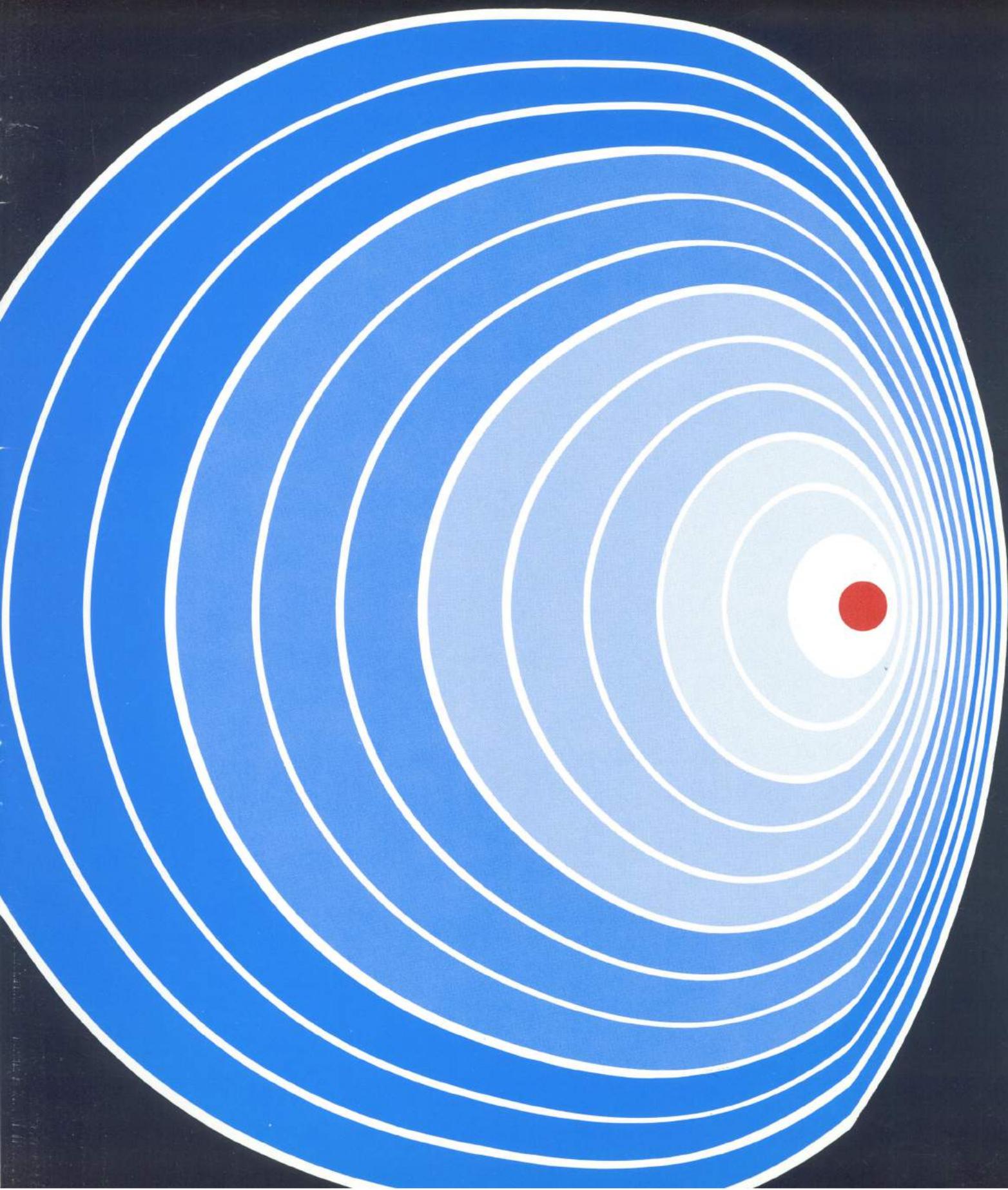


# UK PANEL ON GAMMA & ELECTRON IRRADIATION

A Brief History 1963-1984



# U.K. PANEL ON GAMMA & ELECTRON IRRADIATION

A Brief History  
1963-1984



## Officers in 1984

<b>Chairman</b>	Prof. A. Tallentire
<b>Deputy Chairman</b>	Dr. S. C. Ellis
<b>Treasurer</b>	Mr. A. L. Jobling
<b>Secretary</b>	Mr. R. S. M. Frohnsdorff
<b>Address</b>	"Litkeys", Pinkneys Green Berks SL6 5DS
	Telephone: Maidenhead 21484

## Introduction

The UK Panel on Gamma and Electron Irradiation is an interesting example of an organisation which has evolved informally to meet changing circumstances over a period which now spans 21 years. For convenience the abbreviated name, the Panel, will be used subsequently to refer to the organisation that has existed since 1966. It is useful however to go back a little further in time.

The fact that ionising radiation has a destructive effect on micro-organisms has been known since the end of the last century but it was an outcome of the wartime Manhattan project which accelerated the development of nuclear technology leading to possible peaceful uses for this energy source. The UK took the lead in this development with a successful programme to generate electrical energy. It was as an outcome of this work by the UK Atomic Energy Authority that led in turn to a search for applications of radio-active elements formed as by-products of controlled energy release. The Authority set up a new laboratory on a disused aerodrome at Wantage which was freed from much of the security necessary at their main research establishments.

As early as 1952 (Ref. 1) experiments were carried out by J.O. Dawson and A. Charlesby on the sterilisation of sutures using the mixed radiation in the BEPO atomic pile at Harwell. Sub-

sequently 1.5 MeV electrons from a Van de Graaf generator were investigated although this radiation did not adequately penetrate the sealed glass tubes used for packaging at that time. Collaboration with the Low Temperature Research Station and Metropolitan Vickers extended the study to 5 MeV electrons from a linear accelerator. Subsequently, the major interest switched to the investigation of gamma radiation from radioactive sources.

The latter programme was initiated on the assumption that caesium 137 could be separated economically from fission products in spent fuel elements. Before work on building a caesium separator was started, G.S. Murray (Ref. 2) suggested that cobalt should be used instead of steel as a neutron absorber in gas cooled power reactors. As the resultant cobalt 60 was shown to be cheaper than caesium 137 and produced more penetrating gamma rays, the project to build the large caesium separator was cancelled. Until sufficient cobalt 60 could be produced most experiments made use of the mixed gamma rays from spent fuel elements which were stored in a cooling pond at Harwell.

Originally it was thought that the most significant application for ionising radiations would relate to the preservation of food and, from the early 1950's, extensive programmes have been carried out, initially in the UK and US, and subsequently throughout the world.



The World's first full scale gamma radiation facility completed in 1960 at Wantage Research Laboratory which housed the Isotope Research Division of the Atomic Energy Research Establishment, Harwell. The facility consisted of two plants, one a "continuous" type and the other "batch". Both employed water ponds for the safe position of the cobalt 60 sources. The total source loading reached 500,000 curies by 1970. A wide variety of industrial firms were able to carry out large scale marker trials on their products, prior to the establishment of radiation service plants or the purchase of "in-house" facilities. Following the closure of the Wantage site, the plants were leased to Irradiated Products Limited from 1970 to 1972 and finally demolished in 1973.

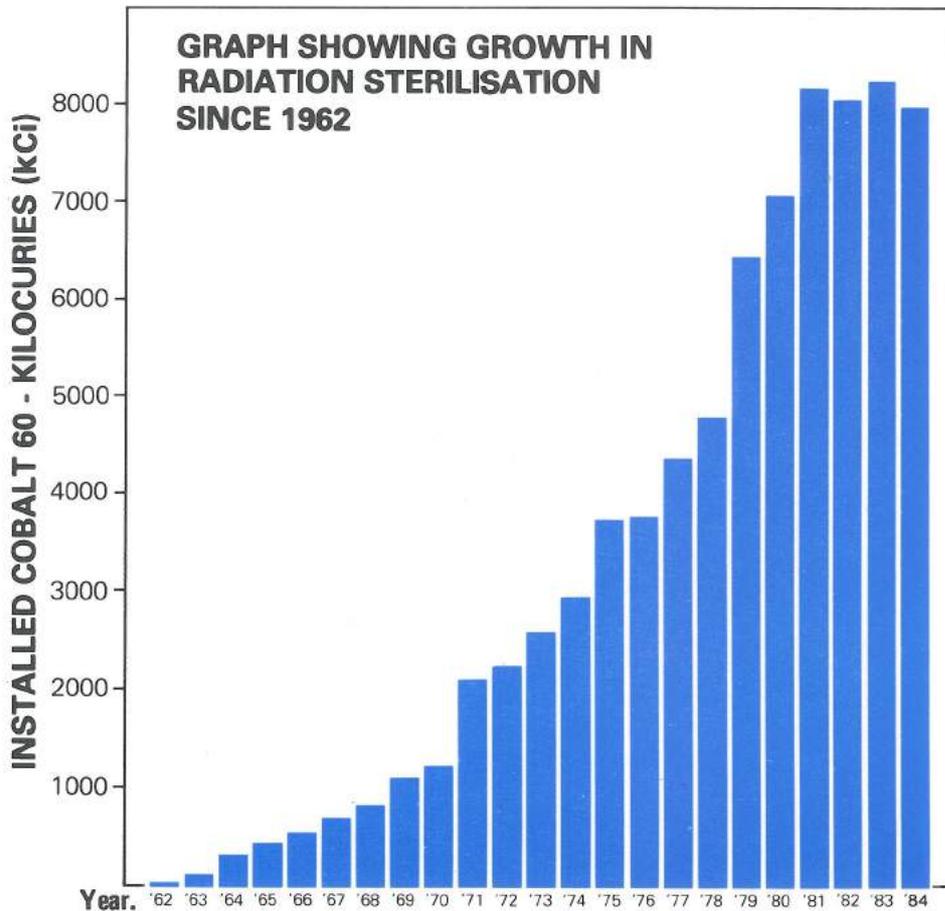
The possibility of preserving food by exposure to radiation is particularly important to the less developed countries where food losses due to deterioration and difficulties of distribution are major economic factors.

In spite of the interest in food, it is perhaps surprising to find that a relatively minor application, the treatment of medical supplies, was the first, and is still some thirty years later, the main commercial use for this radiation technology. The value of the pioneering work of the UKAEA Wantage Laboratory cannot be overstated and the standard text book for many of those working in the industry today has been "Massive Radiation Techniques", a collaborative text produced by a number of colleagues at this laboratory and edited by S. Jefferson (Ref. 3) to whom the Panel owes so much. A number of the original Wantage team and those trained in the associated educational establishment are still members of the Panel today, whilst others are scattered around the world in many famous research centres.

When it was realised that high energy radiation, and particularly that from cobalt 60, had ideal properties for sterilising medical products, a pilot package irradiation plant was designed and built at Wantage. This was commissioned in 1960 and by that time it had become generally accepted that

the sterilisation dose should be 25 kGy (2.5 Mrads) (Ref. 4). With this plant the principle was established of moving packaged product around a stationary radioactive source. This procedure was used in the first three production plants commissioned in the UK by 1963 and indeed in almost all of the plants that exist in the world today. The number of plants now exceeds 110 and it has been estimated that these are loaded with at least 70 mega curies of cobalt 60, with the numbers increasing rapidly (Ref. 5).

The solving of technical problems does not establish a new industrial process. Whilst this is not the place to discuss the general problem, it was realised that in the case of food it was considerations such as the proof of medical safety, wholesomeness, economics, legislation and public awareness and a natural fear of technology, apparently derived from the well publicised destructive uses of nuclear energy, that were a bar to progress. In the case of medical products some of these problems were less acute, but perhaps more important was a fortunate circumstance of timing. In the UK in the early 1960's an embryo industry was developing for pre-packed sterile single use devices for medical use. There was also a state-financed health service which had the technical resources and vision to appreciate the value of the new technology.



## Formation of the Panel

It was this combination of factors that led to the first steps towards collaboration between a number of individuals who were able to form opinion in this country. Initially, an Advisory Panel on Gamma Radiation was formed which held an inaugural meeting on 15th March 1963; the composition of the Advisory Panel is given in Appendix 1. It was responsible for jointly organising, with the Danish Atomic Energy Authority, a successful symposium in Copenhagen on 7/8th December 1964. It was soon realised that the Advisory Panel was too narrowly based and the name had led to confusion about its official status. It was therefore allowed to lapse but, from the original idea, a new body evolved which is the UK Panel on Gamma and Electron Irradiation that exists today.

The reconstituted Panel held its first meeting on 13th January 1966. The Panel had a formal constitution and the membership was divided into two classes (i) Full and (ii) Associate, all responsibility residing with the first class. In Appendix II the initial composition of the Panel is given together with the addition of those who have been elected since its formation. In Appendix III is a list of the companies who have been associated from time to time in the second category of membership.

## Functioning of the Panel

From its inception, it has been made clear that membership of the Panel is restricted to selected persons. A number of these were originally nominated by the industrial companies, who operated commercial sterilising plants in the UK and Ireland, and by certain governmental institutions. These persons and their successors have been the representatives of the two classes of Panel membership designated Industrial and Corporate. A list of these nominated representatives is given in Appendix II. The addition of a further class designated Full Individual Members was an outcome of the founders desire to broaden the base of the Panel to include all those who have a special knowledge and interest in the objective of the Panel regardless of whether their principal interest be in industry, government, academia or medicine. In its Individual Members the Panel has been particularly fortunate in attracting the right blend of expertise.

The name of the Panel is unusual and has sometimes been queried; however, it was never intended to indicate

that the Panel had official status. Nevertheless it has been most influential as the forum for discussion amongst those best informed in this country, on all aspects on the use of radiation for the sterilisation of medical products. The constitution of the Panel has changed little since it was first formally approved in May 1966; however, it was revised to embody minor changes in May 1982. The objectives, together with the different types of membership as defined in the constitution, are given in Appendix IV. Full Members normally meet three times a year and there is also one meeting to which Associate Members are invited.

The detailed work of the Panel is carried out either by the Officers, whose names are listed in Appendix V, or by sub-committees formed according to need. Sub-committees report to the regular meetings of the Full Members. When the Panel was founded in 1966 there was an independent Research Committee. This was discontinued in 1974 in favour of the present more flexible arrangement.

It has been made clear since the Panel's formation that all of the nominated Full Members must have the necessary technical knowledge and should not represent commercial interest. It cannot be too strongly emphasised that the Panel is neither a trade association nor an official government advisory committee. As a forum for discussion, it has, throughout its history, been one of the favourable influences that has enabled the UK to play its enviable pioneering part in the use of radiation for the sterilisation of single use medical products all round the world.

## Panel Achievements

Apart from the Panel being a discussion forum, which is the prime reason for its existence, it has undertaken many important projects. A selection of these will be reviewed under the following headings, which should serve as an indication of the scope of past activities.

### 1. Collaborative and Sponsored Research

The selection of a suitable sterilising dose needs relevant microbiological data. Two collaborative research studies have been carried out, the first to identify the level of pre-sterilisation microbiological contamination to be found on product fabricated under factory conditions (Ref. 6), and the second a practical application of the sub-pro-

cess dose technique (Ref. 7). These projects provided data which support the belief that exposure to a 25kGy sterilisation dose gives products with a high probability of sterility. The sub-process dose technique is now used widely in a variety of monitoring and quality assurance functions and is also the basis of the AAMI dose-setting procedures practised in N. America.

The Panel has also directly sponsored research studies in universities and research centres. These projects are summarised in Appendix VI. They were selected to stimulate research in areas that appeared relevant to the Panel or to expand the scope of radiation treatment. The areas of research include pharmaceuticals, the microbiology of resistant organisms, the destructive effect of high energy radiation on some plastic materials and the study of existing and improved methods for monitoring applied radiation doses by physical and chemical means.

## **2. Symposia**

For both educational purposes and to extend knowledge of the value of the radiation process for industrial sterilisation, a number of symposia and a training course have been organised either solely by the Panel or in collaboration with some other agencies. These are summarised in Appendix VII. Full proceedings of the papers delivered at the Panel symposia have been published.

## **3. Publications**

The provision of information and its circulation to members has been identified as an important Panel activity, the importance of which continues to increase. The items which come directly under this heading are given in Appendix VIII.

For a number of years the Panel produced its own Newsletter under the editorship of Dr. R. J. Berry. Since 1979 it has been circulating the Newsletter of AIII to its members.

In response to the need to keep members abreast of world literature, the Panel reached an agreement with AERE for the Harwell Information Services to produce an Abstract Bulletin on subjects specified by the Panel. This Bulletin is produced four times a year, the first issue appearing in January 1972. The Abstract Bulletin is now also circulated outside the Panel membership.

## **4. Codes of Practice**

Since its formation, codes of good manufacturing practice and related subjects have been a major preoccupation of members, both collectively through the Panel and as individuals keeping the Panel informed.

All the IAEA working parties responsible for producing the Recommended Code of Practice for Radiosterilisation of Medical Products, first presented in Budapest in 1967, and the subsequent revisions of this document, have included members of the Panel acting as individual experts.

Within the EEC the Eurisotop Office, Directorate General for Industrial and Technical Affairs (DG3), set up two working groups to study radiation sterilisation. One of the committees studied public health aspects and was chaired by A. Bishop, the other, chaired by R.S.M. Frohnsdorff studied industrial aspects. All radiation plant operators in Europe participated in these discussions and the latter group reached unanimous agreement on procedures for the control of radiation sterilisation facilities (Ref. 8). Subsequently the Panel gave its formal support to this paper as did the sister organisation in continental Europe AIII and the UK trade association MEDISPA.

Members of the Panel have also largely been responsible for the UK Guide to Good Manufacturing Practice for Sterile Single Use Medical Devices published in 1979, and the revised version, Sterile Medical Devices and Surgical Products 1981, although again these members have been acting in their other professional capacities. Formal recognition is given in these official documents to the EEC paper referred to in reference 8.

More recently the Panel has been included among those formally consulted by AAMI during the course of the development of its document Process Control Guidelines for Radiation Sterilisation of Medical Devices and this continues to be an active source of discussion within the Panel.

A related but more theoretical approach to the same subject has been proposed by Dr. Dorpema in Holland based on the IMO concept. This is currently being actively studied by the Panel's recently formed Microbiology Working Group.

## **5. Radiation Plant Safety**

Although the Panel is not a trade association there have been a number of

instances where the collective experience of plant operators has been of value. When necessary, subgroups have been formed and their activities coordinated by the Panel secretary. Among subjects which have been important has been the formulation of an industry response to the HSE to their Consultative Document - "The Ionising Radiations Regulations 198—". Similarly, it has been necessary for the industry to make representations to the Dept. of the Environment about the need for a national scheme for the disposal of LSA cobalt 60 waste. Other discussions with the HSE have led to agreement on action necessary to combat known hazards in the operation of radiation sterilisation plant.

## 6. Collaboration with AIII

In continental Europe all radiation plant operators, and some located further afield, are members of the Association Internationale d'Irradiation Industrielle. By its constitution the Panel is unable to link too closely with this strictly trade organisation. Nevertheless, in 1975 the Officers of the Panel and those of AIII reached an agreement to exchange information both by meetings between Officers and by correspondence. AIII was invited to become an Associate Member of the Panel and Panel members have been invited to attend AIII meetings as observers. Also the Panel Abstract Bulletin is available to AIII and the AIII Newsletter to Panel members without cost.

## 7. Publications by Members

Members of the Panel have published the results of their research in the scientific literature. Some of this work has been directly related to Panel interest and most of it has been available to Panel members before the publication date. Appendix IX is a general bibliography of such publications but is not a complete listing. There have also been a number of technical papers prepared by members for internal circulation within the Panel.

## 8. Sales of Perspex HX

Since the formation of the Panel the precision and reliability of physical methods of dose measurement have been of considerable importance to members. The Perspex HX system was chosen by the early members of the Research Committee as the system of greatest versatility and precision for the control of gamma and electron processes. As no ready source of suitable dosimetry material was available, the Panel purchased this commercial plastic in bulk and supplied it

free to members. Demand soon increased and the distribution of dosimeters was put on a commercial basis. The plastic sheets have been cut, packaged and sold both to members of the Panel and other customers around the world for most of the Panel's existence. The National Physical Laboratory has been responsible for the quality and dose response characteristics of the material. In recent years the income from this operation has materially improved the financial structure of the Panel, but recently it has been decided that the operation was occupying too great a proportion of the time of the individuals involved. For this reason the sale of Perspex HX was transferred to UKAEA (Harwell) in 1984. Harwell already has a similar commercial venture for Red Perspex.

## Conclusion

It is clear that the Panel has extended its activities over a very wide field and has materially assisted in establishing radiation as the preferred method of sterilisation for many single use products in the UK long before the process was fully accepted elsewhere. There is now a large fund of practical knowledge that could be applied in other geographical areas and to other classes of product. It also appears that the time may be right for major developments in other product areas and in this respect a variety of applications in the food and agricultural industries are the most significant.

---

## REFERENCES

---

1. **L.A. Bailey (1972).** *On this Slender Thread a Life May Depend.* Ethicon Ltd.
2. **Jefferson S, Rogers F and Murray, G.S. (1961)** *Atomic Energy Waste - its Nature, Use and Disposal.* Butterworths, chapter 5.
3. **Jefferson S (1964)** *Massive Radiation Techniques.* George Newnes Ltd.
4. **Jefferson S, Ley, F.J., Rogers F. (1964)** *Nuclear Eng. Aug. 284.*
5. **Cuda J (1983)** *AECL Tech. Paper GPS 311.* Seminar, June 6/9.
6. **Cook A.M. and Berry R.J. (1968)** *Appl. Microbiol. 16, 1156*
7. **Ley, F.J., Winsley B, Harbord P., Keall A., Summers T. (1972)** *J. appl. Bact. 34, 53*
8. **Frohnsdorff R.S.M. and Peter K.H. (1977)** *Int. J. Radiat. Phys. Chem 10, 55.*

## APPENDIX I

### Advisory Panel on Gamma Radiation

The Advisory Panel held its inaugural meeting on 15th March 1963 and the following were named as founder members:

R.A. Glasson  
M. Goldsmith  
Prof. A. Haddow FRS  
S. Jefferson  
Dr. J.C. Kelsey  
J. Page M.P.  
Prof. J. Rotblatt C.B.E.

Subsequent joining members:

Prof. A.M. Cook  
D.E. Seymour

(now subsidiary of  
Isotron Ltd) 16/5/72  
Becton Dickinson &  
Co. Ltd. 15/2/72  
Radiation Dynamics  
Ltd. 25/1/77  
Arbrook Ltd. (now  
Surgikos Ltd.) 23/5/78  
Becton Dickinson  
Vacutainer Systems 18/2/82

### 2. Corporate Date elected

National Physical  
Laboratory 15/5/73  
UK Atomic Energy Auth-  
ority (rejoining member) 25/1/77

### 3. Individual

Prof. J.W. Boag  
(resigned 17/6/70) 17/5/66  
Dr. J.A. Holgate 28/9/67  
Dr. E.M. Darmady  
(resigned-) 18/1/68  
Dr. R.J. Fallon 18/1/68  
Dr. T.A. Miller (resigned  
9/9/69) 18/1/68  
Prof. R.A. Shooter  
(resigned 28/11/72) 18/1/72  
W. Trillwood  
(resigned-) 18/1/68  
J.F.B. Dealler  
(deceased 7/12/70) 24/4/68  
Prof. G.O. Phillips 29/1/69  
Dr. E.T. Conybeare  
(deceased 2/4/79) 3/6/69  
S. Jefferson 6/10/70  
Dr. E.H. Gillespie 6/10/70  
Dr. A. Tallentire 4/5/71  
Dr. S.C. Ellis 15/2/72  
Prof. A. Charlesby 9/7/74  
A. Bishop 18/2/81  
R.S.M. Frohnsdorff 11/2/82

Individuals who have been authorised from time to time to be the Full Member representing Industrial or Corporate Organisations.

Dr. M.J.J. Adams MoH  
Dr. D.J.W. Barber B.D. Vacutainer  
Systems  
W. Barnes J & J and GRS  
E.M. Bavin S & N Res.  
A. Bishop DHSS  
V.J. Boaler Radiation Dynamics  
S.M. Davies MoH  
R.W. Cook MoH  
Dr. M.C.L. Cox Gillette and B.D  
C.G. Crawford JEP  
Dr. G.E. Gale MoH  
J.O. Dawson Ethicon  
W.R. Dean J & J  
S.J. Desmond JEP  
J. Dow S & N Res.  
Miss M.N. Ducan DHSS  
R.A. Elliott J & J  
W.J. Ferguson B.D.  
R.S.M. Frohnsdorff Gillette  
Mrs K.M. Glover UKAEA  
P.E. Harbord JEP  
I.D. Hardie Surgikos

## APPENDIX II

### UK Panel on Gamma and Electron Irradiation

#### Full Members

The reconstituted Panel held its first meeting on 13th January 1966. Membership was restricted to individuals who were either to be nominated or elected. They were classified in three categories

#### 1. Industrial

Ethicon Ltd.  
Gillette Surgical (now Gillette UK Ltd)  
Johnson's Ethical Plastics Ltd.  
(now Johnson & Johnson Ltd.)  
Smith & Nephew Research Ltd.

#### 2. Corporate

Ministry of Health (now Dept. of Health and Social Security)  
UK Atomic Energy Authority (resigned 31/12/71)

#### 3. Individual

Prof. A.M. Cook  
R.A. Glasson (honorary life member)  
Dr. J.C. Kelsey (resigned 29/1/69)  
Prof. J. Rotblatt  
Dr. R.J. Berry (resigned 25/2/75)  
Dr. P. Lindop (resigned 14/7/82)

After the formation of the Panel, the following have been added to Full Membership

#### 1. Industrial Date elected

Gamma Radiation  
Services Ltd. (now sub-  
sidiary of Isotron Ltd.) 16/2/71  
Irradiated Products Ltd.

M.P. Huxley Gillette  
 Dr. J.A. Holgate MoH  
 S. Jefferson UKAEA and GRS  
 A.L. Jobling B.D.  
 F.J. Ley UKAEA and IPL  
 Dr. A.C. Mair Arbrook  
 B.W. Mitchell S & N Res.  
 T.W. Roylance Ethicon  
 E.E. Seymour S & N Res.  
 A.H.K. Smith JEP  
 Dr. A.N.B. Stott U.K.A.E.A.  
 F.T. Summers GRS  
 K. Tattersall S & N Res.

---

### APPENDIX III

---

#### UK Panel on Gamma and Electron Irradiation

##### Companies who have been or are Associate Members

Armour Pharmaceuticals Co. Ltd.  
 Association Internationale  
 d'Irradiation Industrielle.  
 A. Wander Ltd.  
 Baird-Davol Ltd.  
 Baxter Labs  
 Becton Dickinson UK Ltd.  
 Beecham Research Ltd.  
 British Drug Houses (Res) Ltd.  
 Capon Heaton & Co. Ltd.  
 CIBA Laboratories Ltd.  
 Con-rad Engineering Ltd.  
 Coty Ltd.  
 Cynamid of G.B. Ltd.  
 Eschmann Bros. & Walsh Ltd.  
 Expanded Rubber & Plastics Ltd.  
 Glaxo Laboratories Ltd.  
 High Voltage Ltd.  
 ICI Ltd. Pharm. Div.  
 Isoster (Pty) Ltd. S.A.  
 J.G. Franklin & Sons Ltd.  
 London Rubber Co. Ltd.  
 3Ms  
 Nicholas Res. Inst.  
 Nuclear Chemical Plant Ltd.  
 Nusac Plastics Ltd.  
 OPG Gammaster, Utrecht  
 Pfizer Ltd.  
 Portex Ltd.  
 Radiation Development Co. Ltd.  
 Vancouver.  
 Reed Development Services Ltd.  
 Shell Chemical Co. Ltd.  
 Sherwood Medical Ind. Ltd.  
 S.R.C. Rutherford High Energy Lab  
 Swan Morton (Manf.) Ltd.  
 Veedip Ltd.  
 Water Research Lab.

---

### APPENDIX IV

---

#### Objectives

The objectives of the Panel are:

- a. To promote applied research in the field of radiation sterilisation.

- b. To encourage the establishment, acceptance and implementation of codes of practice and related standards in radiation processing, both nationally and internationally.
- c. To make available information on the use of electron and gamma radiation for the killing of micro-organisms.
- d. To give assistance to members or others interested in electron or gamma radiation processing.
- e. To stimulate a wider interest in the application of radiation processing.
- f. To encourage and assist research and education in universities and other establishments on fundamental and applied problems associated with the use of high energy electron and gamma radiation.

#### Membership

Membership of the Panel is restricted to individuals and representatives with appropriate technical qualification and/or experience. There shall be two categories of membership. Full and Associate, defined as follows:

##### a. Full Members

- i. **Industrial:** Representatives of industrial organisations with electron or gamma radiation facilities in the UK or Ireland.
- ii. **Corporate:** Representatives of organisations in the public sector.
- iii. **Individual:** Scientists or others with relevant experience and a special interest in the Objectives of the Panel.

##### b. Associate Members

- i. **Industrial:** Representatives of industrial organisations with an interest in the Objectives of the Panel.
- ii. **Corresponding:** Individuals or organisations located outside the United Kingdom and Ireland having electron or gamma radiation facilities and/or an interest in the Objectives of the Panel.

## APPENDIX V

### Summary of Panel Officers

#### Chairman                      Date elected

1963/5	Prof. A. Haddow	15/3/63
1966/7	Prof. J. Rotblatt	24/2/66
1968/9	Prof. A.M. Cook	18/1/68
1969/71	Dr. E.T. Conybeare	3/6/69
1972/5	Dr. J. A. Holgate	15/2/72
1976/80	A. Bishop	11/2/76
1981/2	Prof. A. Charlesby	12/2/81
1983/	Prof. A. Tallentire	3/2/83

#### Deputy Chairman

1967	A.H.K. Smith	9/2/67
1968/80	R.S.M. Frohnsdorff	18/1/68
1981/2	Prof. A. Tallentire	12/2/81
1983/	Dr. S.C. Ellis	19/5/83

#### Secretary

1963/5	M. Goldsmith	15/3/63
1966/80	S. J. Jefferson	24/2/66
1981/	R.S.M. Frohnsdorff	12/2/81

#### Deputy Secretary

1968/71	J.E. Butland	18/1/68
---------	--------------	---------

#### Treasurer

1966/69	J. Dow	24/2/66
1970/4	W. Barnes	17/2/70
1975/80	F.J. Ley	25/2/75
1981/2	J.O. Dawson	12/2/81
1983/	A.L. Jobling	3/2/83

#### Chairman of the Research Committee

1966/7	Prof. A.M. Cook	24/2/66
1966/70	Dr. R.J. Berry	18/1/68
1971/4	Prof. G.O. Phillips	16/2/71 (office discontinued 24/5/74)

#### Technical Secretary to the Research Committee

1968/70	J.F.B. Dealler	18/1/68
1971/4	Dr.A. Tallentire	16/2/71 (office discontinued 24/5/74)

## APPENDIX VI

### UK Panel Sponsored Research Projects

Year	Location	Title of Project	Project Co-ordinator
1969/71	Dept. of Chemistry and Applied Chemistry University Salford	Effect of ionising radiations on pharmaceutical systems	Prof. G.O. Philips
1970/72	Dept. of Pharmacy University Manchester.	Environment and the radiation resistance of <u>Streptococcus faecium</u> cells	Prof. A. Tallentire
1976/78	Physics Dept. Royal Military College College of Science	Effects of irradiation on plastics	Prof. A. Charlesby
1979/83	Division of Rad. Sc. & Accoustics, Nat. Physical Laboratory	An investigation over the range of conditions occurring in radiation plants of the performance of routine dosimeters based on poly-methylmethacrylate.	Dr. S.C. Ellis

**APPENDIX VII**

**Symposia etc. Organised or Arranged with Panel Support**

Title	Location	Collaboration	Date
The Use of Ionising Radiation for the Anti-microbial Treatment and Sterilisation of Medical Supplies	Riso Denmark	Danish AEA	7-8/12/64
Packaging for Radio-sterilisation	Ditchley Park	—	22/4/68
Radiation Sterilisation of Pharmaceutical and Bioproducts	Salford	Univ. of Salford IAEA	31/3/69 1/4/69
Radiation Dose and Dose Rate Measurement in the Megarad Range	NPL	NPL	6/7/70
Radiation Research and Medical Product sterilisation Exact title not in records	Salford	Univ. of Salford Ass. of Rad. Res.	18-20/12/73
Technical Developments and Prospects of Sterilisation by Ionising Radiation	Vienna Austria	Sponsored by J&J	1-4/4/74
Sterilisation by Ionising Radiation	Vienna Austria	Sponsored by J&J	25-28/4/75
Radiation Sterilisation with Emphasis on Practical Applications (training course)	Harwell	UKAEA Educ. Centre	15-17/4/76

APPENDIX VIII

**UK Panel Publications**

Date	Title	Author(s)	Distribution
1966 (May)	UK Panel on Gamma and Electron Irradiation (press release to 83 scientific and trade journals)	A.M. Cook/ R.J. Berry	Press release
1966 et seq	The Newsletter of the UK Panel on Gamma and Electron Irradiation No. 1 Oct. 1966 No. 2 Aug. 1967 No. 3 Aug. 1968 No. 4 Jan. 1970 No. 5 Jan. 1971 No. 6 Nov. 1973	Ed. R.J. Berry	Private circulation
1972 et seq	UK Panel on Gamma and Electron Irradiation Abstract Bulletin (a quarterly publication for members produced in collaboration with Harwell Information Services) No. 1 dated January 1972 and publication continues to date.)	Anon	Private circulation
1979 et seq	Newsletter prepared by the Association International d'Irradiation Industrielle No. 1 April 1979 No. 2 September 1979 No. 3 April 1980 No. 4 October 1980 No. 5 April 1981 No. 6 October 1981 No. 7 April 1982 No. 8 October 1982 No. 9 April 1983	Anon	Private circulation

## General References

## Papers Sponsored by or Particularly Relevant to the Interest of the UK Panel by Members and Colleagues

- Boag, J.W., Dolphin, G.W. and Rotblat, J. (1958)** *Radiation dosimetry by transparent plastics*. Radiat. Res. 9, 589.
- Burt, M.M., Ley, F.J. (1963)** *Studies on the dose requirement for the sterilization of medical equipment. I. Influence of suspending media*. J. Appl. Bact. 26, 484.
- Burt, M.M., Ley, F.J. (1963)** *Studies on the dose requirement in the sterilization of medical equipment. II. a comparison between continuous and fractionated dose*. J. Appl. Bact. 26, 490.
- Ley, F.J. (1963)** *The influence of dose rate on the inactivation of micro-organisms*. Int. J. Appl. Radiat. and Isot. 14, 38.
- Whittaker, B. (1963)** *The G-value and the reproductibility of the ferrous-ferric dosimeter*. Harwell Report AERE- 3073.
- Whittaker, B. (1964)** *Radiation dosimetry technique using commercial red "Perspex"*. Harwell Report AERE- R 3360.
- Ley, F.J., Tallentire, A. (1964)** *Sterilization by radiation and heat - some microbiological considerations*. Pharm. J. July 18. p.59.
- Jefferson, S. Ley, F.J. and Rogers, F. (1964)** *Radiation sterilization of medical supplies*. Nucl. Eng. August.
- Ley, F.J., Tallentire, A. (1965)** *Radiation sterilization - the choice of dose*. Pharm. J. 195, 216.
- Marshall, C.H and Orton C.G. (1966)** *Measurement of dose distributions with red Perspex*. Phys. Med. Biol. 11,563.
- Orton C.G. (1966)** *Red Perspex dosimetry*. Phys. Med. Biol. 11,551.
- Whittaker, B. and Lowe C.A. (1967)** *Photosensitivity of clear Perspex dosimeters*. Int. J. Appl. Radiat. Isot. 18, 89.
- Cook, A.M. and Berry, R.J. (1967)** *Presterilisation bacterial contamination on disposable hypodermic syringes: necessary information for the rational choice of dose for radiation sterilisation*. IAEA Publication STI/PUB/157, p.306.
- Jefferson, S. and Crawford, C.G. (1967)** *Development of industrial sterilisation of medical products*. IAEA Publication STI/PUB/157, p.361.
- Tallentire, A. (1967)** *Microbiological consequences of dose fractionation*. Private circulation.
- Cook, A.M. and Berry, R.G. (1968)** *Microbial contamination on disposable hypodermic syringes prior to sterilization by ionising radiation*. J. Appl. Microbiol. 16, 1156.
- Gilbert, J. (1969)** *A note on the use of resistant organisms for defining sterilisation process*. Private circulation.
- Ley, F.J. (1969)** *Gamma radiation for product sterilization*, J.Soc. Cosmet. Chem. 20, 399.
- Marshall, C.H. and Berry R.J. (1969)** *Clear Perspex HX as a reference dosimeter for electron and gamma radiation*. Phys. Med. Biol.14, 585/ 596
- Crookall, J.O. and Marshall, C.H. (1970)** *The effect of spectrophotometry error on the accuracy of the Perspex HX megrad dosimeter*. Phys. Med. Biol. 15, 319.
- Rogers, R. Whittaker, B, Salmon, L. and Newton, D. (1970)** *The wholesomeness of irradiated food - The question of induced activity*. Harwell Report AERE- R 6377.
- Phillips, G.O., Powers, D.M. and Stewart, M. (1971)** *Effects of radiation on sodium sulphacetamide*. Radiat. Res. 46, 236.
- Tallentire, A., Dwyer, J. & Ley, F.J. (1971)** *Microbiological quality control of sterilized products; evaluation of a model relating frequency of contaminated items with increasing radiation treatment*. J. Appl. Bact. 34, 521.
- Ley, F.J., Winsley, B., Harbord, P., Keall, A., & Summers, T. (1971)** *Radiation sterilization; microbiological findings from subprocess dose treatment of disposable plastic syringes*. J. Appl. Bact. 35, 53.
- Tallentire, A. (1972)** *Aspects of microbiological control of radiation sterilization*. Int. J. of Radiat. Steril. 1, 85.
- Mavinkurve, S.S. (1973)** *Environment and the radiation resistance of Streptococcus faecium cells*. Ph.D. Thesis, Univ. of Manchester.
- Ley, F.J. (1973)** *The Effect of ionizing radiation on bacteria and biological materials*. Manual on Radiation Sterilisation of Medical and Biological Materials. Chap 3, IAEA Tech. Rep, 149 p.37.
- Ley, F.J. (1973)** *Exploitation of the properties of gamma radiation in sterilization practice*. Int. J. Radiat. Steril. 1, 105.
- Ellis, S.C. (1974)** *Introduction to the Dosimetry Session - Dosimetry in the megrad range , Sterilization by Ionizing Radiation 1*. Multiscience, p.205.
- Frohnendorf, R.S.M. (1974)** *Experience derived from the operation of a large cobalt 60 irradiation plant*. IAEA Tech. Rep. 159 p, 145.
- Phillips, G.O. (1974)** *A consideration of IAEA recommended code of practice for "Radiosterilization of Medical Products"* IAEA Tech. Rep. 259 p.193.
- Frohnendorf, R.S.M. (1974)** *Present status and future prospects for radiation sterilization*. Sterilization by Ionizing Radiation I. Multiscience p. 425.
- Ley, F.J. (1975)** *The Effect of irradiation on packaging materials*. J. Soc. Cosmet. Chem. 20,1.
- Ellis, S.C. (1977)** *The dissemination of absorbed dose standards by chemical dosimetry. Mechanism and use of the Fricke dosimeter*. In Ionizing Radiation Metrology. Editrice Compositori, p.163.
- Frohnendorf, R.S.M. and Peter, K.H. (1977)** *The control of radiation sterilization facilities*. Radiat. Phys. Chem. 10, 55.
- Khan, A.A., Tallentire, A. Dwyer, J. (1977)** *Quality assurance of sterilized products: verification of a model relating frequency of contaminated items and increasing radiation dose*. J. Appl. Bact.
- Khan, A.A. (1977)** *Microbiological quality control of radiation sterilized products*. PhD. Thesis. Univ. of Manchester.
- Tallentire, A. and Khan, A.A. (1978)** *The subprocess dose in defining the degree of sterility assurance*. Sterilization by Ionising Radiation II, Multiscience p.65.
- Frohnendorf, R.S.M. (1978)** *Comments on the situation within the European Economic Community. Sterilization by Ionising Radiation II, Multiscience p.317.*
- Byrne, M.D. (1979)** *Final report on polyporphylene in radiation sterilisation applications*. Royal Military Col. of Sc. Report, private circulation.
- Barrett, J.H., Sharpe, P.H.J., and Stewart, I.P. (1980)** *An investigation over the range of conditions occurring in radiation processing plants of the performance of dosimeters of the type based on polymethylmethacrylate Part 1*. NPL Report RS 49, NPL.
- Ibid (1981)** part II NPL Report RS 52, NPL.
- Frohnendorf, R.S.M. (1981)** *Sterilisation of medical products in Europe*. Radiat. Phys. Chem. 17, 95.
- Ellis, S.C. (1981)** *The provision of national standards of absorbed dose for radiation processing. The role of NPL in the United Kingdom in high-dose measurements in industrial radiation processing*. Tech. Rep. 205 IAEA p.7.
- Sharpe, P.H.G., Barrett, J.H. and Berkley, A.M. (1982)** *Dichromate solution as a reference dosimeter for use in industrial radiation plants* NPL Report RS (Ext) 60.
- Barrett, J.H. (1982)** *Dosimetry with dyed and undyed PMMA*. Int. J. Appl. Radiat. Isot. 33,117721187
- Barrett, J.H. (1982)** *An investigation into the effect of irradiating and storing Perspex HS in sachets* NPL report private circulation.
- Phillips, G.O. (1982)** *Final report on "Effects of ionising radiation on pharmaceutical systems"* private circulation.
- Frohnendorf, R.S.M. (1983)** *Comments on radiation sterilization in the UK and on the efficient operation of a gamma plant*. Radiat. Phys. Chem. 22, 197.
- Ley, F.J. (1984)** *Radiation sterilization - microbiological aspects*. Proc. EUCOMED Conf. on Sterilization Validation of Medical Devices and Surgical Products, Copenhagen 16-17 May 1984.