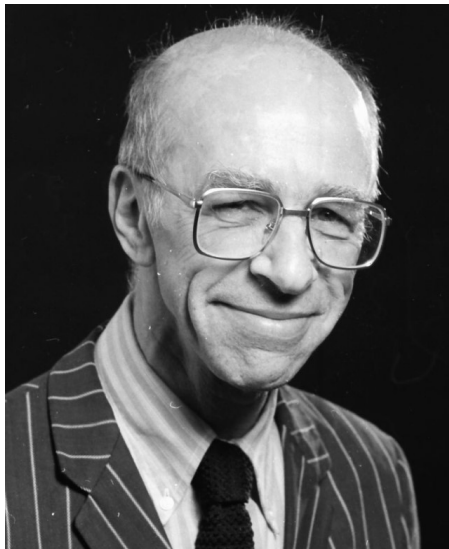Catalogue of the papers and correspondence of

Edward Fraenkel FRS
(1927-2019)

Title:	Catalogue of the papers and correspondence of Edward Fraenkel FRS (1927-2019), mathematician
Compiled by:	Adrian Nardone and Lizzie Richmond
Description level:	Fonds
Date of material:	1934-2020
Extent of material:	65 boxes; 1144 items
Deposited in:	University of Bath Library
Reference code:	GB 1128 Ludwig Edward Fraenkel Collection

NOT ALL THE MATERIAL IN THIS COLLECTION
MAY YET BE AVAILABLE FOR CONSULTATION.
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LIST OF CONTENTS

GENERAL INTRODUCTION

PROVENANCE

The collection was donated to the Library in 2019 by Beryl Fraenkel (née Currie) widow of L.E. Fraenkel.

BRIEF OUTLINE OF THE CAREER OF EDWARD FRAENKEL (1927-2019)

Edward Fraenkel was born Ludwig Eduard Fraenkel in Kiel, Germany, on 28 May 1927, the youngest of the five children of Eduard David Mortier Fraenkel, a prominent classical philologist, and Ruth Fraenkel (née von Velsen). Eduard Fraenkel came from a Jewish background; Ruth von Velsen's background was Lutheran. They were married in a civil ceremony on 2 February 1918. The family did not practice a faith, although the children were raised in a Christian manner. Anti-Semitism laws in Germany severely affected Eduard Fraenkel's career and threatened his family. He took advantage of a scheme organised by the Royal Society to assist persecuted foreign academics and through it was able to secure a post at the University of Oxford in 1934.

Fraenkel attended the Dragon School in Oxford, but was evacuated to Toronto, Canada, in 1940. His host family, the Despards, had misgivings about his German name and sought his parents' permission to address him instead as Edward. Fraenkel completed his schooling at the University of Toronto Schools. He subsequently attended the University of Toronto graduating with a Bachelor of Applied Science in Aeronautical Engineering in 1947. His graduate thesis was on the design of nozzles for supersonic wind tunnels. He did not study for a PhD; he was awarded a Master of Applied Science in 1948.

Fraenkel moved back to the UK in 1948. He worked at the Royal Aircraft Establishment, Farnborough, Hampshire, before taking up an appointment at the University of Glasgow in 1952. After a one-year visiting professorship at California Institute of Technology, USA, Fraenkel took up a position in the Aeronautics Department at Imperial College, London. Between 1958 and 1964 he was based at Imperial College but during this time he began a career progression towards studies in pure mathematics. Later appointments included posts at the University of Cambridge (1964-1974), the Courant Institute of Mathematical Sciences, New York, (1966), California Institute of Technology, (1968), and the University of Sussex, Brighton, first as visiting Professorial Research Fellow (1971,

1973-1974) and then as Professor in the Mathematics Division (1975-1988). Fraenkel officially retired early in 1982 but only with the objective of devoting more time to research. He continued at Sussex before moving to the University of Bath in 1988 where he continued working until 2005.

Fraenkel's research related mainly to problems in fluid mechanics. In the 1960s Fraenkel worked in the field of viscous flows. He was interested in finding a mathematical description of viscous flow separation from a curved boundary. During this time, he also collaborated with Milton Van Dyke on identifying conditions for correct matching of matched asymptotic expansions. In the late 1960s and 1970s he worked with Melvyn S. Berger on the problem of describing the shape of steady vortex rings. He also undertook further studies of fluid separation applying functional analytic methodologies and acting as co-organiser of an important conference on Partial Differential Equations in 1976.

Another of Fraenkel's interests was the study of the electrostatic capacity of bodies and how capacity is affected by the asymmetry of a body. He carried out notable work with his gifted student Charles Amick (1952-1991) on problems of Hill's Spherical Vortex. Over a long period of time Fraenkel made significant contributions to satisfying the long-standing problem of the Stokes conjecture or wave of extreme form, and the problem of wedge entry into water.

Fraenkel received the prestigious Senior Whitehead Prize of the London Mathematical Society in 1989. He was made a Fellow of the Royal Society in 1993.

Fraenkel is survived by his wife Beryl Fraenkel (née Currie) and their two daughters Anna and Juliet.

OVERVIEW OF THE COLLECTION

Section A, Biographical, contains family papers mainly relating to the administration of the estate of Fraenkel's parents and material relating to Fraenkel's education and career honours. The section also contains an unpublished autobiography by Gustav Fraenkel, some family photographs, and a sketch book.

Section B, Teaching, documents Fraenkel's academic teaching during his long career and covers the period from 1955 to 2009. It contains lecture notes, tutorials, exercises and solutions, examination papers, and notes arranged in chronological order. It includes material relating to Fraenkel's supervision of postgraduate students.

Section C, Research, contains extensive material relating to Fraenkel's research activities across a wide range of mathematical topics including Highest Wave, Vortex Rings and Water Entry of a Wedge, and covers the period from 1947 to 2017. The material is arranged, as far as possible, according to the structure imposed upon it by Fraenkel.

Section D, Correspondence, is mainly composed of professional correspondence, but also includes a small amount of material relating to family and friends.

Section E, Publications and Writing, is divided into two parts. The first part is a chronological sequence of off-prints, drafts, notes, and working papers relating to Fraenkel's published outputs between 1950 and 2018. The second, smaller part comprises unpublished material.

Section F, Visits, Conferences and Appointment Diaries, contains a chronological sequence of material generated as a result of Fraenkel's attendance at conferences, seminars and workshops between 1957 and 2017. The section also contains Fraenkel's pocket appointment diaries covering the period from 1954 to 2018.

There is also an index of correspondents.

ACKNOWLEDGEMENTS

We are very grateful to Mrs Fraenkel and to Professor Geoffrey Burton, Professor John Toland and Professor Johannes Zimmer for their assistance in making this material available.

A. Nardone, University of Bath, 2021

SECTION A   **BIOGRAPHICAL**   **A/1-A/7**

This section contains miscellaneous biographical material relating to two generations of the Fraenkel family. It includes correspondence and papers connected with the settlement of the estate of Eduard Fraenkel, a highly regarded classical philologist, and his wife Ruth Fraenkel, who both died in 1970, as well as certificates, memorabilia and photographs relating to Edward Fraenkel and his wife Beryl. It also contains an undated, unpublished autobiography by Fraenkel's brother Gustav Julius Fraenkel.

A/1/1-16	ESTATE OF EDUARD FRAENKEL AND RUTH FRAENKEL (NÉE VON VELSEN)
A/2/1-5	EDUARD FRAENKEL BIOGRAPHICAL
A/3/1-3	ESTATE OF EDWARD FRAENKEL AND BERYL FRAENKEL (NÉE CURRIE)
A/4/1-7	EDUCATION AND CAREER HONOURS
A/5/1-5	MEMORABILIA, ETC.
A/6/1-18	PHOTOGRAPHS
A/7/1	AUTOBIOGRAPHY OF GUSTAV FRAENKEL

| A/1 | **ESTATE OF EDUARD FRAENKEL AND RUTH FRAENKEL (NÉE VON VELSEN)** | **1969-2020** |

This sub-section contains material relating to Edward Fraenkel's parents. Both Eduard and Ruth Fraenkel died in 1970. Their sons, Gustav and Edward Fraenkel, were appointed executors of the family estate.

A/1/1   Letters of condolence from Italian scholars and from Oxford, UK, 1970.

A/1/2   'Condolences from, practical matters raised by, various academies and learned societies and official bodies.' Bundle of correspondence so labelled, 1970-1972.

A/1/3   'Condolences from relatives.' Bundle of correspondence so labelled, 1970.

A/1/4   'Classical scholars [now] neither in Oxford nor Italy: Gerald Toomer, Gordon Williams, Otto Skutsch, R. Pfeiffer, Fritz Jacoby, R. Kilpatrick (Oueens', Ont.) Kenneth Quinn (Toronto) Josef Delz', bundle of correspondence so labelled, 1970.

A/1/5   'Requests from various ladies for documents, letters, etc. [All dealt with-more painstakingly than the ladies deserve.]' Bundle of correspondence so labelled, 1970.

A/1/6   Letters of condolence with some Christmas greeting cards, 1969, 1970.

Includes a photograph of Edith Cooper (née Fraenkel).

A/1/7   Correspondence with Colin William MacLeod and individuals associated with Corpus Christi College, University of Oxford, 1970-1972.

Includes an envelope containing cards and notes relating to books from Eduard Fraenkel's library, 1970, and 8pp calendar of Eduard Fraenkel's papers deposited in the library of Corpus Christi College, 1971.

See also A/1/16 and D/3/34.

A/1/8   Correspondence with Accademia delle Scienze di Torino, Italy, relating to the gold medal associated with the Tommaso Vallauri Prize for Roman Literature, 1974-1977.

A/1/9-A/1/12   'Miscellaneous matters, Father and Mother'. Contents of folder so labelled divided into four for ease of reference, 1970-1973.

Contains correspondence, estate accounts, copies of the wills of Eduard and Ruth Fraenkel, material relating to the sale of Eduard Fraenkel's library and other property, and documents about setting up a trust fund for Andrew Gibson, grandson of Eduard Fraenkel (as specified in Eduard Fraenkel's will).

Four folders.

A/1/13-A/1/15   Correspondence and papers relating to the Andrew Gibson Trust Fund, 1971-1981.

Eduard Fraenkel made provision in his will for the sale of his library and for use of the proceeds towards the education of Andrew Gibson, his grandson.

Three folders.

A/1/16   2pp typescript list of biographical material relating to Eduard Fraenkel transferred to Corpus Christi College, University of Oxford, 2020.

See also A/1/7 and D/3/34.

| A/2 | **EDUARD FRAENKEL BIOGRAPHICAL** | **1969-1971, 2014** |

This sub-section contains a small amount of biographical material relating to Eduard Fraenkel (1888-1970).

A/2/1, A/2/2   A collection of obituaries and associated memorial material written, in English, German and Italian, at the time of Eduard Fraenkel's death or shortly afterwards, 1970-1971.

Two folders.

A/2/3	Box labelled 'David Eduard Mortier Fraenkel University Church of St Mary the Virgin, Oxford, 26 May 1970', containing a quarter inch reel-to-reel (aka open reel) analogue audio tape.
A/2/4	Photocopies of press cuttings relating to the appointment of Eduard Fraenkel to Chair of Latin, Corpus Christi College, University of Oxford, 1934-1935 and of a timeline written by Gus Fraenkel relating to Fraenkel family history, nd c 1991.
A/2/5	Notebook containing notes by Edward Fraenkel relating to a memorial lecture for Eduard Fraenkel, Corpus Christi College, University of Oxford, February 2014.
	See also E/188.

A/3   **ESTATE OF EDWARD FRAENKEL AND BERYL**   **1934, 1978, 1979**
                 FRAENKEL (NÉE CURRIE)

A/3/1-A/3/3	Legal documents and associated papers and correspondence relating to Duck Barn, Telscombe, East Sussex, UK, the home of Edward and Beryl Fraenkel, 1934, 1978, 1979.
	Three folders.

A/4   **EDUCATION AND CAREER HONOURS**   **1947-2020**

This sub-section contains biographical material relating to the education and career of Edward Fraenkel (1927-1919).

A/4/1	Certificate, Bachelor of Applied Science, University of Toronto, Canada, awarded to Edward Fraenkel, 5 June 1947.
A/4/2	Certificate, Master of Applied Science, University of Toronto, Canada, awarded to Edward Fraenkel, 12 November 1948.

A/4/3	Certificate, Master of Arts, University of Cambridge, UK, awarded to Edward Fraenkel, 17 October 1964.
A/4/4	Certificate, London Mathematical Society Senior Whitehead Prize, awarded to Edward Fraenkel, 1989, with a copy of the citation from *Bulletin of the London Mathematical Society*, 22 (94), January 1990.
A/4/5	Certificate, Election as a Fellow of the Royal Society, 3 June 1993.
A/4/6	Correspondence and papers relating to Edward Fraenkel's 90th birthday, April-June 2017.
A/4/7	Offprint of memoir from *Biographical Memoirs of Fellows of the Royal Society 2020*, volume **69**, pp 175-201 by Professor G.R. Burton and Professor J.F. Toland FRS.

A/5   **MEMORABILIA, ETC.**   **1970-2011**

A/5/1	Spiral-bound sketch book labelled 'L.E. Fraenkel', containing pen, pencil and chalk pastel drawings by Fraenkel including of Beryl Fraenkel, and Anna and/or Juliet Fraenkel, and self-portraits, 1962.
A/5/2	'School of Medicine developments', *The Flinders University of South Australia Newsletter*, 2 (1), April 1970.
	The article includes a black and white photographic portrait of Gus Fraenkel and relates to his appointment as Chairman of Flinders University School of Medicine.
A/5/3	'Professor Sir Hugh Cairns 1896-1952', Professor Gus Fraenkel, *Report of the Nuffield Department of Surgery, University of Oxford*, 1987.
	Includes an intercalated black and white photographic portrait of Gus Fraenkel, 1991.

A/5/4	Certificate with covering letter, Bachelor of Arts (Honours), The Open University, awarded to Beryl Jaqueline Margaret Fraenkel, 31 December 1996.
A/5/5	Certificate of Appreciation, Royal British Legion, awarded to Edward Fraenkel, 2011.

A/6	**PHOTOGRAPHS**	**1946-*c* 2001**

A/6/1	Black and white photograph (mounted) showing an unidentified woman on a garden terrace, nd.
A/6/2	Black and white photographic group portrait (mounted) of the University of Toronto Athletic Association Intramural Sports Committee, 1946-1947.
A/6/3	Black and white photographic portrait (mounted) of an unidentified man wearing an academic gown, nd *c* 1946-1948.
A/6/4	Black and white photographic portrait (mounted) of an unidentified man wearing an academic gown, nd *c* 1946-1948.
A/6/5	Black and white photographic portrait (mounted) of an unidentified man wearing an academic gown, nd *c* 1946-1948.
A/6/6	Black and white photographic group portrait (mounted) of IV Year Aeronautical Engineering Class, 1946-1947.
A/6/7-A/6/10	'L.E. and Beryl, Farnborough & wedding. Elizabeth Ward's letter to parents about wedding'. Contents of envelope so labelled, c 1948-1952, 1954.
A/6/7	First page of manuscript letter from Elizabeth Ward giving an account of the wedding of Edward and Beryl Fraenkel, 26 January 1954.

A/6/8	Three black and white photographs showing Fraenkel, possibly taken at Royal Aircraft Establishment Farnborough, Hampshire, UK, nd *c* 1948-1952.
A/6/9	Five black and white photographs of Edward and Beryl Fraenkel's wedding, January 1954.
A/6/10	Black and white photograph showing Edward and Beryl Fraenkel, nd *c* 1950s.
A/6/11	Black and white photographic contact sheet (48 thumbnail images) featuring Anna Fraenkel and her mother Beryl Fraenkel, nd *c* March 1956.
A/6/12	Seven black and white photographs showing Gustav Fraenkel with Edward, Beryl and Anna Fraenkel walking in the countryside, Pasadena, California, USA, February 1958.
A/6/13	Three black and white and one colour photographic portraits of Juliet 'Tod' Fraenkel and Anna Fraenkel, *c* 1963.
A/6/14	Five colour photographs of the wedding of Charles and Joanna Amick (née Hawthorne), 4 August 1979.
A/6/15	Colour photograph of Edward Fraenkel skiing/skating on grass, nd *c* 1980s.
A/6/16	Colour photograph of Gustav Fraenkel, nd *c* May 1994.
A/6/17	Colour photograph of Edward Fraenkel seated in a chair with a book, nd *c* 2001.
A/6/18	Colour photograph of Beryl Fraenkel on a boat, nd *c* 2000s.

A/7   **AUTOBIOGRAPHY OF GUSTAV FRAENKEL**   **1998**

Gustav Julius Fraenkel (1919-1998), Fraenkel's brother, was the eldest of the five Fraenkel children. Gustav pursued a medical career and made his life in Australia.

A/7/1   148pp typescript (?incomplete) entitled 'Fraenkel Family History' by G. J. Fraenkel, 1998.

SECTION B   TEACHING   B/1-B/8

This section contains material documenting Fraenkel's academic teaching over six decades in both the UK and the USA. It is composed of lectures, tutorials, exercises and solutions, examination papers, and associated working notes relating to a broad range of mathematical subjects. It covers PhD supervision as well as undergraduate and postgraduate taught courses.

The material was arranged by Fraenkel according to the educational institution at which he was employed, and within each institutional grouping, ordered by teaching topic. This arrangement has been preserved.

B/1/1-14   IMPERIAL COLLEGE LONDON: DEPARTMENT OF AERONAUTICS

B/2/1-4   CALIFORNIA INSTITUTE OF TECHNOLOGY

B/3/1-18   IMPERIAL COLLEGE LONDON: DEPARTMENT OF MATHEMATICS

B/4/1-71   UNIVERSITY OF CAMBRIDGE

B/5/1-42   UNIVERSITY OF SUSSEX

B/6/1-3   UNIVERSITY OF MINNESOTA

B/7/1-50   UNIVERSITY OF BATH

B/8/1-5   UNIVERSITY COLLEGE LONDON

B/1   **IMPERIAL COLLEGE LONDON: DEPARTMENT   1955-1964, 1981, 1990
OF AERONAUTICS**

Fraenkel was a lecturer in the Department of Aeronautics at Imperial College from 1953 until 1957. After a year at California Institute of Technology, USA, he returned to Imperial College as a reader in the Department of Aeronautics from 1958 to 1961.

The material in this sub-section comprises examination papers, teaching and study notes, solutions and lectures relating to Fraenkel's teaching.

See also B/3.

B/1/1   Typescript examination papers and manuscript solutions relating to aerodynamics and potential flow, 1955-1961.

B/1/2, B/1/3   'History of Hydrodynamics and [1981 notes] of Some Mathematics'. Contents of folder so labelled divided into two for ease of reference, 1960, 1981-1990.

Fraenkel returned to these notes and adapted them for his inaugural lecture at the University of Bath in May 1990.

Two folders.

B/1/4-B/1/14   Lectures, problems and associated papers relating to aerodynamics, potential, and high-speed flow, 1960-1961.

B/1/4   '3rd Year Potential Flow I'. Contents of folder so labelled, 1960-1961.

B/1/5   '3rd Year Potential Flow II'. Contents of folder so labelled, 1960-1961.

B/1/6   '3rd Year Aerodynamics Problems 1960-1961'. Contents of folder so labelled, 1960-1961.

B/1/7   Third year boundary layer lectures and papers, 1961.

B/1/8   'High Speed Flow Course I'. Contents of folder so labelled, 1961-1962.

Includes 19pp typescript entitled 'Some Notes on Vectors and Cartesian Tensors'.

B/1/9   'High Speed Flow Course II'. Contents of folder so labelled, 1960-1961.

B/1/10   'High Speed Flow Lectures II'. Contents of folder so labelled, nd.

B/1/11   'High Speed Flow Course III.' Contents of folder so labelled, nd.

B/1/12   'High Speed Flow Lectures III'. Contents of folder so labelled, nd.

B/1/13   'Postgraduate lectures on High Speed Flow'. Contents of folder so labelled, nd.

B/1/14   'Problems for High Speed Flow Course'. Contents of folder so labelled, nd.

B/2   **CALIFORNIA INSTITUTE OF TECHNOLOGY   1957-1958**

Between 1957 and 1958 Fraenkel was a visiting assistant professor at California Institute of Technology, Pasadena, California, USA. This sub-section contains lectures, teaching notes, examination papers and solutions relating to his work during this time.

B/2/1   'Complex Variable Lectures (Caltech 116a)'. Contents of folder so labelled, nd *c* 1957.

B/2/2   'Eng'g Mathematics I (2nd Term at Cal. Tech.)'. Contents of folder so labelled, nd *c* 1957-1958.

B/2/3	'Engineering Mathematics II (3rd term at Cal. Tech.)'. Contents of folder so labelled, nd *c* 1957-1958.
B/2/4	'Cal. Tech. 1958: Various examinations.' Contents of folder so labelled, 1958.

B/3 **IMPERIAL COLLEGE LONDON: DEPARTMENT OF MATHEMATICS** **1961-1967, 1987**

Fraenkel was a reader in the Department of Mathematics at Imperial College from 1961 to 1964. This sub-section contains lectures, examination papers, solutions and teaching notes, and associated papers relating to his academic work during this time.

See also B/1.

B/3/1	BSc Special Examination (Mathematics) notes, examination papers and solutions, 1961-1964.
B/3/2	BSc (Engineering) Mathematics notes, examination papers and solutions, 1962-1964.
B/3/3	Engineering Mathematics II CMI: 1st term lectures, nd *c* 1962-1963.
B/3/4	Engineering Mathematics II CMI: 2nd and 3rd term lectures, nd *c* 1963.
B/3/5	Engineering Mathematics II CMI: Exercises, 1962-1963.
B/3/6, B/3/7	'Viscous flow M31'. Contents of folder so labelled divided into two for ease of reference. Lecture notes, 1963. Two folders.

B/3/8	'JH solution for: M31B Viscous Flow'. Contents of folder so labelled. 1p typescript entitled 'Jeffrey-Hamel solutions', nd *c* 1963.
B/3/9	'M31: Viscous Flow Problems'. Contents of folder so labelled, nd *c* 1963.
B/3/10	'M10: Mechanics Problems'. Contents of folder so labelled, nd *c* 1963.
B/3/11	'M16: Dynamics Exercises'. Contents of folder so labelled, 1960.
B/3/12	'M17: Elasticity Exercises'. Contents of folder so labelled, nd *c* 1963.
B/3/13, B/3/14	Papers relating to Fraenkel's supervision of Nicholas S. Clarke's PhD thesis entitled 'Asymptotic solutions displaying the effects of gravity and viscosity on certain flows with free boundaries' nd *c* 1963-1965. Two folders.
B/3/15, B/3/16	Papers relating to Fraenkel's supervision of Peter M. Eagles' PhD thesis entitled 'Numerical methods and composite series in the Orr-Sommerfeld problem for symmetric channel flow', 1964-1967, 1987. Two folders.
B/3/17, B/3/18	Teaching notes relating to Fraenkel's teaching on the publication *Principles and Techniques of Applied Mathematics* by Bernard Friedman, 1956, with notes on the textbooks *Calculus I*, 1961 and *Calculus II*, 1962 by Tom Apostol. Two folders.

B/4	**UNIVERSITY OF CAMBRIDGE**	**1962-1976**

Fraenkel was a lecturer in the Department of Applied Mathematics and Theoretical Physics at the University of Cambridge from 1964 until 1975. This sub-section contains lectures, exercises, solutions, and other teaching notes and papers relating to his work in this role.

Fraenkel divided the material into three groups, the first comprising Tripos I and II (B/4/1-B/4/38), the second comprising Tripos III (B/4/39-B/4/58) and the third comprising graduate teaching and supervision (B/4/59-B/4/71). The original order has been preserved.

B/4/1-B/4/38   Manuscript and typescript lectures, notes, exercises, problems and solutions, examination papers, and associated teaching papers relating to Tripos I and II, 1962-1975.

B/4/1   'Mathematical Methods and Elasticity: Lectures'. Contents of folder so labelled, nd *c* 1964.

B/4/2   'Mathematical Methods and Elasticity: Exercises, etc.' Contents of folder so labelled, 1964-1965.

B/4/3, B/4/4   'Partial Differential Equations of Physics: Notes and Exercises.' Contents of folder so labelled divided into two for ease of reference, 1965-1967.

Two folders.

B/4/5   'Partial Differential Equations of Physics: Exercises, etc.' Contents of folder so labelled, 1971-1973, 1975.

B/4/6   'Partial Differential Equations of Physics: Lectures.' Contents of folder so labelled, 1971-1973, 1975.

B/4/7   'Ordinary Differential Equations.' Contents of folders so labelled, 1967-1969.

B/4/8   'Ordinary Differential Equations.' Contents of folders so labelled, 1967.

B/4/9   'Non-Linear Differential Equations Part II 1971: Solutions with Marking Scheme'. Contents of folder so labelled, 1971.

B/4/10   'Non-Linear Differential Equations Part II 1971: Solutions.' Contents of folder so labelled,1971.

B/4/11   'Dynamics and Fluid Dynamics summaries including Quantum Theory.' Contents of folder so labelled, nd *c* 1964-1965.

B/4/12   'Fluid Dynamics I: Exercises and Supplementary Notes.' Contents of folder so labelled, 1971.

B/4/13   'Fluid Dynamics I: Notes Rejected.' Contents of folder so labelled, 1971, 1972.

B/4/14   'Fluid Dynamics I.' Contents of folder so labelled, 1972-1974.

B/4/15   'Potential Theory 1975.' Contents of folder so labelled, 1975.

B/4/16   'Potential Theory 1975: Exercise, subsidiary scribbles, etc.' Contents of folder so labelled, 1975.

B/4/17   Set of three typescript reports relating to examination questions and how students answered with them, 1971.

B/4/18, B/4/19   'Math Part 1A: Solutions.' Contents of folder so labelled divided into two for ease of reference, 1962-1966.

Two folders.

B/4/20 — 'Mechanics of Elastic Media: Duplicated notes, solutions to some exercises, etc.' Contents of folder so labelled, 1971.

Includes typescript notes entitled 'Part IB Mechanics of Elastic Media' by R. Hill.

B/4/21 — 'GKB: Examples part IB - Introduction to Analytical Fluid Dynamics.' Contents of folder so labelled, 1965.

Includes examples by G.K. Batchelor.

B/4/22 — 'Waves: Fluid dynamics II.' Contents of folder so labelled, 1969-1971.

Includes exercises by M.J. Lighthill.

B/4/23 — 'Quantum Mechanics Exercises: Part IB.' Contents of folder so labelled, 1968.

Includes exercises by J. Goldstone, A.J. Macfarlane and H.K. Moffatt.

B/4/24 — 'Dynamics Exercises (Part IB).' Contents of folder so labelled, 1965-1967.

Includes exercises by R. Burridge and H.K. Moffatt.

B/4/25 — 'Methods of Mathematical Physics III (Part IB): Exercises.' Contents of folder so labelled, 1967.

Includes exercises by P.C. Clemmow, E.R. Lapwood and N.O. Weiss.

B/4/26 — 'Prelim: Solutions.' Contents of folder so labelled, 1963-1965.

B/4/27 — 'Math. Part IB: Solutions.' Contents of folder so labelled, 1966-1967.

B/4/28 — 'Examining Part II: Solutions.' Contents of folder so labelled, 1970.

B/4/29 — 'Math. Part II: Solutions.' Contents of folder so labelled, 1963-1967.

B/4/30 — 'Non-Linear Differential Equations: Notes and solutions.' Contents of folder so labelled, 1970-1971.

Includes manuscript notes and exercises (copy) by H.P.F. Swinnerton-Dyer.

B/4/31-B/4/38 — Examination papers (annotated), 1962-1975.

B/4/31 — The Mathematical Tripos, Part I, 1962, 1963,1964.

B/4/32 — The Mathematical Tripos, Part IA, 1965, 1966, 1967, 1968, 1969, 1970, 1971, 1972, 1973, 1974.

B/4/33 — The Mathematical Tripos, Part 1B, 1966, 1967, 1971, 1972, 1973, 1974.

B/4/34 — The Mathematical Tripos, Part II, 1962, 1963, 1964, 1965, 1966, 1967, 1968, 1969.

B/4/35 — The Mathematical Tripos, Part II, 1970, 1971, 1972, 1973, 1974, 1975.

B/4/36 — The Mathematical Tripos, Part III, 1964-1970.

B/4/37 — The Mathematical Tripos, Part II 1975.

B/4/38 — Manuscript background notes relating to the drafting of 1975 examination papers.

B/4/39-B/4/58	Manuscript and typescript lectures, notes, exercises, problems and solutions, examination papers, and associated teaching papers relating to Tripos III, 1965-1974.
B/4/39, B/4/40	'Perturbation Methods in Fluid Mechanics.' Contents of folder so labelled divided into two for ease of reference, 1965-1969. Two folders.
B/4/41	'Perturbation Methods, Michaelmas.' Contents of folder so labelled, 1974.
B/4/42	'Perturbation Methods in Fluid Mechanics: Exercises.' Contents of folder so labelled, 1966-1969.
B/4/43	'Perturbation Methods: Exercises and Supplementary Notes.' Contents of folder so labelled, 1974.
B/4/44	'Perturbation Methods in Fluid Mechanics: Part III Examination Papers.' Contents of folder so labelled, 1965-1974.
B/4/45	'Preparation for Course on Navier-Stokes Equation.' Contents of folder so labelled, 1968.
B/4/46	'Some Mathematical Aspects of the Navier-Stokes Equation.' Contents of folder so labelled, 1968.
B/4/47	'Ladyzhenskaya, Hopf: Preparation for Courses: Navier-Stokes Equations.' Contents of folder so labelled, 1968.
B/4/48, B/4/49	'Applications of Functional Analysis to Continuum Mechanics.' Contents of folder so labelled divided into two for ease of reference, 1969. Two folders.
B/4/50, B/4/51	'Applications of Functional Analysis to Continuum Mechanics: Rough Notes.' Contents of folder so labelled divided into two for ease of reference, 1969. Two folders.
B/4/52	'AFACM (Applications of Functional Analysis to Continuum Mechanics): Exercises.' Contents of folder so labelled, 1970-1972.
B/4/53	'Part III: Applications of Functional Analysis to Continuum Mechanics Exam.' Contents of folder so labelled, 1971, 1972.
B/4/54, B/4/55	'Fixed Point Theorems and their Application.' Contents of folder so labelled divided into two for ease of reference, 1973. Two folders.
B/4/56, B/4/57	'Lectures: Fixed Point Theorems and their Application.' Contents of folder so labelled divided into two for ease of reference, 1973. Two folders.
B/4/58	'Fixed Point Theorems and their Application: Rough Notes.' Contents of folder so labelled, 1973.
B/4/59-B/4/71	Manuscript notes, exercises, problems and solutions, correspondence and associated papers relating to graduate teaching and supervision, 1966-1976. The material is arranged alphabetically by surname of student.
B/4/59-B/4/61	Amick, Charles J., 1975, 1976. Amick's PhD thesis was entitled 'Some Contributions to Navier-Stokes Theory and to Related Techniques of Analysis', University of Cambridge, 1977. See also D/2/2 and D/3/2-D/3/9. Three folders.

B/4/62-B/4/65   Keady, Grant, 1970-1972.

Keady's PhD thesis was entitled 'Some Problems of Gravity Waves and Free Streamlines', University of Cambridge, 1972.

Four folders.

B/4/66   Lloyd, Noel G., 1971.

Noel Lloyd was a student of Peter Swinnerton-Dyer.

Lloyd's PhD thesis was entitled 'Periodic Solutions of Differential Equations', University of Cambridge, 1972.

B/4/67, B/4/68   Sheer, Andrew F., 1970.

Includes a copy of Sheer's paper 'A uniformly asymptotic solution for flow round thin sharp-edged aerofoils', Mathematical Proceedings of the Cambridge Philosophical Society, 70(1), pp135-155, 1971.

Two folders.

B/4/69, B/4/70   Tillett, Paul, 1966.

Tillett's PhD thesis was entitled '1. Free Liquid Jets at High Reynolds Numbers; 2. Slow Flow Past Slender Bodies', Cambridge, 1969.

Two folders.

B/4/71   De Villiers, Johan M., 1973.

De Villiers' PhD thesis was entitled 'Two Rigorous Applications of the Method of Matched Asymptotic Expansions', University of Cambridge, 1974.

B/5   **UNIVERSITY OF SUSSEX**   **1978-2006**

Fraenkel was a visiting professorial research fellow at the University of Sussex in 1971 and then again from 1973 to 1974. He returned to the University as a Professor in 1975, staying in the post until 1988. This sub-section contains lectures, exercises, solutions, examination papers and associated notes relating to his teaching and postgraduate supervision work during this time.

B/5/1-B/5/12   Functional Analysis I and II.

B/5/1, B/5/2   'MSc Course: Functional Analysis I.' Contents of folder so labelled divided into two for ease of reference, 1978-1980.

Two folders.

B/5/3   'Functional Analysis I: Exercises and Miscellaneous.' Content of folder so labelled, 1978-1982.

B/5/4   'Notes for Functional Analysis I (discarded after 1978).' Contents of folder so labelled, 1978.

B/5/5   'MSc Course: Functional Analysis I: Exercise Sheets.' Contents of folder so labelled, 1980, 1983.

B/5/6   'MSc Functional Analysis II.' Contents of folders so labelled, 1983.

B/5/7   'Functional Analysis II: Exercises Sheets.' Contents of folders so labelled, 1983.

B/5/8   'Functional Analysis II: Lectures.' Contents of folder so labelled, 1984.

B/5/9, B/5/10   'Functional Analysis I and II: Exercises, Examples.' Contents of folder so labelled divided into two for ease of reference, 1977-1984.

Two folders.

B/5/11	'Functional Analysis I and II: Solutions to Exercises and Examination Questions.' Contents of folder so labelled, 1979-1983 [2006].
B/5/12	Special examination questions with associated correspondence and notes, 1982.
B/5/13-16	Potential Theory.
B/5/13	'Potential Theory: Term 6.' Contents of folder so labelled, 1979.
B/5/14	'Potential Theory: Term 6.' Contents of folder so labelled, 1982.
B/5/15	1p typescript syllabus entitled 'Potential Theory', 1981.
B/5/16	'Potential Theory: Exercises and Supplementary Notes.' Contents of folder so labelled, 1982.
B/5/17, B/5/18	Differential Equations.
B/5/17	'Ordinary Differential Equations: Tutorials.' Contents of folder so labelled, 1981-1985.
B/5/18	'Ordinary Differential Equations: Tutorials.' Contents of folder so labelled, 1985.
B/5/19, B/5/20	Calculus.
B/5/19	'Calculus II: Tutorials.' Contents of folder so labelled, 1980-1982.
B/5/20	'Calculus III: Tutorials.' Contents of folders so labelled, 1979-1981.

B/5/21-B/5/23	Elliptic Equations.
B/5/21	'MSc Course: Elliptic Equations I.' Contents of folder so labelled, 1982.
B/5/22	'Elliptic Equations I: Exercise Sheets.' Contents of folder so labelled, 1979-1982.
B/5/23	'Elliptic Equations I: Supplementary Notes, Solutions to Exercises.' Contents of folder so labelled, 1982.
B/5/24	'Inviscid Rotational Flow: Lectures.' Contents of folders so labelled, 1984.
B/5/25, B/5/26	Complex Analysis.
B/5/25	'Analysis II and Algebra II: Tutorials.' Contents of folders so labelled, 1978, 1979.
B/5/26	'Complex Analysis (Analysis IV): Exercises.' Contents of folder so labelled, 1984-1987.
B/5/27-B/5/29	Functions of Several Variables.
B/5/27	'Functions of Several Variables: Term 6.' Contents of folder so labelled, 1987, 1988.
B/5/28	'Functions of Several Variables: Tutorials.' Contents of folder so labelled, 1987-1989.
B/5/29	'Functions of Several Variables: Exercises Sheets, Solutions.' Contents of folder so labelled, 1987, 1988.

B/5/30, B/5/31	BSc finals examination papers, 1976-1981.
	Two folders.

| B/5/32 | BSc finals examination papers, 1982. |

| B/5/33 | BSc finals examination papers, 1984. |

| B/5/34 | BSc finals examination papers, 1985. |

| B/5/35 | BSc finals examination papers, 1986. |

| B/5/36 | MSc examination papers, 1979 1980. |

| B/5/37-B/5/41 | Correspondence and papers relating to Fraenkel's supervision of candidates for higher degrees, 1970-1989. |

B/5/37, B/5/38	Adebiyi, Adebimpe, 1976.
	Adebiyi's DPhil thesis was entitled 'On the Motion of Thin Vortex Tubes', University of Sussex, 1978.
	See also D/2/1.
	Two folders.

B/5/39	Norbury, John, 1970-1971.
	Norbury's PhD thesis was entitled 'A Family of Steady Vortex Rings', University of Sussex, 1971.

| B/5/40 | Supervision of Awil Ali Abdi, candidate for Master of Science, 1980-1981. |

| B/5/41 | Supervision of Mr. Tadié, candidate for MPhil, 1985-1989. |

| B/5/42 | Miscellaneous papers from the desk and the noticeboard in Fraenkel's office at the University of Sussex. |

B/6	**UNIVERSITY OF MINNESOTA**	**1986**
	This sub-section contains material relating to Fraenkel's six month visit to the School of Mathematics at the University of Minnesota, Minneapolis, USA, in 1986.

| B/6/1 | Lecture notes with index page, references, and exercises relating to weak derivatives and Sobolev spaces, 1986. |

| B/6/2 | Supplementary notes relating to lectures on weak derivatives and Sobolev spaces, 1986. |

| B/6/3 | Miscellaneous papers from Fraenkel's desk in Murphy Hall on the University of Minnesota campus, 1986. |

B/7	**UNIVERSITY OF BATH**	**1988-2006**
	Fraenkel was a Professor in the Department of Mathematical Sciences at the University of Bath from 1988 until 2005. The material in this sub-section relates to his teaching activities during this time. It comprises lectures, exercises and solutions, examination questions, notes, and associated background papers.

B/7/1, B/7/2	Illustrative materials relating to Fraenkel's inaugural lecture, May 1990.
	Two folders.

B/7/3-B/3/23	Functional Analysis.
B/7/3	'G.R. Burton - Functional Analysis: Notes and Exercises.' Contents of folder so labelled, 1989-1990. Copy set of notes on functional analysis by Professor Geoffrey Burton.
B/7/4	3pp manuscript examination questions on functional analysis with solutions, 1992-1994.
B/7/5	'Functional Analysis: Exercises etc.' Contents of folder so labelled, 1992.
B/7/6	'Functional Analysis: Notation and Conventions'. Contents of folder so labelled, 1992-1994.
B/7/7	'Functional Analysis: Solutions to Exercises.' Contents of folder so labelled, 1992-1993.
B/7/8	'Functional Analysis: Lecture Notes.' Contents of folder so labelled, 1993.
B/7/9	'Functional Analysis: Background.' Contents of folder so labelled, 1993.
B/7/10	'Functional Analysis: Odds and Ends.' Contents of folder so inscribed, 1993.
B/7/11	'Functional Analysis (M22).' Contents of folder so labelled, 1994.
B/7/12	'M22 Functional Analysis: Solutions to Exercise.' Contents of folders o labelled, 1994.
B/7/13	'Functional Analysis (M22).' Contents of folder so labelled, 1995.

B/7/14	'Functional Analysis: Exercises and Additional Notes.' Contents of folder so labelled, 1995.
B/7/15	'Functional Analysis M22: Elementary Things to be Included …' Contents of envelope so labelled, 1995.
B/7/16	Reports relating to student/lecturer performance on the functional analysis course sent by Fraenkel to the Director of Studies, 1999-2002.
B/7/17	Solutions to functional analysis exercises, February 2000.
B/7/18	Background papers and notes relating to functional analysis examinations, 2000.
B/7/19	Functional analysis exercises and solutions, 1999-2001.
B/7/20	Background papers and notes relating to functional analysis examinations, 2001.
B/7/21	Background papers and notes relating to functional analysis examinations, 2002.
B/7/22	Functional analysis exercises and solutions, March 2002.
B/7/23	Background papers and notes relating to functional analysis examinations, 2003.
B/7/24, B/725	Spectral Theory and Fourier Series.
B/7/24	Spectral theory and Fourier series exercises and solutions, 1994.

B/7/25	Spectral theory and Fourier series exercises and solutions, 1995.
B/7/26-B/7/36	Real and Abstract Analysis.
B/7/26	Real and abstract analysis exercises and solutions, 1996.
B/7/27	Real and abstract analysis lecture notes, 1996.
B/7/28	Real and abstract analysis exercises and solutions relating to Hilbert space and Baire's theorem, 1996-1997.
B/7/29	Background papers and notes relating to real and abstract analysis examinations, 1997.
B/7/30	Background papers and notes relating to real and abstract analysis examinations, 1997-1998.
B/7/31, B/7/32	Real and abstract analysis lecture notes, 1997. Two folders.
B/7/33	Real and abstract analysis exercises and solutions, 1998.
B/7/34	Real and abstract analysis lectures, 1999.
B/7/35	Real and abstract analysis exercises and solutions (master copes), 1997-1998.
B/7/36	Background papers and notes relating to real and abstract analysis examinations, 1998-1999.

B/7/37-B/7/43	Symmetry and the Maximum Principle.
B/7/37-B/7/39	Symmetry and the maximum principle lecture notes, 1989, 1991, 1992. Three folders.
B/7/40	Notes, exercises and supplementary lecture pages marked 'discarded' by Fraenkel relating to symmetry and the maximum principle, 1989.
B/7/41	Symmetry and the maximum principle examination questions and solutions, 1990.
B/7/42	Symmetry and the maximum principle examination questions and solutions, 1991.
B/7/43	Symmetry and the maximum principle examination questions and solutions, 1992.
B/7/44, B/7/45	Basic Theory of Elliptic Partial Differential Equations.
B/7/44	Spiral bound notebook containing notes relating to basic theory of elliptic partial differential equations course, 2002.
B/7/45	Basic theory of elliptic partial differential equations lectures and exercises, 2002.
B/7/46-B/7/48	Topological Degree and Fixed-Point Theorems.
B/7/46	Course papers relating to topological degree and fixed-point theorems including exercises, solutions and supplementary lecture pages, and plan of assessment, 2006.
B/7/47	Topological degree and fixed-point theorems lectures, 2006

B/7/48	Spiral bound notebook containing notes relating to topological degree and fixed-point theorems, 2006.

B/7/49, B/7/50	Sobolov Spaces.

B/7/49	Sobolov spaces lectures, 2006.

B/7/50	Sobolov spaces exercises and solutions, 2006.

B/8	**UNIVERSITY COLLEGE LONDON**	**2008-2009**

	Fraenkel was employed as a part-time lecturer at University College London between 2008 and 2009 and taught a course entitled 'Introduction to Second-Order Elliptic Partial Differential Equations'. The lectures, teaching notes, exercises and solutions in this sub-section relate to work undertaken by Fraenkel in this role.

B/8/1	Spiral bound notebook containing course notes relating to elliptic partial differential equations, 2008.

B/8/2	Elliptic partial differential equations course outline and lectures, 2008.

B/8/3	Elliptic partial differential equations exercises, solutions and rough notes, 2008-2009.

B/8/4	Examination papers 'Introduction to Second-Order Elliptic Partial Differential Equations', and solutions, May 2008, April 2009.

B/8/5	'Elliptic Partial Differential Equations at UCL: Additional notes.' Contents of folder so labelled, 2008-2009.

SECTION C   **RESEARCH**   **C/1-C/10**

This section contains papers and notebooks relating to Fraenkel's research activities from the late 1940s up until 2017. In 2009 Fraenkel described his research work in the following terms: 'Approximately half of my struggles have been to prove theorems about particular problems in fluid mechanics, the aim being to establish existence and properties of solutions in more detail than the general theory yields or for cases where the general theory does not apply'. He also analysed problems and questions across a broad range of mathematical topics as and when they were posed by colleagues and collaborators.

The arrangement of the material seeks to reflect the original filing structure devised by Fraenkel. He used alphabetical and numerical sequences to order files of work on different (sometimes overlapping) themes, creating indexes of contents where notebooks or files covered various subjects.

C/1/1-61	MISCELLANEOUS NOTES SERIES
C/2/1-5	BASIC ANALYSIS
C/3/1-21	PROBLEMS BY SURNAME OF RESEARCHER
C/4/1-43	PROBLEMS BY SUBJECT
C/5/1-39	HIGHEST WAVE
C/6/1-8	VISCOELASTIC FLOW PAST A PLATE
C/7/1-48	VORTEX RINGS
C/8/1-40	WATER ENTRY WEDGE
C/9/1-30	NOTEBOOKS
C/10/1	RESEARCH ASSESSMENT EXERCISE, 2008
C/11/1, 2	TI-92 CALCULATORS

C/1   **MISCELLANEOUS NOTES SERIES**   **1947-2017**

This sub-section contains research notes covering Fraenkel's career from 1947 onwards. He organised the notes into a series of numbered folders. Each folder includes an index of contents recording the name of an author or researcher associated with a mathematical problem and the title of the problem. Fraenkel appears to have used the folders to keep abreast of and engage with current thinking and developments in the field of mathematical science.

The first folder is inscribed by Fraenkel with a '0' and thereafter Roman numerals were used (I-LI). The folders are ordered chronologically. The dates listed below refer to the year in which Fraenkel started each folder.

The sub-section also includes the contents of a ring binder which Fraenkel labelled 'Current Notes & Letters'. It comprises extracts from the numbered folder series that were of relevance to his current research work.

C/1/1   0: Non-Mathematical Papers, etc., nd *c* 1947.

C/1/2   I: Notes of Mathematical Papers, 1940s.

C/1/3, C/1/4   II: Notes of Mathematical Papers, 1940s, 1950s.

Two folders.

C/1/5   III: Notes of Mathematical Papers, 1950s.

C/1/6, C/1/7   IV: Notes of Mathematical Papers, 1950s.

Two folders.

C/1/8   V: Notes of Mathematical Papers, 1950s.

C/1/9   VI: Notes of Mathematical Papers, 1955-1958.

C/1/10   VII: Notes of Mathematical Papers, 1955-1958.

C/1/11, C/1/12   VIII: Notes of Mathematical Papers, 1959.

Two folders.

C/1/13   IX: Notes of Mathematical Papers, 1960.

C/1/14   X: Notes of Mathematical Papers, 1961.

C/1/15, C/1/16   XI: Notes of Mathematical Papers, 1961.

Two folders.

C/1/17   XII: Notes of Mathematical Papers, 1962.

C/1/18   XIII: Notes of Mathematical Papers, 1963.

C/1/19   XIV: Notes of Mathematical Papers, 1964.

C/1/20   XV: Notes of Mathematical Papers, 1966.

C/1/21, C/1/22   XVI: Notes of Mathematical Papers, 1968.

Two folders.

C/1/23, C/1/24   XVII: Miscellaneous Notes, 1970.

C/1/25   XVIII: Miscellaneous Notes, 1971.

C/1/26	XIX: Miscellaneous Notes, 1973.
C/1/27	XX: Miscellaneous Notes, 1975.
C/1/28	XXI: Miscellaneous Notes, 1976.
C/1/29	XXII: Miscellaneous Notes, 1977.
C/1/30	XXIII: Miscellaneous Notes, 1977.
C/1/31	XXIV: Miscellaneous Notes, 1978.
C/1/32	XXV: Miscellaneous Notes, 1980.
C/1/33	XXVI: Miscellaneous Notes, 1981.
C/1/34, C/1/35	XXVII: Miscellaneous Notes, 1984. Two folders.
C/1/36	XXVIII: Miscellaneous Notes, 1985.
C/1/37	XXIX: Miscellaneous Notes, 1986.
C/1/38	XXX: Miscellaneous Notes, 1988.
C/1/39	XXXI: Miscellaneous Notes, 1989.
C/1/40	XXXII: Miscellaneous Notes, 1990.
C/1/41	XXXIII: Miscellaneous Notes, 1991.
C/1/42	XXXIV: Miscellaneous Notes, 1992.
C/1/43	XXXV: Miscellaneous Notes, 1993.
C/1/44	XXXVI: Miscellaneous Notes, 1994.
C/1/45	XXXVII: Miscellaneous Notes, 1995.
C/1/46	XXXVIII: Miscellaneous Notes, 1998.
C/1/47	XXXIX: Miscellaneous Notes, 1998.
C/1/48	XL: Miscellaneous Notes, 1999.
C/1/49	XLI: Miscellaneous Notes, 2000.
C/1/50	XLII: Miscellaneous Notes, 2000.
C/1/51	XLIII: Miscellaneous Notes, 2002.
C/1/52	XLIV: Miscellaneous Notes, 2003.
C/1/53	XLV: Miscellaneous Notes, 2005.

C/1/54	XLVI: Miscellaneous Notes, 2006.
C/1/55	XLVII: Miscellaneous Notes, 2007.
C/1/56	XLVIII: Miscellaneous Notes, 2008.
C/1/57	XLIX: Miscellaneous Notes, 2011.
C/1/58	L: Miscellaneous Notes, 2014.
C/1/59	LI: Miscellaneous Notes, 2017.
C/1/60, C/1/61	'Current notes & letters.' Contents of ring binder so labelled divided into two for ease of reference, 2014. Includes notes, correspondence and copies of extracts from notebooks and the miscellaneous notes series, 1997-2014. Two folders.

C/2	**BASIC ANALYSIS**	**nd *c* 1960s**

This sub-section contains two folders not included in Fraenkel's main filing system. The folders labelled 'Basic Analysis I' and 'Basic Analysis II', each have an index page at the front recording the names of researchers and the mathematical problem they are associated with. The two folders appear to have been used by Fraenkel to collate his research notes and work on Basic Analysis problems.

C/2/1-C/2/3	Basic Analysis I, nd *c* 1960s. Three folders.
C/2/4, C/2/5	Basic Analysis II, nd *c* 1960s. Two folders.

| C/3 | **PROBLEMS BY SURNAME OF RESEARCHER** | **1960-2001** |

This sub-section contains single folders or small folder sequences relating to problems that Fraenkel associated with particular mathematicians. Within his original filing system, these folders were variously described as 'Ancient researches', 'Research that went nowhere', 'Oddments', 'Old researches' and 'Scribbles that yielded nothing'. The files themselves were labelled with the name of the researcher and a short subject title.

The material is arranged here alphabetically by last name.

C/3/1-C/3/10	Berger, Melvyn Stuart
C/3/11	Carbery, Anthony Patrick
C/3/12	Mitchell, Andrew Ronald
C/3/13	Puel, Jean-Pierre
C/3/14	Silvaloganathan, Jeyabal
C/3/15	Squire, Herbert Brian
C/3/16-C/3/18	Stewartson, Keith
C/3/19-C/3/21	Various researchers including G. Keady and J.B. McLeod

| **C/3/1-C/3/10** | **Berger, Melvyn Stuart** | **1969-1986** |

Fraenkel collaborated regularly with Melvyn Stuart Berger. They began working together during Fraenkel's 1966 visit to the Courant Institute, New York, USA.

C/3/1   'First Ideas for Boundary-Layer Analysis of Buckling Plate (MSB).' Contents of folder so labelled, 1969.

C/3/2   'Buckling of Clamped Plate (MSB).' Contents of folder so labelled, nd.

C/3/3   Folder containing Fraenkel's notes on *Perspectives in Nonlinearity*, Berger and Berger (1968), a copy of a lecture by Robin Dyer relating to degree theory, and notes relating to *Principles and Techniques of Applied Mathematics*, Bernard Friedman (1956), 1969.

C/3/4   'Second Problem with MSB (extension of Nehari's work).' Contents of folder so labelled, 1969.

C/3/5   'Notes on Differential Geometry Related to Work with Mel Berger.' Contents of folder so labelled, 1969-1983.

C/3/6, C/3/7   'Normal Modes: Periodic Solutions of Nonlinear Wave Equations.' Contents of folder so labelled divided into two for ease of reference, nd *c* 1971.

Includes material relating to differential geometry of the 2-sphere and Laplace-Beltrami operator, etc.

Two folders.

C/3/8   'Differential Geometry.' Contents of folder so labelled filed under the label 'Ancient Researches', 1972-1983.

Includes material relating to periodic solutions of Hamiltonian systems, periodic solutions of systems of second order ordinary differential equations, etc.

C/3/9   'Almost Periodic Functions.' Contents of folder so labelled, 1986.

Includes material relating to almost periodic solutions of conservative dynamical systems.

C/3/10   'Notes on a Conversation Held with M.S. Berger.' Contents of an envelope so labelled, May 1989.

Includes material relating to Wiener's inequality and the Feigenbaum map of Chaos theory.

| **C/3/11** | **Carbery, Anthony Patrick** | **1987** |

C/3/11   'Matters Related to Anthony Carbery.' Contents of folder so labelled, 1987.

6pp manuscript notes relating to a question on capacity. There also appears to be input into the discussion from Thomas Joseph Ransford.

C/3/12	Mitchell, Andrew Ronald	1975

C/3/12 — 'Andrew Mitchell: Navier-Stokes Numerical Work.' Contents of folder so labelled, 1975.

Material relating to numerical computation of steady Navier-Stokes solutions for exterior domains and Green function of the Laplace equation.

C/3/13	Puel, Jean-Pierre	1980

C/3/13 — 'Puel's Question.' Contents of folder so labelled, 1980.

Includes letter from Jean-Pierre Puel and Fulbert Mignot asking to meet Fraenkel during his forthcoming visit in Paris to discuss standard boundary values in Navier-Stokes equations and notes by Fraenkel apparently related to their discussions.

C/3/14	Silvaloganathan, Jeyabal	1995

C/3/14 — 2pp notes relating to rank-one convexity and quasiconvexity and the work of Fraenkel's University of Bath colleague, Jeyabal Silvaloganathan.

C/3/15	Squire, Herbert Brian	1960

Professor Herbert Brian Squire was Zaharoff Chair of Aviation at Imperial College, London.

C/3/15 — 'Finite-depth Surface Waves (Discussions with HBS).' Contents of folder so labelled.

Notes on linearized incompressible flow and vortex rings, calculations by Squire on oscillations of mercury and a covering note to Fraenkel, nd *c* 1960.

C/3/16-C/3/18	Stewartson, Keith	1960-1967

Keith Stewartson was Professor of Mathematics at Durham University and then, from 1964, Professor of Applied Mathematics at University College London.

C/3/16 — 'Oscillations of a Rotating Fluid etc.' Contents of a folder so labelled, 1961.

Correspondence and associated papers relating to A.J. Reynolds' dissertation.

C/3/17 — 'K. Stewartson: Source in a Rotating Fluid.' Contents of folder so labelled, 1967.

Includes a typescript preprint by Stewartson entitled 'A Note on a Source in a Rotating Liquid'.

C/3/18 — '3 dimensional b.l.' Contents of folder so labelled, 1960.

Includes notes by Fraenkel on incompressible fluid equations, flow past a slender cone, flow of mercury in a magnetic field, etc.

C/3/19-C/3/21	Various researchers including G. Keady and J.B. McLeod	1967-1981, 2001-2002

C/3/19 — 'Rough Mathematical Notes: Conversations with P.H. Roberts, H. Brézis - abandoned scribbles.' Contents of folders so labelled, 1967-1981.

Includes notes relating to the work of M. Slemrod, Ed Spiegel, Victor Mizel, Joe Taylor and John Hinch, 1967-1981.

C/3/20 — Notes relating to work by G. Keady and J.B. McLeod, 2001-2002.

C/3/21 — 'Notes on Wasow's book. Lyusternik, Eckhaus de Jager on Vasil'eva papers, etc.' Contents of folders so labelled, nd.

C/4	**PROBLEMS BY SUBJECT**	**1960-2011**

This sub-section contains single folders or small folder sequences of notes relating to a variety of mathematical problems worked on by Fraenkel. The folders were labelled with the names of the problems. Within Fraenkel's original filing system, these folders were variously described as 'Ancient researchers', 'Research that went no-where', 'Old researches' and 'Scribbles that yielded nothing'.

The arrangement is in date order with undated material at the end of the sub-section. Some of the material has been difficult to date.

C/4/1   'Viscous Swirling Pipe Flow.' Contents of folder so labelled, nd *c* 1960.

C/4/2   'Differential Geometry, Numerical Methods.' Contents of folder so labelled, nd *c* 1961.

C/4/3-C/4/11   Jeffrey-Hamell flows, nd *c* 1963-1981.

C/4/3, C/4/4   'Jeffrey-Hamell Flows: I.' Contents of folder so labelled divided into two for ease of reference, nd *c* 1963.

Two folders.

C/4/5   'Jeffrey-Hamell Flows: IA.' Contents of folder so labelled, 1981.

Includes notes relating to work by Hooper, Duffy & Moffatt.

C/4/6   'Jeffrey-Hamel Flows: II.' Contents of folder so labelled, 1963.

Includes notes relating to viscous flow in channels with slightly curved walls.

C/4/7   'Jeffrey-Hamel Flows: III.' Contents of folder so labelled, nd.

C/4/8   'Jeffrey-Hamel Flows: III-2.' Contents of folder so labelled, nd.

C/4/9   'Jeffery-Hamel Flows: IV (Attempt at rigorous proof of channel theory').' Contents of folder so labelled, nd.

C/4/10   'Attempt at Strict Justification of JH approxn: I.' Contents of folder so labelled, 1969.

C/4/11   'Strict Justification of J.H. approxn: II.' Contents of folder so labelled, 1969-1973.

C/4/12   'Poincaré Problem: Equilibrium Figures.' Contents of folders so inscribed, 1972, 1983.

C/4/13   'Partial Differential Equations with Slowly Varying Coefficients.' Contents of folders so labelled, nd *c* 1972.

C/4/14   'Towards Paper on JH Channels: 11th hr bits of theory and computations on $R\alpha$-bdry for energy inequality.' Contents of folder so labelled, 1973.

C/4/15   'Infinite Channels and Tubes: Are there Navier Stokes solutions?' Contents of folder so inscribed, 1973-1975.

C/4/16   'Search for Non-rigid Closed Surface.' Contents of folder so labelled, 1973.

C/4/17   'Bifurcation from the Green Function.' Contents of folder so labelled, 1973-1977.

C/4/18   'Mathematical Boundary Layer Theory.' Contents of folder so labelled, 1975.

C/4/19   'Radial Hydraulic Flow.' Contents of folder so labelled, 1977.

C/4/20-C/4/22 | 'Completeness of Nonlinear Eigenfunctions.' Contents of folders so labelled, *c* 1977-1978.

Three folders.

C/4/23-C/4/27 | 'Polar Moment of Inertia of Boundary $\partial\Omega$.' Contents of folders so labelled, 1983-2007.

Five folders.

C/4/28 | 'Distributions and Fourier Transforms.' Contents of folder so labelled, *c* 1986.

C/4/29 | 'Hall, Hayman and Weitsman.' Contents of folder so labelled, *c* 1989.

C/4/30 | Notes relating to nonlinear mapping, 1992.

C/4/31 | 'C$^\infty$ functions $\mathbb{R}\to\mathbb{R}$.' Contents of folder so labelled, *c* 1993.

C/4/32 | 'Ilia Kamotski: Excessive answer (Maz'ya et al) to my question about centre of change.' Contents of envelope so labelled, 2005.

Includes notes relating to asymptotics of solutions of elliptic boundary value problems in domains with singularly perturbed boundaries.

C/4/33 | 'Unsteady, Axi-sym. Flow with Swirl, Ewler and Navier-Stokes.' Contents of folder so labelled, 2011.

C/4/34 | 'Boundary Regularity Figures.' Contents of folder so labelled, nd.

C/4/35 | 'Extension of Functions W_p^k (w), w small.' Contents of folder so labelled, nd.

C/4/36 | 'Butzer and Nessel, Fourier analysis.' Contents of envelope so labelled, nd.

C/4/37 | 'Magnetohydrodynamic Stokes Flow.' Contents of folder so labelled, nd.

C/4/38 | 'Radial Hydraulic Flow.' Contents of folders so labelled, nd.

C/4/39 | 'Slow Flow with Constant Vorticity.' Contents of folder so labelled, nd.

C/4/40 | 'Sonic Distributions.' Contents of folder so labelled, nd.

C/4/41 | 'Small-gap disc condenser.' Contents of folder so labelled, nd.

C/4/42 | 'The Wuest-Dean Orifice.' Contents of folder so labelled, nd.

C/4/43 | 'Exponential Channel: Preliminary Efforts.' Contents of folder so labelled, nd.

C/5 | **HIGHEST WAVE** | **1980-2008**

The material in this sub-section relates to Fraenkel's work associated with the resolution of the Stokes conjecture on the form of the wave of greatest height. It mainly consists of a series of titled folders and shorthand notebooks numbered with roman numerals (I-XX) dating from 1980 up to 2008. The series is followed by folders of rough notes and a small amount of correspondence, ranging in date from 1985 to 2007. The dates listed refer to the year in which Fraenkel started each folder.

C/5/1 | I: Highest Wave and Stokes Conjecture, nd.

C/5/2 | II: Toland's (and McLeod's) Highest Wave and the Stokes Conjecture, *c* 1980.

C/5/3	III: Highest Wave and Stokes Conjecture, *c* 1981.
C/5/4	IV: Highest Wave and Stokes Conjecture, 1990.
C/5/5	IVa: Highest Wave (Notes Intended for File IV and the Judged Secondary), 1990.
C/5/6	V: Highest Wave and Stokes Conjecture, 1995.
C/5/7	Va: Highest Waves and Stokes… Rough Notes, 1995.
C/5/8	VI: Highest Wave and Stokes Conjecture,1995. Spiral bound shorthand notebook.
C/5/9	VI cont'd: Highest Wave and Stokes Conjecture, 2000. Spiral bound shorthand notebook.
C/5/10	VII: Highest Wave and Stokes Conjecture, 1997.
C/5/11	VIIa: Highest Wave and Stokes Conjecture, 1997. Spiral bound shorthand notebook.
C/5/12	VIII: Highest Wave and Stokes Conjecture, 1997.
C/5/13	Notepad P99 (Highest Wave Notes Preceding or Supplementary VIII), 1999. Spiral bound shorthand notebook.

C/5/14	IX: Highest Wave and Stokes Conjecture, 2003.
C/5/15	X: Highest Wave and Stokes Conjecture, 2003.
C/5/16	XI: Highest Wave and Stokes Conjecture, 2004.
C/5/17	XII: Highest Wave and Stokes Conjecture, 2004.
C/5/18	XIII: Highest Wave and Stokes Conjecture, 2004.
C/5/19	XIV: Highest Wave and Stokes Conjecture, 2005.
C/5/20	XV: Highest Wave and Stokes Conjecture, 2005.
C/5/21	XVI: Highest Wave and Stokes Conjecture, 2005
C/5/22	XVII: Highest Wave and Stokes Conjecture, 2006.
C/5/23	XVIII: Highest Wave and Stokes Conjecture, 2007.
C/5/24	XIX: Highest Wave and Stokes Conjecture, 2007.
C/5/25	XX: Highest Wave and Stokes Conjecture, 2008.
C/5/26-C/5/39	Additional notes and papers relating to Fraenkel's work on Highest Wave and Stokes Conjecture, 1985-2007.
C/5/26	6pp typescript draft entitled 'The Asymptotic Behaviour near the Crest of Waves of Extreme Form' by J. B. McLeod, 1985.

| C/5/27, C/5/28 | Notes relating to the use and contents of Fraenkel's TI-92 calculator, 1995.

Two folders. |
| --- | --- |
| C/5/29 | Reprints of papers by G.A. Chandler, I.G. Graham, G. Keady, J.B. McLeod, J. Norbury, and J.F. Toland, and associated notes, 1995. |
| C/5/30 | Correspondence and papers on numerical results relating to extreme waves including notes by Ivan Graham and a letter from William M. Drennan, 1995. |
| C/5/31 | Reprints of papers by A. B. Aleksandrov, L. Grafakos and S. K. Pichorides and associated notes relating to the Hilbert transform, 1997. |
| C/5/32 | Notes from Grant Keady relating to highest wave, 1997. |
| C/5/33 | 7pp untitled manuscript formulae, c 2003. |
| C/5/34 | 12pp manuscript notes entitled 'The Optimist's Equn. for f_κ', 2004. |
| C/5/35 | 10pp untitled manuscript and typescript notes, 2006. |
| C/5/36 | 18pp untitled manuscript notes, c 2005. |
| C/5/37 | 'Highest Wave: Rubbish heap of rough notes.' Contents of folder so labelled, 2005. |
| C/5/38 | 10pp untitled manuscript notes, 2005. |
| C/5/39 | 12pp manuscript notes entitled 'The Harmonic Conjugate of an Okamoto-Shoji Function', 2005. |

C/6	**VISCOELASTIC FLOW PAST A PLATE**	***c* 1986-1988**

This sub-section contains material relating to Fraenkel's development of a theory proposed by Daniel D. Joseph (1929-2011). It comprises eight folders of notes associated with a number of Fraenkel's scientific papers on viscoelastic flow past a plate published in the late 1980s and early 1990s.

C/6/1	I: Dan Joseph's Flat Plate Problem, nd.
C/6/2	II: Dan Joseph's Flat Plate Problem, nd.
C/6/3	III: Dan Joseph's Flat Plate Problem, nd.
C/6/4	IV: Dan Joseph's Flat Plate Problem, nd.
C/6/5	V: Dan Joseph's Flat Plate Problem - more about Bμ, final formulae for papers, nd.
C/6/6	VI: Dan Joseph's Flat Plate Problem, nd.
C/6/7	VI: Dan Joseph's Flat Plate Problem - rough notes, 1988.
C/6/8	Plate Problem with General Shear Kernel G, 1986.

C/7	**VORTEX RINGS**	**1974-2013**

The research notes and papers in this sub-section relate to Fraenkel's work on fundamental existence and uniqueness theorems for steady vortex rings. The dates listed refer to the year in which Fraenkel started each folder.

C/7/1-6	Cat's eye vortices in a viscous fluid
C/7/7-30	Diffusing vortex circle
C/7/31, 32	Norbury's Vortex
C/7/33-35	Steady vortex ring in Stokes flow
C/7/36-41	Steady vortex rings with swirl
C/7/42, 43	The uniqueness of steady vortex rings of small cross-section
C/7/44-48	Steady, plane exterior Navier Stokes problem

C/7/1-C/7/6	**Cat's eye vortices in a viscous fluid**	**2006-2009**

C/7/1	I: Cat's Eye Vortices, 2006.
C/7/2	II: Cat's Eye Vortices in a Viscous Fluid, 2006.
C/7/3	III: Cat's Eye Vortices in a Viscous Fluid, 2007.
C/7/4	IV: Cat's Eye Vortices in a Viscous Fluid, 2009.
C/7/5	'JTS pad.' Spiral bound shorthand notebook so labelled, 2006.
C/7/6	'Cat's Eye Vortices - rough notes.' Contents of folder so labelled, *c* 2006.

C/7/7-C/7/30	**Diffusing vortex circle**	**1996-2014**

C/7/7	I: Diffusing Vortex Circle, 1996.
C/7/8	II: Diffusing Vortex Circle, 1996.
C/7/9	III: Diffusing Vortex Circle, 1998.
C/7/10	IV: Diffusing Vortex Circle, 1998.
C/7/11	V: Diffusing Vortex Circle, 2012.
C/7/12	VI: Diffusing Vortex Circle, 2013.
C/7/13	'Diffusing Vortex Circle - rough notes.' Contents of folder so labelled, 2000-2012.
C/7/14	'DVC: Tidy Supplements to Rough Notes.' Contents of folder so labelled, nd.
C/7/15	'Diffusing Vortex Circle: Notes from J.B. McLeod.' Contents of folder so labelled, 1996.
C/7/16	'Diffusing Vortex Circle.' Contents of folder so labelled, 1993, 2002.

C/7/16 Notes on scientific papers and correspondence, including a referee's report, relating to a paper by L.E. Fraenkel and J.B. McLeod.

C/7/17-C/7/19	Application for Leverhulme Fellowship, 2008-2011.
	Fraenkel was seeking funding for his research on Navier-Stokes solutions for diffusing vortices.
C/7/17, C/7/18	Correspondence and papers, including draft application and Fraenkel's curriculum vitae, 2010-2011.
	Two folders.
C/7/19	Correspondence relating to an application to the Royal Society Scientific Relief Fund to support research on Navier-Stokes solutions for diffusing vortices, 2008-2009.
C/7/20-C/7/22	'Diffusing Vortex Circle: Notes from Mark Preston.' Contents of folder so labelled, 2008-2010.
	Three folders.
C/7/23	'Diffusing Vortex Ring.' Contents of folder so labelled, nd.
C/7/24-C/7/29	Notebooks, 1998-2011.
	Fraenkel used many shorthand notebooks. Those identified as relating to his work on diffusing vortex circle are presented here in chronological order. Generally, the dates given are the year in which each notebook was begun. Fraenkel has indexed most of the notebooks on the inside page.
	See also C/9.
C/7/24	Notebook II, 1998.
C/7/25	Notebook III, 1998.
C/7/26	'DVC, Primary Fragments.' Notebook so labelled, 1999.
	Includes notes on lectures by Alexander Mielke, Bath, April 1999.

C/7/27	'DVC, Secondary Fragments.' Notebook so labelled, July 1999.
C/7/28	'DVC, Secondary Fragments.' Notebook so labelled, August 2000.
C/7/29	'Mainly Diffusing Vortex Circle (DVC).' Notebook so labelled, August 2009.
C/7/30	'UAFS: Unsteady axi-sym. flow with swirl.' Notebook so labelled, July 2011.

C/7/31, C/7/32	**Norbury's Vortex**	**1983, 1986**
C/7/31	'Norbury's Vortex: Detailed calculations supplementing paper.' Contents of folder so labelled, 1983.	
C/7/32	'Norbury's Vortex: Discussions with C.J.A., including analyticity of ∂A; final supplementary calculations.' Contents of folder so labelled, 1986.	

C/7/33-C/7/35	**Steady vortex ring in Stokes flow**	**1989**
C/7/33	I: Steady Vortex Ring in Stokes Flow, 1989.	
C/7/34	II: Steady Vortex Ring in Stokes Flow, nd.	
C/7/35	5pp untitled manuscript notes, nd.	

C/7/36-C/7/41	**Steady vortex rings with swirl**	**1990-2004**
C/7/36	A: Steady Vortex Rings with Swirl, 1990.	
C/7/37	B: Steady Vortex Rings with Swirl, 1999.	

C/7/38	C: Steady Vortex Rings with Swirl, 2004.

C/7/39	Preliminary and rough notes relating to steady vortex rings with swirl, 2002.

C/7/40	'FRJ (Further Rough Jottings).' Notebook so labelled, September 2000.

C/7/41	'RN 01 (Rough Notes).' Notebook so labelled, February 2001.

C/7/42, C/7/43	**The uniqueness of steady vortex rings of small cross-section**	***c* 1986, 1987**

C/7/42	'Tadié's Problem.' Contents of folder so labelled, *c* 1986.

C/7/43	8pp untitled manuscript notes, 1987.

C/7/44-C/7/48	**Steady, plane exterior Navier Stokes problem**	***c* 1974-1988**

C/7/44	I: Steady, Plane Exterior Navier Stokes Problem, c 1974.

C/7/45	II: Steady, Plane Exterior Navier Stokes Problem, 1975.

C/7/46	III: Steady, Plane Exterior Navier Stokes Problem, 1977.

C/7/47	IV: Steady, Plane Exterior Navier Stokes Problem, 1984.

C/7/48	12pp manuscript notes entitled 'Constantin and Foias, Notation and a few related results', 1988.

C/8	**WATER ENTRY OF WEDGE**	**1987-2017**

This sub-section contains notes, associated papers, and correspondence relating to Fraenkel's work on water entry of wedge. The dates listed refer to the year in which each folder was started.

C/8/1	A: Water Entry of Wedge, *c* 1987.

C/8/2	B: Water Entry of Wedge, 1987.

C/8/3	C: Water Entry of Wedge, 1990.

C/8/4	D: Water Entry of Wedge, 1990.
	Includes copies of notes by J.B. McLeod.

C/8/5	E: Water Entry of Wedge, 1993.
	Includes copies of notes by J.B. McLeod.

C/8/6	F: Water Entry of Wedge, 1993.

C/8/7	G: Water Entry of Wedge, 1993.

C/8/8	H: Water Entry of Wedge, 1993.

C/8/9	I: Water Entry of Wedge, 1994.
	Includes copies of notes by J.B. McLeod.

C/8/10	J: Water Entry of Wedge, 1996.

C/8/11	K: Water Entry of Wedge, 1997.
C/8/12	L: Water Entry of Wedge, 2001.
C/8/13	M: Water Entry of Wedge, 1994-2009.
C/8/14	N: Water Entry of Wedge, 2010.
C/8/15	O: Water Entry of Wedge, 2010.
C/8/16	P: Water Entry of Wedge, 2010-2011.
C/8/17	P: Water Entry of Wedge, *c* 2010-2012.
C/8/18	Q: Water Entry of Wedge, 2011.
C/8/19	R: Water Entry of Wedge, 2011.
C/8/20	S: Water Entry of Wedge, 2015.
C/8/21	T: Water Entry of Wedge, 2015.
C/8/22	V: Water Entry of Wedge, 2017.
C/8/23	'Water Entry of Wedge: Rough Notes.' Contents of folder so labelled, *c* 1987, 1988.

| C/8/24, C/8/25 | Copies of notes by J.B. McLeod with notes and annotations by Fraenkel, 1987-1989.

Two folders. |
|---|---|
| C/8/26, C/8/27 | 'Water Entry of Wedge: Ragbag of very rough (probably useless) notes.' Contents of folder so labelled, 1993-2013.

Two folders. |
C/8/28	Copy of a (?draft) paper entitled, 'A Numerical Study of the Wedge-Water-Entry Problem: Fixed Points of Separable and Mixed-Monotone Positive Operators' by G. Keady with notes and annotations by Fraenkel, 1997.
C/8/29	'Water Entry of Wedge: Bits and Pieces for T.Y. Hou, A A. Korobkin et al.' Contents of folder so labelled, 2000, 2003.
C/8/30	'Current Work on Water Entry.' Contents of folder so labelled, 2002.
C/8/31-C/8/40	Notebooks, 1994-2017.

Fraenkel used many shorthand notebooks. Those identified as relating to wedge entry are presented here in chronological order. Generally, the dates given are the year in which each notebook was begun. Fraenkel has indexed most of the notebooks on the inside page.

See also C/9. |
C/8/31	Notebook WeP, March 1994.
C/8/32	Notebook WeQ, April 1996.
C/8/33	Notebook RN01a, May 2001.
C/8/34	Notebook We09, November 2009.

C/8/35 Notebook We12, March 2012.

C/8/36 'Bap We: Bits and Pieces, Water Entry'. Notebook so labelled, 2015.

C/8/37 Notebook We16, August 2016.

C/8/38 Notebook We16 - Rough Notes I, 2016.

C/8/39 Notebook We16 - Rough Notes II, 2016.

C/8/40 Notebook We17, January 2017.

C/9 **NOTEBOOKS** **1975-2017**

This sub-section comprises Fraenkel's shorthand notebooks. They contain notes relating to research, scientific papers, teaching, conferences and talks attended, and various mathematical problems that came to his attention. The notebooks are arranged in date order as far as possible. Generally, the dates given are the year in which each notebook was begun. Fraenkel has indexed most of the notebooks on the inside page.

Some notebooks, those relating predominantly to highest wave, wedge entry and vortex work, can be found in other sub-sections. Notebooks covering multiple topics are presented here.

C/9/1 'Small Red Pad A.' Notebook so labelled,1975-1976.

Includes notes on vortex tubes, non-self-adjoint operators, potential theory, external operators and trace on manifolds, Thomson's principle, and energy of harmonic polynomial in starlike set.

C/9/2 'Small Red Pad B.' Notebook so labelled, 1976.

Includes notes relating to attempts to find inequalities for reduction of Dirichlet integral under symmetrisation, capacity in terms of modulus of asymmetry, Thomson's principle, and potential theory.

C/9/3 'Durham - Administrative Matters; Heriot-Watt.' Notebook so labelled, September 1976.

C/9/4 'Boundary Regularity and Sobolev Spaces; Stuttgart.' Notebook so labelled, 1977-1978.

Includes notes on new slant on curve forming curvilinear axis of tubular, solenoid vector field, and a lecture by Helen Lanchon.

C/9/5 'Small Notebook E.' Notebook so labelled, 1978.

Includes notes on Navier-Stokes solutions, channels of various types, and conformal maps.

C/9/6 Spiral-bound notebook containing notes relating to completeness of non-linear eigen functions, elementary linear difference (recurrence) equations, and Euler's product for the Riemann zeta function, 1979.

C/9/7 'Lausanne and Potential Theory.' Notebook so labelled, 1979.

C/9/8 'Exterior Problem.' Notebook so labelled, Autumn 1981.

C/9/9 'Chicago, October 1981; Oxford, July-August 1982.' Notebook so labelled, 1981-1982.

C/9/10 Notebook CWeV, August 1992.

Includes notes on Carbery's question about $U_{xy} \geq I$ on square, Poisson integral for a ball, water entry, simplest derivation of formula for Hilbert transform, and vortex rings.

C/9/11   Notebook VR, 1995.

C/9/12   Notebook MRN, 1995.

C/9/13   Notebook RSD (Rome, Sussex, Durham), June 1996.

C/9/14   Notebook II, 1996.

C/9/15   Notebook III, 1996.

                Includes notes relating to a module taught at the University of Bath on real
                and abstract analysis.

C/9/16   Notebook I, 1997.

                Includes notes relating to highest wave and Stokes conjecture, water entry,
                Kelvin reflection for proofs of symmetry, and matrix approach to Lagrangian
                fluid dynamics.

C/9/17   Notebook II, 1997.

                Includes notes on water entry of wedge, boundary layer theory, and a
                workshop on partial differential equations, Paris, France, 21-23 May 1997.

C/9/18   'Current Rough Notes.' Notebook so labelled, October 1997-January 1998.

C/9/19   Notebook FRN (Further Rough Notes), September 1999.

                Includes notes on steady vortex rings with swirl, and vortex flows past a
                sphere.

C/9/20   'Paper for Korobkin.' Notebook so labelled, 2002.

C/9/21   Notebook G 02, April 2002.

                Includes notes on uniqueness of Hahn-Banach extensions, wedge entry,
                moment of inertia of $\partial\Omega$, and conversations with Alistair King.

C/9/22   'St Leonard, Farleigh Hungerford.' Notebook so labelled, 2002.

                Includes notes on degree theory, fixed point theorems and logarithmic
                capacity, and relating to Fraenkel's duties as a sexton at the church of St
                Leonard, Farleigh Hungerford, Somerset, UK.

C/9/23   Notebook RN, 2003.

                Includes notes on elliptic co-ords, non-linear functional analysis, Stokes
                conjecture, a Sobolev-epsilon inquiry, and highest wave.

C/9/24   Notebook SN 04, January 2004.

                Includes notes on highest wave, and diffusing vortex circle.

C/9/25   'Rough Notes at Mittag-Leffler Institute I.' Notepad so labelled, September-
                November 2005.

                Contains notes relating to a visit by Fraenkel to the Mittag-Leffler Institute,
                Stockholm, Sweden.

                See also C/9/26.

C/9/26   'Rough Notes at Mittag-Leffler Institute II.' Notepad so labelled, September-
                November 2005.

                Contains notes relating to a visit by Fraenkel to Mittag-Leffler Institute,
                Stockholm, Sweden, and notes on a visit to the University of Surrey, UK, in
                2006.

                See also C/9/25.

C/9/27   Notebook VRN 13, September 2013.

                Includes notes on wedge entry, diffusing vortex circle, Navier Stokes theory,
                and on work by Ladyzhenskaya.

C/9/28   'Rough Notes.' Notebook so labelled, November 2014.

Includes notes relating to Fraenkel's father Eduard Fraenkel.

C/9/29   'Current Rough Notes.' Notebook so labelled, July 2017.

C/9/30   Hardback notebook used by Fraenkel for notes on library loans and requests, library contacts, etc, 1979-2016.

C/10   **RESEARCH ASSESSMENT EXERCISE**   **2008**

The Research Assessment Exercise 2008 was conducted jointly by UK higher education funding bodies. Its purpose was to produce quality profiles for each submission of research activity made by institutions. The quality profiles were then used to determine research grant allocations with effect from 2009.

C/10/1   Correspondence and papers relating to the Department of Mathematical Sciences, University of Bath.

C/11   ***TI-92* CALCULATORS**   ***c* 1998, 2013**

This sub-section contains Frankel's *TI-92* calculators. Fraenkel was distrustful of numerical, high-performance computing methods. Throughout his career he chose instead to rely on manual calculations. In 1998 as a compromise, he purchased the first Texas Instruments symbolic calculator, the *TI-92* and when it failed in 2013, he sought out an identical reconditioned machine.

C/11/1   Texas Instruments *TI-92* symbolic calculator, *c* 1998.

C/11/2   Texas Instruments *TI-92* symbolic calculator, labelled 'Second one' by Fraenkel, with instruction manual and original packaging, May 2013.

SECTION D   **CORRESPONDENCE**   **D/1-D/5**

This section contains Fraenkel's correspondence. It spans his whole academic career and covers a wide range of topics. It includes correspondence with colleagues, long-term collaborators, friends, and students about particular mathematical problems, the publication of papers, ongoing projects, academic supervision, conferences, and the wider scientific community. It also includes a small amount of personal and family-related correspondence.

The organisational arrangement of the material imposed by Fraenkel has been preserved.

D/1/1-32   REFEREE REPORTS

D/2/1-20   SCIENTIFIC PAPERS BY OTHERS

D/3/1-91   CORRESPONDENCE BY SURNAME

D/4/1-99   MISCELLANEOUS CORRESPONDENCE

D/5/1-3   ADDRESSES

D/1	**REFEREE REPORTS**	**1949-2011**

Fraenkel maintained a sequence of files associated with his work as a referee or reviewer for scientific papers and books. The material includes a mix of typescript and manuscript correspondence, notes, reports, preprints, off prints and cuttings.

The presentation is chronological.

D/1/1	1949-1963.
D/1/2	1964-1966.
D/1/3	1967-1968.
D/1/4	1969-1971.
D/1/5	1971-1972.
D/1/6	1973.
D/1/7	1974.
D/1/8-D/1/10	1975.
	Three folders.
D/1/11	1976.
D/1/12	1977.

D/1/13	1978-1979.
D/1/14	1980-1981.
D/1/15	1982-1983.
D/1/16	1984.
D/1/17	1985.
D/1/18	1986-1987.
D/1/19	1988.
D/1/20	1989.
D/1/21	1990.
D/1/22	1991.
D/1/23	1992.
D/1/24	1993.
D/1/25	1994.
D/1/26	1995-1996.

D/1/27   1997.

D/1/28   1998.

D/1/29   1999-2000.

D/1/30   2001-2003.

D/1/31   2004-2006.

D/1/32   2007-2011.

D/2   **SCIENTIFIC PAPERS BY OTHERS**   **1960s-2007**

Fraenkel kept a large collection of scientific papers, drafts and proofs by various authors. Those presented here have been annotated or are associated with correspondence. Some relate to his work as a referee, others are papers he took a particular interest in or helped the author to get published.

The presentation is in alphabetical order of the last name of the author.

D/2/1   Adebiyi, Bimpe, 1980.

See also B/5/37 and B/5/38.

D/2/2   Amick, Charles J., *c* 1987.

See also B/4/59-B/4/61 and D/3/2-D/3/9.

D/2/3   Ardavan, H., 1990.

D/2/4   Avrin, J.D., 1985.

D/2/5   Bang, Ha Huy, 1995.

D/2/6, D/2/7   Edmunds, D.E., nd *c* 1992.

Two folders.

D/2/8   Evans, W.D. and Harris, D.J., 1985.

D/2/9   Fuglede, B., 1985.

D/2/10   Güngör, F. and Gunson, J., *c* 1987.

D/2/11, D/2/12   Longuet-Higgins, M.S., 2007.

Two folders.

D/2/13   Hui, Y., 2011.

D/2/14   Kobayashi, K., 2005.

D/2/15   Marchioro, C., Benedetto, D. and Caglioti, E., 1996.

D/2/16   Socolescu, D., 1990.

D/2/17, D/2/18   Toland, J.F., 1999, *c* 2006.

Two folders.

D/2/19   Watson, E.J., nd *c* 1960s.

D/2/20   Wittwer, P. and Bichel, D., 2005-2007.

D/3   **CORRESPONDENCE BY SURNAME**   **1951-2018**

This sub-section contains a sequence of correspondence organised by Fraenkel into alphabetical order by last name of the correspondent. It mainly covers a wide range of work-related topics, but also includes a small amount of personal and family correspondence.

D/3/1   Ahrens, Mark, 1988.

D/3/2-D/3/9   Amick, Charles James, 1974-1991.

See also B/4/59-B/4/61 and D/2/2.

Eight folders.

D/3/10   Anderson, Milne, 2012.

D/3/11   Ball, John M., 1993, 2014-2017.

D/3/12   Barrett, Diana, 1984.

D/3/13   Baxandall, Kay (née Simon), 1988-2010.

D/3/14   Berg, Michiel van den, 2007-2008.

D/3/15-D/3/22   Berger, Melvyn Stuart, 1967-1996.

Eight folders.

D/3/23   Bickley, W.G., 1966.

D/3/24   Böhmer, Christian, 2009.

D/3/25   Borne, Eckart von den, 1970, 1975.

D/3/26   Burch, Dorothy V., 1970, 1979.

D/3/27   Bushell, P.J.,1991, 2005.

D/3/28   Calder, William M., 1975-1977.

D/3/29   Carlotti, Pierre, 1999.

D/3/30   Chambers, Mortimer, 1990.

D/3/31   Clark, E.F., 2011.

D/3/32   Clunie, James G., 1984-1985.

D/3/33   Cole, Julien D., 1995.

D/3/34   Corpus Christi College, University of Oxford, 2005-2016.

                Correspondence relating to the papers of Fraenkel's father Eduard Fraenkel
                held at Corpus Christi College.

                See also A/1/7 and A/1/16.

D/3/35   Davies, Brian, 2016-2017.

D/3/36   Day, Robin, 1973.

D/3/37   Dover, Sir Kenneth, 1994

D/3/38-D/3/41   Ewer, Patrick, 1979-1982.

                Four folders.

D/3/42   Foster, Peter, 1999, 2008-2017.

D/3/43   Fraenkel, Anna, *c* 1966.

D/3/44-D/3/50   Fraenkel (née Currie), Beryl J.M., 1951-1953.

D/3/44   1951.

D/3/45   January-February 1952.

D/3/46   March-May 1952.

D/3/47   June-July 1952.

D/3/48   August 1952.

D/3/49   September-October 1952.

D/3/50   1953.

D/3/51   Fraenkel, Eduard, 1969.

D/1/52   Fraenkel, Gustav J., 1985-1992.

D/3/53-D/3/55   Hall, Richard R., 1991-1992, 2002-2003, 2007.

                Three folders.

D/3/56   International Centre for Mathematical Sciences (ICMS), 2009.

D/3/57   Joseph, Daniel Donald, 1988, 2011.

D/3/58-D/3/63   Keady, Grant, 1982, 1995-2012.

                Six folders.

D/3/64   Kirchgässner, Klaus, 1976, 1993, 2011.

D/3/65   Labrun, Frank, 1977.

D/3/66   The Leverhulme Trust, 1999-2000.

D/3/67   The London Mathematical Society, 2007-2011.

D/3/68	Longuet-Higgins, Michael, 2005-2006.

D/3/69	Mace, Brian R., 2010.

D/3/70 Mestel, Leon, 2007.

Correspondence relating to the obituaries of Agathe Henriette Franziska Thornton (1910-2006) and Sir William Hunter McCrea (1904-1999).

D/3/71 Muecke, Frances, 2004.

Correspondence relating to copyright and a forthcoming translation of *Plautinisches im Plautus* by Eduard Fraenkel.

D/3/72	Murray, James D., 1976, 1999.

D/3/73	Nichol, Karl, 1988.

D/3/74	O'Farrell, Anthony G., 1995.

D/3/75	Oliver, James, 2008.

D/3/76	Poppleton, E.D., 1959-2000.

D/3/77	Queens' College, University of Cambridge, 2006.

D/3/78, D/3/79 Reichel, Wolfgang, 1993-2009.

Two folders.

D/3/80	Rossi, L.E., 1969-1988.

D/3/81	Ski Club of Great Britain, 2011.

D/3/82	Smith, Catherine I., 1998-2007.

D/3/83, D/3/84 Socolescu, Dan, 1976-1983.

Two folders.

D/3/85	Stenzel, Joachim, 1985.

D/3/86	Swinnerton-Dyer, Sir Peter, 1977.

D/3/87	Velsen, Dorothee von, 1960-1966.

D/3/88	Warnock, Baroness Mary, 1991, 1993.

D/3/89	Wiley, John, 1982.

D/3/90, D/3/91 The Wolf Foundation, 2006-2007.

Correspondence relating to the nomination of V. Maz'ya for the Wolf Prize in Mathematics.

Two folders.

D/4   **MISCELLANEOUS CORRESPONDENCE**   **1949-2015**

This sub-section contains a chronological sequence of folders described by Fraenkel as 'miscellaneous correspondence'. The earlier folders, covering 1949 to 1984, are numbered (I-XIV).

D/4/1, D/4/2   I, 1949-1954.

Two folders.

D/4/3, D/4/4   II, 1954-1955.

Two folders.

D/4/5, D/4/6   III, 1956-1957.

Two folders.

D/4/7   IV (USA), 1957-1958.

D/4/8   V (USA), 1958.

D/4/9-D/4/11   VI, 1958-1961.

Three folders.

D/4/12-D/4/14   VII, 1961-1964.

Three folders.

D/4/15-D/4/18   VIII, 1964-1968.

Four folders.

D/4/19   VIII A (New York), 1966.

D/4/20   VIII B, 1968.

D/4/21-D/4/23   IX, 1968-1969.

Three folders.

D/4/24-D/4/27   X, 1970-1971.

Four folders.

D/4/28   X A, 1971.

D/4/29-D/4/32   XI, 1971-1973.

Four folders.

D/4/33-D/4/36   XII, 1973-1974.

Four folders.

D/4/37-D/4/39   XIII, 1974-1975.

Three folders.

D/4/40-D/4/44   XIV, 1975-1977.

Includes a colour photographic print of Fraenkel with colleagues.

Five folders.

D/4/45-D/4/47   XV, 1977-1978.

Three folders.

D/4/48-D/4/50	XVI, 1978-1979. Three folders.
D/4/51-D/4/53	XVII, 1980. Three folders.
D/4/54-D/4/56	XVIII, 1981-1982. Three folders.
D/4/57	[XVIII A] Letters received in Chicago, October to December 1981.
D/4/58-D/4/61	XIV, 1982-1984. Four folders.
D/4/62-D/4/64	1984-1985. Three folders.
D/4/65-D/4/68	1985-1986. Four folders.
D/4/69	Minneapolis,1986.
D/4/70-D/4/72	1987-1988. Three folders.
D/4/73, D/4/74	1988-1989. Two folders.

D/4/75, D/4/76	1989-1990. Two folders.
D/4/77, D/4/78	1990-1991. Two folders.
D/4/79, D/4/80	1991-1992. Two folders.
D/4/81, D/4/82	1992-1993. Two folders.
D/4/83-D/4/85	1993-1994. Three folders.
D/4/86-D/4/88	1995-1996. Three folders.
D/4/89-D/4/92	1997-1999. Four folders.
D/4/93-D/4/95	2000-2002. Three folders.
D/4/96-D/4/98	2003-2009. Three folders.

D/4/99   2010-2015.

D/5   **ADDRESSES**   **nd**

                    This sub-section contains Fraenkel's address book and contacts index.

D/5/1   Hardback (black) address book A-Z.

D/5/2, D/5/3   Set of index address cards A-Z.

                    Two folders.

SECTION E   **PUBLICATIONS AND WRITING**   **E/1-E/3**

This section contains material relating to Fraenkel's publications and writing. It comprises working notes, draft material, preprints and correspondence spanning six decades from 1950 to 2018. A complete list of Fraenkel's publications compiled by Professors John Toland and Geoffrey Burton can be found in sub-section E/3.

E/1/1-100   DRAFT MATERIAL AND REPRINTS

E/2/1-7   UNPUBLISHED MATERIAL

E/3/1   LIST OF PUBLICATIONS

E/1　　　　　　　**DRAFT MATERIAL AND REPRINTS**　　　　　　　**1950-2018**

This sub-section contains reprints, draft material and working notes relating to published reports and papers written by Fraenkel.

The material is arranged chronologically by date of publication.

E/1/1　　　'The External Drag of Some Pitot-Type Intakes at Supersonic Speeds: Part I' by L.E. Fraenkel, Royal Aircraft Establishment, Report No. Aero. 2380, 1950.

E/1/2　　　'The External Drag of Some Pitot-Type Intakes at Supersonic Speeds: Part II' by L.E. Fraenkel, Royal Aircraft Establishment, Report No. Aero. 2422, (1951).

E/1/3　　　'Calculations of the Pressure Distributions and Boundary Layer Development on a Body of Revolution with Various Parabolic Afterbodies at Supersonic Speeds' by L.E. Fraenkel, Royal Aircraft Establishment, Report No. Aero. 2482, 1953.

Includes manuscript and typescript notes.

E/1/4　　　'Some Curves for Use in Calculations of the Performance of Conical Centrebody Intakes at Supersonic Speeds and at Full Mass Flow' by L.E. Fraenkel, Ministry of Supply, Aeronautical Research Council, CP No. 108, 1953.

E/1/5　　　'Curves for Estimating the Wave Drag of Some Bodies of Revolution, based on Exact and Approximate Theories' by L.E. Fraenkel, Ministry of Supply, Aeronautical Research Council, CP No. 136, 1953.

E/1/6　　　'On the Vertical Water Entry of a Slender Cone' by L.E. Fraenkel, Royal Armaments Research Development Establishment, memorandum (B) 22/58, 1958.

Includes 1p manuscript covering note, 1 January 1987.

E/1/7　　　Manuscript notes relating to 'Supersonic Flow Past Slender Bodies with Discontinuous Profile Slope' by L.E. Fraenkel, H. Portnoy, *Aeronautical Quarterly*, 05/1955, 6(2), pp114-124, 1955.

E/1/8　　　Manuscript and typescript notes relating to 'The Wave Drag of Wing-quasi-cylinder Combinations at Zero Incidence' by L.E. Fraenkel, *Aeronautical Quarterly*, 02/1958, 9(1), pp55-70, 1958.

E/1/9-E/1/11　　　Manuscript notes relating to 'Incompressible Flow Past Quasi-Cylindrical Bodies, and Some Associated Problems' by L.E. Fraenkel, *Quarterly Journal of Mechanics and Applied Mathematics*, II, pp212-222, 1958.

Three folders.

E/1/12-15　　　Manuscript notes relating to 'A Cylindrical Sound Pulse in a Rotating Gas' by L.E. Fraenkel, *Journal of Fluid Mechanics*, 5, pp637-649, 1959.

Four folders.

E/1/16, E/1/17　　　Manuscript notes relating to 'A Shallow-liquid Theory in Magnetohydrodynamics' by L.E. Fraenkel, *Journal of Fluid Mechanics*, 7, pp81-107, 1960.

Two folders.

E/1/18　　　Manuscript notes relating to 'On Benjamin's Theory of Conjugate Vortex Flows' by L.E. Fraenkel, *Journal of Fluid Mechanics*, 28, pp85-96, 1967.

E/1/19　　　Manuscript notes relating to 'On the Method of Matched Asymptotic Expansions: I' by L.E. Fraenkel, *Proceedings of the Cambridge Philosophical Society*, 65, pp209-231, 1969.

E/1/20　　　Manuscript notes relating to 'On the Method of Matched Asymptotic Expansions: II' by L.E. Fraenkel, *Proceedings of the Cambridge Philosophical Society*, 65, pp233-261, 1969.

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E/1/21	Manuscript notes relating to 'On the Method of Matched Asymptotic Expansions: III' by L.E. Fraenkel, *Proceedings of the Cambridge Philosophical Society*, 65, pp263-284, 1969.
E/1/22	Manuscript notes relating to 'On the Asymptotic Solution of a Nonlinear Dirichlet Problem' by L.E. Fraenkel, M.S. Berger, *Journal of Mathematics and Mechanics*, 19, pp553-585, 1970.
E/1/23	Manuscript notes relating to 'On Singular Perturbations of Nonlinear Operator Equations' by L.E. Fraenkel, M.S. Berger, *Indiana University Mathematics Journal*, 20, pp 623-631, 1971.
E/1/24-E/1/32	Manuscript notes relating to 'Examples of Steady Vortex Rings of Small Cross-Section in an Ideal Fluid' by L.E. Fraenkel, *Journal of Fluid Mechanics*, 51, pp119-135, 1972.
	Nine folders.
E/1/33	Manuscript notes relating to 'On a Theory of Laminar Flow in Channels of a Certain Class: II' by L.E. Fraenkel, *Proceedings of the Cambridge Philosophical Society*, 73, pp361-390, 1973.
E/1/34-E/1/37	Manuscript notes relating to 'A Global Theory of Steady Vortex Rings in an Ideal Fluid' by L.E. Fraenkel, M.S. Berger, *Bulletin of American Mathematical Society*, 79, pp806-810, 1973 and *Acta Mathematica*, 132:1-2, pp13-51, 1974.
	Four folders.
E/1/38	Manuscript notes and correspondence relating to 'On a Theory of Laminar Flow in Channels of a Certain Class: II' by L.E. Fraenkel, P.M. Eagles, *Mathematical Proceedings of the Cambridge Philosophical Society*, 77, pp199-224, 1975.
E/1/39	First and second proof of 'Formulae for High Derivatives of Composite Functions' by L.E. Fraenkel, *Mathematical Proceedings of the Cambridge Philosophical Society*, 83, pp159-165, 1978.

E/1/40, E/1/41	Correspondence, notes and reprint relating to 'Steady Solutions of the Navier-Stokes Equations Representing Plane Flow in Channels of Various Types' by L.E. Fraenkel, C.J. Amick, *Acta Mathematica*, 144:1-2, pp 83-152, 1980.
	Two folders.
E/1/42	Typescript draft (annotated) with manuscript notes relating to 'Non-Linear Desingularization in Certain Free-Boundary Problems' by L.E. Fraenkel, M.S. Berger, *Communications in Mathematical Physics*, 77, pp149-172, 1980.
E/1/43	Annotated proof of 'Completeness Properties in L_2 of the Eigenfunctions of Two Semi-Linear Differential Operators' by L.E. Fraenkel, *Mathematical Proceedings of the Cambridge Philosophical Society*, 88, pp451-468, 1980.
E/1/44	Annotated proof of 'A Numerical Sequence and a Family of Polynomials Arising from a Question of Completeness' by L.E. Fraenkel, *Mathematical Proceedings of the Cambridge Philosophical Society*, 88, pp 469-481, 1980.
E/1/45	Notes, correspondence and draft material relating to 'A Lower Bound for Electrostatic Capacity in the Plane' by L.E. Fraenkel, *Proceedings of the Royal society of Edinburgh*, 88A, pp267-273, 1981.
E/1/46	'On the Stokes Conjecture for the Wave of Extreme Form' by C.J. Amick, L.E. Fraenkel, J.F. Toland, *Acta Mathematica*, 148, pp193-214, 1982.
E/1/47	Manuscript notes relating to 'On the Embedding of $C^1(\overline{\Omega})$ in $C^{0,\alpha}(\overline{\Omega})$' by L.E. Fraenkel, *Journal of the London Mathematical Society*, 26(2), pp290-298, 1982.
E/1/48	Offprint (copy) and manuscript notes (copy) relating to 'The Uniqueness of Hill's Spherical Vortex' by L.E. Fraenkel, C.J. Amick, *Archive for Rational Mechanics and Analysis*, 92(2), pp91-119, 1986.
E/1/49	Offprint (copy) and manuscript notes relating to 'On the Behaviour Near the Crest of Waves of Extreme Form' by L.E. Fraenkel, C.J. Amick, *Transactions of the American Mathematical Society*, 299, pp273-298, 1987.

E/1/50	'The Uniqueness of a Family of Steady Vortex Rings' by C.J. Amick, L.E. Fraenkel, *Archive for Rational Mechanics and Analysis*, 100(3), 1988, pp207-241, 1988.
E/1/51	Typescript draft and correspondence relating 'On Steady Vortex Rings with Swirl and a Sobolev Inequality' by L.E. Fraenkel, *Progress in Partial Differential Equations* edited by C. Bandle et al., 1992.
E/1/52-E/1/55	Manuscript notes and correspondence relating to 'The Capacity of Slender Toroidal Sets in $\mathbb{R}^N$' by L.E. Fraenkel, *Archive for Rational Mechanics and Analysis*, 118, pp116-193, 1992.
	Four folders.
E/1/56-E/1/59	Drafts, notes and annotated reprints relating to 'Some Results for the Entry of a Blunt Wedge into Water' by L.E. Fraenkel, J.B. McLeod, *Philosophical Transactions of the Royal Society*, 355(1724), pp523-535, 1997.
	Four folders.
E/1/60-E/1/88	Notes and draft material relating to *Introduction to Maximum Principles and Symmetry in Elliptic Problems* by L.E. Fraenkel, Cambridge University Press, 2000, 1991-1998.
E/1/60	File A, *c* 1991-1997.
E/1/61	File B, 1994.
E/1/62	Notepad C, 1994
E/1/63	Notepad D, 1994.
E/1/64	File E, *c* 1996.
E/1/65	File F, *c* 1997.

E/1/66	Notepad G, 1996-1997.
E/1/67	Notepad T, 1995.
E/1/68	Notepad containing notes on sources, 1997.
E/1/69	Notepad containing notes relating to printing the book, *c* 1998.
E/1/70	Typescript drafts (annotated) relating to the preface and preamble entitled 'Some notation, terminology and basic calculus', 1998.
E/1/71	20pp typescript draft (annotated) entitled 'Introduction', 1997.
E/1/72, E/1/73	Manuscript and typescript drafts relating to a chapter (2) entitled 'Some maximum principles for elliptic equations', nd.
	Two folders.
E/1/74	20pp manuscript draft relating to a chapter (T) entitled 'Symmetry for a non-linear equation in a symmetric set Ω', 1998.
E/1/75	35pp manuscript draft relating to a chapter (3) entitled 'Symmetry for the non-linear Poisson equation in $\mathbb{R}^N$ ', 1998.
E/1/76	39pp manuscript draft relating to a chapter entitled (4) 'Symmetry in a bounded region Ω', 1998.
E/1/77	27pp manuscript draft relating to a chapter (5) entitled 'Monotonicity of positive solutions in a bounded set Ω', 1998.
E/1/78	55pp manuscript and typescript draft relating to Appendix A entitled 'On the Newtonian Potential', *c* 1998.

E/1/79	53pp manuscript draft relating to Appendix B entitled 'Rudimentary facts about harmonic functions and the Poisson equation', *c* 1998.
E/1/80	8pp manuscript draft relating to Appendix C entitled 'Construction of the primary function of Siegel Type', *c* 1998.
E/1/81	28pp manuscript draft relating to Appendix D entitled 'On the divergence theorem and related matters', *c* 1998.
E/1/82	19pp manuscript draft relating to Appendix E entitled 'The edge-point lemma', *c* 1998.
E/1/83	Manuscript notes relating to appendices B and D, nd.
E/1/84	Miscellaneous manuscript and typescript untitled miscellaneous notes, nd.
E/1/85, E/1/86	Manuscript master copies of solutions to exercises, nd. Two folders.
E/1/87	10pp manuscript notes on sources, 1997.
E/1/88	8pp typescript notes on references, 1997.
E/1/89	Correspondence, draft material, notes, and published text of an oration for Professor John Raymond Willis, FRS, Doctor of Science, University of Bath, 2007.
E/1/90, E/1/91	Manuscript notes and text relating to 'On the Increase of Capacity with Asymmetry' by L.E. Fraenkel, *Computational Methods and Function Theory*, 8, pp203-224, 2008. Two folders.

E/1/92	Correspondence relating to reviewer's remarks and alterations to 'On Kelvin-Stuart Vortices in a Viscous Fluid' by L.E. Fraenkel, *Philosophical Transactions of the Royal Society*, A 366, pp2727-2728, 2008.
E/1/93, E/1/94	Manuscript notes, correspondence, and draft material relating to 'On the Local Uniqueness and the Profile of the Extreme Stokes Wave' by L.E. Fraenkel, *European Journal of Applied Mathematics*, 21, pp137-163, 2010 and 'The Behaviour Near the Crest of an Extreme Stokes Wave', *European Journal of Applied Mathematics*, 21, pp65-180, 2010. Two folders.
E/1/95	Correspondence and draft material relating to 'On a Singular Initial-Value Problem for the Navier-Stokes Equations' by L.E. Fraenkel, M.D. Preston, *Mathematika*, 61(2), pp277-294, 2015.
E/1/96-E/1/100	Manuscript notes, correspondence, and draft material relating to 'Frederick Gerard Friedlander 25 December 1917-20 May 2001' by L.E. Fraenkel, D.E. Edmunds, M. Pemberton, *Biographical Memoirs of Fellows of the Royal Society*, 2018. Five folders.

E/2	**UNPUBLISHED MATERIAL**	***c* 1987-2013**

This sub-section contains a small amount of material relating to writings by Fraenkel that were not published.

E/2/1	44pp typescript with illustrative figures entitled 'Hyperbolic Phenomena in a Linear Model of Viscoelastic Flow Past a Plate' by L.E. Fraenkel, nd *c* 1987.
E/2/2-E/2/7	Notes, correspondence and draft material relating to a proposed paper on water entry of wedge by L.E. Fraenkel and J.B. McLeod, 2009-2013.
E/2/2-E/2/5	Correspondence and notes, 2010-2014. Four folders.

E/2/6   Notes by J.B. McLeod, 2009-2010.

E/2/7   Manuscript draft (copy) entitled 'Water Entry', 28 October 2013.

E/3   **LIST OF PUBLICATIONS**   **2020**

E/3/1   3pp typescript listing of Franekel's publications compiled by Professor John
               Toland and Professor Geoffrey Burton as part of their work on the *Royal
               Society* memoir for Fraenkel, 2020.

SECTION F   **VISITS, CONFERENCES AND APPOINTMENT DIARIES**   **F/1-F/3**

This section contains material relating to Fraenkel's worked-related visits, the conferences, both domestic and international, that he attended, and lectures and talks he gave outside of his regular teaching timetable. Sometimes the exact location and audience of the talk is not known.

The section also contains notes taken by Fraenkel when he attended lectures, talks and seminars given by others. It includes a series of notes labelled 'Sussex Seminars' made by Fraenkel at seminars led by colleagues and visiting academics hosted by the University of Sussex.

Fraenkel's appointment diaries covering the period from 1952 to 2018 and used as an aide-memoir of professional and private activities are also presented in this section.

F/1/1-167   VISITS AND CONFERENCES

F/2/1-4   SUSSEX SEMINARS

F/3/1-60   APPOINTMENT DIARIES

F/1	**VISITS AND CONFERENCES**	**1957-2016**

This sub-section contains a long sequence of material relating to nearly fifty years of conferences attended and visits made by Fraenkel. The original order he imposed has been preserved as far as possible and, because it was organised more as a working resource than as final a record of the lectures, seminars and talks he gave at a wide range of events, there is some overlapping and repetition of content.

The presentation is chronological.

F/1/1   'Talks'. Contents of folder so labelled, 1957-1979.

F/1/2-F/1/4   California Institute of Technology, Pasadena, California, USA, 1957-1958.

Fraenkel was on sabbatical as a visiting assistant professor at the California Institute of Technology during 1957 and 1958.

F/1/2   Manuscript notes relating to lectures on transonic flow by Julian David Cole, 1957.

F/1/3   Manuscript notes relating to lectures on transonic flow by Julian David Cole, 1958.

F/1/4   Manuscript notes relating to lectures on magnetohydrodynamics by Julian David Cole and Hans Wolfgang Liepmann, 1958.

F/1/5, F/1/6   University of St Andrews, Scotland, UK, 15-25 July 1964.

F/1/5   Manuscript notes relating to lectures entitled 'Erdelyi: Distributions', nd.

Arthur Erdelyi was professor of mathematics at the University of Edinburgh, Scotland, UK.

F/1/6   Untitled manuscript lecture notes, nd.

F/1/7   2pp manuscript lecture notes entitled 'Laminer Flow in Channels with Slightly Curved Walls', 1964.

F/1/8   8pp manuscript lecture notes entitled 'Vortex Rings of Permanent Form', 1965.

F/1/9   5pp manuscript lecture notes relating to a method of matched asymptotic expansion, January 1966.

F/1/10   Courant Institute for Mathematical Sciences, New York, USA, 1966.

Fraenkel spent three months at the Courant Institute at the end of 1966.

Manuscript notes relating to lectures on mathematical physics by Kurt Otto Friedrichs, 11 October-20 December 1966.

F/1/11-F/1/15   Instructional Conference on Differential Equations, University of Edinburgh, Scotland, UK, 18-22 September 1967.

Typescript texts of lectures.

Five folders.

F/1/16   11pp manuscript lecture notes entitled 'Miscellaneous Checks and Calculations for Edinburgh Notes on b.l. similarity solutions', 1967.

F/1/17   6pp manuscript lecture notes entitled 'On Vortex Rings of Permanent Form in an Ideal Fluid', 1968.

F/1/18   3pp manuscript lecture notes entitled 'Waterfall', *c* 1968.

F/1/19   3pp manuscript lecture notes entitled 'On a Class of Linear p.d.e.'s with Slowly Varying Coefficients', c 1968.

F/1/20, F/1/21	Seminars on partial differential equations, University of Sussex, Brighton, UK, May-June 1970.
F/1/20	Programme information, correspondence and notes, 2 March-22 June 1970.
F/1/21	Notes relating to lectures, 1970.
F/1/22	Seminars, University of Essex, Colchester, Essex, UK, 26-30 July 1971.
	5pp untitled manuscript notes, 1971.
F/1/23	6pp manuscript notes entitled 'Laminar Flow in Channels of a Certain Class', December 1971.
F/1/24	Seminars, University of Essex, Colchester, Essex, UK, 28 August-1 September 1972.
	3pp untitled manuscript notes, 1972.
F/1/25	Symmetrization and Discontinuous $f(x, u)$, University of Sussex, Brighton, UK, September 1972.
	Fraenkel spent the week beginning 28 August 1972 at the University of Sussex.
	Correspondence and lecture notes.
F/1/26	4pp manuscript lecture notes entitled 'Steady Vortex Rings in the Large', Bradford, UK, 1 November 1972.
F/1/27	Conference on Techniques of Asymptotic Expansion, University of Sussex, Brighton, UK, 3-5 January 1973.
	Programme, typescript texts and manuscript lecture notes.
F/1/28	4pp manuscript notes entitled 'Steady Vortex Rings in the Large', January 1974.

F/1/29	3pp manuscript notes entitled 'Steiner Symmetrization and All That', Southampton, UK, 28 May 1974.
F/1/30	3pp manuscript notes entitled 'Tubular Solenoidal Vector Fields', Essex, UK, December 1974.
F/1/31	Conference, Göttingen, Federal Republic of Germany, 2-5 April 1975.
	Papers, illustrative figures and manuscript notes relating to German and English language versions of a lecture by Fraenkel entitled 'Boundary Value Problems for the Steady Navier-Stokes Equations'.
F/1/32	2pp manuscript notes entitled 'II Decomposition of $L_2(\Omega \rightarrow R^3)$', Glasgow, Scotland, UK, May 1975.
F/1/33	5pp manuscript notes entitled 'A First Lesson in Mathematical Hydrodynamics', London Mathematical Society, London, UK, 17 October 1975.
F/1/34	3pp manuscript notes entitled 'Steady Vortex Rings in the Large', Stuttgart/Darmstadt, Federal Republic of Germany, November 1975.
F/1/35-F/1/38	Partial Differential Equations Symposium, London Mathematical Society, Durham University, Durham, UK, 12-23 July 1976.
	Fraenkel was involved in the organisation of the event.
	Correspondence and papers relating to arrangements, programme, lists of delegates and speakers, black and white photograph of attendees and symposium report, 1974-1977.
	Four folders.
F/1/39	2pp manuscript notes entitled 'Regularized Distance and Related fns.', Sussex, UK, June 1977.

F/1/40   Navier-Stokes Equations, University of Stuttgart, Federal Republic of
         Germany, 4 February 1978.

         Manuscript notes with illustrative figures.

F/1/41   Symposium on Fluid Dynamics, University of Toronto, Ontario, Canada, 5-8
         June 1978.

         Fraenkel gave a lecture entitled 'On Steady Solutions of the Navier-Stokes
         Equations Representing Flows in Infinite Channels'.

         Correspondence relating to arrangements, notes, programme and book of
         abstracts, 1977-1978.

F/1/42   Mathematical Theory of the Navier-Stokes Equations, Ecole Polytechnique,
         Lausanne, Switzerland, March-April 1979.

         Manuscript and typescript notes.

F/1/43   Talk on symmetrisation, University of Massachusetts at Amherst, Amherst,
         Massachusetts, USA, 4 September 1979.

         Hardback notebook.

         See also F/1/44.

F/1/44   Conference, Heriot-Watt University, Edinburgh, Scotland, UK, 9-13
         September 1979.

         3pp manuscript notes by Luc Tartar on solenoidal extension of given vector
         field on boundary.

         See also F/1/43.

F/1/45   11pp manuscript notes on a tutorial and lecture given by Luc Tartar, April
         1980.

F/1/46   Lecture series Trento, Italy, March-April 1981.

         Manuscript and typescript notes on steady vortex rings and the Stokes
         conjecture for the water wave of extreme form.

F/1/47   Manuscript and typescript notes entitled 'Dirichlet's Principle and the
         Sobolev space W_2^{1}', Aberdeen, Scotland, UK, 1 May 1981.

F/1/48   4pp manuscript notes with illustrative figures entitled 'A Set of Navier-Stokes
         Solutions Exhibiting Flow Separation', Northwestern University, Illinois, USA,
         26 October 1981.

F/1/49   7pp manuscript notes relating to talks on steady vortices, Department of
         Mathematics, University of Chicago, Illinois, USA, 30 October 1981 and 9
         December 1981.

F/1/50   Systems of Nonlinear Partial Differential Equations, NATO/London
         Mathematical Society Advanced Study Institute, Hertford College, University
         of Oxford, Oxford, UK, 25 July-7 August 1982.

         Programme, abstracts, list of delegates and 1p manuscript notes.

F/1/51   3pp manuscript notes entitled 'On the Divergence Theorem', University of
         Bath, Bath, UK, 21 January 1983.

F/1/52   Mathematics Research Centre, University of Wisconsin-Madison, Madison,
         Wisconsin, USA, *c* April-May 1983.

         Manuscript notes with illustrative figures entitled 'Steady Vortex Rings'.

F/1/53   3pp manuscript notes entitled 'A Little Uniqueness in the Theory of Steady
         Vortex Rings', Northwestern University, Illinois, USA, 4 June 1983.

F/1/54   London Mathematical Society/SERC Symposium on Potential Theory,
         Durham University, Durham, UK, 11-22 July 1983.

         Correspondence and papers relating to arrangements, programme, notes
         and abstracts.

F/1/55   American Mathematical Society Meeting, Albany, New York, USA, 8-11 August 1983.

Correspondence and papers relating to arrangements, programme and abstracts, 1983.

F/1/56   Seminar, Heriot-Watt University, Edinburgh, Scotland, UK, 22 June-17 July 1984.

Fraenkel presented papers entitled 'On the Behaviour near the Crest of Extreme Water Waves' and 'Some Effects of Bad Boundaries $\partial\Omega$ on the Spaces $C^k(\bar{\Omega})$ and $W_p^m(\Omega)$'.

Papers relating to arrangements, programme, and manuscript lecture notes

F/1/57   London Mathematical Society Symposium on Bifurcation Theory and Applications, Durham University, Durham, UK, 22 July-1 August 1984.

Programme, correspondence and papers relating to arrangements, and list of delegates.

F/1/58-F/1/60   'Special lectures', University of Sussex, Brighton, UK, 1984-1987.

F/1/58   9pp manuscript lecture notes entitled 'Material Co-ordinates in Inviscid Rotational Flow', October 1984.

F/1/59   9pp manuscript lecture notes entitled 'An Embedding Theorem of Trudinger', November 1985.

F/1/60   8pp manuscript lecture notes entitled 'Symmetrization and the Spectrum of the Laplace Operator', June 1987.

F/1/61   2nd Gregynog Symposium on Differential Equations, Gregynog, Newtown, Powys, Wales, UK, 1-5 July 1985.

Programme, correspondence and papers relating to arrangements, list of delegates, abstracts, and manuscript notes on lectures.

F/1/62   Free Boundary Problems Conference, Mathematical Research Institute of Oberwolfach, Baden-Württemberg, Federal Republic of Germany, 15-21 September 1985.

Papers and correspondence relating to arrangements, programme, abstracts, and manuscript notes.

F/1/63   One-Day meeting on Functional Theory, University College London, London, UK, 23 September 1985.

Manuscript notes (copy) entitled 'An Exercise set by Nirenberg: In a Real Two-Dimensional Banach Space …'.

F/1/64   3pp manuscript notes (copy) entitled 'If the Plane is Merely Normed, What Length can the Norm Give to the Boundary of the Unit Ball?', University of Sussex, Brighton, UK, October 1985.

F/1/65   Lecture notes relating to a problem posed by Daniel Donald Joseph on viscoelastic flow and the space B_μ, 1986-1989.

F/1/66   Visit to Mathematical Institute, University of Oxford, Oxford, UK, September 1987-March 1988.

Correspondence relating to arrangements.

F/1/67   2pp manuscript notes entitled 'Recent Progress in the Theory of Steady Vortex Rings', University of Bristol, Bristol, UK, 19 January 1989.

F/1/68   Carbery Workshop, University of Sussex, Brighton, UK, 15, 16 June 1989.

Manuscript notes.

F/1/69   Lectures on 'Symmetry by Way of the Maximum Principle', University of Pittsburgh, Pennsylvania, USA, 2, 10 and 24 October 1989.

Manuscript notes.

F/1/70 — Manuscript notes with illustrative figures entitled 'On the Logarithmic Potential of Line Segment and L-Capacity', University of Bath, Bath, UK, June 1990.

Fraenkel became Professor of Mathematics at the University of Bath in 1988 but his inaugural lecture did not take place until May 1990.

See also B/1/2 and B/1/3.

F/1/71 — Manuscript notes and overhead projector transparencies relating to vortex rings and Hilbert space, June 1990.

F/1/72, F/1/73 — Mathematical Problems in Nonlinear Elasticity, Conference, Mathematical Research Institute of Oberwolfach, Baden-Württemberg, Germany, 24-30 June 1990.

Correspondence and papers relating to arrangements, programme, abstracts and lecture notes entitled 'On the Newtonian Potential and Steady Vortex Rings'.

Two folders.

F/1/74, F/1/75 — Nonlinear Dynamics in Mathematics and Science Symposium, University of Massachusetts at Amherst, Amherst, Massachusetts, USA, 19 October 1990.

Correspondence and papers relating to arrangements, programme, abstracts and manuscript notes.

Two folders.

F/1/76 — Manuscript and typescript notes on lectures by Francis Edward Burstall, University of Bath, Bath, UK, December 1990-1991.

F/1/77 — 4pp manuscript notes entitled 'Capacity of Slender Toroidal Sets', University of Sussex, Brighton, UK, 18 February 1991.

F/1/78 — Manuscript notes with overhead projector transparencies entitled 'Symmetry by Way of the Maximum Principle', École Polytechnique Fédérale de Lausanne, Switzerland, March 1991.

F/1/79, F/1/80 — First European Conference on Elliptic and Parabolic Problems, Pont-à-Mousson, France, 17-21 June 1991.

Correspondence and papers relating to arrangements, programme, abstracts and manuscript notes.

Two folders.

F/1/81, F/1/82 — The Mathematics of Nonlinear Systems Conference, University of Bath, Bath, UK, 1-5 July 1991.

Correspondence and papers relating to arrangements, programme, and manuscript lecture notes with overhead transparencies entitled 'Water Entry of a Wedge'.

Two folders.

F/1/83 — Manuscript notes with overhead projector transparencies entitled 'Capacity of Slender Toroidal Sets', Oxford, UK, November 1991.

F/1/84 — 'Applied Dynamics and Bifurcation Theory' Conference in honour of Klaus Kirchgässner, Mathematical Research Institute of Oberwolfach, Baden-Württemberg, Federal Republic of Germany, 12-18 January 1992.

Correspondence and papers relating to arrangements, programme, black and white group photograph of delegates, and abstracts.

F/1/85 — 2nd Fourier Analysis Workshop, University of Sussex, Brighton, UK, 10-14 August 1992.

Correspondence and papers relating to arrangements, programme, and notebook.

F/1/86 — Conference in honour of James B. Serrin, Ferrara, Italy, 26-30 October 1992.

Fraenkel initially accepted an offer to attend this conference but a cycling accident prevented him from doing so.

Correspondence and papers relating to arrangements and abstract.

F/1/87   University of Pittsburgh and Carnegie-Mellon University Joint Colloquium on Phragmèn-Lindelöf Theory for Subharmonic Functions, University of Pittsburgh, Pittsburgh, Pennsylvania, USA, 29 January 1993.

Abstract, lecture notes and overhead projector transparencies.

F/1/88   Workshop on Mathematical Problems in Viscoelasticity, Center for Nonlinear Analysis, Carnegie Mellon University, Pittsburgh, Pennsylvania, USA, 4-6 February 1993.

Programme, manuscript notes and overhead projector transparencies.

F/1/89   George Green Bicentennial Celebration, The Royal Society, London, UK, 16 July 1993.

Programme, list of participants and text of lectures given by Julian Schwinger and Freeman Dyson.

F/1/90   One-Day Function Theory Meeting, The Open University, Milton Keynes, UK, 27 September 1993.

Papers and correspondence relating to arrangements, and programme.

F/1/91, F/1/92   Innovations in Multiphase Flow, International Fluid Mechanics Symposium, Minneapolis, Minnesota, USA, 25-27 March 1994.

Fraenkel gave a talk entitled 'On a Toroidal Analogue of the Hadamard-Rybczynski Bubble in Stokes Flow'.

F/1/91   Correspondence and papers relating to arrangements, programme, list of delegates and abstracts.

F/1/92   Fraenkel lecture notes and overhead projector transparencies.

F/1/93, F/1/94   Instructional Conference on Harmonic Analysis and Partial Differential Equations, International Centre for Mathematical Sciences, Edinburgh, Scotland, UK, 5-15 April 1994.

F/1/93   Correspondence and papers relating to arrangements, programme, and list of delegates.

F/1/94   Manuscript and typescript lecture notes.

F/1/95-F/1/97   Instructional Conference on Analytic Aspects of Partial Differential Equations, University of Bath, Bath, UK, 19-24 September 1994.

F/1/95   Correspondence and papers relating to arrangements.

F/1/96, F/1/97   Typescript and manuscript lecture notes entitled 'Maximum Principles for Elliptic Operators'.

Two folders.

F/1/98   One-Day Function Theory Meeting, Imperial College, London, UK, 26 September 1994.

Correspondence and papers relating to arrangements, and programme.

F/1/99   Analytical Approaches in Continuum Mechanics Workshop, London Mathematical Society, London, UK, 26-27 June 1995.

Programme, list of delegates, abstracts, and manuscript lecture notes entitled 'Genuflexion to Electrostatic Capacity'.

F/1/100   One-Day Function Theory Meeting, University of Nottingham, Nottingham, UK, 25 September 1995.

Correspondence and papers relating to arrangements, and programme.

F/1/101   5pp manuscript lecture notes entitled 'Symmetry by Way of the Maximum Principle II', University of Pittsburgh, Pennsylvania, USA, 21 February 1996.

F/1/102   Violent Surface Motion Meeting, Royal Society, London, UK, 16, 17 April 1996.

Fraenkel's paper was entitled 'Some Results for the Entry of a Blunt Wedge into Water'.

Correspondence and papers relating to arrangements, programme, list of delegates, and abstracts.

F/1/103   Visit to the University of Rome, La Sapienza, Italy, 3-13 June 1996.

Correspondence relating to arrangements.

F/1/104   Function Spaces and their Applications Workshop, University of Sussex, Brighton, UK, 21-22 June 1996.

Correspondence relating to arrangements, and programme.

F/1/105   Partial Differential Equations and Spectral Theory Symposium, Durham University, Durham, UK, 24 June-4 July 1996.

Fraenkel's lecture was entitled 'Symmetry by Way of the Maximum Principle: Some Recent Addenda'.

Correspondence and papers relating to arrangements, programme, and manuscript notes.

F/1/106   One-Day Function Theory Meeting, Imperial College, London, UK, 23 September 1996.

Papers relating to arrangements, programme, and manuscript notes.

F/1/107   Nonlinear Partial Differential Equations and Related Topics Workshop, Institut Henri Poincaré, Paris, France, 21-23 May 1997.

Correspondence and papers relating to arrangements, programme, and manuscript notes.

F/1/108   Function Theory Meeting, Cambridge University, Cambridge, UK, 22, 23 September 1997.

Programme and list of delegates.

F/1/109   Lectures on Semi-Groups of Linear Operators by Professor John Toland, University of Bath, Bath, UK, 1997-1998.

Manuscript notes.

F/1/110   Singular Perturbations and Nonlinearities in Continuum Mechanics Workshop, University of Bath, Bath, UK, 5-8 January 1998.

Fraenkel gave a lecture entitled 'Some Results for the Entry of a Blunt Wedge into Water' with J. B. McLeod.

Programme and abstracts.

F/1/111   4pp manuscript notes entitled 'On Symmetry and Asymmetry of Positive Solutions of $\Delta u + f(u) = 0$ when f is Discontinuous' with 12pp typescript proof, University of Bristol, Bristol, UK, 28 April 1998.

F/1/112   3pp manuscript notes and overhead projector transparencies (copy) entitled 'A Maximum Principle for an Elliptic Equation on the Thin set Ω: Part II', University of Pittsburgh, Pittsburgh, Pennsylvania, USA, 24 March 1998.

F/1/113   Manuscript notes (copy) and overhead projector transparencies entitled 'Symmetry by Way of the Maximum Principle', Durham University, Durham, UK, June 1998.

F/1/114   9th British Differential Equations Tour, various UK venues, 11-22 May 1998.

Correspondence and papers relating to arrangements, and programme.

F/1/115   Water Entry of Wedge Workshop, University of Bath, Bath, UK, 6 January 1998.

Manuscript and typescript notes with overhead projector transparencies.

F/1/116   Functional Analysis, Partial Differential Equations and Applications Conference in Honour of Vladimir Maz'ya, Rostock University, Germany, 31 August-4 September 1998.

Correspondence and paper relating to arrangements, list of delegates, programme, and abstracts.

F/1/117 — One-Day Function Theory Meeting, University College London, London, UK, 20 September 1999.

Papers relating to arrangements, programme, and 2pp manuscript notes.

F/1/118 — One-Day Function Theory Meeting, The Open University, Milton Keynes, UK, 21 September 1999.

Papers relating to arrangements, programme, and list of delegates.

F/1/119 — Symmetry by Way of the Maximum Principle: Some Recent Theorems and Counterexamples Seminar, University of Maynooth, Kildare, Republic of Ireland, 24 March 1999.

Correspondence and papers relating to arrangements.

F/1/120 — The British Applied Mathematics Colloquium, University of Bath, Bath, UK, 12-15 April 1999.

Papers relating to arrangements, programme, and abstracts.

F/1/121 — Titchmarsh Centenary Meeting, Mathematical Institute, University of Oxford, Oxford, UK, 1 June 1999.

Papers relating to arrangements, and programme.

F/1/122 — Experimental, Computational and Mathematical Fluid Dynamics Workshop, University of Pittsburgh, Pittsburgh, Pennsylvania, USA, 4-6 November 1999.

Programme and abstracts.

F/1/123 — Manuscript notes with overhead projector transparencies entitled 'A Basic Method for Parabolic Equations', University of Bath, Bath, UK, 17 May 2000.

F/1/124 — Manuscript and typescript notes with overhead projector transparencies entitled 'On Approximating Boundaries $\partial\Omega$ of Class $\mathcal{C}^1$ and $\mathcal{C}^2$', University of Bath, Bath, UK, 24 May 2000.

F/1/125 — 'Partial Differential Equations' Short Course, University of Bath, Bath, UK, 4-8 September 2000.

Fraenkel gave a lecture entitled 'The Newtonian Potential and Nonlinear Poisson Equations'.

Correspondence and papers relating to arrangements, programme, list of delegates, and manuscript and typescript notes.

F/1/126, F/1/127 — 2nd International Conference on 'Boundary Integral Methods: Theory and Applications', University of Bath, Bath, UK, 12 16 September 2000.

Fraenkel gave a lecture entitled 'On the Entry of a Wedge into Water: A Remaining Question'.

F/1/126 — Correspondence and papers relating to arrangements, programme, and abstracts.

F/1/127 — Manuscript notes with overhead projector transparencies.

F/1/128 — Two-Day Function Theory and Function Spaces Meeting, University of Nottingham, Nottingham, UK, 18, 19 September 2000.

Fraenkel gave a lecture entitled 'The Diffusing Vortex Circle: A Singular Solution of the Navier-Stokes Solution'.

Correspondence and papers relating to arrangements, programme, list of delegates, manuscript notes and overhead projector transparencies.

F/1/129 — Some Forgotten Facts About the Neumann Problem Seminar, Cardiff University, Cardiff, Wales, UK, 14 February 2001.

Correspondence relating to arrangements, 3pp manuscript notes and overhead projector transparencies.

F/1/130 — Partial Differential Equations and Function Spaces Conference, University of Sussex, Brighton, UK, 21, 22 September 2001.

Fraenkel gave a lecture entitled 'A Bizarre Banach Space for a Navier-Stokes Problem'.

Correspondence relating to arrangements and programme.

F/1/131 — Fourth Order Parabolic Equations Workshop, University of Bath, Bath, UK, 7-9 January 2002.

Programme, list of delegates, and abstracts.

F/1/132, F/1/133 — Seminaire D'Analyse, École Polytechnique Fédérale de Lausanne, Switzerland, 11 April 2002.

Fraenkel presented two papers entitled 'An Elementary Maximum Principle for Thin Sets' and 'The Diffusing Vortex Circle: A Singular Solution of the Navier-Stokes Equations'.

F/1/132 — Correspondence and papers relating to arrangements.

F/1/133 — Manuscript notes and overhead projector transparencies.

F/1/134-F/1/136 — Seminar, Delft, The Netherlands, 6-10 May 2002.

Fraenkel gave a lecture entitled 'Water Entry of Blunt Wedge'

Correspondence relating to arrangements, notes and overhead projector transparencies.

Three folders.

F/1/137 — International Union of Theoretical and Applied Mechanics (IUTAM) Symposium on Asymptotics, Singularities and Homogenisation in Problems of Mechanics, University of Liverpool, UK, 8-11 July 2002.

Correspondence and papers relating to arrangements, programme, list of delegates, abstracts, and manuscript notes.

F/1/138 — One-Day Function Theory Meeting, London, UK, 16 September 2002.

Programme.

F/1/139 — One-Day Function Theory Meeting, London, UK, 15 September 2003.

Programme.

F/1/140 — Wave Motion Workshop, Mathematical Research Institute of Oberwolfach, Baden-Württemberg, Germany, 25-31 January 2004.

Correspondence and papers relating to arrangements, list of delegates, manuscript notes with overhead projector transparencies, and report.

F/1/141 — 'Bifurcation Theory and Nonlinear Waves' Workshop, École Polytechnique Fédérale de Lausanne, Switzerland, 21-25 June 2004.

Fraenkel gave a lecture entitled 'On Steady Vortex Rings with Swirl and a Mean Helicity'.

Correspondence and papers relating to arrangements and manuscript notes.

F/1/142 — One-Day Function Theory Meeting, London, UK, 20 September 2004.

Correspondence relating to arrangements.

F/1/143 — Series of six lectures by K. W. Morton entitled 'Geometric Integration, Sympletic Maps and Hamiltonian Systems', University of Bath, Bath, UK, *c* September-December 2004.

Typescript and manuscript (copy) notes.

F/1/144 — Manuscript notes (copy) and overhead projector transparencies entitled 'Diffusing Vortex Circle', University College London, London, UK, 2 June 2005.

F/1/145 — Operator Theory and Spectral Analysis Symposium, Durham University, Durham, UK, 2-12 August 2005.

Fraenkel gave a lecture entitled 'A Constructive Existence Proof for the Extreme Stokes Wave'.

Programme, list of delegates, abstracts, manuscript notes, overhead projector transparencies, and photographs.

F/1/146 — Multiscale Problems: Modelling, Analysis and Applications Conference, University of Bath, Bath, UK, 12-14 September 2005.

Programme, list of delegates, and abstracts.

F/1/147   One-Day Function Theory Meeting, London, UK, 19 September 2006.

Fraenkel gave a lecture entitled 'Resolution of a Question Concerning the Entry of a Wedge into Water'.

Correspondence relating to arrangements and programme.

F/1/148   Nonlinear Waves Workshop, Mittag-Leffler Institute, Djursholm, Sweden, 21 September-15 November 2005.

Correspondence relating to arrangements and list of delegates.

F/1/149   One-Day Meeting in Honour of L.E. Fraenkel, University of Bath, Bath, UK, 16 December 2005.

Correspondence and papers relating to arrangements, programme, and manuscript notes (copy) by W. Hayman entitled 'On Fraenkel Asymmetry'.

F/1/150   One-Day Function Theory Meeting, London, UK, 2006.

Fraenkel gave a lecture entitled 'A Modulus of Asymmetry and a Lower Bound for Capacity'.

Correspondence relating to arrangements, programme, and 9pp manuscript notes (copy).

F/1/151   'Theoretical Fluid Dynamics in the 21st Century' Meeting in honour of Trevor Stuart, Imperial College London, UK, 15, 16 December 2006.

Fraenkel gave a lecture entitled 'Past and Future Aspects of Kelvin-Stuart Vortices'.

Correspondence relating to arrangements, programme, and manuscript notes.

F/1/152   Numerical Analysis: Multiscale Methods, Adaptivity and Complexity Workshop, University of Bath, Bath, UK, 4-6 September 2007.

Programme, list of delegates, and abstracts.

F/1/153   One-Day Function Theory Meeting, London, UK, 10 September 2007.

Programme and 8pp manuscript notes.

F/1/154   One-Day Function Theory Meeting, Open University, Milton Keynes, UK, 8 September 2008.

Programme and correspondence relating to arrangements.

F/1/155   Manuscript notes entitled 'Liverpool Talk on Capacity and Asymmetry: Background Notes', Liverpool, UK, 1 October 2008.

F/1/156   Variational and Topological Methods and Water Waves Conference in Honour of the 60th birthday of Professor John Toland on, University of Bath, Bath, UK, 14-16 May 2009.

Correspondence and papers relating to arrangements, programme, list of delegates, and abstracts.

F/1/157   Centre for Mathematical Sciences 50th Anniversary Party, University of Cambridge, Cambridge, UK, 23-25 September 2009.

Papers relating to arrangements, programme, and list of delegates.

F/1/158   Inaugural lecture of Professor Gui-Qiang G. Chen, Keble College, University of Oxford, Oxford, UK, 11 November 2010.

Correspondence relating to arrangements.

F/1/159   New Trends in Spectral Theory and Applications Meeting to Celebrate the 80th Birthday of D. E. Edmunds and the 70th Birthday of W. D. Evans, Cardiff University, Cardiff, Wales, UK, 18-20 December 2010.

Programme, list of delegates, and abstracts.

F/1/160   One-Day Function Theory Meeting, London, UK, 5 September 2011.

Programme.

F/1/161   One-Day Function Theory Meeting, London, UK, 3 September 2012.

Programme.

F/1/162   Bifurcation Theory, Numerical Linear Algebra and Applications Conference in Honour of the 65th Birthday of Professor Alastair Spence on, University of Bath, Bath, UK, 1, 2 July 2013.

Papers relating to arrangements, programme, list of delegates, and abstracts.

F/1/163   Analysis of Partial Differential Equations Symposium in Honour of 75th Birthday of Vladimir Maz'ya on, University of Liverpool, Liverpool, UK, 16, 17 December 2013.

Fraenkel gave a lecture entitled 'A Singular Initial-Value Problem for the Navier-Stokes Equations'.

Papers relating to arrangements, programme, abstracts, list of delegates, and overhead projector transparencies.

F/1/164   One-Day Function Theory Meeting, London, UK, 1 September 2014.

Abstracts.

F/1/165   Bryce McLeod Memorial Event, University of Oxford, Oxford, UK, 30 May 2015.

Programme and abstracts.

F/1/166   One-Day Function Theory Meeting, London, UK, 7 September 2015.

Programme and abstracts.

F/1/167   Young Applied Analysts in the UK Conference, University of Bath, Bath, UK, 26, 27 May 2016.

Programme and abstracts.

F/2   **SUSSEX SEMINARS**   **1975-1987**

This sub-section comprises the contents of a folder containing notes made by Fraenkel on seminars presented at the University of Sussex by various colleagues between 1975 and 1987. The notes are arranged in date order.

F/2/1-F/2/4   'Sussex Seminars.' Contents of folders so labelled divided into four for ease of reference.

F/2/1   Manuscript notes relating to seminars hosted by the University of Sussex (Mathematics Division), Brighton, UK, 1975.

The dates and last names of the seminar speakers are as follows:
Stampacchia with Brézis, 3 March 1975
Conway, 6 October 1975
Toland, 10 October 1975
Peletier, 21 October 1975
Eells, 24 October 1975
Wood, 12 December 1975
Thompson, 19 December 1975.

F/2/2   Manuscript notes relating to seminars hosted by the University of Sussex (Mathematics Division), Brighton, UK, 1976-1977.

The dates and last names of the seminar speakers are as follows:
Willmore, 23 January 1976
Evans, 6 February 1976
Taylor, 13 February 1976
McLeod, 27 February 1976
Fishel, 23 April 1976
Brézis and Browder, 30 July 1976
Hess, 6 August 1976
Brézis, 25 August, 1 September 1976
Singer, 4 February 1977
Hempel, 23 May 1977
Nirenberg, 18 July 1977
Ringrose, 11 November 1977
Swinnerton-Dyer, 14 November 1977
Ortiz, 28 November 1977.

F/2/3   Manuscript notes relating to seminars hosted by the University of Sussex (Mathematics Division), Brighton, UK, 1978-1980.

The dates and last names of the seminar speakers are as follows:
Aronson, 2 June 1978
Dancer, 2, 17 October and 13 November 1978
Roy, 11 May 1979
Martin, 23 May 1979
McKean, 26 November 1979
Ball, 12 June 1980
Fleckinger, 8 October 1980
Goldstein, 13 October 1980
Whiteman, 24 October 1980
Li Ta-Tsien, 26 October 1980
Garling, 5 December 1980.

F/2/4   Manuscript notes relating to seminars hosted by the University of Sussex (Mathematics Division), Brighton, UK, 1981-1987.

The dates and last names of the seminar speakers are as follows:
Goldstein, 22 January 1981
Greiner, 27-30 April 1981
Keady, 14 April 1982
Friedlander, 11 February 1983
Everitt, 4 March 1983
Bushell, March 1984
Haigh, 26 October 1984
'P.J.B.'; 21 June 1985
Triebel, 25 June 1985
Wei-Ming Ni, 28 June 1985
Carbery, 9 December 1985
Bushell, 27 January 1986
Toland, 12 May 1986
Falconer, 19 January 1987
Cobos, 26 January 1987
Ball, 2 February 1987
Gillespie, 9 February 1987
Sogge, 23 February 1987
Seeger, 6 March 1987
Canavatis, July 1987.

F/3   **APPOINTMENT DIARIES**   **1952-2018**

This sub-section contains Fraenkel's small pocket appointment diaries dating from 1952 through to 2018. Fraenkel used to them to note activities and engagements but also sometimes for recording notes and ideas.

The presentation is chronological.

F/3/1   1952-1953.

F/3/2   1954.

F/3/3   1955.

F/3/4   1956.

F/3/5   1957.

F/3/6   1959.

F/3/7   1960.

F/3/8   1961.

F/3/9   1962.

F/3/10   1963.

F/3/11   1964.

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F/3/12	1965-1966.
F/3/13	1967.
F/3/14	1967-1968.
F/3/15	1968-1969.
F/3/16	1969-1970.
F/3/17	1970-1971.
F/3/18	1971-1972.
F/3/19	1972-1973.
F/3/20	1973-1974.
F/3/21	1974-1975.
F/3/22	1975-1976.
F/3/23	1976-1977.
F/3/24	1977-1978.
F/3/25	1978-1979.

F/3/26	1980.
F/3/27	1981.
F/3/28	1982.
F/3/29	1983.
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F/3/31	1985.
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F/3/33	1987.
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F/3/35	1988-1989.
F/3/36	1989-1990.
F/3/37	1990-1991.
F/3/38	1991-1992.
F/3/39	1992-1993.

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F/3/40	1993-1994.
F/3/41	1994-1995.
F/3/42	1995-1996.
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F/3/44	1998.
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F/3/46	2000.
F/3/47	2001.
F/3/48	2002.
F/3/49	2002-2003.
F/3/50	2003-2004.
F/3/51	2004-2005.
F/3/52	2005-2006.
F/3/53	2006-2007.

F/3/54	2007-2008.
F/3/55	2008-2009.
F/3/56	2009-2010.
F/3/57	2011.
F/3/58	2012.
F/3/59	2012-2013.
F/3/60	2017-2018.

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