications to set aside subpoenas in the Central Office or a District Registry are made to the Q.B. Masters or District Registrars (see *R.* v. *Interim Review* [1928] 2 K.B. 644; *Macbryan* v. *Brooke* [1946] 2 All E.R. 688, C.A.). In the Chancery Division, they are also made by summons to the Master.

As to setting aside Crown Office subpoenas, see previous note.

The power of the Master to set aside a subpoena does not extend to a witness summons issued under s.97 of the Magistrates' Court Act 1980 (previously s.77 of the 1952 Act), but application to set aside such a witness summons is made to the Court out of which summons was issued or to the Divisional Court of the Q.B.D. (see Criminal Procedure (Attendance of Witnesses) Act 1965, s.2, and *R.* v. *Hove Justices, ex p. Donne* [1967] 2 All E.R. 1253n).

The more convenient course is to apply to the Divisional Court of the Q.B.D., which has an inherent jurisdiction to set aside a witness summons served under s.97 of the Magistrates' Courts Act 1980 (previously s.77 of the 1952 Act) if there has been an abuse of the process of the Court or if it is clear in fact that the witness cannot give relevant evidence (*R.* v. *Lewes JJ. ex p. Secretary of State for Home Department* [1972] 1 Q.B. 232; [1971] 2 All E.R. 1126).

On all applications to set aside subpoenas, the Court is concerned to see that the parties do not abuse their privilege of summoning witnesses (*Raymond* v. *Tapson* (1882) 22 Ch.D. 430, p.435, C.A.). A witness served with a subpoena cannot have it set aside merely by swearing that he can give no material evidence, but if the Court is satisfied that the writ of subpoena *ad testificandum* has not been issued bona fide for the purpose of obtaining relevant evidence and that the witness named in it is in fact unable to give relevant evidence, it will set it aside. Such an order will not prejudice the power of the Judge at the trial to order the witness to attend if he thinks his presence is necessary (*R.* v. *Baines* [1909] 1 K.B. 258). The Court will also set aside a subpoena in a case where a statute excludes the power to issue it (*R.* v. *Hertfordshire* [illegible]

[1901] W.N. 195; 8 T.L.R. 84.

The Court will also set aside a subpoena *ad testificandum* which is oppressive by forcing a party to reveal information, *e.g.* as to the extent of his assets and his testamentary intentions, in proceedings in which he is not a party and his privacy ought not to be invaded in that way (*Morgan* v. *Morgan* [1977] Fam. 122; [1977] 2 All E.R. 515).

A subpoena *duces tecum* or an application in the nature of such a subpoena, such as an order to produce a film and to show it may be set aside or refused where it appears that the request is irrelevant, fishing, speculative or oppressive (see *Senior* v. *Holdsworth, ex p. Independent Television News Ltd.* [1976] Q.B. 23; [1975] 2 All E.R. 1009, C.A.).

Foreign subpoena—Where a foreign Court issued a subpoena ordering the disclosure of documents by the London branch of an American bank which concerned clients of the bank but which would be in breach of the bank's duty of confidentiality, the English Court has power to restrain the disclosure of such documents by the English branch (*Re a Bank, The Times*, February 4, 1983). 38/14–19/12

III. Hearsay Evidence

Interpretation and application (O.38, r.20)

20.—(1) In this Part of this Order "the Act" means the Civil Evidence Act 1968 and any expressions used in this Part of this Order and in Part I of the Act have the same meanings in this Part of this Order as they have in the said Part I. 38/20

(2) This Part of this Order shall apply in relation to the trial or hearing of an issue or question arising in a cause or matter and to a reference, inquiry and assessment of damages, as it applies in relation to the trial or hearing of a cause or matter.

Added by R.S.C. (Amendment) 1969 (S.I. 1969 No. 1105).

Scope and operation of Part III—Part III contains the rules which were authorised, and in some cases required, to be made by s.8 of the Civil Evidence Act 1968 (hereinafter referred to as "the Act"). These rules provide the machinery for adducing hearsay evidence at the trial or hearing of civil proceedings in the High Court. They should be read together with Part I of the Act (see Vol.2, Pt.18) which provides for the admissibility of hearsay evidence in civil proceedings. Part I of the Act has been brought into force for the Supreme Court (except for bankruptcy proceedings) as from October 1, 1969 (S.I. 1969 No. 1104) from which date ss.1 and 2 and part of s.6 of the Evidence Act 1938 were repealed; see s.20 of the Act. 38/20/1

The classes of hearsay evidence which are dealt with by Part III of this Order include:

(1) Section 2 statements, *i.e.* statements made out of court, whether orally or in writing and whether the person making such a statement is or is not called as a witness (see rr.21 and 22);

(2) Section 4 statements, *i.e.* statements contained in records (see rr.21 and 23);

(3) Section 5 statements, *i.e.* statements produced by computer (see rr.21 and 24);

(4) Statements in provisions legal proceedings (see rr.21 and 28);

(5) Statements affecting the credibility of a maker of out of court statement (see rr.21 and 30 and s.7 of the Act);

(6) Inconsistent statements made by person not called as a witness (see rr.21 and 31, and s.3 of the Act).

Part III of this Order does not apply to the classes of hearsay evidence admissible under s.9 of the Act, see Vol.2, Pt.18.

In broad outline, the machinery provided by these rules for adducing hearsay evidence operates in a two-stage process by the service of the requisite notice and counter-notice by one party on the other.

The first stage is for the party who desires to adduce hearsay evidence at the trial to serve the requisite notice of his intention to do so on every other party (see r.21) and such notice must contain the necessary particulars according to what is the particular class of hearsay evidence to which it relates (see r.22 (s.2 statements); r.23 (s.4 statements); r.24 (s.5 statements); r.28 (statements in previous legal proceedings); r.31 (inconsistent statements)). It is for the party who seeks to adduce evidence at the trial to take the initial step of serving the requisite notice upon all the other parties. If he complies with this obligation, he will (unless a counter-notice is served on him) be in a position to adduce such hearsay evidence at the trial if and in so far as it is admissible under the Act. If he defaults in complying with this obligation, or if a counter-notice is duly served, he will not be entitled to adduce such hearsay

evidence at the trial, subject, however, to the overriding discretion of the Court to admit such evidence (see r.29) or to his being able to show that the maker of the statement is unavailable.

The second stage is for any party served with a notice under r.21, if he so wishes, to serve a counter-notice requiring a person mentioned in the notice to be called as a witness at the trial (see r.26(1)). If the notice under r.21 states that that person cannot or should not be called as a witness and this is disputed, the counter-notice must contain a statement to that effect (see r.26(2)). Where a question arises as to the reasons stated under a r.21 notice for not calling a person as a witness, the Court may on the application of any party, determine that question before the trial or give directions as to its determination *e.g.* as a preliminary issue (see r.27). By the service of such a counter-notice, a party can, subject to the person named in the notice being unavailable and subject to the overriding discretion of the Court under r.29, ensure either that the named person who might otherwise not attend the trial at all should be called as a witness or otherwise that the statements to which the notice under r.21 relates will not be admitted in evidence at the trial (see r.26(4)). On the other hand, if the service of such a counter-notice is unreasonable, the party may suffer a penalty in costs (see r.32).

The procedure for the service of a counter-notice does not apply with respect to statements made in previous legal proceedings (see r.26(3)) but in relation to such statements the parties may apply to the Court for directions (see r.28). On the other hand, if a party desires to adduce evidence as to the credibility of a person whose statements are sought to be adduced under s.2 or s.4 of the Act and who is available to be called, he must either serve a counter-notice requiring that person to be called as a witness or, if the statements were made in previous legal proceedings, apply by summons to the Master or Registrar for a direction that he will be so called (see r.30). In Admiralty actions, special provisions in this regard apply, see O.75, r.25.

38/20/2 The machinery of Part III of this Order is designed to achieve two main objectives (*a*) that all questions concerning the giving of hearsay evidence at the trial should, so far as practicable be dealt with and disposed of before the trial, so that the trial itself should proceed smoothly without unnecessary objections relating to such hearsay evidence, and (*b*) that in relation to any hearsay evidence which any party desires to adduce, there should be no surprises at the trial.

It should be emphasised that these rules do not make any statement of fact admissible which is otherwise not admissible. They are merely procedural in their operation and do not affect the substantive law. The test of whether any hearsay statement is admissible evidence is governed by Part I of the Act. Indeed, r.29 confers express power on the Court, if it thinks it just to do so, to allow statements falling within ss.2, 4 or 5 of the Act to be given in evidence at the trial, even though there has been a non-compliance with the procedural requirements on the part of the adducing party by failing either to serve a r.21 Notice or to call a witness required to be called by a counter-notice under r.26. On the other hand, where the adducing party has complied with the procedural requirements of these rules relating to statements falling within ss.2, 4 and 5 of the Act, and either there is no counter-notice or it can be shown that the maker is unavailable, it would appear that the Court has no discretion to exclude such a statement (see s.8(3)(*a*) of the Act). Nevertheless, mere compliance with the rules does not by itself make the statements evidence at the trial; the adducing party must in fact put in evidence the statement or such of the statements as are contained in the r.21 Notice as he desires to put, and they will then form part of his evidence at the trial.

These rules do not apply to evidence by affidavit, which is governed by r.2 (see r.2(4)) nor do they affect the operation of O.41, r.5, as to the contents of affidavits (see r.21(4)) nor do they detract from the powers of the Court under r.3, to order the manner in which evidence of particular facts may be given at the trial (see r.21(4)).

In Admiralty actions, certain special provisions apply; see O.75, rr.25(1), 31(3), 32 and 38.

Moreover, these rules do not apply to any interlocutory proceedings but only to the stage of "the trial or hearing of the cause or matter," *i.e.* at the stage when the cause or matter is being finally disposed of by the evidence of a witness given orally and in open court (see r.1). They apply, however, to a reference, inquiry and assessment of damages as they apply to a trial (see para. (2)).

For forms, see Editorial Forms, EF 1–13, Vol.2, Pt.2, paras.601 *et seq.*

Notice of intention to give certain statements in evidence (O.38, r.21)

38/21 21.—(1) Subject to the provisions of this rule, a party to a cause or matter who desires to give in evidence at the trial or hearing of the cause or matter any statement which is admissible in evidence by virtue of section 2, 4 or 5 of the Act must—

(*a*) in the case of a cause or matter which is required to be set down for trial, within 21 days after it is set down or so adjourned, or within such other period as the Court may specify, and

(*b*) in the case of any other cause or matter, within 21 days after the date on which an appointment for the first hearing of the cause or matter is obtained, or within such other period as the Court may specify,

serve on every other party to the cause or matter notice of his desire to do so, and the notice must comply with the provisions of rule 22, 23 or 24, as the circumstances of the case require.

(2) Paragraph (1) shall not apply in relation to any statement which is admissible as evidence of any fact stated therein by virtue not only of the said section 2, 4 or 5 but by virtue also of any other statutory provision within the meaning of section 1 of the Act.

(3) Paragraph (1) shall not apply in relation to any statement which any party to a probate action desires to give in evidence at the trial of that action and which is alleged to have been made by the deceased person whose estate is the subject of the action.

(4) Where by virtue of any provision of these rules or of any order or direction of the Court the evidence in any proceedings is to be given by affidavit then, without prejudice to paragraph (2), paragraph (1) shall not apply in relation to any statement which any party to the proceedings desires to have included in any affidavit to be used on his behalf in the proceedings, but nothing in this paragraph shall affect the operation of Order 41, rule 5, or the powers of the Court under Order 38, rule 3.

(5) Order 65, rule 9, shall not apply to a notice under this rule but the Court may direct that the notice need not be served on any party who at the time when service is to be effected is in default as to acknowledgment of service or who has no address for service.

Amended by R.S.C. (Writ and Appearance) 1979 (S.I. 1979 No.1716).

38/21/1 **Application of rule**—This rule makes it obligatory on the party who desires to adduce hearsay statements admissible under ss.2, 4 or 5 of the Act to serve notice of his intention to do so on every other party. Failure to comply with this requirement may cause serious prejudice to another party, who will be unable to serve the requisite counter-notice under r.26, and may, subject to the discretion of the Court under r.29, preclude the party from giving in evidence at the trial a statement which would otherwise be admissible under ss.2, 4 or 5 of the Act. Compliance with this rule is therefore of cardinal importance to the party who desires to rely on hearsay statements admissible under ss.2, 4 or 5 of the Act.

This rule applies to statements that fall within ss.2, 4 or 5 of the Act, and also to inconsistent statements intended to be given in evidence made by a person mentioned in a r.21 Notice who is not to be called as a witness at the trial (see r.31(2)).

This rule applies to hearsay evidence contained in a document exhibited to an affidavit, since statements contained in an exhibit are not deemed to be included in the affidavit for all purposes, and therefore the exemption from service of a notice under this rule conferred by paragraph (4) in relation to evidence "or to be given by affidavit" does not extend to documents exhibited to an affidavit (*Re Koscot Interplanetary (U.K.) Ltd* [1972] 3 All E.R. 829).

Where one party gives notice in accordance with this rule that he intends to rely upon hearsay evidence and the other party intends to rely upon that evidence, the other party should also give notice under this rule. In *Letraset Ltd.* v. *Dymo Ltd.* [1976] R.P.C. 65, p.68 hearsay evidence given by the plaintiff at a previous trial was not admitted upon the defendant's application, even though the plaintiff had given notice under this rule of an intention to rely upon the evidence. Similarly, where either party has included documents in a list of documents disclosed on discovery and the other party desires to rely upon the contents of those documents as proving the truth of what is stated therein, that party should give notice under this rule, *Minnesota Mining & Mfg. Co.* v. *Johnson & Johnson Ltd.* [1976] F.S.R. 6; [1976] R.P.C. 671, C.A., where the obligation to give notice was waived.

On the other hand, this rule does not apply to any out-of-Court statement which is admissible in evidence independently of Part I of the Act (para.(2)) *e.g.* admissible by virtue of any other statutory provision or by agreement of the parties (see s.1(1) of the Act).

This rule does also not apply to statements made by the deceased in a probate action (para.(3)).

This rule does not extend to a statement containing expert evidence, since this would result in the evasion of the express provisions relating to the admission of expert evidence

the evasion in C.38, r.2 (*Rover International Ltd. v. Cannon Films Sales Ltd.* [1987] 1 W.L.R. 1597; [1987] 3 All E.R. 986).

38/21/2 **Parties to be served by r.21 Notice**—The requisite notice under this rule must be served by the adducing party on every other party to the cause or matter. The notice must, therefore, be served on every other plaintiff and defendant, whether or not the hearsay evidence would be admissible against him at the trial. Although it may appear anomalous the notice must be served by the plaintiff on every third or subsequent party, and equally the third or subsequent party must serve such notice on the defendant and the plaintiff.

The notice must also be served on a party who is in default of acknowledgment of service or who has no address for service, though the Court has power to dispense with service on such a party (see para. (5)). The need for the service of such a notice on a defendant in default of acknowledgment of service arises particularly when judgment is entered by damages to be assessed, since the defendant may desire to attend the hearing and contest the issue of damages.

Service of a notice under this rule need not, of course, be effected personally, but must comply with the requirements of O.65, r.5.

38/21/3 **Time for service of r.21 Notice**—The rule draws a distinction as to the time within which the notice under the rule must be served, according to whether the action is required to be set down for trial or hearing or adjourned into Court. As in what actions are required to be set down, see O.34, r.1. The term "adjourned into Court" in para.(1)(*a*) means adjourned into Court for the purpose of the trial or hearing of the action.

Service of a notice under this rule is allowed within 21 days from setting down or adjournment into Court. Ordinarily, therefore, a r.21 Notice may be served after the hearing of a summons for directions, but there is nothing to prevent a party from serving such a notice before the time specified, and in many cases it may be convenient to serve such a notice before the hearing of the summons for directions, especially with regard to statements in previous legal proceedings, *e.g.* at an inquest or in criminal proceedings.

The classes of cases which fall within para (1)(*b*) which are not required to be set down or adjourned into Court, include trials before the Official Referee, trials by consent and assessments of damages by a Master, trials and probably also summary determination of issues pleader and garnishee issues, and trials of other issues, *e.g.* whether or not a writ has been duly served. They also include references and inquiries under O.36 (see r.20(2)). In all such cases, service of a notice under this rule is required to be made within 21 days from the date of obtaining the appointment for the first hearing.

The period of 21 days is similar to that provided by O.27, r.5, for the service of notices to admit or produce documents. The Court, however, has a discretion to specify some other period, *e.g.* it may abridge this period where an order is made for a speedy trial in the Short Cause List. Although the service of a r.21 notice is out of time, the Court has a discretionary power to administer it, even if it is not very satisfactory since the weight will be a matter for the Court (*Rover International Ltd. v. Cannon Films Sales Ltd.* [1987] 1 W.L.R. 1597; [1987] 3 All E.R. 986, and see also r.29(1), below).

Special provisions with regard to time, etc., apply in Admiralty actions; see O.75.

38/21/4 **Contents of r.21 Notice**—A notice under this rule is not required to be in any particular form, but it must contain the particulars specified in rr.22, 23 or 24, as the circumstances of the case require. Failure to comply with these requirements will, of course render such notice defective and irregular but it will not render it a nullity; see O.2. The serving party will presumably be entitled to serve a corrective or substituted notice containing all the necessary particulars, and presumably also any party affected by such notice may apply for any particulars omitted to be supplied or in an extreme case he may apply by summons to the Master or Registrar to strike out such notice and to preclude the hearsay evidence to which it relates from being given at the trial. The powers of amendment under O.20, r.8, would seem to extend to such notice. Any objection that a r.21 Notice is defective should be taken as soon as practicable and should not be left to be raised for the first time at the trial, more particularly as the obligation to serve a counter-notice under r.26 would seem to arise even though the r.21 Notice is or may be defective.

As to Admiralty actions, see O.75.

For forms of r.21 Notice, see Editorial Forms, EF 1-4, Vol 2, Part 2, paras. 601 *et seq.*

Statement admissible by virtue of section 2 of the Act: contents of notice (O.38, r.22)

38/22 22.—(1) If the statement is admissible by virtue of section 2 of the Act and was made otherwise than in a document, the notice must contain particulars of—

(*a*) the time, place and circumstances at or in which the statement was made;

(*b*) the person by whom, and the person to whom, the statement was made;

(*c*) the substance of the statement or, if [illegible]

(2) If the statement is admissible by virtue of the said section 2 and was made in a document, a copy or transcript of the document, or of the relevant part thereof, must be annexed to the notice and the notice must contain such (if any) of the particulars mentioned in paragraph (1)(*a*) and (*b*) as are not apparent on the face of the document or part.

(3) If the party giving the notice alleges that any person, particulars of whom are contained in the notice, cannot or should not be called as a witness at the trial or hearing for any of the reasons specified in rule 25, the notice must contain a statement to that effect specifying the reasons relied on.

Statement admissible by virtue of section 4 of the Act: contents of notice (O.38, r.23)

38/23 23.—(1) If the statement is admissible by virtue of section 4 of the Act, the notice must have annexed to it a copy or transcript of the document containing the statement, or of the relevant part thereof, and must contain—

(*a*) particulars of—

(i) the person by whom the record containing the statement was compiled;

(ii) the person who originally supplied the information from which the record was compiled, and

(iii) any other person through whom that information was supplied to the compiler of that record;

and, in the case of any such person as is referred to in (i) or (iii) above, a description of the duty under which that person was acting when compiling that record or supplying information from which that record was compiled, as the case may be;

(*b*) if not apparent on the face of the document annexed to the notice, a description of the nature of the record which, or part of which, contains the statement; and

(*c*) particulars of the time, place and circumstances at or in which that record or part was compiled.

(2) If the party giving notice alleges that any person, particulars of whom are contained in the notice, cannot or should not be called as a witness at the trial or hearing for any of the reasons specified in rule 25, the notice must contain a statement to that effect specifying the reason relied on.

Statement admissible by virtue of section 5 of the Act: contents of notice (O.38, r.24)

38/24 24.—(1) If the statement is contained in a document produced by a computer and is admissible by virtue of section 5 of the Act, the notice must have annexed to it a copy or transcript of the document containing the statement, or of the relevant part thereof, and must contain particulars of—

(*a*) a person who occupied a responsible position in relation to the management of the relevant activities for the purpose of which the computer was used regularly during the material period of store or process information;

(*b*) a person who at the material time occupied such a position in relation to the supply of information to the computer, being information which is reproduced in the statement or information from which the information contained in the statement

ation of the computer during the material period;

and where there are two or more persons who fall within any of the foregoing subparagraphs and some only of those persons are at the date of service of the notice capable of being called as witnesses at the trial or hearing, the person particulars of whom are to be contained in the notice must be such one of those persons as is at that date so capable.

(2) The notice must also state whether the computer was operating properly throughout the material period and, if not, whether any respect in which it was not operating properly or was out of operation during any part of that period was such as to affect the production of the document in which the statement is contained or the accuracy of its contents.

(3) If the party giving the notice alleges that any person, particulars of whom are contained in the notice, cannot or should not be called as a witness at the trial or hearing for any of the reasons specified in rule 25, the notice must contain a statement to that effect specifying the reason relied on.

Reasons for not calling a person as a witness (O.38, r.25)

38/25 25. The reasons referred to in rules 22(3) 23(2) and 24(3) are that the person in question is dead, or beyond the seas or unfit by reason of his bodily or mental condition to attend as a witness or that despite the exercise of reasonable diligence it has not been possible to identify or find him or that he cannot reasonably be expected to have any recollection of matters relevant to the accuracy or otherwise of the statement to which the notice relates.

38/22–25/1 **Application of rr.22, 23 and 24**—These rules apply to statements which are admissible under ss.2, 4 and 5 of the Act respectively. They specify in great detail the particulars required to be contained in a r.21 Notice relating to s.2 or s.4 or s.5 statements, as the case may be. In essence, these particulars reflect the direct oral evidence which would have been given at the trial for which the hearsay statement is being substituted. Under these rules it is imperative that the r.21 Notice must contain the specified particulars, and it is also imperative that, where applicable, the notice must contain a statement that the maker of the statement cannot or should not be called as a witness at the trial and must specify the reason relied on; see r.25.

It should be noted that r.22 also applies to a notice under r.31; see r.31(2).

For the definition of "document" see s.10(1) of the Act. Under r.22(2) if the hearsay statement was made in a document which the opposite party cannot understand unless it is transcribed, a transcript must be annexed to the notice.

This transcript of evidence in criminal proceedings is admissible in evidence under ss.1 and 4 of the Act, and probably, also, the transcript of the Judge's summing-up is admissible in evidence under s.4 of the Act as being a record compiled by a shorthand writer in his capacity as such (*Taylor* v. *Taylor* [1970] 1 W.L.R. 1148; [1970] 2 All E.R. 609, C.A.). Certain documents, *e.g.* a tithe map and survey made under the Tithe Act 1836, are admissible in evidence of the facts stated therein under s.4(1) of the Act (*Knight* v. *David* [1971] 1 W.L.R. 1671; [1971] 3 All E.R. 1066).

38/22–25/2 **Statements produced by computer**—R.24, which relates to computerised records is, of course, somewhat novel. It should be read closely with ss.5 and 6(3)(*c*) of the Act.

Under para.(1) of r.24, there should generally be no need to specify more than one person falling within each of the categories of persons set out in subparas.(*a*) (*b*) and (*c*) and indeed in many instances, it may well be that only a single person, who comes within all these three categories, would need to be specified. The need for the three categories mentioned in these three subparagraphs is to provide an opportunity to the opposite party, by serving a counter-notice under r.26, to require the person named in each category to be called as a witness at the trial, so as to hear him give his evidence and if necessary to cross-examine him on the computer system, so far as it relates to the "business side" (see subpara. (*a*)) the system for ensuring that the relevant information is accurately fed into the computer (see subpara.(*b*)) and the "hardware" and programming of the computer (see subpara.(*c*)). It should be emphasised that the rule requires that the persons who are specified in the r.21 notice under these three subparagraphs should be persons who are capable of being called as witnesses at the trial rather than those who are otherwise unavailable, although they may also possess the necessary qualifications to come within these categories.

Para.(2) of r.24 reflects s.5(2)(*c*) of the Act. This provision requires the r.21 Notice relating to a statement produced by computer to state in relation to that statement that the computer was working properly or that its failure to do so was not such as to affect the accuracy of the statement. This provision is necessary in order to enable the opposite party to decide whether or not to dispute that the conditions specified in s.5(2)(*c*) of the Act have been satisfied.

Since a computer is a device by means of which information is stored or processed, a print-out which is part of that device is a statement produced by the computer, and if the conditions specified in the Civil Evidence Act 1968, s.5 and r.24 are complied with, and it is clear that the operator who fed the information into the computer could not reasonably be expected to have any recollection of that information, the print-out will be admitted in evidence (see *R.* v. *Ewing* [1983] Q.B. 1039; [1983] 2 All E.R. 645, C.A. decided under the Criminal Evidence Act 1965, s.1).

38/22–25/3 **Reasons for not calling a person as a witness**—R.25 specifies the conditions which under the maker of a statement or a person concerned in the compilation of an ordinary or computerised record unavailable, *i.e.* the reasons why he cannot or should not be called as a witness at the trial. The terms of the rule are taken *verbatim* from s.8(2)(*b*) of the Act. Compare the grounds for ordering depositions to be taken before the trial under O.39, r.1; see para. 39/1/4.

The five reasons that can be relied on under s.8(2)(*b*) of the Act and under r.25 for not calling a person as a witness at the trial or hearing are disjunctive, so that if any *one* of those reasons is established on the balance of probabilities, it is not necessary to establish any other reason, *e.g.* if it be so established that the maker of the statement is beyond the seas, it is unnecessary to establish also that he cannot be found by the exercise of reasonable diligence, and moreover, if any *one* such reason is so established, the Court has no residual jurisdiction to exclude his statement by reference to other circumstances (*Rasool* v. *West Midlands Passenger Transport Executive* [1974] 3 All E.R. 638).

Where a party seeks to give in evidence a statement made by a person said to be beyond the seas, it is not necessary to show that efforts had been made to procure the maker of the statement to give evidence at the trial, since the fact that he is abroad is in itself a sufficient reason for admitting the statement, and the Court has no discretion to exclude it (*Piermay Shipping Co. S.A.* v. *Chester* [1978] 1 W.L.R. 411; [1978] 1 All E.R. 1233, C.A.).

As to the determination of questions whether a person can or should be called as a witness, see r.27.

The Channel Islands and the Isle of Man are "beyond the seas" for the purposes of the Civil Evidence Act 1968, s.8(2)(*b*) and r.25, and accordingly a statement by a person living in Guernsey is admissible under the Act of 1968 and the rule as evidence of the facts stated therein (*Rover International Ltd.* v. *Cannon Films Sales Ltd.* (*No. 2*) [1987] 1 W.L.R. 1597; [1987] 3 All E.R. 986).

Counter-notice requiring person to be called as a witness (O.38, r.26)

38/26 26.—(1) Subject to paragraphs (2) and (3), any party to a cause or matter on whom a notice under rule 21 is served may within 21 days after service of the notice on him serve on the party who gave the notice or a counter-notice requiring that party to call as a witness at the trial or hearing of the cause or matter any person (naming him) particulars of whom are contained in the notice.

(2) Where any notice under rule 21 contains a statement that any person particulars of whom are contained in the notice cannot or should not be called as a witness for the reason specified therein, a party shall not be entitled to serve a counter-notice under this rule requiring that person to be called as a witness at the trial or hearing of the cause or matter unless he contends that that person can or, as the case may be, should be called, and in that case he must include in his counter-notice a statement to that effect.

(3) Where a statement to which a notice under rule 21 relates is one to which rule 38 applies, no party on whom the notice is served shall be entitled to serve a counter-notice under this rule in relation to that statement, but the foregoing provision is without prejudice to the right of any party to apply to the Court under rule 28 for directions with respect to the admissibility of that statement.

(4) If any party to a cause or matter by whom a notice under rule 21 is served fails to comply with a counter-notice duly served on him under this rule then, unless one of the reasons specified in rule 25 applies in relation

to the person named in the counter-notice, and without prejudice to the powers of the Court under rule 29, the statement to which the notice under rule 21 relates shall not be admissible at the trial or hearing of the cause or matter as evidence of any fact stated therein by virtue of section 2, 4 or 5 of the Act, as the case may be.

38/26/1 **Application of rule**—The broad object of this rule is to enable a party, against whom a hearsay statement under ss.2, 4 or 5 of the Act may be admitted in evidence in consequence of the service on him of a r.21 Notice, to require, by means of a counter-notice, the attendance of the person who made such statement to attend the trial and to give direct oral evidence of the facts relied on and to be cross-examined thereon. The rule operates, as it were, to exclude what would have been admissible as secondary evidence of the facts contained in a hearsay statement by requiring the best evidence of such facts to be given at the trial.

Any party on whom a r.21 Notice has been served is entitled, at his own risk as to costs, to serve a counter-notice under this rule, subject to the important exception that no counter-notice can be served under this rule if the r.21 Notice relates to statements made in previous legal proceedings. In relation to such statements, however, an alternative procedure to the service of a counter-notice is provided, namely, an application for directions under r.28 as to the admissibility of such statements; see para. (3).

A counter-notice under this rule must be served within 21 days after the service of the r.21 Notice. As to the extension of such time, see O.3, r.5. As to Admiralty actions, see O.75, r.32(4).

A counter-notice under this rule cannot require that a person should be called as a witness at the trial, if the r.21 Notice had stated that he cannot or should not be called, unless the counter-notice itself contains an express statement that such person can or should be called. In such case, the question whether such person can or should be called as a witness at the trial may be determined by the Master or Registrar before the trial on the application of either party under r.27 or for directions under r.28. As to Admiralty actions, see O.75, r.23.

In order to be effective, however, the counter-notice under this rule must successfully raise an issue regarding the reason alleged in the r.21 Notice for not calling the maker of the statement as a witness at the trial or hearing, and if the counter-notice is ineffective in this respect the r.21 Notice takes effect to make such statement admissible (*Rasool v. West Midlands Passenger Transport Executive* [1974] 3 All E.R. 638).

As to costs occasioned by the unreasonable service of a counter-notice, see r.32.

38/26/2 **Effect of service or non-service of counter-notice**—If a counter-notice under r.26 is not served, the party serving the r.21 Notice will be relieved of the obligation to call as a witness at the trial the person or persons who made the statements to which that notice refers. He must, however, still satisfy the trial Court that those statements are admissible in evidence by virtue of the provisions of Part I of the Act or any other statutory provisions or by agreement of the parties (see s.1 of the Act). Thus, for example, under s.2(3) of the Act, only "first-hand" hearsay evidence of an out-of-court oral statement is admissible (unless the statement was made in previous legal proceedings) and therefore such statement can only be proved by a person who heard it, and he must be called to say so, even if no counter-notice under this rule has been served.

On the other hand, the service of a counter-notice under this rule has, subject to the overriding discretion of the Court under r.29, or unless for any of the reasons specified in r.25 the person who made the statement is not called as a witness, the following effects, namely,

(1) to exclude altogether a s.2 statement made orally, *i.e.* what may be called normal "first-hand" hearsay;
(2) to exclude altogether a s.2 statement made in a document;
(3) to exclude a s.4 statement, *i.e.* a statement contained in a record, altogether if the counter-notice relates to the person who originally supplied the information, but if it relates to a person who recorded the information, only if that "recorder" is not called; and
(4) to exclude a s.5 statement, *i.e.* a statement produced by computer, only if the person specified is not called.

These consequences flow from ss.2, 4 and 5 of the Act, as well as in part from para (4). The failure to call, in response to a counter-notice under this rule, a person specified in that counter-notice makes the statement mentioned in the r.21 Notice inadmissible at the trial to the extent indicated above. If the statement is a s.2 statement, calling the maker in response to a counter-notice does not itself make the statement admissible unless the Court in its discretion so directs. If it is a s.4 statement, its admissibility depends upon whether the person called in response to the counter-notice is the original informant or "the recorder" of the statement. If it is the former, calling him does not make the statement admissible unless the Court in its discretion so directs, but if it is the latter, calling him does make the record admissible. If it is a s.5 statement, calling the person concerned in the compilation of a computerised record does make the record admissible where the counter-notice relates only to the person so called.

For form of counter-notice under r.26, see Editorial Forms [illegible]

as a witness (O.38, r.27) 38/27

27.—(1) Where in any cause or matter a question arises whether any of the reasons specified in rule 25 applies in relation to a person particulars of whom are contained in a notice under rule 21, the Court may, on the application of any party to the cause or matter, determine that question before the trial or hearing of the cause or matter or give directions for it to be determined before the trial or hearing and for the manner in which it is to be so determined.

(2) Unless the Court otherwise directs, the summons by which an application under paragraph (1) is made must be served by the party making the application on every other party to the cause or matter.

(3) Where any such question as is referred to in paragraph (1) has been determined under or by virtue of that paragraph, no application to have it determined afresh at the trial or hearing of the cause or matter may be made unless the evidence which it is sought to adduce in support of the application could not with reasonable diligence have been adduced at the hearing which resulted in the determination.

Directions with respect to statement made in previous proceedings (O.38, r.28)

28. Where a party to a cause or matter has given notice in accordance with rule 21 that he desires to give in evidence at the trial or hearing of the cause or matter— 38/28

(*a*) a statement falling within section 2(1) of the Act which was made by a person, whether orally or in a document, in the course of giving evidence in some other legal proceedings (whether civil or criminal), or
(*b*) a statement falling within section 4(1) of the Act which is contained in a record of direct oral evidence given in some other legal proceedings (whether civil or criminal)

any party to the cause or matter may apply to the Court for directions under this rule, and the Court hearing such an application may give directions as to whether, and if so on what conditions, the party desiring to give the statement in evidence will be permitted to do so and (where applicable) as to the manner in which that statement and any other evidence given in those other proceedings is to be proved.

Application of rules 27 and 28—These rules, which should be read with r.33, together provide the machinery for enabling all questions concerning the adducing of hearsay statements at the trial, so far as practicable, to be dealt with and disposed of before the trial. These three rules relate to the following matters or questions, namely, 38/27–28/1

(*a*) To the determination of questions whether a person can or should be called as a witness at the trial; see r.27
(*b*) To directions with respect to statements made in previous legal proceedings; see r.28
(*c*) To directions that a person whose credibility as the maker of a hearsay statement is being attacked should be called as a witness at the trial; see r.30;
(*d*) For leave that an out-of-court statement, whether made orally or in writing, be given in evidence, even though the person who made it is to be called as a witness at the trial, see r.33 and s.2(2)(*a*) of the Act;
(*e*) For directions as to the manner in which oral statements made in previous legal proceedings should be admitted in evidence at the trial, see r.33, and s.2(3) of the Act;
(*f*) For leave that a hearsay statement contained in a record be given in evidence, even though the person who originally supplied the information from which the record was compiled is to be called as a witness at the trial, see r.33 and s.4(2)(*a*) of the Act;
(*g*) For directions as to the manner in which a document or copy or material part

[illegible] intended to be produced at the trial may be authenticated, see r.31 and s.6(1) of the Act.

For forms of summons, see Editorial Forms, EF 10–13, Vol.2, Pt.2, paras. 610–613

An application under r.27 to determine whether a person can or should be called as a witness at the trial must be made by summons, but applications relating to any other of the above matters or questions may be made by summons or on the summons for directions and notice thereunder. As to Admiralty actions, see O.75, r.25.

38/27–28/2 Question whether person can or should be called as a witness—The question whether the maker of a hearsay statement can or should be called as witness at the trial may arise either:

(1) when a r.21 Notice contains a statement that he cannot or should not be called as a witness at the trial and specifies the reason relied on, and the counter-notice under r.26 states that he can or should be so called; or

(2) when a party desires to adduce evidence to attack the credibility of the maker of the statement who is mentioned in a r.21 Notice; see r.30.

Such a question may also arise when a r.21 Notice relates to a hearsay statement made in previous proceedings, though in such case the application should be for directions under r.28 and not for determination under r.27; see r.26(3).

The application under r.27 must be by summons, and unless the Court otherwise directs such summons must be served by the party making the application on every other party, who for this purpose will include every third and subsequent party, but not a party who has failed to acknowledge service or who has no address for service; see O.65, r.9. As to Admiralty default actions, see O.75, r.32(3).

On the hearing of such an application, the Court may determine the question raised summarily or it may give directions for it to be determined before the trial, *e.g.* by directing the trial of an issue, which by consent may be tried by the Master; see O.36 r.9. For forms of summons and order, see Editorial Forms, EF 6–7, Vol.2, Pt.2, paras. 606–607.

The statement of a person who was, but is no longer, in the employ of the opposite party will not be allowed to be adduced in evidence at the trial, since there is no reason why the maker of the statement could not be called as a witness (*Greenaway* v. *Homelea Fittings (London) Ltd.* [1985] 1 W.L.R. 234).

Once the question whether a person can or should be called as a witness at the trial has been determined before the trial, it cannot be raised or determined afresh at the trial, except upon fresh evidence which could not with reasonable diligence have been earlier adduced (para.(3)), *e.g.* by reason of a change of circumstances, as where a sick person may have recovered or a potential witness may have returned from abroad. A party seeking to raise the question afresh at the trial should give notice to the opposite party, stating the grounds on which he seeks to have the question determined afresh.

38/27–28/3 Directions respecting statements made in previous proceedings—An application for directions respecting statements made in previous legal proceedings, whether admissible under s.2 or s.4, may be made by any party, including the party who served the r.21 Notice. The application should be made by summons or a notice under the summons for directions to the Master, which must be served on every other party. As to Admiralty actions, see O.75 r.25.

Rule 28 does not provide any time within which such an application is required to be made, but it should ordinarily be made as soon as practicable after the service of the r.21 Notice. It is desirable that the parties should know, as early as possible, and as long as may be before the trial, what the position is with regard to the admissibility of statements made in previous legal proceedings.

On the hearing of such an application the Court has wide powers whether to exclude such a statement notwithstanding that it otherwise fulfills all the conditions necessary for admissibility or to order such statement to be admissible in evidence at the trial; and the Court has a wide discretion to impose appropriate conditions on the admissibility of such a statement.

Where, however, the defendant alleges that the conviction relied on in the statement of claim was erroneous (see O.18, r.7A(3)(*b*)) the Court, in the exercise of its discretion under r.28, will more readily admit on the part of the plaintiff the statements made by the witness in the criminal proceedings, for otherwise the plaintiff may be compelled to call as *his* own witness those who gave evidence in the criminal proceeding. The defendant will thereby gain the advantage of being able to cross-examine them, instead of calling them as *his* witnesses to discharge the burden of showing that the conviction was erroneous (see s.11(2)(*a*) of the Act and see also 15th Report of the Law Reform Committee, Cmnd. 3391 (1967) para.22). The same position will apply, *mutatis mutandis*, where the defendant alleges that the finding of adultery and adjudication of paternity was erroneous (see O.18, r.7A(3)(*b*)).

The position may perhaps be different, where the defendant denies that the conviction, finding of adultery or adjudication of paternity is relevant to any issue in the proceedings (see O.18 r.7A(3)(*c*)). In such case, the burden of proving relevancy lies on the plaintiff, and for this reason different considerations may apply to the admissibility of the statements made by witnesses in the previous legal proceedings; and the Court may, in its discretion under r.28 impose terms for the admissibility of such statements, *e.g.* that the witness if available should be called at the trial.

[illegible] any question arises [illegible] should be called as a witness at the trial the Court has power in its discretion under r.28 to order under r.27.

For form of summons, see Editorial Forms, EF 8, Vol.2, Pt.2, para.608.

Power of Court to allow statement to be given in evidence (O.38, r.29)

29.—(1) Without prejudice to section 2(2)(*a*) and 4(2)(*a*) of the Act and rule 28, the Court may, if it thinks it just to do so, allow a statement falling within section 2(1), 4(1) or 5(1) of the Act to be given in evidence at the trial or hearing of a cause or matter notwithstanding— **38/29**

(*a*) that the statement is one in relation to which rule 21(1) applies and that the party desiring to give the statement in evidence has failed to comply with that rule, or

(*b*) that that party has failed to comply with any requirement of a counter-notice relating to that statement which was served on him in accordance with rule 26.

(2) Without prejudice to the generality of paragraph (1) the Court may exercise its power under that paragraph to allow a statement to be given in evidence at the trial or hearing of a cause or matter if a refusal to exercise that power might oblige the party desiring to give the statement in evidence to call as a witness at the trial or hearing an opposite party or a person who is or was at the material time the servant or agent of an opposite party.

38/29/1 Application of rule—This rule is of paramount importance in the procedural code for dealing with hearsay evidence (see 13th Report of the Law Reform Committee, Cmnd. 2964 (1966) paras. 25 and 31).

It implements s.8(3)(*a*) of the Act by expressly conferring upon the Court a residual discretion to admit a hearsay statement in evidence, notwithstanding the failure to comply with the requirement to serve a notice under r.21 with respect to such statement or to call a witness at the trial in response to a counter-notice served under r.26. The principle underlying the rule is that non-compliance with the procedural requirements of the rules should not by itself result in the exclusion of material hearsay evidence which is otherwise admissible, but the Court should have power, if it thinks it just to do so, to allow such statements to be given in evidence. The rule is remedial in its intent and operation and the overriding discretion under the rule is designed to enable the Court to do what is just in the particular circumstances of the case. *Cf.* O.2 (non-compliance with rules). The Court can, for example, waive the necessary requirement of giving notice in advance (*Taylor* v. *Taylor* [1970] 1 W.L.R. 1148; [1970] 2 All E.R. 609, C.A.). In *George Doland Ltd.* v. *Blackburn Robson Coates & Co.* [1972] 1 W.L.R. 1388; [1972] 3 All E.R. 959, Geoffrey Lane J. admitted hearsay evidence at the trial notwithstanding the failure to comply with the rules as to prior service of the requisite notice.

The principle on which the Court should exercise its discretion under rr.28 and 29 should be the furtherance of justice, and on this basis, transcript of evidence given in criminal proceedings should be admitted on terms that an opportunity be given to challenge such evidence by cross-examination (*Tremellege (Selangor) Ltd.* v. *Stekel* [1971] 1 W.L.R. 226; [1971] 1 All E.R. 940). But the Court can only exercise its discretion under this rule in favour of a defaulting party if it is in possession of all the relevant facts, and therefore there can be no valid exercise of such discretion if there has been, for any reason, a deliberate withholding from the Court of the reason for non-compliance with the requirements of this rule (*Ford* v. *Lacon* [1971] 1 W.L.R. 623; [1971] 2 All E.R. 983, C.A.). On the other hand, the Court may properly exercise its discretion, without imposing any terms, to admit a statement to be given in evidence at the trial or hearing, although no proper notice has been given, where to do so would not cause prejudice or injustice to the other party, but not where there is ground to suppose that injustice will be caused or that the other party will be materially prejudiced or embarrassed (*Morris* v. *Stratford-on-Avon Rural District Council* [1973] 1 W.L.R. 1059; [1973] 3 All E.R. 263, C.A.).

Where one party gives notice in accordance with this rule that he intends to rely upon hearsay evidence and the other party also intends to rely upon that evidence, the other party should also give notice under this rule. In *Lettraset Ltd.* v. *Dymo Ltd.* [1976] R.P.C. 65, p.68 hearsay evidence given by the plaintiff at a previous trial was not admitted upon the defendant's application, even though the plaintiff had given notice under this rule of an intention to rely upon the evidence. Similarly, where either party has included documents in a list of documents disclosed on discovery and the other party desires to rely upon the contents of those documents as proving the truth of what is stated therein, that party should give notice under this rule (*Minnesota Mining & Mfg. Co.* v. *Johnson & Johnson Ltd.* [1976] F.S.R. 6; [1976] [illegible] where the obligation to give notice was waived).

two factors, that Part I of that Act in 1968 has replaced the Evidence Act 1938, of which it had been said that it should be given a liberal interpretation (see *per* Denning L.J. in *Jones v. Lambert and Cooke (Contractors) Ltd.* [1951] 2 K.B. 937, p. 947; and *per* Devlin L.J. in *Newmans Ltd. v. Metropolitan Police District Receiver* [1961] 1 W.L.R. 631, p. 657; [1961] 1 All E.R. 384, p. 393) and that if any statement is admitted in evidence, still the weight to be attached to it is a matter that remains to be considered by the Court. As to the weight to be attached to hearsay evidence, see s.6(3) of the Act, Vol.2, Pt.18.

Para.(2) of this rule singles out a particular factor to be considered by the Court in exercising its discretion whether to allow a statement to be given in evidence, namely, that the refusal to do so might require a party to call as his witness the opposite party or his servant or agent. The need for this provision is to ensure that the counter-notice procedure should not result in compelling one party to call as *his* witness the opposite party or a servant or agent of his, and para. (2) while not imposing any obligation on the Court, gives guidance to it to exercise its discretion to prevent this happening.

Restriction on adducing evidence as to credibility of maker, etc. of certain statements (O.38, r.30)

38/30 30. Where—

(*a*) a notice given under rule 21 in a cause or matter relates to a statement which is admissible by virtue of section 2 or 4 of the Act, and

(*b*) the person who made the statement, or, as the case may be, the person who originally supplied the information from which the record containing the statement was compiled, is not called as a witness at the trial or hearing of the cause or matter, and

(*c*) none of the reasons mentioned in rule 25 applies so as to prevent the party who gave the notice from calling that person as a witness,

no other party to the cause or matter shall be entitled, except with the leave of the Court, to adduce in relation to that person any evidence which could otherwise be adduced by him by virtue of section 7 of the Act unless he gave a counter-notice under rule 26 in respect of that person or applied under rule 28 for a direction that that person be called as a witness at the trial or hearing of the cause or matter.

38/30/1 **Application of rule**—This rule is based upon s.8(4) of the Act (see 13th Report of the Law Reform Committee, Cmnd. 2964 (1966) para. 33). The object of the rule is that, if the credibility of the maker of an out-of-Court statement is sought to be attacked, he should be called as a witness at the trial and should be able to defend himself. For this purpose, the rule requires a party who intends to take this course either to serve a counter-notice under r.26 or, if the statement was made in previous legal proceedings, to apply for directions under r.28 that the maker of the hearsay statement should be called as a witness at the trial.

The rule gives the Court a discretion to admit evidence impugning the credibility of the maker of a statement who has not been called as a witness at the trial in response to a counter-notice but whose statement has nevertheless been admitted in evidence under the discretionary powers of the Court under r.29.

The rule gives the Court a further discretion to allow evidence to be admitted attacking the credibility of the maker of a statement, notwithstanding the failure to serve a counter-notice in respect of that person, *e.g.* if a party discovers that that person has made an inconsistent statement only when it is too late to serve a counter-notice under r.26.

Notice required of intention to give evidence of certain inconsistent statements (O.38, r.31)

38/31 31.—(1) Where a person, particulars of whom were contained in a notice given under rule 21 in a cause or matter, is not to be called as a witness at the trial or hearing of the cause or matter, any party to the cause or matter who is entitled and intends to adduce in relation to that person any evidence which is admissible for the purpose mentioned in section 7(1)(*b*) of the Act must, not more than 21 days after service of that notice on him serve on the party who gave that notice, notice of his intention to do so.

(2) Rule 20(4) and (5) shall apply to a notice under this rule as if it relates were a statement admissible by virtue of section 2 of the Act.

(3) The Court may, if it thinks it just to do so, allow a party to give in evidence at the trial or hearing of a cause or matter any evidence which is admissible for the purpose mentioned in the said section 7(1)(*b*) notwithstanding that the party has failed to comply with the provisions of paragraph (1).

38/31/1 **Application of rule**—This rule applies where the maker of a statement which is the subject of a r.21 Notice is not going to be called as a witness at the trial. In such event, of course, it would be useless to serve a counter-notice under r.26, but this rule provides an alternative procedure where it is sought to attack the credibility of that person, by putting in evidence inconsistent statements made by him which are admissible under s.7(1)(*b*) of the Act. In such case, a notice under this rule must be served and such a notice must contain the same particulars as if it were a notice under rule 21. For form of notice, see Editorial Forms, EF 9, Vol. 2, Pt. 2.

Costs (O.38, r.32)

38/32 32. If—

(*a*) a party to a cause or matter serves a counter-notice under rule 26 in respect of any person who is called as a witness at the trial of the cause or matter in compliance with a requirement of the counter-notice, and

(*b*) it appears to the Court that it was unreasonable to require that person to be called as a witness,

then, without prejudice to Order 62 and, in particular, to rule 10(1) thereof, the Court may direct that any costs to that party in respect of the preparation and service of the counter-notice shall not be allowed to him and that any costs occasioned by the counter-notice to any other party shall be paid by him to that party.

Amended by R.S.C. (Amendment) 1986 (S.I. 1986 No. 632).

38/32/1 **Application of rule**—This rule gives express guidance to the Courts in relation to costs where a counter-notice under r.26 is unreasonably served. The discretion of the Court is in no way fettered, but particular attention is drawn to O.62 r.10(1). This rule indicates a clear general practice that the unreasonable service of a counter-notice should result in the party concerned paying the costs thereby occasioned, as well as that party being disallowed any costs in respect of the preparation and service of the counter-notice. (See 13th Report of Law Reform Committee, Cmnd. 2964 (1966) para. 24).

Certain powers exercisable in chambers (O.38, r.33)

38/33 33. The jurisdiction of the Court under sections 2(2)(*a*), 2(3), 4(2)(*a*) and 6(1) of the Act may be exercised in chambers.

38/33/1 **Application of rule**—This rule enables the powers of the Court under the specified sections of the Act to be exercised in Chambers, with the object that they should be so exercised before the trial; see para. 38/27–28/1.

Statements of opinion (O.38, r.34)

38/34 34. Where a party to a cause or matter desires to give in evidence by virtue of Part I of the Act, as extended by section 1(1) of the Civil Evidence Act 1972, a statement of opinion other than a statement to which Part IV of this Order applies, the provisions of rules 20 to 23 and 25 to 33 shall apply with such modifications as the Court may direct or the circumstances of the case may require.

(Amendment) 1974 (S.I. 1974 No. 295).

(see Vol.2, para. 6100) which implemented the recommendations of the Seventeenth Report of the Law Reform Committee, (Cmnd. 4489 (1970)) relating to the admissibility in evidence of statements of opinion.

The effect of s.1 is to apply Part I of the Civil Evidence Act 1968 (see Vol.2, paras 6100 *et seq.*) which, subject to specified conditions makes hearsay evidence of statements of fact admissible in civil proceedings, to statements of opinion, and the effect of this rule is to apply the machinery of adducing hearsay evidence of statements of fact, as enlarged in rr.20–23 and 25–33, above, to statements of opinion with such modifications as the Court may direct or the circumstances of the case may require.

Accordingly, the party who desires to adduce hearsay evidence of lay opinion at the trial must disclose the statement containing that opinion and must serve the requisite notice of his intention to rely upon such statement on every other party as required by r.21, and such notice must contain the hearsay particulars as required by rr.22 and 23, with the modification that the statement to be adduced in evidence are statements of opinion. If no counter-notice is served pursuant to r.26, requiring the witness who made the statement to be called at the trial, the statement would become admissible at the time as evidence of any matter of lay opinion contained in it, as well as of any fact stated in it which was known to the witness as a result either of his own observations or of his general professional knowledge or experience. If such counter-notice is served, the statement, of course, would not be admissible at the trial unless the witness himself was called or unless he was unavailable for any of the reasons specified in r.25, or unless the Court gives leave for the statement to be admitted in evidence under r.29.

The Civil Evidence Act 1972, s.1 excludes s.5 of the Civil Evidence Act 1968 (statements produced by computers) and this rule excludes any reference to r.21.

IV. Expert Evidence

Interpretation (O.38, r.35)

38/35 35. In this part of this Order a reference to a summons for directions includes a reference to any summons or application to which, under any of these Rules, Order 25, rules 2 to 7, apply and expressions used in this Part of this Order which are used in the Civil Evidence Act 1972 have the same meanings in this Part of this Order as in that Act.

38/35/1 **Scope and operation of Part IV**—Part IV of this Order was added by R.S.C. (Amendment) 1974 (S.I. 1974 No. 295) and contains the rules which were authorised to be made by s.2 of the Civil Evidence Act 1972 (see Vol.2, para. 6100) with respect to expert reports and oral expert evidence, which substantially implemented the recommendations of the Seventeenth Report of the Law Reform Committee on Evidence of Opinion and Expert Evidence (Cmnd. 4489 (1970)) which itself so far as concerns medical expert evidence in personal injury actions has followed and adopted the recommendations of the Committee on Personal Injuries Litigation, Cmnd. 3691 (1969) paras. 277–283).

These rules restrict the right of the parties to adduce expert evidence in civil proceedings as a matter of course, and they provide the machinery for the pre-trial disclosure by each party to the other of the medical and other expert evidence intended to be relied on at the trial.

It should be stressed that s.2 of the Civil Evidence Act 1972 has not abrogated the rule of substantive law that the reports of experts prepared for the purpose of pending or contemplated civil proceedings or in connection with the obtaining or giving of legal advice are privileged from disclosure (see *Worrall v. Reich* [1955] 1 Q.B. 296; [1955] 1 All E.R. 363, C.A.; *Re Saxton decd.* [1962] 1 W.L.R. 968; [1962] 3 All E.R. 92, C.A.; *Causton v. Mann Egerton (Johnsons) Ltd.* [1974] 1 W.L.R. 162; [1974] 1 All E.R. 153, C.A.). This rule of law remains in operation, and such reports remain privileged documents, and one party cannot compel the disclosure of such reports by the opposite party, unless such privilege is waived (*ibid.*). The effect of s.2 of the 1972 Act and of Part IV is to preclude oral expert evidence being adduced at the trial or hearing of any cause or matter except in the following circumstances

(*a*) with the leave of the Court;
(*b*) where all parties agree;
(*c*) where it is given by affidavit (r. 36(2)) or
(*d*) where in accordance with the rules under Part IV the Court has given a direction that it may be so adduced in evidence.

The machinery provided by the rules of Part IV is as follows. The rules no longer distinguish between different classes of expert evidence. The Court will ordinarily order the disclosure of all expert reports unless there are special reasons for not doing so. The courts have as yet not determined what are likely to amount to "special reasons." The Court may direct that part only of the expert evidence should be disclosed [illegible]

disclosed without first being disclosed (r.39). Where the expert whose report has been disclosed is called as a witness, his report may be put in evidence at the outset of his examination in chief (r.43); and the opposite party may himself put in evidence any expert report disclosed to him (r.42). Hearsay expert evidence may be admitted where the expert cannot or should not be called as a witness in the same way as other hearsay evidence may be admitted (r.41). Any direction given by the Court may be revoked or varied by a subsequent direction (r.44); and the failure or refusal to comply with any direction given by the Court as to the pre-trial disclosure of expert evidence will result in the party being unable to adduce such evidence at the trial unless the Court gives leave.

38/35/2 The rules of this Part of this Order constitute a radical departure in the law and practice relating to adducing expert evidence at the trial of civil proceedings. In the first place, the right of a party to call such expert evidence as he chooses at the trial has been restricted by the provision that he can only do so subject to the leave of the Court or agreement between all the parties or subject to compliance with the direction of the Court that he should disclose before the trial the substances of such expert evidence to any other party but this is subject in the case of actions for personal injuries to O.25, r.8(1)(*b*) and (*c*). In the second place, the right of a party to withhold the disclosure of his expert evidence until the trial has been modified by the provision that he is required to make such disclosure before the trial as a condition precedent to using it at the trial unless the Court considers that there are special reasons for not ordering such disclosure. These rules thus make a significant advance in the direction of a more open system of pre-trial proceedings so as to enable the parties to prepare and present their respective cases on the basis of material evidence known to them rather than to do so in the dark. The objects intended to be achieved by the rules are many and may be said to include the following, to assist the parties to reach a fair settlement or perhaps a settlement on a fairer basis in the light, rather than in the dark, concerning the expert evidence, to avoid surprise at the trial, to securing agreed expert reports and thus obviating the need for the attendance of experts at the trial, to shorten the evidence at the trial by identifying the matters of expert opinion which are really in controversy between the parties, and to enable the experts themselves to prepare their evidence on those matters more thoroughly and helpfully. In these several ways, these rules are designed to improve the conduct and the quality of civil trials, by reducing cost, delay and vexation particularly in that they avoid surprise at the trial and the unnecessary attendance at the trial of experts who could be more usefully employed elsewhere.

The machinery for the pre-trial disclosure of expert evidence is, however, intended to operate on the basis of fairness and mutuality as between the parties, and conversely that neither party should be able or should be allowed to operate such machinery so as to overreach any other party, by obtaining the disclosure of the party's expert evidence before the trial without *at the same time* disclosing his own expert evidence to that party or being precluded from calling such expert evidence at the (civil) trial. To achieve such fairness and mutuality the machinery is intended to operate so as to provide for the simultaneous exchange of expert's reports on or before a fixed date which it may be convenient to call the "exchange date," and the parties will be expected and required, to carry out arrangements for the exchange of expert reports in the sense of simultaneously disclosing their reports to each other. This normal rule of practice will no doubt be subject to variations subject to the special circumstances of particular cases, but always the overriding consideration will be to maintain fairness and mutuality between the parties. The terms of the rules do not limit the powers of the Court in the orders it can make for the disclosure of experts' reports, and therefore in special circumstances, as where the area of inquiry goes back many years and involves investigation of the plaintiff's various working conditions and the state of knowledge about the consequences of particular activities, *e.g.* excessive noise, an order not for simultaneous but for the sequential exchange of experts' reports is fair and proper (*Kirkup v. British Rail Engineering Ltd.* [1983] I.R.L.R. 1165; [1983] 3 All E.R. 147, C.A. affirming [1983] I.W.L.R. 190; [1983] I All E.R. 159). However in personal injuries actions, the plaintiff is now required to serve his medical evidence with his statement of claim.

Restrictions on adducing expert evidence (O.38, r.36)

38/36 36.—(1) Except with the leave of the Court or where all parties agree, no expert evidence may be adduced at the trial or hearing of any cause or matter unless the party seeking to adduce the evidence—

(*a*) has applied to the Court to determine whether a direction should be given under rule 37 or 41 (whichever is appropriate) and has complied with any direction given on the application, or
(*b*) has complied with automatic directions taking effect under Order 25, rule 8(1)(*b*).

to be given by affidavit or shall affect the enforcement under any other provision of these Rules (except Order 15, rule 5) of a direction given under this part of this Order.

Amended by R.S.C. (Amendment No.2) 1980 (S.I. 1980 No.1010) and by R.S.C. (Amendment 1987 (S.I. 1987 No. 1423).

38/36/1 **Effect of rule**—The effect is to preclude every party from adducing any expert evidence at the trial or hearing of any cause or matter except (1) with the leave of the Court or (2) where all the parties agree or (3) where the evidence is given by affidavit or (4) where the party seeking to adduce such evidence has first applied to the Court to determine whether or not and if so to what extent, he must disclose the substance of his expert evidence to any other party before the trial and he has complied with such direction or (5) where he has complied with the automatic directions under O.25, r.8(1)(*b*). It thus becomes of prime importance that every party, whether plaintiff or defendant or third party, intending to use expert evidence of any character at the trial of civil proceedings to apply to the Court for a direction under rr.37 and 41, as the case may be, for otherwise he will simply be prevented from adducing such expert evidence at the trial, unless he secures the consent of all the other parties or applies to adduce such evidence by affidavit. The sanction for failure of any party to apply for the direction of the Court to adduce expert evidence at the trial is the effective exclusion of the expert evidence of that party.

The application for a direction under r.37 (expert oral evidence) or r.41 (expert evidence contained in statement) must be made by summons to the Master or District Registrar or as the case may be, *e.g.* to the circuit Judge taking Official Referee business in Official Referee actions, to the Judge in charge of the Commercial Court in commercial actions, to the Admiralty Registrar in admiralty actions. The application may be made at any stage of the proceedings, though it should ordinarily be made at the hearing of the summons for directions or by notice under such summons. Indeed, by virtue of O.25, r.3, consideration must be given at the hearing of the summons for directions as to whether orders or directions under Part IV of this Order should be made or given, if necessary by the Court of its own motion, and therefore all parties must, where practicable, make an application on the hearing of the summons for directions for leave to adduce expert evidence at the trial and as to the disclosure of experts' reports (see *Practice Direction* (*Evidence: Expert*) [1974] 1 W.L.R. 904; [1974] 2 All E.R. 966). The application may be made after the action is set down for trial, but of course it should be made at a reasonable time before the trial, precisely because it may be required for the purposes of the trial. Although the rule seems to require each party to make a separate application to the Court, it would seem that in practice if any party makes such application, the Court will be in a position to deal with the question whether or not it should give a direction as to the pre-trial disclosure of the expert evidence of the other parties. In the ordinary case, no affidavit would be necessary on the hearing of any such application.

Although the Court has power under O.38, r.4 to limit the *number* of medical or other expert witnesses to be called at the trial, it has no power under this rule or under its inherent jurisdiction, where a party has made due application under this rule, to bar that party from calling an expert witness at the trial, *e.g.* expert actuarial evidence, and at the interlocutory stage, the Master or the Judge in Chambers is not entitled to rule on the admissibility of such evidence (*Sullivan* v. *West Yorkshire Passenger Transport Executive* [1985] 2 All E.R. 134, C.A.).

38/36/2 The rule leaves it open to the parties to agree that all or any of them may adduce expert evidence at the trial without seeking a direction of the Court whether or not there should be any pre-trial disclosure of such expert evidence. For this purpose all the parties must agree on this course, and such agreement should be explicit and precise. It remains to be seen to what extent parties in civil proceedings who have the means at hand to identify what is the expertise on which they differ, to avoid the need for the attendance at the trial of their expert witnesses, to reduce costs and eliminate surprise at the trial, should agree upon the opposite course of withholding from each other their respective expert evidence so as to be in the position of adducing such evidence at the trial. If, however, they all agree upon this course it would seem that the Court will have no option but to allow such expert evidence to be adduced at the trial.

On the other hand, the power to order the compulsory disclosure of expert evidence under rr.37, or 41, does not affect the right of any party voluntarily to disclose his own experts' reports to the opposite party in the negotiations before litigation is started or thereafter at an earlier stage than the summons for directions. The voluntary disclosure of such reports would make it easier to demonstrate to the Court that the relevant expert evidence on both sides is of a kind which is appropriate for an order for compulsory exchange; and in any event, the disclosure of such report is a condition precedent to its admissibility as of right in evidence at the trial.

This rule does not apply to expert evidence which is permitted to be given by affidavit. The obvious reason is that the filing of an affidavit and its service on the other parties is an effective a means of securing the disclosure of expert evidence as is provided by Part IV of this Order, and moreover, it would be highly impracticable to apply the provisions of that Part of the Order to proceedings, such as interlocutory proceedings in which evidence is so given.

This rule does not apply to patent actions in which the special provisions in O.104, r.10 apply (see O.104, r.10(5)).

This rule explicitly excludes the modes of committal and sequestration for the enforcement of the orders or directions of the Court for the compulsory disclosure of expert evidence, since such stringent modes would be inappropriate. On the other hand, the rule recognises that the sanction for the failure or refusal to comply with such orders or directions of the Court could be the stay or dismissal of the action or the striking out of the defence, as the case may be.

Direction that expert report be disclosed (O.38, r.37)

37.—(1) Subject to paragraph (2), where in any cause or matter an application is made under rule 36(1) in respect of oral expert evidence, then, unless the Court considers that there are special reasons for not doing so, it shall direct that the substance of the evidence be disclosed in the form of a written report or reports to such other parties and within such period as the Court may specify. 38/37

(2) Nothing in paragraph (1) shall require a party to disclose a further medical report if he proposes to rely at the trial only on the report provided pursuant to Order 18, rule 12(1A) or (1B) but, where a party claiming damages for personal injuries discloses a further report, that report shall be accompanied by a statement of the special damages claimed and, in this paragraph, "statement of the special damages claimed" has the same meaning as in Order 18, rule 12(1C).

Substituted by R.S.C. (Amendment No.4) 1989 (S.I. 1989 No. 2427).

Meeting of experts (O.38, r.38)

38. In any cause or matter the Court may, if it thinks fit, direct that there be a meeting "without prejudice" of such experts within such periods before or after the disclosure of their reports as the Court may specify, for the purpose of identifying those parts of their evidence which are in issue. Where such a meeting takes place the experts may prepare a joint statement indicating those parts of their evidence on which they are, and those on which they are not, in agreement.". 38/38

Substituted by R.S.C. (Amendment) 1987 (S.I. 1987 No. 1423).

Disclosure of part of expert evidence (O.38, r.39)

39. Where the Court considers that any circumstances rendering it undesirable to give a direction under rule 37 relate to part only of the evidence sought to be adduced, the Court may, if it thinks fit, direct disclosure of the remainder. 38/39

Amended by R.S.C. (Amendment) 1987 (S.I. 1987 No. 1423).

38/37–39/1 **Effect of rules 37 and 39**—The effect is to provide, in the cases in which they apply, for the compulsory disclosure, and ordinarily for the compulsory exchange, of experts' reports, or parts thereof, before the trial. As a result of the substitution of the new rule 37 there is now no distinction between personal injury and non-personal injury actions so far as the disclosure of expert reports is concerned.

It should be observed that if the Court shall decline to direct or order that a party's experts' reports should be disclosed, that party will thereby be at liberty to withhold his experts' reports and to adduce oral expert evidence at the trial. The effect of not giving a direction that one party's expert's report should be disclosed is to free that party from disclosing that report and entitling him to call that expert to give his oral testimony at the trial. In this connection, it should be observed that, just as in the case of the disclosure of experts' reports where, on the principle of fairness and mutuality, the Court will ordinarily order the compulsory exchange of such reports, so if it should decline to order one party to disclose his experts' reports, the Court will ordinarily decline to order the disclosure of the experts' reports of the opposite party, so that both parties will be free to withhold their experts' reports from disclosure and to call the experts to give oral evidence at the trial. It is only in exceptional circumstances that the Court would be inclined to order one party to disclose *his* experts' reports, while declining to give a direc-

APPENDIX FOUR

ACCESS TO JUSTICE

CIVIL PROCEDURE RULE COMMITTEE

Draft Civil Procedure Rules

(For comment by committee members)

July 1998

PART 32
EXPERTS AND ASSESSORS

Contents of this Part

Duty to restrict expert evidence

32.1 Expert evidence should be restricted to that which is reasonably required to resolve the proceedings .

Interpretation

32.2 A reference to an 'expert' in this Part is a reference to an expert who has been instructed to give or prepare evidence for the court.

Experts - overriding duty to the court

32.3 (1) It is the duty of an expert to help the court on the matters relevant to his expertise.

(2) This duty overrides any obligation to the person from whom he has received instructions or by whom he is paid.

Court's power to restrict expert evidence

32.4 (1) No party may call an expert or put in evidence an expert's report without the court's permission.

(2) When a party applies for permission under this rule he must-

(a) name the expert he wishes to use; or

(b) if it is not practicable to name the expert, identify the field in which he wishes to call expert evidence.

(3) If permission is granted under this rule it shall be in relation only to the expert named or the field identified under paragraph (2).

(4) The court may limit the amount that the party who wishes to call the expert may recover from any other party by way of the fees and expenses of the expert.

(5) The court may vary or withdraw any permission given under this rule.

General requirement for expert evidence to be given in a written report

32.5 (1) Expert evidence is to be given in a written report unless the court directs otherwise.

(2) If a claim is on the fast track, the court will not direct an expert to attend a hearing unless it is necessary to do so in the interests of justice.

Written questions to experts

32.6 (1) A party may put to-

(a) an expert instructed by another party; or

(b) a single joint expert appointed under rule 32.7,

written questions about his report.

(2) Written questions under paragraph (1)-

(a) may be put once only; and

(b) must be for the purpose only of clarification of the report;

unless in either case,

(i) the court permits; or

(ii) the other party agrees.

(3) An expert's answers to questions put in accordance with paragraph (1) shall be treated as part of the expert's report.

Court's power to direct that evidence is to be given by a single joint expert

32.7 (1) Where two or more parties wish to submit expert evidence on a particular issue, the court may direct that the evidence on that issue is to given by one expert only.

(2) The parties wishing to submit the expert evidence are called 'the instructing parties'.

(3) Where the instructing parties cannot agree who should be the expert, the court may-

(a) select the expert from a list prepared or identified by the instructing parties; or

(b) direct that the expert be selected in such other manner as the court may direct.

(4) The court may vary a direction given under this rule.

Instructions to a single joint expert

32.8 (1) Where the court gives a direction under rule 32.7 for a single joint expert to be used, each instructing party may give instructions to the expert.

(2) When an instructing party gives instructions to the expert he must, at the same time, send a copy of the instructions to the other instructing parties.

(3) The court may give directions about -

(a) the payment of the expert's fees and expenses; and

(b) any inspection, examination or experiments which the expert wishes to carry out.

(4) The court may, before an expert is instructed-

(a) limit the amount that can be paid by way of fees and expenses to the expert; and

(b) direct that the instructing parties pay that amount into court.

(5) Unless the court otherwise directs, the instructing parties are jointly and severally liable(GL) for the payment of the expert's fees and expenses.

Power of court to direct a party to provide information

32.9 Where a party has access to information which is not reasonably available to the other party, the court may direct the party who has access to the information to-

(a) to prepare and file the information; and

(b) to serve a copy of the information on the other party.

Contents of report

32.10(1) An expert's report must comply with the requirements set out in a practice direction.

(2) At the end of an expert's report there must be a statement that -

(a) the expert understands his duty to the court; and

(b) he has complied with that duty.

(3) The expert's report must state the substance of all material instructions, whether written or oral, on the basis of which the report was written.

(4) The instructions referred to in paragraph (3) shall not be privileged against disclosure but the court will not, in relation to those instructions-

(a) order disclosure of any specific document; or

(b) permit any questioning in court, other than by the party who instructed the expert,

unless it is satisfied that there are reasonable grounds to consider the statement of instructions given under paragraph (3) to be inaccurate or incomplete.

Use by one party of expert's report disclosed by another

32.11 Where a party has disclosed an expert's report, any other party may use that expert's report as evidence at the trial.

Discussions between experts

32.12(1) The court may, at any stage, direct a discussion between experts for the purpose of requiring the experts to-

(a) identify the issues in the proceedings; and

(b) where possible, reach agreement on an issue.

(2) The court may specify the issues which the experts must address when they meet.

(3) The court may direct that following any discussion between the experts they must prepare a statement for the court showing-

(a) those issues on which they agree; and

(b) those issues on which they disagree and a summary of their reasons for disagreeing.

(4) The contents of the discussion between the experts shall not be referred to at the trial.

(5) Where experts reach agreement on an issue during their discussions, the agreement shall not bind the parties unless the parties expressly agree to be bound by the agreement.

Consequence of failure to disclose expert's report

32.13 A party who fails to comply with a direction to disclose an expert's report may not use the report at the trial or call the expert to give evidence orally unless the court permits.

Expert's right to ask court for directions

32.14(1) An expert may file a written request for directions to assist him in carrying out his function as an expert.

(2) An expert may request directions under paragraph (1) without giving notice to any party.

(3) The court, when it gives directions, may also direct that a party be served with -

(a) a copy of the directions; and

(b) a copy of the request for directions.

Assessors

32.15(1) The court may appoint a person (an 'assessor') to assist the court in dealing with a matter in which the assessor has skill and experience..

(2) An assessor shall take such part in the proceedings as the court may direct and in particular the court may-

(a) direct the assessor to prepare a report for the court on any matter at issue in the proceedings; and

(b) direct the assessor to attend the whole or any part of the trial to advise the court on any such matter.

(3) If the assessor prepares a report for the court before the trial has begun-

(a) the court will send a copy to each of the parties; and

(b) the parties may use it at trial .

(4) Any remuneration to be paid to the assessor for his services shall be determined by the court and shall form part of the costs of the proceedings.

(5) The court may order any party to deposit in the court office a specified sum in respect of the assessor's fees and, where it does so, the assessor will not be asked to act until the sum has been deposited.

(6) The court may vary or revoke an order made under this rule.

APPENDIX FIVE

DRAFT PROTOCOL OF BEST PRACTICE IN THE INSTRUCTION AND USE OF EXPERTS

Introduction

This protocol is intended as guidance to help those who instruct experts **in all cases except family matters** and make use of expert evidence to do so more effectively and more efficiently. It is also intended to facilitate better communication and dealings between the expert and the instructing party and more widely between the opposing parties to a dispute. It incorporates **and may be read in conjunction with** the Academy of Experts Model Form of Expert's Report and the Law Society's codes of practice. **Assistance from an expert may be needed at various stages of a dispute and for different purposes, the expert performing a different role in each of these respects. The balance between the duties to the party instructing the expert and the duty to the court will differ depending upon the context. However, when preparing a report for use in evidence at court or when giving oral evidence, the expert has a primary duty to the court of objectivity and partiality.** Whilst it is for the parties to decide whether or not and if so to what extent to adhere to the specific provisions of the protocol, they do reflect principles which a court will expect litigants and experts to observe. **The court is likely to take adherence to the protocol into account in exercising its discretion as to costs.**

Appointment

1 Those appointing experts, before doing so, ought to consider whether the appointment is reasonable and/or necessary, for which the following factors ought to be taken into account (and are likely to be taken into account by a court in exercising its discretion as to costs):-

(a) what the facts in issue are likely to be;

(b) whether those facts might be proved by existing available witnesses;

(c) whether an expert is necessary to prove those facts;

(d) **whether opinion evidence from an expert is likely to be relevant or helpful to the court;**

(e) whether an expert is necessary to put those opinions into evidence;

(f) whether the court will be assisted by the expert in relation to the issues or whether the issues are ones which the court can determine alone;

(g) the cost of the expert balanced against both the importance of the opinion to the issues in the case and either the value or importance to the client of the case.

2 An expert should not be appointed if he/she is unable to produce a report within a reasonable time of instruction, having regard to the timetable of the case. The time within which the expert should produce a report should be agreed on appointment. Where the agreed time limit cannot be met, notice of the delay should be given by the expert as soon as possible.

3 Appointment should be of an expert of an appropriate level of seniority, experience, expertise and training.

4 **Economy in the use of experts and a less adversarial expert culture is to be encouraged. Parties should consider whether they might instruct one expert in a particular discipline, to whom both parties have no objection, to whom each party might put questions, either before or after the report is prepared and disclosed, and whether one expert might be jointly instructed from the outset. Where the parties decide to retain their own experts, they should still consider what steps might be taken to narrow the issues between them and save costs, whether sequential disclosure of experts reports (rather than mutual exchange), or discussions and meetings between experts, or otherwise.**

5 **Sharing expert evidence is likely to be more appropriate in relation to the quantification of a claim than to establishing primary liability and will be especially pertinent in lower value claims where proportionality of costs is required to be in the minds of the parties".**

Terms of Business

6 Terms of business should be agreed between the expert and those instructing him/or at the outset. These should include:

(a) The basis of the expert's charges: either daily or hourly rates and an estimate of the time likely to be required, or a fee for the services.

(b) Treatment of travelling time and likely expenses and disbursements.

(c) Rates for attendance at court and contingency provisions for payment of the specified fee in the event of late notice of cancellation of a court hearing.

(d) Provision for a preferred timing of payment.

7 Payments to an expert witness contingent upon the nature of the evidence given or upon the outcome of a case must not be offered, accepted or made.

8 Any agreement with an expert which will provide the expert with repeated instructions whether in return for discounted fees or otherwise should not be made.

9 Those instructing an expert should make it clear if fees are to be paid by a third party, including the Legal Aid Board, any special provisions this might require, and/or if payment of those will be subject to taxation.

Instructions

10 A copy of this protocol will be given to the expert upon instruction.

11 The expert should be kept informed regularly about the timetable for the proceedings and any deadlines for the preparation of his/her report/advice.

12 Those instructing experts should ensure that they give clear instructions (in writing unless this is not practicable) specifying the requirements **which will usually include the following:**

(a) basic information such as names, addresses, telephone numbers, dates of birth, and dates of incidents;

(b) the type of expertise which is called for;

(c) the purpose for requesting the report, and a description of the matter to be investigated;

(d) questions to be addressed;

(e) the history of the matter, identifying any factual matters that may be in dispute;

(f) details of any relevant documents stating which if any (i) the expert may refer to in the report and (ii) the expert may not refer to and why;

(g) whether proceedings have been commenced (in which case a copy of the pleadings should be provided) or are contemplated, the identity of the parties, and whether the expert may be required to attend to give evidence;

(h) whether the expert will be expected to confer with experts instructed by other parties with a view to reaching agreement on the issues or narrowing those in dispute;

(i) whether prior authority to incur the estimated fees needs to be obtained before the instructions can be confirmed;

(j) in the case of medical reports; where the medical records are situated (including, where possible, the hospital record number); whether consent to an examination and disclosure of records has been given; and whether the records are to be obtained by or provided for the expert;

(k) whether this report is intended as advice or for use in court;

An expert who does not receive such clear instructions should request them or withdraw from the case in default.

13 **Depending on the complexity of the features of the case, a discussion between the expert and those instructing him/her is recommended in order to ensure that the pleadings accurately reflect the expert's opinions on the issues.**

14 An expert must not express an opinion outside the scope of his/her competence. Experts should as soon as possible after being instructed, identify any aspects of a commission with which they are unfamiliar, or with which they are not competent to deal, or on which they require further information or guidance.

15 Instructions should be accepted only in matters where the expert:

(a) has the knowledge, experience, academic qualifications, or professional training appropriate for the assignment;

(b) has the resources to complete the matter within the timescales and to the standard required for the assignment;

(c) is competent to deal with the issues involved.

Reports

16 While it is the expert's duty:-

(i) to explain to the client and his/her instructing lawyer both the weaknesses and the strengths of the case; and

(ii) when providing a report, or giving evidence in court, to be objective and not to mislead the court; and

(iii) when giving evidence in court, to assist the court and be impartial,

save where, as a matter of law, for him/her to identify any relevant recognised body of opinion not already referred to in the report, which differs from that of the expert.

17 It is not the expert's duty tα-

(iv) anticipate arguments which may be put forward by the party opposing his/her instructing client; or

(v) address in the final report matters which are not in issue.

18 In providing a report complying with the principles in clause 23, the expert-

(i) must express any qualification or reservation which would affect his/her opinion;

(ii) must not be asked to and must not amend, expand or alter any part of the report to reflect an opinion which is not the expert's true opinion;

(iii) may be invited to amend or expand a report for the purposes of completeness, or clarity, or readability, or to ensure factual accuracy or internal consistency;

19 All experts reports should include the following:

(i) The expert's curriculum vitae.

(ii) A statement of the source of instructions and the purpose of the report.

(iii) Basic information, for example names and dates of birth in a personal injury action.

(iv) A chronological history of the matter.

(v) A statement of the methodology employed.

(vi) Details of the documents or any other evidence upon which any aspect of the report is based.

(vii) A copy of a summary of the instructions.

(viii) A declaration that the report has been prepared in accordance with this protocol.

20 In addressing questions of fact and opinion the report should have regard to the following:-

(i) Matters of fact and opinion should be clearly distinguished and kept separate from each other in the report.

(ii) Where there is a conflict of evidence the expert should not express a view in favour of one of the competing sets of facts. However, if an expert can exclude one set of facts as being improbable or less probable because of his particular learning and experience, he should express that view **and give his reasons therefore**.

(iii) The source of statements of fact relied upon should be clearly identified within the following categories:

(a) observed by the expert

(b) observed by others, stating whom

(c) contained in the instructions or documents supplied, identifying which

(d) assumed, stating upon what basis

(e) inferred, stating the logic applied.

(iv) Each opinion expressed by the expert should be the expert's own. If the opinion was not formed by the expert independently it should be clear from whom it was adopted.

21 In structuring the report the expert should bear in mind the following:

(i) The report should stand alone and avoid cross reference to external documents where possible.

(ii) The style should be concise and text arranged in short sentences and paragraphs.

(iii) The report should be in the first person singular and signed personally by the expert.

(iv) Appendices should be used where the inclusion of material in the main body of the report would render it less clear.

(v) Conclusions should be given in the final section of the report before appendices and should be cross-referenced to the text which supports them.

22 **Where parties have agreed to the joint instruction of a single expert, the expert's report should set out clearly the issues which are of particular concern to the respective parties (where these are different), and should set out the questions which each party has raised with the expert and the expert's answers to the questions.**

Procedure

23 Following completion of the report, the expert is entitled:

(a) to be advised whether, and if so when, the report has been disclosed to the other side;

(b) to an opportunity to consider and comment upon any other expert's report which deals with the same issues;

(c) to be kept informed of the progress of the action including any amendments to the pleaded case relevant to the expert's opinion.

24 The parties and their lawyers should consider and, if appropriate, take steps aimed at agreement of experts' evidence, or narrowing the issues. **The instructing party should also consider, as the circumstances of the case demand, whether a discussion would help the parties and their lawyers identify the issues.** Where each party to the proceedings instructs its own expert, the experts should be encouraged to communicate or meet to seek to agree the facts or otherwise narrow the issues in dispute. Such communications cannot be disclosed to the Court, will not bind the instructing parties and should take place as soon as practicable with regard to the issues in dispute.

25 If a meeting is to take place, the parties, their lawyers and the experts should co-operate to produce a concise agenda for that meeting reflecting the issues in the case on which the experts should give their opinions. The agenda should wherever possible consist of questions to which the experts can state their agreement or disagreement to facilitate the preparation of a note defining those matters which are agreed and those which are still in issue.

26 If there has been a meeting **or communication**, a note stating the areas of agreement and disagreement should be prepared and agreed between the experts without delay preferably at **the time of** the meeting **or communication**. This note may be produced to the Court. Those instructing experts must not give and experts must not accept instructions not to reach agreement at such meetings on areas within the expert's competence.

Attendance at trial

27 If audio-visual link technology facilities are available which permit the expert evidence to be heard without requiring the expert's attendance at court but also without compromising in any way the quality or the purpose of the evidence, then those instructing experts should consider using them.

28 Those instructing an expert should make all reasonable efforts to ensure that a trial date is arranged that is convenient for the expert, and should keep him/her informed about the trial date/trial programme and to give him/her as early notice as possible of the dates on which he/she is likely to be required to attend.

29 An expert must take all steps to ensure that he/she is available to attend court if and when required, but should be aware that a solicitor may need to serve a subpoena, in the event of difficulties.

30 Whenever experts are required to attend court, all parties should ask the court to hear the expert evidence when convenient and out of the normal chronology if necessary.

31 When giving evidence at court, the role of an expert is to assist the court and to remain independent of the parties: experts should give evidence in an objective and unbiased way and confine that evidence to matters within their competence.

APPENDIX SIX

the UNIVERSITY of GREENWICH

Mr. Justice
Queen's Bench Division,
Royal Courts of Justice,
Strand,
London WC2A 2LL.

9th December 1996

Dear Mr. Justice

Further to my telephone conversations with the Judicial Studies Board and the Lord Chancellors Office, I am writing to you directly in the hope that you may be willing to assist me in the development of some empirical research I am currently undertaking for my doctoral thesis.

In addition to being registered as a Ph.D student with Professor Carol Harlow (Law Department) at the London School of Economics and Political Science, I am also employed as a Senior Lecturer at the University of Greenwich.

My research centres around the issue of expert evidence (in particular scientific expert evidence) and the challenge such evidence poses for the expert, the adversarial system and most importantly, judicial decision making.

One of the areas that I find particularly interesting (and would like to develop further) is the controversial claim put forward by some academics that judges should be encouraged to adopt "applied statistical probabilistic reasoning" to their decision making process. The reason put forward to justify such claims is based on the notion that judges should be able to provide the methodological rationale for their judgments.

The traditional view is that of the American Judge, Cardoza, who said that a judge must "balance all his ingredients, his philosophy, his logic, his analogies, his history, his customs, his sense of right, and all the rest, and adding a little here and taking out there, must determine as wisely as he can, which weight shall top the scales". Later writings refer to judges as being "rational actors" with judges having to receive and assess information, to calculate according to paradigms that have a high probability of giving the right answer. While others, view the judicial process as having to integrate "rational organizational and personal perspectives". The rational perspective is served by a decision based on scientific fact and deduction; the organizational perspective, by a decision that will guide future case law and lead credence to the judicial process; and the personal perspective, to a just decision for the case at hand.

Avery Hill Campus
Mansion Site
Bexley Road, Eltham
London SE9 2PQ
Telephone: +44 (0)181-331 8000

Today scientific evidence (genetics, epidemiology, toxicology) is becoming ever more complex, it relies on (and uses) methodology with which many judges are unfamiliar. Such evidence typically involves the interpretation of complicated sets of statistical data which then imposes on legal notions of causality. Increasingly however, in addition to interpretation and comprehension of statistics, some academics would like to take this process a stage further by proposing that judges also apply statistically based probabilistic reasoning to their ultimate decision.

While I appreciate that this is a somewhat unusual request, I would be very interested to know your views on this development, in particular, whether you have had to deal with cases of this kind, and if so, what problems, they presented.

In addition, it would be very helpful to receive your comments on the following observations:

i) the distinction between law and science is becoming increasingly blurred, particularly in cases where there is an array of complex expert evidence;

ii) the traditional view of the judge (as expressed by Cardoza and others) is representative of the role of the judicial decision maker;

iii) while statistical analysis of evidence can facilitate the attainment of legal objectives. Principles underlying this analysis should not control the entire process of judicial fact finding or judicial decision making;

iv) "applied probabilistic reasoning" is an appropriate method upon which to base the ultimate decision of a case.

Thank you for taking the time to read this letter. I hope that the subject matter is sufficiently interesting to stimulate your response.

I look forward to hearing from you in the near future.

Yours sincerely,

Rebecca Harrison.
Senior Lecturer,
Law School.

APPENDIX SEVEN

Lord Irvine of Lairg
The Lord Chancellor

KEYNOTE ADDRESS TO THE SOLICITORS' ANNUAL CONFERENCE

10:30am
Saturday, 18 October 1997

Cardiff

I come here this morning to announce an integrated package of proposals, on every one of which I intend to consult with the profession.

There has been a lot of trailing, speculation and advance comment. You are about to hear the real thing as a whole. Hear it through and judge it when you have considered it all.

You all know that major change is on the way. The thing to do with change is to manage it through consultation and in a spirit of consultation.

Your Society today is in strong progressive hands with your new President Philip Sycamore, as it was under Tony Girling. I look forward to the consultations that will take place with your profession under its present leadership. But first I should tell you what I have in mind.

The message from the Prime Minister at the Labour Party Conference was strong and clear. The route to a Britain that becomes a model 21st century nation is modernisation of our institutions. What follows is that hard choices are unavoidable.

On 2 May, I inherited two great challenges - the failure of the civil justice system to fulfil its role as a guarantor of people's rights; and the collapse of public confidence in legal aid. Today I set out how we can make civil justice a model system; where it needs to be modernised and how; and the tough choices we have to make.

There are two major priorities, two main targets. First, legal aid has become a leviathan with a ferocious appetite. I have to grapple with that. Second, the civil justice system is a machine with many faults. I plan to remove them. Those are my targets, taking control of legal aid and modernising civil justice.

Civil justice today is too expensive and too exclusive. The very rich and the very poor have access but middle income Britain is left out in the cold - and middle income Britain is the overwhelming majority of people in this country. They cannot litigate because the lawyers' fees are so high and because they cannot afford the risk of losing and having to pay their opponent's lawyers' fees as well.

Not only is civil justice far too expensive for people to afford because of the scale of the costs: they are deterred from pursuing good cases because they cannot make any rational assessment of how much it will cost them in the end. These and the level of costs are the biggest bars to access to justice.

And civil justice is too expensive for the taxpayer as well. It is the taxpayer who today funds a costly legal aid scheme that fails to provide the right kind of help at the right time to the people who need it most. The taxpayer also pays in the end for the wider cost to the economy of unnecessary delay and complexity in the civil justice system.

My reforms aim to drive down costs for the benefit of the individual litigant and ultimately the taxpayer; and, at the same time, to throw open the doors of the justice system to all who need to enter. The civil justice system should be accessible for everyone - not just the very poor and the very rich.

Before I say more, I acknowledge two debts the system owes. The first is to Lord Woolf, for his two distinguished and historic Reports. The second is to Sir Peter Middleton. His review of civil justice and legal aid, commissioned on 6 June, was delivered to me at the end of September. There have been many, often conflicting, proposals swirling round the issues of reform. Sir Peter's report has provided me with a strong framework against which these proposals can be evaluated. His Report is being printed as I speak. It will be published on Monday.

We just have to get a grip on legal aid expenditure. Let us look the facts in the face. Net expenditure in 1990-91 was £682 million. Only 6 years later, expenditure had rocketed to £1,477 million. That is an increase of 115%.

90% of the legal aid bill goes mainly on lawyers' fees. That bill has consistently risen faster than the number of cases handled. In the last 4 years average payments in civil legal aid have increased by more than 43%. The number of people helped has actually gone down by 9%. Since 1993-94, the cost of legal aid has risen by 22%. But the inflation rate over the same period was only 7%. The taxpayer is paying more for less.

No other area of public expenditure has grown so fast over so short a period of time. I am not claiming to be the first Lord Chancellor who has said this - but I am determined to be the Lord Chancellor who finally tackles the problem and brings legal aid under control.

Legal aid must be re-focused. It must be made a tool to promote access to justice for the needy - not be seen by the public as basically a means of keeping lawyers in business. It is the people's needs that justify a legal aid system in the first place. It is their needs, not the needs of legal aid suppliers, that justify asking every taxpayer to commit £57 a year to keep the scheme going.

The resources available for legal aid are finite. The days of free-flowing public expenditure are gone for ever. No Government could tolerate an ever-growing, demand-led budget that just cannot be controlled.

I have thought for a long time about the future of legal aid. The future lies in contracting for services, in both criminal and civil cases. The way ahead is contracts that will specify in advance just what services are being bought, and at exactly what prices.

It is only through contracting that Government can hope to gain sufficient control over the shape of the legal aid scheme to ensure that resources are targeted on the needy. To stop cases going on far too long. To cut out waste and duplication. To trim costs and expense. And to focus this vital fund on the people who need it.

Legal aid work will, in time, be restricted to those providers who have a contract with the Legal Aid Board. No longer demand-led, as now, the civil legal aid scheme will become more responsive to the Legal Aid Board which will purchase - at agreed and fixed - I emphasise fixed - prices - services which have been determined in advance under plans made locally on the advice of Regional Legal Services Committees.

No lawyer can be compelled to contract at a fixed price. Lawyers must make a commercial judgment. Depending on how each case progresses, the fixed price in every case will, at the end, seem too high or two low. It is called "taking the rough with the smooth". It is the overall outcome from all contracts on which lawyers' profitability will depend.

Legislation will be needed before contracting can be introduced. There remains much detailed planning work to be done. The Legal Aid Board's franchising scheme offers a foundation for the management of contracts but, as you know, so far it focuses centrally on the management of lawyers' firms and their business, not on the quality of the legal services they provide.
I want to see the Legal Aid Board developing quality standards too - effective quality assurance and control. And I want to see that developed as part of a move towards contracting for legally aided services. Lawyers must become more precise in their predictions. Those predictions should be monitored by the Legal Aid Board, against achieved outcomes. This is an important means by which the Board will judge whether particular firms deserve to continue to be awarded contracts. But there are no doubt other ways in which competence and quality can be assessed. Clearly this is something that demands consultation between the Government and the professions. That consultation will take place. You will, I am sure, want to join me in demonstrating that it is only high quality services that are being provided. I will welcome your views on how best to test that, monitor it and, where necessary, weed out contractors who do not measure up to high quality standards.

I propose also to extend contracting to criminal legal aid. In the medium-term, the greater part of criminal work will be drawn into contracting arrangements. But we need to work hard to decide how the interests of justice in criminal cases - particularly the rights of defendants and the need to avoid delay - can be dovetailed with a contracting system managed through the Legal Aid Board. That work is already in hand.

Contracting at fixed prices, agreed in advance, will give the Government control over the legal aid budget. It will enable choices to be made. It will allow us to set priorities, and to shape the budget to fit the country's needs and circumstances. It will give the community the chance to choose between spending money on legal aid and spending it on, for example, health or education. But this reform must go hand-in-hand with better ways of prioritising the cases which call on the legal aid scheme for assistance.

A grant of legal aid depends on the case passing what is commonly called the merits test. That test needs tightening.

Too often the Legal Aid Board is told that a case has a "good" or an "average" chance of success without any hard reasoning or evidence to back up the claim; and without the lawyer having to nail his colours to the mast of a precise percentage prospect of success. Lawyers will be required to do that in future. Of course they can only do so on the basis of the evidence then available to them. But woolly unquantified advice can have no place in a reformed legal aid scheme.

My approach to legal aid is no different from the approach I would expect of reasonable people who can afford to pay for their own litigation. They would require a very high likelihood of success - at least as much as 75%, unless there is some compelling reason, such as loss of the home, for taking a greater risk. I would not myself litigate at my own expense with any lesser prospects of success, and would probably require a good deal better. I am against a go-go litigation culture which tries it on in speculative cases - cases should never go forward on that basis and certainly never at the expense of the State. I can see no reason why the state should fund a poor person to engage in litigation which a prudent person - who could himself afford to fund it - would not enter at his own expense, unless the interest to be protected was very important to them, say keeping a roof over the family's head.

In cases where it is the prospects of success which are central, I hope to see the merits test stipulate a 75% likelihood of success. Starting litigation is not like putting £1 each way on a horse in the Derby. We all have speculative flutters. Litigation is hugely expensive; the downside of losing is appalling. No prudent person would run the risk of litigating out of his own resources with less than a 75% likelihood of success. I cannot see why the State should bear the costs of weak litigation where the penalty is on the unassisted defendant who cannot recover his costs from the legally-aided plaintiff.

I also intend that the merits test should, in future, reflect the pressure on the legal aid budget. Sir Peter Middleton says in his report that this should be one factor to be brought into the equation alongside the importance of the case to the individual and the likelihood of success. It is only by bringing the overall availability of resources into play that the Government can guarantee keeping legal aid within an annual pre-determined budget. But by careful planning in the contracting process - and granting overlapping contracts that last for several years ahead - we shall ensure that there is a steady level of services available at all times to meet the priority cases identified through the merits test.

The changes I propose to the merits test will require legislation, so I cannot give you a timetable for change now. My intention, in the interim, is to invite the professions and other interested parties to offer their advice on how the reformed test should be framed and operated in practice.

Before I move on from the merits test, I acknowledge there are categories which would not pass the test, and where the predicted cost would be disproportionate to the likely benefit to the individual - but where it is plainly in the public interest for a particular point of law to be examined, or for a precedent to be established. I believe it would be right to make special arrangements for these cases.

I am attracted by two proposals which have been made to me by Sir Peter Middleton for handling these cases of public importance. First, that the Legal Aid Board should establish a separate fund specifically designed to carry them forward. And, second, that consideration should be given to placing them under special judicial management.

It would be difficult to establish a separate budget for public interest cases until the cost of civil legal aid overall has been brought under control; and I certainly do not wish to discourage people from using other existing sources of funding to bring public interest cases. But I have decided that these proposals deserve serious thought and discussion. My officials will be consulting widely on this issue over the coming months.

I have one last point to make about deciding which cases deserve legal aid. The last Government proposed that everyone who receives assistance from the legal aid fund should pay a minimum contribution. They argued that this was the only way to ensure that poor litigants had a real personal commitment to their action.

Sir Peter Middleton has re-examined this issue. He has concluded that it would be reasonable for the Government to ask for a contribution of five or ten pounds, even from those who are dependent on Income Support.

This is one of the few recommendations from Sir Peter Middleton which I am unable to accept. Income Support is set at levels which are intended to meet essential needs: housing, food, warmth. There is no fat. People living on Income Support have no money to spare to help finance the legal aid scheme. These are among the poorest in society. I cannot accept that they should be expected to pay a flat rate charge as a ticket of admission to legal aid. Besides that, a flat rate contribution reflects only on the ability of the individual to pay. It says nothing about the merits of the individual's case. We should be relying in these cases on the merits test, not ability to pay a contribution, to determine which cases should be assisted from the legal aid fund.

Mr President, I turn now to the linked question of conditional fees.

Individuals need to know what their costs will be before they start on litigation. That is important if everyone is to feel that the justice system belongs to them - not just to the very rich and the very poor. I want to eliminate as much uncertainty as possible. The way forward is to widen access to conditional fee agreements, the "no win, no fee" system.

My Department will be consulting over the next few months on the maximum possible extension of conditional fee agreements to all civil proceedings, other than family cases, from April, 1998. Conditional fee arrangements mean that the risk of bringing a case is shared between the litigant and his lawyer. They therefore provide an incentive for lawyers to take more care in their advice, their assessment of prospects, and the steps they decide to take in litigation.

Conditional fee agreements have been working well in the personal injury field. "No-win, no-fee" agreements are, for the great majority of people, the only practicable way of pursuing their rights.

The Law Society has been very positive about the benefits to be obtained from conditional fees. I hope the Society will sit round the table with the Government to ensure that these advances are delivered.

Some of you will, I expect, be less enthusiastic about my next proposition. The extension of conditional fee agreements to a wide range of cases must prompt the question: "should legal aid also be offered in cases where other arrangements already exist to support litigants?" I think not. Subject to consultations, I expect to exclude most claims for money or damages from legal aid. Legal aid will continue to be available for all civil cases not claiming damages or other money: for example, care of children; judicial review; and the threat of homelessness, not to mention the whole of criminal legal aid.

Excluding claims for money or damages from legal aid will put those on low income, as well as those on middle or higher incomes, on an equal footing - taking forward a civil case will depend on whether or not it has the merit to persuade a lawyer to handle it on a "no win, no fee" basis. The decision whether or not to go ahead with any particular case will depend on its strength, not on the financial resources of the client.

If lawyers think the case too risky even to enter into a success fee arrangement, I do not think we should be looking to the taxpayer to support what will be, by definition, a case with insufficient prospects of success. It is one thing to expect taxpayers to subsidise the poor so that the poor can enjoy the things that taxpayers can afford for themselves: it is quite another to ask them to subsidise a case which they would not themselves be able to pursue without a conditional fee agreement.

An alternative approach which has been suggested is that, rather than leaving the less well-off to make "no-win no-fee" agreements, there should be a contingency, or conditional, legal aid fund - a CLAF for short. People would still receive legal aid in the traditional way, but successful litigants would hand over some of their winnings to the Fund to help meet the cost of the cases that lose. This is a listening Government, so I am willing to consider this proposal. I do, however, have major concerns about the way this Fund would work. It is not suggested, at any rate by solicitors, that conditional fee agreements which have worked so well should be swept away and be replaced by a Contingency Legal Aid Fund. Would there not be a real risk that only weaker cases would be supported by a CLAF, because lawyers would prefer to cream off the stronger cases under "no-win no-fee" agreements and so recover their ordinary fees plus the success fees? So I ask, would CLAF not become the exclusive preserve of the weaker cases?

So I cannot conceal from you that I doubt whether a Contingency Legal Aid Fund points the way forward. But I readily acknowledge that my proposal needs to be carefully developed to avoid any question of undue hardship for those who are currently eligible for legal aid.

Even before making this announcement, I have already received suggestions: for instance, that there should perhaps be provision for the Legal Aid Fund to meet the insurance premiums, to protect, against the risk of loss, those who are eligible for legal aid, and wish to enter into conditional fee arrangements. There is also an argument that medical negligence is a special case, because substantial costs are incurred in investigating it before a view can be formed whether it has the prospects of success to merit carrying it forward. The question is whether the lawyers should accept these costs as a commercial risk they should bear in arriving at a decision whether to make a beneficial conditional fee agreement.

These are examples of the issues we will have to resolve in the next few months. I have given what I hope is a very clear indication of the direction in which the Government wishes to move. But it is essential that the details are right. We seek to avoid any rough edges, and any new inequities. We shall be consulting widely and openly. We are an open Government, committed to openness. I have deliberately avoided trying to settle all the details behind the closed doors of Whitehall. I want an open exchange of views on those details.

My officials will, next week, be inviting the professional bodies and others to join them for immediate discussions on the important details of how we take forward extending conditional fee agreements and reforming legal aid.

I am willing to consider any arguments made to me, but I will always test them against the principle that legal aid exists only to remedy an imbalance between the poor and those who are better-off, not to put the poor in a privileged position.

Mr President, three key changes are at the heart of my vision for the future of legal aid:

- altering the basis of payment to contracts at agreed, fixed, prices;
- tightening the merits test; and
- the widest possible extension of conditional fee arrangements, and reliance on them in preference to legal aid from the taxpayer.

Some of these changes will require legislation. So I am not yet in a position to predict the timetable. But you should know that major changes are on their way.

The suggested extension of conditional fees for most civil proceedings except family cases would, at last, give middle income Britain a real opportunity to enforce its rights in the courts. The poor, the rich and the merely "comfortable" should enjoy equality of access to legal advice and representation. I repeat: those between the very poor and the very rich are the overwhelming majority of people in this country.

But to extend conditional fees and refocus legal aid is not enough. We must also make radical changes to the culture of civil justice, its procedures and its structures.

In his Reports, Lord Woolf identified five fundamental weaknesses in civil justice. These were excessive delay; excessive cost; undue complexity; uncertainty over the amount of time and money likely to be involved in bringing a case; and, perhaps worst of all, unfairness, where a financially stronger party can exploit all the other failings of the system to defeat an opponent. I agree with Lord Woolf. I am pretty sure all of you do as well.

Reducing delay and complexity in the courts, and fixing costs at the outset of cases, will reduce expense for both the individual and ultimately the taxpayer. It will promote certainty and confidence.

This Government embraces Lord Woolf's vision of a more efficient civil justice system: a modern civil justice system designed for the twenty-first century, in which people who are legally aided, and those who are not, have equal access to simpler, faster procedures for securing their rights.

Mr President, I turn now to the steps we intend to take to deliver.

First, we will expand the small claims procedure. This has been a major success of the civil justice system. It is simple, fast and cheap. In a study published in 1996, the National Audit Office found widespread satisfaction among users: eighty-two per cent of claimants surveyed found the small claims procedure very or fairly easy to use; and seventy per cent of plaintiffs considered the procedure either very or fairly cheap. Sixty-eight per cent of claims were heard within twelve weeks of the defence being filed. The speed, simplicity and inexpensiveness of the small claims procedure makes it a model of its kind.

The last Government raised the small claims limit from £1,000 to £3,000 in January, 1996. The effects of that change have been monitored, as Lord Woolf proposed. I am now satisfied that we are ready to implement the next step. I therefore propose that the small claims limit should be raised to £5,000 as part of an overall package of reform.

The last Government left at £1,000 the limit for personal injury claims in the small claims procedure. I know this has been controversial with personal injuries solicitors. There has been pressure for all personal injury cases to be taken out of small claims. I am not, however, persuaded that this would be in the interests of all personal injury litigants. Many of the injuries involved are very minor, and the cost of pursuing damages in the county court would be quite disproportionate to the damages sought. I am persuaded that the small claims procedure is an effective means of dealing with these small personal injury cases.

From an opposing standpoint, I have had to consider arguments that higher value personal injury cases should also be dealt with as small claims. I am not convinced. Claims of this value may involve more serious injuries. They need careful investigation of a kind not appropriate to small claims. They require the professional assistance of lawyers. So my intention initially is that only cases valued at under £1,000 should be dealt with as small claims.

We also want to help those who must have access to a more sophisticated judicial process. We will adopt Lord Woolf's proposals for more "hands on" management of cases by judges, transferring power from lawyers to judges, and giving the courts greater control over the progress, cost and length of those cases as they move to trial. I intend to oversee the creation of two new routes through civil justice to replace the complexities of the present: a "fast-track"; and a "multi-track", designed to deal appropriately and proportionately with civil cases which are not suitable for the small claims court.

Cases allocated to the "fast-track" will be subject to a fixed timetable, requiring the case usually to be heard within thirty weeks of allocation. I have considered the views of those who have advocated that all personal injury claims should be in the "multi-track" and excluded from the "fast-track". I do not believe so extreme a case to be made out. There may be personal injury cases where the claim is up to £15,000 where certainty about costs and a fixed timetable in the "fast-track" are appropriate.

Cases allocated to the "multi-track" will be those of higher value or greater complexity which will benefit from a greater level of judicial intervention, tailored to the special features of each dispute. So many personal injury claims may qualify for "fast-track", and some may not.

The Government intends to have these two tracks up and running in April 1999. This is six months later than the last Government's plans. I never believed that October 1998 was an achievable date for implementation of the "fast-track" and "multi-track". I know that the professions have also had their doubts. And so does Sir Peter Middleton. It is more important to allow ourselves a little headroom to get the reforms right. If you act in haste, you repent at leisure. April 1999 will give us the extra time we need to make sure we secure what we want.

Lord Woolf recommended that the "fast-track" procedure should deal with all cases up to £10,000. If this had been in place last year, eleven thousand cases would have been disposed of in the "fast-track". My view is that even more litigants should be able to benefit from the speed of the "fast-track". I therefore intend to initiate consultation on whether the "fast-track" limit should be set at £15,000.

The strength of the "fast-track" will be the strong judicial control imposed on the progress of cases. The responsibility to be put on the judges is great. They must not fail because the public will believe that the judges have failed if the reforms fail.

But tough judicial control may not be enough on its own to ensure that the "fast-track" works well. I have been persuaded by both Lord Woolf and Sir Peter Middleton that judicial management must go hand-in-hand with a fixed costs regime if the Government's objectives for cheaper, faster, more certain justice are to be achieved.

The introduction of the fast-track, in April 1999, should be accompanied by an associated fixed costs regime. Much work, however, remains to be done on the detail of how the regime would operate in practice.

My Department is funding research from the Institute of Advanced Legal Studies into "fast-track" costs, based on hypothetical cases. The Law Society has two representatives on the Steering Committee for this project. The Bar Council has one. I am grateful to the professions for their contribution to this study. I intend to consult them fully.

If justice is to be accessible to all, we must address all the other factors which exclude people from the court system. I intend to look again at the structure of civil court fees. My starting point is that the cost of the civil courts should be met by those who use them. As I said in Parliament in July, I do not accept there is a constitutional right to a court system which is free at the point of delivery. That would be a misuse of the word "constitutional". I do, however, accept that people should not be excluded from the court system because the fees they are asked to pay are unfair.

The civil fee structure is irrational and hopelessly out-of-date. It needs to be reformed. I will be issuing a Consultation Paper next month inviting discussion on the principles which should underlie a new fee structure.

The aim is a rebalancing of the fee structure which will be much fairer to all court users, reflecting the cost of the various components in litigation as it is carried forward to the conclusion of the trial. Such a structure should avoid a disproportionately large fee being levied at the outset as a ticket of admission.

Meanwhile, I want to help the many who cannot afford the fees already in place because of their low incomes. At present, only those in receipt of Income Support are exempt from all court fees. In response to concerns raised in Parliament, I propose to extend exemptions to those in receipt of income-related Job Seeker's Allowance, or Family Credit, or Disability Working Allowance. I intend that this change should come into effect at the end of next month.

I believe that I have described a radical package of reform designed to modernise the civil justice system and promote access to justice for all who need it. But these are not reforms intended simply to deal with the problems of today. I have my sights set on another, longer-term, goal - a Community Legal Service.

The development of a Community Legal Service was a Manifesto pledge. We said we would "develop local, regional and national plans for the development of Legal Aid according to the needs and priorities of regions and areas."

The principal aim of a Community Legal Service will be to help people decide if their problem is really a <u>legal</u> one and, if it is not, to point them in the right direction for appropriate help. There are many existing information and advice sources: the CABs, the Law Centres, the Advice Centres, and mediation bodies. We intend to co-ordinate these services under a coherent scheme which will provide a service to the whole public which is both easy to access and to understand.

We have already brought the voluntary sector into the legal aid scheme by contracting with advice agencies to provide help. In addition, we have now launched the first Regional Legal Services Committee - a network covering the whole of England and Wales is to follow. These Committees will be providing key information and advice to the Legal Aid Board and Government about the needs and priorities of the regions they serve. In the first instance, this will allow the Board to develop local, regional and national plans for meeting those needs through the legal aid scheme. And contracting will give the Board enough control to ensure that the right level of service can be provided, delivered in the right ways, and tailored to the requirements of each area.

Local communities should have a strong say in the development of information and advice services which meet their needs. In the longer term, the work of the Committees will help shape the development of a Community Legal Service. All this chimes with the Government's broader policies of devolving powers to people locally.

I do not expect the development of a Community Legal Service to lead to greater demands on the public purse. The resources needed will come from the re-focusing of the legal aid scheme as a tool to help poor people solve social welfare problems by gaining access to the justice system.

This re-focusing will be achieved by a combination of better prioritisation, contracting, and the use of conditional fees for money claims.

This can be no more than an outline of the Government's intentions for the Community Legal Service. Much more work needs to be done to develop this proposal. I have decided to create a Project Team within my Department to develop and carry forward detailed plans. I will be embarking on a consultation process and encourage all of you to help by expressing your views. We are all part of the community. We will all have a stake in a Community Legal Service.

As the Prime Minister said at the Labour Party conference, Government is about hard choices. It is also about leadership, and being beholden to the whole country, not to any vested interest. I am not a Lord Chancellor committed to change for its own sake. But I will not flinch from taking difficult decisions if I believe them to be the right ones. My job is to act in the wider public interest.

There will be those in the profession who will oppose these reforms. The Bar expressed its concerns first. Barristers are, of course, reared in a culture that they are paid, win, lose or draw. For them it would be a culture shock to be paid only if they win, but not if they lose. Conditional fee agreements are, however, well understood and accepted by solicitors. There will be some who will see their own financial future disturbed. But I also know that many in the professions want to see reform and modernisation of both legal aid and civil justice. They know that change is inevitable and desirable. The legal system must develop or decay. I know what I want to see happen.

Conditional fees will enable middle income Britain - the overwhelming majority of people in this country - to regain access to the court system to enforce its rights, with the only risk the risk and cost of losing. The poor will also benefit from conditional fees, while the legal aid system will be focused more clearly on helping the needy with social welfare problems which have a direct effect on the quality of their lives. The taxpayer benefits from the establishment of firm control over legal aid expenditure. No longer will legal aid grow and grow, while delivering less and less. And the nation will benefit from a faster, fairer, more open legal system.

To any sceptics in this Hall, I say this: before you leap to oppose, reflect:

The package I envisage will bring great benefit to you; extending conditional fees into so many new areas means more business; the public will believe that the risks and the benefits for lawyers in these new arrangements will motivate lawyers to do their very best for their clients. More rapid procedures in the civil courts will enable you to deal with more cases, more quickly - upping your overall caseload - as more people, especially from middle income Britain, gain access to justice though the new terms.

It gives me no pleasure to say this: but I do believe that, today, public cynicism at lawyers and the undue length and complexity of our current court procedures causes the great majority of the public to see lawyers as representing no more than an old-style vested interest.

I doubt if anyone in this Hall would seriously argue that the legal profession in recent years has done anything other than fall lower and lower in public estimation. I want to reverse that. I want, as Lord Chancellor, to preside over a legal system that is so highly respected for its speed, its economy and efficiency, that lawyers can begin to compete in public esteem with teachers and doctors and nurses in what they put into society.

The new regime I have mapped out today should go a long way to heighten the public standing of lawyers. I cannot, however, achieve that on my own. I look to you for support so that, together, we can carry these changes forward into the 21st century - not in an atmosphere of mutual recrimination, but in a spirit of co-operation. That is the way I want to modernise the part of the institutions of our country for which I, and you, share responsibility.

End

APPENDIX EIGHT

SAMUEL GEE LECTURE
ROYAL COLLEGE OF PHYSICIANS
TUESDAY 13TH MAY 1997
MEDICS LAWYERS AND THE COURTS

I am honoured and grateful for being allowed to give this lecture. Honoured because the lecture is given in memory of Samuel Gee who is a most distinguished former Fellow of this College. I am delighted to note that like myself he had the advantage of being educated at University College London, of which I am proud to be Pro-Chancellor.

I also observe that he was one of the most brilliant teachers of his time although he had "certain mannerisms" (not identified) which students delighted to mimic. It is reassuring that even the most distinguished medical practitioner can have human failings.

I am grateful to have this opportunity of saying publicly the extent to which I am indebted to the Royal Colleges in general and this Royal College in particular for the help which they gave me during my inquiry into Access to Justice.

I am also grateful for the opportunity to discuss with you the reforms which I have recommended as a result of that inquiry. However before turning to those reforms, I would like to stress that in general my experience is that the relationship between the medical profession on the one hand and the judiciary and the courts on the other has always been of a high order. The courts are very conscious that in many fields of litigation, they depend on the expert medical advice in order to come to a just decision.

The general approach of the courts is to apply the standards which the medical profession adopt. Thus we judge whether there has been negligence in the treatment of a patient by asking whether or not the medical treatment which is the subject of complaint accords with standards which any recognised section of the medical profession regards as acceptable. If the treatment does accord with such a standard, then in general we do not categorise it as negligent. By adopting this standard the courts have managed to hold the balance fairly between the interests of the patient and the interest of the profession. By striking the right balance, the courts reduce the risk of proper medical practice being undermined by the fear of litigation and the need for compensation to be paid where treatment is of an unacceptable standard. In addition the courts do not impose their ethical standards upon the medical professions. Wisely, on the whole they leave the medical profession to determine what is, and what is not, ethical behaviour.

However, because of the increasing complexity of society, members of the medical profession are from time to time faced with problems as to whether or not a particular course of treatment is or is not lawful. When the medical profession have problems of this nature, they can rightly expect the courts to provide them with an answer. It is primarily the responsibility of the courts to define what is lawful and what is unlawful behaviour. Furthermore if the problem needs to be resolved urgently because the health of a patient is at stake, then the courts are under a heavy duty to ensure that it is resolved expeditiously. Here I believe the courts can take pride in what they have achieved with the co-operation of the legal profession.

First of all, the courts have significantly changed their attitude to giving advisory declarations in relation to medical issues. At one time it was the courts practice not to grant advisory declarations as to whether future conduct would or would not be unlawful. This meant that a doctor could be faced with the choice of either not giving treatment or taking the risk of giving treatment and having that treatment later condemned as unlawful. Now it is clearly established that if there is a doubt as to the lawfulness of treatment, the court can rule on this in advance of the treatment being given. As a judge of first instance I was by chance involved in the three cases upon which the present approach is based. The first case was one involving the Royal College of Nursing who were concerned as to what part a nurse could properly play in procuring an abortion without being under the direct supervision of a doctor. The second was as to the lawfulness of doctors providing advice to children on methods of contraception when they were below the age which it was lawful to have

sexual intercourse with them. The third case involved an issue as to what advice and assistance could lawfully be given to an individual who wished to terminate his life.

An area where it has been particularly important that the courts should be willing to grant advisory declarations is where a patient is unconscious as a result of an accident or illness and is incapable of stating whether or not he consents to a particular course of care. The law has laid down that in such circumstances a doctor may lawfully treat such a patient as long as he acts in the patients' best interest. Indeed, if the patient is already in his care he is under a duty to treat him. The case which made this clear was only decided in 1989.[1] That was a case in which it was obvious that it would be desirable to sterilise an adult woman of unsound mind and the court held it was lawful for the operation to take place.

However, doctors are not entitled to impose treatment on someone who is of sound mind, however much that treatment might be in his interest, if he does not consent to have that treatment. A patient may if he or she wishes starve him or herself to death. But what of a situation where what is involved is a decision as to whether to provide or to continue to provide treatment or care which could or might prolong the life of a patient if the continuance of the treatment is futile? Futile since it would not confer any benefit upon the patient. This was the issue that came before the court in a particularly acute form in relation to Anthony Bland, the young man who was a victim of the Hillsborough football disaster. He was 21 years of age when the matter came before the House of Lords. He had been in a persistent vegetative state for 3½ years. The House of Lords drew a distinction between two situations. The first would be euthanasia and unlawful. It is bringing a patient's life to an end by positive steps, such as administering a drug to bring about his death. The second is not prolonging the patient's life by discontinuing medical treatment. This includes stopping artificial feeding and the administration of anti-biotic drugs when it is known that the result will be that the patient will die. This is lawful. This is subject to a proviso which again involves the standards of the profession. The proviso is that responsible and competent medical opinion is of the view that it is not in the patient's best interest to prolong his life. Two members of the House, Lord Browne-Wilkinson and Lord Mustill, were especially concerned about having to reach a decision. This was because this is an area where it is particularly important that Parliament should review the law. They also recognised that the solution which was being provided was not ideal. As Lord Browne-Wilkinson said:

> "How can it be lawful to allow a patient to die slowly, though painlessly, over a period of weeks through lack of food, but unlawful to produce the immediate death by a lethal injection, thereby saving his family from yet another ordeal to add to the tragedy that had already struck them? I find it difficult to find a moral answer to that question."

As perhaps could be forecast, Parliament has not provided the legislation which their Lordships thought desirable and so the courts are still having to develop the law on a case by case basis.

Since the Anthony Bland case there have been a reasonably substantial number of other cases where similar assistance has been sought in the courts. Some of the cases have been variations of the Anthony Bland case. Others have raised different issues. There has recently been a case where a mother was in danger of inflicting injury upon herself and the loss of the baby she was about to have because she suffered from a needle phobia. The needle phobia was preventing her making any decision at all. The situation was extremely urgent and the court at first instance sat at 9.25 to 9.55 in the evening so that it could grant a declaration. An an appeal was heard on the same day from 11.00pm to 1.00am and a declaration granted by the Court of Appeal with the consequence that later that morning the mother having learnt of the decision of the court voluntarily gave her consent and I am happy to say that she was delivered of a healthy child.

---

[1] *F v. The West Berkshire Health Authority* (Mental Health Act Commission intervening) [1990]2 A.C. 1.

The courts also recognise that cases of this nature need a special form of case management. As the issues were often of a similar nature to those dealt with by the Family Division the cases were allocated to that Division so that the Family Division judges of the High Court could develop expertise in their disposal. Furthermore the President of the Family Division laid down procedures which would ensure that they received the urgent attention they required. The consequence is a marked improvement in the ability of the courts to assist the medical profession and in so doing the interests of justice and the needs of the public.

Turning to medical negligence litigation the story is not so happy. Medical negligence was given a high profile during my inquiry and has been the subject of a number of the recommendations which I have made. This is because medical negligence was one of the areas of litigation - I emphasise one of the areas of litigation - where it was obvious to anyone involved that the civil justice system was not working satisfactorily and radical change was desperately needed. I am confident that no one who has personal experience of this subject would dispute this diagnosis.

The recommendations I have made for the improvement of the handling of medical negligence cases are but an example of my recommendations for the improvement of litigation generally. If the general recommendations are not sound then I have to acknowledge my recommendations as to the handing of medical negligence cases must be flawed. _

It is because of this I now refer to a campaign of opposition to my recommendations upon which Professor Michael Zander has felt it right to embark. I do so, because if he is right in the criticisms which he makes, then the support which I have received from this College and the other Colleges has been misplaced. In addition, those who have been and are still working on carrying forward my reforms are engaged on a futile task. Among those to whom I am here referring are the medical and health practitioners lawyers and insurers who have been carrying forward the reforms as part of the Clinical Disputes Forum. They include, a partner in a firm of well known solicitors who conduct litigation on behalf of plaintiffs in medical negligence cases, who felt the inquiry into access to justice was such an important opportunity that she gave up her practice for 9 months to work entirely voluntarily to assist in the preparation of my report.

I had been aware that Professor Zander has been concerned about my recommendation for some time. He is a friend and he has been punctilious in keeping me informed of the criticisms that he is making. If criticisms are constructive I welcome them. It is for that reason that I invited Professor Zander to address a meeting was were held in connection with my inquiry and I have also accepted an invitation to appear on the same platform to discuss my report. For the same reason I have deliberately restrained my response to his criticisms though I have observed they are becoming more strident as time passes. However, last week he gave a lecture for which he invited wide media attention which I am afraid I regard as being misleading and inaccurate I therefore propose to devote part of the remainder of this evening to responding, insofar as time permits, to the criticisms which he makes.

As I understand his thesis, it is that there is nothing very much wrong with the way the civil justice system is working but insofar as there is anything wrong, it is unlikely that anything can be done about it, because lawyers will not change their ways and, in any event, the recommendations which I have made will make the situation worse rather than better.

In making this root and branch attack on the reforms, Professor Zander recognises that he is, as he has said himself, a Cassandra figure. He said in his lecture last week "the Woolf project appears to have almost universal support including, so far as one can tell, that of the senior judiciary, the Bar and The Law Society as well as both the lay and the legal press". He adds that "one might have expected that of all people, practising lawyers would take exception to Lord Woolf's caustic view of the way that they operate. But neither the Bar or The Law Society has raised a peep of protest about this calumny. Indeed Lord Woolf's view was essentially not different from that of the independent working party set up in 1992 jointly by the General Council of the Bar and The Law Society". He is here referring to the report brought out under the chairmanship of Miss Hillary Heilbron QC and Mr Henry Hodge which reflected the views of 44 highly experienced practitioners.

He suggests there has been "remarkably little interest in awkward facts and analysis that suggest that this emperor is wearing no clothes".

In general I must confess the tenor of his lecture reminded me very much of the remark attributed to a nineteenth century judge who was reported to have said "reform, don't talk to me about reform, things are bad enough already". Professor Zander concluded his lecture by saying, and I quote :

> " 1. The arguments I have been pressing are very strong ones and that they deserve an answer. But they have not been answered - perhaps because they are unanswerable.
> 2. That the new Lord Chancellor should say, "I want to be told by someone in detail and addressing the facts and figures why Zander is wrong". And Zander should be given an opportunity to reply to such an assessment of his argument. And let there be a reply to Zander's reply and let this process go on until both sides have said what they have to say. Such exchanges or advice to the Lord Chancellor should be published and then let the Lord Chancellor decide which is the better argument.
>
> 3. A prudent approach might, for instance, lead us to stand by implementing the proposal made in 1979 by the Cantley Committee that attention should be directed first and foremost at the small minority of cases that plainly appear to be lagging. If a case has not been set down for trial within X months of issue of the proceeding a summons should be issued requesting an explanation. The court could then give whatever directions seemed appropriate in the light of what it was told about the reasons for delay. That would be a reform targeted at the right cases, as opposed to Lord Woolf's scatter-gun approach which would apply the reforms mainly to cases that do not need them."

If you heard his lecture you would no doubt be impressed by his eloquence but you should not have been impressed by the content. It was not based on any relevant practical experience. He is a distinguished academic and contributions from academics can be important. However he has not suggested that the views that he holds are based on any research which he has conducted himself into the workings of the civil courts in recent time.

By contrast, although I of course accept this does not mean that my recommendations have any validity, they were produced after an intense two years consultation process conducted with the assistance of assessors with a wide ranging experience of the subject with which my report deals. I was also helped by expert working parties of highly experienced practitioners and academic consultants of distinction whose findings supported my conclusions.

Those findings were that the civil justice system has become excessively adversarial, slow complex and expensive. That this is especially true of litigation over alleged medical negligence in the delivery of health care whether by doctors, nurses or other health carers. For example there are five respects in which medical negligence actions conspicuously failed to meet the needs of litigants :

1. The relationship between the costs of the litigation and the amount involved was particularly disproportionate. The costs were peculiarly excessive, especially in low value cases.
2. Delay; the period which regularly elapsed before claims are resolved is more often unacceptable in the case of medical negligence claims than other classes of proceedings
3. Unmeritorious cases are pursued and clear-cut claims defended for longer than happened in other areas of litigation.
4. The success rate is also lower than in other personal injury litigation.
5. Finally the lack of co-operation between the parties to the litigation and the mutual suspicion as to the motives of the opposing party is frequently more intense than in other classes of litigation.

I emphasise that the system is not meeting the needs of patients or professional health carers. They are both being let down by the civil justice system at present. The pain is not only caused to the potential plaintiffs. It is caused also to those who have been responsible for delivering the health care of which complaint is made. All too often they find themselves in a nightmare situation. Their

ambition throughout has been to help the patient but instead they find that they are the subject of hurtful allegations of negligent mistreatment. The allegations often only surface after the carer has ceased to have any real recollection of what happened. Frequently the carer feels intense frustration. They believe that if only they could have an opportunity of discussing the issues with the patient they could satisfactorily explain why things turned out as they did. However outdated conventions as to behaviour makes this impossible. The concern is, that if there is an apology, or if even an explanation is given this could be used in evidence against him or prejudice his position with medical defence bodies. The result is patients feel let down. Treatment has gone wrong, sometimes because of unrealistic expectations as to what could be achieved and carers react defensively in respect of attacks from patients which they regard as unjustified.

I was convinced that a way had to be found for breaking down the barriers which divided the patient from his carers so that wherever possible litigation could be avoided. This could only help everyone involved. It would save on costs. It could result in those patients who deserve to be compensated receiving proportionate compensation voluntarily, and in an atmosphere which did not poison relations between the patients and those who had been treating them. Often, where things have gone wrong the need for treatment is at its greatest and the breakdown results in the professional feeling frustrated in not being able to provide that treatment.

The opposition of Professor Zander to my recommendations is based on his unwillingness to accept that the civil justice system has these serious faults that I and virtually all commentators are agreed the system suffers from, and his unwillingness to accept that, if the faults do exist, my recommendations will improve the situation. Let me therefore deal with these points in turn.

THE FAULTS : At the outset I should make it clear that all the blame for the problems which I believe exist is not to be laid at the door of the legal profession. Too often in individual cases lawyers are at least partly to blame but more important as a cause of the problems is the disproportionate way the present adversarial system operates which encourages excessive delay, expense and unnecessary complexity. It is the system, not the lawyers, that explains, for example, the hostility and bitterness which distorts medical negligence litigation.

DELAY : On the question of delay Professor Zander in his lecture relies on two reports which were into personal injury alone. One published almost 30 years ago (1968 Winn) and the other is brief and published 18 years ago without any attempt at consultation (Cantley 1979). Even 18 years is a long time ago. The Winn report as Professor Zander accepts did consider that delay was a problem and though not coming to identical conclusions substantially shared my views. Cantley was a limited exercise there was no consultation and it took a more sanguine view of the position. Professor Zander suggests I may have not considered the evidence provided by those reports, I know not why he makes this suggestion but it is ill founded. I did however prefer to rely on the up to date statistics set out in my Interim Report and what I and my team found to be the position after what is suggested to have been the most extensive and thorough examination which has ever taken place into the civil justice system. I did not act as Professor Zander suggests on "unsubstantiated opinions" which I agree would be "a recipe for getting things radically wrong".

The statistics included the following figures; High Court cases taking 163 weeks in London and 189 weeks elsewhere to proceed from issue to trial. In the county court dealing with smaller cases the figure was 80 weeks. These figures were I emphasise for the average case. Many would take substantially longer. Research for my inquiry by Professor Genn indicated that in medical negligence cases the average time from issue to conclusion was 6 years 5 months and in ordinary personal injury actions over 4.5 years. To these figures have to be added the substantial periods sometimes years which is allowed to pass prior to the action being commenced.

I said in my report that the figures were unacceptable and as far as I am aware no one has sought to suggest the figures are inaccurate or apart from Professor Zander that my criticism is unwarranted. I was also concerned about the time cases were taking to settle. Here the figures available were for 1993. Of the cases which were set down for trial - that means they had gone through all steps necessary to make them ready for trial, only 13% were determined after trial, 9% settle at the door of the court or during the trial. That is, after all the expense has been incurred. I also referred to the research of Professor Genn which showed that the majority of cases took as long

as 4 to 6 years to settle - larger cases took longer. Again I regard the figures as unacceptable. In doing so, I have very much in mind the trauma that litigation can cause to those involved and why, especially in medical negligence cases it can leave both sides with a grave sense of the justice system having failed them. In minimising the problem as to delay Professor Zander displays remarkable complacency.

Professor Zander however suggests that I am being "Canute like" and defying reality in suggesting something can and should be done about this instead of recognising that "the enterprise is hopeless." He also categorises the failures of lawyers in this area as "minor failures". In expressing these views, he refers to the unfortunate experience in relation to the automatic strike out provisions. They were introduced into the county court rules in an effort to do something about the situation in 1990. The device was simple and crude. If a plaintiff allowed 15 months to elapse after the time when the parties had set out their case in writing in documents called pleadings before taking the steps necessary to enable the court to fix the date for trial the action would be struck out automatically and they would have to apply for it to be restored. What was not foreseen is that in some 20000 cases or more the plaintiffs lawyer would delay for over a year and a quarter to take the elementary step of setting down the case which is a condition precedent to the case coming to trial. I at least here am able to agree with Professor Zander that this result has been a "disaster" there have been appeals galore and actions for negligence and numerous applications for the action to be restored. However I certainly dissent from his conclusion as to what should be the response. Professor Zander suggests we should accept and I quote;

"there is really nothing that can be done about the problem other than the application of sanctions that are ridiculously out of proportion to the offence, a policy which, sooner or later has to be abandoned because it is manifestly unjust"

The error which was made when the rule was introduced not appreciating that there would be anything like this number of cases which it would affect. The error was understandable because the system could not provide the information which was needed to know otherwise. What then should be done? First, the lesson should be learnt that there will be a substantial number of the cases, in which contrary to Professor Zanders views, if the lawyers for the Plaintiffs are left to their own devices they will delay taking even the most elementary steps in the interests of their clients.

Secondly it must be accepted that in the interests of justice, as no one else can take the responsibility, the court must take the responsibility for seeing this does not happen.

Thirdly, it must be recognised that the solution is not to impose Draconian sanctions except as a last resort but to achieve a situation where sanctions of this sort are not necessary because (a) the court does not allow the situation to deteriorate to the extent that they become necessary and (b) the court has the wider range of alternative sanctions I propose. Unfortunately this will only be possible when the technology I have recommended is in place.

The experience with automatic strike outs is therefore not an argument against case management but for case management. Ironically in relation to delay, despite his uncomplimentary remarks about my proposals and my own personal qualities (in addition to being Canute like and indulging in scatter gun tactics, I am building castles on sand and proceeding like the Generals of the first world war, just thoughtlessly blundering ahead) Professor Zander does at least make 2 and only 2, positive proposals which I hope he will not be disappointed to learn are very much the same as my own. They are that dates for trial should be fixed at an early stage in a case's life and if a case is manifestly lagging behind schedule it should be called in for directions. Where we differ, is I do not restrict myself to these modest steps because delay is by no means the only subject which has to be tackled. There is in particular the need to reduce costs, to simplify the system, to remove disproportionate behaviour of differing kinds which identify and to divert cases from the courts when there is a preferable alternative method for resolving the dispute.

Costs; The research conducted on behalf of the inquiry established clearly that costs are disproportionate to the issues involved in litigation. They are substantially higher than those in some other jurisdictions, particularly Germany, with which comparisons were drawn as a result of the

research conducted on behalf of the Inquiry by Adrian Zuckerman of Oxford. There is incontrovertible evidence that cases frequently involve costs of one party alone in excess of the amount in dispute. Unless they are assisted large sections of the community can not afford to go to court. This is again especially true of medical negligence litigation. Over 90% of the cases which reached the stage of litigation are legally aided. 92% of the successful litigants are legally aided. Yet the legally aided section of the community is no more vulnerable than other sections of the community to medical negligence. These figures must suggest if those other sections of the community were entitled to legal aid more actions would be brought which would succeed. Even as things are the April, 1997 edition of Health Law estimates that the costs for 1996 to the Health Service are £170m. and the outstanding contingent liability is £1billion. (these figures include the awards of damages but a substantial part of the sum is costs). The author goes on to say ;

"Legal aid does not secure access to justice or ensure compensation for deserving cases. Instead it impoverishes the health service"

Professor Zander ignores this situation as he does the other situation namely housing where a similar waste of public expenditure can be demonstrated to be occurring. I do not believe he would do so if he had the opportunity that I had of learning at first hand from litigants, both patients and doctors and health carers, who are embroiled in this class of litigation what the experience is like. It is horrendous. Has it occurred to Professor Zander that the explanation for the failure of the lawyers and judges not to object to my "calumny" which he finds so surprising, is that as practitioners they are all too well aware of what is happening on the ground and they agree with the diagnosis of the inquiry? Why does he make no mention of the consumer bodies who were adamant that radical action was necessary and who support my programme of reform?. Are they unaware of the views of their members?

There are plenty other diseases to which the system is prone, including the lack of certainty as to what will be the consequences of becoming involved in litigation, the fact that it fails to allow for the inequalities in resources of the parties and it is excessively adversarial. There are problems as to discovery and experts. However as the remainder of my diagnosis is not under specific challenge but ignored by Professor Zander I will turn now to the reforms or, should I say the medicine which I have recommended.

The Medicine: Professor Zander's criticism to date as far as I am aware is only as to two important elements of the package of reforms that have been recommended. They are the related subjects of the fast track and case management. However the merits of those two recommendations can only be appreciated in the context of the recommendations as a whole. Among the most important of these recommendations are the reorganisation of the civil courts, the creation of a single Rule Committee for the civil justice system as a whole and the creation of the Civil Justice Council and the greater involvement of litigants in their own litigation. These recommendations are intended to provide the structure in which a radically reformed system can operate and to then enable that system to be kept under review.

Among the more specific recommendations are those as to protocols and expert evidence in the case of both of which my recommendations are designed to establish an agreed best practice.
The protocols are a wholly novel concept designed :
1. to focus the attention of litigants on the desirability of resolving disputes without litigation
2. to enable them to obtain the information they need to settle the action or to make an offer to settle
3. and, if settlement is not possible to enable the ground to be prepared for the action to proceed expeditiously.

The protocols will receive the support of the court and will be published in practice guides issued by the court. It is intended that they should be taken into account by court if litigation results on the question of costs. They will be in effect a guide as to how to resolve disputes both prior to litigation and during litigation. It is essential if the protocols are to have credibility that they should be drawn up by a working group with unquestionable extensive practical experience of the problem areas of litigation to which they relate.

In the case of medical negligence the working party is known as the Clinical Disputes Forum. The Forum has members who are distinguished doctors, health carers, lawyers who act for plaintiffs and the defendants and insurers. Under this umbrella, representatives of the different interests, for the first time working together, have been struggling to find the right way forward and are reasonably close to agreeing a protocol which accords with my recommendations. Let me quote from a report they have prepared:

> "At present there is often mistrust by both sides. This can mean that patients fail to raise their concerns with the healthcare provider at an early stage, and pursue a complaint or claim which has no or a weak foundation due to a lack of sufficient information and understanding. It can also mean that patients become reluctant, once advice has been taken on a potential claim, to disclose sufficient information to enable the provider to investigate that claim efficiently and, where appropriate, to resolve it.
>
> On the side of the healthcare provider this mistrust can be shown in a reluctance to be honest with patients, a failure to provide prompt clear explanations, especially of adverse outcomes (whether or not there may have been negligence) and a tendency to "close ranks" once a potential claim is signalled.
>
> If this mistrust is to be removed, and a more co-operative culture is to develop:-
>
> - Healthcare professionals and providers need to adopt a constructive approach to complaints and claims. They should accept that concerned patients (or their representatives) are entitled to an explanation and an apology, if warranted, and, injured ones to appropriate redress, and that an overly defensive approach is not in the long term interest of their man goal : patient care.
>
> - Patients and their representatives should recognise that some degree of risk is inherent in most medical treatment, (even the best practitioners make mistakes) and that misdiagnosis or unintended consequences of treatment can only be rectified if they are brought to the attention of the healthcare provider quickly.

The openness on the part of both parties which the protocols will encourage will in turn provide the information which is necessary for disputes wherever possible to be resolved by recourse to the now justifiably fashionable ADR. This could be dealt with in-house by hospitals. There is everything to be gained by the hospital using its resources to make available mediators and neutral claim evaluators at their own expense. The CDF is holding a conference on this subject on 3 June next and I hope it will receive your support.

Both sides of the legal profession are now providing lawyers who are highly skilled in this activity. A pilot mediation scheme of this nature has already been set up. While it may be premature for the courts to insist on ADR, ADR is sufficiently established to justify the court taking into account an unreasonable refusal to resort to ADR when determining what costs should be awarded.

The courts have to offer more specialisation than they have hitherto. Judges in this country have always prided ourselves on being generalists. However society has become so complex and the issues so sophisticated, we must if we are going to deal with the work effectively have the necessary expertise. It takes time to instruct a judge who has no background knowledge of the intricacies of this area of negligence and time in court is expensive.

A Master of the Supreme Court has already been earmarked to deal with the interlocutory stages of these cases in the High Court and the same thing should happen at major centres in other parts of the country. You also need a judge to try the case who understands the medical issues to which this litigation can give rise. It is for this reason I recommended and still do recommend that there should be a special list for cases of this nature in the High Court so that they can come before a judge whose experience they will respect. The judge must be on equal terms with the lawyers for the parties.

That brings me to a further problem area and that is of expert evidence. I have been surprised but pleased by the interest the medical profession is taking in my recommendations as to expert evidence. I sense that the medical profession are not at all comfortable about the present situation. Here again there is an unhealthy polarisation. There is a tendency for medical experts to be categorised as plaintiffs or defendants experts. They are looked upon by the side which has instructed them - and this can be their own perception of their position - as hired guns, brought in to fight to the best of their ability on behalf of the side which is employing them. It is specially unfortunate that this should be the situation in medical cases because the court is dependent on medical advice for resolving the three issues liability, quantum and causation which are often particularly difficult in this area of litigation.

While there has been some improvement, it can still be difficult to find an expert if you are a plaintiff. This is because of the understandable reluctance, on the part of healthcare professions, to criticise colleagues. The result is those experts who are prepared to give reports on behalf of plaintiffs, are diverted from their practice and become, over dependant upon medico-legal reporting for their livelihood which can further undermine their independence.

My report seeks to improve the situation by making it clear that the experts first responsibility is to the court and not to the side that instructs them. For this reason reports are to be made to the court. However I would go further.

There are some issues near the "cutting edge" of medical science where there are two schools of thought. However there are many areas where what is proper medical practice is not a matter of controversy, the issue is whether that practice has been adhered to. There are many issues as to quantum where one opinion is very likely to be very similar to another opinion. I believe there is scope for the joint instructing of a single expert, at least in the first place, in those cases where there is no controversial medical issue involved. A breakthrough is needed because at present both sides contend that they cannot trust the expert instructed by the other side and so instruct their own experts. This tends to make agreement of medical issues more difficult instead of less difficult. We need a more co-operative approach but that will only arise if the independence of the expert is clear. This really should not be a problem where those who are consulted are asked to advise because of their professional expertise and standing. At the present time one has the ludicrous position that because experts and those who instruct them are not trusted, the parties will not even agree to sequential as opposed to simultaneous disclosure of experts reports.

There should also be more frequent meetings between experts to resolve issues. Lack of communication between experts often explains their failure to reach agreement

Changes of this nature represent a change of culture. They are suitable subjects for protocols They will bring about significant changes to both cost and speed with which disputes can be disposed of .More importantly they will help eradicate the suspicion which has been so destructive to the relationship between patient and carer.

Case Management: I now turn to the two areas of the recommendations which are the subject for Professor Zander's attack. Case management is central to my recommendations because it is the means by which cases are handled in the court system. There is nothing new about it. It an essential part of any system and is used with differing degrees in every developed system of civil justice. My recommendations are criticised because they call for more management by the court. This is exactly what is happening in Canada, New Zealand, Australia and has been happening in the USA for a great many years. It is also part of civil systems. It is practical today to exert greater case management than in the past because of the advances in technology which make it possible for courts to monitor the progress of cases. It was the absence of the ability to monitor cases which meant that it was not possible to implement the Cantley recommendation which Professor Zander finds so attractive. It is this change which explains in part why in my report I attach such importance to technology. The other reason is the savings to the system which it will achieve. As in medicine technology opens new horizons.

While I favour greater case management which is now possible I recognise that case management does involve the parties in more expense and so it can only be justified if the savings and other benefits which can be achieved justify that expense. Therefore as Professor Zander does not acknowledge, " hands on" case management is to be limited to those cases where it is likely to produce real dividends. Just because a medicine can be effective you do not use it unless it is justified.

In medical negligence cases for example it has a clear role to play which will undoubtedly be beneficial. It will weed out the hopeless cases which create unnecessary dislocation and expense to hospitals, it will ensure that discovery is controlled, it will confine the parties to the real issues and control expense by limiting hearings. It will be used to encourage settlement and restrict the issues. Administrative arrangements have already been made to deal with the fear of Professor Zander that it will result in inconsistency of treatment by having the same procedural judge or Master to deal with all the cases in London and similar arrangements will need to be made outside London.

I believe that it would be difficult to find a practitioner who knows what he is talking about who would say that litigation of this sort would not benefit from selective case management. It is not the schoolmaster type of process which Professor Zander seems to have in mind. It is the court providing a forum in which the lawyers and the judge can work out the most satisfactory way a case can be dealt with and the judge then supervising the progress to trial in accordance with that programme. What the judge will prevent is parties not fulfilling their responsibilities, acting unfairly to a weaker party or acting unreasonably. Other types of litigation where case management is unnecessary will move directly to a hearing.

In support of his criticisms Professor Zander cites Sir Jack Jacob who he rightly describes as "truly a master of civil procedure and wiser in these matters than any of us" but he makes no reference to the fact that in his Hamlyn Lecture of 1986 under the heading *Prospects for the Future* Sir Jack set out in outline just the sort of changes that I am advocating as being necessary in the future.

The other source from which Professor Zander seeks assistance is the Rand Report on judicial case management in the USA. Here the selective way Professor Zander cites from the report indicates that he has wholly failed to grasp the true nature of my recommendations or he has not fully absorbed the contents of the Rand report.

I would not wish litigation in the field of medical negligence or in any other field to be handled this country as it is in the States. However even if the situations are comparable which they are not I would not have anything to fear from Rand. First Rand indicates that early case management reduces time to disposition. It also found that my approach as to early settling of a trial date and reduced discovery reduced both delay and costs. While early case management had an upward effect on costs, the overall effect was to reduce delay without having any significant effect on costs or the perception of fairness.

Why I am however particularly critical of the use by Professor Zander of the Rand report is that its general conclusion is that it found little change in what was happening before 1990 when it started its survey and afterwards. The reason being that the act of Congress whose effect they were monitoring was loosely worded so judges could interpret what they were doing prior to the act as compliance with the act. Furthermore, as Professor Resnick who really does know what she is talking about has pointed out, the increase in costs detected by Rand in relation to early case management could be the consequence of Congress, making national rules apply to small cases when the rules are only appropriate for the large cases for which they were designed.

This unselective approach which Rand examined is wholly contrary to the thrust of my report. Remarks by Professor Zander suggest he has failed to grasp the elementary point that I am not recommending that case management shall apply to all cases where a defence is entered. In particular hands on case management, in the sense that term is used by Rand, is intended to have no application to cases on the fast track. Yet he uses Rand to suggest in his lecture that lawyers would

not use the fast track because of the additional expense to which they would be put by case management.

The fast track in its strict form will not be suitable for medical negligence cases. They are too complicated for application to the fast track. The virtues of the fast track would be beneficial for small medical claims such as claims against dentists if a suitably modified fast track could be devised. The virtues are that they provide a restricted procedure and a no frills form of litigation on a fixed timetable at a fixed cost. It provides a litigant with certainty as to what he is letting himself in for. A working group of volunteers are conducting an experiment in Birmingham to test whether a modified fast track could work in small cases. I should therefore deal briefly with the unjustified criticisms heaped on the fast track by Professor Zander.

1. First he seeks to apply the Rand conclusions to the fast track when they have no application.
2. Secondly he seems to think they are to be subject of the Draconian sanctions when the idea is to call cases in for directions if the timetable is not kept in a way which will prejudice the fixed date of trial. It is however intended that if a lawyer wants more time he should apply in advance and not when time has already expired.
3. Thirdly he says lawyers are not capable of working to a time- table. This is not correct. Experience now exists that if time- tables are set which are reasonable (and the Fast Track time-table is being drawn up in conjunction with those with great experience) then lawyers have no difficulty in complying with time- tables and they welcome the certainty they produce.
4. Then he says it will produce a sense of unfairness and prevent proper exploration of the issues. However this is to ignore the alternative which can be no access to justice at all. It can also result in totally disproportionate litigation.
5. Finally he says that I am setting the fixed cost too high citing against me Adrian Zuckerman and then suggests the cost will be unfairly low. I do not see how he can make either of these criticisms since the cost is still the subject of consultation by the profession.

I know the fast track is unpopular with the Association of Personal Injury lawyers as they see it as a threat to their livelihood and I would wish to take their concerns into account insofar as it is in the public interest to do so but I do not believe the Association would be happy about all of the criticisms which Professor Zander makes.

While I reject Professors Zander's criticisms I do not suggest the process of implementing my report is going to be easy. There are bound to be teething troubles. Modifications of detail will need to be made. My proposals are not written in stone. However they do offer a practical programme to achieve a dramatic improvement in the way we handle civil litigation and in access to justice. That that improvement should happen is important to the public as a whole. It is particularly important to medics and all whose work is the provision of health care and those who receive that care. A great many right thinking lawyers and medics have worked and are working hard in their valuable spare time to ensure the improvements come about.

This is why I do not apologise for spending so much of this lecture in answering that of Professor Zander's of 2 weeks ago. The issue is of great importance to the medical profession. It is right that what is being sought to be achieved should be the subject to fair and balanced criticism. It is no part of my argument that the new Lord Chancellor should not conduct the review as he indicated prior to the election would happen. It would however be unfortunate indeed if the Lord Chancellor were to call a halt to all the work that is in progress at the present time as Professor Zander suggests. To pay serious attention to what Professor Zander has said would be to give him credit he does not deserve. I regret having to say this of a friend but the fact is that his lecture was not a balanced consideration of this serious subject and ill considered. Ill considered because he is oblivious of what is in fact happening on the ground. Unintentionally he could damage a process of change which is already taking place and which while it will not be smooth, offers real hope for the future as judges, practitioners and insurance bodies up and down the land recognise.