

The Two Braggs Exhibition August 25- 31st 2013

Credits

A.M. Glazer, Organizer of the Exhibition

Professor Pamela Thomas, Co-organizer of the Exhibition

Dr. Stephen Soanes, Project Manager of the Exhibition

Dr David Walker, Steve Hubard, Dan Nye and Alexander Glazer – Exhibition Assistants

Charlotte New and Frank James, The Royal Institution of Great Britain

Professor Malcolm Longair, The Cavendish Laboratory, Cambridge

Annette Faux, The MRC Laboratory of Molecular Biology, Cambridge

Kevin Johnson, The Science Museum of London

Stephen Johnston, The Oxford Museum of History of Science

John W. Mills, Sculptor

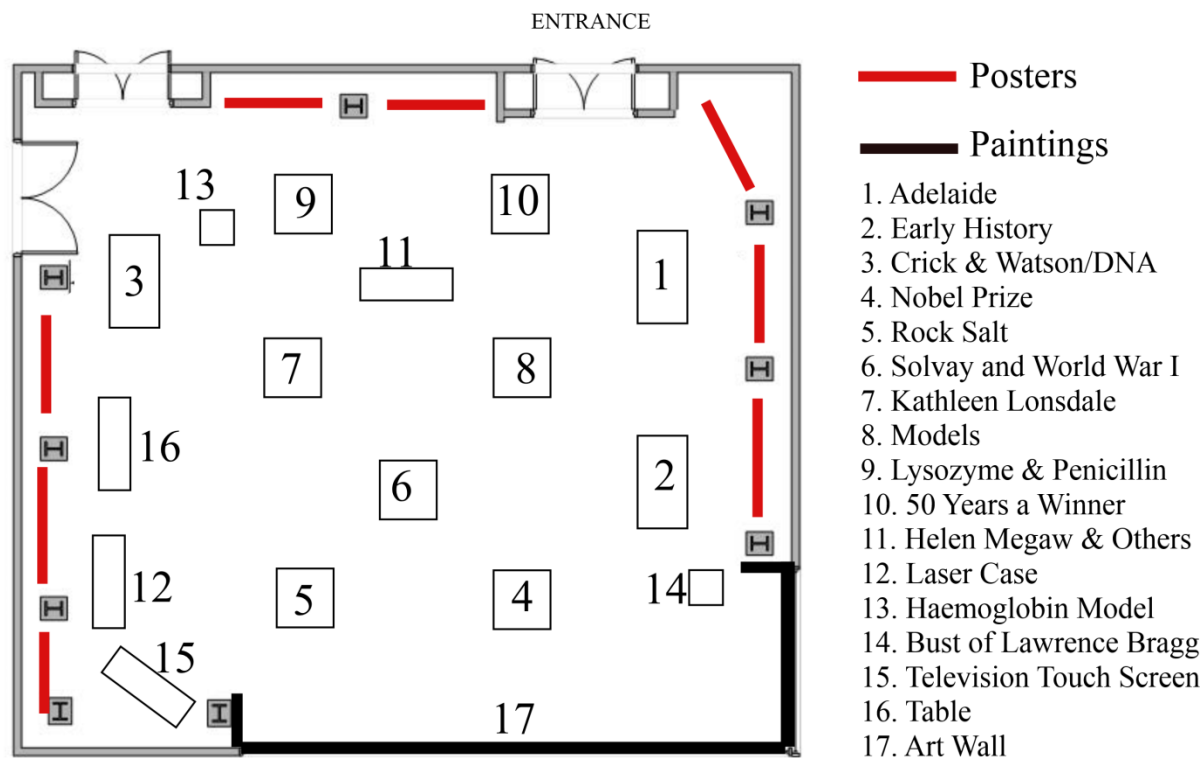
Patience Thomson, Daughter of Lawrence Bragg

Stephen Bragg, Son of Lawrence Bragg

The Lady Adrian, Granddaughter of William Bragg and Daughter of Gwendy Caroe, Sister of
Lawrence Bragg

Other members of the Bragg family

General Layout of Exhibits (Helen Martin Studio, Warwick University Arts Centre)





Listing

1. Adelaide

- William Bragg Adelaide notebook – Practical Physics book 10 (Loaned by Royal Institution Collection)
- Letter from William Bragg to his ‘Two Little Boys’, illustrated with little drawings of the activities he has done. (Loaned by Royal Institution Collection)
- Photograph of William Bragg in pantomime dress (Loaned by Royal Institution Collection)
- Box displaying ‘Sepia Braggi’ cuttlefish bones, collected by John Jenkin (Loaned by A.M. Glazer)
- Collection of Australian stamps from 2012, commemorating Lawrence Bragg in Adelaide (Loaned by Clare Staughton, granddaughter of Lawrence Bragg)
- Two illustrations by Lawrence Bragg of Charles Todd (complete with newspaper cutting showing same image) and the boat which the family returned to England on from Australia (Loaned by Royal Institution Collection)
- Two lecture notes of William Bragg, Natural Philosophy Sept 21st 1886 & Acoustics Aug 16th 1886 (Loaned by Royal Institution Collection)

2. Early History

- Signed framed photograph of Max Von Laue (originally belonged to Lawrence Bragg, loaned by A.M. Glazer)
- Three letters from Laue to William Bragg & Lawrence Bragg (two to William Bragg and one to Lawrence Bragg) from the collection of early letters, all dated October or November 1912 (Loaned by Royal Institution Collection)
- Collection of letters from Lawrence Bragg to William Bragg concerning his experiments with Rock Salt, 1912 (Loaned by Royal Institution Collection)
- A letter from William Bragg to Lawrence Bragg concerning Lawrence’s work with Rock Salt, 1912 (Loaned by Royal Institution Collection)
- Two letters from Lawrence Bragg to William Bragg concerning his experiments with Mica, 1912 (Loaned by Royal Institution Collection)
- Letter and photograph from Lawrence Bragg to William Bragg concerning his experiments with Mica, 1912 (Loaned by Royal Institution Collection)
- Original sample of Mica and X-ray photograph by Lawrence Bragg in 1912 (loaned by Cavendish Laboratory, Cambridge)
- Letter from Lars Vegard to William Bragg describing the new experiments Laue is undertaking in Germany, 1912 (Loaned by Royal Institution Collection)

3. Crick & Watson/DNA

- Original publication of the book 'The Double Helix' by James Watson (Loaned by Royal Institution Collection)
- Original manuscript by James Watson entitled 'Honest Jim' (Loaned by Royal Institution Collection)
- Collection of letters from Wilkins, Crick, Lawrence Bragg and Watson discussing the publication of 'The Double Helix' (Loaned by Royal Institution Collection)
- Model of DNA made by Michael Fuller in 1953 for Crick to take on his lecture tours (loaned by the MRC Laboratory of Molecular Biology, Cambridge)

4. Nobel Prize

- Lawrence Bragg & William Bragg Nobel Prize Certificates (Loaned by Royal Institution Collection)
- Lawrence Bragg & William Bragg replicas of Nobel Prize Medals (Loaned by Royal Institution Collection)
- Telegram to Lawrence Bragg from Nobel Foundation notifying him that he & his father have won the Nobel Prize (Loaned by Royal Institution Collection)
- Letter from Nobel Foundation regarding the financial arrangements of the Nobel Prize 1915 (Loaned by Royal Institution Collection)
- Original William Bragg Ionization Spectrometer from Royal Institution (Loaned by Royal Institution Collection)
- Photograph of William Bragg in the Royal Institution laboratories (Loaned by Royal Institution Collection)

5. Rock Salt

- Original model of Rock Salt (Loaned by Royal Institution Collection)
- Lawrence Bragg's 1912 notebook open at page where Bragg's Law first appears (in cosine form) (Loaned by Royal Institution Collection)
- Lawrence Bragg's personal reprint of his 1912 (published 1913) Cambridge Philosophical Society paper (Loaned by Royal Institution Collection)
- Original X-ray photograph of Rock Salt (to go with 1912 Notebook) (Loaned by Royal Institution Collection)
- Original William Bragg Ionization Spectrometer (from the UCL laboratory of Kathleen Lonsdale (On loan from the Science Museum)
- Photograph of William Bragg next to Ionization Spectrometer, probably at UCL (Loaned by Royal Institution Collection)
- Two of William Bragg's Leeds Notebooks (Loaned by Royal Institution Collection)
- Images of Whin Brow at Cloughton, where in the summer of 1912 Lawrence Bragg and William Bragg first discussed the letter from Vegard informing them about Laue's experiment (from Chris Hammond, Leeds)

6. Solvay & World War I

- Three images of Solvay Conference, 1913 (William Bragg invited but not Lawrence), 1927 (Lawrence present), 1933 – signed by participants (Loaned by Royal Institution Collection)
- Postcard to Lawrence Bragg, 1913, signed by the participants of the Solvay Conference (Loaned by Royal Institution Collection)
- Letter from Lorentz to William Bragg regarding attending the Solvay Conference 1913 (Loaned by Royal Institution Collection)
- Letter from Lawrence Bragg to William Bragg, WWI (Loaned by Royal Institution Collection)
- Letter from Lawrence Bragg to William Bragg, WWI (Loaned by Royal Institution Collection)
- Letter from Lawrence Bragg to William Bragg, WWI (Loaned by Royal Institution Collection)
- Letter from Lawrence Bragg to William Bragg, WWI (Loaned by Royal Institution Collection)
- William Bragg WWI identity card for the Admiralty (Loaned by Royal Institution Collection)
- Lawrence Bragg photograph album showing WWI images (Loaned by Royal Institution Collection)
- Lawrence Bragg photograph of his WWI research group working on sound-ranging (Loaned by Royal Institution Collection)

7. Kathleen Lonsdale

- Original Ionization Spectrometer built for Kathleen Lonsdale 1929 (Loaned by Royal Institution Collection)
- Photograph of Kathleen Lonsdale (Loaned by Royal Institution Collection)
- Photograph of modern X-ray diffractometer manufactured by Agilent (loaned by A.M. Glazer)
- Lawrence Bragg sketch book (Loaned by Royal Institution Collection)

8. Models

- Original model of Graphite (Loaned by Royal Institution Collection)
- Original model of Rock Salt (small version) (Loaned by Royal Institution Collection)
- Original model of Naphthalene made by Lawrence Bragg from Ping-Pong balls and painted black (loaned by A. M. Glazer)
- Original model made by Lawrence Bragg out of Ping-Pong balls showing how an octahedral crystal can be built from the cubic close packing of atoms (loaned by A.M. Glazer)
- Original Paper of William Bragg 'Crystal Structures & ' 1915 (Loaned by Royal Institution Collection)
- Original Paper of Lawrence Bragg 'Crystal Structures &' 1915 (Loaned by Royal Institution Collection)

- 6 Original William Bragg's Magic Lantern Slides (Loaned by Royal Institution Collection)
- Original Model of Diamond (Loaned by Royal Institution Collection)
- Lawrence Bragg's Diopside crystal (loaned by Cavendish Laboratory, Cambridge)
- Diffraction patterns by Lawrence Bragg (on loan from Cavendish Laboratory, Cambridge)
- Lawrence Bragg's Aragonite crystal (loaned by the Cavendish Laboratory, Cambridge)
- Original Ionization Spectrometer used by Lawrence Bragg at the Cavendish Laboratory (loaned by the Cavendish Laboratory, Cambridge)
- Collection of medals from William Bragg & Lawrence Bragg, including the Brussels 1954 exhibition, and both their Royal Society Copley Medals (Loaned by Royal Institution Collection)
- Box of crystal samples probably used by Lawrence Bragg on the Ionization Spectrometer at the Cavendish Laboratory (loaned by the Cavendish Laboratory, Cambridge)

9. Lysozyme & Penicillin

- Model of Lysozyme, the first enzyme structure to be solved by David Phillips in 1965. This model was taken by Lawrence Bragg on a lecture tour to the USA and occupied its own 1st class seat on the aircraft (Loaned by Royal Institution Collection)
- Sketch by Lawrence Bragg of the structure of Lysozyme (Loaned by Royal Institution Collection)
- Fourier stack of potassium benzyl penicillin made by Dorothy Hodgkin, Barbara Low, Charles Bunn & A. Turner-Jones in 1945 together with plot of the crystal structure by A.M. Glazer (on loan from the Oxford Museum of the History of Science)
- Photograph of Dorothy Hodgkin (Loaned by Royal Institution Collection)

10. 50 Years a Winner

- Sketch of John Kendrew by Lawrence Bragg (loaned by the MRC Laboratory of Molecular Biology, Cambridge)
- Fourier stack of Myoglobin by John Kendrew (worked under the direction of Lawrence Bragg and shared the 1962 Nobel Prize for Chemistry with Max Perutz) (Loaned by the MRC Laboratory of Molecular Biology, Cambridge)
- Sketch of Max Perutz by Lawrence Bragg (loaned by the MRC Laboratory of Molecular Biology, Cambridge)
- Letter from Max Perutz to Lawrence Bragg wishing him a happy birthday in 1960 (Loaned by Royal Institution Collection)
- Letter from Max Perutz to Lawrence Bragg after Perutz was awarded the Nobel Prize, commenting that it was 'all down to you!' (i.e. Lawrence Bragg) (Loaned by Royal Institution Collection)
- Two '50 Year's a Winner' photo albums, from BBC film made in 1965 (Loaned by Royal Institution Collection)
- Card produced by the Royal Institution and signed by living Nobel Prize winners on the 50th anniversary of Lawrence Bragg winning the Nobel Prize (Loaned by Royal Institution Collection)

11. Helen Megaw & other items

- Prototype box of Beevers-Lipson Strips (1936), previously stored at the Cavendish Laboratory (loaned by A.M. Glazer)
- Crystal model of the mineral hydrargyllite $\text{Al}(\text{OH})_3$ constructed by Helen Megaw together with Dorothy Hodgkin in 1934 in Cambridge (loaned by A.M. Glazer)
- Early sketchbook of William Bragg first used when he began to paint, late 1890s (loaned by the Lady Adrian, granddaughter of William Bragg)
- Pair of sketchbooks from the trip to England in 1897-8, one by Gwendoline Bragg (nee Todd) and the other by William Bragg (loaned by the Lady Adrian, granddaughter of William Bragg)
- First edition of William Bragg's 'The World of Sound' (loaned by the Lady Adrian, granddaughter of William Bragg)
- Crystal model of Dolomite, built for the Dome of Discovery, 1951 Festival of Britain (loaned by A.M. Glazer)
- Commercial oscillation/rotation camera & manual (Stubbens camera) marketed by Unicam, Cambridge after an original design by J.D. Bernal. This example originally came from the Crystallography Laboratory Cambridge set up by Lawrence Bragg at the Cavendish Laboratory (loaned by A.M. Glazer)
- Photograph of Helen Megaw with a Stubbens Rotation/Oscillation Camera (from Wellcome Collection)
- Model made for Helen Megaw illustrating the linkage between oxygen octahedra in Perovskite crystal structures (loaned by A.M. Glazer)
- One of Helen Megaw's notebooks (loaned by A.M. Glazer)

12. Laser Case

- Two laser experiments – simulating diffraction by a crystal, using laser light instead of X-rays. One mask contains a set of molecules with 4-fold symmetry, showing that the diffraction pattern consists of spots arranged in 4-fold symmetry. The second mask contains helical molecules showing that the diffraction pattern contains spots in the form of a cross. The apparatus designed by T.R. Welberry, ANU Canberra, Australia (loaned by A.M. Glazer)
- A series of x-ray powder cameras, made by A.J. Bradley (while in Lawrence Bragg's laboratory at Manchester, commercial version made by Unicam Cambridge, commercial powder camera made by Phillips Co – known as a Debye-Scherrer camera (loaned by A.M. Glazer)
- The first commercial Coolidge X-ray tube manufactured in 1913 by General Electric and a modern X-ray tube cut away to reveal the internal components (loaned by A.M. Glazer)
- Commercial Weissenberg camera marketed by Unicam, Cambridge complete with its manual. This example originally came from the Crystallography Laboratory Cambridge, set up by Lawrence Bragg in the Cavendish Laboratory (loaned by A.M. Glazer)
- Early vertical Weissenberg camera built in the Cavendish Laboratory by Charles Chapman, workshop assistant (on loan from the Cavendish Laboratory Cambridge)

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13. Standalone pillar (Haemoglobin)

Three-dimensional model of Haemoglobin by Max Perutz (worked under the direction of Lawrence Bragg and shared the 1962 Nobel Prize for Chemistry with John Kendrew) (Model on loan from the MRC Laboratory of Molecular Biology, Cambridge)

14. Standalone pillar (Bust)

Bronze bust of Lawrence Bragg by John W. Mills (Loaned by Royal Institution Collection)

15. Television touch screen

Enabling viewing of films the history of the Two Braggs, Lawrence Bragg lecturing at the RI, letters, artwork, the notebook of William Bragg in Leeds (from Leeds University), (loaned by the Diamond Light Source).

16. Table

Collection of books by William Bragg and Lawrence Bragg and related books on Crystallography. Included William Bragg's book "The Universe of Light" (1933) containing inscription from W.H. Bragg to C.H. Jenkinson (who constructed the Ionization Spectrometers in 1913), Kathleen Lonsdale's handwritten Tables of Structure Factors. The tablecloth with the electron density pattern of the mineral Afwillite was designed by Helen Megaw for the 1951 Festival of Britain. (On loan from A.M. Glazer)

17. Art Wall

- Fourier map of Haemoglobin by Michael Rossmann (on loan from MRC Laboratory of Molecular Biology, Cambridge)
- Two portrait photographs of Lawrence Bragg in Adelaide, one straight on & one in profile (on loan from the Lady Adrian, granddaughter of William Bragg)
- Photograph of Gwendoline Bragg with Lawrence & Robert Bragg, taken in Market Harborough (loaned by the Lady Adrian, granddaughter of William Bragg)
- Signed photograph of WH Bragg while at the Royal Institution (loaned by the Lady Adrian, granddaughter of William Bragg)
- Copy of a photograph showing Lawrence Bragg's Manchester research Group on an outing to Castleton, Derbyshire in 1929, probably taken by Lawrence Bragg (Discovered recently by Professor Robin Marshall, Manchester University)
- Schools lecture photograph showing Lawrence Bragg lecturing to sixth form pupils on 'interference of waves' December 1958. Mike Glazer can be seen in the audience. (Loaned by Royal Institution Collection).
- Photograph of George Paget Thomson with Lawrence Bragg at the 50 years a Winner Celebration at the Royal Institution (loaned by Patience Thomson)
- William Bragg at the Royal Institution Christmas Lectures (loaned by the Lady Adrian, granddaughter of William Bragg)
- William Bragg 'The World of Sound' RI Christmas Lectures 1919 (loaned by the Lady Adrian, granddaughter of William Bragg)

- William Bragg in Faraday's (and his own) study at the Royal Institution 1936 Feb 11th (loaned by the Lady Adrian, granddaughter of William Bragg)
- Colour image of William Bragg (Loaned by Royal Institution Collection)
- Pen & ink drawing of William Bragg with his spectrometer (Loaned by Royal Institution Collection)
- William Bragg photograph (Smithsonian Archive SIA2007-0341)
- Portrait of Lawrence Bragg at the RI by Lotte Meitner-Graf (on loan from Patience Thomson, daughter of Lawrence Bragg)
- Photograph of Lawrence & his father William at the British Association, Toronto 1924 (Smithsonian Institution Archives SIA2007-0340)
- Three photographs showing Lawrence Bragg and members of the Cavendish Laboratory, 1913, 1938 & 1953 (on loan from A.M. Glazer and Cavendish Laboratory, Cambridge)
- Painting of restaurant scene by Gwendy Bragg, sister of Lawrence Bragg (on loan from Patience Thomson, daughter of Lawrence Bragg)
- Four watercolours by Gwendoline Bragg, wife of William Bragg painted while in New Zealand (loaned by Patience Thomson, daughter of Lawrence Bragg)
- Painting of William Bragg at the Royal Institution by Gwendy Caroe (née Bragg), Lawrence Bragg's sister (Loaned by Royal Institution Collection)
- William Bragg's pencil sketches drawn at Fitzwilliam, New Hampshire USA, lecture tour 1930 (loaned by the Lady Adrian, granddaughter of William Bragg)
- Crayon sketch of William Bragg by William Rothenstein (loaned by Stephen Bragg, son of Lawrence Bragg)
- Lady Bragg, wife of Lawrence painted by William Dring (on loan by Patience Thomson, daughter of Lawrence Bragg)
- The Todd family in their summer cottage at Port Elliot South Australia, watercolour painted by Gwendoline Bragg (nee Todd) (loaned by Stephen Bragg, son of Lawrence Bragg)
- William Bragg watercolour of South Australian landscape probably near Victor Harbour or Port Elliot (loaned by the Lady Adrian, granddaughter of William Bragg)
- Longlands, Findern, Derby, home of Stephen Bragg's family 1958-1971. Watercolour sketch with ink outline by Lawrence Bragg c1960 (loaned by Stephen Bragg, son of Lawrence Bragg)
- Watercolour by Lawrence Bragg of Selworthy Somerset (loaned by Patience Thomson, daughter of Lawrence Bragg)
- Watercolour view of Lisbon painted by Lawrence Bragg in 1957 (loaned by Charles Bragg, grandson of Lawrence Bragg)
- Watercolour view in Venice painted by Lawrence Bragg in 1957 (loaned by Charles Bragg, grandson of Lawrence Bragg)
- No.10 Madingley Road, Cambridge. Lawrence's family home in the 1950's. Watercolour sketch with ink by Lawrence Bragg 1953 (loaned by Stephen Bragg, son of Lawrence Bragg)
- Pencil Sketch of George Paget Thomson – Nobel laureate 1937 for the discovery of electron diffraction, by Lawrence Bragg (loaned by Patience Thomson, daughter of Lawrence Bragg)
- Original master of the bronze relief near the lecture theatre entrance at the RI in honour of the schools lecture programme (loaned by the sculptor John W. Mills)
- Self portrait in pencil by Lawrence Bragg (loaned by Patience Thomson, daughter of Lawrence Bragg)

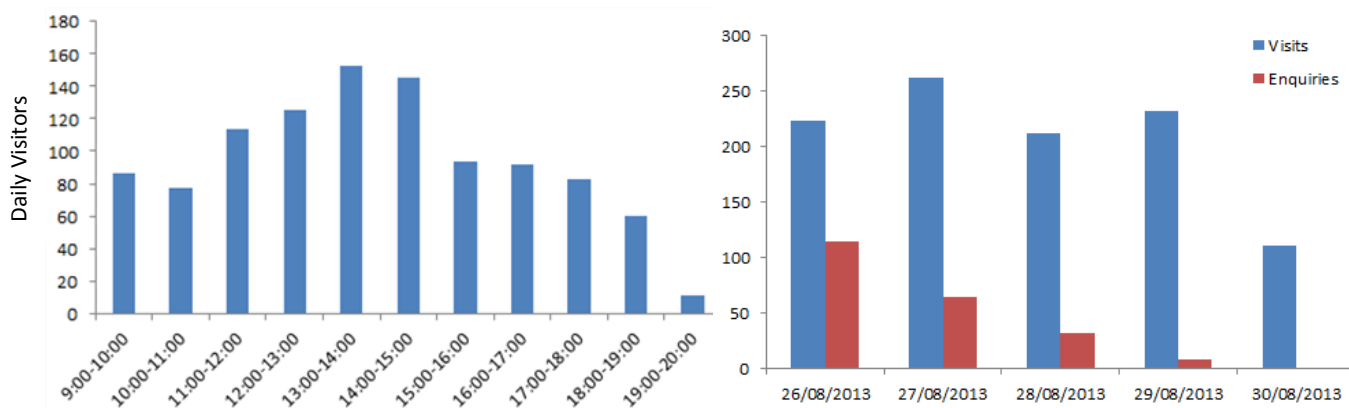
- Malting House Lane, Newnham Cambridge. Pen & ink sketch by Lawrence Bragg 1950c (loaned by Andrew Bragg, grandson of Lawrence Bragg)
- Drawing room at the Royal Institution by Lawrence Bragg (Loaned by Royal Institution Collection)
- The old tide mill, Woodbridge Suffolk. Watercolour sketch by Lawrence Bragg c1960 (loaned by Nigel Bragg, grandson of Lawrence Bragg)
- Sketch in biro of 3 West Road, his house in Cambridge by Lawrence Bragg (loaned by Patience Thomson, daughter of Lawrence Bragg)
- Rooftop view from the Royal Institution by Lawrence Bragg (Loaned by Royal Institution Collection)
- Drawing with letter by Lawrence Bragg to Clare Staughton (loaned by Clare Staughton granddaughter of Lawrence Bragg)
- Dining Room in the flat of the RI by Lawrence Bragg. The chairs originally belonged to Michael Faraday (Loaned by Royal Institution Collection)
- Letter from Lawrence Bragg to Patience with illustrations of squirrels (on loan from Patience Thomson, daughter of Lawrence Bragg)
- Portrait of William Bragg by his daughter Gwendy Bragg before 1932 (loaned by the Lady Adrian, granddaughter of William Bragg)
- Drawing by Lawrence Bragg of Clare Staughton (loaned by Clare Staughton)

Posters were supplied by personnel and organizations from around the UK

Time Sheets

X = closed

Date/ Time	9- 10	10- 11	11- 12	12- 13	13- 14	14- 15	15- 16	16- 17	17- 18	18- 19	19- 20	Total Visitors	Front Desk Enquiries Total
26/08	5	15	25	13	26	60	14	15	33	16	1	223	115
27/08	35	18	34	27	33	21	19	25	25	15	10	262	64
28/08	26	23	22	32	33	27	24	15	8	2	X	212	32
29/08	18	14	22	35	36	29	29	17	10	22	X	232	8
30/08	2	7	11	18	25	8	8	20	7	5	X	111	
Total Visitors	86	77	114	125	153	145	94	92	83	60	11	1040	



Opening Reception (3.00-5.45pm August 25th)

Approximately 70 guests attended including many members of the Bragg family, Sir Richard Lambert (Chancellor of the University of Warwick) and many sponsors. Professor Pamela Thomas welcomed the guests on behalf of the University and Mike Glazer introduced Sir Mark Walport, Chief Scientific Adviser to the Government, who formally opened the Exhibition.

Outreach Discovery Day (August 30th)

Between August 26th and August 29th the Exhibition coincided with the European Crystallography Meeting ECM28. August 30th was reserved for non-participants of the ECM. The program of events was

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|-------------|--|
| 11.00 | Lecture on "The Crystal World" by Mike Glazer and Pam Thomas – Approximately 30 attendants |
| 12.00 | Guided visits to the X-ray laboratory in the Physics Department and to the Exhibition |
| 14.00 | Lecture on "The Bragg Legacy: From Table Salt to Drug Discovery" by Elspeth Garman – Approximately 40 attendants |
| 15.00 | Showing of the film "Driven to Diffraction" |
| 16.00-19.00 | Guided visits to the Exhibition |

General Support and Loans

Cambridge Philosophical Society



Cavendish Laboratory Cambridge



Diamond Light Source



European Crystallographic Association



Faraday Division of Royal Society of Chemistry **RSC** Advancing the Chemical Sciences

Ferroelectrics Group University of Warwick



International Union of Crystallography



John W. Mills



MRC Laboratory of Molecular Biology



Museum of the History of Science, Oxford

Oxford University Physics



Royal Institution of Great Britain



Royal Society



Science Museum London



Science & Technology Facilities Council



Smithsonian Institution Archives



University of Leeds



University of Warwick



We are especially grateful to the members of the Bragg family for the loan of many of the exhibits on show

Financial Sponsors

Agilent Technologies



British Crystallographic Association



Bruker Corporation



De Beers Research Centre



Diamond Light Source



Faraday Division of Royal Society of Chemistry



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