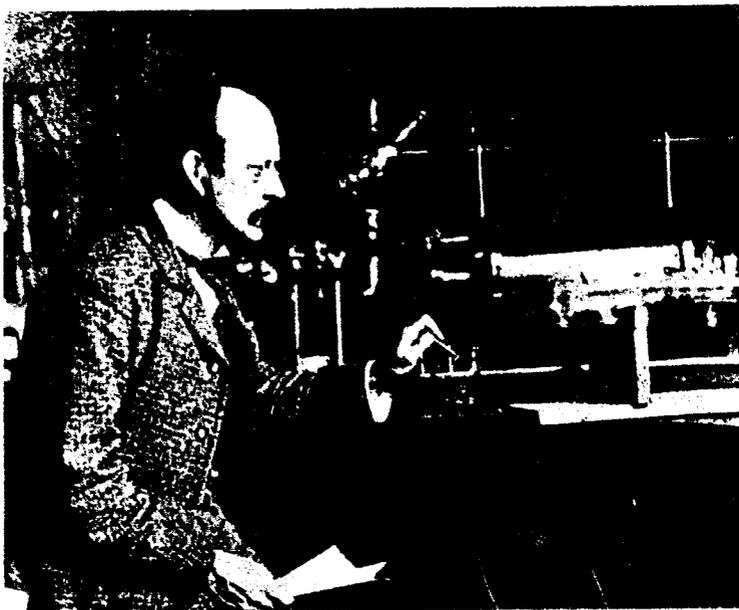


History of Physics Group



CENTENARY OF THE ELECTRON

NEWSLETTER

No. 10 *Spring 1997*

Institute of **Physics** _____

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**Institute of Physics
History of Physics Group
Annual General Meeting
Saturday, 19 October 1996**

Chairman's address

I would like to thank the outgoing Chairman, Sir Brian Pippard not only for his excellent services as a Chairman but for supporting the history of physics. I am quite sure that his period as Chairman has raised the standing of history within the Institute of Physics.

I would also like to thank Dr Alan Morton for his services as Honorary Secretary of the group. One enormous benefit of his period of office is that the Group is now closely associated with the Science Museum. Because of this we are having the present meeting at the Museum and the new Honorary Secretary is a museum officer. Given the vast repository of instruments and devices of historical importance to the history of physics it is most appropriate that we should have close ties with the museum. I hope that we will maintain these ties and make better use of them.

We are now about 14 years old. When, precisely, we began is a matter for historical research among future historians of science.

We have had many very successful meetings and socially enjoyable meetings over the years, the most recent on the 20 April, on the Influence of the Sun on the Earth. We have had many distinguished lecturers over the years: I can think of Sir Neville Mott at Raj Williamson's meeting in Manchester, Brian Josephson of the Josephson effect at a meeting organised by Stuart Leadstone; Harry Lipson; Frank Llewellyn Jones; Brian Petley; Nicholas Kurti, who was on our committee in its early years; Harry Rosenberg who, sadly died soon after he addressed another meeting organised by Raj Williamson.

We have on tape the voices of quite a number of famous physicists, some of whom, sadly, have now passed away.

The Group has stimulated historical research among physicists, the kind of research which only physicists are competent to carry out, and it is important that it should continue to do so.

With a new Chairman and a new Honorary Secretary, I am sure that you expect new ideas, new initiatives new enthusiasm. This, indeed, is what I hope that all of us in the committee and in the Group at large can provide. The Group has now some 400 members, a considerable growth since our Sir Brian Pippard and Alan Morton took over the running of the Group. This means that there are people out

there interested in the history of physics. We must stimulate more to attend our meetings. We must be more inventive in finding meetings which they would be tempted to attend.

Should we use the internet more; to set up discussions of matters of interest to us?

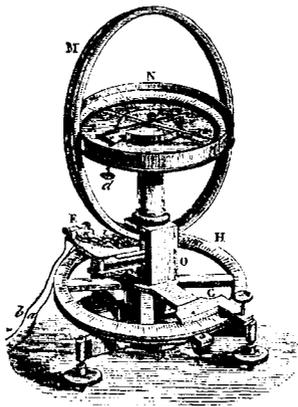
We are all probably much more pressured than we were when the group was set up in 1982. We have less time to prepare for meetings and even, perhaps to attend meetings. We must try to deal with this by streamlining and minimising the effort we need to put into organisation; but also we must make our meetings more attractive for people with so much pressure on their time. Perhaps we need to look at committee meetings and group meetings and regularise time slots.

Can we be more relevant? We already play a supportive and a stimulating role in physics. Can we make a contribution to the national problem of the alienation of school and University students from Physics? Can we find ways of making physics more attractive, less unintelligible to students. I will remind you of goal number 3 of the Constitution of the Group. Generally to advance the understanding of the subjects within the scope of the Group. This can be interpreted very broadly. I would like to see an expansion of meetings of the sort which we have had to-day. Historical studies of concepts which are important yet difficult to teach and a deliberate attempt to use these studies to clarify these concepts. Also, if we can come up with something useful, I am sure we can publish in an appropriate physics journal devoted to education.

Perhaps we can find more interesting subjects for our meetings. Perhaps we need to give our members a greater say in the choice of speakers: by calling for papers, for example.

I would like you to view the arrival of a new Chairman and a new Honorary Secretary as an opportunity to carry out a reappraisal of the Group, its goals and activities.

John Roche



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Institute of Physics
History of Physics Group
Annual General Meeting
Saturday, 19 October 1996

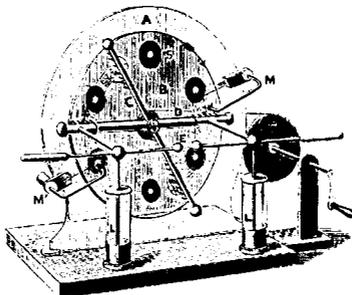
Honorary Secretary's Report

The Group has organised two meetings in the last year, both at the Science Museum in London. The first was the meeting 'The influence of the Sun upon the Earth: changing views over two centuries', held on 20 April. This was sponsored jointly by the History of Physics Group, the History Group of the Royal Meteorological Society, and the Royal Astronomical Society. It was a successful meeting, with over 70 people registering to attend. The second was the meeting on 'Vectors in Physics: origins and significance' which preceded the AGM, and which was attended by about 20 people. In addition to these meetings Dr. Alan Morton had organised a successful half day session at the IOP Annual Congress in Telford on 23 April.

The Group has 422 members. Typically fewer than one in ten attend the meetings which are the main activity of the Group. This is noted every year, and the committee constantly needs to consider how to provide for members who cannot attend meetings, or do not attend them for other reasons.

There has been some tension between the Secretary and the Conference Department at the IOP. It was pointed out that the April meeting did not conform to the procedures laid down by the Conference Department. These make one-day meetings expensive for the participants and a lot of work for the organiser, compared with half-day or evening meetings which can be subsidised from the Group's grant and administered in a simpler way. One-day meetings are most convenient for members, but they do not allow the Group to make full use of the grant provided by the Institute, so that, in effect, the additional subscriptions paid by members are not being used for the purposes of the Group. The committee will need to consider the implications of this for the future programme.

Neil Brown



Extract from Committee Meeting December 7th 1996.

The Chairman suggest that the meeting should consider what the Group should be doing as it moves into the next century, and what changes might be needed. There was considerable discussion of this. The Group has tended to concentrate on the *physics* of the history rather than other aspects, and on nineteenth century work. This interest should continue, but in addition the Group ought to try to find physicists to talk about twentieth century work, especially work they have been involved in, and it would be worth holding meetings about historical figures, especially relatively recent ones. The idea of compiling a list of eminent physicists who might talk about their work was mooted. The difficulties of attracting people, especially physicists in industry, to meetings, was mentioned.

Because of the constraints imposed by Headquarters procedures for one-day meetings, there was reluctant agreement to holding (long) half-day meetings. There was agreement to try occasional evening meetings with a single speaker. The proposed pattern of meetings was a long meeting in the spring of each year, and evening meeting in late June or early July, and another long meeting, to coincide with the AGM. One of the long meetings should be on a physical concept. For the spring of 1997 it was agreed the Group should try to re-run the 'Vectors in Physics' meeting (with some changes to speakers if necessary) in Edinburgh, at India House.

PROPOSED MEETINGS

Spring 97	Vectors 2	Edinburgh
Summer 97	Medical Physics	T.B.A.
Autumn 97	Entropy	Manchester
Spring 98	N.P.L.	N.P.L.
Summer 98	Open	T.B.A.
Autumn 98	Fields	T.B.A.

The Summer 98 evening meeting has been left open for members to suggest a leading person in some area of Physics that they would like to hear speaking on their field of activity. Ideas can be sent to the secretary below.

Some details have since been finalised. Please see information later in the newsletter.

**The concept of entropy: past and present
a call for papers.**

The history of Physics Group in The Institute of Physics will hold a meeting on the concept of Entropy on Saturday 18 October 1997 in the School of Physics at The University of Manchester. The meeting will consider aspects of the history of the **concept of entropy**, the text-book tradition of presenting entropy and suggestions for improving the teaching of entropy. The group is concerned to promote a better understanding and presentation of key physics concepts by a study of their history. If you have done or are currently doing work on any of these topics, or are prepared to do work between now and the October meeting, please contact Dr Peter Rowlands, Oliver Lodge Laboratory, University of Liverpool, Oxford Street, Liverpool or on email prowl@hep.ph.liv.ac.uk.

On the 17 October 1998 the Group will hold a similar meeting on the **electromagnetic field**. Again we would welcome offers for papers, along the lines described above for the concept of entropy. Please write to John Roche, Linacre College, St Cross Road, Oxford OX1 3JA or email john.roche@linacre.ox.ac.uk.

APPEAL

Donations to the group are not required, however literary contributions are welcome. These can range from short pieces such as in 'Snippets', anecdotes, museum visits, uses of apparatus, etc., to larger articles on an area of interest to the author.

MEETINGS ORGANISED 1995-96

27 March 1995 Session on the history of physics at the IOP Annual Congress at Telford.

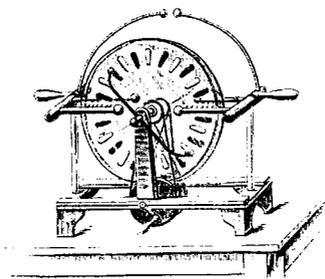
13 May 1995 Meeting at the Oxford Museum of the History of Science and at the Clarendon Laboratory, with lunch at Keble College, attended by between 20 and 25 people. It included a session at which some participants spoke about pieces of historic apparatus which they had brought with them.

21 October 1995 Annual General Meeting in the Department of Physics and Astronomy at the University of Manchester. The meeting planned to coincide with the AGM had to be cancelled at the last minute: organisational difficulties had cause it to be advertised rather late, and there was insufficient support for it.

20 April 1996 Joint meeting at the Science Museum, London, with the history groups of the Royal Meteorological Society and the Royal Astronomical Society on 'The influence of the Sun upon the Earth: changing views over two centuries. This was a very well supported meeting, attended by over seventy people.

23 April 1996 Session on the history of X-rays and radioactivity at the IOP Annual Congress at Telford.

19 October 1996 ' Vectors in Physics: Origins and Significance', at the IOP, London , followed by the Annual General Meeting.



INTERNET

Now that more people have access to the Internet system members may like to communicate with one another via this means. If you would like to send in your internet address with a brief piece on your areas of interest then they will be included in this section of the newsletter.

The e-mail addresses of the Chairman and Secretary are given below:

Chairman: John.Roche@Linacre.ox.ac.uk.

Secretary: n.brown@nmsi.ac.uk.

This information has kindly been supplied by the British Society for the History of Mathematics (BSHM) and is their copyright.

New history of scientific instruments list

A new e-mail distribution list has been set up to carry information and discussion on history of scientific instruments. The list is open to all: curators, historians, students, collectors and dealers are all welcome. To join, send the following message to majordomo@maillist.ox.ac.uk:

subscribe rete

This message should be in the body of the message—leave the 'subject' space blank. You'll then receive further instructions when your subscription is accepted. Once subscribed, you can send messages to other list participants by posting messages to the address rete@maillist.ox.ac.uk:

If you have any problems, contact Jim Bennett at jim.bennett@histsci.ox.ac.uk.

<http://www.dcs.warwick.ac.uk/bshm/>

- the BSHM's own website, including our cumulative abstracts.

<http://www.mat.uni-lj.si/matem.htm>

- history of mathematics in Slovenia, and information on Slovenian mathematicians including Jurij Vega (1754-1802).

<http://www.ams.org/mathweb/mi-mathhist.html>

- another new Web site: one for the AMS- MAA Joint Committee on Archives. Not quite a home page yet but all the links are ready.

<http://www.ams.org/mathweb/History/collections.html>

- a beginning of a list of archival sources in North America.

<http://www.altavista.digital.com/>

- Not a history of mathematics page but an address recommended by Graham Jagger as "a new web browser, infinitely superior to all the rest I have tried". If you put in one or more key words it will come up with a number of choices with brief descriptions—obviously, the more key words you insert the more the search is narrowed down. You can then click to access any of the choices that seem promising.

<http://forum.swarthmore.edu/math.history/>

Archive of past discussion on the MAA math-history-list from September 1995 to the present, so that you can explore what questions have been asked and what answers provided. There are various sorting options: by subject, by contributor, &c. (The math-history-list was described in *BSHM Newsletter* #30 p.63.)

A meeting of The History of Physics Group
in conjunction with
The James Clerk Maxwell Foundation



*Maxwell's
Birthplace
14 India Street
Edinburgh*

This meeting will look at the origins of the vector concept, conceptual difficulties with vectors and methods of presenting vectors to students. It is a genuine attempt to honour one of the original intentions of the History of Physics Group, namely the clarification of concepts through historical analysis. The contributors include mathematicians and physicists, university academics and practising teachers. It is a repeat at a northern venue of the meeting held in London in October 1996, of which an account appears elsewhere in this Newsletter. It will however have two contributions which were not included in the London meeting.

Further details and registration form are provided overleaf.

VECTORS IN PHYSICS: ORIGINS AND SIGNIFICANCE

A meeting of The History of Physics Group, in conjunction with
The James Clerk Maxwell Foundation.

Date: Saturday 12 April 1997

Venue: 14 India Street, Edinburgh: Maxwell's Birthplace
(by kind permission of the JCM Foundation)

Registration: Please detach the form opposite, complete both sides and
forward as indicated.

PROGRAMME

0930 Registration and coffee

1000 *Quaternions and Clifford Algebras, Antecedents of the Vector Concept*
Dr Peter Rowlands (University of Liverpool)

1050 *Flaming Swords and Hermaphrodite Monsters: Peter Guthrie Tait and the
Promotion of Quaternions: Vectors compete with Quaternions*
Mr Chris Pritchard (The McLaren High School, Callander)

1140 *Molecular Dynamics Using Quaternion Trajectories on the Hypersphere*
Professor Stuart Pawley (University of Edinburgh)

1230 Lunch

1340 *Perennial Problems with the Vector Concept in Physics*
Mr Stuart Leadstone (Banchory Academy)

1430 *Possible Strategies for Teaching Vectors*
Dr John Roche (Linacre College, Oxford)

1520 *Vectors, Vector Spaces and Vector Fields: A Mathematician's Perspective*
Professor Edward Patterson (University of Aberdeen)

1610 Discussion

1630 Tea

This form to be completed
and returned (not later
than 31 March 1997) to:-

Neil Brown
Science Museum
South Kensington
London SW7 2DD

REGISTRATION FORM

Vectors in Physics: Origins and
Significance

Saturday 12 April 1997

14 India Street, Edinburgh

1 (Mrs/Mr/Ms/Miss/Dr/Prof) _____
SURNAME _____
FIRST NAME (for lapel badge) _____ INITIALS _____

2 AFFILIATION _____

3 ADDRESS FOR COMMUNICATIONS _____

TELEPHONE _____ FAX _____

Please tick boxes as appropriate:-

4 MEMBERSHIP IoP/Affl^d Orgⁿ Mem^p No. _____
 Affiliated School JCMF Associate

5 DATE _____ SIGNATURE _____

Continued overleaf

6 MEETING FEE (excluding lunch).

- Member £ 15
- Non-member £ 17
- Retired/Student Member* £ 13

*Student's supervisor to sign here _____

7 LUNCH

- I shall require lunch at £ 5
- I am a vegetarian
- I shall not require lunch

8 PAYMENT OF FEES

- Cheque enclosed ** ** made payable to "James Clerk Maxwell Foundation"
- PO Enclosed **
- Payment will follow from employer
- Please provide an invoice/receipt

REQUEST FOR DETAILS OF MEMBERSHIP

Please send me details of membership of the Institute of Physics

Name and Style _____

Address _____

Vectors in Physics: Origins and Significance

Meeting of the Institute of Physics History of Physics Group,
Saturday 19th October 1996.

A personal assessment by Hugh Montgomery.

The idea for this meeting came from John Roche and Stuart Leadstone, who were concerned by the fact that students today seem to find more difficulty with the concept of vectors than most of us did when we were students ourselves. In tackling this problem they were naturally led back to the history of vectors, and to the difficulties which physicists experienced when they used vector algebra for the first time. From the start the agenda for the meeting developed two distinct but related themes; the history of the vector-quaternion controversy in the nineteenth century, and the problems of teaching vectors today. Personally I feel that the existence of the two separate themes was an excellent feature of the conference; one cannot spend a whole day beating one's breast and asking where have we gone wrong with our students, and equally one cannot spend a whole day discussing the problems of the nineteenth century without any comparison with the problems of today.

Peter Rowlands' paper began with the story of the discovery of quaternions by William Rowan Hamilton in 1843. In a two-dimensional space both vectors and the rotations of vectors can be represented by complex numbers, and quaternions extend this formalism into a space of three dimensions. However in doing so they create a fourth dimension whose coordinates are represented by real numbers. Hamilton believed that this fourth dimension could be related to time, and that quaternions could explain why physical space is three dimensional. Quaternions were "the key to the universe."

Was Hamilton right, or hopelessly wrong? With the exception of Peter Guthrie Tait, few contemporary physicists viewed quaternions with much enthusiasm, and eventually they were discarded in favour of the Vector Analysis developed by Oliver Heaviside and Josiah Willard Gibbs. This system drew its ideas from quaternion theory, but it was related in a more commonsense way to physical concepts, and it carefully avoided the use of complex numbers. Gibbs' first account of the subject was written in 1881, and by the 1920's vector analysis was well established. Quaternions became a museum piece, and as Peter Rowlands put it:

"They are not taught in university physics courses because they are worthless, and their worthlessness is proved by the fact that they are no longer taught."

And yet quaternions possess a mathematical elegance which is ultimately lacking in vector analysis, and their power to handle topics such as rotational mechanics, electromagnetism and relativistic quantum theory cannot be denied.

Chris Pritchard then gave a fascinating and scholarly paper on the history of the vector-quaternion controversy. Tait began to study Hamilton's treatise on quaternions in 1853, and like everyone else he found it incomprehensible. Five years passed before he began to realise the value of Hamilton's ideas in physics; once converted he became a strong advocate of quaternion methods, and he continued to develop them until his death in 1901. However it became clear that if quaternions were to be generally accepted, at least one other eminent physicist would

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have to speak out in their favour. The obvious candidate was William Thomson, but he declared roundly that both quaternions and vectors were useless concepts, and that the correct way to handle a directed quantity was by a set of three Cartesian coordinates. Arthur Cayley, the inventor of matrices, entered the discussion at a much deeper level; he and Tait carried on a long correspondence on quaternions, but when Cayley died in 1895 he was still quite unconvinced.

James Clerk Maxwell was ambivalent. His deep insight went right to the heart of all the problems, and he saw that it was vital to escape from the straitjacket of Cartesian coordinates. But he also realised intuitively that quaternions were not quite the formalism he needed. In his Treatise on Electricity and Magnetism the equations are presented both in Cartesian form and in quaternions, but as Heaviside noted Maxwell did not use the distinctive properties of quaternions in a creative way. Owing to Maxwell's early death in 1879 he never saw vector analysis in the form presented by Heaviside and Gibbs, and we can only speculate what his response might have been.

With hindsight we can see this controversy as a battle between the Romantics and the Pragmatists, in which the latter emerged as the apparent victors. In such a protracted debate it is unlikely that all the good arguments are on one side. The great strength of vector analysis lay in the fact that most physicists could gain an understanding of its concepts in physical terms, whereas for quaternions this was not the case: they formed a self-contained mathematical system whose relevance to physics was by no means obvious. My own feeling is that Hamilton's original insight was brilliant but incomplete. On their own quaternions could not withstand the attack from vector analysis, but when they are combined with the ideas of Grassmann and Clifford they provide a valuable formalism for the study of the physical world. Peter Rowlands introduced Clifford algebras in the second half of his talk, and he gave references to a number of papers by Hestenes which develop the theory in detail.

We now come to the second theme of the meeting, the problems of teaching vectors today to students at school and university. This was tackled by two penetrating papers by Stuart Leadstone and John Roche, and it is convenient to take them together. John Roche pointed out that physicists usually work with an intuitive understanding of topics such as space and motion, rather than with the conscious understanding which might be the aim of the philosopher. As physicists we wish to impart our intuitive understanding to our students, but this can be done only through the language of conscious understanding. This argument must touch a raw nerve in every teacher's soul. So often we find ourselves dodging this issue, and particularly in university lectures the aim seems to be not to clarify the concepts but to anaesthetise the patients, so that they can learn to sleepwalk their way through the subject in an accepted manner! Stuart Leadstone ended his talk with a quotation from Maxwell which every teacher should take to heart:

"Mathematicians may flatter themselves that they possess new ideas which mere human knowledge is as yet unable to express. Let them make the effort to express these ideas in appropriate words without the aid of symbols, and if they succeed they will not only lay us laymen under a lasting obligation, but, we venture to say, they will find themselves much enlightened during the process, and will even be doubtful whether the ideas as expressed in symbols had ever found their way out of their equations into their minds."

Stuart Leadstone began his paper with a detailed analysis of the effect of sloppy language on the teaching of dynamics, with some telling examples taken from examination questions. He deplored the fact that while we have two words, "speed" and "velocity" to describe the scalar and vector aspects of the rate of motion, there are no corresponding two words in the case of acceleration. The phrase "free fall" is often used glibly to describe situations in which a body may in fact be rising. We speak quite wrongly of the moon "accelerating towards" the earth. This part of his talk provoked a detailed discussion, and not everyone agreed with his suggestions; but he achieved his aim of making people sit up and think.

He then discussed the Parallelogram Law of Forces, which is sometimes presented as an experimental law, and sometimes as a deduction from previous statements. He claimed that students find particular difficulty in relating the Parallelogram Law to the Triangle Law, and this led to the knotty question of free and bound vectors. He suggested that vectors are mathematically free and physically bound, a statement I agree with most of the time. During his paper I had the feeling that some of his students' problems arise because they spend too much time playing with computers and too little time thinking about Euclidean geometry, and this doubtless reveals my antiquity.

John Roche developed these arguments further from a slightly different angle, giving a student's eye view of the subject. Vector analysis is partly graphical and partly algebraic, and the second aspect is both difficult in itself and hard to relate to the first. Angular velocity is a particularly puzzling; it is defined as a vector lying along the axis of rotation, and yet in a rotating body all the movement is taking place at points which do not lie on this axis. This touches on the problem of the axial vector and the pseudovector, a topic which is handled much better by quaternion theory than by vector analysis. In a Clifford algebra a rotation is represented by a spinor or quaternion, involving a bivector which defines an oriented plane area rather than a single axis. However it seems unlikely that a student could appreciate this approach if he or she had not first studied vector analysis.

The meeting was rounded off by a shrewd discussion by Rom Harré, taking up many of the points raised in the earlier papers and exploring their philosophical implications. It would be wrong for me to try to paraphrase his arguments as I would soon be out of my depth, but his distinction between the grammatical and the substantive (the mathematical and the physical?) is one which pervaded the whole day's discussion. A good meeting throughout.

HAMILTON, SIR WILLIAM ROWAN (1805-1865), mathematician, born in Dublin at midnight, between 3 and 4 A.ug. 1805, was the fourth child of Archibald Hamilton, a solicitor there, and his wife Sarah Hutton, a relative of Dr. Hutton the mathematician. Archibald Hamilton was Scottish by birth, and went to Dublin when a boy with his father, William Hamilton, who settled as an apothecary there, and his mother, who was the daughter of the Rev. James McFerrand, parish minister of Kirkmichael, Galloway. The Rev. R. P. Graves maintains that William Rowan Hamilton was Irish by descent, while admitting that both the paternal and maternal grandmothers are Scottish; but the express statements of Professor Tait and

Dr. Ingelby that the paternal grandfather went to Dublin from Scotland seem conclusive. The apothecary had also brought a second son, James, from Scotland, who studied for the church, became curate of Trim, co. Meath, and earned some reputation as a linguist. To this uncle William Rowan was entrusted by his father, the solicitor, when less than three years old. Hamilton read Hebrew when but seven years of age, at twelve had not only studied Latin, Greek, and the four leading continental languages, but could profess a knowledge of Syriac, Persian, Arabic, Sanskrit, Hindustani, and even Malay, and in 1819 he wrote a letter to the Persian ambassador in his own language. The choice of languages was owing to his father's intention originally to obtain

for him a clerkship under the East India Company. The mathematical bent of his mind, however, was presently to assert itself. In his tenth year he was matched in public with Zerah Colburn, the American 'calculating boy,' retiring from the arithmetical duels not without honour. About the same time he fell upon a Latin copy of Euclid, and studied it with such effect that within two years he read the 'Arithmetica Universalis' of Newton, and soon after began the 'Principia.' In 1822 good evidence shows that he understood much of that work, and had acquired such command of mathematical methods as to speedily master several modern books on analytical geometry and the differential calculus. Hamilton thus appears to have been mainly self-taught in mathematical learning. In his seventeenth year, when reading the 'Mécanique Céleste' of Laplace, he found an error in the reasoning on which one of the propositions was based. This discovery led to Hamilton's introduction to Dr. Brinkley, the astronomer royal for Ireland, afterwards bishop of Cloyne, whom he still further surprised by an original paper on osculation of certain curves of double curvature. The discipline of Newton and Laplace had already brought into relief the marked features of a mathematical genius of very rare quality and power.

In 1823 Hamilton became a student of Trinity College, Dublin. His achievements in mathematics alone implied great and continuous mental effort, but his success in other departments of thought was scarcely less remarkable. First in all subjects and at all examinations, twice gaining the vice-chancellor's prize for English verse, decorated with the 'double optime' (almost unprecedented), and, but for the appointment to which his special qualifications entitled him, certain to gain both gold medals (a thing quite unprecedented), he was characterised by a candour and enthusiastic eloquence that well became him as scholar, poet, and metaphysician, not less than as mathematician or natural philosopher.

In 1824, when only a second year's student, Hamilton read before the Royal Irish Academy a 'Memoir on Caustics,' and being invited to develop the subject, he some time after produced a celebrated paper on systems of rays, and predicted 'conical refraction.' Applying the laws of optics he proved that under certain circumstances a ray of light passing through a crystal will emerge not as a single or double ray but as a cone of rays. This theoretical deduction involved the discovery of two laws of light; and under the mathematical aspect was pronounced by Sir

John Herschel to be 'a powerful and elegant piece of analysis,' while Professor Airy, on the physical side, said 'it had made a new science of optics.' This result, that light refracts as a conical pencil both internally and externally, obtained on purely theoretical grounds, was soon after verified for universal acceptance, when Professor Humphrey Lloyd, at Hamilton's suggestion, put the new law to the test by means of a plate of arragonite (*Transactions of the Royal Irish Academy*, xvii. 145). The ray of light either issues as a cone with its vertex at the surface of emission, or issues as a cylinder after being converted on entering the crystal into a cone whose vertex is at the point of incidence.

Hamilton, when still an undergraduate, was appointed in 1827 Andrews professor of astronomy and superintendent of the observatory, and soon after astronomer royal for Ireland. He was twice honoured with the gold medal of the Royal Society, first for his optical discovery, and secondly, in 1834, for his theory of a general method of dynamics, which resolves an extremely abstruse problem relating to a system of bodies in motion. Next year, on the occasion of the British Association visiting Dublin, Hamilton was knighted by the lord-lieutenant. In 1837 he was chosen president of the Royal Irish Academy, and had the rare distinction of becoming a corresponding member of the academy of St. Petersburg.

About 1843 Hamilton began more or less clearly to shape out the new mathematical method which when perfected was to give him right to rank in originality and insight with Diophantus, Descartes, and La Grange—a method which, as set forth and illustrated in his own writings, can 'only be compared with the "Principia" of Newton and the "Mécanique Céleste" of La Place as a triumph of analytical and geometrical power' (Professor Tait in *North British Review*, September 1866). In 1844, before the Royal Irish Academy, of which he was still president, he formally defined the term 'quaternions,' by which the new calculus was to be known; but not till 1848 can the method be considered as systematically established, when he began, in Trinity College, Dublin, the 'Lectures on Quaternions,' which were published in 1853. Nearly the whole of this bulky octavo, occupying 808 pages, besides an introduction of 64 pages, can be understood only by advanced mathematicians. But for Professor Tait of Edinburgh, who interpreted the new science for more common-place mathematicians, Hamilton's merits must long have remained unrealised or absolutely unknown. The truth is that this great book

of Hamilton's, as well as his so-called 'Elements of Quaternions,' is frequently unpleasant in style, besides being obscure and difficult of interpretation.

Hamilton's method involved a remarkable extension of science. He showed that the 'impossible quantities' which so frequently occur in analysis admit of easy interpretation by a natural extension of the symbol's meaning. The so-called imaginary or unreal factor really denoted an operation to be performed on the line or surface in question, the operation of rotation. If we multiply a line by (-1) the result is the same as if the line were turned through 180° in its plane, and hence if multiplied by $(-1)^{\frac{1}{2}}$ the line will be turned through 90° . On that discovery of the operational character of 'imaginary' factors and expressions was based the whole science of quaternions. Warren in 1828, Peacock (see *Algebra*, vol. ii. chap. xxxi.), De Morgan in his 'Double Algebra,' and others had clearly discussed the interpretation of $(-1)^{\frac{1}{2}}$. The notion of motion, virtual transference and rotation, was now combined with the application of algebra to geometry, and while the word 'add' represented motion forward and backward, the word 'multiply' was specialised to represent circular motion. Hamilton freed the science from the limitations of ages, and by his new adaptation of symbols dealt with lines in all possible planes, quite irrespective of any such restricting axes of reference as were necessary to the Cartesian system. To bring any line in space to complete coincidence with any other line may be called finding its quaternion: so named from the four numbers or elements occurring in the geometrical question of comparing two lines in space, viz. their mutual angle, the two conditions determining their plane and their relative length.

This new algebra accordingly could express the relations of space directionally as well as quantitatively, and recommended itself as a powerful organ in solid geometry, dynamical questions involving rotation, spherical conics or surfaces of the second order, besides innumerable applications in physical and astronomical problems, crystallography, electrical dynamics, wherever, in short, there occurs motion or implied translation in tridimensional space, or where the notion of polarity is involved.

In spite of the undoubted power of this 'algebra of pure space' and its trenchant disposal of many classes of physical and geometrical problems, the method has not attracted much attention, except among a few advanced mathematicians. Professor Kelland for several years showed the applica-

tion of the method to elementary geometry, conics, and some central surfaces of the second order; but at present none of our universities appear to encourage the study, partly from lack of time to deal adequately with the highest physical applications of mathematical work. There are great difficulties from the use of familiar terms in an extended sense, which is frequently difficult of interpretation geometrically. As a whole the method is pronounced by most mathematicians to be neither easy nor attractive, the interpretation being hazy or metaphysical and seldom clear and precise.

As a professor of astronomy Hamilton was not successful, especially in the practical part of his duties, partly perhaps from want of previous training in instrumental and technical work. Some of his professorial lectures, however, were admired for their fluent ornate style, frequently rising into eloquence. From the knowledge of languages which he acquired in youth he was able to read Latin, Greek, German, and Arabic for relaxation, and was frequently seen reading Plato and Kant. He had excellent taste in poetical composition, and wrote many sonnets and other poems. He corresponded with Wordsworth, Coleridge, and Southey, and lived on terms of intimacy with Miss Edgeworth and Mrs. Hemans. He had also an extensive correspondence with Professor De Morgan from 1841 till 1865, the year of his death. A mere 'selection' of the letters occupies 390 pages of the concluding volume of the Rev. R. P. Graves's 'Life of Hamilton.' From his genial and candid disposition and the simplicity of his manners, Hamilton was esteemed both by young and old, not only by those in his home circle, but by all with whom he came in contact.

The second great literary work of Hamilton, 'The Elements of Quaternions,' was published posthumously, edited by his son William Edwin Hamilton, C.E., in 1866. Besides the previous four years spent in accumulating the material of the 'Elements of Quaternions,' the last two years of the author's life were incessantly occupied in the work of revision, selection, and compression. So devoted indeed was his attention that he is supposed to have seriously injured his health, which had already been affected by a gouty illness, and even his brain-power. Latterly there were also epileptic symptoms. He died on 2 Sept. 1865. The pension of 200*l.* which he had received since he was knighted was afterwards continued to his widow.

A list of Hamilton's papers, memoirs, and posthumous publications is given in the Rev.

MEMBERS ACTIVITIES

One of our members has been involved in the move to honour famous physicists by means of a development of the Blue Plaque scheme (originally devised by English Heritage). It is good to hear from members who are quietly furthering the interests of the group in all sorts of areas. If you have been involved in any event, of an historical nature, however slight, please write in and we can combine these snippets into a longer piece.

BLUE PLAQUES

In a note to members of the South Central branch of the IoP, Dr. Ruth Fenn, the newly elected Branch Chairperson, wrote that an initiative started by her predecessor, Dr. Malcolm Cornwall, was in support of the 'More Blue Plaques for Physicists' plan (within the branch area).

She asked whether any member(s) could provide any relevant information about Sir James Jeans (amongst others), who died in Dorking in 1946, including an appropriate building where a plaque may be installed.

At the AGM of the History of Physics group held on October 19 1996 I suggested that the idea of such blue plaques for eminent (dead) physicists be extended nationwide and that our group might be a catalyst for any action.

The following is an account of my own actions and the results of those actions relating to Sir James.

I live not far from Dorking and wrote to our local newspaper asking if any readers could supply information. I was greatly encouraged (perhaps surprised) by the amount of response and support I received, including a letter from the Chief Executive of Mole Valley District Council.

Sir James resided in Cleveland Lodge, Westhumble (near Dorking), an imposing residence set in several hectares of ground, from 1918 until his death. He took part in several local activities such as the Westhumble Association and the Horticultural Society. I had an interesting conversation with a 92 year old who said that he had attended a talk by Sir James on 'The Universe' at the Dorking Rotary Club.

One respondent told me that he had a large number of papers relating to Sir James's researches which had been given to him by one of James's sons, Christopher. I viewed these, partly in the hope that there might have been some written in Sir James's own hand, but this proved negative! The papers were prints from publications of bodies like the Physical Society. I was greatly impressed, even amazed, by the volume and variety of his researches, by his logic and foresight, and by the elegance of his mathematics. The papers included theories about the destruction of matter (published 1930) and about the origins of the universe down to possible ways of parachuting from aircraft, long before the ejector seats were invented.

The respondent is willing for other persons to view the papers so if anyone is interested will he/she contact me at 99 Stag Leys, Ashtead, Surrey, KT21 2TL (an SAE will be appreciated) and I will set the ball rolling.

Sir James, his first wife Charlotte, an American who died in 1933, and his second wife Susi, an Austrian who died in 1993, are buried in nearby Mickleham churchyard.

Cleveland Lodge was bequeathed by Lady Susi to the Royal School of Church Music, which will move there from its present premises in Croydon. Lady Susi was an accomplished organist and harpsichordist, and Sir James built a large, acoustically designed room to house one of the four organs acquired by his wife.

The Chief Executive of the RSCM expressed to me his support for the idea of a plaque. He said that work was due to commence soon on the necessary alterations etc. to Cleveland Lodge, and may continue to the end of 1998, so it seems unlikely that a plaque will be installed before then.

In view of Sir James's interest and work on astronomy perhaps 11 August, 1999 might be an appropriate date for the installation, when there will be a total eclipse of the Sun (total however only in Cornwall).

(Mr) Kenneth Barritt (Retired Member)

In a further note Mr Barritt informs us that a correspondent has sent him a typewritten sheet which once belonged to Sir James. On one side is a draft of one of his books with corrections in his own handwriting. On the other side is a 'homely' list of 'Jobs for the Handymen'. It includes items such as window cleaning, lawn mower and grass, fencing, paint frames, etc.,etc. The sheet is to be deposited in the appropriate archive.

Mr Barritt attended the AGM of the National Trust and drew the attention of the committee to the Blue Plaque Scheme and suggested that the NT could liaise with English Heritage etc. to honour scientists, engineers and technologists.

OPPORTUNITY

Members may wish to promote this method of honouring Physicists in their area. The IOP, in association with Kings College, London recently unveiled a plaque commemorating James Clerk Maxwell's tenure in the 1860's. As a start you could consult a Dictionary of Scientists and then go to the Dictionary of National Biography (DNB) to find out if there was a connection in your locality. If so, have a word with the Chairperson of your IOP group and the committee could make approaches to English Heritage or some other organisation.



was born 11 September 1877 at Birkdale, Southport, the only son of William Tulloch Jeans, parliamentary journalist, by his wife, Martha Ann Hopwood. He had two younger sisters. His grandfather, who was town clerk of Elgin, Scotland, and his great-grandfather were newspaper proprietors, and his father wrote two books of lives of scientists.

Precocious, Jeans's chief childish interest was in clocks; he could tell the time at the age of three, and early read leading articles from *The Times* to his parents, the pious atmosphere of whose home was not, however, very congenial to him. Living at Tulse Hill, London, he attended Merchant Taylors' School, and proceeded as mathematical entrance scholar to Trinity College, Cambridge, where in 1898 he was bracketed second wrangler. He studied also practical physics for one year at the Cavendish Laboratory, and in 1900 gained a first class in part ii of the mathematical tripos, an Isaac Newton studentship in astronomy and optics, and in 1901 a Smith's prize. In that year he became a fellow of his college.

He had to leave Cambridge in 1902 to enter sanatoria for treatment of tuberculosis of the joints which was completely cured. While there he wrote his *Dynamical Theory of Gases* (1904) on original lines. This important work embodied much research of his own on the theory of statistical equilibrium and equipartition, the persistence of molecular velocities after collision, and the escape of gas from planetary atmospheres. Later editions included some quantum theory; in 1940 he rewrote and reissued it as *An Introduction to the Kinetic Theory of Gases*.

His period of active mathematical research in physics and astronomy lasted from 1900 to 1928; he soon achieved a deservedly great reputation, and was elected F.R.S. in 1906 at the age of twenty-eight. He taught mathematics from 1904 to 1912: as university lecturer at Cambridge (1904-5), and later as Stokes lecturer there (1910-12), after a period (1905-9) at Princeton as professor of applied mathematics.

At Princeton he published two university textbooks, which included examples to be worked out: *Theoretical Mechanics* (1906) and *The Mathematical Theory of Electricity and Magnetism* (1908). There also he married in 1907 Charlotte Tiffany (died 1934), daughter of Alfred Mitchell, explorer and traveller, of New London, Connecticut. By her he had one daughter.

In 1912 he resigned the Stokes lectureship, and thereafter held no university or other regular office; his wife was well-to-do, and in later life he wrote many lucrative books. They lived in London from 1912 to 1918. He gave the Bakerian lecture before the Royal Society in 1917, on 'The configurations of rotating compressible masses'; he was awarded the Adams prize of the university of Cambridge, also in 1917, for a remarkable essay, *Problems of Cosmogony and Stellar Dynamics*, which set out his own and others' contributions to the subject; it was published as a book in 1919. He had become a fellow of the Royal Astronomical Society in 1909, and while in London played an active part in its life, and in that of the dining club which forms its inner circle. He took little part in the scientific effort involved during the two wars.

From 1919 to 1929 he was one of the two (honorary) secretaries of the Royal Society; as such he wielded (with great self-confidence and success) considerable power and influence in the British scientific world; this period coincided with the presidencies of Sir Charles Scott Sherrington and Sir Ernest (later Lord) Rutherford [q.v.].

During these years, and later, he received many honours: in 1919 a Royal medal of the Royal Society; in 1922 the gold medal of the Royal Astronomical Society for his cosmogonic work; the Hopkins prize of the Cambridge Philosophical Society for 1921-4, for his work on gas-theory, radiation, and the evolution of stellar systems. He gave the Halley lecture (Oxford, 1922) on the nebular hypothesis and modern cosmogony, and the Guthrie lecture (Physical Society, 1923), and the Rouse Ball lecture (Cambridge, 1925). He was president of the Royal Astronomical Society (1925-7), to which in 1926 he gave £1,000 to endow an annual 'George Darwin' lecture. He was knighted in 1928. He became research associate of the Mount Wilson Observatory, California, in 1923, and visited it more than once. He was a foreign member of the National Academy of Sciences, Washington; and received the Franklin (1931), Joykissen Mookherjee (1937), and Calcutta (1938) medals, and many honorary degrees.

The release from his secretarial work for the Royal Society in 1929 marked also the end of his mathematical researches, and the beginning of a highly successful

new career as a popularizer of science. His books, *Eos or the Wider Aspects of Cosmogony* (1928), *The Universe Around Us* (1929), *The Mysterious Universe* (1930; the Rede lecture, Cambridge), *The Stars in their Courses* (1931), *The New Background of Science* (1933), *Through Space and Time* (1934), followed in quick succession and won immediate widespread fame. They were fluent and persuasive, full of apt and striking similes. They were also somewhat over-positive. This was hardly a fault in the eyes of the general reader, but that and his deistic inferences were criticized by some of his colleagues. One of his most famous passages (in *The Mysterious Universe*), discussing the nature of God, concludes that God is a pure mathematician.

After science, music was one of Jeans's greatest interests; he played the organ from the age of twelve, and the piano still earlier. At Cleveland Lodge, Dorking, where he lived from 1918, he had an organ built, and often played for three or four hours a day, but never to other people, even friends. Bach was one of his favourite composers. In 1935 he married as his second wife the concert organist Susanne (Susi), daughter of Oskar Hock, of Vienna, originally of Prague; she survived him and by her he had two sons and one daughter. Music was a great common interest between them, and he installed at Cleveland Lodge a second organ for her use, designing sound insulation so that both could play without disturbance. He became a director of the Royal Academy of Music in 1937, and in the same year (at his wife's suggestion) he produced his admirable semi-popular book *Science and Music* dedicated to her. This deals with the human ear, the theory of pure tones and harmonics, different musical scales and instruments, the acoustics of concert rooms, and the acoustic properties of materials.

In 1934 Jeans was president of the British Association meeting at Aberdeen. In 1935 the Royal Institution established a chair of astronomy, and he was annually elected its professor until he resigned owing to ill health in 1946. In 1939 he was appointed to the Order of Merit, and in 1941 became honorary fellow of his old college. In 1937-8 he took the presidency of the jubilee meeting of the Indian Science Congress, vacant owing to Rutherford's death. He received the freedom of the Merchant Taylors and so became a freeman of the City of London.

In January 1945 Jeans had an attack of coronary thrombosis; recovering, he reduced his activities, but succumbed, after six hours of suffering, to a second attack, 16 September 1946, at his Dorking home, to which he had been able to return after the war (when it had been requisitioned and he had lived in Somerset). In his book *Physics and Philosophy* (1942) he showed that in his last years he felt the need to survey the universe as a whole; according to E. A. Milne [q.v.], who traversed the same road from mathematics, physics, and astronomy to philosophy, it 'affords little pleasure to either physicists or philosophers'.

Jeans's scientifically productive period, twenty-eight years long, began with a series of brilliant attacks on problems of gases, equipartition of energy, radiation, which established the necessity for some form of quantum theory. Then he directed his main efforts to cosmogony, mainly dealing with the forms of equilibrium of rotating gravitating masses, but also with kinetic theories of aggregates of stars. This was perhaps the greatest and most enduring part of his work. The last decade was devoted to stellar structure and evolution; it included his important recognition of radiative viscosity in stars. For a few years around 1917 the meetings of the Royal Astronomical Society were enlivened by scientific controversy between Jeans and (Sir) Arthur Eddington [q.v.] on the subject of stellar structure.

Jeans's bearing was somewhat aloof, and he occasionally gave offence by remarks which seemed supercilious. He was immensely hard-working, not only in his researches and authorship, but also in scientific business, in which at times he acted with rather ruthless decision. His manner was partly a shield for a shy and sensitive spirit; only a few knew him in simple unconstrained friendship. Working always alone, he had no personal disciples and created no school of research.

There is a portrait of Jeans by P. A. de László at Cleveland Lodge, Dorking.

[E. A. Milne in *Obituary Notices of Fellows of the Royal Society*, No. 15, May 1947; E. A. Milne, *Sir James Jeans*, 1952; personal knowledge.] SYDNEY CHAPMAN.

JEANS, SIR JAMES HOPWOOD (1877-1946), mathematician, theoretical physicist, astronomer, and popular expositor of physical science and astronomy,

CENTENARY OF THE DISCOVERY OF THE ELECTRON

In April 1897, at the Royal Institution, J. J. Thomson announced his measurements of the charge to mass ratio of the particles comprising cathode rays, and suggested they could best be explained by assuming that cathode rays were very small negatively charged sub-atomic particles. Thomson's 'corpuscles' are what we now call electrons, and his work is regarded as the discovery of the electron. A number of meetings are planned by various bodies to celebrate this event. History of Physics Group Members will be welcome at any of the following.

History of Physics Group, at the Institute of Physics Annual Congress, Leeds, 25 March 1997, one-day meeting on '100 Years of the Electron'

The History of Physics Group is organising a meeting to mark the centenary of the discovery of the electron. Dr. Graeme Gooday of the Department of Philosophy at the University of Leeds, will speak on 'Tales of hot charged bodies: the reception of researches by Frederick Guthrie and J. J. Thomson.' Guthrie was one of the founders of the Physical Society, which eventually became part of the IOP. Dr. Alan Morton of the Science Museum, London, will give a paper on 'J. J. Thomson, the IOP and physics research.' (Dr. Morton has stepped in at the last minute in place of a previously announced speaker who has had to withdraw.) Dr. Isobel Falconer, a historian of science whose thesis was on Thomson's work, will give a paper entitled 'From smoke rings to the electron.' Dr. Jeff Hughes of the Centre for the History of Science, Technology and Medicine at Manchester will speak to the title 'From particle to wave: instruments, theories and the origins of electron diffraction', and his paper will touch on work in which J. J. Thomson's son, G. P. Thomson, was involved. Dr. Arnold Lynch, a retired electrical engineer will look at what J. J. Thomson achieved from the viewpoint of a 'hands-on' engineer in a paper entitled 'Half the electron.' Dr. Lynch will also give his recollections of Thomson lecturing in the 1930s, and will show a video copy of film of Thomson taken at about that time and now in the archives of the Institution of Electrical Engineers. For full details of this meeting see the Congress registration booklet, or contact Mr. Neil Brown at the Science Museum, South Kensington, London, SW7 2DD, telephone 0171 938 8046, e-mail n.brown@nmsi.ac.uk

Institution of Electrical Engineers, Savoy Place, London, WC2R 0BL, 12 March 1997, an afternoon Discussion Meeting 'From Electrons to Devices'

The History of Physics Group is co-sponsoring this meeting organised by the Professional Group S7 (History of Technology) of the Institution of Electrical Engineers. Full details should be included with this Newsletter, or can be obtained from Ms. Gita Prabhu, Groups Officer, IEE, Savoy Place, London, WC2R 0BL, telephone 0171 344 5439, or e-mail gprabhu@iee.org.uk

Institution of Electrical Engineers, Savoy Place, London, WC2R 0BL, 12 March 1997, at 17.30 (tea at 17.00), evening lecture by Dr. Arnold Lynch on 'Half the Electron'

The discussion meeting at the IEE will be followed by a lecture by Dr. Arnold Lynch, a retired electrical engineer who will look at the work of Thomson from the viewpoint of a 'hands-on' engineer, will give his recollections of Thomson lecturing in the 1930s, and will show film of Thomson taken at about that time and now in the archives of the Institution of Electrical Engineers. The meeting is free and open to non-members. For more information telephone Ms. Gita Prabhu at the IEE on 0171 344 5439, or e-mail gprabhu@iee.org.uk

British Society for the History of Science, two-day conference at The Royal Society, 6 Carlton House Terrace, London, SW1Y 5AG, on Friday, 11 April 1997 and at the Science Museum, South Kensington, London, SW7 2DD, on Saturday 12 April 1997.
For further details contact Dr. Alan Morton at the Science Museum, South Kensington, London, SW7 2DD. telephone 0171 938 8044. e-mail a.morton@nmsi.ac.uk

Science Museum, South Kensington, London, SW7 2DD, from 15 April 1997
The Science Museum will be mounting a small exhibition to mark the centenary of the discovery of the electron. For further information contact Miss Sophie Duncan at the Science Museum, South Kensington, London, SW7 2DD, telephone 0171 938 8236, e-mail s.duncan@nmsi.ac.uk

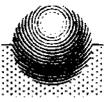
The exhibition, **Life, the Universe and the Electron**, will open to the public on Wednesday 16 April and run for a year. It will explore the impact the discovery of the electron has had on our lives by contrasting the technology of the 1890s with the 1990s. A video showing a reconstruction of Thomson's experiment and one of his original tubes will be on display. Through the use of interactives and images the exhibition will highlight why the discovery of the electron is important. In conjunction with the IOPP we will be developing a Web site which will also be accessible from the exhibition.

Special events include a birthday party on 15 April for invited guests and a series of electron related activities on May 3-5 for visitors to the Museum.



FIFTIETH ANNIVERSARY OF THE DISCOVERY OF STRANGE PARTICLES

The centenary of the discovery of the electron is not the only anniversary to be celebrated in 1997. This year also marks the fiftieth anniversary of the discovery of the strange particles in Manchester in 1947. Professor robin Marshall of the University of Manchester is planning a two-day meeting, in Manchester, on 16 and 17 September, to celebrate this event. This is not an IOP meeting, but may be of interest to History of Physics Group members. Further details are not available at the time of writing, but anyone interested should contact Mr. Neil Brown at the Science Museum, South Kensington, London, SW7 2DD (telephone 0171 938 8046, or e-mail n.brown@nmsi.ac.uk), who will forward information when it is received.



LECTURES AND MEETINGS

This information has kindly been supplied by the BSHS and is their copyright. Nearly all these meetings are open to people who are not members of the society concerned, sometimes at a slightly higher cost. We remind readers to check before departure that the event has not been cancelled.

New Exhibition

*The Noble Dane, Images of Tycho Brahe
at Museum of History of Science, Oxford
on 21 January to 26 March 1997

This exhibition is occasioned by the restoration of a painting in the Museum's collection and deals with the image and influence of Tycho. Further details from Dr J A Bennett, Museum of the History of Science, Broad Street, Oxford, OX1 3AZ.

American Philosophical Society

Surveying the Record: North American Scientific Exploration to 1900
at American Philosophical Society
on 14-16 March 1997

The purpose of this interdisciplinary meeting is to illuminate new historical approaches to scientific expeditions and surveys. Further details from North American Exploration Conference, American Philosophical Society Library, 105 South Fifth Street, Philadelphia, PA 19106-3386, USA. E-mail: ecarter@main.sas.upenn.edu.

Royal Meteorological Society History Group

*History of research into the stratosphere
at Blythe House (Science Museum outstation), West London
on 15 March 1997

Speakers will be C D Walshaw, A W Brewer, B Thrush and R M Goody. Items from the Science Museum's collections will be on display. Details from the Group Secretary, R Lewis, c/o Royal Meteorological Society, 104 Oxford Road, Reading RG1 7LJ.

*Deciphering enemy weather reports in WW2
at Bletchley Park Museum
on 21 June 1997

Weather information received from Europe during WW2 was deciphered at Bletchley Park. It is hoped that a few of the people who were involved will be present. Group agm. Details from the Group Secretary, R Lewis, c/o Royal Meteorological Society, 104 Oxford Road, Reading RG1 7LJ.

*A century of progress in understanding the role of CO₂ in the ocean-atmosphere system
at Meteorological Office, Bracknell
on 8 November 1997

Joint meeting with the History Groups of the Challenger Society and Royal Society of Chemistry. Further details from Bruce Callander, Meteorological Office, London Road, Bracknell, RG12 2SZ.

Society for Renaissance Studies

Gresham College Quartercentenary Conference
at Birkbeck College
on 20-21 March 1997

The conference will explore the place of Gresham College in the intellectual life and the development of education in late Elizabethan and Stuart London. Topics will cover commercial and mercantile practice; the intellectual climate of late sixteenth century England and the contribution of the College to the History of Education; the College and the teaching of practical subjects; and cultural activity at the time of the foundation of the College. Speakers will include: J Bennett, I Blanchard, M Feingold, R Goulding, L Jardine, M Pelling and A Saunders. In addition there will be a recital of contemporary music. Due to the support of Gresham College, there is no conference fee. Further details and booking form are available from Dr Kenneth Carleton, Society for Renaissance Studies, 35 Winchester Avenue, Cranham, Uprminster, Essex, RM14 3LP.

Royal Society

*Symposium on the Foundations of Newtonian Scholarship
at The Royal Society
on 21 March 1997

This symposium which is joint with the History of Science Society and supported by the National Science Foundation will discuss recent advances in understanding Newton's *Principia* and *Opticks*, which have been made possible by the editions of Newton's correspondence, his mathematical and optical papers and variant readings of the third edition of the *Principia*. The speakers will be A Cook, I B Cohen, A E Shapiro, J B Brackenridge, G E Smith, R Dalitz, J Fauvel, M Nauenberg, A R Hall, D T Whitside and C Wilson. Further details from J B Brackenridge, Dibner Institute for the History of Science and Technology, Dibner Building, MIT E56-100, 38 Memorial Drive, Cambridge, Massachusetts 02139, USA. and from R H Dalitz, Department of Physics, 1 Keble Road, Oxford, OX1 3NP, E-mail: dalitz@av1.ph.ox.ac.uk. A registration form is available on the WWW at <http://physics.ucsc.edu/people/personal/nauenberg.html>

European Science Foundation

*Coping with Sickness: Medicine, Law and Human Rights: Historical Perspectives
at Castelvecchio di Pascoli
on 22-27 March 1997

The themes for the conference will be health and human rights, law and medical expertise, regulation of medicine and regulations concerning life and death. Speakers will include C Crawford, R Davidson, A Dorries, D Porter and M Thomson. Further details from Josip Hendekovic, European Science Foundation, 1 Quai Lezay-Marnésia, 67080 Strasbourg Cedex, France. E-mail: euresco@esf.org.

University of Texas at Austin

*From Energy to Information: Representation in Science, Art and Literature
at University of Texas at Austin
on 3-5 April 1997

This conference provides an opportunity to examine the representation of scientific concepts in the art and literature of modern and postmodern culture. Speakers will include N Wise, B Hunt, B Clarke and T. Lenoir. Further details from Energy to Information Symposium, c/o Center for the Study of Modernism, Department of Art and Art History, University of Texas, Austin, Texas, 78712-1104, USA. E-mail: nrgy2inf@ccwf.cc.utexas.edu.

American Association for the History of Medicine

Annual Meeting
at Williamsburg
on 3-6 April 1997

Offers of papers to and further information from Todd L Savitt, Department of Medical Humanities, East Carolina University School of Medicine, Greenville, North Carolina 27858-4354, USA.

British Society for the History of Science

*The Electron: 100 years of physics and history
at Royal Society and the Science Museum
on 11-12 April 1997

This conference will explore the history of modern physics to mark the centenary of the discovery of the fundamental particle later called the electron. Speakers and discussants include Harvey Brown, Laurie Brown, Jed Buchwald, Isobel Falconer, Paul Forman, Graeme Gooday, Anna Guagnini, John Heilbron, Bruce Hevely, Jeff Hughes, Frank James, Helge Kragh, Benoit Lelong, Arthur Miller, Alan Morton, Dominique Pestre, Andy Pickering, Michael Redhead, Simon Schaffer, Sam Schweber, Andrew Warwick, and Bruce Wheaton. Further details from BSHS Executive Secretary, Wing Commander G Bennett, 31 High Street, Stanford in the Vale, Faringdon, Oxfordshire, SN7 8LH.

*Aspects of the History of Microscopy
at Society of Antiquaries, Burlington House
on 4 June 1997

This meeting, organised jointly with the Light Microscopy Section of the Royal Microscopical Society, will immediately precede the BSHS Extraordinary General Meeting at 15.30 in the same location. Speakers will be Gerard L'Estrange Turner, Savile Bradbury, Brian Bracegirdle, Stella Butler, Alison Morrison-Low and Robert Nuttall. To register for this meeting e-mail: meetings@rms.org.uk or write to The Administrator, Royal Microscopical Society, 37/38 St Clements, Oxford, OX4 1AJ.

*Psychoanalysing Robert Boyle
at Harkness Hall, Birkbeck College
on 12 July 1996

This conference offers a new approach to the use of psychoanalysis in scientific biography. A single historical figure, Robert Boyle (1627-1691), will be subjected to interpretations by practitioners from three contrasting psychoanalytical schools. The speakers will be John Clay, Karl Figlio and Brett Kahr with an historical introduction by Michael Hunter. There will also be opportunities for a full discussion of the issues involved. Further details from Professor Michael Hunter, Department of History, Birkbeck College, Malet Street, London, WC1E 7HX.

*50th Anniversary Conference - History of Science as Public Culture?
at University of Leeds
on 9-11 September 1997

To mark its fiftieth anniversary, which falls in 1997, the British Society for the History of Science is holding a conference with the title: 'The history of science as public culture?'. Its object will be to explore ways in which the enterprise of history of science has functioned in public culture and within academia, particularly in Britain during the past fifty years. The primary focus for the conference will be on the role played by the history of science in public culture - in public debate, in public celebrations, in museums, and in visual and printed

media. In addition, the conference will consider the extent to which scholars in other disciplines have responded to the history of science as an academic discipline, and will examine the British tradition of academic history of science from an international perspective. The first day will be jointly organised with the British Association History of Science Section. The meeting will include the Presidential Address by John Brooke. Other speakers will include Gillian Beer, David Edgerton, David Knight, Joan Leach, Helen Haste, Caroline van den Brul, James R Moore, Robert Anderson, Dominique Feriot, Steve de Clerq, Simon Chaplin, Ken Arnold, Ghislaine Lawrence, Jim Bennett, Liba Taub, Geoffrey Cantor, Sophie Forgan, Christine Blondel, Jon Turney, Simon Schaffer, Costas Gavroglu, H Floris Cohen, Pietro Corsi, Dominique Pestre, Steven Fuller, Steven French, Sally Shuttleworth and Frank Close. Further details: Dr Jon Topham, Darwin College, Cambridge, CB3 9EU.

Joint Atlantic Seminar in the History of Biology and Medicine

***33rd Annual Meeting**
at Yale University
on 11-12 April 1997
Further details from Joint Atlantic Seminar, c/o Section of the History of Medicine, Yale University School of Medicine, L132 Sterling Hall of Medicine, 333 Cedar Street, New Haven, CT 06510, USA. E-mail: JOSEPHDG@biomed.med.yale.edu.

***P M S Blackett and Twentieth Century British Science**
at Imperial College
on 16-17 April 1998
This is a joint meeting with and Imperial College. Speakers will include Sir Michael Howard, Sir Bernard Lovell, and Rt Hon Tony Benn MP. Further details from David Edgerton, Centre for the History of Science, Technology and Medicine, Sherfield Building, Imperial College, London, SW7 2AZ. E-mail: d.edgerton@ic.ac.uk

Wellcome Institute for the History of Medicine

***Symposium on Health and the Environment**
at The Wellcome Building
on 25 April 1997
Speakers will be M Dobson, N. Rupke, W Luckin, J Clark, P Thorsheim, G Kearns, M Harrison and K Pelis. Further details from F Houser, Wellcome Institute for the History of Medicine, 183 Euston Road, London, NW1 2BE.

***Symposium on the History of Neurolinguistics**
at The Wellcome Building
on 18 June 1997
Speakers will be S Finger, D Roe, P Eling, S Jacyna, S Greenblatt, T Gelfand, H Buckingham, J Marshall and H Whitaker. Further details from F Houser, Wellcome Institute for the History of Medicine, 183 Euston Road, London, NW1 2BE.

Society for the History of Natural History

11th International Conference
at Charlottesville, Virginia
on 27-26 April 1997
The theme of this meeting will be 'The Natural Bridge: The Transatlantic Exchange'. Further details from Kathryn Morgan, Special Collections Department, Alderman Library, University of Virginia, Charlottesville, Virginia 22903-2498, USA. E-mail: knm2m@virginia.edu.

Society for the History of Alchemy and Chemistry

*Ancient Chemical Technologies

at Science Museum and Imperial College Library

on 15 May 1997

Speakers will include I Freestone on early glass making, J Edmonds on ancient dyeing techniques, W Oddy on assaying gold in antiquity and P Craddock on zinc production in India and China. Further details from John Hudson, Applied Sciences, Anglia Polytechnic University, East Road, Cambridge CB1 1PT.

University of Oxford

*Thomas Harriot Lecture

at Oriel College

on 22 May 1997 at 5pm

The lecturer will be John North on 'Stars and Atoms'. Further details of this and previous Harriot lectures from Robert Fox, Modern History Faculty, Broad Street, Oxford, OX1 3BD. E-mail: robert.fox@history.ox.ac.uk.

CHEIRON: The International Society for the History of the Behavioral and Social Sciences

Annual Meeting

at University of Richmond

on 19-22 June 1997

Offers of papers to (by 1 February 1997) and further details from John Carson, Cheiron Program Chair, Department of Science and Technology Studies, 632 Clark Hall, Cornell University, Ithaca, NY 14853-2501. E-mail: jsc15@cornell.edu.

European Physical Society, History of Physics Interdivisional Group

Radioactivity: History and Culture (1896-1930s)

at Institut Curie, Paris

on 7-9 July 1997

This meeting is being held jointly with the Commission on the History of Modern Physics of the International Union of the History and Philosophy of Science, the French Physical Society and the Forum on the History of Physics of the American Physical Society. Offers of papers on themes such as national characteristics, international relationships, instrumentation, experimental methods and industrial connections will be particularly welcome. Offers (by 31 March 1997) to and further details from Christine Blondel, CRHST, Cité des Sciences et de l'Industrie, F-75930 Paris Cedex 19, France.

ICOHTEC

Symposium

at Liège

on 20-26 July 1997

This symposium will be held in conjunction with the 20th International Congress of the History of Science. Further details from Hans-Joachim Braun, Universität der Bundeswehr Hamburg, 22039 Hamburg, Germany.

International Union of the History and Philosophy of Science

XXth International Congress of the History of Science

at University of Liège

on 25-30 July 1997

The second circular is now available and can be obtained from Centre d'Histoire des Sciences et des Techniques, Université de Liège, Avenue des Tilleuls 15, B-4000 Liège, Belgium. E-mail: chstulg@vm1.ulg.ac.be

*Charles Darwin: His Life and Times

at Kellogg College, Oxford

on 26 July - 1 August 1997

The Oxford University Summer School will study Darwin's life and work, as well as focus on the subsequent debates surrounding natural selection following the appearance of the *Origin of Species* in 1859. Seminar leader: M Oster. Further details from OUSSA, Rewley House, 1 Wellington Square, Oxford, OX1 2JA.

Royal Society of Edinburgh

*International Geological Conference

at London and Edinburgh

on 30 July - 9 August 1997

This conference, which is jointly organised with the Geological Society, will mark the bicentenaries of the death of James Hutton and of the birth of Charles Lyell. The first part of the conference, in London will concentrate on Lyell, while the second part, in Edinburgh, will deal with Hutton. Speakers will include L Wilson, M. Rudwick, J Burchfield, J Thackray, E Vaccari, R Dott, J Fleming, D McIntyre and G H Davies. Further details from The Conference Office, The Geological Society, Burlington House, Piccadilly, London, W1V 0JU. E-mail: Cons@Geolsoc.Cityscape.Co.UK.

University of London

*Music, Healing and Culture: Towards a Comparative Perspective

at The Royal College of Music and the Warburg Institute

on 20-21 August 1997

This conference brings together scholars working on the borders between history, literary studies, anthropology, musicology and music therapy. Its central focus is the therapeutic powers of music, and how these have been used and understood at different times in both Western and non-Western cultures. Speakers include: Linda Austern, Leslie Bunt, Charles Burnett, Penelope Gouk, John Janzen, Michael Neve, George Rousseau, Lyn Schumaker, Henry Stobart. For further details contact Dr Penelope Gouk, Wellcome Unit for the History of Medicine, University of Manchester. Tel: 0161-275-5910; fax: 0161-275-5699; email: gouk@fs4.ma.man.ac.uk.

Texas Tech University

*Webs of Discourse: The Intertextuality of Science Studies

at Texas Tech University

on 5-7 February 1998

This conference will address the possibility of a comprehensive synthesis of science studies across the discursive discipline. Plenary speakers will be Donna Haraway, Marcos Novak and Carl Rubino. Offers of papers (by 30 September 1997) and further details from Bruce Clarke, Department of English, Texas Tech University, Lubbock, TX 79409-3091, USA. E-mail: bruno@ttu.edu.

University of Edinburgh

*Medicine, Science, and Enlightenment, 1685-1789

at Edinburgh

on 11-14 August 1998

Proposals for papers and/or sessions are invited for this conference which is sponsored by the Institute for Advanced Studies in the Humanities, University of Edinburgh. The deadline for proposals is 1 September 1997, and they should be sent to the programme coordinators: Professor Roger Emerson, Department of History, Social Sciences Centre, University of Western Ontario, London, Ontario, Canada, N6A 5C2 (e-mail: emerson@sscl.uwo.ca) and Professor Paul Wood, Department of History, University of Victoria, P.O. Box 3045, Victoria, B.C., Canada, V8W 3P4 (e-mail: pbwood@uvvm.uvic.ca). Conference participants are encouraged to take part in the Institute Project: European Enlightenment, sponsored by the Institute for Advanced Studies in the Humanities. Information regarding the Institute Project and the Fellowship programme administered by the Institute can be obtained by writing: Professor Peter Jones, Institute for Advanced Studies in the Humanities, University of Edinburgh, Hope Park Square, Edinburgh, EH8 9NW, Scotland, U.K.

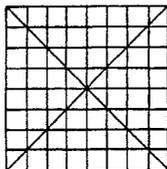
University of Plymouth

ECLIPSE 99: Navigational Stimulus to the History of Science

at University of Plymouth

on 9-12 August 1999

This conference, which coincides with the next total eclipse of the Sun to be visible from England, will explore the impact of navigation on the history of science. Offers of papers to and further information from P A H Seymour, Institute of Marine Studies, University of Plymouth, Drake Circus, Plymouth, Devon, PL4 8AA.



This information has kindly been supplied by the BSHM and is their copyright. We remind readers to check before departure that the event has not been cancelled.

Saturday 22 February 1997

HIMED 97

Our annual meeting about history in mathematics education will be held on Saturday 22 February at the Mathematics Education Centre, Sheffield Hallam University. The theme of the day is *'Using the history of mathematics in the school classroom'*. Several talks and workshops are being arranged, and it is hoped that there will be a discussion about the themes of the forthcoming ICMI Study on *The role of the history of mathematics in the teaching and learning of mathematics*. A detailed programme will be issued nearer the time. For further details contact the organiser *David Lingard, Sheffield Hallam University, 25 Broongrove Road, Sheffield S10 2NA*. • phone 0114 -2532307 • Fax 0114 -2532339 • d.lingard@shu.ac.uk

Friday-Saturday March 14-15 1997

JJ SYLVESTER 1814-1897

The centenary of the death of James Joseph Sylvester on 15 March 1897 is being commemorated by complementary meetings at two of the major sites of his activities, London and Oxford.

On the morning of Friday 14 March there is a memorial gathering at Sylvester's grave in the Jewish cemetery, Kingsbury Road, north London. On that afternoon a meeting will be held at University College London, with talks by Adrian Rice (*Sylvester the Londoner*), Ivor Grattan-Guinness (*Sylvester's applied mathematics*); Karen Parshall (*Sylvester's pure mathematics*); and John D. Klier (*The Jewish educational experience in nineteenth-century England*). There will also an exhibition in the UCL Cloisters on Sylvester's life, work and context.

On the morning of Saturday 15 March there will be a commemorative meeting at New College Oxford, organised by Ioan James.

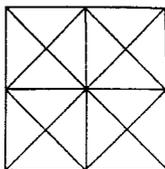
Further details from Adrian Rice, 71 Plimsoll Road, London, N4 2EB.

Friday-Monday 11-14 April 1997

RESEARCH IN PROGRESS

Our residential 'Research in Progress' meeting in 1997 is to be held at the Mathematics Institute, University of Warwick. It is a three-day conference for all those interested in history of mathematics research, particularly current research students, followed on the Monday by a meeting jointly with the Mathematics Research Institute in celebration of the 60th birthday of David Fowler.

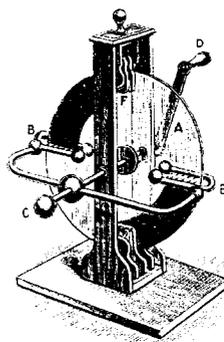
Further details from *John Fauvel, Mathematics Faculty, The Open University, Milton Keynes MK7 6AA* • j.g.fauvel@open.ac.uk •



SPRING 1997

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ACKNOWLEDGEMENTS

Photo of J.J.Thomson from 'The Structure of Matter' by Joan Solomon, pub. David and Charles, Newton Abbot, 1973.

Electrical and Magnetic diagrams from 'Magnetism and Electricity' by A. W. Poyser pub. Longman Green and Co., London, 1901.

Biography of Sir William Rowan-Hamilton from 'Dictionary of National Biography' (DNB), Ed. Stephen and Lee, pub. Smith Elder and Co., London, 1908. By courtesy of O.U.P.

Biography of Sir James Jeans, 'DNB 1941-1950', Ed. L.G. Wickham Legg and E.T. Williams, pub. Oxford University Press, Oxford, 1959.