

Catalogue of the papers and correspondence of

Albert Freedman

(1916 - 2004)

by Lizzie Richmond and Peter Harper
NCUACS catalogue no.137/2/05

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GENERAL INTRODUCTION

PROVENANCE

The papers were received in July 2003 and July 2004 from Dr Freedman and the Freedman family.

OUTLINE OF THE CAREER OF ALBERT FREEDMAN

Albert Freedman was born on 26 July 1916 in London. He received part of his early education in Fontainebleau, France and Basel, Switzerland but returned to England in 1933 to enrol at Regent Street Polytechnic, London. After attending a course of evening classes, he graduated with a BSc in Physics and Maths from London University in 1940 and was awarded a PhD for his work on echo formation in fluids by the same institution in 1962.

Between 1936 and 1938 Freedman worked in the research department of The Gramophone Company, now Electric and Musical Industries (EMI), based in Hayes, Middlesex, on the development of fluorescent screens for cathode ray tubes. In 1940 he moved to Portsmouth to take up a position with the Naval Establishment as a research assistant on HMS Vernon where he contributed to work relating to searchlight technology used in the defence of naval convoys. The following year Freedman joined the Underwater Detection Establishment, which later became the Admiralty Underwater Weapons Establishment (AUWE), in Portland, Dorset. In 1966 he was appointed Principal Scientific Officer. He stayed with the organisation for over thirty-five years until his retirement.

A fluent speaker of French and German, Freedman was sent, in 1945, as a naval intelligence officer to assess recently captured Nazi scientific research facilities in the Netherlands. Some of Freedman's work on this assignment remains classified.

Freedman's work at the AUWE was varied and involved both theory and application. His interests included the design of electro-magnetic equipment, shock and vibration protection, radiator fields, effects of baffles and layers, the measurement of echoes, and scattering and radiation processes. He was a pioneer in the use of computers for physics research and worked on the implementation of a number of specially developed early computer programmes. Freedman spent 1964/1965 as an exchange scientist with the Transducer Division at the US Navy Electronic Laboratory in San Diego,

California, USA, where his research focussed on the problems associated with transducer array and signal processing.

After his retirement in 1977, Freedman continued his theoretical research work privately, concentrating particularly on aspects of interaction of plates with incident acoustic fields. He was a Fellow of the Institute of Physics and the Institute of Acoustics. He served on the editorial board of the *Journal of Sound and Vibration* for seventeen years and regularly refereed papers submitted for publication in *Acustica*, the *Journal of the Acoustical Society of America* and *Transactions of the Institute of Electrical and Electronics Engineers*.

DESCRIPTION OF THE COLLECTION

The material is presented in the order given in the contents list. It covers the period from ca 1929 to 2004.

Section A, Biographical, contains a very small amount of material relating to various aspects of Freedman's professional career.

Section B, Research, is the largest section in the catalogue and constitutes a fairly comprehensive representation of Freedman's scientific work. A series of titled folders containing a selection of research notes on a variety of topics, ranging from acoustic array investigations and bi-static scattering to lamb modes and transducer theory, documents Freedman's professional and private research interests from 1949 to 1996. Some material relating to Freedman's research work for papers submitted to scientific journals appears in this section. Plots and computer printout relating to Freedman's work during the 1980s on programmes for acoustic modelling is also presented here.

Section C, Publications, mainly comprises a chronological sequence of Freedman's published scientific papers, 1948-1996. It contains working papers and drafts as well as a small amount of correspondence with publishers. Material relating to Freedman's unfinished and unpublished books is also presented here.

Section D, Admiralty Underwater Weapons Establishment (AUWE), contains material from between 1944 and 1994 relating to Freedman's period of employment by the organisation. It comprises a series of formal AUWE reports authored by Freedman with associated working papers and drafts, a

selection of lecture notes relating to courses attended at the South Dorset Technical College, Weymouth and a small amount of administrative correspondence.

Section E, Visits and conferences, is composed of correspondence and papers relating to conferences and meetings attended by Freedman between 1956 and 1983. Freedman contributed a talk or discussion paper to some of these conferences, most of which took place in the UK. The section also includes material concerning several events in the USA attended by Freedman during his time as an exchange scientist based in San Diego, California.

Section F, Societies and organisations, contains a small amount of material relating to nine scientific and academic bodies, including the Council for National Academic Awards, the Acoustical Society of America and the Leverhulme Trust, with which Freedman was connected. It includes correspondence and papers documenting research projects undertaken by Freedman in collaboration with the Department of Mathematics, University of Dundee.

Section G, Correspondence, comprises material covering the period 1949 to 2001 and documents a range of work and research-related topics. It includes correspondence relating to proposed study visits within the UK and abroad and to Freedman's collaborative work with staff at the University of Salford on the design and development of computer programmes for acoustic modelling.

There is also an index of correspondents.

ACKNOWLEDGEMENTS

We are very grateful to the Freedman family, Dr Philippe Blondel and Dr Olga Gomez for their assistance in making this material available.

L. Richmond

Bath 2005

SECTION A	BIOGRAPHICAL	A.1-A.14
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A.1, A.2	MEMORIAL SERVICE
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A.3-A.9	BIOGRAPHICAL AND BIBLIOGRAPHICAL
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A.10-A.14	CAREER
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A.1, A.2	MEMORIAL SERVICE	2004
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A.1	Programme, 1 April 2004.
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A.2	1p typescript memorial address delivered by Dr Phillippe Blondel, University of Bath, at Albert Freedman's cremation service, Weymouth, Dorset, 1 April 2004.
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A.3-A.9	BIOGRAPHICAL AND BIBLIOGRAPHICAL	ca 1976-ca 1996
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A.3	3pp typescript curriculum vitae, nd, latest bibliographical reference 1978.
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A.4	6pp typescript entitled 'Albert Freedman: Major Professional Experience', nd, latest bibliographical reference 1995.
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A.5	2pp untitled typescript list of Admiralty Underwater Weapons Establishment (AUWE) reports and papers, 1963-1975.
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See also D.1-D.51.

A.6	4pp typescript entitled 'Publications since 1978', nd, latest bibliographical reference 1980.
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See also C.44, C.45.

Biographical

- A.7 6pp typescript entitled 'List of Publications Containing References to my Papers', nd, latest bibliographical reference 1976.

See also C.46.
- A.8 2pp typescript entitled 'Brief Summaries and Background Sketches of Papers and Reports Submitted', nd.
- A.9 4pp typescript entitled 'Set 2: Laudatory Comments', nd, latest bibliographical reference 1996.
- A.10-A.14 CAREER ca 1929-1933, 1964-1983**
- A.10 Softback notebook inscribed on the front cover 'Schreibhaft für Albert Friedman bei Herr Spony', containing calligraphy and handwriting exercises, nd ca 1929-1933.
- A.11 'Calendar' US Navy Electronics Laboratory newspaper, including piece on the arrival of Dr Albert Freedman, 28 May 1964.
- A.12 Correspondence and papers *re* Freedman's employment and work at the Admiralty Underwater Weapons Establishment (AUWE), ca 1966-1968.
- A.13 Correspondence and papers *re* Freedman's submission for entry in the *Who's Who of British Scientists*, 1966-1983.
- A.14 Correspondence and papers *re* Freedman's candidature for the award of a DSc degree, University of London, 1975-1977.

Research

SECTION B

RESEARCH

B.1-B.269

This section contains material relating to various aspects of Freedman's research and scientific work. Some of the research undertaken by Freedman appears to have been directly related to his various publications in journals, although some is connected with lecture courses on maths and other subjects attended by Freedman at South Dorset Technical College, Weymouth. Freedman continued his research on acoustics and associated topics after his retirement in 1977. Material relating to this later work is also presented here. It includes plots, diagrams and printout relating to his interest in and development of computer programmes for theoretical acoustic modelling using different parameters.

There was no obvious scheme of organisation to the material as it was received. Freedman appears to have worked in a meticulous but rather spontaneous way recording his ideas and thoughts on whatever paper was available at the time and rarely dating or titling notes. Much of the research material presented in this section takes the form of raw data and ongoing project work rather than thoroughly collated and organised final reports.

B.1	THESIS
B.2-B.17	NOTEBOOKS
B.18-B.176	TITLED SERIES
B.177-B.182	UNTITLED SERIES
B.183-B.261	PLOTS AND DIAGRAMS
B.262-B.269	COMPUTER PRINTOUT

Research

- | | | |
|---|---|---------------------|
| B.1 | THESIS | 1961 |
| <p>PhD thesis (bound) entitled 'The Formation of Acoustic Echoes in Fluids', A. Freedman, University of London, September 1961.</p> | | |
|
 | | |
| B.2-B.17 | NOTEBOOKS | 1948-ca 1974 |
| <p>Most of the notebooks in this sub-section, though undated, appear to have been used by Freedman during his time at the Admiralty Underwater Weapons Establishment from 1944 to 1970. Some of them have a printed label on the front cover indicating that they were distributed by South Dorset Technical College, Weymouth. Inscriptions added to the covers suggest that Freedman may have used them to record notes taken during lectures he attended at the College.</p> <p>The notebooks are presented in chronological order. Those without dates have been placed at the end of the sequence.</p> <p>See also D.71-D.135.</p> | | |
|
B.2 |
Softback notebook inscribed on the front cover 'A. Freedman: Maths I' containing manuscript notes and calculations on differentiation, integration, infinite limits, hyperbolic functions and other topics, nd ca 1948. | |
|
B.3 |
Softback notebook inscribed on the front cover 'A. Freedman: Maths II' containing manuscript notes and calculations on differential equations, solutions in series, Bessel functions and other topics, nd ca 1948. | |
|
B.4 |
Softback notebook inscribed on the front cover 'A. Freedman: Maths III' containing manuscript notes and calculations on vector analysis, determinants, matrices and other topics, nd ca 1948. | |
|
B.5 |
Softback notebook inscribed on the front cover 'A. Freedman: Maths IV' containing manuscript notes and calculations on matrices, nd ca 1948. | |
|
B.6 |
Softback notebook inscribed on the front cover 'A. Freedman: Maths V' containing manuscript notes and calculations on network theory, improper integrals, Laplace transforms and other topics, December 1948. | |

Research

- B.7 Softback notebook inscribed on the front cover 'A. Freedman: Maths VI' containing manuscript notes and calculations on Laplace transforms, nd *ca* 1949.
- B.8 Softback notebook inscribed on the front cover 'A. Freedman: Maths (Rough book)' containing untitled manuscript notes and calculations, nd *?ca* 1949.
- B.9 Softback notebook inscribed on the front cover 'A. Freedman: Maths, Rough notes' containing untitled manuscript notes and calculations, nd *?ca* 1949. Loose material intercalated.
- B.10 Softback notebook inscribed on the front cover 'A. Freedman: Maths (Rough Notes)' containing untitled manuscript notes and calculations, nd *?ca* 1949/1950. Loose material intercalated.
- B.11 Softback notebook inscribed on the front cover 'A. Freedman: Maths 1949/50 - No. 1' containing manuscript notes and calculations entitled on the first page 'Differential Equations', 1949/1950.
- B.12 Softback notebook inscribed on the front cover 'A. Freedman: Maths 1949/50 - No. 2' containing manuscript notes and calculations entitled on the first page 'Soln. of a circuit problem by Heaviside methods', 1949/1950.
- B.13 Softback notebook inscribed on the front cover 'A. Freedman: Maths 1949/50 - No. 3' containing untitled manuscript notes and calculations, 1949/1950.
- B.14 Softback notebook inscribed on the front cover 'A. Freedman: ~~Radio~~ Maths Notes' containing manuscript notes and calculations entitled on the first page 'Phantatron', nd *?ca* 1949/1950.
- B.15 Hardback notebook inscribed on the front cover 'A. Freedman', containing untitled manuscript notes, calculations and diagrams, *ca* February 1952. Loose material intercalated.
- B.16 Hardback notebook containing 17pp of manuscript notes, calculations and diagrams entitled on page one 'ffowes-Williams: Physics of Sound Creation', *ca* 1974.

Research

B.17 Softback notebook inscribed on the front cover 'A. Freedman' containing untitled manuscript notes and calculations, nd.

B.18-B.176 TITLED SERIES nd, 1949-ca 1996

The contents of a series of boxes and folders clearly titled by Freedman according to broad research categories are presented here. The material comprises notes, calculations and papers relating to Freedman's research in a range of subject areas. It has been catalogued according to the title assigned to it by Freedman.

See also B.177-B.182.

The presentation is alphabetical by subject title.

B.18-B.20 'Acoustic Array Investigations.' Contents of folder so inscribed divided into three for ease of reference.

B.18 8pp typescript with appendix entitled 'An Examination of the Usefulness of Electrical Interaction Coefficients in Acoustic Array Investigations', nd, latest bibliographical reference 1965.

B.19 31pp manuscript notes entitled 'Relations between Electrical and Mechanical Interaction Coefficients', nd.

B.20 Various untitled manuscript notes and calculations, nd.

B.21, B.22 'Array Interaction Scaling Laws.' Contents of folder so inscribed divided into two for ease of reference.

Various untitled manuscript notes, calculations, illustrative figures and plots, ca 1971.

Two folders.

B.23 'Asymptotes.' Contents of folder so inscribed.

Various untitled manuscript notes, calculations and plots, nd.

Research

- B.24-B.32 'Behaviour at the Critical Angles.' Contents of folder so inscribed divided into nine for ease of reference.
- B.24 3pp manuscript notes entitled 'Determination of Conditions when U_{22d} is zero at Normal Incidence', nd.
- B.25 5pp manuscript notes and plot entitled 'Steel in Water at 1st Critical Angle', May 1980.
- B.26 7pp manuscript notes and plot entitled 'Steel in Water at 2nd Critical Angle', May 1980.
- B.27 Various untitled manuscript notes and calculations, May-June 1980.
- B.28 4pp manuscript calculations entitled 'Check of Corrected Formulae at 1st Critical Angle' June 1980.
- B.29 4pp manuscript notes and calculations entitled 'Behaviour of Lamb Modes at Critical Angles', nd.
- B.30 7pp manuscript notes and calculations entitled 'At the First Critical Angle', nd.
- B.31 11pp manuscript notes and calculations entitled 'Computations at Critical Angles', nd.
- B.32 7pp manuscript notes and calculations entitled 'Behaviour of $[U_{225}]$ at First Critical Angle, nd.
- B.33 'Bi-static Scattering.' Contents of folder so inscribed.

13pp manuscript notes with appendix entitled 'Bi-static Scattering of Acoustic Pulses by a Smooth Rigid Surface', nd.

Research

- B.34 'Calculation of Special Points along Modal Loci, including Intersections. Also of Half Cycles across Plate.' Contents of folder so inscribed.
- Various untitled manuscript notes, calculations and plots, nd.
- B.35, B.36 'Circular Piston Results.' Contents of folder so inscribed divided into two for ease of reference.
- Variously titled manuscript notes, calculations, plots and computer printouts, nd.
- Two folders.
- B.37, B.38 'Coatings.' Contents of folder so inscribed divided into two for ease of reference.
- Variously titled manuscript notes, calculations and plots, ca 1976-1977.
- Two folders.
- B.39 'Composition of Radiated and Backscattered Acoustic and Electromagnetic Fields at Short Wavelengths.' Contents of folder so inscribed.
- 3pp typescript with manuscript illustrative figures and plots, nd.
- B.40, B.41 'Diffraction.' Contents of folder so inscribed divided into two for ease of reference.
- B.40 9pp manuscript notes entitled 'The Sound Field of an Arbitrary Radiator on a Rigid Baffle Forming a Surface Revolution', 7 June 1963.
- B.41 7pp manuscript notes entitled 'The Sound Field of an Arbitrary Radiator on a Rigid Baffle Forming a Surface of Revolution', nd.
- B.42, B.43 'Dirac Pulses in $s(n)$ (t).' Contents of folder so inscribed divided into two for ease of reference.
- Various untitled manuscript notes and calculations, nd.
- See also B.94.
- Two folders.

Research

- B.44 'Dispersion Curves.' Contents of folder so inscribed.

Various untitled manuscript calculations and plots, nd.
- B.45, B.46 'Dispersion Curves for Infinite Plates.' Contents of folder so inscribed divided into two for ease of reference.
- B.45 8pp manuscript notes entitled 'Surface Phase Velocity of Free Waves in a Plate in Vacuum', nd.
- B.46 Various titled manuscript notes and calculations, ca 1972-1974.
- B.47-B.58 'Early Echo Work (I).' Contents of box so inscribed divided into twelve for ease of reference.

See also B.59-B.67.
- B.47 Softback notebook inscribed on the front cover 'A. Freedman' containing manuscript notes, calculations and illustrative figures entitled on the first page 'Cottage Lab Memo 4 (continued)', December 1953. Loose material intercalated.
- B.48 4pp typescript notes with illustrative figures entitled 'The Design of a Body of Revolution Giving a Small Axial Scattering Cross Section', nd.
- B.49 'Echo and Reverberation Simulator.' Contents of folder so inscribed.

Various untitled manuscript notes, calculations and diagrams, nd.
- B.50 'Effect of Flooding Spheres.' Contents of folder so inscribed.

3pp manuscript notes entitled 'Comparison of Free-Field Target Strength of an 18" Steel Sphere when Air- and Water-Filled', with manuscript notes, calculations and plots, 1954.
- B.51 'Multiple Paths.' Contents of folder so inscribed.

4pp manuscript notes entitled 'Path Lengths between Two Points in an Isotropic Medium Bounded by Two Reflecting Boundaries for Various Reflected Paths', nd.

Research

- B.52 'Pictorial Representation of Objects by Asdic and Radar Systems: Part II.' Contents of folder so inscribed.
- 13pp (?incomplete) typescript with 1p typescript abstract entitled 'Criteria of Definition within the Echo Field' with plots and illustrative figures, nd.
- See also B.53, B.54.
- B.53 'Pictorial Representation of Objects by Asdic and Radar Systems: Part III.' Contents of folder so inscribed.
- 10pp untitled typescript extract with 1p abstract entitled 'The Effects of Sampling the Echo Field' with illustrative figures, nd.
- See also B.52, B.54.
- B.54 'Pictorial Representation of Objects by Asdic and Radar Systems: Part IV.' Contents of folder so inscribed.
- 10pp typescript with 1p abstract entitled 'Comparison between an Optical Image and the Echo Field', with illustrative figures, nd.
- See also B.52, B.53.
- B.55-B.57 'The Portrayal of Body Shape by a Sonar System.' Contents of a folder so inscribed divided into three for ease of reference.
- B.55 50pp manuscript with 1p abstract entitled 'Experimental Study of Echo Formation', nd.
- B.56 Variously titled manuscript notes, calculations, illustrative figures and plots, nd.
- B.57 Black and white photographic illustrative figures, nd.
- B.58 3pp untitled manuscript notes and calculations with 1p typescript memorandum entitled 'Suggested Basic Research on DC Components of Echoes', 12 November 1954.

Research

- B.59-B.67 'Early Echo Work (II).' Contents of box so inscribed divided into nine for ease of reference.
- See also B.47-B.58.
- B.59, B.60 'Analysis of Fine Structure for Icewhale Trials.' Contents of folder so inscribed divided into two for ease of reference.
- B.59 Various manuscript notes and calculations entitled on the first page 'Analysis of Fine Structure of Echoes and Reverberations', ca 1954.
- B.60 Various untitled black and white photographic images, nd.
- B.61 'Echo Notes.' Contents of folder so inscribed.
- 6pp manuscript calculations entitled 'Determination of Detection Range for Noise Pulses' with various untitled plots and illustrative figures and 1p typescript memorandum entitled 'Underwater Tripod', 14 February 1956.
- B.62 'Lectures on Echo Formation.' Contents of folder so inscribed.
- Variously titled manuscript notes *re* two lectures given by Freedman under the general title 'The Principles of Echo Formation and their Relation to the Question "Can an Asdic System Provide a Pictorial Representation of a Target?"', July 1958.
- B.63 'Measurements of Echoes from Spherical Caps.' Contents of folder so inscribed.
- Various untitled manuscript notes, drawings and calculations with photographic images and illustrative figures, ca 1955.
- B.64 7pp typescript entitled 'Recent Approaches to Echo Structure Theory' with 1p typescript abstract and covering letter *re* 68th Meeting of the Acoustical Society of America, Austin, Texas, USA, October 1964.
- See also E.11.
- B.65 6pp typescript entitled 'Summary of Main Steps in Mathematical Analysis', nd.

Research

- B.66 'Thoughts on the Effect of Acoustic Absorbing Materials for Camouflage.' Contents of folder so inscribed.

Various untitled typescript and manuscript notes, calculations and plots, nd.
- B.67 Various untitled manuscript notes and plots, nd.
- B.68, B.69 'Echo from Cone at Non-Axial Incidence.' Contents of folder so inscribed divided into two for ease of reference.
- B.68 8pp untitled typescript, nd.
- B.69 6pp manuscript notes entitled 'The Echo from a Cone with Smooth Spherical Termination' with 4pp untitled manuscript notes, nd.
- B.70, B.71 'Echoes from Cylinder.' Contents of folder so inscribed divided into two for ease of reference.
- B.70 7pp typescript entitled 'The Echo Structure of Finite Circular Cylinders', October 1973.
- B.71 Various untitled manuscript notes, calculations and plot, ca 1972.
- B.72-B.93 'Echo Formation.' Contents of box so inscribed divided into twenty-two for ease of reference.
- B.72 Softback notebook inscribed on the front cover 'Echo Measurements in Tank' containing manuscript notes and calculations, November-December 1957.
- B.73-B.76 'Current work on Formation of Acoustic Echoes in Fluids.' Contents of folder so inscribed divided into four for ease of reference.

Various untitled manuscript and typescript notes and calculations with plots and illustrative figures, ca 1957.

Four folders.

Research

- B.77 Various manuscript notes and calculations entitled on the first page 'Echo Formation: Points Raised by Mole', nd,
- B.78 'Echo Formation Theory.' Contents of folder so inscribed.

15pp typescript entitled 'Appendix: Theoretical Analysis of Echoes from Rigid Target' with illustrative figures, nd.
- B.79 'Echo from Cone at Non-Axial Incidence.' Contents of folder so inscribed.

8pp untitled typescript, nd.
- B.80, B.81 'Echo from Cylinder Under Pulse Conditions.' Contents of folder so inscribed divided into two for ease of reference.
- B.80 24pp manuscript entitled 'The Echo from a Right Rigid Circular Cylinder of Dimensions $\gg \lambda$ ' with illustrative figures, nd.
- B.81 Various manuscript notes and calculations entitled on the first page 'Echo from Curved Surface of Cylinder', nd.
- B.82 'Effect of Pulse Length.' Contents of folder so inscribed.

Various untitled notes, calculations and illustrative figures, nd.
- B.83 'Effect of Transmission Length on Echo to Reverberation Ratio as Deduced from the Image Pulse Concept.' Contents of folder so inscribed.

Various untitled manuscript notes and calculations with plot, nd.
- B.84 'Formation of Acoustic Beams and Echoes in Fluids.' Contents of folder so inscribed.

Variously titled manuscript notes and calculations, ca 1958.
- B.85 'Image Pulse Theory.' Contents of folder so inscribed.

Variously titled manuscript notes and calculations, ca 1955.

Research

- B.86 'Image Pulse Theory of Echo Formation.' Contents of folder so inscribed.

Various untitled manuscript notes, photographic illustrative figures and plots with 2pp typescript entitled 'Summary of Information relating to the Image Pulse Theory Supplementary to "An Introduction to the Image Pulse Concept of Echo Formation"', 2 September 1957.
- B.87 'Image Pulse Theory of Echo Formation.' Contents of folder so inscribed.

Various untitled manuscript and typescript notes, *ca* 1959.
- B.88 'Mechanism of Acoustic Echo Formation.' Contents of folder so inscribed.

Various untitled manuscript notes and calculations with plot, *nd*.
- B.89 'Mechanism of Electromagnetic Echo Formation.' Contents of folder so inscribed.

Variously titled manuscript notes and calculations, *ca* 1962.
- B.90 'Target Strengths of Cylinders (Theoretical).' Contents of folder so inscribed.

Various untitled manuscript notes and calculations', *nd*.
- B.91 'Theoretical Work: Echoes at Short Ranges.' Contents of folder so inscribed.

Various manuscript notes with illustrative figures, *nd*.
- B.92 4pp manuscript notes entitled 'Variation of Echo with Surface Roughness', *nd*.
- B.93 Various untitled manuscript notes and calculations, *nd*.
- B.94 'Features Giving Rise to Dirac Pulses.' Contents of folder so inscribed.

Various untitled manuscript and typescript notes, calculations and graphs, *nd*.

See also B.42, B.43.

Research

- B.95 'Field of Pulsed Circular Piston.' Contents of folder so inscribed.
7pp untitled manuscript calculations and plots, nd.
- B.96-B.100 'Four Wave Trains within a Plate.' Contents of folder so inscribed divided into five for ease of reference.
- B.96 39pp manuscript notes and calculations entitled 'Four Internal Wave Trains', November-December 1982.
- B.97 7pp manuscript calculations entitled 'Complex Wavetrain Amplitudes A_d , B_d , C_s and D_s ', November 1982.
- B.98 2pp manuscript notes entitled 'Investigation of High Tangential Displacements at S_0 Mode when d/λ_{25} is Small', December 1982.
- B.99 4pp manuscript calculations entitled 'Checks on Values of A_d , B_d , C_s and D_s obtained in AF12 on PET', nd.
See also B.266.
- B.100 7pp manuscript calculations entitled 'Peak Values and Phases of Displacement Components', nd.
- B.101 'Ideas for Further Research.' Contents of folder so inscribed.
Various untitled manuscript notes and calculations, nd.
- B.102, B.103 'Impulse Response Approach.' Contents of folder so inscribed divided into two for ease of reference.
Various untitled manuscript notes, calculations and plots, nd.
Two folders.

Research

- B.104 'Impulse Response Function of Circular Piston.' Contents of folder so inscribed.
Various untitled manuscript and typescript notes, calculations and plots, nd.
- B.105-B.107 'Integration Over a Discontinuity.' Contents of folder so inscribed divided into three for ease of reference.
- B.105 7pp untitled manuscript notes, 19 July 1959.
- B.106 3pp manuscript notes entitled 'Integration of the Derivative of a Function over a Point where Function is Discontinuous', nd.
- B.107 Various untitled manuscript and typescript notes and calculations, nd.
- B.108 'Lamb Modes I.' Contents of folder so inscribed.
Variously titled manuscript notes, *ca* 1951.
- B.109 'Lamb Modes II'. Contents of folder so inscribed.
Variously titled notes and calculations, 1952-1957.
- B.110 'Lamb Modes III.' Contents of folder so inscribed.
Variously titled manuscript notes, 1958-1973.
- B.111 'Lamb Modes IV.' Contents of folder so inscribed.
Variously titled manuscript notes and calculations, 1974-1976.
- B.112 'Lamb Modes VI.' Contents of folder so inscribed.
Variously titled manuscript notes and calculations, 1983-1992.

Research

- B.113 'Lamb Modes VII.' Contents of folder so inscribed.
Variously titled manuscript notes and calculations, ca 1993.
- B.114-B.126 'Lamb Modes Work'. Contents of box so inscribed divided into thirteen for ease of reference.
- B.114, B.115 'Conversion of Lamb Mode Equations.' Contents of folder so inscribed divided into two for ease of reference.
Variously titled manuscript notes and calculations, ca 1987.
Two folders.
- B.116 'Internal Fields of Insonified Plates along Loci of Zero and First Order Lamb Modes.' Contents of folder so inscribed.
Various untitled manuscript notes, calculations and incomplete drafts *re* a paper submitted to the *Journal of Sound and Vibration* by Freedman and G. G. Swinerd, ca 1979.
See also C.33.
- B.117 'Lamb Mode Graphs.' Contents of folder so inscribed.
Variously titled manuscript graphs with notes and calculations, nd.
- B.118 'Lamb Modes for Aluminium in Water, Air and Vacuum.' Contents of folder so inscribed.
5pp manuscript graphs, nd.
- B.119 'Lamb Modes for Brass 1 in Water and in Vacuum.' Contents of folder so inscribed.
3pp untitled manuscript notes and plot, nd.
- B.120 'Lamb Modes for Brass 2 in Water.' Contents of folder so inscribed.
Variously titled manuscript calculations, illustrative figures and graphs, nd.

Research

- B.121 'Lamb Modes in Rubber.' Contents of folder so inscribed.
2pp manuscript graphs entitled 'Rubber in Glycerol', nd.
- B.122 'Lamb Modes in Perspex.' Contents of folder so inscribed.
Various untitled manuscript calculations and graphs, nd.
- B.123 'Lamb Modes for Steel in Water and in Vacuum and in Air.' Contents of
folder so inscribed.
Various untitled manuscript calculations and graphs, nd.
- B.124 'Shear and Dilatational Components along Lamb Mode Spectra.' Contents of
folder so inscribed.
Various untitled manuscript and typescript notes and calculations, ca 1994.
See also B.125.
- B.125 'Shear and Dilatational Components along Lamb Mode Spectra: Working
Papers.' Contents of folder so inscribed.
Various untitled manuscript and typescript notes, calculations and graphs, ca
1996.
See also B.124.
- B.126 'Single Elastic Layer in a Fluid.' Contents of folder so inscribed.
Various untitled manuscript notes and calculations, nd.
- B.127-B.132 'Layered Media.' Contents of folder so inscribed divided into six for ease of
reference.
- B.127, B.128 'Brekhovskikh, Kästner.' Contents of folder so inscribed divided into two for
ease of reference.
- B.127 33pp manuscript notes entitled 'Brekhovskikh', nd.

Research

- B.128 34pp manuscript notes entitled 'Kästner - Reflection and Transmission at Visco-Elastic Layer Systems', nd.
- B.129 'Brekhovskikh's Treatment for Layered Media.' Contents of folder so inscribed.
- Various titled manuscript notes and calculations, nd.
- B.130 'Käster's Treatment for Layered media.' Contents of folder so inscribed.
- Various untitled manuscript notes and calculations, nd.
- B.131 'Transmission through a Plate.' Contents of folder so inscribed.
- 13pp manuscript notes entitled 'Transmission of a Plane Wave through a Parallel-Walled Fluid Layer of Infinite Extent and Finite Thickness', ca 1954.
- B.132 Various untitled manuscript notes, nd, latest bibliographical reference 1972.
- B.133-B.137 'Linear System Work.' Contents of box so inscribed divided into 5 for ease of reference.
- This material appears to relate to work for Freedman's unpublished book on linear system theory.
- See also C.48-C.53.
- B.133 'Linear System Notes.' Contents of folder so inscribed.
- Various untitled manuscript and typescript notes, nd.
- B.134 'Linear System Theory'. Contents of folder so inscribed.
- Various untitled manuscript notes and calculations, nd.
- B.135, B.136 'Non-Linear Acoustics.' Contents of folder so inscribed divided into two for ease of reference.
- B.135 9pp manuscript notes entitled 'Symposium on Non-Linear Underwater Acoustics', 19 July 1966.

Research

- B.136 3pp manuscript notes entitled 'Non-Linear Acoustics - Berktaý', 28 June 1972.
- B.137 Various untitled manuscript notes and calculations, nd.
- B.138 'Nearfield Calibration.' Contents of folder so inscribed.

11pp manuscript notes entitled 'Transducer Calibration from Nearfield Data', ca 1961.
- B.139-B.141 'Nearfield Contours.' Contents of folder so inscribed divided into three for ease of reference.
- B.139 Various untitled manuscript notes, calculations and plots, ca 1963.
- B.140 Variously titled manuscript and typescript notes, calculations and graphs, ca 1963.
- B.141 Various untitled manuscript notes, calculations and plots, nd.
- B.142, B.143 'Nearfield of Pulsed Circular Acoustic Radiator.' Contents of folder so inscribed divided into two for ease of reference.

Various untitled manuscript and typescript notes, calculations and graphs, nd.

Two folders.
- B.144-B.146 'Nearfield of Pulsed Rectangular Acoustic Radiator.' Contents of folder so inscribed divided into three for ease of reference.
- B.144 5pp manuscript calculations entitled 'The Field of a Rectangular Piston in the Plane of the Piston', nd.
- B.145 7pp manuscript calculations entitled 'Rectangular Radiator: Farfield', nd.

Research

- B.146 Various untitled manuscript notes and calculations, nd.
- B.147 'Nearfield of Rectangular Piston by Replica Pulse Method.' Contents of folder so inscribed.

Various untitled manuscript calculations with illustrative figures, ca 1961.
- B.148 'Nearfields.' Contents of folder so inscribed.

21pp manuscript notes with calculations and plots entitled 'Appendix 3: the Very Short Range and the Paraxial Sound Field of a Rectangular Transducer Vibrating with Uniform Amplitude and Phase', nd.
- B.149 'Peak Displacements along Modal Loci.' Contents of folder so inscribed.

4pp manuscript notes entitled 'Peak Displacement Curves for A_0 and S_0 Modes' with untitled notes, calculations and plots, ca 1976.
- B.150 'Plane Arrays.' Contents of folder so inscribed.

14pp typescript (annotated) entitled 'Some Trends in Performance of Plane Arrays in the Presence of Acoustic Interaction' with 17 plots, ca 1965.
- B.151 'Plane Radiators.' Contents of folder so inscribed.

9pp typescript entitled 'Some Generalisations Concerning the Solution of Sound Fields Produced in Fluids by Plane Radiators', nd.

See also B.152.
- B.152 'Plane Radiators.' Contents of folder so inscribed.

Various untitled manuscript notes, calculations and graphs, nd.

See also B.151.
- B.153 'Pulsed Radiator Fields.' Contents of folder so inscribed.

Variously titled manuscript notes and calculations *re* the work of P. R. Stepanishen, nd.

Research

- B.154 6pp manuscript notes entitled 'Pulse Transmission from Rectangular Transducer', nd.
- B.155-B.157 'Radiators with no Baffle or with Finite Baffle.' Contents of folder so inscribed divided into three for ease of reference.
- B.155 9pp manuscript notes entitled 'The Sound Field of an Arbitrary Radiator on a Rigid Baffle Forming a Surface of Revolution', 7 August 1963.
- B.156 10pp copy manuscript notes entitled 'Radiation from Sources on a Rigid Body of Revolution', nd, latest bibliographic reference 1963.
- B.157 Various untitled manuscript notes with graphs, nd ca 1963.
- B.158 5pp manuscript calculations entitled 'Rectangular Radiator', nd.
- B.159 'Reflection of a Plane Wave at a Plane Boundary between Two Fluids.' Contents of folder so inscribed.

Variously titled manuscript notes and calculations with graphs, nd.
- B.160 'Reflection and Transmission Coefficients along Modal Loci.' Contents of folder so inscribed.

17pp untitled manuscript calculations with graphs, nd.
- B.161 'Reflection and Transmission at an Elastic Plate.' Contents of folder so inscribed.

Various untitled manuscript notes, calculations and graphs, nd.

See also B.162, B.173-B.176.
- B.162 'Reflectivity and Transmittivity of Elastic Plates: Used Material.' Contents of folder so inscribed.

Various untitled manuscript notes and calculations, nd.

See also B.161, B.173-B.176.

Research

- B.163 7pp manuscript calculations entitled 'Relationship between Boundary Motions and Transmission and Reflection Coefficients', 17 August 1978.
- B.164 'Salford Papers.' Contents of folder so inscribed.
Untitled manuscript notes, calculations and computer printout, July 1984.
See also B.165, B.262-B.269, G.8, G.9, G.11, G.12.
- B.165 'Salford Results.' Contents of folder so inscribed.
Untitled manuscript notes, calculations and illustrative figures *re* collaborative work on computer programming with the University of Salford, nd ca 1981-1990.
See also B.164, B.262-B.269, G.8, G.9, G.11, G.12.
- B.166 'Spectra of Overlapping Pulses.' Contents of folder so inscribed.
Various untitled manuscript notes, calculations, graphs and illustrative figures, nd.
- B.167 'Steel Layer in Water $d/\lambda_s = 0.55$.' Contents folder so inscribed.
Various untitled manuscript notes, calculations, graphs and illustrative figures, ca 1976.
- B.168 'Symmetry and Anti-Symmetry along Modal Branches.' Contents of folder so inscribed.
Variously titled manuscript notes, calculations and plots, ca 1979.
- B.169-B.172 'Transducer Theory.' Contents of folder so inscribed divided into four for ease of reference.
- B.169 4pp manuscript notes entitled 'Analysis of Ceramic Transducer Element', nd.
- B.170 13pp manuscript notes entitled 'A Deviation and Tabulation of the Piezo-Electric Equations of State', nd.

Research

- B.171 4pp manuscript notes entitled 'Piezo-Electric Relations for a Crystal', nd.
- B.172 6pp manuscript notes entitled 'Longitudonal Piezo-Electric Driving Systems', nd.
- B.173-B.176 'Transmission and Reflection for a Plate.' Contents of box so inscribed divided into four for ease of reference.

See also B.161, B.162.
- B.173 9pp manuscript notes entitled 'Transmission of Sound through a II Walled Solid of Finite Thickness and Infinite Extent', January 1949.
- B.174, B.175 'Work Associated with the Reissner Formulae for Transmission of Sound through a Plate.' Contents of folder so inscribed divided into two for ease of reference.
- B.174 4pp untitled manuscript notes with plots, 26 April 1949.
- B.175 7pp manuscript notes entitled 'Velocity of Sound in Solids' with plots, 16 May 1949.
- B.176 '(Reflection Coeff)² for a Layer of Fluid in between Two Different Fluids.' Contents of folder so inscribed.

1p untitled manuscript notes with 9pp graphs, nd.

Research

B.177-B.182

UNTITLED SERIES

nd, ca 1976-1981

The contents of a small group of untitled folders are presented here. The material comprises notes, calculations and papers relating to Freedman's research in a range of subject areas.

See also B.18-B.176.

The presentation is chronological. Undated material is presented at the end of the sequence.

- | | |
|-------|---|
| B.177 | Various untitled manuscript notes and calculations <i>re</i> reflection and transmission, <i>ca</i> 1976. |
| B.178 | Variously titled manuscript calculations <i>re</i> displacements, <i>ca</i> 1979-1981. |
| B.179 | Various untitled manuscript notes, calculations, plots and computer printout, <i>ca</i> 1981. |
| B.180 | Various untitled manuscript notes and calculations, nd. |
| B.181 | Various untitled manuscript notes and calculations, nd. |
| B.182 | Various untitled manuscript calculations, notes and illustrative figures, nd. |

Research

B.183-B.261

PLOTS AND DIAGRAMS

nd, 1984-1987

This sub-section contains a series of computer-generated plots and diagrams relating to Freedman's theoretical research work. The material, which comprises a large number of plots of preliminary results of acoustic modelling for different parameters, is not consistently dated. Although organised into labelled folders, individual plots are not always titled. The original order of the contents of each folder has, therefore, been preserved.

The presentation is alphabetical by folder inscription.

See also B.262-B.269.

B.183-B.185

'Convolution Diagrams: (a) Plane Wave, (b) Varying Pulse Length, (c) Special Points.' Contents of folder so inscribed divided into three for ease of reference, *ca* June 1975-April 1976.

Three folders.

B.186-B.192

'Convolution Diagrams (Half Scale).' Contents of folder so inscribed divided into seven for ease of reference, *ca* July 1975-April 1976.

Seven folders.

B.193-B.201

'Convolution Diagrams (Full Scale).' Contents of folder so inscribed divided into nine for ease of reference, *ca* July 1975-April 1976.

Nine folders.

B.202, B.203

'Convolution: Plane Wave Removal.' Contents of folder so inscribed divided into two for ease of reference, *ca* November 1975.

Two folders.

B.204-B.211

'Graphs of Reflection and Transmittivity (Plots from Layer Programs).' Contents of folder so inscribed divided into eight for ease of reference, *ca* 1976-1977.

Eight folders.

Research

- B.212-B.215 'Four-Layer Systems.' Contents of folder so inscribed divided into four for ease of reference, *ca* 1976-1977.
- Four folders.
- B.216, B.217 'Lossy Rubber Plates in Water I.' Contents of folder so inscribed divided into two for ease of reference, *ca* 1977.
- Two folders.
- B.218, B.219 'Lossy Rubber Plates in Water II.' Contents of folder so inscribed divided into two for ease of reference, *ca* 1977.
- Two folders.
- B.220, B.221 'Lossy Steel Plates in Water.' Contents of folder so inscribed divided into two for ease of reference, *ca* 1976-1977.
- Two folders.
- B.222, B.223 'Perspex Plates in Water.' Contents of folder so inscribed divided into two for ease of reference, *ca* 1977.
- Two folders.
- B.224, B.225 'Plates in Fluid.' Contents of folder so inscribed divided into two for ease of reference, *ca* 1976-1977.
- Two folders.
- B.226-B.228 'Polymer in Water.' Contents of folder so inscribed divided into three for ease of reference, *ca* 1977.
- Three folders.
- B.229, B.230 'Steel Plates in Air.' Contents of folder so inscribed divided into two for ease of reference, *ca* 1976-1977.
- Two folders.

Research

- B.231-B.233 'Steel Plates in Water I.' Contents of folder so inscribed divided into three for ease of reference, *ca* 1976-1977.
- See also B.234-B.241.
- Three folders.
-
- B.234-B.236 'Steel Plates in Water I'. Contents of folder so inscribed divided into three for ease of reference, *ca* 1976-1977.
- See also B.231-B.233, B.237-B.241.
- Three folders.
-
- B.237, B.238 'Steel Plates in Water II.' Contents of folder so inscribed divided into two for ease of reference, *ca* 1976-1977.
- See also B.231-B.236, B.239-B.241.
- Two folders.
-
- B.239-B.241 'Steel Plates in Water III.' Contents of folder so inscribed divided into three for ease of reference, *ca* 1976-1977.
- See also B.231-B.238.
- Three folders.
-
- B.242, B.243 'Water-Steel-Air.' Contents of folder so inscribed divided into two for ease of reference, *ca* 1977.
- See also B.244, B.245.
- Two folders.
-
- B.244, B.245 'Water-Steel-Air.' Contents of folder so inscribed divided into two for ease of reference, *ca* 1977.
- See also B.242, B.243.
- Two folders.

Research

- B.246-B.260 15 rolled plots produced with the Ghost-80 plotting package and a Benson plotter relating to computer printout results, 1984-1987.
- Freedman himself highlighted the unreliability of this method of plotting. The plots presented here were selected for preservation as a representative sample to illustrate Freedman's use of the technique.
- See also B.262-B.269.
- B.246 Plot entitled 'RSXME38 CWZAF40 run on 1906A/7600' annotated 'Normal & Tangential Displacements: S3 Mode', 27 September 1984.
- B.247 Plot entitled 'RSXME38 CWZAF38 run on 1906A/7600' annotated 'Normal & Tangential Displacements: A3 Mode', 19 October 1984.
- B.248 Plot entitled 'RSXME38 CWZAF60 run on 1906A/7600', 25 January 1985.
- B.249 Plot entitled 'RSXME38 CWZAF66 run on 1906A/7600' annotated 'Perspex in Water Normal & Tangential Displacements A1 & SØ Modes', 5 June 1985.
- B.250 Plot entitled 'RSXME38 CWZSA20 run on MFZ' annotated 'Steel in Water SØ Mode', 21 April 1986.
- B.251 Plot entitled 'RSXME38 CWZSA20 run on MFZ' annotated 'Steel in Water A2 Mode', 21 April 1986.
- B.252 Plot entitled 'RSXME38 CWZPS10 run on MFZ' annotated 'Perspex in Water S1 Mode', 12 June 1986.
- B.253 Plot entitled 'RSXME38 CWZSO10 run on MFZ' annotated 'Steel in Water $d/\lambda_s = 0.1$ ', 16 June 1986.
- B.254 Plot entitled 'RSXME38 CWZSA20 run on MFY' annotated 'Steel in Water A2 Mode Z Contours', 7 October 1987.
- B.255 Plot entitled 'RSXME38 CWZSS00 run on MFY' annotated 'Steel in Water SØ Mode Z Contours', 7 October 1987.

Research

- B.256 Plot entitled 'RSXME38 CWZPA10 run on MFY' annotated 'Perspex in Water A1 Mode Z Contours', 8 October 1987.
- B.257 Plot entitled 'RSXME38 CWZPA10 run on MFY' annotated 'Perspex in Water A1 Mode X Contours', 11 October 1987.
- B.258 Plot entitled 'RSXME38 CWZSS00 run on MFY' annotated 'Steel in Water SØ Mode X Contours', 11 October 1987.
- B.259 Plot entitled 'RSXME38 CWZSS20 run on MFY' annotated 'Steel in Water S2 Mode X Contours', 11 October 1987.
- B.260 Plot entitled 'RSXME38 CWZSA20 run on MFY' annotated 'Steel in Water A2 Mode X Contours', 11 October 1987.
- B.261 2 polar plot diagrams entitled 'Rim Wave of a Circular Piston $a/\lambda_0 = 10.5$ Cycle Pulse Percentage Error of Approximate Formula Shown as a Distribution in Space', nd.

B.262-B.269

COMPUTER PRINTOUT

1983-1988

This sub-section contains computer printout relating to various programmes designed and developed by Freedman, in collaboration with members of staff at the University of Salford, for theoretical acoustic modelling using different parameters.

See also B.164, B.165, B.246-B.261, G.8, G.9, G.11, G.12.

B.262

Various manuscript notes and calculations relating to the design and use of computer programmes, nd ca 1986-1988.

Research

- B.263 Various computer printouts *re* eight run jobs using operating system commands, with manuscript annotations, July 1983-October 1987.
- These printout listings document the editing of programme files and the programming environment in which Freedman was working. They include Freedman's analysis and debugging notes.
- B.264 Computer printouts of results for Perspex in water arranged chronologically according to mode, May 1985-July 1988.
- See also B.222, B.223, B.252, B.256, B.257.
- B.265 Computer printout results for steel in water arranged chronologically according to plate thickness in shear wavelengths and mode, January 1985-October 1987.
- See also B.220, B.221, B.229-B.245, B.250, B.251, B.253-B.255, B.258-B.260.
- B.266-B.269 Various computer printouts *re* programmes written in FORTAN, 1983-1988.
- B.266 Computer printouts documenting the use and evolution of a programme called AF*** (the asterisks apparently denote the version number) with manuscript annotation *re* the programming and results, July 1983-April 1984.
- See also B.99.
- B.267 Computer printouts documenting the use and evolution of a programme called AFTOT* (the asterisk apparently denotes the version number) with manuscript annotation *re* programme debugging, October 1987, May 1988.
- B.268 Computer printouts documenting the use and evolution of a programme called AFCOX* (the asterisk apparently denotes the version number) with manuscript annotation *re* programme debugging, October 1987, June 1988.
- B.269 Computer printouts documenting the use and evolution of a programme called AFCOZ* (the asterisk apparently denotes the version number) with manuscript annotation *re* programme debugging, October 1987, June 1988.

SECTION C

PUBLICATIONS

C.1-C.87

This section contains copies of published papers written or co-authored by Freedman and some correspondence with publishers concerning Freedman's contributions to the *Journal of the Acoustical Society of America*, the *Journal of Sound and Vibration* and other journals. Working papers, notes, calculations and drafts associated with Freedman's published papers are presented here. The section also contains a small amount of material relating to Freedman's two unpublished books.

C.1-C.46 PAPERS, REPORTS AND ARTICLES

C.47-C.53 BOOKS

C.54-C.87 DRAFTS AND CORRESPONDENCE

Publications

C.1-C.46 PAPERS, REPORTS AND ARTICLES 1948-1996

This sub-section contains a sequence of off-prints and reprints of Freedman's published papers. The sequence includes scientific reports published by the US Navy Electronics Laboratory, San Diego, California, USA. Typescript lists of Freedman's publications can be found at the end of the subsection.

For Admiralty Underwater Weapons Establishment (AUWE) reports authored by Freedman see D.1-D.51.

The presentation is chronological.

- C.1 'A New Instrument for Timing the Switching Sequence of a Contact System', *Journal of the Royal Naval Scientific Service*, **III(5)** pp 203-207, September 1948.
- C.2 'Measurement of Small Time-Intervals Occurring in a Contact-switching Sequence', *Journal of Scientific Instruments and Physics in Industry*, **26(10)** pp 344-348, October 1949.
- C.3 'Sound Field of a Rectangular Piston', *Journal of the Acoustical Society of America*, **32(2)** pp 197-209, February 1960.
- C.4 'A New Interpretation of Acoustic Echo Formation', *Journal of the Royal Naval Scientific Service*, **16(2)** pp 63-69, March 1961.

See also E.5, E.6.
- C.5 'Portrayal of Body Shape by a Sonar or Radar System', *Journal of the Royal Naval Scientific Service*, **17(6)** pp 311-318, November 1962.
- C.6 'A Mechanism of Acoustic Echo Formation', *Acustica* **12(1)** pp 10-21, 1962.
- C.7 'The High Frequency Echo Structure of Some Simple Body Shapes', *Acustica* **12(2)** pp 61-70, 1962.

Publications

- C.8 'The Portrayal of Body Shape by a Sonar or Radar System', *Journal of the British Institution of Radio Engineers*, **25(1)** pp 51-64, January 1963.
- C.9 'An Experimental Examination of Acoustic Echo Structure', *Acustica*, **14(2)** pp 89-104, 1964.
- C.10 'Acoustic Interaction Effects in Arrays – A Theoretical Introduction', *US Navy Journal of Underwater Acoustics*, **15(1)** pp 143-159, January 1965.
- C.11 9pp typescript entitled 'An Examination of the Usefulness of Electrical Interaction Coefficients in Acoustic Array Investigations', US Navy Electronics Laboratory, San Diego, California, USA, June 1965.
- C.12 'Sound Field of a Pulsed Plane Transducer', Research and Development Report 1304, US Navy Electronics Laboratory, San Diego, California, USA, 9 August 1965.
- C.13 15pp typescript entitled 'Arrays with Elements Connected in Groups', US Navy Electronics Laboratory, San Diego, California, USA, August 1965.
- C.14 11pp copy manuscript with appendices entitled 'Nel's Approach to the Computerized Design by Optimization of Piezoelectric Transducer Elements', US Navy Electronics Laboratory, San Diego, California, USA, August 1965.
- C.15 'The Sound Field of Pulsed Plane Radiators', *Journal of the Royal Naval Scientific Service*, **24(2)** pp 66-74, March 1969.
- C.16 'Transient Fields of Acoustic Radiators', *Journal of the Acoustical Society of America*, **48(1)** pp 135-138, July 1970.
- C.17 'Sound Field of Plane or Gently Curved Pulsed Radiators', *Journal of the Acoustical Society of America*, **48(1)** pp 221-227, July 1970.
- C.18 'Farfield of Pulsed Rectangular Acoustic Radiator', *Journal of the Acoustical Society of America*, **49(3)** pp 738-748, March 1971.

Publications

- C.19 'A Comparison of Geometrical Features as Acoustic Scatterers within a Fluid', British Acoustical Society, February 1971.
- C.20 'Approximate Scaling Laws of Acoustic Array Interaction', British Acoustical Society, April 1971.

See also D.20, D.65-D.67, E.16, E.38.
- C.21 'Sound Field of a Pulsed, Planar, Straight-Edged Radiator', *Journal of the Acoustical Society of America*, **51(5)** pp 1624-1639, 1972.
- C.22 'Reply to "Comments on Farfield of Pulsed Rectangular Acoustic Radiator"', *Journal of the Acoustical Society of America*, **52(1)** pp 437-438, 1972.
- C.23 'Comment on "Characteristics of Line and Disk Underwater Sound Transducers in the Near- to Farfield Transition Region"', *Journal of the Acoustic Society of America*, **55(5)** p 1080, May 1974.
- C.24 'The Use of Linear System Theory in Acoustic Radiation and Scattering Analysis', *Journal of Sound and Vibration*, **52(2)** pp 265-276, 1977.

See also C.48, C.56, C.57, D.20, E.28-E.31.
- C.25 'The Reflectivity and Transmittivity of Elastic Plates I: Comparison of Exact and Approximate Theories', *Journal of Sound and Vibration*, **59(3)** pp 369-393, 1978.
- C.26 'Book review - Acoustical Oceanography: Principles and Applications', *Journal of Sound and Vibration*, **60(4)**, pp 615-616, 1978.
- C.27 'Seminar on the High Frequency Scattering and Radiation of Transients', *Revista de Acustica*, **11(1)** pp 34-51, 1980.
- C.28 'Internal Field of an Insonified Elastic Plate', A. Freedman and G. G. Swinerd, *Journal of Sound and Vibration*, **68(4)** pp 515-552, 1980.

Publications

- C.29 'Displacement Field of an Insonified Thick Elastic Plate', G. G. Swinerd and A. Freedman, *Journal of Sound and Vibration*, **70(2)** pp 231-266, 1980.
- See also C.58.
- C.30 'Errata and Clarification - Internal Field of an Insonified Elastic Plate', A. Freedman and G. G. Swinerd, *Journal of Sound and Vibration*, **73(1)** pp 147-148, 1980.
- C.31 'On the Overlapping Resonances Concept of Acoustic Transmission through an Elastic Plate I: An Examination of Properties', *Journal of Sound and Vibration*, **82(2)** pp 181-195, 1982.
- See also C.32, C.59-C.65.
- C.32 'On the Overlapping Resonances Concept of Acoustic Transmission Through an Elastic Plate II: Numerical Examples and Physical Implications', *Journal of Sound and Vibration*, **82(2)** pp 197-213, 1982.
- See also C.31, C.59-C.65.
- C.33 'Internal and External Fields of Insonified Plates Along Lamb Mode Branches of Zero Order', A. Freedman and G. G. Swinerd, *Journal of Sound and Vibration*, **83(4)** pp 479-500, 1982.
- See also B.116.
- C.34 'The Variation with the Poisson Ratio of Lamb Modes in a Free Plate I: General Spectra', *Journal of Sound and Vibration*, **137(2)** pp 209-230, 1990.
- See also C.66-C.68.
- C.35 'The Variation with the Poisson Ratio of Lamb Modes in a Free Plate II: At Transitions and Coincidence Values', *Journal of Sound and Vibration*, **137(2)** pp 231-247, 1990.
- See also C.69-C.71.
- C.36 'The Variation with the Poisson Ratio of Lamb Modes in a Free Plate III: Behaviour of Individual Modes', *Journal of Sound and Vibration*, **137(2)** pp 249-266, 1990.

Publications

- C.37 'Conversion of Modes in a Free Elastic Plate', *Journal of Sound and Vibration*, **145(3)** pp 391-407, 1991.
- C.38 'Acoustic Field of a Pulsed Circular Piston', *Journal of Sound and Vibration*, **170(4)** pp 495-519, 1994.
- See also C.72, C.73, E. 35-E.37.
- C.39 'Anomalies of the A_0 Leaky Lamb Mode of a Fluid-Loaded Elastic Plate', *Journal of Sound and Vibration*, **183(4)** pp 719-737, 1995.
- See also C.74-C.78.
- C.40 'On Resonance Widths of Leaky Lamb Modes', *Journal of the Acoustical Society of America*, **97(3)**, March 1995.
- C.41 'Comment on "On the Crossing Points of Lamb Wave Velocity Dispersion Curves"', *Journal of the Acoustic Society of America*, **98(4)** pp 2363-2364, October 1995.
- See also C.79, C.80.
- C.42 'Effects of Fluid-Loading on Lamb Mode Spectra', *Journal of the Acoustical Society of America*, **99(6)** pp 3488-3496, June 1996.
- See also C.81-C.87.
- C.43 'On the Cause of Anomalous Behaviour of the A_0 Leaky Lamb Mode', *Journal of Sound and Vibration*, **191(5)** pp 999-1002, 1996.
- C.44 3pp typescript list entitled 'Publications by Albert Freedman', 1960-1996.
- See also A.6.
- C.45 26pp typescript (annotated) entitled 'Lists of My Publications', 1948-1996.
- See also A.6.

Publications

C.46 40pp typescript entitled 'List of Publications Containing References to My Papers', 1961-1995.

See also A.7.

C.47-C.53

BOOKS

1971, 1975, nd

This sub-section contains correspondence, notes and drafts relating to Freedman's two unfinished books.

See also B.133-B.137.

C.47 Bound typescript with illustrative figures entitled 'Fields of Acoustic Radiators', 1971.

C.48 Bound typescript with illustrative figures entitled 'Linear System Theory in Acoustic Radiation and Scattering', 1975.

See also C.24, C.56, C.57, D.51, D.70, E.28-E.31.

C.49-C.53 'An Alternative Representation of Linear Systems', nd.

C.49, C.50 167pp typescript (annotated).

Two folders.

C.51, C.52 173pp typescript (annotated) with illustrative figures.

Two folders.

C.53 'Masters of Diagrams with Text for Book'. Contents of folder so inscribed.

39pp manuscript notes, illustrative figures, graphs and calculations.

Publications

C.54-C.87	DRAFTS AND CORRESPONDENCE	1969-1996
	<p>This sub-section contains correspondence, working notes and drafts relating to the writing and publication of Freedman's papers in various journals.</p> <p>The presentation is chronological.</p>	
C.54	Correspondence and papers <i>re</i> the publication and reprinting of papers published in the <i>Journal of the Acoustic Society of America</i> , 1969-1973.	
C.55	6pp manuscript notes entitled 'Hints on Mathematical Typing', 7 January 1974.	
C.56, C.57	'Working Papers for Linear System Theory.' Contents of folder so inscribed divided into two for ease of reference.	
	See also C.24, C.48, D.51, D.70, E.28-E.31.	
C.56	Correspondence and papers <i>re</i> the publication of Freedman's paper in the <i>Journal of Sound and Vibration</i> , 1966-1977.	
C.57	6pp typescript with illustrative figures entitled 'The Use of Linear System Theory in Acoustic Radiation and Scattering Analysis', 1976.	
C.58	32pp typescript with illustrative figures entitled 'Displacement Field of an Insonified Thick Elastic Plate' by A. Freedman and G. G. Swinerd, nd ca 1980.	
	See also C.29.	
C.59-C.65	'Working Papers for Overlapping Resonances of Acoustic Transmission through an Elastic Plate.' Contents of folder so inscribed divided into seven for ease of reference.	
	See also C.31, C.32.	
C.59	Correspondence, notes and papers <i>re</i> the publication of Freedman's paper, 1980-1981.	

Publications

- C.60-C.63 Various untitled manuscript working papers, notes and calculations, *ca* 1979-1980.
- Four folders.
- C.64 3pp manuscript entitled 'On Transmission Nulls and Related Phenomena in Elastic Plates' with various untitled manuscript notes and calculations, *nd ca* 1979-1980.
- C.65 45pp typescript with illustrative figures entitled 'On the Overlapping Resonances Theory of Acoustic Transmission through an Elastic Plate', *nd ca* 1980.
- C.66-C.68 'Working Papers for the Variation of Poisson's Ratio of Lamb Modes in Free Plate I.' Contents of folder so inscribed divided into three for ease of reference.
- See also C.34.
- C.66 Various untitled manuscript working papers, notes and calculations, *ca* 1985-1990.
- C.67 2pp manuscript entitled 'Notes for Discussion with Redgment', 30 March 1987 with various untitled manuscript notes and calculations, *ca* 1985-1990.
- C.68 34pp typescript entitled 'The Variation with Poisson's Ratio of Lamb Modes in a Free Plate I: General Spectra', *nd ca* 1990.
- C.69-C.71 'Working Papers for the Variation of Poisson's Ratio of Lamb Modes in Free Plate II.' Contents of folder so inscribed divided into three for ease of reference.
- See also C.35.
- C.69, C.70 Various untitled manuscript working papers, notes and calculations, *ca* 1984-1990.
- Two folders.

Publications

- C.71 27pp typescript with illustrative figures entitled 'The Variation with Poisson's Ratio of Lamb Modes in a Free Plate II: Limiting Spectra and Individual Modes', nd ca 1990.
- C.72, C.73 'Working Papers for Acoustic Field of a Pulsed Circular Piston.' Contents of folder so inscribed divided into two for ease of reference.
- See also C.38, E.35-E.37.
- C.72 Various untitled manuscript notes and calculations, ca 1991.
- C.73 53pp typescript with illustrative figures entitled 'Field of Pulsed Circular Acoustic Radiator', nd, latest bibliographical reference 1972.
- C.74-C.78 'Working Papers for Anomalous Behaviour of the A_0 Leaky Lamb Mode.' Contents of folder so inscribed divided into five for ease of reference.
- See also C.39.
- C.74 Correspondence and papers re publication of Freedman's paper in the *Journal of Sound and Vibration*, 1993-1996.
- C.75-C.78 Various untitled manuscript working papers, notes and calculations ca 1993-1994.
- Four folders.
- C.79, C.80 'Working Papers for Comment on the Crossing Points of Lamb Wave Velocity Dispersion Curves.' Contents of folder so inscribed divided into two for ease of reference.
- See also C.41.
- C.79 Correspondence and papers re publication of Freedman's paper in the *Journal of the Acoustical Society of America*, 1994-1995.
- C.80 6pp typescript entitled 'Comment on "On the Crossing Points of Lamb Wave Velocity Dispersion Curves"', nd ca 1995.

Publications

- C.81-C.87 'Effects of Fluid Loading on Lamb Mode Spectra Working Papers.' Contents of folder so inscribed divided into seven for ease of reference.
- See also C.42.
- C.81 Correspondence and papers *re* publication of Freedman's paper in the *Journal of the Acoustical Society of America*, 1995-1996.
- C.82-C.86 Various untitled manuscript working papers, notes and calculations, nd.
- Five folders.
- C.87 22pp typescript entitled 'Effects of Fluid-Loading on Lamb Mode Spectra', nd, latest bibliographical reference 1995.

SECTION D

**ADMIRALTY UNDERWATER WEAPONS
ESTABLISHMENT (AUWE)**

D.1-D.162

This section contains material relating to the period of Freedman's employment by the Admiralty Underwater Weapons Establishment (AUWE). Freedman joined the Underwater Detection Establishment, which later became the Admiralty Underwater Weapons Establishment, in Portland, Dorset in 1940 and stayed until his retirement in 1977. During 1964/1965 Freedman worked as an exchange scientist at the US Navy Electronics Laboratory in San Diego, California, USA. He was appointed AUWE Principal Scientific Officer in 1966. His work included the design of electro-mechanical equipment, theoretical acoustic research, the development of shock and vibration protection and methods of echo and reverberation measurement. During the later part of his career Freedman was also involved in setting up and directing several post-doctoral research fellowships at UK universities.

The material presented here includes formal AUWE reports produced by Freedman for internal circulation, some of Freedman's working papers, a variety of lecture notes and a small amount of AUWE-related correspondence.

D.1-D.51	REPORTS
D.52-D.70	WORKING PAPERS AND DRAFTS
D.71-D.157	LECTURE AND COURSE NOTES
D.158-D.162	CORRESPONDENCE AND PAPERS

AUWE

D.1-D.51

REPORTS

1954-1975

This sub-section contains a sequence of scientific reports written by Freedman for internal publication within the Underwater Detection Establishment (UDE) and, later, the Admiralty Underwater Weapons Establishment (AUWE).

See also A.5.

The presentation is chronological.

- D.1 'A Theoretical Treatment of the Target Strength of Smooth Rigid Cylinders', UDE Pamphlet No. 335, April 1954.
- D.2 'A Theoretical Treatment of Echo Formation From Smooth Rigid Surfaces and its Application to Practical Cases', UDE Pamphlet No. 337, April 1954.
- D.3 'A Note on the Second Harmonic Content of Echoes', UDE Pamphlet No. 407, March 1955.
- D.4 'Target Detectability and the Effect Thereon of Absorbing Coatings for Asdic and Radar Camouflage', unpublished, 1956.
- D.5 'A Note on the Treatment of Scattering From Rigid Surfaces', UDE Pamphlet No. 563, August 1957.
- D.6 'The Image Pulse Concept of Echo Formation', UDE Pamphlet No. 572, May 1958.
- D.7 'Distortion in Acoustic Beams of Steered Linear Arrays', July 1958.
- D.8 'Pictorial Representation of Objects by Asdic and Radar Systems: Part I – The Echo Field Concept', UDE Pamphlet No. 574, August 1958.
- D.9 'The Sound Field of a Rectangular Piston', UDE Pamphlet No. 589, August 1958.

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- D.10 'Some Observations of Echo Structure', UDE Pamphlet No. 601, August 1958.
- D.11 'Survey of Mechanisms of Acoustic Echo Formation', UDE Pamphlet No. 605, August 1958.
- D.12 'Distortion in Acoustic Beams Steered by Means of Continuous Phase Taper', UDE Pamphlet No. 643, January 1949.
- D.13 'The Formation of Acoustic Echoes in Fluids: Part I', AUWE Report 64/62, May 1962.
- D.14 'The Formation of Acoustic Echoes in Fluids: Part II', AUWE Report 65/62, May 1962.
- D.15 'The Formation of Acoustic Echoes in Fluids: Part III', AUWE Report 66/62, May 1962.
- D.16 'The Formation of Acoustic Echoes in Fluids: Part IV', AUWE Report 67/62, May 1962.
- D.17 'Reflection and Transmission of a Plane Acoustic Wave at a Plane Boundary Between Two Fluids', AUWE Technical Note 135/63, October 1963.
- D.18 'Acoustic Interaction Effects in Arrays: A Theoretical Introduction', AUWE Technical Note 138/64, January 1964.
- D.19 'Cavitation in Front of Circular and Rectangular Pistons', AUWE Technical Note 139/64, February 1964.
- D.20 'Some Scaling Laws of Acoustic Array Interaction', AUWE Technical Note 144/64, March 1964.

See also C.20, D.65-D.67, E.38.

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- D.21 'An Examination of the Usefulness of Electrical Interaction Coefficients in Acoustic Array Investigations', June 1965.
- D.22 'Sound Field of a Pulsed Plane Transducer', June 1965.
- D.23 'NEL Transducer Division's Procedure for Transducer Element Analysis and Array Prediction', AUWE Memo No. 1, January 1966.
- D.24 'Sound Field of a Pulsed Plane Transducer', February 1966.
- D.25 'The Image Pulse Concept of Acoustic Scattering and Related Radiation Phenomena', AUWE Publication 13722, March 1966.
- D.26 'The Transient Sound Field of a Plane Array Steered by Time Delay', AUWE A1.2 Memo No. 4, 16 January 1968.
- D.27 'Some Applications of Computers in Analysis and Design of Transducers and Arrays', AUWE A1.2 Memo No. 5, 19 February 1968.
- D.28 'The Acoustic Field of a Plane Array with Regular Gaps', AUWE A1.2 Memo No. 6, 2 April 1968.
- D.29 'On the Determination of the Velocity Distribution over Large, Planar, Acoustic Arrays which are Rectangular and Have Quadrantal Geometrical Symmetry', AUWE A1.2 Memo No. 7, 22 April 1968.
- D.30 'Techniques for Studying Array Bandwidth Limitations Caused by Acoustic Interaction', AUWE A1.2 Memo No. 8, 3 May 1968.
- D.31 'The Sound Field of Pulsed Plane Radiators', AUWE A1.2 Memo No. 9, 3 May 1968.
- D.32 'Bandwidth Comparisons of 72-Element Planar Acoustic Arrays Using Three Different Types of Drive', AUWE A1.2 Memo No. 10, 15 May 1968.

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- D.33 'The Effect of Type of Electrical Drive on the Rocking Forces Experienced by Elements of an Acoustic Array', AUWE A1.2 Memo No. 11, 15 May 1968.
- D.34 'Approximations for the Mutual Radiation Impedance Coefficients between Baffled and Unbaffled Circular Pistons', AUWE Technical Note 320/68, October 1968.
- D.35 'The Sound Field of Pulsed Plane Radiators', AUWE Technical Note 331/69, December 1968.
- D.36 'Brief Survey of Papers on Transient Fields of Acoustic Radiators', AUWE DF2 Memo No. 12, 9 June 1969.
- D.37 'Sound Fields of Plane or Gently Curved Pulsed Radiators', AUWE DF2 Memo No. 13, 23 June 1969.
- D. 38 'Further Considerations Concerning the Determination of the Velocity Distribution Over Large Planar Acoustic Arrays which are Rectangular and Have Geometrical Symmetry', AUWE DF2 Memo No. 14, 24 October 1969.
- D.39 'Bibliography of Papers Relating to Mechanisms of Acoustic Scattering from Single Targets', AUWE DF2 Memo No. 15, 7 January 1970.
- D.40 'On Portraying Shape by a Sonar System', AUWE Publication 24419, January 1970.
- D.41 'Far Field of Pulsed Rectangular Acoustic Radiator', AUWE DF2 Memo No. 16, 31 March 1970.
- D.42 'General Survey of Work Done by the Admiralty Baffle Research Panel – Part 1 of Final Report of Admiralty Baffle Research Panel Under Contract N/CP12/8996/67', AUWE Technical Note 385/70, June 1970.

See also D.53-D.64.

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- D.43 'Sound Field of Pulsed Planar Straight-Edged Radiator', AUWE DF2 Memo No. 17, 2 November 1970.
- D.44 'Bibliography on Plane Wave Acoustic Transmission through and Reflection from Infinite Plates', AUWE DF2 Memo No. 18, 14 February 1973.
- D.45 'The Echoes from Partially Shaded External-Tank Bulkheads in Submarines', AUWE DF2 Memo No. 19, 21 March 1973.
- D.46 'Nearfield of Pulsed Circular Acoustic Radiator', AUWE DF2 Memo No. 20, 26 March 1973.

See also D.68, D.69.
- D.47 'Methods for Determining Velocity Distributions over very large Acoustic Transmitting Arrays', AUWE WR5 Memo No. 1, 18 May 1973.
- D.48 'The Echo Structure of Finite Circular Cylinders', AUWE WR5 Memo No. 2, 16 October 1973.
- D.49 'Notes on a Paper by Liamshev "Diffraction of Sound upon a Thin Bounded Plate in Liquid"', AUWE WR5 Memo No. 5, 9 May 1974.
- D.50 'Field of Pulsed Circular Acoustic Radiator', AUWE Technical Note 531/75, September 1975.
- D.51 'Linear System Theory in Acoustic Radiation and Scattering Analysis', 1975.

See also C.24, C.48, C.56, C.57, D.70, E.28-E.31.

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D.52-D.70

WORKING PAPERS AND DRAFTS

1968-1975

Working papers and drafts relating to Freedman's AUWE scientific reports and papers are presented here.

D.52

'Sound Fields of Steered Projectors Under Pulse Conditions.' Contents of folder so inscribed.

Various untitled manuscript and typescript notes and calculations *re* a report prepared by Freedman and circulated to colleagues within AUWE, 1968.

D.53-D.64

Series of typescript reports and associated draft material *re* the work of the Admiralty Baffle Research Panel, 1970.

The Admiralty Baffle Research Panel was set up in early 1968 to improve understanding of the effects caused by finite baffle rigidity and finite baffle extent and curvature on received and transmitted sound fields and radiated noise levels. The Panel consisted of members of staff from the mathematics departments of Imperial College, London, the University of Dundee and the University of Surrey and was co-ordinated by Freedman.

See also D.42.

D.53

5pp typescript entitled 'General Survey of Work Done by the Admiralty Baffle Research Panel: Part 1 of Final Report of Admiralty Baffle Research Panel Under Contract N/CP12/8996/67', nd *ca* 1970.

D.54

'Part 2 of Final Report of Admiralty Baffle Research Panel Under Contract N/CP12/8996/67.' Contents of folder so inscribed.

15pp typescript entitled 'The Effect of Surface Compliance upon Acoustic Radiation' by D. G. Crighton with illustrative figures and various untitled manuscript notes and calculations, nd *ca* 1970.

D.55

'Part 3 of Final Report of Admiralty Baffle Research Panel Under Contract N/CP12/8996/67.' Contents of folder so inscribed.

9pp typescript entitled 'Baffle Impedance Conditions' by C. H. Ellen with illustrative figure and various untitled manuscript notes, nd *ca* 1970.

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- D.56 'Part 4 of Final Report of Admiralty Baffle Research Panel Under Contract N/CP12/8996/67.' Contents of folder so inscribed.
- 7pp typescript entitled 'The Free Wave Speeds of Plates Fitted with Transducer Elements', by C. H. Ellen with illustrative figure, nd ca 1970.
- D.57 'Part 5 of the Final Report of Admiralty Baffle Research Panel Under Contract N/CP12/8996/67.' Contents of folder so inscribed.
- 10pp typescript entitled 'The Amplification of Hydrodynamic Sound by Turbulence Driven Elements of a Sonar Array' by J. E. ffewes Williams with illustrative figures, nd ca 1970.
- D.58 'Part 6 of the Final Report of Admiralty Baffle Research Panel Under Contract N/CP12/8996/67.' Contents of folder so inscribed.
- 9pp typescript entitled 'Scattering by a Rigid Inertial Screen' by D. S. Jones with various untitled manuscript notes, nd ca 1970.
- D.59 'Part 7 of the Final Report of Admiralty Baffle Research Panel Under Contract N/CP12/8996/67.' Contents of folder so inscribed.
- 24pp typescript entitled 'Scattering by a Screen with Local Inertia' by D. S. Jones with illustrative figure and various untitled manuscript notes, nd ca 1970.
- D.60 'Part 8 of the Final Report of Admiralty Baffle Research Panel Under Contract N/CP12/8996/67.' Contents of folder so inscribed.
- 19pp typescript entitled 'Radiation from a Vibrating Plate Set in a Rigid Baffle' by F. G. Leppington with illustrative figure, nd ca 1970.
- D.61 'Part 9 of the Final Report of Admiralty Baffle Research Panel Under Contract N/CP12/8996/67.' Contents of folder so inscribed.
- 8pp typescript entitled 'Mechanics of Discrete Particle Structures' by M. J. P. Musgrave with illustrative figures, nd ca 1970.
- D.62 'Part 10 of the Final Report of Admiralty Baffle Research Panel Under Contract N/CP12/8996/67.' Contents of folder so inscribed.
- 9pp typescript entitled 'Radiation of Sound from a Piston Set in a Non-Rigid Baffle' by R. Shail with illustrative figures and 5pp manuscript notes, nd ca 1970.

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- D.63 'Part 13 of the Final Report of Admiralty Baffle Research Panel Under Contract N/CP12/8996/67.' Contents of folder so inscribed.
- 10pp typescript entitled 'Circular Piston Oscillating in a Finite Concentric Rigid Circular Baffle' by W. E. Williams with illustrative figures and various untitled manuscript notes and calculations, nd ca 1970.
- D.64 'Part 14 of the Final Report of Admiralty Baffle Research Panel Under Contract N/CP12/8996/67.' Contents of folder so inscribed.
- 5pp typescript entitled 'Radiation Field of a Rectangular Piston Vibrating on the Surface of a Rigid Wedge' by W. E. Williams with illustrative figure and various untitled manuscript notes and calculations, nd ca 1970.
- D.65-D.67 'Scaling Laws of Array Interaction.' Contents of folder so inscribed divided into three for ease of reference.
- See also C. 20, D.20, E.38.
- D.65 Various untitled manuscript and typescript notes and calculations, nd ca 1971.
- D.66 8pp manuscript draft entitled 'Approximate Scaling Laws of Acoustic Array Interaction' nd ca 1971.
- D.67 4 numbered transparencies *re* array interaction, nd ca 1971.
- D.68, D.69 'Working Papers for Nearfield of Pulsed Circular Acoustic Radiator.' Contents of folder so inscribed divided into two for ease of reference.
- See also D.46.
- D.68 Various untitled manuscript notes and calculations, nd ca 1973.
- D.69 63pp typescript entitled 'Nearfield of Pulsed Circular Acoustic Radiator (unfinished draft)' with illustrative figures, nd ca 1973.
- D.70 Bound typescript entitled 'Linear System Theory in Acoustic Radiation and Scattering Analysis (unfinished draft)', 1975.
- See also C.24, C.48, C.56, C.57, D.51, E.28-E.31.

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D.71-D.157	LECTURE AND COURSE NOTES	1944-1974
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D.71-D.135 Lectures and courses attended by Freedman

D.136-D.157 Lectures and courses delivered by Freedman

D.71-D.135	Lectures and courses attended by Freedman	1944-1974
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During the period of his employment at AUWE, Freedman attended a number of lecture courses for AUWE scientific staff at the South Dorset Technical College, Weymouth. Notes distributed by lecturers as well as notes taken by Freedman are presented here.

The presentation is chronological.

D.71	3pp manuscript entitled 'Lectures given by Dr. Emmerson: Electronics Course', listing topics covered by lectures, 1944.
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D.72	2pp manuscript entitled 'Lectures given by Mr. Shaylor: Electronics Course', listing topics covered by lectures, 1949-1950.
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D.73	38pp manuscript notes with list of contents entitled 'Acoustics Lectures given by Mr. Daintith' April-May 1950.
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D.74	57pp manuscript notes with list of contents entitled 'Electro-Acoustic Transducers Lectures by G. Morris', June-November 1950.
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D.75	Circular informing AUWE employees of the availability and content of evening lecture courses at South Dorset Technical College, Weymouth, Dorset, 13 September 1950.
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D.76	81pp manuscript notes with list of contents entitled 'Circuit Noise: Dr. Mole's Lectures', October 1950-January 1951.
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- D.77, D.78 111pp manuscript notes with list of contents entitled 'Maths Lectures given by Mr. Daintith', October 1950-January 1951.
- Two folders.
- D.79, D.80 99pp manuscript notes with list of contents 'Dr. Tucker's Lectures: Non-linear Circuits', October 1950-January 1952.
- Two folders.
- D.81 79pp manuscript notes with list of contents entitled 'Zobel Filters: Lectures by Dr. Mole', October 1951-March 1952
- D.82 2pp manuscript entitled 'Acoustics Lectures given by Dr. Fisher', listing topics covered by lectures, nd ca 1951.
- D.83 Softback notebook inscribed on the front cover 'A. Freedman: Acoustics Lectures by Fisher & Daintith', containing manuscript notes, nd ca 1951. Loose material intercalated.
- D.84 4pp manuscript notes entitled 'Derivation of Wave Equation Allowing for Variations in the Applied Force', nd ca 1951.
- D.85 79pp manuscript notes with list of contents entitled 'Statistics Course: Lectures given by Dr. Mole, Mr. Daintith and Mr. Griffiths', October-December 1953.
- D.86, D.87 105pp manuscript notes with list of contents entitled 'Hydrodynamics Course: Lectures by Mr. Daintith', October 1954-March 1955.
- Two folders.
- D.88 Circular informing AUWE employees of the availability and content of lecture courses at South Dorset Technical College, Weymouth, Dorset, 26 August 1956.

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- D.89, D.90 110pp manuscript notes with list of contents entitled '1) Matrix Analysis of 4 Terminal Active and Passive Electric Networks, 2) Stochastic Processes given by Mr. Nutbourne', October 1957-April 1958.
- Two folders.
- D.91-D.107 'Signal Processing.' Contents folder so inscribed divided into seventeen for ease of reference.
- A course of twelve lectures on the latest sonar signal processing principles was delivered at AUWE by members of staff of the University of Loughborough during 1962-1963.
- D.91 Typescript circulars informing AUWE employees of the availability and content of the lectures, January 1963.
- D.92 4pp typescript entitled 'Talk No. 1: Introduction to Probability'.
- D.93 6pp typescript entitled 'Talk No. 2: Introduction to Probability (continued)'.
- D.94 5pp typescript (annotated) entitled 'Talk No. 3: Introduction to Statistics'.
- D.95 7pp typescript entitled 'Talk No. 4: Specific Probability Functions'.
- D.96 4pp typescript entitled 'Talk No. 5: Application to Time Series'.
- D.97 8pp typescript entitled 'Talk No. 6: Introduction to Decision Theory'.
- D.98 7pp typescript entitled 'Talk No. 7: Space-Time Decision Theory'.
- D.99 7pp typescript entitled 'Talk No. 8: Examples in Space-Time Decision Theory'.
- D.100 3pp typescript entitled 'Talk No. 10: Applications to Sonar Systems'.

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- D.101 3pp typescript entitled 'Talk No. 11: Applications to Sonar Systems (cont.)'.
- D.102 2pp typescript entitled 'Talk No. 12: Applications to Sonar Systems (cont.)'.
- D.103 2pp typescript entitled 'Talk No. 14: Adaptive and Learning Processes'.
- D.104 39pp manuscript notes entitled 'Signal Processing', November 1962-February 1963.
- D.105 4pp manuscript notes and calculations entitled '1st Homework'.
- D.106 3pp manuscript notes and calculations entitled '2nd Homework'.
- D.107 3pp manuscript notes and calculations entitled '3rd Homework'.
- D.108, D.109 81pp manuscript notes with contents list entitled 'Digital Computer Course',
October 1962-March 1963.

Two folders.
- D.110-D.113 'Planar Array Transducer Elements Seminar.' Contents of folder so inscribed
divided into four for ease of reference.
- D.110-D.112 Various typescript and manuscript notes with list of illustrative figures,
calculations and list of attendees, December 1964.

Three folders.
- D.113 24pp manuscript notes entitled 'NEL Seminar on Transducer Array Analysis
and Evaluation', June 1965.
- D.114 Softback notebook inscribed on the front cover 'A. Freedman: Algol Course'
containing manuscript notes entitled 'Elliott Algol Course: Derek Smith', 6
February 1967.

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- D.115-D.124 'Acoustics 1969.' Contents of folder so inscribed divided into ten for ease of reference.
- See also D.125-D.130.
- D.115 Typescript circulars informing AUWE employees of the availability and content of the lectures, February 1969.
- D.116 15pp typescript notes entitled 'Review of Basic Mathematics for Acoustics Theory', 4 February 1969.
- D.117 12pp typescript notes entitled 'Chapter 1: Generalised Functions', nd ca February 1969.
- D.118 4pp typescript notes entitled 'Chapter 2: Convolution Algebra', 7 February 1969.
- D.119 13pp typescript notes entitled 'Chapter 3: Fourier Transforms', 14 March 1969.
- D.120 11pp typescript notes entitled 'Chapter 4: Green's Functions', nd ca 1969.
- D.121 9pp typescript notes entitled 'Chapter 5: Some Important Green's Functions for an Unbound Space', nd ca 1969.
- D.122 16pp typescript notes entitled 'Chapter 6: Development of Relevant Equations', nd ca 1969.
- D.123 26pp typescript notes entitled 'Radiation and Scattering', nd ca 1969.
- D.124 Various untitled manuscript calculations and notes, nd ca 1969.

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- D.125-D.130 'Acoustics 1969.' Contents of folder so inscribed divided into six for ease of reference.
- See also D.115-D.124.
- D.125 10pp manuscript calculations entitled 'Leppington: Review of Basic Mathematics for Acoustics Theory', 4 February 1969.
- D.126-D.129 216pp manuscript notes and calculations entitled 'Acoustics Course', 13 February-5 February 1969.
- Four folders.
- D.130 Various untitled manuscript calculations, 1969-1970.
- D. 131-D.134 'Numerical Analysis Course AUWE 1972/1973.' Contents of folder so inscribed divided into four for ease of reference.
- D.131 Softback bound typescript notes entitled 'Numerical Analysis, Block 1, Parts A and B'.
- D.132 Softback bound typescript notes entitled 'Numerical Analysis, Block 2, Parts A and B'.
- D.133 Softback bound typescript notes entitled 'Numerical Analysis, Block 4, Parts A and B'.
- D.134 Various untitled manuscript calculations and notes, 1972-1973.
- D.135 Typescript circulars informing AUWE employees of the availability and content of lectures on signal processing, March 1973-January 1974.

AUWE

D.136-D.157 Lectures and courses delivered by Freedman 1954-1956, nd

During the period of his employment at AUWE, Freedman wrote and delivered a number of lecture courses attended by his AUWE colleagues. Freedman's lecture notes and notes prepared by Freedman for distribution to attendees are presented here.

A number of undated transparencies which appear to have been used by Freedman to illustrate his lectures are presented at the end of the sequence at D.152-D.157.

D.136, D.137 69pp variously numbered manuscript notes with list of contents and illustrative figures entitled 'Acoustics Course given by A. Freedman', 1954-1955.

Two folders.

D.138 Circular informing AUWE employees of the availability and content of a course of lectures on acoustics to be given by Freedman, 22 August 1955.

D.139 'Acoustics Course: Part I.' Contents of folder so inscribed.

See also D.140-D.142.

72pp manuscript notes with list of contents entitled 'Acoustics Course', 1955-1956.

D.140-D.142 'Acoustics Course: Part II.' Contents of folder so inscribed divided into three for ease of reference.

See also D.139.

135pp variously numbered untitled manuscript notes with illustrative figures, 1955-1956.

D.143-D.147 'Acoustics Course 1955-1956.' Contents of folder so inscribed divided into five for ease of reference.

203pp copy manuscript notes with illustrative figures *re* a course of lectures given at H. M. Underwater Detection Establishment (HMUDE) by Freedman, 1955-1956.

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- D.148 Papers *re* attendance at lectures on acoustics delivered by Freedman, 1955-1956.
- D.149-D.151 'Fields of Acoustics Radiators.' Contents of folder so inscribed divided into three for ease of reference.
- 119pp typescript with list of contents and illustrative figures produced for publication (?) based on lectures given by Freedman to members of the Royal Naval Scientific Service, nd ca 1956.
- Three folders.
- D.152 Numbered series of 21 transparencies, the first entitled 'Model of the Infinite Elastic Plate with Incident Plane Wave, nd.
- D.153 8 unnumbered transparencies, the first entitled 'Time-Resolved Components of Acoustic Field of Rectangular Piston', nd.
- D.154 21 unnumbered transparencies, the first entitled 'Applicability of Kirchhoff Approximation although Conditions are Violated Locally', nd.
- D.155 11 unnumbered transparencies, the first entitled 'Pressure in Farfield of Rectangular Piston', nd.
- D.156 42 variously numbered and titled transparencies, nd.
- D.157 12 variously numbered transparencies, the first entitled 'The FMU Approximation', nd.

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D.158-D.162

CORRESPONDENCE AND PAPERS

1954-1994

A small amount of miscellaneous material relating to various AUWE administrative matters is presented here.

D.158

2pp typescript circular entitled 'Proposed Items of Future Work', 8 December 1954.

D.159

Correspondence and papers *re* various aspects of AUWE business including draft annual reports of work, open day brochure and Freedman's job description, 1966-1977.

D.160

Staff reports, 1973-1977.

D.161

Correspondence and papers *re* Freedman's contact with the AUWE after his retirement in July 1977, covering topics including the possibility of consultancy work, the publication of scientific papers and the AUWE table tennis club, 1977-1994.

D.162

Correspondence and papers *re* Freedman's public service pension, 1976-1982.

SECTION E

VISITS AND CONFERENCES

E.1-E.46

This section contains a chronological sequence of correspondence and papers relating to visits made and conferences attended by Freedman, 1956-1983. It includes material concerning Freedman's study trip to Spain in 1979 which was sponsored by the Royal Society.

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|----------|---|
| E.1, E.2 | Residential Course on Numerical Analysis, Dillington House, Ilminster, Somerset, UK, 14-18 May 1956. |
| E.1 | Programme, list of delegates and post card sent by Freedman to his family. |
| E.2 | 80pp manuscript notes entitled 'Numerical Analysis'. |
| E.3, E.4 | Short Course on Analogue Computers, College of Technology, Bristol, 10-11 April 1959. |
| E.3 | Correspondence and papers <i>re</i> arrangements, programme and 6pp typescript lecture notes. |
| E.4 | 30pp manuscript lecture notes entitled 'Course on Analogue Computers'. |
| E.5, E.6 | Physical Society Acoustics Group Symposium, Imperial College, London, 26 May 1960.

Freedman delivered a lecture entitled 'A New Interpretation of Acoustic Echo Formation'.

See also C.4. |
| E.5 | Programme. |
| E.6 | 7pp typescript with illustrative figures. |

Visits and conferences

- E.7 'Paper prepared for Symposium on Echoing Properties of Missiles to be held at RAE in June 1960.' Contents of folder so inscribed.
- 4pp typescript (annotated) with illustrative figures entitled 'A New Interpretation of High-Frequency Scattering', nd.
- E.8-E.10 Symposium on Sonar Systems, University of Birmingham, 9-12 July 1962.
- Freedman delivered a paper entitled 'The Portrayal of Body Shape by a Sonar System'.
- See also E.12.
- E.8, E.9 Programme including copies of symposium papers and press cutting.
- Two folders.
- E.10 15pp typescript with illustrative figures.
- E.11 68th Meeting of the Acoustical Society of America, Austin, Texas, USA, October 1964.
- 7pp typescript (annotated) with illustrative figures entitled 'Recent Approaches to Echo Structure Theory'.
- See also B.64.
- E.12 22nd Navy Symposium on Underwater Acoustics, Austin Texas, USA, October 1964.
- 9pp typescript entitled 'On Portraying Body Shape by a Sonar System'.
- See also E.8-E.10.
- E.13, E.14 Mechanics Seminar, Washington D.C., Catholic University of America, USA, 25 March 1966.
- Freedman delivered a paper entitled 'The Image Pulse Concept of Acoustic Scattering and Related Radiation Phenomena'.
- E.13 Correspondence *re* arrangements.

Visits and conferences

- E.14 20pp typescript with illustrative figures.
- E.15 British Acoustical Society Meeting, 26 February 1971.

4pp copy typescript entitled 'A Comparison of Geometrical Features as Acoustic Scatterers within a Fluid'.
- E.16 British Acoustical Society Spring Meeting, University of Birmingham, 5-7 April 1971.

Freedman delivered a paper entitled 'Approximate Scaling Laws of Acoustic Array Interaction'.

See also C.20, D.20, D.65-D.67, E.38.

Programme and 6pp copy typescript of Freedman's paper.
- E.17 Softback notebook inscribed on the front cover 'USA visit, 1973' containing notes entitled 'Catholic University, 22 June 1973'.
- E.18-E.23 8th International Congress on Acoustics, London, 24-30 July 1974.
- E.18 Programme and catalogue.
- E.19 List of participants.
- E.20 Two volumes of invited lectures.
- E.21, E.22 Two volumes of contributed papers.

Two folders.
- E.23 Softback notebook inscribed on the front cover '8th Acoustic Congress' containing notes and calculations.

Visits and conferences

- E.24 8th International Congress of Acoustics Satellite Symposium on Underwater Acoustics, University of Birmingham, 1-2 August 1974.
- Proceedings.
- E.25 Softback notebook containing notes and calculations with 5pp intercalated manuscript notes entitled 'Bath University', 20 November 1974-2 November 1978.
- E.26 Softback notebook containing untitled notes and calculations taken during a visit to the USA, 14 April 1975.
- See also E.27.
- E.27 Softback notebook inscribed on the front cover 'USA Visit 1975' containing untitled notes and calculations, 16 April 1975.
- See also E.26.
- E.28-E.31 Institute of Acoustics Underwater Group Conference on Recent Developments in Underwater Acoustics, Admiralty Underwater Weapons Establishment, Portland, Dorset, UK, 31 March-1 April 1976.
- Freedman gave a talk entitled 'The Use of Linear System Theory in Acoustic Radiation and Scattering Analysis'.
- See also C.24, C.48, C.56, C.57, D.51, D.70.
- E.28 Correspondence and papers *re* arrangements.
- E.29 9pp typescript with illustrative figures.
- E.30 16pp typescript with illustrative figures prepared for publication.
- E.31 Published proceedings.

Visits and conferences

- E.32-E.34 Institute of Physics Seminar on Ultrasonic Spectroscopy, City University, London, 27 October 1976.
- Freedman gave a presentation entitled 'Some Basic Echo Formation Theory in the Time and Frequency Domains'.
- E.32 Correspondence and papers *re* arrangements.
- E.33 1p typescript abstract with illustrative figures.
- E.34 Seminar report.
- E.35-E.37 Institute of Acoustics Spring Conference, University of Cambridge, UK, 5-7 April 1978.
- Freedman delivered a lecture entitled 'On the Acoustic Field of a Pulsed Circular Piston.'
- See also C.38, C.72, C.73.
- E.35 Programme, list of participants and correspondence *re* arrangements.
- E.36 6pp typescript with illustrative figures.
- E.37 23 transparencies.
- E.38 Institute of Acoustics Underwater Acoustics Group Meeting on Sound Propagation and Underwater Systems, Imperial College, London, 10-11 April 1978.
- Freedman delivered a lecture entitled 'Approximate Scaling Laws of Acoustic Array Interaction'.
- See also C.20, D.20, D.65-D.67, E.16.
- Extended abstracts.

E.39-E.41	Institute of Acoustics Spring Conference, London, April 1980. Freedman delivered a paper entitled 'An Examination of the Overlapping Resonances Theory of Acoustic Transmission Through an Elastic Plate'.
E.39	14pp untitled manuscript draft with amendments.
E.40	9pp manuscript paper.
E.41	4pp typescript copy extract from proceedings.
E.42, E.43	International Symposium on Underwater Acoustics, Tel Aviv, Israel, 15-18 June 1981. Freedman gave a paper entitled 'Plate Transmittivity Viewed in Terms of Overlapping Resonances'.
E.42	Correspondence and papers <i>re</i> arrangements.
E.43	Programme and list of participants.
E.44, E.45	Visit to the Institute of Acoustics, Madrid, Spain, June 1979. Freedman's study visit was sponsored by the Royal Society.
E.44	Correspondence and papers <i>re</i> arrangement.
E.45	Manuscript draft and typescript (Spanish) with illustrative figures <i>re</i> a seminar on high frequency scattering and radiation of transients at which Freedman presented a paper.
E.46	Institute of Acoustics Underwater Acoustics Group Conference on Acoustics and the Sea-Bed, University of Bath, 6-8 April 1983. List of participants.

SECTION F

SOCIETIES AND ORGANISATIONS

F.1-F.24

This section contains a small amount of material relating to the various societies and organisations with which Freedman was connected. It includes correspondence and papers documenting research projects undertaken by Freedman in collaboration with the Department of Mathematics, University of Dundee.

F.1, F.2	ACOUSTICAL SOCIETY OF AMERICA
F.3	CITY UNIVERSITY, LONDON
F.4	COUNCIL FOR NATIONAL ACADEMIC AWARDS
F.5, F.6	INSTITUTE OF ACOUSTICS
F.7	INSTITUTE OF PHYSICS
F.8-F.14	JOURNAL OF SOUND AND VIBRATION
F.15	THE LEVERHULME TRUST
F.16	NAVAL RESEARCH LABORATORY, WASHINGTON, DC, USA
F.17-F.24	UNIVERSITY OF DUNDEE, SCOTLAND, UK

Societies and organisations

F.1, F.2 ACOUSTICAL SOCIETY OF AMERICA 1959-1973, 1994-2000

Correspondence and papers *re* membership, Freedman's election to fellowship, refereeing papers and submitting papers for publication in the Society's journal.

See also C.3, C.16-C.18, C.21-C.23, C.40-C.42, C.54, C.79, C.81.

Two folders.

F.3 CITY UNIVERSITY, LONDON 1976-1980

Correspondence *re* collaborative research work and an application to the Science Research Council for funding towards a senior research fellowship.

F.4 COUNCIL FOR NATIONAL ACADEMIC AWARDS 1974-1981

Correspondence and papers *re* Freedman's proposed application for the award of the Council's Higher Doctorate.

F.5, F.6 INSTITUTE OF ACOUSTICS 1976-2000

Correspondence and papers *re* membership, meetings and conferences.

Two folders.

F.7 INSTITUTE OF PHYSICS 1978-2000

Correspondence and papers *re* membership.

Societies and organisations

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|------------------|--|------------------|
| F.8-F.14 | JOURNAL OF SOUND AND VIBRATION | 1968-2003 |
| | <p>Correspondence and papers <i>re</i> the submission, revision and publication of Freedman's papers, and Freedman's refereeing of papers by others.</p> <p>See also C.24-C.26, C.28-C.39, C.43, C.56, C.74, G.6, G.7.</p> <p>Seven folders.</p> | |
| F.15 | THE LEVERHULME TRUST | 1978-1979 |
| | <p>Correspondence and papers <i>re</i> Freedman's application for a research fellowship.</p> | |
| F.16 | NAVAL RESEARCH LABORATORY, WASHINGTON, DC, USA | 1970 |
| | <p>3pp typescript copy letters <i>re</i> mutual research interests.</p> | |
| F.17-F.24 | UNIVERSITY OF DUNDEE, SCOTLAND, UK | 1968-1991 |
| F.17-F.22 | <p>Correspondence, papers and reports <i>re</i> the work of Ministry of Defence research fellows in the Department of Mathematics, University of Dundee, 1968-1991.</p> <p>Six folders</p> | |
| F.23 | <p>Softback notebook inscribed on the front cover 'A. Freedman: Visits to Dundee', containing variously titled manuscript notes <i>re</i> research work, administrative arrangements and research fellows, 10 April 1968-13 January 1970.</p> | |
| F.24 | <p>Softback notebook inscribed on the front cover 'Dundee: A. Freedman', containing variously titled manuscript notes <i>re</i> research work, administrative arrangements and research fellows, 9-10 September 1970.</p> | |

SECTION G

CORRESPONDENCE

G.1-G.35

This section contains correspondence covering a range of work and research-related topics including the writing and publication of scientific papers, ongoing scientific work, possible visits in the UK and research trips to the USA and Germany. It also includes correspondence relating to Freedman's collaborative work with the University of Salford on computer programming for physics research.

The correspondence covers the period 1949-2001 and is sorted alphabetically by name of correspondent or corresponding organisation.

G.1	A	1949, 1970-1971
G.2	British Institution of Radio Engineers	1962-1963
G.3	B-C	1965-1989
G.4, G.5	Dabirikhah, Hamid Correspondence and associated papers <i>re</i> shared research interests concerning Plate (Lamb) waves. Two folders.	1991-1996
G.6, G.7	Doak, Philip E Correspondence <i>re</i> the <i>Journal of Sound and Vibration</i> . See also F.8-F.14. Two folders.	1978-1986

Correspondence

G.8, G.9	Duddell, David	1984-1987
	Correspondence <i>re</i> collaborative work on computer programming with the University of Salford.	
	See also B.164, B.165, B.262-B.269, G.11, G.12.	
	Two folders.	
G.10	D-G	1962-1995
G.11, G.12	Hibbert, Jack	1981-1990
	Correspondence <i>re</i> collaborative work on computer programming with the University of Salford.	
	See also B.164, B.165, B.262-B.269, G.8, G.9.	
	Two folders.	
G.13	H	1962-1994
G.14	I-K	1967-1981
G.15	L	1959-1995
G.16, G.17	M	1963-1990
	Two folders.	
G.18	N-Q	1975-1993
G.19	R	1958-1995

Correspondence

G.20-G.32	Swinerd, Graham G	1976-1982
	Correspondence and associated papers <i>re</i> Swinerd's work as a Ministry of Defence research fellow in the Department of Mathematics, University of Dundee.	
	See also F.17-F.24.	
G.20, G.21	1976.	
	Two folders.	
G.22	1977.	
G.23-G.26	1978.	
	Four folders.	
G.27-G.29	1979.	
	Three folders.	
G.30, G.31	1980.	
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G.32	1981-1982.	
G.33	S	1972-1994
G.34	T-W	1960-2001
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