

THE ROYAL COMMISSION ON HISTORICAL MANUSCRIPTS

Report on the papers of

SIR JAMES GRAY FRS

(1891-1975)

deposited in Cambridge University Library

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CONTEMPORARY SCIENTIFIC ARCHIVES CENTRE

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Report on the papers of

Sir James Gray, F.R.S.

(1891 - 1975)

Compiled by: Jeannine Alton

Harriot Weiskittel



Description of the collection

The papers were received from Lady Gray and from Dr. Hans Lissmann at the Department of Zoology, Cambridge.

Gray's work on animal locomotion comprises the major portion of the collection, but his early work on cell division and ciliary movement (and his return to this research towards the end of his career) is recorded in notebooks and working papers B.7-B.9, B.11-B.13, and C.1-C.4. B.10 is of interest in describing experiments with bull spermatazoa, which were brought to the attention of Sir Geoffrey Taylor and led to a sequence of papers published by Taylor 1951-52; see the memoir of Taylor by G.K. Batchelor, Biographical memoirs of Fellows of the Royal Society, 22, 1976 pp.613-614, 630.

Autobiographical reminiscences of his career at Cambridge can be found in Gray's lecture 'Fifty years of Zoology at Cambridge', item D.39.

Section A includes material relating to Gray's service in the First World War (maps, field orders, roll books, personal journals) which is of interest for military history. A hand grenade found with the military papers has been deposited in the Imperial War Museum, London.

All items are manuscript unless otherwise indicated. Titles and descriptions in inverted commas are those which appear on the files or documents.

A selection of Gray's films on animal locomotion has been offered to the National Film Archive, London.

Summary of the career of Sir James Gray

b. 1891

	Educated Merchant Taylors' School
	King's College, Cambridge
1911	Natural Sciences Tripos, Cl. I
1914	Fellowship, King's College, Cambridge
1914-18	War service with Queen's Royal West Surrey Regiment
1918	Awarded Military Cross and Croix de Guerre avec Palme
1919-23	Balfour Student, Department of Zoology, Cambridge
1920	Married Norah King
1923-37	Lecturer, later Reader in Experimental Zoology, Cambridge
1925-54	Editor, <u>Journal of Experimental Biology</u>
1929	Fellow, the Royal Society
1937-59	Professor of Zoology, Cambridge
1943-47	Fullerian Professor of Physiology, Royal Institution
1945-55	President, Marine Biological Association
1954	Knighted
1959	President, British Association for the Advancement of Science

Contents of the handlist

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A. Biographical (A.1 - A.21)

- A.1. Memoir, obituary notice, bibliography, portrait sketch.
- A.2. Miscellaneous souvenirs relating to Gray's early days at Cambridge: autographed menu, photograph and badge of King's College Boat Club Trials, 1909; printed letter from A.S. Shipley on the election of J. Stanley Gardiner to the Chair of Zoology, 1909; letter of congratulation to Gray on his First Cl. Honours degree, 1911; programme for Zoology Department 'At Home', 1912; press-cutting announcing Gray's appointment as Demonstrator of Comparative Anatomy; M.A. certificate, 1916.
- A.3. 4 letters from Professor J. Stanley Gardiner:
- to Gray's father, dated 13 November 1918, re Gardiner's wish for Gray to have a year at pure research 'for I want him to go to the very top of the tree as rapidly as possible and I know he has the ability, the determination and the personal characters which help. I may say to you that he has the very best brain of any man I have ever had to deal with in my subject and I shall not be content until I have seen him go in science far beyond where I can reach'. (Photocopy of copy.)
  - to Gray, dated 10 November 1918, re Gardiner's plans for the Zoology Department after the war and asking Gray if he would like his position held open for him.
  - to Gray, dated 13 November 1918, congratulating him on his M.C. and suggesting that he 'have a year at Research for which I can probably find you a grant of £200'. (Gray was awarded a Balfour Studentship.)
  - to Gray, dated 12 December 1918, re future of the Zoology Department: 'I want you all here to ... help me to start our zoology afresh in view of new conditions'.
- A.4. Miscellaneous photographs: family, school, holidays, Cambridge, war service.
- A.5. Letters written to Gray by his family and friends during the War.
- A.6-A.19. Material relating to service in 1914-18 War

Sir James Gray served in the Queen's Royal West Surrey Regiment, reaching the rank of Captain. He was awarded the Military Cross and the Croix de Guerre for action in the July-August offensive 1918.



- A.6. Misc. maps of Palestine.
- A.7. Misc. maps of the Western Front, some with Gray's annotations, principally relating to the offensive of August 1918.
- A.8. Misc. German maps.
- A.9. Misc. press-cuttings and photographs re war in Middle East and on Western Front.
- A.10. Misc. Ms. field orders and information re Queen's Regiment August-September 1918.
- A.11. Misc. duplicated Orders of the Day, Standing Orders etc. 1918.
- A.12. Army Book 152 (with some loose additional pages), Ms. notes by Gray of training programmes, begun 3 Dec. 1914.
- A.13. Black notebook, inscribed inside 'Nominal Roll "C" Coy 2/4 Queens'.
- A.14. Red 'Company Roll Book', "D" Coy 2/5 Queens.
- A.15. Army Book 153, Ms. notes on general conduct of company and official procedures, inscribed 'J. Gray Capt<sup>n</sup> & Adj.'.
- A.16. Army Book 153, inscribed 'J. Gray Lt'. This book covers July-Aug. 1918, and contains a journal of the offensive, casualty lists, Gray's orders as Commander "C" Coy., and his recommendations for awards for gallantry in the field.
- A.17. Gray's Diary, 1917-18. He embarked for Egypt 30 Nov. 1917, and the diary describes his arrival and service, his return to Europe and service on the Western Front especially July-Aug. 1918. (Last entry in the diary is 21 Sept.) Inserted on loose pages are his 'Notes on Modern Egyptians', 'The Desert', 'Impressions of Malta' (1917), and an account of his hospitalisation in No.24 Stationary Hospital, Kantara (see also A.19).
- A.18. Pocket diary, 1919. The last few pages contain an itinerary for 10 October-31 December 1918.
- A.19. Miscellaneous documents and souvenirs: certificates of attendance at course of instruction; commission as Second Lieutenant, 1914; dispatch, press notice and congratulatory letter from the members of his father's firm re the award of the Croix de Guerre, 1918; Gray's own impressions and observations: 'Malta at dawn', 'Xmas Day on a Troopship' and a diary entry for 4 December 1917; autographed menu, 7 November 1918; demobilisation order, 25 February 1919; etc.
- A.20-A.21 Account books:     A.20 1914-1932  
                                  A.21 1933-1941



B.                      Notebooks (B.1 - B.14)

B.1-B.6.            Undergraduate notebooks:

- B.1.            Notebook entitled 'Miscellaneous Biological Notes. August 1909' containing notes on the literature, and notes on an exhibition in the South Kensington Science Museum commemorating Charles Darwin.
- B.2.            Notebook labelled inside front cover with name and date (December 1909) and also with 'Notes on Physiology of Plants, L. Jost' in another hand. The index and the notes at the beginning of the book are in Gray's hand; they are mostly notes on the literature with the subject headings: 'Cave Animals', 'Crysomelid Beetles', and 'Fauna of the Sea'. Notes later in the book are in another hand - perhaps a child's "Quiz".
- B.3.            'Lecture notes on vertebrata. Professor J. Stanley Gardiner' January 1911: notes and drawings. (The cover of the book is missing.)
- B.4.            'Practical Invertebrate Zoology, October 1911': notes and drawings. (The cover of the book is missing.)
- B.5.            'Chick (cf. Balfour's Embryo)': notes. (The cover of the book is missing.)
- B.6.            Botanical notes and drawings. (The cover and first few pages are missing.)
- B.7.            Black notebook labelled on first page 'Cell Division etc. Millport 1921, Millport 1923, Millport 1924' containing laboratory notes, observations, drawings, and descriptions of laboratory procedures. Many loose notes of a similar nature are inserted in the notebook; some notes are on the literature.
- B.8.            Green notebook containing drawings of cell division, tabular summaries of data and laboratory observations on experiments with fish; extensive laboratory notes (1935-37) on experiments with eels, nemertines, leeches. From the other end of the book: notes taken at Plymouth, 1935, on cell division experiments.
- B.9.            Red notebook labelled inside front cover 'Radiation from Echinus Eggs. Millport. April 1933' containing graphs and charts, tabular summaries of data, drawings of apparatus. Many loose notes, graphs and charts are inserted; not all are in Gray's hand.



- B.10. Red notebook labelled inside front cover 'Millport. July 1951' containing notes and diagrams of laboratory experiments with sperm, time sequences of films recording the experiments. Continued in 1953. (See note on p.1.)
- B.11. Notebook labelled with name, address and date (July 1911). Subject index on first page. (Many of the notes and drawings are in another hand - perhaps L. Doncaster?). Many loose additional pages were inserted at the end of the book; some of these have been extracted and listed separately as C.2.
- B.12. 'Misc. research. Cilia. Viscosity of sperm suspensions': file containing working notes, calculations, graphs and drawings. Two manuscript drafts, one beginning 'the following experiments constitute an attempt to analyse the relationship of a growing cell to its inorganic environment'. (c.1922. unpublished).
- B.13. Blue notebook labelled on cover 'Cilia. 1930. i/ Abfrontal cycles' containing graphs of kinetic cycle. Loose graphs and charts are inserted; most are labelled.
- B.14. Notebook, signed, with entry on first page 'Dogfish 1935' containing record of photographs and experiments. Followed by a section titled 'Notes on Goldfish, Stickleback, and Xenopus in rotating tank'. Also contains notes by K.C. Williamson and H. Lissmann on frogs and toads 1939-46.

C. Working Papers (C.1 - C.53)

The files have been grouped according to broad areas of interest although the sections inevitably overlap somewhat as Gray often used his research in one field to augment his work in another. Most of the files are of a very miscellaneous composition: notes, bibliographies, graphs, diagrams, calculations from the data, drawings, photographs, relevant correspondence, etc. Many of the papers are undated.

C.1-C.3. Cell Division (see also B.7, B.8, B.11)

- C.1. Drawings of cell division. Notes on 'conditions for fertilisation and segmentation E. miliaris 1921'.
- C.2. Manuscript of 'Cytological observations on the developing eggs of hybrids between species of Echinus' by L. Doncaster and J. Gray (published as 'Cytological observations on the early stages of segmentation of Echinus hybrids') (see also B.11). Drawings to accompany the paper. Doncaster's correspondence from Dr. C. Shearer of The Marine Biological Association, Plymouth (1911). 1911-13



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|-----------|--|------------------|
| C.3.      | Miscellaneous later notes, bibliographies and correspondence on the subject of cell division.  | 1926,<br>1952-55 |
| C.4.      | <u>Ciliary Movement</u> Notes, graphs, charts, bibliographical references, photographs, some correspondence (incomplete), review of <u>Ciliary Movement in The Lancet</u> .  | 1928,<br>c. 1952 |
| C.5-C.16. | <u>Undulatory Movement</u>   |                  |
| C.5.      | 'Flagella - Bacteria': correspondence with colleagues, bibliography, notes, photographs.   | 1944-57          |
| C.6.      | 'Sperm - Sea Urchin': annotated offprint of 'The propulsion of sea-urchin spermatozoa' by J. Gray and G.J. Hancock, correspondence between collaborators (1953-55, 1961). Notes, calculations and drawings. Correspondence with Victor Rothschild re <u>P. miliaris</u> and re his comments on the 1955 paper. | 1951-55,<br>1961 |
| C.7.      | 'Sperm - Bull': correspondence re Gray's paper 'Movement of the spermatozoa of the bull': notes, observations and drawings used in preparing paper.  | 1954-58          |
| C.8.      | 'Sperm - Frog, Toad': correspondence, notes, drawings.   | c.1955-56        |
| C.9.      | 'Sperm - General': correspondence with Vishwa Nath plus typescript 'note on the movement of sperm' sent by Nath; correspondence with colleagues in Britain (1951-57); typescript note on Ostracod sperm; bibliography (see also E.11, correspondence with Victor Rothschild on spermatozoa).                   |                  |
| C.10.     | 'Snake': ms. draft, notes, diagrams and calculations, minor correspondence.  |                  |
| C.11.     | 'Snake - One Right Angle': diagrams, notes, draft titled 'Theory of three contiguous segments exhibiting serpentine movement'.   |                  |
| C.12.     | 'Snake - Two Right Angles': calculations, graphs, drawings.  |                  |
| C.13.     | 'Snake - Two Unequal Angles': notes, calculations, drawings.   |                  |
| C.14.     | 'Snake - Several Curves': graphs and notes.  |                  |
| C.15.     | 'Snake - Gliding': calculations, drawings.   |                  |
|           | (Items C.10-C.15 probably represent work for 'The Mechanism of Locomotion in Snakes' published 1946.)  |                  |
| C.16.     | Misc. ms. notes, calculations, charts, graphs and bibliographies relative to work on undulatory movement (not all the notes are in Gray's hand).   |                  |



C.17-C.29. Fishes and Fish Propulsion

- C.17. 'The upstream migration of salmon': manuscript, typescript, figures and drawings. c.1960
- C.18. Portions of various ms. drafts on fish propulsion, including graphs and charts.
- C.19. Misc. work on fish propulsion: charts and graphs labelled 'Rigid plate oscillating', 'Propulsive thrust for different values of  $\Theta$  and  $V_x$ '. Typescript (with Gray's annotations) of 'The Physical Aspects of Fish Locomotion, II' by E.G. Richardson.
- C.20. Ms. notes titled 'Current produced by a fish which is unable to move forward' and 'The resistance encountered by a moving fish'; calculations. (See also C.45.)
- C.21. 'Fish - Pseudo-Rheotropism': bibliographical notes, correspondence, offprint of Gray's paper 'Pseudo-Rheotropism in Fishes', diagrams, calculations, especially re stickleback and goldfish. 1936
- C.22. 'Dogfish': ms. notes titled 'responses of normal fish' and 'simple transection', correspondence with A. Sand re their joint papers, 'The locomotory rhythm of the dogfish' and 'Spinal reflexes of the dogfish' (1936), diagrams and charts. 1936
- C.23. 'Overfishing': ms. draft and calculations.
- C.24. 'Fish - acceleration': experimental data, drafts and notes.
- C.25. 'Trout eggs': graphs and notes titled 'Buffering effect of top water', 'viscosity and conductivity', and 'Exosmosis from gelatin and agar'.
- C.26. 'Fish': bibliography and notes on the literature.
- C.27. Correspondence with G.E. Gadd on fish propulsion and oscillating systems. 1949
- C.28. 'How fishes swim' published in Scientific American, August 1957: correspondence from interested readers. 1957
- C.29. Misc. correspondence re fish. 1950-59
- C.30. 'Skeleton Muscles and Nerves - Branchial': drawings, notes, bibliographical references, draft titled 'Musculature of the dogfish', typescripts of lecture notes (probably not Gray's) on teleosts, elasmobranchs, amphibia, and jaws and jaw muscles of vertebrates.



- C.31. 'Skeleton, Muscles and Nerves - Skull': drawings, notes, bibliographical references.
- C.32. 'Skeleton, Muscles and Nerves - Girdle': drawings, notes, bibliographical references and notes, typescript titled 'paired fins', typescript draft titled 'comparative functional anatomy of the pectoral girdle of vertebrates'.
- C.33. Bibliographical material, diagrams, drawings, charts, notes (one set is entitled 'Long and short extrinsic muscles') relating to Gray's work on tetrapods (see also C.47).
- C.34. 'Gaits': one file of numerous graphs and diagrams of the speeds and stepping plots of various animals. (One set of notes is labelled 'all gaits can be divided into eight phases'.)
- C.35. Typescript (46pp.) labelled 'Strasser: Lehrbuch der Muskel - und Gelenkmechanik, 1908-13, pp.434-474. Supplement. The position of standing of the quadrupeds'. English translation of the work, with numerous figures and drawings.
- C.36. 'Jumping': notes, bibliography, experimental data, drawings, correspondence.
- C.37. Aquatic mammals: correspondence and notes on whales, dolphins, porpoises. (Perhaps work for 'Studies in animal locomotion'.) 1933-35, 1950
- C.38. 'Migration': bibliographical references and notes, 2 typescripts (different versions) titled 'Migration of vertebrate animals', published in 1946. Correspondence. 1945-46
- C.39. 'Flight': various manuscripts and typescripts titled 'Flapping flight', 'Analysis of the flight of the pigeon', 'Wind tunnel tests on feathers', and 'Balance and stability'. Bibliographical references, graphs, some correspondence. (Perhaps work for 'The flight of animals' published 1955) (see also C.50). 1952-54
- C.40. Notes and experimental data for paper 'The mechanism of locomotion in the leech'. 1937-38
- C.41. 'Myriapods': several ms. drafts re locomotion in myriapods, bibliographical notes, drawings and photographs.
- C.42. 'The co-ordination of limb movements in the amphibia': typescript. Notes, experimental data, charts and drawings used in preparation for this paper and for papers on the effects of deafferentation on the locomotory activity of amphibian limbs (see also C.48). 1946



- C.43. 'Earthworm': notes, experimental data and graphs for paper 'Locomotory reflexes in the earthworm'. 1938

C.44-C.53. Animal Locomotion

This is work compiled by Gray for his book Animal Locomotion published in 1968. Many of the papers date from a much earlier period of his career and were supplemented and/or reworked by Gray to take account of new findings and data.

- C.44. Corrected typescript of Animal Locomotion.
- C.45. Chapter II 'Mechanisms of Fish Propulsion': misc. notes and drafts. Most of the notes are unlabelled and some are not in Gray's hand.
- C.46. Drawings, typescript for Chapter II, correspondence.
- C.47. Chapter V 'Terrestrial tetrapod animals as mechanical systems': typescript with numerous manuscript amendments and additions.
- C.48. Chapter VI 'Amphibia': annotated typescript; typescript of 'Aquatic and terrestrial types of locomotion in the toad'; manuscript of 'The effect of limb amputation on the ambulatory pattern'; notes on the literature; diagrams and graphs. Letter from official of Calaveras County, California, re statistics from jumping frog contests.
- C.49. Chapter VIII 'Reptiles': notes on the literature.
- C.50. Chapter IX 'Flight of Birds': notes on the literature, drafts for various manuscripts, miscellaneous notes and thoughts, mostly re gliding.
- C.51. Birds: bibliographical material.
- C.52. Chapter X 'Mammals': notes on the literature, manuscript drafts, graphs and charts, correspondence.
- C.53. Chapter XV 'Mollusca': manuscript and typescript of chapter, notes on the literature, notes on swimming in gastropods.

D. Lectures (D.1 - D.70)

D.1-D.23. Lectures delivered at the Royal Institution, London

- D.1-D.4. 'Anatomy and Function of Brains in the Lower Vertebrates': 1945
- D.1. Lecture 1. Fish: ms. notes, list of slides, coloured drawings.
- D.2. Lecture 2. Fish, Amphibia, Reptiles: ms. notes.



- D.3. Lecture 3. Birds: ms. notes.
- D.4. Lecture 4. Mammals: ms. lecture notes from a variety of sources (several are from Gray's courses of lectures at Cambridge), bibliographical references, coloured drawings.
- D.5-D.12. This series was originally given in 1944-45 and the first four lectures were repeated in 1946 in a slightly different form.
- D.5. Lecture I. Locomotion of Fishes: ms. notes for one lecture (probably given in 1946), typescript of another lecture on the same subject(given in 1944?).
- D.6. Lecture II. Evolution of Limb: ms. and typescript titled 'Transition from aquatic to terrestrial life' (1944), ms. (untitled) of 1946 lecture.
- D.7. Lecture III. Co-ordination of Limbs: ms. draft notes, typescript of same name; 2 sets of ms. notes for 1946 lecture.
- D.8. Lecture IV. Adaptation of Limbs: ms. draft notes, typescript, list of slides.
- D.9. Lecture V. Re-adaptation to water. Snakes: ms. notes, typescript on snakes, ms. notes re dolphin with photographs of aquatic mammals.
- D.10. Lecture VI. Adaptation to air: ms. notes.
- D.11. Lecture VII. Birds: ms. notes, photographs.
- D.12. Lecture VIII. Control of Movements: ms. notes, diagrams of brain.
- D.13. 'Life in the Sea', 2 lectures 14 and 21 Feb. 1946: ms. notes. 1946
- D.14. 'Flight' (single lecture), November: ms. notes. 1946
- D.15. 'Migration': ms. notes. 1946
- D.16. 'Flight', 2 lectures: ms. notes for Lecture II (Lecture I was a repetition of 'Adaptation to Air' as delivered in 1945), list of slides, 2 sets of ms. notes for lectures on flight (one is dated 1953). 1946
- D.17. Notebook containing lists of slides and films for lectures, bibliographical references.



- D.18-D.23. 'How Animals Move', Christmas lectures for Children. 1951-52  
These lectures were later written up and published as a book of the same name.
- D.18. Lecture I. The Machinery of Movement: programme of the series, 3 sets of ms. drafts (different versions), lists of demonstrations, correspondence re specimens and animals to be borrowed for exhibition from the Zoological Society of London and the British Museum of Natural History.
- D.19. Lecture II. Swimming: ms. notes.
- D.20. Lecture III. Walking and Running: ms. notes.
- D.21. Lecture IV. Jumping, Creeping and Diving: 2 sets of ms. notes.
- D.22. Lecture V. Flying: ms. notes, with list of demonstrations.
- D.23. Lecture VI. Flying (continued): ms. notes, list of slides, notes on insect flight prepared by F.S.J. Hollick (?).
- D.24-D.27. Zoology Course lectures at Cambridge University
- D.24. 'Vertebrates. Part II Lectures': sets of lecture notes of various dates including rough diagrams, list of slides and other visual aids. Many of the notes bear several different dates and titles indicating that Gray reworked and rearranged the material each year. c.1948-51
- D.25. 'Vertebrates. Part II Lectures. References': careful, lengthy notes by Gray on the literature.
- D.26. 'Fisheries. B Course.' Lectures 1 and 2: ms. notes for lectures. 1953
- D.27. Schedules of lectures and practicals with notes of slides, handout sheets, etc. 1955-56
- D.28. 'Mechanism of Cell Division': ms. draft. n.d.
- D.29. 'The analysis of ciliary movement by optical methods': ms. n.d.
- D.30. 'The stroboscope in microscopy': ms. n.d.
- D.31. 'Microscopic Machinery': typescript. n.d.
- D.32. 'Flight of Birds' (2 lectures, one given in York): mss. n.d.



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| D.33. | 'Aspects of animal locomotion' (7 different lectures):<br>4 sets of ms. notes with that title (one is labelled<br>'Philos. Lect. 1948').<br>1 ms. titled 'Physical aspects of animal locomotion'.<br>1 typescript titled 'Some aspects of locomotion in<br>terrestrial vertebrates'.<br>1 ms. titled 'Some aspects of animal locomotion' with<br>note 'Germany'. |      |
| D.34. | 'Problems in animal locomotion' (6 different lectures, some<br>are titled 'Mechanical problems ...'): mss.   | n.d. |
| D.35. | 'Animal language': 2 typescripts with ms. annotations.   | n.d. |
| D.36. | 'British Contributions to Science': 2 typescripts with ms.<br>annotations.   | n.d. |
| D.37. | 'Zoology. Past, present and to come': ms.  | n.d. |
| D.38. | 'Careers in zoology': ms.  | n.d. |
| D.39. | 'Fifty years of zoology at Cambridge': ms. contains<br>many autobiographical reminiscences.  | n.d. |
| D.40. | 'Life of sperm', lecture to the Cambridge University<br>Natural Sciences Club: ms. notes and diagrams.   | n.d. |
| D.41. | 'Fins and Wings': ms.  | n.d. |
| D.42. | 'Taxonomy - principles of classification': ms.   | n.d. |
| D.43. | 'Life of spermatozoa': ms.   | n.d. |
| D.44. | 'Man's Place in Nature': ms.   | n.d. |
| D.45. | 'Migration of animals': ms.  | n.d. |
| D.46. | 'Biological aspects of animal behaviour': ms.  | n.d. |
| D.47. | 'Physiological analysis of animal locomotion': incomplete ms.  | n.d. |
| D.48. | Untitled notes for lecture on animal locomotion.   | n.d. |
| D.49. | 'The mentality of fishes', Evening Discourse, British<br>Association, 6 Sept.: typescript.   | 1937 |
| D.50. | 'Propulsion mechanisms of the tetrapod limb', 'Tea party<br>lecture': ms. notes.   | 1946 |
| D.51. | 'Mechanism and Efficiency of Propulsion in Fishes':<br>Challenger Society Lecture: ms.   | 1947 |



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|-------|---|--------------|
| D.52. | 'Physiological Aspects of Behaviour', delivered in Oxford: ms. and list of slides.  | 1949         |
| D.53. | 'Undulatory movement', 'Tea Party Lecture': envelope containing notes titled 'Mechanical forces and undulating movement', 'Undulatory Movement', 'Undulatory Movement II' and 'Pt. II 1952'.                    | 1949<br>1952 |
| D.54  | 'Peripheral sense organs and locomotion', Society of Experimental Biology Symposium, July 1949: ms.   | 1949         |
| D.55. | 'Aspects of animal locomotion', Royal Philosophical Society, Glasgow, 2 February 1950: ms.  | 1950         |
| D.56. | 'General problems of animal locomotion', Holland, May: ms.  | 1950         |
| D.57. | 'Role of peripheral sense organs', Holland, May 1950: ms. and figures.  | 1950         |
| D.58. | 'Flight', Holland, May 1950: ms.  | 1950         |
| D.59. | 'The locomotion of fishes', Elmhirst Memorial Lecture: ms.  | 1952         |
| D.60. | 'Machinery of life', Fison Memorial Lecture, Guy's Hospital, London: envelope containing 4 sets of notes for lectures on this topic; history of the Fison Lecture with list of lecturers 1925-51.               | 1952         |
| D.61. | 'Some aspects of animal locomotion', Royal Philosophical Society, Edinburgh and Glasgow: ms.  | 1954         |
| D.62. | 'Problems in animal locomotion', Marlborough Lecture: ms.   | 1956         |
| D.63. | 'Cilia and flagella', 'Tea Party Lecture': ms.  | 1957         |
| D.64. | 'How animals find their way about', Leicester: ms. and list of slides. Ms. for unidentified lecture on the same topic.  | 1957         |
| D.65. | 'The proper study of mankind is man', Presidential Address to the British Association, York, 2 September 1959: offprint, congratulatory letters to Gray after his address, annual report of the BA for 1959-60. | 1959         |
| D.66. | Notes and list of slides for lecture in Bristol, 8 February.  | 1960         |
| D.67. | 'General principles of vertebrate locomotion', Zoological Society Symposium, 9 November 1960: ms.   | 1960         |
| D.68. | 'Problems in animal locomotion', John Ray Society, 21 February 1960: ms.  | 1960         |
| D.69. | 'Flight of Birds', Jubber Memorial Lecture, Mill Hill, 1 November 1961: ms.   | 1961         |



- D.70. 'Physical aspects of animal locomotion', Manchester Mathematical Association, 22 September 1964: ms. 1964

E. Correspondence and Committees (E.1 - E.13)

- E.1. Correspondence re undulatory movement. 1931-34
- E.2. re reptiles (especially re snakes). 1943-62
- E.3. re amphibia. 1933, 1946, 1963-70
- E.4. re flagella. 1950-54, 1966
- E.5. re nematodes. 1958-70
- E.6. re flight (includes correspondence with W.L. Bragg re observations on the flight of albatrosses, 1955). 1940-68
- E.7. Correspondence re fish and fish propulsion. 1933-53
- E.8. re fish and fish propulsion. 1956-70
- E.9. re animal locomotion (especially re tetrapods). 1936-65
- E.10. Misc. correspondence re publications, symposia and conferences, reviews.
- E.11. Correspondence with Victor Rothschild (Lord Rothschild) especially re spermatozoa, forms of waves and curvature. File includes lengthy comments by Rothschild on Gray's paper 'Undulatory propulsion' (1953) and various notes, calculations, graphs and charts. 1951-70
- E.12. Salmon Research Group, Salmon Research Committee, Department of Agriculture and Fisheries for Scotland (Gray was Chairman of the Group from 1955 to 1968). The file includes chairman's notes, minutes for 1964-68, correspondence and papers re the Sub-committee on Research into the Passage of Smolts through Turbines.
- E.13. Supervisory Group on Methods of Excluding Fish from Water Intakes, Ministry of Agriculture, Fisheries and Food (Gray was chairman from 1955 to 1968). The file includes minutes of the group's meetings and correspondence.

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