



### **Forthcoming Events.**

While every effort is made to be accurate, please check with the organiser to make sure that non-members of the sponsoring body will be welcome and that the meeting is taking place! To avoid repetition, most of the necessary names and addresses are given at the end of the list.

27th February 1989. (Monday.)

**Strength of Materials : Solids of Equal Resistance in the Seventeenth and Eighteenth Centuries.**

Research Seminar. Dr Ronald Gowing. 15.45 for 16.30.  
RICHST. Royal Institution Council Room.

6th March 1989. (Monday.)

**The Early History of the British Radio Industry.**

Lecture by R F Pocock (Rolls Royce Associates.) 17.30.  
I.E.E. London.

14th March 1989. (Tuesday.)

**New Thoughts on Michael Faraday.**

Royal Institution Library Discussion Group. Dr Frank James.  
18.00. (Non-members may be invited.)

18th March 1989. (Saturday.)

**URGENT!**  
**IOP History of Physics Workshop for Physics Teachers.**  
Please see special notice on page 9.

20th March 1989. (Monday.)

**The Road to Albemarle Street :**

**The Career of Thomas Garnett (1766-1802.)**

Research Seminar. Prof R Fox. 15.45 for 16.30.  
RICHST. Royal Institution Council Room.

4th to 7th April 1989. (Tuesday to Friday.)

**A Century of Physical Chemistry.**

As part of the Royal Society of Chemistry's Annual Congress at the University of Hull, a symposium is being held on topics such as thermodynamics, chemical kinetics and electrochemistry in the 1880s. (Information thanks to the BSHS Newsletter.)

5th April 1989. (Wednesday.)

**The IEE, Technical Education and World War 1.**

Lecture by J Marsh (UMIST) 17.30.  
I.E.E. London. (See below for address.)

### Forthcoming Events.

21st April 1989. (Friday.)

**Maxwell and the Displacement Current.**

Talk by Dr John Roche (Linacre College, Oxford.). 17.00.

Chadwick Laboratory, University of Liverpool.

The History of Science & Technology Group, Liverpool University.

6th May 1989. (Saturday.)

**Lewis Fry Richardson - Mathematician and Meteorologist.**

Day meeting, School of Mathematics, Bristol. 10.30 for 11.00.

The British Society for the History of Mathematics.

Further details : Dr Colin Fletcher, Dept. of Mathematics,  
University College of Wales, Aberystwyth, Dyfed SY23 3BZ.

15th to 18th May 1989. (Monday to Thursday.)

**The Place of Knowledge : The Spatial Setting and its Relation to the Production of Knowledge.** Annual International Workshop.

Tel-Aviv University and the van Leer Jerusalem Institute.

(There are also evening meetings relevant to the History of Physics in Tel-Aviv or Jerusalem on March 13th, April 12th, and June 7th 1989.)

Further information from : Edna Ullmann-Margalit and Shulamit Laron, P.O.B. 4070, Jerusalem 91040.

16th May 1989. (Tuesday.)

**Science at the Stillborn University of Warrington (1757-1786).**

Talk by Dr Pdraig O'Brien on the subject of his book describing the attempt by Joseph Priestley and others to establish a Dissenters Academy.

17.00. Chadwick Laboratory, University of Liverpool.

The History of Science & Technology Group, Liverpool University.

20th May 1989. (Saturday.)

**The History of Chemistry in Photography.**

An open meeting of the Society for the History of Alchemy and Chemistry at the Science Museum, London.

(Information thanks to the BSHS Newsletter.)

Details from : Dr Ann Newmark, The Science Museum,  
South Kensington, London SW7 2DD.

8th June 1989. (Thursday.)

**Oliver Lodge and the Boy with a Bullet in his Wrist.**

Talk by Dr David Edwards on an early medical use of X-rays.

17.30. Chadwick Laboratory, University of Liverpool.

The History of Science & Technology Group, Liverpool University  
and the Liverpool Medical History Group.

### **Forthcoming Events.**

17th to 20th July 1989. (Monday to Thursday.)

**James Prescott Joule (1889-1989) Centenary : One Hundred Years of Energy.**

International Conference in Manchester and Salford.

17/18th July : "The Life, Times and Work of J.P. Joule."

19th July : "Joule and Energy in the Teaching of Science."

20th July : "Energy Conservation Today : Saving the Joules".

There will also be an exhibition of Joule's papers and apparatus at the John Rylands Library in Manchester 17th to 20th July.

Details from Mrs. R. Williamson (See below.)

1st to 9th August 1989. (Tuesday onwards.)

**18th International Congress of History of Science.**

Hamburg and Munchen (Munich), Federal Republic of Germany.

Further details from : ICHS Congress 1989, CPO HANSER SERVICE, Postfach 1221, D-2000 Hamburg-Barsbüttel, Federal Republic of Germany.

11th to 14th September 1989. (Monday to Thursday.)

**The History of Technology, Science & Society, 1750-1914.**

Jordanstown Campus, University of Ulster.

Details : Prof R B Schofield, Dept. of Adult and Continuing Education, University of Ulster at Jordanstown, Shore Rd., Newtonabbey, Co. Antrim BT37 0QB.

11th to 15th September 1989. (Monday to Friday.)

**Science 89.**

British Association 151st Annual Meeting. Sheffield.

13th to 16th September 1989. (Wednesday to Saturday.)

**(French Mathematics 1789 - 1830.)**

International Meeting at Gonville and Caius College Cambridge, arranged by the British Society for the History of Mathematics.

23rd September 1989. (Saturday.)

**The History of Electrical and Magnetic Units.**

IOP History of Physics Group, The Institution of Electrical Engineers and The Whipple Museum.

Joint meeting to be held at the Whipple Museum, Cambridge.

Further details from Dr John Roche, Linacre College, Oxford OX1 3JA.

23rd to 25th September 1991. (Provisional.)

**Paraday Bicentenary Meeting.**

It is hoped that a three-day conference to be organised by the IOP History of Physics Group, the IEF, the Royal Institution and other bodies will be held in London between these dates.

### **Forthcoming Events.**

#### Addresses for Details of Meetings.

British Association for the Advancement of Science, Fortress House, 23, Savile Row, London W1X 1AB.

Institution of Electrical Engineers,  
Savoy Place, London WC2R 0BL.  
(Telephone enquiries to Mary Ryan 01-240-1871 ext. 278 or 294.)

Liverpool University History of Science and Technology Group.  
Hon Sec : Dr D N Edwards, Oliver Lodge Laboratory, P.O. Box 147,  
Liverpool L69 3BX. (Telephone 051-794-3361.)

Royal Institution Centre for the History of Science and  
Technology. 21, Albemarle St., London W1X 4BS.  
(Enquiries to Frank James. Telephone :01-409 2992.)

Royal Society of Chemistry. Burlington House, Piccadilly,  
London W1V 0BN.

Mrs. Rajkumari Williamson, Schuster Laboratory, Dept. of Physics,  
University of Manchester, Manchester M13 9PL.  
Telephone : Manchester (061) 980 7016.

#### **Other Seminars in the History of Science and Technology.**

(Reprinted from BSHM Newsletter No 10 page 5.)

The Science Museum, South Kensington, London SW7 2DD. Wednesdays  
4 p.m. in the Board Room at the Science Museum. (Tea at 3-45). for  
details and mailing list, phone Robert Bud, 01-938-8041.

Imperial College of Science and Technology. History of Science  
and Technology Group. Wednesdays. Times and Rooms vary. For  
details and mailing list, phone Dr J Secord 01-589-5111 ext.  
7063.

University of Oxford. Science and Culture in Early Modern  
Europe. Wednesdays at 5 p.m. during Hilary term 1989. Hovenden  
Room, All Souls. Details from Penelope Gouk, St. Catherine's  
College, Oxford.

#### **Congratulations.**

The new President of the British Society for the History of  
Mathematics is Dr. E J Aiton and the recently elected Secretary is  
Dr. R W Bray, Dept. of Mathematics, University of Essex, Wivenhoe  
Park, Colchester, CO4 3SQ, England.

Congratulations to both of them on their appointment and also  
to Professor Robert Fox who is the new Professor of the History of  
Science at Oxford.

## Editorial.

It seems appropriate to commemorate important happenings at least every fifty years, for to wait for centenaries means that many events might not be celebrated in a normal lifetime. Three events of particular significance to the Editor occurred just one hundred and fifty years ago.

That of least importance (although of more significance in the development of technical education than generally recognised) was the decision in January 1839 to found what is now Chester College of Higher Education. The first Principal of the College was Arthur Rigg who was influential in the development of technical education; for a short time William Crookes, (later PRS) was one of his Lecturers. Crookes of course, was closely involved with the development of photography, as well as in many other areas of natural philosophy.

The second event in January 1839 was the first publication of the existence of a viable photographic process by Louis Daguerre (1787-1851). Photographs of a kind had been made long before this but commercial applications were not then seriously considered.

The third and most significant event was the reading of a paper entitled Some Account of the Art of Photogenic Drawing, or, the Process which Natural Objects May Be Made to Delineate Themselves without the Aid of the Artist's Pencil to the Royal Society on the 31st of the same month. The author of the paper was William Henry Fox Talbot (1800-1877). He followed it up on the 20th. February 1839 with a second paper which gave more technical details of his process. It was basically the negative/positive method usually used today. Thus photography was born. The daguerreotype was important for only about twenty years; successive improvements in the Talbot process led to the diffusion of photography throughout society.

After 1839, of course, photography played, and plays, a very important function in scientific research. Indeed, remembering that the circuits in modern computers depend on photographic processes for their construction, it is difficult to think of any present-day research in physics which cannot be in some way dependent on the work of the early pioneers of photography.

It is intended that the theme of the next issue of this Newsletter shall be early photography and brief contributions would be welcome on this or indeed any other topic relevant to the history of physics. What was the first research paper in physics making use of photography? Perhaps William Crookes may have had a hand in it!

I am very grateful to the secretary, many members and the others who keep me well supplied with what I hope is interesting or useful information. I would also like to thank Bernard Spurgin and Clive Jones for considerable help in the production of this Newsletter.

## The Group Annual General Meeting.

The Annual Meeting of the Group was held at the Royal Institution on 26th October 1988. Apart from past and present Committee members the attendance was almost nil. We are very grateful to Mr. Gigl for his attendance. Without him we would not have been quorate for part of the meeting! While the small attendance may have been due to the lateness of the hour or to general satisfaction with the work of the Committee, it is hoped that more members will attend in 1989, as it is nearly impossible for fewer to attend!

We were sorry to hear of the resignation of Professor A. J. Meadows as Chairman of the Group, but delighted to welcome Sir Brian Pippard as his successor, together with Alan Morton and Peter Rowlands as new Committee members. During the meeting John Roche, the Group Secretary, presented Jack Meadows with a small farewell present from members of the Committee. In making the presentation, John Roche recalled that an article by Jack Meadows in Physics Bulletin had prompted him in 1982 to begin the process of forming the Group. Jack Meadows had from the very beginning promoted the formation of the Group at Institute Headquarters. He accepted the Chairmanship of the Steering Committee and was elected first Chairman in 1986. Dr Roche remarked particularly on Jack's good humour and skill in handling committee meetings and chairing meetings of the Group. Many titles for meetings, speakers to be invited and even titles for Group publications were suggested by Jack. The Group will particularly miss his notorious wit! John Roche recognised that the pressures of many commitments had forced Jack to resign, but it was hoped that he would find time later to be involved again in the work of the Committee.

Professor Nicholas Kurti also resigned from the Committee at the same time. It was a pity that he was not able to stay for the A.G.M. and to hear the tributes made to him. Both the past Chairman, Professor Meadows and the newly-elected Chairman, Sir Brian Pippard, asked the Secretary to convey the thanks of the Group to Professor Kurti and this was endorsed by the Committee. Professor Kurti was one of the founders of the Group, joining the steering committee in 1984. His international reputation was of no small importance in winning acceptability for the Group, both within the Institute and amongst many other scientific bodies. Now, with a membership of over 300 and with many successes to its credit, the viability of the Group is not in doubt, but this was not so in the early days! Nicholas Kurti frequently declared that his main function on the Committee was to be an "irritant". However Committee members will remember him for his wise suggestions and are much more likely to have taken away from meetings a feeling of affection for this warm-hearted man.

Continued.

## The Group Annual General Meeting.

Continuation.

Following these changes the Group Committee now consists of the following :

Professor Sir Brian Pippard FRS (Chairman), Dr John Roche (Secretary), Mr Brian Davies, Mr David Hooper, Mr Stuart Leadstone, Dr Alan Morton, Mr Peter Rowlands, Mr Bernard Spurgin and Mrs Rajkumari Williamson.

### Notes for Contributors.

The Newsletter is edited by David Hooper, 36, Flag Lane North, Upton Heath, Chester CH2 1LE. His telephone number is Chester (0244) 380844. It is hoped to publish the next issue of the Newsletter about October 1989 but this will depend on the amount of copy received. If you have contributions which are not particularly date-sensitive, please send them at once. For the time being, it has been decided **not** to include book reviews, research papers and advertisements except in exceptional cases unless the author is a member of the Group. Organisers of relevant meetings are invited to send details to the Editor for possible publication.

### Recent Publications.

Normally only publications (or part-publications) by Members of the Group or books edited by them are recorded here. Members are requested to inform the editor when a suitable item is published.

The Editor understands that Nicholas Kurti and Giana Kurti published their anthology But the Crackling is Superb in October 1988. This concerns food and drink, certainly a suitable subject for historians of physics and others! This hardback was mainly written by Fellows and Foreign Members of the Royal Society. The price is £12.50 but members of the Institute may have it from Adam Hilger for the modest sum of £10.

The recent Handlist of Instrument Makers' Catalogues to 1914 by John Burnett, Robert A. Anderson and, member of the Group, Brian Gee was mentioned on page 12 of Newsletter No 3. We are pleased to know that "Mr Gee" is now Dr Gee. The article by Dr Gee on trade catalogues has been held over yet again because of lack of time and space but has not been forgotten! My apologies.

David Hooper.

## **History of Physics Workshop for Physics Teachers.**

### **URGENT NOTICE.**

A one-day meeting will be held on Saturday 18th March 1989 at IOP Headquarters, 47, Belgrave Square, London SW1X 8QX.

Registration and Coffee at 10.15 for a start at 10.45.

The meeting will provide an opportunity for Physics Teachers and Historians of Physics to come together and explore ways in which the History of Physics can enrich Physics teaching at secondary (11-18) level. A publication outlet to enable suitable material to be made available to teachers is being sought. Participants are encouraged to bring ideas, however modest or ambitious, for consideration and support.

Members of the Group working in Secondary education should already have received the programme. Anyone else interested in attending should send a stamped addressed envelope to Stuart Leadstone, Atlantic College, Llantwit Major, South Glamorgan CF6 9WF, **without delay please.**

### **Tamar Literary Services.**

Overseas Members of the Group, and others, may like to know that Tamar Literary Services offers research and editorial assistance "particularly in history of science and technology and science education". Details from Dr Brian Gee, 7 Barton Close, Landrake, Saltash, Cornwall PL12 5BA. His telephone is 075-538451 until the end of June 1989. Afterwards it will be 0752-851451.

### **Disclaimer.**

The IOP Historical Group Expresses the views of the Editor or of named contributors, and not necessarily those of the Group nor of the Institute of Physics as a whole. While every effort is made to ensure accuracy, information must be checked before use of it is made which would involve financial or other loss. The Editor would like to be told of any errors as soon as they are noted, please.

## The Fourier Breakthrough in Crystal Structures in 1934.

C A Beevers (Dept. of Chemistry, University of Edinburgh) and  
H Lipson (Dept. of Physics, UMIST, Manchester).

The story begins when we were both research students in the Liverpool University Physics Department, having graduated in 1929 and 1930 respectively. The Department was anxious to extend its range of research and asked us to try our hands at crystal-structure determination, a fairly new subject, less than twenty years old.

We had no supervisor and only rudimentary apparatus; our camera and even X-ray tubes were largely constructed by ourselves. But we soon learnt how to index oscillation photographs and to derive space groups. But what were we to do with our data? With some temerity we sought help from the world-renowned department at Manchester University under Professor W L Bragg, and with help we worked out two tetragonal crystal structures. We then, rather rashly, decided to try something more challenging and chose copper sulphate pentahydrate,  $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ , which was triclinic.

We were soon in trouble! By noting certain regularities in the intensities, we were able to locate the copper and sulphur atoms. We knew the shape and size of the SO group but that was all. Where could we put five water molecules?

Then C.A.B suggested that we try the Fourier method advocated by W L Bragg in 1926. His father W H Bragg, in 1914, had laid down the basic idea and W.L. had shown that it would work in a two dimensional problem. This was with a silicate, diopside, whose structure had been worked out by ordinary methods. Since we knew the copper and sulphur positions, we thought that we might be able to apply the method to a new structure.

The first problem was how to sum a two-dimensional series. As undergraduates we had summed one-dimensional series, with a few terms, but now we had to work in two dimensions, and with about 90 terms! W.L. would not tell us how he did it for diopside.

The arithmetic involved summing a group of terms

$$F(h,k) \cos 2\pi(hx + ky)$$

where F was the structure amplitude, h and k were the indices, and x and y were co-ordinates of points in the unit cell. We decided to divide the unit cell sides in 60 parts (six degree intervals) and to take the sign of F, which had to be positive or negative, from the positions of the copper and sulphur atoms. The signs would not all be correct, but most of them would be.

Continued.

## The Fourier Breakthrough in Crystal Structures in 1934.

continuation.

C A Beevers took the data home and evaluated the series for one point in 40 minutes. At that rate it would take us nine months for the lot! Even for us that was too long, so we tried to systematize the process.

We took a standard cosine curve with ordinates at six degree intervals and amplitude 100; only one quarter, of course, was required. We used a slide rule to get different amplitudes, and read off the numbers at different intervals - successive numbers for index one, alternate numbers for index two, and so on. We entered the results in a notebook and then added them mentally. We had to do this for each value of  $x$ , so that we had quite a collection of numbers at the end.

One of the problems was that the origin was arbitrary, since  $\cos 2\pi(hx + ky)$  was involved; we had carefully to consider where the curve started. Then one of us (H.L.) had a bright idea - to expand  $\cos(hx + ky)$  into  $\cos hx \cdot \cos ky - \sin hx \cdot \sin ky$ . C.A.B. thought this was crazy - two terms instead of one! But H.L. pointed out that the same curves could be used for  $(h,k)$  and  $(h,\bar{k})$  and that the same curves could be used over and over again.

Now it occurred to us that we need not write the numbers in a notebook; we could write them on strips and re-use them if appropriate. We acquired a good collection in this way and in odd moments we filled in the gaps. H Lipson's mother helped by writing the negative values on the backs of the strips. With these methods we completed the summation in a month. We checked by summing with the second co-ordinate first and the results agreed very well.

To file the strips we made boxes with sloping sides, so that when a strip was taken out a space remained, into which the strip could be re-inserted without searching. Two boxes were needed, one for cosines and the other for sines.

The values of the ordinates for each term are recorded on the strip at the intervals of  $6^\circ$ , each ordinate being given to the nearest digit, as shown. In this figure a cosine and a sine strip are shown, the

76	C 7	76	56	8	43	74	66	23	31	69	72	38	16	41	76	51	0
19	S 6	0	11	18	18	11	0	11	18	18	11	0	11	18	18	11	0

sequence of symbols at the left-hand side representing the amplitude, cosine (C) or sine (S), and index. The total number of strips is approximately 4000.

A Beevers-Lipson Strip.

Continued.

## The Fourier Breakthrough in Crystal Structures in 1934.

continuation.

Other people heard of the strips and asked if they could copy them; we were only too pleased. We explored the possibility of printing them, and after some reluctance Manchester University lent us the money in spite of the enormous cost - £200! The task of getting the numbers printed, checked and cut into strips was a saga in itself. We gave about half a dozen sets away as propaganda, but the orders flowed in and we soon repaid the cost, being allowed to keep the profit ourselves - our first consultancy fees!

Later in Edinburgh, the strips were reprinted at three degree intervals to deal with larger unit cells. The first boxes were made in Manchester by a firm of carpenters who wore paper hats, just like the carpenter in Alice in Wonderland.

The first set was sold in June 1936, and by September 1946, sales had reached 69 over the world. They were then replaced by the three degree sets and sales had reached 503 by February 1970. Then the electronic digital computer entered the fray and the demand for the strips gradually reduced.

What is the point of recording all this? We think it is important as an example of how science develops. Politicians, for example think that scientists do their work to achieve personal glory, but there was nothing of this aspect in our work. We had a problem to solve and we wanted to find a way of dealing with it. It never occurred to us that a couple of young men in an outpost of physics could have a lasting influence on their subject. But that is just what we did! Largely because of our strips, the Fourier method became a standard way of solving crystal structures, and no crystal structure paper was complete without a Fourier diagram. We had achieved fame, but not fortune! The Beevers-Lipson strips are still remembered, even if they are not now used.

### References :

- Beevers C.A. and Lipson H. (1934) Phil. Mag. 17 855.  
Lipson H. and Beevers C.A. (1936) Proc. Phys. Soc. 48 772.  
Lipson H. "Physics in a Minor Department" in Williamson R. (ed.) (1987) The Making of Physicists. Bristol : Adam Hilger 94-100.

### **Congratulations.**

The new President of the British Society for the History of Mathematics is Dr. E J Aiton and the recently elected Secretary is Dr. R W Bray, Dept. of Mathematics, University of Essex, Wivenhoe Park, Colchester, CO4 3SQ, England.

Congratulations to both of them on their appointment and also to Professor Robert Fox who is the new Professor of the History of Science at Oxford.

## **History of Physics in other IOP Publications.**

We are pleased to see that SNIPPETS, the IOP publication, intended for school science teachers, has introduced a History of Physics Section. We also note, with interest, the article by Becky Parker "Hands On' History of Physics" Physics World (February 1989).<sup>2</sup> 28-29. The suggestion is made that the teaching of physics through historical apparatus reconstructions is rapidly gaining interest. How far should the Group go in this particular direction?

## **Chapters in the History of Low Temperature Research in Britain.**

A very successful meeting organised jointly by the History of Physics and Low Temperature Groups of the Institute of Physics and RICHST was held at the Royal Institution on 26th October 1988. In the morning we were entertained and informed by a series of excellent lectures by Professor Cardwell on the Joule-Thomson partnership, by Dr. Latimer on Andrews' Experiments at Queen's College, by Dr. Brock on the work of Dewar and by Dr. Gardner of BOC on "The Evolution of Low Temperature Air Separation Processes".

After an enjoyable buffet lunch and the opportunity to see some of the treasures of the R.I., we were privileged to hear contributions by four Fellows of the Royal Society. Professors D Shoenberg and J F Allen spoke on the early days of low temperature physics in Cambridge. Some of the very important work done at Oxford, was well presented (and represented), by Professor Kurti and the Group Chairman elect, Professor Sir Brian Pippard drew attention to some of the interesting work done in Bristol and London, as well as bringing together themes from the earlier contributions.

The organisers and in particular Mrs. R. Williamson are to be congratulated and thanked for an efficiently arranged and most enjoyable day.

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## Conference on the History and Present Significance of the Researches of George Green.

This first conference on the work of the mathematical physicist, George Green was held on the 15th and 16th July 1988 at the University of Nottingham and was organised jointly by the History of Physics Group and the George Green Memorial Fund. At the opening reception, provided by the University, its Senior Pro-Vice-Chancellor, Professor G B Warburton, and the Lord Mayor of Nottingham, Councillor Martin Suthers, O.B.E., extended their welcome to the conference members. The conference sessions were chaired by Professor A J Meadows and Professor L J Challis, Chairman of the George Green Memorial Fund.

George Green was a working miller till the age of 37. At 40 he went as an undergraduate to Gonville & Caius College, Cambridge, and was ranked as Fourth Wrangler in 1837. Two years later he was elected to a Fellowship but after only six months he returned to Nottingham and died the following year, in 1841.

Green's first and major work, containing both Green's Theorem and Green's functions was written while working full-time at his mill. This was his Essay on the Application of Mathematical Analysis to the Theories of Electricity and Magnetism, published by private subscription in Nottingham in 1828 and thereafter forgotten until it was re-discovered by the young William Thomson, later Lord Kelvin, in 1845. One subscriber, Sir Edward Bromhead, however, encouraged Green to continue his mathematical work. He finally wrote nine memoirs, all but one being published in the Cambridge Philosophical Transactions.

There are few known facts concerning Green's life and many points remain unexplained. The most important problem is how a miller working in a provincial town in the first quarter of the nineteenth century, with only four terms of education at the age of eight, became familiar with the contemporary publications of Laplace, Poisson and other French philosophers. How was he able to use the methods of continental analysis at a time when these were only slowly filtering their way into the Newtonian fastnesses of Cambridge? This issue was explored in detail in the papers of Dr J J Roche of Linacre College, Oxford, Secretary of the Group, who spoke on "Green's Contributions to Mathematical Electricity and Magnetism" and Dr I Grattan-Guinness, whose title was "George Green and Divergence Theorems".

Professor Challis had opened the conference proceedings with a review of some of the fields where Green's techniques and concepts were now of considerable importance. He recalled how Green's pioneering work on electricity and magnetism had greatly influenced Kelvin, as the latter fully acknowledged in many footnotes to his collected works in this area. Kelvin's interest and important contributions to elasticity and the reflection of waves at interfaces had been stimulated by the need to understand the properties of the aether.

**Conference on the History and Present Significance of the  
Researches of George Green.**

Continuation.

The full history of the application of Green's functions to quantum mechanics in the late 1940's has still to be written. One such area was however examined by Professor A J M Spencer, F.R.S., in his paper on "Green's Essay and the Basis of Electricity."

Finally Dr J E G Farina and Dr F W Sheard described the use of Green's work in modern physics. Initially, spacially varying Green's functions were introduced to quantum mechanics to describe particle scattering in a similar way to the classical wave treatment. Later, time-dependent Green's functions were introduced to represent forces by a train of impulses.

The conference members spent the Saturday morning at Green's Mill and Science Centre in Sneinton, Nottingham, the centre of Green's domestic life. Here is the mill and millhouse in which he worked and lived, with the site of the house in which he died a stone's throw away. Just across the road is his grave in St. Stephen's churchyard. The Mill, derelict since the 1860's, has been restored. This project was launched by the George Green Memorial Fund and Professor Challis, its founder-chairman, and brought to fruition by the City of Nottingham and various voluntary bodies. When we visited, the sails were turning and some members bought their bags of freshly-ground flour!

Of particular interest to physicists is the Green Science Centre, which not only provides, with the aid of an audio-visual show, information on Green and on mills and milling, but also houses a number of working science models. These were originally designed by members of the University Physics Department and colleagues, and are immensely popular with younger visitors, who, encouraged by the "hands-on" approach can themselves experiment with electricity and magnetism, sound and light.

This visit to "Green-land", the Mill, was rounded off by a talk on the mathematician's life and education by Miss D M Cannell, Secretary of the George Green Memorial Fund, who has made a study of the background to the few known facts of Green's life.  
John Roche.

(A preliminary report on this meeting is in Newsletter No 3.)

**Food for Thought from Mr R G Stansfield.**

The result was entirely different from what the book said should happen, and what the master expected. When I asked the reason none was forthcoming - I was advised to get on with the matter in hand.

Dainton F S, (Lord Dainton) 'The swing away from science.'  
The Listener. 18 May 1967 pp 645-7.

THE INSTITUTE OF PHYSICS HISTORY OF PHYSICS GROUP NEWSLETTER.

No. 4

February 1989.

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**The Institute of Physics History of Physics Group Committee.**

Chairman : Sir Brian Pippard F.R.S.

Secretary : Dr John Roche.

Members : Mr Brian Davies.  
Mr David Hooper.  
Mr Stuart Leadstone.  
Dr Alan Morton.  
Mr Peter Rowlands.  
Mr Bernard Spurgin.  
Mrs Rajkumari Williamson.