



# DIAS

Institiúid Ard-Léinn | Dublin Institute for  
Bhaile Átha Cliath | Advanced Studies

Title	DIAS Annual Report 1985
Creators	DIAS, Council
Date	1985
Citation	DIAS, Council (1985) DIAS Annual Report 1985. Communications of the Dublin Institute for Advanced Studies.
URL	<a href="https://dair.dias.ie/id/eprint/96/">https://dair.dias.ie/id/eprint/96/</a>

INSTITIÚID ARD-LÉINN BHAILE ÁTHA CLIATH  
(Dublin Institute for Advanced Studies)

**ANNUAL REPORT  
1985**

10 Burlington Road, Dublin 4

INSTITIÚID ARD-LÉINN BHAILE ÁTHA CLIATH  
(Dublin Institute for Advanced Studies)

Annual Report of the work of the  
Institute and its Constituent  
Schools presented by the Council  
to the Minister for Education  
in respect of the year ended  
31 December 1985

INSTITIÚID ARD-LÉINN BRAILE ÁTHA CLIATH  
(Dublin Institute for Advanced Studies)

Summary of Annual Report  
of the work of the Constituent Schools  
for the year ended 31 December 1985

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School of Celtic Studies

Professor Tomás de Bhaldraithe was appointed Chairman of the Governing Board for the quinquennium beginning 1 April and three new members were appointed: Professor Pádraig Ó Fiannachta, Professor Máirtín Ó Murchú and Professor Gerard Stockman.

The year 1985 saw the retirement of Professor James Carney as Senior Professor and his replacement from 1 October by Professor Proinsias Mac Cana. The vacancy caused by the death of Professor David Greene in 1981 remained unfilled. The two posts of Junior Research Assistant, vacant since 1980, were filled with effect from 1 October, thus enabling work on cataloguing Irish manuscripts to be intensified. Of the eight Scholars who worked in the School, three were Irish two were from the USA, and one each from Australia, England and West Germany. In addition there was a Visiting Scholar from Wales.

Three new works and three reprints were published and four further works were in course of printing. Staff-members and Scholars contributed thirteen articles or shorter items to periodicals.

School of Theoretical Physics

Professor McConnell was re-elected Chairman of the European Molecular Liquids Group for three years. Professor Lewis was elected Treasurer of the International Association of Mathematical Physics.

A substantial collection of periodicals and reprints was given to the School by Professor Synge.

In addition to the use made by Staff, Scholars, and Research Associates of the School in their primary research activities, much use was made also by visitors, particularly during the summer months, of the School's facilities for research - especially of the opportunities for informal discussions, and of the library resources. Twenty-six research workers from universities and other institutes of research or higher education were admitted as research associates of the School; forty-nine scientists from abroad visited the School during the year.

The Easter and Christmas Symposia were held as in previous years; seminars at DIAS and joint seminars (with UCD, TCD, Maynooth, NIHED) in special subject areas were continued. Five courses were given, including two for final-year undergraduates (or first-year graduates) in the Dublin area. Nine contributions were made to the Journals' Club, and four lectures were given at Irish university or other third-level colleges in Ireland. The Statutory Public Lecture was given at UCD by Visiting Professor N. M. Hugenholtz; his subject was "On the Approach to Equilibrium of Thermodynamic Systems". A Symposium entitled "Future Research in Molecular Liquids" was held by the EMLG at DIAS on 24-25 May.

The School continued its research. The primary areas of research were theoretical particle physics, classical statistical mechanics, quantum statistical mechanics, and quantum electronics; secondary areas were general relativity and gravitation, and applied mathematics. Thirty-four contributions to scientific journals or proceedings were published.

Members of the School attended twenty-five conferences abroad, and gave seminars, posters, and one series (4 lectures) at sixteen of these. They gave 27 lectures and 5 courses of lectures at universities abroad.

School of Cosmic Physics

Astronomy Section:

Research on the inter-relation between stellar structure and circumstellar matter has included an examination of evidence for mass loss by cepheid variable stars and the observation of structure near to young stars which are believed to produce jets of matter into the interstellar medium. Other investigations concern the stability of asteroid orbits and the identification of an X-ray source in the globular cluster M15.

Electronics work included a start on the construction of digital circuits for a particle detector in the forthcoming USSR 'Phobos' mission to the planet Mars.

The year 1985 was taken as the bicentenary year of Dunsink Observatory. A colloquium on Circumstellar Matter was among several events marking the bicentenary; writing of a history of the observatory was started.

The Royal Inauguration of the Spanish International Observatory of the Canary Islands took place during the year, with the attendance of the President of Ireland.

Cosmic Ray Section

The preparation for the particle detector experiment on the Giotto mission to Comet Halley was completed during the year, the launch being made in July. During the cruise phase the equipment registered solar wind particles reliably. Preparation began on construction and software-design of a Solar Low Energy Detector intended for the Phobos Mission to Mars in 1988/89.

With serious delays in retrieval of the LDEF spacecraft following the Space Shuttle disaster, nuclear track detector work has centred on tests and experimental routines to study chemical processing effects and aging characteristics of the latent image in etching plastic material.

### Geophysics Section

Geodetic work was carried out in the large dome of the Observatory at Dunsink linking it with the worldwide network via satellite. A method for deducing coordinates values for points in Ireland from the Ordnance sheet maps has been devised with an accuracy of  $\pm 1\text{m}$ .

Design and development of an easily portable seismic recording system was carried out and fifteen sets constructed. They were extensively used from June onwards.

The seismic network continued to operate satisfactorily until a lightning storm in July caused severe damage to various installations. These took a considerable effort and time to repair. Following the Welsh earthquake of 1984 minor events were recorded in the Irish Sea and this active area is being investigated more fully.

A major seismic exercise called Celtic Onshore-Offshore Lithospheric Experiment(COOLE) was carried out comprising seismic profiling over 2000 km. Three vessels were used for the sea explosions including the Irish R.V. Lough Beltra and the German F.S. Valdivia. Collaborating in this were the Universities of Dublin, Hamburg and Karlsruhe. Financial assistance came from a number of oil and exploration companies, from the Department of Energy and from the National Board for Science and Technology.

In collaboration with the University of Hamburg an extensive area of the south-west coast was surveyed gravitationally, magnetically and seismically from the F.S. Valdivia.

The Section, together with the Geophysics Institute of the University of Karlsruhe, won an EEC Contract to develop seismic interpretation methods over a three year period to early 1989.

Interpretation of palaeomagnetic results from lake sediments was continued satisfactorily.

INSTITIÚID ARD-LÉINN BHAILE ÁTHA CLIATH  
(Dublin Institute for Advanced Studies)

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Annual Report of the work of the Institute  
and its Constituent Schools presented by  
the Council for the year ended  
31 December 1985

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In accordance with the provisions of Section 29 of the Institute for Advanced Studies Act, 1940 (No. 13 of 1940), the Council of the Institute has the honour to present to the Minister for Education for submission to the Government a report of the work and activities of the Institute and its Constituent Schools for the year ended 31 December 1985.

The report is presented under the following principal heads:-

- I - Constitution of the Council of the Institute and of the Governing Boards of the three Constituent Schools on the 31 December 1985.
- II - Report of the Governing Board of the School of Celtic Studies.
- III - Report of the Governing Board of the School of Theoretical Physics.
- IV - Report of the Governing Board of the School of Cosmic Physics.



1 Constitution of the Council of the Institute and of the  
Governing Boards of the three Constituent Schools on the  
31 December 1985.

1 THE COUNCIL OF THE INSTITUTE

Chairman

T. K. Whitaker, D.Econ.Sc.

Ex-Officio Members

T. Murphy, M.D., D.P.H., B.Sc.Pub.H., President, University  
College, Dublin; W. A. Watts, M.A., Sc.D., Provost, Trinity  
College, Dublin; T. K. Whitaker, D.Econ.Sc., President,  
Royal Irish Academy.

Members appointed by the Governing Board of Constituent Schools

B. Ó Cuív, M.A., D.Litt.; T. de Bhaldraithe, M.A., Ph.D., D.Litt.;  
J.T. Lewis, B.Sc., Ph.D.; A. J. McConnell, M.A., M.Sc.,  
Sc.D., F.T.C.D.; T. Murphy, D.Sc.; E.F.Fahy, M.Sc., Ph.D.

2 GOVERNING BOARD OF THE SCHOOL OF CELTIC STUDIES

Chairman

T. de Bhaldraithe, M.A. Ph.D., D.Litt.

Senior Professors

P. Mac Cana, M.A., Ph.D.; B. Ó Cuív, M.A., D.Litt.

Appointed Members

G. Mac Eoin, M.A., Ph.D.; P. Ó Fiannachta, M.A.; T. Ó Floinn, M.A.;  
M. Ó Murchú, M.A.; S. Ó Tuama, M.A., Ph.D.; E. G. Quin, M.A.,  
F.T.C.D.; G. Stockman, M.A., Ph.D., Dip. Ed.; G. Victory,  
B.A., Mus.D.; T.K. Whitaker, D.Econ.Sc.

3 GOVERNING BOARD OF THE SCHOOL OF THEORETICAL PHYSICS

Chairman

A. J. McConnell, M.A., M.Sc., Sc.D., F.T.C.D.

Senior Professors

J.T. Lewis, B.Sc., Ph.D.; J. R. McConnell, M.A., D.Sc.;  
L. O'Raiheartaigh, M.Sc., Ph.D.

Appointed Members

J. Dooge, M.E., M.Sc., C.Eng., F.I.E.I., F.A.S.C.E.,  
D.Agr.Sc.; J.N.Flavin, M.Sc., Ph.D.; M.A. Hayes, M.Sc., Ph.D.;  
P. Quinlan, B.E., D.Sc., Ph.D.; T.D. Spearman, M.A.,  
Ph.D. (Cantab.) F.T.C.D.; S.S. Tóibín, M.Sc., Ph.D.

4 GOVERNING BOARD OF THE SCHOOL OF COSMIC PHYSICS

Chairman

E.F. Fahy, M.Sc., Ph.D.

Senior Professors

T. Murphy, D.Sc.; P. A. Wayman, Ph.D.

Appointed Members

A. Brock, M.A., Ph.D., F.R.A.S., F.Inst.P.; D.J. Bradley, Ph.D.,  
F.R.S., F.T.C.D.; P.K. Carroll, M.Sc., Ph.D.; M.de Groot,  
Ph.D.; G.F. Imbusch, Ph.D., D.Sc.; D. L. Linehan, B. Sc.,  
B.E.; V.J. McBrierty, B.Sc., M.A. Ph.D. (Lond.), Sc.D., C.Phys.,  
F.INST.P., F.T.C.D.; N.A. Porter, Ph.D.; E.T.S. Walton  
M.A., M.Sc., Ph.D., D.Sc., F.T.C.D.; D.L. Weaire, B.A. (Cantab.)  
Ph.D. (Cantab.).

5 ADMINISTRATIVE STAFF

Registrar

Lt. Col. J. P. Duggan, B.A., H.Dip.Ed., M.Litt., MIL.

Senior Clerk

Maura Devoy, B.A.

Accounts Clerk

Mary A. O' Rourke, B.A.

Clerks

Angela Stubbs; Noreen Granahan; Caitríona Tubridy;  
Desmond Pender.

11 - Annual Report of the Governing Board of the School of Celtic Studies for the year ended 31 December 1985 adopted at its meeting on 6th June, 1986.

1. STAFF AND SCHOLARS

Senior Professors

Brian Ó Cuív, Director; James Carney (retired 30 September);  
Proinsias Mac Cana (appointed 1 October).

Professor:

Heinrich Wagner.

Assistant Professors:

Pádraig de Brún; Fergus Kelly; Rolf Baumgarten;  
Mícheál Ó Siadhail.

Research Assistant:

Malachy McKenna.

Assistant (part-time):

Mrs. Nessa Doran.

Junior Research Assistants:

Aoibheann Nic Dhonnchadha, Pádraig Ó Macháin (appointed  
1 October).

Assistant Librarian/Clerk:

Máire Breatnach

Secretary/Publications Officer:

Máire Uí Chinnseala.

Clerical Staff:

Patricia Dunne

Professor Emeritus:

D. A. Binchy

Scholars:

Anthony Harvey (to 15 March); Neil McLeod, Erich Poppe (to 30 September); James Fife (to 30 November); Máirín Ní Dhonnchadha, Colmán Etchingham; Bette Crigger, Kevin A. Walsh (from 1 October).

Visiting Scholar

Dr. Huw Pryce (University of Wales). Michaelmas term.

While the third Senior Professorship remained unfilled in 1985, the retirement of Professor James Carney, arranged for 30 September, left the way open for the appointment of Professor Proinsias Mac Cana as Senior Professor with effect from 1 October. Another welcome addition to the staff came with the appointment as Junior Research Assistants of Aoibheann Nic Dhonnchadha and Pádraig Ó Macháin which took effect from the same date.

2. RESEARCH AND EDITING

Professor Brian Ó Cuív completed the editing and proof-correcting of Celtica xvii. He read the manuscript draft of the glossary, indexes and appendix to Professor Kenneth Jackson's edition of Aislinge meic Con Glinne, and in September, at the request of Professor Jackson who felt unable through illness to complete his work of editing, he undertook on behalf of the School to see the work through its final stages. He continued editorial work on a number of texts from Irish manuscripts, and he also did some further work on the catalogue of Irish manuscripts in the Bodleian Library in Oxford. He read proofs of his article on 'Sandhi phenomena in Irish' (to appear in Sandhi phenomena in the language of Europe, to be published by Walter de Gruyter & Co. Berlin/New York). The following article was accepted for publication: 'Deascán Filíochta' (to be published in Féilscríbhinn Thomáis de Bhaldraithe). See also § § 7, 8, 9a, 9b, 9f.

Professor James Carney worked on Early Irish Poetry and other literary matters. See also § § 4, 7, 9e.

Professor Proinsias Mac Cana worked on a book dealing with the evolution of the learned and poetic orders in early and medieval Ireland. The following articles were accepted for publication: (i) several articles (c. 20,000 words) on Celtic religions for the Encyclopedia of Religions; (ii) 'An tEirreadh Nuachair: notaí breise ar an deasghnáth' for Féilscríbhinn Thomáis de Bhaldraithe; (iii) 'The Voyage of St. Brendan: Literary and Historical Origins', for the Proceedings of the St. Brendan Conference, TCD, July 1985. See also § § 7, 9c, 9f.

Professor Heinrich Wagner did some preliminary work on a Comparative Celtic Grammar. The following articles were accepted for publication: (i) 'Das Keltische und die indogermanischen Gutturale' (Festschrift Ernst Risch, Zürich 1986); (ii) 'Roots of Finno-Ugrian Folk Poetry' (Proceedings of the Kalevala Commemoration, Dublin 1985); (iii) 'Iarfhocal ar Ní agus Cha sa Ghaeilge' (Féilscríbhinn de Bhaldráithe, 1986); (iv) 'The Celtic Invasions of Ireland and Britian' (an extended version of the 1984 Statutory Lecture); and (v) 'Phonetic Texts from Dunquin' for ZCP 42. See also § § 7, 9c.

Dr. Pádraig de Brún continued to catalogue the Irish MSS in TCD (with Aibheann Nic Dhonnchadha from October); to assemble material for the completion of the annotated dictionary of the Ir. Society's Bible Teachers, 1818-27; he did some preparatory work on a guide to locations of manuscripts in Irish. The following articles were accepted for publication in Kerry Archaeological and Historical Society Journal: (i) 'Further fragments of the Civil Survey'; (ii) 'Some lists of Kerry priests, 1750-1835'. See also § § 8, 9f.

Fergus Kelly continued work on a general introduction to Early Irish Law and prepared an edition of a text on law-courts for Peritia V. He supervised Neil McLeod's work on Di astud Chor and Bette Crigger's on an edition of Di Dligiud Raith 7 somáine. Reviews of some publications were accepted for Celtica and the following articles were accepted for publication in Ériu: (i) 'Old Irish creccaire, Scottish Gaelic krabbir' and (ii) Two notes on Final-Verb constructions. See also § § 4, 7, 9f.

Rolf Baumgarten corrected the final proofs of Bibliography of Irish Linguistics and Literature, 1942-71. The collection of material for the next volume (1972-86) progressed and the possibility of computerisation was researched. An article entitled 'The kindred metaphors in Bechbretha and Coibnes Uisci Thairidne' was accepted for publication in Peritia 4. See also § § 6, 8.

Mícheál Ó Siadhail continued work on his forthcoming book on Aspects of Irish Dialects. See also § § 3, 7, 9c, 9f.

Dr. Malachy McKenna continued work on 'The Spiritual Rose' and prepared a review of G. Broderick's Handbook of Late Spoken Manx for publication in ZCP. The index and corrigenda to 'The Breton of Guéméné-sur-Scorff' were accepted for publication in ZCP 40. See also § 5.

Mrs. Nessa Doran checked proofs of Fasc. IX of Catalogue of Irish Manuscripts in the National Library of Ireland and completed descriptions of MSS G 434 - G 463 for Fasc. X and MSS G 505, G 512 for Fasc. XI. She supervised the work of Pádraig Ó Macháin who is cataloguing the bulk of Fasc. XI. She revised the 1984 Best Memorial Lecture - Collectors of Irish Manuscripts: Motives and Methods for publication in Celtica xvii and checked the proofs. See also § 9b, 9f.

Aoibheann Nic Dhonnchadha commenced work on the cataloguing of medical manuscripts in Trinity College, Dublin, under the supervision of Pádraig de Brún. See also § 8.

Pádraig Ó Macháin worked on the preparation of Fasc. XI of Catalogue of Irish MSS in the National Library of Ireland, under the supervision of Mrs. Nessa Doran. He assisted Professor Ó Cuív in checking the typescript of K. Jackson's edition of Aislinge meic Con Glinne and in proof-reading Celtica xvii and Fasc. IX of Catalogue of Irish MSS in NLI. See also § 8.

Anthony Harvey completed a statistical analysis of features of Ogam orthography. See also § 9f.

Dr. Neil McLeod worked on the Brehon law of contracts and fosterage with special attention to the texts Di astud Chor and Córus Iubaile. See also § 5.

Dr. Erich Poppe worked on the final draft of his edition of Cáin Éimíne Báin and completed the preparation of two articles: (i) on the word-order in the Mid. Welsh text Cyfranc Lludd a Llefelys and (ii) on K. Gessner and the Celtic language. An article entitled 'Éimíne, Íam at, and Íaman' was accepted for publication in Ériu 37. See also § 7, 9f.

James Fife wrote articles for a proposed publication entitled Studies in Welsh word order (co-edited with Erich Poppe); entered the texts of two Branches of the Mabinogion on computer for syntactic analysis; drafted an outline of a proposed book on the Grammar of Classical Welsh. He did preliminary work on an article dealing with the semantics of O.Ir. RO- and prepared a six weeks course on the Táin and Mabinogion. He was awarded a Ph.D. degree by the University of Wales in March and worked on the revision of his thesis for publication by University of Wales Press. Several articles and reviews were accepted for publication in the Bulletin of the Board of Celtic Studies, Word, Journal of Linguistics,

Celtica, ZCP, Journal of the International Phonetics Association. See also § 5, 9f.

Máirín Ní Dhonnchadha continued work on (i) an edition of Cáin Adomnáin; (ii) secondary material including other Cáin texts and relevant material in Corpus Iuris Hibernici; (iii) admissibility of written evidence (Diplomata etc.) in Old and Middle Irish. She attended a weekly seminar on Córus Bésnai in TCD. A review of Religiones Prerromanas (Primitivas Religiones Ibericas, J. M. Blázquez, 1983) was accepted for publication in Celtica xvii. See also § 9f.

Colmán Etchingham continued research on his doctoral thesis, to be submitted to TCD, on the extent of monastic 'paruchia' in early medieval Ireland. See also § 5.

Bette-Jane Crigger's principle research was devoted to analyzing concepts of social identity encoded in the O.Ir. laws; secondary research included review of relevant archaeological data corroborating legal descriptions of social structure of the early Christian period. Preparation of an edition of the clientship tract Di dliugiud raith 7 somafne flaith under the supervision of Fergus Kelly progressed. She attended the weekly seminar at TCD on Córus Bésnai.

Kevin A. Walsh prepared an edition of the modern version (18th century MSS) of Scéla Mucce Meic Dathó which was accepted for publication as an article in Éigse 22.

### 3 STATUTORY PUBLIC LECTURE

A Statutory Lecture entitled 'Irish and English - Aspects of Language Contact' was delivered by Mícheál Ó Siadhail at Trinity College, Dublin on 29 November.

### 4 SEMINARS

Professor James Carney held a seminar on Old Irish Poetry during the Hilary and Michaelmas terms.

Fergus Kelly's seminar on the Heptads beginning at Corpus Iuris Hibernici 41.1 was held during the Michaelmas term.

Dr. Huw Pryce, who visited the School during Michaelmas term, held a seminar on 'An Introduction to Medieval Welsh Law'.



5 TIONÓL

- Neil Buttimer : Irish Bardic Poetry and Performance
- Colmán Etchingham : The Columban Federation and the Southern Uí Néill c. 700 to c. 1000
- Malachy McKenna : The Conjugation of the Verb in E. Ulster
- James Fife : Passivity and the Welsh Impersonal
- Heinrich Wagner : Problems of Comparative Celtic Grammar
- Donncha Ó Corráin : Cáin Lánamna: Some Canon-Law Aspects
- Pádraig Ó Riain : Background to the Synod of Raith Bhreasail? Fursa's Vita Secunda
- Gearóid Ó Cruallaíoch : An Chailleach Bhéara - Cér díobh í?
- Neil McLeod : Contractual Capacity in Early Brehon Law

6 PUBLIC LECTURE

A Public Lecture entitled 'A Luvian spell, the dawn cows of India and Ireland, and the language and poetry of the Trojans' was delivered by Professor Calvert Watkins at the Institute on 7 October.

7 EXTERNAL ACTIVITIES

Professor Brian Ó Cuív, as Visiting Professor at the University of Toronto from 4 January to 18 April, delivered a course of 48 lectures and conducted a series of tutorials on 'Irish Literature and Society: 500-1600'. On 20 January he gave a Thomas Davis Lecture on RTÉ Radio 1 on 'Home Rule in Ireland: Before and After'. On 20 February he lectured on 'Ireland and Scandinavia; some cultural links' in St. Paul, Minnesota, under the auspices of the Irish-American Cultural Institute; on 22 February he lectured in the University of Minnesota on 'The Training of the Medieval Irish Poet'; and on 8 April he lectured on 'Culture and Nationhood: 1916, the Irish Language, and the Making of the Irish State' as part of the Easter programme on 'Culture and Destiny' in St. Michael's College, Toronto. He attended the annual colloquium of the Henry Sweet Society in St. Peter's College, Oxford, 2 - 5 September and read a paper on 'Henry Sweet in Dublin'. He visited Edinburgh 25-26 September to arrange with Professor Jackson for the completion of the edition of Aislinge meic Con Glinne.

Professor James Carney attended a Celtic Studies Conference at Berkley, California in April and lectured on 'The Earliest Irish Verse'.



Professor Proinsias Mac Cana visited the University of Uppsala on 14-15 October where he conducted a seminar on 'The Medieval Irish Poet' and delivered a lecture entitled 'Early Irish Voyage Literature'; he was a member of the Irish delegation to the General Assembly of Unesco at its meeting in Sofia, Bulgaria 26 October - 1 November.

Professor Heinrich Wagner delivered a lecture on 'Roots of the Finno-Ugrian Folk-Epic' at the Kalevala Conference which was held at University College, Dublin in September.

Fergus Kelly visited the University of Oslo in May where he lectured on 'Early Irish Society' and 'The Early Irish'.

Rolf Baumgarten lectured on 'Placenames, etymology, and the structure of fianaigeacht' at the Kalevala Conference at University College, Dublin in September.

Mícheál Ó Siadhail visited various universities in the United States during October-November. He delivered the Trimbull lecture on 'Early Irish Lyric Poetry' at Yale on 21 October; at the Catholic University of America he lectured on 'Anglo-Irish: a myth that served' and took part in a seminar on Irish Culture 25-26 October he delivered the Hull Memorial Lecture on 'Modern Irish orthography: a mishandled Eclog' at Harvard on 12 November.

Dr. Erich Poppe attended the Henry Sweet Society Colloquium at Oxford in September and lectured on 'K.Gessner's Mithridates: Notes on Working Methods and Argumentation'.

#### 8. CATALOGUING OF IRISH MANUSCRIPTS

Proofs of A Catalogue of Irish Manuscripts in Cambridge Libraries, which is to be published by Cambridge University Press, were checked and corrected.

Work on the Irish manuscripts in the National Library of Ireland continued, and from October on Mrs. Nessa Doran was assisted by Pádraig Ó Macháin. Fasciculus IX, comprising MSS G 374 - G 433, was published; preparatory work on Fasciculus X, comprising MSS G 434 - G 463, was completed by Mrs. Doran, who also catalogued two medical manuscripts, G 505 and G 512, for inclusion in Fasciculus XI which is being prepared by P. Ó Macháin.

Cataloguing of the Irish manuscripts in Trinity College in Dublin was continued by Dr. Pádraig de Brún who was assisted in this work from October on by Aoibheann Nic Dhonnchadha.

Professor Brian Ó Cuív did some further work on the Irish manuscripts in the Bodleian Library in Oxford.

9 PUBLICATIONS

(a) Works in the course of Printing at December 31

The Annals of Ulster - Part II (containing an Introductory note and 3 Indexes compiled by G. Mac Niocaill).

Bibliography of Irish Linguistics and Literature 1942-71  
compiled by R. Baumgarten.

Uraicecht Becc edited by C. McAll

Catalogue of Irish MSS in the National Library of Ireland  
Fasc. IX compiled by Nessa Ní Shéaghda

(b) Books Published by the Institute

Corpus Genealogiarum Sanctorum Hiberniae ed. Pádraig Ó Riain.  
pp. liv + 347. £30

Celtica xvii ed. Brian Ó Cuív. pp. 188. £12.

Collectors of Irish Manuscripts: Motives and Methods  
Nessa Ní Shéaghda. pp. 28. £1.

(c) Books published outside the Institute

Proinsias Mac Cana

Ériu 36. Published by the Royal Irish Academy and edited by Proinsias Mac Cana and E. G. Quin.

Heinrich Wagner

Das Hethitische vom Standpunkte der typologischen Sprachgeographie. Published by Pisa University Press.

Micheál Ó Siadhail

Lehrbuch der Irischen Sprache. Published by Helmut Buske,  
Verlag, Hamburg.

(d) Reprints of Institute publications

Early Irish History and Mythology

A Historical Morphology and Syntax of Breton

(e) Reprint of work originally published elsewhere

The Irish Bardic Poet by James Carney

(f) Contributions to periodicals and other publications

Brian Ó Cuív:

Fragments of Irish medieval treatises on horses.  
Celtica xvii. 113 - 122

Dán a chum Eleanor Knott ibid. 188

Proinsias Mac Cana

A Note on the prepositional relative.  
Ériu 36. 210 - 212.

Pádraig de Brún.

Kildare Place Society in Kerry: IV. Summary and discussion.  
Kerry Archaeological and Historical Society Journal  
17. 153 - 205.

Fergus Kelly

Review of Cath Maige Tuired: The Second Battle of Mag Tuired,  
ed. Elizabeth A. Gray. Celtica xvii. 185 - 186.

Rolf Baumgarten

The geographical orientation of Ireland in Isidore and Orosius.  
Peritia 3. 189 - 203.

Mícheál Ó Siadhail

Irish labhaois, labhaoiseach. Celtica xvii. 158

Nessa Ní Shéaghdha

Collectors of Irish Manuscripts: Motives and Methods.  
Celtica xvii. 1 - 28.

Anthony Harvey

The Significance of Cothraige. Ériu 36. 1 - 9.

Erich Poppe

A Middle Irish Poem on Éimíne's Bell. Celtica xvii.  
59 - 72.

James Fife

The Impersonal Verbs in Welsh. Bulletin of the Board of  
Celtic Studies 32. 92 - 126.

Copulation and existence. Linguistic Notes from La Jolla  
13. 1 - 24.

Máirín Ní Dhonnchadha

Review of Léachtaí Cholm Cille xv. Comhar. Bealtaine 1985.  
36 - 38. Meitheamh 1985. 34.

III - Annual Report of the Governing Board of the School of Theoretical Physics for the year 1985, adopted at its meeting on 29th Sept. 1986.

1. STAFF, SCHOLARS, EMERITUS PROFESSOR, RESEARCH ASSOCIATES, and VISITING SCIENTISTS.

Senior Professors:

John T. Lewis, Director from 1 January 1975; James R. McConnell; Lochlainn S. O'Raifeartaigh.

Assistant Professor:

J. Burzlaff

Librarian-Executive:

Evelyn R. Wills

Secretary:

Margaret Matthews

Scholars:

E. Müller (Fed. German Rep.), P. Horváthy (Hungary), H. Yoneyama (Japan), A. Wipf (Fed. German Rep.); J. Alberty (Portugal) 1 January to 30 Sept.; M. Vandyck (Belgium), D. Ó Sé (Ireland) from 1 October.

Emeritus Professor

John L. Synge

Research Associates (all appointments to 31 December 1987):

TCD: D.J. Bradley, R.K. Dodd, P.S. Florides, H.C. Morris, A.E. Raftery, B.K.P. Scaife, D. Weaire

UCD: P.A. Hogan, D.J. Judge, J.D. McCrea, J.V. Pulè, W. Sullivan

St. Patrick's College, Maynooth: P. McGill, C. Nash, A. O'Farrell, J. Spelman, D.H. Tchrakian

UCG: M. J. Conneely, T.N. Sherry

DIT Kevin Street: T. Garavaglia, B. Goldsmith, D. Heffernan, M. Tuite.

DIT Bolton Street: P. Houston (from 1 January 1985)

NIHED: E. Buffet (from 1 January 1985)

NIHEL: J. Kinsella

An Foras Forbartha: J. M. Golden

Open University: A. I. Solomon

Oxford University: R.C. Flood

Visiting Scientists;

G. Auberson (Montpellier) 24 April; M. van den Berg (Heriot-Watt) 20-30 May, 23 Sept. - 2 Oct.; M. Carroll (Berkeley) 21 May - 1 June; J. Chayes (Harvard) 3 - 11 July; L. Chayes (Harvard) 3 - 11 July; J. Conlon (Missouri) 4-5 July; G. G. Emch (Göttingen) 3-4 Dec.; D.E. Evans (Warwick) 30 Dec. 1984 - 13 Jan. 1985, 3-10 Nov.; G. W. Ford (Ann Arbor) 1 July - 3 Aug.; G. W. Froad (Lakehead) 28 Aug. 1984 - 23 Aug. 1985; R. B. Griffiths (Carnegie-Mellon) 30 July - 2 Aug.; K. C. Hannabuss (Oxford) 10 - 14 June; F. W. Hehl (Cologne) 13 Aug. - 10 Sept.; R. Holzner (Zurich) 20-27 May; N.M. Hugenholtz (Groningen) 9-14 Oct.; R. Kerr (Canterbury, NZ) 25 April; C. King (IAS, Princeton) 9-16 Jan.; D.H. Lyth (Lancaster) 4 Mar. - 4 April; J. McCabe (Florida) 22-27 July; G. W. Mackey (Harvard) 6 July - 9 Aug.; N. S. Manton (Cambridge) 10-14 June; W. J. Moore (Sydney) 10-14 June; R. Musto (Naples) 1-25 Sept., 17 Nov. - 1 Dec.; D. J. O'Connor (Austin) 19-20 Dec.; A. Okopinska (Warsaw) 1 Sept. - 9 Oct.; G. Parravicini (Milan) 29 July - 28 Aug., 30 Dec. 1985 - 13 Jan. 1986; G. E. Prince (Melbourne Inst.) 28 Dec. 1984 - 4 Jan. 1985; J. Rawnsley (Warwick) 24-31 Aug.; M. van der Rest-Jaspers (Liège) 1-19 Sept; H. Risken (Ulm) 2-3 April; P. de Smedt (Leuven) 9-24 April; W. van Wandenfels (Heidelberg) 20-30 Nov.; M. Yor (Paris) 17-18 June, H. Maassen (Delft Tech.) 7-14 Feb.; R.F. O'Connell (Baton Rouge) 1 July - 3 Aug.

2 GENERAL

Professor McConnell was re-elected Chairman of the European Molecular Liquids Group for three years. Professor Lewis was elected Treasurer of the International Association of Mathematical Physics from January.

A substantial collection of periodicals and reprints was given to the School by Professor Synge (see § 11).

In continuing fulfillment of the School's statutory function "to train advanced students in the methods of original research", postdoctoral scholarships (up to six at any one time) were awarded to J. Alberty (Portugal), P. Horváthy (Hungary), E. Müller and A. Wipf (Fed. German Rep.), D. Ó Sé (Ireland), and M. Vandyck (Belgium).

In addition to the use made by Staff, Scholars, and Research Associates of the School in their primary research activities, much use was made also by visitors, particularly during the summer months, of the School's facilities for research - especially the opportunities for informal discussions and the library resources. Twenty-six research workers from universities and other institutes of research or higher education were admitted as research associates of the School. For details of Visitors to the School see § 9.

### 3 RESEARCH AND STUDY

Primary areas -

#### (a) Theoretical Particle Physics

For Professor O'Raifeartaigh the early months of 1985 were largely occupied in completing his book "Group Structure of Gauge Theories", which was sent off to the Cambridge University Press in May. His research during this period and the rest of the year was divided between further development of effective potential theory (with Drs. Wipf and Yoneyama), study of the spontaneous symmetry breaking patterns of the  $SO(10)$ -invariant Higgs potential (with Professors Michel, McGlinn, and Wali), investigation of the  $U(1)$ -anomaly and the index-theorem for non-compact (Euclidean) spaces (with Professor Musto and Dr. Wipf), and Colour-breaking by monopoles (with Dr. Horváthy). Dr. Wipf also completed some earlier work on functional determinants (tunnel determinants).

Professor O'Raifeartaigh also continued his collaboration with Professor Burzlaff in the study of spontaneous symmetry-breaking. They concentrated on non-maximal stability groups and horizontal symmetries.

Professor Burzlaff continued his study of classical Yang-Mills-Higgs solutions. He discussed saddle points and vortices, in the context of dimensional reduction, with Dr. Sherry and Dr. Tchrakian. In collaboration with Dr. Tchrakian he found finite-action solutions of higher order Yang-Mills-Higgs theory. He worked also with Dr. N. O'Murchadha on an extension of class theory with global existence proofs to include time-dependent monopoles.



Dr. Alberty studied anomalies in quantum electrodynamics of an external field, formulated as a supersymmetric quantum mechanical system.

Dr. Ó Sé collaborated with Dr. Tchrakian in work on classical gauge field theories.

Dr. Garavaglia used the quark-parton model and Q.C.D. to calculate the structure functions associated with deep inelastic scattering of polarized leptons from polarized targets.

Dr. Tuite continued his study of field theories at finite temperatures, including new techniques provided by "thermo-field dynamics".

(b) Classical Statistical Mechanics

(i) Brownian Motion and Relaxation Phenomena

Professor McConnell continued his research on nuclear magnetic relaxation, with especial reference to dipolar interactions. He continued preparation of a book for the Cambridge University Press on the theory of nuclear magnetic relaxation in liquids. He commenced preparation of material for an invited article on dielectric properties in solids for the Dizionario delle Scienze Fisiche.

Professor Frood, in collaboration with Professor McConnell and Professor Scaife, considered collision induced infrared absorptions in gases, with a view to gaining insight into this same phenomenon in liquids. Professor Frood also began a study of the so-called electrorheological fluids in liquid dielectrics.

Dr. Sullivan continued his study of  $L^2$  relaxation rates of Markov chains and related diffusions. His study has concentrated on the use of the graph structure of allowed transitions to obtain estimates of relaxation rates.

(ii) Phase Transitions in Lattice Systems

Professor Lewis continued his collaboration with Dr. D. E. Evans (Warwick) on the  $C^*$ -algebra formulation of phase-transitions in lattice systems.

Dr. Solomon continued his work on Lie-algebraic methods applied to multi-phase systems.



(c) Quantum Statistical Mechanics

(i) Asymptotic Evolution of Open Systems

Dr. Müller continued his work on the coupling of a material system to the quantized radiation field; he studied an algebraic algorithm for the different orders of approximation.

(ii) Boson Condensation

Professor Lewis, in association with Dr. M. van den Berg (Heriot-Watt) and Dr. J. V. Pulè, began a study of condensation in models of an inter-acting boson gas using the Large Deviation Principle.

Dr. Müller studied an application of the mathematical theory of boson condensation in an ideal gas to free photons.

(iii) Quantum Stochastic Processes

Professor Lewis continued his collaboration with Professor G.W. Ford (Ann Arbor) and Professor R.F. O'Connell (Baton Rouge) on applications of the quantum Langevin equation in atomic physics.

(d) Quantum Electronics

Dr. Garavaglia used quantum field theory methods to study properties of quantum and thermal noise in electrical systems.

Dr. Heffernan, supported by an NBST Research Award, investigated non-linear processes in semiconductor lasers, and non-linear dynamical processes in optical systems. He also investigated transient phase conjugation in organic and inorganic materials.

Secondary areas -

(e) General Relativity and Gravitation

Dr. Vandyck considered the extension of the relativistic plane wave to Supergravity, and found that the supersymmetry plane wave possesses more degrees of freedom than does the usual relativistic wave. He investigated the properties of the new polarisation, by solving the problem of the motion of a cloud of test-bodies falling freely under the influence of such a wave.

Dr. McCrea, in collaboration with Professor Hehl, studied the conservation laws for energy-momentum and spin in relativistic field theories, and in particular the relation between Bianchi identities and Noether identities. They also studied, in collaboration with Dr. E. Schrnefer (Bonn), the further development of Dr. Schrnefer's REDUCE package, EXCALC, with reference to Poincaré gauge theory.

(f) Applied Mathematics

Professor Synge continued his collaboration with Professor Lewis on problems in wave-propagation.

Research Reports

Research work during the year was written up in the first instance in research reports. Two lists of titles of these reports (preprints) were prepared and circulated to a mailing list of approximately 300 research institutes and university departments throughout the world. As far as available, copies of the preprints were supplied to research workers in response to requests. Many of the reports appeared later as publications, or were in press at the end of the year (See Section 10).

- DIAS-STP-85-01: D. M. HEFFERNAN, J. McINERNEY, L. REEKIE, & D.J. BRADLEY: Bistability by induced waveguiding in coupled semiconductor lasers.
- 02: D. E. EVANS & J. T. LEWIS: On a  $C^*$ -algebra approach to phase transition in the two-dimensional Ising model, II.
- 03: T. GARAVAGLIA: A comment on the Dirac bracket.
- 04: A. WIPF: Upper and lower bounds for the bounce action.
- 05: P. A. HORVÁTHY & J. H. RAWNSLEY: Internal symmetries of non-Abelian gauge field configurations.
- 06: A. I. SOLOMON & J. L. BIRMAN: Dynamical algebra, unitary states, and thermal Green's functions of many fermion systems.
- 07: J. T. LEWIS, J. V. PULÈ, & Ph. de SMEDT: The persistence of boson condensation in the van der Waals' limit.
- 08: T. GARAVAGLIA: Finite temperature field theory and quantum noise in an electrical network.

- DIAS-STP-85-09: T. GARAVAGLIA: The Runge-Lenz vector and Einstein perihelion precession.
- 10: J. BURZLAFF & D. H. TCHRAKIAN: Finite-action solutions of high-order Yang-Mills-Higgs theory in four dimensions.
- 11: D. G. FROOD & B. Tjipto MARGO: Clausius-Mossotti function for restricted one-dimensional oscillators.
- 12: J. McCONNELL: Theory of nuclear magnetic relaxation by dipolar interaction.
- 13: L. O'RAIFEARTAIGH: Spontaneous breaking in supersymmetry.
- 14: J. BURZLAFF: Statics and dynamics of classical Yang-Mills-Higgs systems: Some recent developments.
- 15: J. BURZLAFF & N. Ó MURCHADHA: Global existence of time-dependent Yang-Mills-Higgs monopoles.
- 16: E. BUFFET & J. V. PULÈ: Hard bosons in one dimension.
- 17: P. A. HORVÁTHY & C. NASH: A geometric view on topologically massive gauge theories.
- 18: J. BURZLAFF & L. O'RAIFEARTAIGH: Disconnected non-maximal stability groups and horizontal symmetry.
- 19: P. A. HORVÁTHY: The non-Abelian Bohm-Aharonov effect.
- 20: P. A. HORVÁTHY: The problem of "global color" in gauge theories.
- 21: A. WIPF: Tunnel determinants.
- 22: G. W. MACKEY: Hermann Weyl and the application of group theory to quantum mechanics.
- 23: B. GOLDSMITH: On endomorphisms and automorphisms of torsion-free modules.

- DIAS-STP-85-24: P. A. HORVATHY & J. RAWNSLEY: Monopole invariants.
- 25: A. I. SOLOMON & J. L. BIRMAN: Green's functions and unitary states in many fermion systems.
- 26: J. L. SYNGE: An action principle for photons.
- 27: J. L. SYNGE: Backward energy-flux for spherically symmetric scalar waves.
- 28: D. H. TCHRAKIAN: A dimensional reduction of the GYM-Dirac system in  $4p$ -dimensions.
- 29: L. O'RAIFEARTAIGH, A. WIPF, & H. YONEYAMA: The constraint effective potential.
- 30: G. W. FORD, J. T. LEWIS, & R. F. O'CONNELL: Stark shifts due to blackbody radiation.
- 31: A. CHAKRABARTI & D. H. TCHRAKIAN: A compactification of, and instantons in,  $4p$ -dimensional gravity.
- 32: E. MÜLLER: Bose-Einstein condensation of free photons in thermal equilibrium.
- 33: E. MÜLLER: Scalar potentials for vector fields and an application to quantum electrodynamics.
- 34: Y. FUJIMOTO, K. IDEORA, Y. NAKANO, & H. YONEYAMA: The finite temperature renormalization group equation in  $\lambda\phi^4$  theory.
- 35: E. MÜLLER: Bose-Einstein condensation of free photons.

#### 4. SEMINARS, REVIEW LECTURES, SERIES, COURSES.

Seminar and review lectures, series, and courses, in specialised areas of physics and/or mathematics were given at DIAS-STP throughout the year, by members or Visitors; as in previous years these were attended by members of staff and students from the universities and other third level and research institutes in the Dublin Area, and by members of the scientific schools of DIAS. And seminars or lectures were given at the Journals' Club, and at other Irish venues.

- (a) Seminar and review lectures given at DIAS-STP;
- Prof. G. AUBERSON (Montpelier): The confinement phase transition in the bag model.
- Prof. M. CARROLL (Univ. of California, Berkeley): Non-linear standing waves in electromagnetism and mechanics.
- Dr. J. CHAYES (Harvard): Phase-structure of fractal percolation.  
Invasion percolation.
- Dr. L. CHAYES (Harvard): Random resistors in flow networks.  
Invasion percolation.
- Prof. J. CONLON (Missouri): Ground state energy of N-particle Coulomb systems when N is large.
- Prof. A. DALGARNO (Harvard U. Obser.): The cosmic abundance of deuterium.
- Prof. G. G. EMCH (Göttingen): Geometric quantization revisited.
- Prof. R.B. GRIFFITHS (Carnegie-Mellon): The method of effective potentials: A new approach to commensurate-incommensurate phase transitions in one dimension.
- Dr. K. HANNABUS (Balliol Coll., Oxford): Finite-temperature representations of loop graphs.
- Prof. F. W. HEHL (Cologne): On the kinematics of torsion of space time.
- Dr. R. HOLZNER (Zürich): NMR-laser experiments on multi-stability and chaos.
- Prof. N. M. HUGENHOLTZ (Gröningen): The approach to thermodynamical equilibrium. C\* algebraic method.
- Prof. R. KERR (Canterbury, NZ): Fermi null coordinate systems in general relativity.

- Dr. C. KING (IAS, Princeton): Construction of Abelian gauge theories.
- Prof. J. K. KNOWLES (CALTEC): The failure of ellipticity in elastic materials.
- Dr. J. McCABE (Florida): Superspace and superfluids.  
Harmonic superspaces ( $N \geq 2$  super-symmetry).
- Dr. P. McGILL (Maynooth & DIAS): Martingales and large-deviations at fixed times.
- Dr. N. S. MANTON (DAMTP, Cambridge): The Schwinger model and its axial anomaly.  
Monopole-monopole scattering.
- Dr. E. MÜLLER (DIAS): Scalar potentials for vector fields (with an application to quantum electrodynamics).
- Prof. R. MUSTO (Naples): Background to string theory (2 lectures).  
Vertex operator in string theory: Something old, something new.
- Dr. R. F. O'CONNELL (Louisiana State): Melting temperature of a two-dimensional Wigner lattice.
- Dr. G. E. PRINCE (Roy. Melbourne Inst. Tech): Generalised gauge freedom in Lagrangian mechanics.
- Prof. H. RISKEN (Ulm): Brownian motion in periodic potentials.
- Prof. D. J. SIMMS (TCD): Introduction to homology theory.
- Dr. M. Van-der-REST-JASPERS (Liège): Dirac constraints and some applications.
- Prof. W. von Waldenfels (Heidelberg): Positive functionals on  $C^*$ -coalgebras.  
 $C^*$ -bialgebras and quantum increment processes.
- Dr. A. WIPF (DIAS): String theory (4 seminars).

- Dr. H. YONEYAMA (DIAS): Sufficient condition for quark confinement in lattice gauge theory.
- Prof. M. YOR (Paris VI): Asymptotic behaviour of some multiple integrals of Brownian motion.

(b) Series and courses given at DIAS-STP:

Professor LEWIS completed his course on STATISTICAL MECHANICS for graduate and final year undergraduate students, begun the previous October.

Professor O'RAIFEARTAIGH completed his course of lectures on SYMMETRIES IN QUANTUM MECHANICS & SOLID STATE PHYSICS, forming part of the M.Sc. course for universities in the Dublin Area, begun the previous October.

The series of seminars on PROBABILISTIC TECHNIQUES, organized by Professor LEWIS and Dr. MCGILL, was continued; the main topic studied was THE THEORY OF LARGE DEVIATIONS.

In July Professor MACKAY gave a series of four lectures, 2 on GROUP REPRESENTATIONS IN QUANTUM MECHANICS, and 2 on THE IMPORTANCE OF HARMONIC ANALYSIS FOR NUMBER THEORY; and

Professor FORD gave a course of 4 tutorials on PATH-INTEGRAL CALCULATIONS.

(c) Contributions to the Journals' Club (Joint TCD-UCD-Maynooth-DIAS Meeting, held in TCD);

- Dr. J. ALBERTY: Quenched master fields and Large-N expansion.
- Dr. P. HORVÁTHY: Non-Abelian Aharonov-Bohm effect.
- Prof. J. T. LEWIS: The stochastic mechanics of the hydrogen atom.
- Dr. E. MÜLLER: Bose-Einstein condensation of free photons.
- Dr. D. Ó SÉ: Surface integrals and dimensional reduction.
- Dr. H. YONEYAMA: Constraint effective potential.
- Reports on Rutherford Meeting, and on Erice Summer School.
- Dr. A. WIPF: On functional determinants.



(d) Other lectures or seminars given in Ireland by members of DIAS-STP:

Professor J. T. LEWIS:	Stochastic differential equations. Given at DIT, Kevin St.
Professor J. BURZLAFF:	Gauge theories and magnetic monopoles. Given at UCC.
Dr. D. HEFFERNAN:	Bistability and chaos in non-linear system. Given at NIHED.  Bistability, chaos and the optical computer. Given at Non-linear Mathematics Meeting. TCD.

Dr. HEFFERNAN was a Member of the Organizing Committee for the 4th Dublin Physics Summer School, OPTICAL FIBRES IN COMMUNICATIONS AND SENSORS, in July.

#### 5. ACTIVITIES OUTSIDE IRELAND

Professor McCONNELL attended the Conference of the Condensed Matter Division of the European Physical Society, at the Technical University of Berlin, 18-22 March, and presented a poster. He visited the University of Bremen 22-26 March, for discussions on dielectric theory, and to give a lecture; and he visited the Rheinisch Westfalen Technische Hochschule, Aachen, 26-28 March for discussions on nuclear magnetic resonance, and to give a lecture. From 15 to 17 April he attended the Conference of the British Radiofrequency Spectroscopy Group, at the University of Kent (Canterbury), and he presented a poster there. From 11 to 19 September he attended the Third European Molecular Liquids Group Conference; he chaired meetings of the Steering Committee, International Executive Committee, and General Meeting of the EMLG. He visited the University of Pavia, 4-21 October, for discussions on dielectric properties of solids, and to give a lecture. On 18-19 December he attended the Conference at Liverpool Univ. to celebrate the 80th Birthday of H. Fröhlich.



Professor LEWIS attended the Boltzmann Seminar, in Vienna, 15-27 February, followed by a Meeting of the Organizing Committee for the Quantum Probability Summer School, Heidelberg, 24-27 February. He visited the Mathematics Research Center, Warwick from 25 March to 3 April for research, he visited the Univ. of Kaiserslautern from 24-28 April, and gave a lecture course at the Univ. Studi of Milan from 29 April to 18 May. He attended a 2-day meeting on Stochastic Processes, at Swansea, 4-5 June, and gave a talk, and attended a 1-day meeting in Warwick on 6 June. He visited Heriot Watt Univ. from 5-9 August for discussions and a seminar, and attended the International Conference on Statistical Mechanics and Field Theory, Groningen, 26-30 August, and the NATO Advanced Research Workshop on Fundamental Aspects of Quantum Theory, at Como, 2-7 September, where he gave talks. He gave a course of lectures at the EEC Advanced Study Institute in Leuven in September. From 14-29 October he visited the USSR; he gave lectures on quantum stochastic processes at the Steklov Mathematical Institute, Moscow, and at the Romanovsky Mathematical Research Institute of the Usbek Academy of Sciences in Tashkent; he gave lectures on boson condensation at the Dobrushin-Minlos-Sinai Seminar in Moscow State University and at the Institute of Theoretical Physics of the Ukrainian Academy of Science in Kiev. He attended and spoke at the 9th Statistical Mechanics Conference, at the Open University, on 6 December.

Professor O'RAIFEARTAIGH visited Imperial College London on 5 February, Cambridge on 6 Feb., and Queen Mary College London on 7 Feb., for seminars and discussions. He attended the Karpacz Winter School, 18 Feb. - 2 March, and gave a series of lectures there. He visited Cracow Univ. on 4 March and Warsaw Univ. on 5th March, and gave a talk at each. He visited IHES, Bures-sur-Yvette, from 1-8 April, and Univ. Marseille 9-16 April; he visited the Univ. of Napoli for the month of May, and gave a course; and he attended the Capri Conference on Spontaneous Symmetry Breaking, 20-26 May, and gave a lecture. He visited the Univ. of Southampton 24-30 June, and gave a course.

Professor BURZLAPP visited Bonn Univ. from 27-31 May, for collaborative work with Dr. TCHRAKIAN. During August he visited Japan; he spent 2 days at Kyoto University, 2 days at the Research Institute for Theoretical Physics (Kyoto), 2 days at Kyushu University, 1 day at Hiroshima Univ., and 3 days at Fukuoka Univ., he gave talks at all of them. He visited SEOUL, Korea, and attended and spoke at the Fourth Symposium on Theoretical Physics, and the Fourteenth International Colloquium on Group Theoretical Methods in Physics. He visited Univ. Kaiserslautern on 4 Dec., and gave a talk.

Professor FROOD attended the IEE Symposium on Electrically Active Fluids, London, 13 February, and the 10th AIRAPT Conference on High Pressure Physics, Amsterdam, 7-12 July, where he gave a paper.

Dr. WIPF attended the Scottish Universities Summer School in Physics: Supersymmetry and Supergravity, Edinburgh, 28 July - 9 August. In December he visited Zürich (for discussions and a lecture), Munich (for work with Dr. Börner), and Kaiserslautern (for a lecture).

Dr. YONEYAMA attended the Conference on Non-Perturbative Methods, at Montpellier, 9-15 July, and the International School of Subnuclear Physics, at the Ettore Majorana Centre, Erice, 1-14 August. He visited Kyushu Univ. from 22 August-30 September, for discussions and to give seminars.

Dr. ALBERTY attended the Niels Bohr Centennial Symposium on Recent Developments in Quantum Field Theory, in Copenhagen, 6-10 May, and gave a talk. He visited the Centro de Fisica da Materia Condensada, Lisbon, in August, and gave a talk.

Dr. MÜLLER attended the Workshop on Fundamental Aspects of Quantum Theory, at Como, 2-7 September, and he visited the Univ. of Zürich on 10 September and gave a talk.

Dr. HORVÁTHY visited Marseille in September, for discussions with Professor Souriau, and Orsay in October for discussions with Dr. Comtet.

Dr. Ó SÉ and Dr. TUIE attended the Rutherford High Energy Physics Conference 16-18 December.

Dr. GARAVAGLIA visited the CERN Theory Division, 8-17 September, for discussion of theoretical research on scattering with polarized high energy leptons, and gave a talk; he attended the Workshop on Aspects of Quantum Theory at Como (see above).

Dr. HEFFERNAN attended the Conference on Directions in Physics, at Cornell Univ. 19-27 May. He visited Robinson Coll. Cambridge 26-28 August, and Imperial College London 18-30 August, to discuss ongoing research with collaborators at these places (NBST Cooperative Venture Research Award).

Dr. McCREA attended the 14th International Conference on Differential Geometric Methods in Mathematical Physics, Univ. of Salamanca, 24-29 June, and gave a lecture.

Dr. HOGAN visited the Univ. of Texas at Dallas, 3-15 March for research collaboration with Professor Robinson and Professor Trautman. He visited the Univ. of Louvain 15 June - 15 July, to give a course.

Seminars, Lectures, Posters, and Courses given Abroad:

Professor McCONNELL:

- Lecture: Intramolecular nuclear magnetic relaxation theory. Bremen.
- Lecture: Nuclear magnetic relaxation: By intramolecular dipolar interaction. Aachen.
- Lecture: Intramolecular nuclear magnetic interaction for asymmetric molecules. Pavia.
- Poster: Stochastic rotation operator for molecular models. Berlin.
- Poster: Nuclear magnetic relaxation by intramolecular dipolar coupling. Canterbury.

Professor LEWIS:

- Lecture: Quantum stochastic processes. Swansea, Moscow, Tashkent.
- Seminar: Brownian motion on a submanifold. Edinburgh.
- Lectures: Dissipative Hamiltonian systems. Vienna, Heidelberg, Kaiserslautern.
- Lecture Course: Statistical Mechanics. Milan.
- Lecture: Why do bosons condense? Groningen, Moscow, Kiev, Open Univ.
- Lecture: The quantum Langevin equation. Como.
- Lecture Course: Introduction to quantum probability. Leuven.

Professor O'RAIFEARTAIGH:

Lecture: Colour breaking by monopoles. Imperial Coll.,  
Crackow.

Lecture: Effective potential theory. Queen Mary Coll.,  
Cambridge, Warsaw.

Lecture: Spontaneous symmetry breaking. Capri.

Course on Group Structure of Gauge Theories. Napoli,  
Southampton.

Four Lectures on Supersymmetry and Spontaneous Symmetry  
Breaking. Karpacz.

Professor BURZLAPP:

Lecture: Statics and dynamics of classical Yang-Mills-  
Higgs systems: Some recent developments. Kyoto  
Univ., RITP, Seoul Symposium.

Lecture: Disconnected non-maximal stability groups and  
horizontal symmetry. Kyushu, Seoul Colloquium,  
Hiroshima.

Lecture: A saddle point in the Weinberg-Salam model. Kyushu,  
Fukuoka.

Lecture: The inflationary universe. Kaiserslautern.

Professor FROOD:

Lecture: The essentials of the new theory of the Clausius-  
Mossotti function. Amsterdam.

Dr. WIPP:

Lecture: The constraint effective potential. Zürich,  
Kaiserslautern.

Dr. YONEYAMA:

Lecture: Effective potential in the field theory. Kyushu.

Lecture: Real space renormalization group in lattice gauge  
theory. Kyushu.

Dr. ALBERTY:

Lecture: Fifth-time autocorrelation in stochastic quantization. Copenhagen.

Dr. MÜLLER:

Lecture: Bose-Einstein condensation of free photon, a new RASER? Como.

Dr. GARAVAGLIA:

Lecture: Finite temperature electrical network theory. CERN.

Dr. McCREA:

Lecture: Poincaré gauge theory of gravitation: foundations, exact solutions and applications of computer algebra. Salamanca.

Dr. HOGAN:

Course: Gravitational Radiation. Louvain.

#### 6. STATUTORY PUBLIC LECTURE

A Statutory Public Lecture under the auspices of the School was delivered by Professor N. M. HUGENHOLTZ (Univ. of Groningen) on 11 October in University College Dublin. The title was 'On the Approach to Equilibrium of Thermodynamic Systems'.

#### 7. SYMPOSIA

Two Mathematical Symposia were held during the year, 3-4 April, and 19-20 December. The attendances (30 in April, 40 in December) included professors, lecturers, and graduate students from the Irish universities and other third-level and research institutes, and from institutes abroad, and members of the scientific Schools of DIAS.

Lectures were given as follows:

APRIL:

Review Lectures:

Prof. A. G. O'FARRELL (Maynooth): Geometric intuition in analysis.

Prof. J. T. LEWIS (DIAS): Energy versus entropy.

Lectures:

Dr. A. WOOD (NIHED): Asymptotic theory of linear ordinary differential equations.

Dr. C. L. THOMPSON (Southampton): A Nonstandard approach to metric spaces.

Prof. A. G. O'FARRELL (Maynooth): The proof of the Bieberbach conjecture.

Prof. J. BURZLAFF (DIAS): Dynamics of vortices and monopoles.

Short Talks:

Dr. N. Ó MURCHADHA (UCC): The scalar curvature and the size of sets in two dimensions.

Dr. P. DOLAN (Imperial Coll., Lond.): Accelerated motion in general relativity.

Dr. A. WIPF (DIAS): A Rayleigh-Ritz principle for nonlinear field equations.

Mr. G. LESSELLS (NIHEL): Matrix algebra by Plato.

Dr. E. MÜLLER (DIAS): Scalar potentials for vector fields and an application to electrodynamics.

Prof. P. M. QUINLAN (UCC): The edge-function method in fracture mechanics.

DECEMBER:

Review Lectures:

- Prof. L. O'RAIFEARTAIGH (DIAS): Supersymmetric quantum mechanics.
- Prof. M. NEWELL (UCG): On isotropic tensors from an elementary point of view.

Lectures:

- Dr. P. MCGILL (Maynooth): What is a probabilistic proof?
- Dr. D. J. O'CONNOR (Copenhagen & Texas): Quasi-local effective Lagrangians.
- Dr. S. GARDINER (UCD): Convexity and subharmonic functions.
- Dr. R. TIMONEY (TCD): Linearization of holomorphic functions.

Short talks:

- Dr. C. THOMPSON (Southampton): Rotation numbers and almost additive sequences.
- Dr. P. HORVÁTHY (DIAS): The topology of monopoles.
- Dr. R. DIMITRIC (DIT Kevin St.): Coslender groups.
- Dr. A. KINSELLA (DIT) & Dr. A. DUNNE (UCD): A simple model for lung treatment assessment.
- Prof. J. FLAVIN (UCG): Some simple upper "decay" estimates for a class of harmonic functions.

8. EUROPEAN MOLECULAR LIQUIDS GROUP SYMPOSIUM

A Symposium entitled "Future Research in Molecular Liquids", to honour the 70th Birthday of Professor James McConnell, was held at DIAS-STP on 24-25 May. The attendance was 27, and there were six forty-five minutes invited lectures, three sectional research group meetings, and a poster session. The invited lectures were as follows:

- F. HUFNAGEL (Joh. Guten, Univ., Mainz): A molecular approach to the liquid state.
- W. A. STEELE (Penn. State U.): Translation-rotation coupling.
- Th. DOFMÜLLER (Univ. Bielefeld): Dipolar glasses
- D. TILDESLEY (Southampton U.): A molecular approach to multicomponent liquids.
- H. G. HERTZ (Univ. Karlsruhe): Intramolecular rotation in liquids as studied by nuclear magnetic relaxation.
- G. WILLIAMS (Univ. Aberystwyth): Internal motion in liquids.

M. LYES read a paper entitled "Stimulation of European cooperation and scientific and technical interchange". There were 10 posters; the concluding session considered proposals for future action.

9. VISITORS

For lectures given by Visitors, see §§ 4, 6, 7, 8.

As in previous years, visitors from abroad came to the School for short or long periods, for discussions with School members, to give seminars, and to avail of the School's library resources for their research work.

Short visits (up to one week) were made by

- J. K. KNOWLES (CALTEC), 21 March
- H. RISKEN (Ulm Univ.), 2-3 April
- A. DALGARNO (Harvard Univ. Obs.), 10 April
- G. AUBERSON (Montpellier), 24 April



S. CIUILLI (Montpellier), 24 April  
R. KERR (Canterbury, NZ), 25 April  
C. GRAHAM (Simon Fraser Univ.), 2 June  
W. J. MOORE (Univ. Sydney), 10-14 June  
N. S. MANTON (DAMTP, Cambridge), 10-14 June  
K. C. HANNABUSS (Balliol Coll., Oxford), 10-14 June  
R. BOTT (Harvard), 13 June  
M. YOR (Paris 6), 17-18 June  
J. CONLON (Missouri), 4-5 July  
J. McCABE (Univ. Florida), 22-27 July  
R. B. GRIFFITHS (Carnegie-Mellon), 30 July - 2 August  
P. DOLAN (Imperial Coll., Lond.), 9 August  
D. Ó MATHÚNA (Boston), 1 October  
N. M. HUGENHOLTZ (Rijksuniv. Groningen), 9-14 October  
G. G. EMCH (Univ. Göttingen), 3-4 December  
Dr. D. J. O'CONNOR (Univ. Texas at Austin), 19-20 December

Longer visits were made by

D. G. FROOD (Lakehead Univ.), 28 August 1984 to 23 August 1985  
G. E. PRINCE (Roy. Melbourne Inst. Tech.), 28 December 1984  
to 4 January 1985  
D. E. EVANS (Warwick), 30 December 1984 to 13 January 1985;  
3-10 November.  
C. KING (IAS, Princeton), 9-16 January.

- H. MAASSEN (Tech. Univ. Delft), 7 - 14 February.
- D. H. LYTH (Lancaster), 4 March - 4 April.
- P. de SMEDT (Leuven), 9-24 April.
- M. van den BERG (Heriot-Watt Univ.), 20-30 May; 23 Sept.- 2 Oct.
- R. HOLZNER (Zürich), 20-27 May.
- M. CARROLL (Univ. California, Berkeley), 21 May - 1 June.
- G. W. FORD (Univ. Michigan, Ann Arbor), 1 July - 3 August.
- R. F. O'CONNELL (Louisiana State Univ., Baton Rouge), 1 July -  
3 August.
- J. CHAYES (Harvard). 3 - 11 July.
- L. CHAYES (Harvard). 3 - 11 July.
- G. W. MACKEY (Harvard), 6 July - 9 August.
- G. PARRAVICINI (Milan), 29 July - 28 August; 30 December 1985  
to 13 January 1986.
- F. W. HEHL (Köln), 13 August - 10 September.
- J. RAWNSLEY (Warwick), 24 - 31 August.
- M. van der REST-JASPERS (Liège), 1 - 19 September.
- A. OKOPINSKA (Warsaw), 1 September - 9 October.
- R. MUSTO (Naples), 1 - 25 September; 17 November - 1 December.
- M. van WALDENFELS (Heidelberg), 20-30 November.

Visits to the School in connection with the EMLG Symposium  
(see § 8 ) were made by

F. Hufnagel (Joh. Guten. Univ., Mainz), W. A. Steele (Penn.  
State U.), Th. Dofmüller (Bielefeld), D. Tildesley (Southampton),  
H. G. Hertz (Karlsruhe), G. Williams (Aberystwyth), and M.  
Lyes (NBST).

10. PUBLICATIONS

Note: Items marked with an asterisk have been recorded as in press in previous reports.

(1) Book:

In the press:

- \* L. O'Raiifeartaigh. Group structure of gauge theories. Cambridge University Press.

(2) Communications of the Dublin Institute for Advanced Studies, Series A (Theoretical Physics):

None published.

(3) Contributions to periodical and other publications:

J. McConnell:

- \* Theory of nuclear magnetic relaxation. *Polymer* 26 (1985), 193-196.

Stochastic rotation operator for molecular models. Abs. 5th Gen. Conf. Condensed Matter Div. of EPS. Berlin 1985, 9A (1985). PTh-9-148.

M. van den Berg & J. T. Lewis:

- \* Brownian motion on a hypersurface. *Bull. Lond. Math. Soc.* 17 (1985), 144-150.

G. W. Ford, J. T. Lewis, & R. F. O'Connell:

Quantum oscillator in a blackbody radiation field. *Phys. Rev. Lett.* 55 (1985), 2273-2276.

J. T. Lewis & H. Maassen:

- \* Hamiltonian models of quantum stochastic processes. *Quantum Probability and Applications to the Quantum Theory of Irreversible Processes*, Proc. Conf., Villa Mondragone, Sept. 1982, Eds. L. Accardi, A. Frigerio, & V. Gorini, Springer 1984, LNM 1055. pp. 245-276.

J. T. Lewis:

- \* Quantum stochastic processes. I. Phys. Repts. 77 (1981), 339-349.

A. Frigerio:

- \* Quantum stochastic processes. II. Phys. Repts. 77 (1981), 351-358.

A. Frigerio, J. T. Lewis, & J. V. Pulè:

- The averaging method for asymptotic evolutions. II. Quantum open systems. J. Approximation Theory 45 (1985), 310-338.

J. T. Lewis & J. V. Pulè:

- The equivalence of ensembles in statistical mechanics. Proc. Conf. on Stochastic Analysis and Applications, Swansea, 1983. Eds. A. Truman & D. Williams, Springer 1984, LNM 1095. pp. 25-35.

E. Buffet & J. V. Pulè:

- A hard core Bose gas. J. statist. Phys. 40 (1985), 631-653.

H. Nakazawa:

- Wiener-Ito decomposition of polynomial operators formed with boson quasi-free fields. J. math. Anal. Appl. 111 (1985), 353-373.

L. Papiez:

- \* Microscopic open systems. Ann. Phys. 161 (1985), 101-120.

E. E. Müller:

- \* Note on relative entropy and thermodynamical limit. Helvetica phys. Acta 58 (1985), 622-632.

J. Burzlaff, T. Murphy, and L. O'Raiheartaigh:

- \* Nonmaximal and disconnected stability groups: SU(3) counterexample to Michel conjecture. Phys. Lett. 154B (1985), 159-165.

J. Burzlaff:

- \* Radially separated classical lumps in non-Abelian gauge models. *J. math. Phys.* 26 (1985), 826-830.

J. Burzlaff & V. Moncrief:

- \* The global existence of time-dependent vortex solutions. *J. math. Phys.* 26 (1985), 1368-1372.

J. Burzlaff, T. N. Sherry, & D. H. Tchrakian:

- \* Dimensional reduction, vortices and saddle points. II *Nuovo Cim.* 87A (1985), 463-478.

G. M. O'Brien & D. H. Tchrakian:

- \* Self-duality in Euclidean supergravity. *Gen. Rel. Grav.* 17 (1985), 55-61.

D. H. Tchrakian:

- \* Spherically symmetric gauge field configurations with finite action in  $4p$ -dimensions ( $p$ =integer). *Phys. Lett.* 150B (1985), 360-362.

A. Wipf:

Non-relativistic Yang-Mills particles in a spherically symmetric monopole field. *J. Phys. A: Math. Gen.* 18 (1985), 2379-2384.

Upper and lower bounds for the bounce action. *J. Phys. A: Math. Gen.* 18 (1985), 2521-2529.

P. S. Florides:

- \* Generalized Robertson-Walker Metrics and some of their properties II. *Gen. Rel. Grav.* 17 (1985), 319-341.

P. A. Hogan:

Asymptotic symmetries in general relativity. *LMP* 10 (1985), 283-288.

P. Horváthy & J. H. Rawnsley:

Survival of grand unified monopoles. *LMP* 9 (1985), 195-200.

Internal symmetries of non-Abelian gauge field configurations. *Phys. Rev.* 32D (1985), 968-976.

On the existence of monopoles in grand unified theories. *J. Phys. A: Math. Gen.* 18 (1985), 2647-2651.

D. Heffernan:

- \* Multistability, intermittency and remerging Feigenbaum trees in an externally pumped ring cavity laser system. *Phys. Lett.* 108A (1985), 413-422.

D. M. Heffernan, J. McInerney, L. Reekie, & D. J. Bradley:

Bistability by induced waveguiding in coupled semiconductor lasers. *IEEE J. Quant. Electronics* QE-21 (1985), 1505-1512.

M. W. Evans & F. Marchesoni:

- \* Limitations of the one-body approach to dielectric relaxation: comparison with rise transients from computer simulation. *J. Phys. D: Appl. Phys.* 18 (1985), 137-143.

F. Marchesoni & J. K. Vij:

- \* Brownian motion in a periodic potential: application to dielectric relaxation. *Z. Phys. B* 58 (1985), 187-198.

T. Garavaglia:

Comment on the Dirac bracket. *Phys. Rev. Lett.* 54 (1985), 488-489.

J. L. Synge:

An action principle for photons. *Nature* 317 (1985), 675.

A. I. Solomon & J. L. Birman:

Dynamical algebra, unitary states, and thermal Green functions of many-fermion systems. *Phys. Lett.* 111A (1985), 423-426.

J. L. Birman & A. I. Solomon:

Methods of dynamical Lie algebra for many fermion Green functions. *Progr. Th. Phys. Suppl.* 80 (1984), 62-75.

In the press:

J. McConnell:

Theory of nuclear magnetic relaxation by dipolar interaction. *Physica A*.

D. E. Evans & J. T. Lewis:

On a  $C^*$ -algebra approach to phase transition in the two-dimensional Ising model. II. *Commun. math. Phys.*

D. Kaymakçalan, L. Michel, K. C. Wali, W. D. McGlinn, & L. O'RaiFeartaigh:

Absolute minima of a  $SO(10)$  invariant Higgs potential. *Nuclear Phys. B*.

L. O'RaiFeartaigh, A. Wipf, & H. Yoneyama:

The constraint effective potential. *Nuclear Phys. B*.

J. Burzlaff & L. O'RaiFeartaigh:

Disconnected non-maximal stability groups and horizontal symmetry. *Proceedings, 14th International Colloquium on Group Theoretical Methods in Physics, Seoul, 1985.*

J. Burzlaff & N. Ó Murchadha:

Global existence of time-dependent Yang-Mills-Higgs monopoles. *Commun. math. Phys.*

J. Burzlaff:

Statics and dynamics of classical Yang-Mills-Higgs systems: Some recent developments. *Proceedings, 4th Symposium on Theoretical Physics, Seoul, 1985.*

J. Burzlaff & D. H. Tchrakian:

Finite-action solutions of higher-order Yang-Mills theory in four dimensions. *11 Nuovo Cim. A*.

G. M. O'Brien & D. H. Tchrakian:

Stress tensor for GYM in 4p dimensions and viability of GYM-Higgs in four dimensions. *LMP*.

A. Chakrabarti & D. H. Tchrakian:

A compactification of, and instantons in, 4p-dimensional gravity, Phys. Lett. B.

D. Ó Sé, T. N. Sherry, & D. H. Tchrakian:

Surface integrals in lower dimensions from higher-order Chern classes and a class of solutions in three dimensions. J. math. Phys.

A. W. Wipf:

Tunnel determinants. Nuclear Phys. B.

H. Yoneyama:

The Martinelli-Parisi systematic expansion in lattice gauge theory - Z (2) model on a cubic lattice. J. Phys. A Math. Gen.

Migdal renormalization group approach to deconfinement phase transition. Z. Phys. C.

Y. Fujimoto, K. Ideura, Y. Nakano, & H. Yoneyama.

The finite temperature renormalization group equation in theory. Phys. Lett. B.

S. Caracciolo & H. Yoneyama:

Optimization of the potential shifting in the Martinelli-Parisi expansion of the Z(2) gauge theory on a cubic lattice. J. Phys. A.

E. Müller:

Bose-Einstein condensation of free photons in thermal equilibrium. Physica A.

Bose-Einstein condensation of free photons. Proceedings of Workshop, Como, September 1985, on Fundamental Aspects of Quantum Theory, Eds. V. Gorini & A. Frigerio.

P. A. Horváthy & C. Nash:

A geometric view on topologically massive gauge theories. Phys. Rev. D.



P. A. Horváthy:

Non-Abelian Aharonov-Bohm effect. Phys. Rev. D.

P. A. Horváthy & J. Rawnsley:

The problem of "global color" in gauge theories.  
J. math. Phys.

T. Garavaglia:

The Runge-Lenz vector and Einstein perihelion precession.  
Am. J. Phys.

Finite temperature electrical network theory. Proc.  
NATO Adv. Res. Workshop on Fundamental Aspects of  
Quantum Theory, Como, 1985. Plenum.

F. W. Hehl & J. D. McCrea:

Bianchi identities and the automatic conservation of  
energy-momentum and angular momentum in general-  
relativistic field theories. Found. Phys.

D. G. Froot & B. T. Margo:

Clausius-Mosotti function for restricted one-dimensional  
oscillators. Physica B.

## 11. LIBRARY

Approximately 270 new titles were added to the library stock during the year; approximately 200 current periodicals were taken, of which almost half were received by gift or under exchange arrangements. The RIA 'permanent loan' scheme was continued, as were other forms of cooperation with research libraries at home and abroad.

Offprints and preprints were received from many scientific institutes and university departments at home and abroad, either directly or in response to requests.

Professor Synge made a valuable gift to the Library from his personal holdings of periodicals and reprints. Among these are Foundations of Physics (1970 - continuation), Bulletin of the London Mathematical Society (1969-1985), and the following publications of the Royal Society of London: Notes and Records (1946 - continuation), Obituary Notices of Fellows (1943-1954), Biographical Memoirs of Fellows (1955-continuation). The sets of reprints include Chandrasekhar, Coxeter, Infeld, Levi-Civita, and many others.

In addition to the above, gifts of books or journals have been received from Professor Lewis, Professor J. McConnell, Dr. J. A. Kriz, Dr. K. Keegan, The American Vacuum Society, Colutron Research (Boulder), "Higher School" Kharkov, KEK, Syracuse University, and Warsaw University.

IV - Annual Report of the Governing Board of the School of Cosmic Physics adopted at its meeting on 13 February, 1986.

A ASTRONOMY SECTION

1 STAFF, SCHOLARS AND EMERITUS PROFESSOR

Senior Professor:

P.A. Wayman

Professor:

T. Kiang

Research Assistant

I. Elliott

Experimental Officer:

B.D. Jordan

Research Associates:

P.B. Byrne (Armagh), B. McBreen (UCD), T.P. Ray (UCD),  
R.M. Redfern (UCG)

Technical and Clerical Staff:

A.M. Callanan, W.H. Dumpleton, M. Smyth (1 July 1985 - )

Scholars:

H.P. Deasy, P.J. Callanan

Emeritus Professor:

H.A. Brück

Mr. Michael Smyth was appointed Technician in the Astronomy Section from 1 July 1985.

Visiting scientists to the Astronomy Section during the year were S.P. Xiang (Hefei, China), 15-27 March; D.J. Mullan (Delaware), 18 August - 7 September; A.G. Hearn (Utrecht), 25 August - 7 September; A.A. Boyarchuk (Crimea), 25 August-19 September.

Emeritus Professor Hermann A. Brück, Senior Professor in the School from 1947 to 1957, represented the Pontifical Academy of Sciences at the Bicentenary Commemoration of the Royal Irish Academy in Dublin on 23rd May. A reception welcoming Professor and Mrs. Brück was held at Dunsink Observatory on 24th May.

Mr. P. Linehan (UCD) worked as a Vacation Student in the Section for ten weeks from 8 July.

P.A. Wayman completed 9 years' service with the Executive Committee of the International Astronomical Union on 28th November. Since 1976 the functions carried out were:

1976 - 1979 Assistant General Secretary  
1979 - 1982 General Secretary  
1982 - 1985 Adviser to Executive Committee

The period as General Secretary included introduction of new staff to the first premises occupied permanently by the Secretariat of the Union, the Pavillon Quest of l'Observatoire de Paris. Major accomplishments in the period 1979-1982 included re-instatement of the People's Republic of China in the Union in 1980 and the holding of the 18th General Assembly of the Union in Patras, Greece, with the 1800 participants, in August 1982.

Having been a member of the Board of Governors of Armagh Observatory since 1964, P. A. Wayman was appointed to membership of a new Management Committee of Armagh Observatory and Armagh Planetarium in April in his capacity as Head of the Astronomy Section. He served on the National Committee for Astronomy during the year; I. Elliott continued as Chairman of that Committee. P.B. Byrne replaced I. Elliott as Secretary of the Irish Astronomical Science Group in April and P.A. Wayman was elected Chairman. P. A. Wayman was appointed to the Joint Committee of the Royal Irish Academy and the Royal Dublin Society on Historic Instruments and continued on the Irish National Committee for the History and Philosophy of Science. I. Elliott continued as Observer for Ireland on the Joint Organisation for Solar Observations and was nominated as Irish representative on the La Palma Users' Group with effect from September.

## 2 RESEARCH WORK

### Pulsation Effects, Cepheid Variables:

P.A. Wayman, H.P. Deasy, with C.J. Butler (Armagh).

Following observation with the IUE satellite in 1984, and use of the IUE archival data, spectra of bright cepheid variable stars were analysed for evidence of mass loss. Using Starlink computer programs and some special routines, accurate velocity measurement of the absorption components in the MgII k-line profiles and measurements of equivalent widths gave evidence of mass-loss rates of up to  $10^{-10}M_{\odot}$  per year for the cepheids zeta Geminorum and  $\epsilon$  Carinae.

In order to provide background calculations, the computer code for radiative transfer in a co-moving frame, derived in Boulder, Colorado in 1984 from work by S.A. Drake and J.L. Linsky, was implemented on the CRAY 1 computer at University College, London, with the help of A.E. Lynas-Gray. Access through the Irish Universities' Network and Starlink enabled the Boulder results to be reproduced, followed by a series of runs to test the effect on the 'synthetic' MgII k-line of altering various input parameters, including those which characterise the atmospheres of cepheid variable stars. For a broad range of selected atmospheric parameter sets, the iterative process to solve the radiative transfer problem in a co-moving frame converged satisfactorily. Useful information was derived on the effect of an outward flux of mass on the line-profile shape for the k-line.

A proposal for further IUE observations in conjunction with D.J. Mullan (Delaware) received the award of co-ordinated ESA and NASA shifts. Further observations at different phases for zeta Geminorum and  $\epsilon$  Carinae and new observations of beta Doradus and T Vulpeculae were secured. No clear evidence for mass loss in T Vul was obtained, contrary to indications from some observations of infrared excesses.

With available data from the IRAS (Infrared Astronomical Satellite) point source catalogue, a search was made for bright galactic cepheids. Over thirty showed up in at least one IRAS band and comparison with non-variable supergiants near to the instability strip was sought in the catalogue. Diagrams for infrared excesses were constructed. It was found that, whilst short-period cepheids were similar to non-variable supergiants, long-period cepheids, especially those with high-amplitude variation, showed notable excess reddening in the ir bands as compared to other nonvariable supergiants, indicating the presence of mass loss of up to  $10^{-6}$  solar masses per year.

This new result was incorporated into a paper by H. Deasy and C.J. Butler and accepted for publication; all the material from IUE, IRAS and CRAY 1 forms part of the PhD thesis of H. Deasy. A proposal for guest observer time on the Hubble Space Telescope has been prepared by H. Deasy and C.J. Butler jointly with E.G. Schmidt (Nebraska), for use of the High Resolution Spectrograph on cepheid stars with IRAS infrared excesses, or other evidence of mass loss.

Asteroid Dynamics: T. Kiang

A new approach on the question of asteroid stability was begun during 1985. In 1963 Brouwer obtained an approximate integral of motion,  $\Gamma$ , whose zero-order term with respect to Jupiter/Sun mass-ratio, depends only on semi-major axis  $a$ , and whose first order term depends also on eccentricity  $e$  and slowly-varying position-angle  $\sigma$ . Brouwer thought that the existence of this quasi-integral explains the Kirkwood gaps. In fact it does not do so, but a new significance has been found for  $\Gamma$ ; it has been found that the variation of this quantity determines whether or not a gap will form at a particular resonance with Jupiter. The behaviour has been represented by a fourth-order homogeneous differential equation with periodic coefficients, permitting discussion of the stability of the solutions. Helleman's method of 1978 of finding periodic orbits in the galactic field is being adapted to the asteroids in the solar system field. The method yields a Fourier representation of the periodic orbit, but the nature of the force-function for the asteroids means that the adaptation is not straightforward.

(Assistance of Prof. D. Judge, UCD, and Mr. Wang Song, TCD, is gratefully acknowledged).

Relativistic Astrophysics - T. Kiang, with S.P. Xiang (Hefei, China)

Xiang has investigated superluminal velocities in the neighbourhood of a rotating Kerr black hole and has obtained some striking results. A discussion of the validity of certain partial derivatives has been carried out by correspondence.

Observations of the Ap star 21 Comae - I. Elliott with P.J. Callanan.

Photometry of 21 Com was carried out with the 1-m Jacobus Kapteyn telescope (Canary Is.) in March. The observations were made in collaboration with T.J. Kreidl (Lowell Observatory, Arizona). Weather conditions restricted observations at both sites but 181 data sets were obtained in 16 hours over five nights on La Palma and at Lowell the data consisted of 149 sets during 9.6 hours on three nights. With differential reduction, power spectrum analysis of the combined data revealed no definite evidence for

short-period variability above the noise level of .001 magnitude for frequencies higher than  $0.5 \text{ hr}^{-1}$ . A value of 1.22 days was obtained for the rotation period of 21 Com.

Other proposals for observation of 21 Com are in preparation including possible co-ordination of Ap star observation at Beijing Observatory, China.

Blue Compact Galaxies - B. McBreen (UCD), T.P. Ray (UCD),  
P.A. Wayman

The UCD/DIAS CCD system consisting of two dewars, a filter wheel, control electronics and an LSI 14 control computer were shipped to La Palma in February 1985. The system was interfaced to the 1m telescope and operated for 10 nights. The majority of the nights were cloudy but good astronomical data were obtained on 4 nights. Both the RCA thin and thick CCDs were used. The performance of both systems was excellent. Good CCD images of compact blue galaxies of the Haro and Markarian types were obtained in the B, V, R and I bands. The observers on this run were L. Metcalfe, T. Ray and B. McBreen. Criteria in the data are being investigated as to whether these are old systems undergoing a burst of star formation, or young systems which have only formed a few million years ago. P. Grimley, at Cardiff formerly, joined the group in October. He has presented a new proposal for further observations in 1986.

Jets from Young Stars - T.P. Ray (UCD), B. McBreen (UCD)  
and P.A. Wayman.

It has been known for some time that energetic processes of mass loss accompany some early stages of star formation. The evidence is in observed large-scale bipolar outflows and the recent discovery (c.1980) of small-scale supersonic jets. In September T.P. Ray and P.A. Wayman began a search for jets from young stars using the 2.5-m Isaac Newton Telescope (Canary Is.) All observations were made using a thin RCA charge-coupled device (CCD) at the prime focus of the telescope, giving a field of approximately  $7 \times 3$  arc-minutes. Excellent conditions were secured, with "seeing" being one arc-second or better. In total five new jets, associated with Herbig-Haro objects HH3, HH24 and HH105 and with two other nebulae GGD 34 and RNO 43, showed on images that corresponded to an SII spectral line. Two new HH objects were found in the Cepheus A cloud. The HH objects lie close to the axis of the known CO bipolar outflow associated with this cloud.

The CCD images, with preliminary information on the new jets, were presented at the Royal Astronomical Society in London, in November, by T.P. Ray.



The RS CVn Star II Peg - P.B. Byrne (Armagh) and P.A. Wayman,  
with P. Panagi (Armagh).

Data obtained in 1984 are being analysed by P. Panagi as an M.Sc. thesis project. Light variations in II Peg, a single line spectroscopic binary of RS CVn type, have a period of 6.72 days, equal to the orbital period. The INT spectra give information on H and K emission lines simultaneously with IUE spectra and ground-based photometric data. The variations are interpreted in terms of large magnetically-cooled areas on the surface of the primary star.

X-Ray Sources: P. Callanan, M. Redfern (UCG)

Analysis of 1984 Exosat data for the globular cluster M15 is now complete. The model found is that of a neutron star accreting from a late-type star via an accretion disk, possibly with an accretion disk corona.

Identification of an optical object for the X-ray source in M15 was secured by Aurière and collaborators at the Canada-France-Hawaii telescope, but this identification has to be confirmed with simultaneous X-ray and optical work. A test-run with Exosat and the CTIO (Chile) telescope proved that a procedure was feasible. Further work on the identification is the subject of a joint proposal to PATT with P.A. Charles (Oxford); other proposals have been submitted to IUE and to Exosat.

A joint proposal for use of the Space Telescope on the M15 source is in preparation.

Results to date on the X-ray lightcurve show no periodic variations. Models for an X-ray heated star in orbit about a neutron star have been considered and it has been shown that for systems at low inclination periodic optical variation is possible without an X-ray eclipse.

For quasi-periodic oscillations, a model involving positive feedback on neutron stars with weak magnetic fields, where the dipole axis is aligned with the spin axis, is under consideration.

### 3. OBSERVATORY DEL ROQUE DE LOS MUCHACHOS

The Royal Inauguration of the International Observatory of the Canary Islands took place on 28th and 29th June 1985.

The Inauguration was performed by King Juan Carlos of Spain in the presence of Queen Beatrix of the Netherlands, Queen Margarethe of Denmark, King Carl Gustav of Sweden, President von Weizsacker of the German Federal Republic, President Hillery of Ireland, and Prince Richard, Duke of Gloucester, United Kingdom, representing Queen Elizabeth.



The second day, 29th June, was spent by the royal party and the guests of the International Scientific Council on the island of La Palma. Queen Beatrix and President Hillery jointly performed the opening ceremony of the Jacobus Kapteyn Telescope that took place on the rising platform of the telescope building.

The ceremonies were attended by a group from Ireland that included Mrs Hillery, Mrs Gemma Hussey T.D., Minister for Education, Dr. T.K. Whitaker, Chairman of the Council of the Institute, Dr. I. Elliott, Chairman of the National Committee for Astronomy, and, from the School of Cosmic Physics, Prof. T. Murphy and Professor P.A. Wayman.

During the period September 1984 to August 1985 inclusive, the Kapteyn telescope was scheduled by the Panel for Allocation of Telescope Time of the U.K. Science & Engineering Research Council, for a total of 27 weeks. The remaining 25 weeks were used for further commissioning work, for 'Spanish' time, and for service observing. 'Irish' time comprised two weeks with the Kapteyn telescope during the above period, plus three excellent and valuable nights with the 2.5-m Isaac Newton telescope in September 1985.

The optical system of the 1-m Kapteyn telescope was provided with a new mirror-support system during the year. The image quality is now satisfactory for most purposes but astrometric quality is still not attained fully. The electrical and electronic systems are now fully commissioned but additional disk storage is needed for the data-acquisition computer system.

#### 4. HISTORICAL ASTRONOMY P.A. Wayman

During the year the compilation of a history of Dunsink Observatory, to mark the 185 bicentenary, for publication in 1986 required a summarizing of W.R. Hamilton's main contributions, an investigation of the origin of the Grubb mounting for the South telescope, the history of the telescope in the main building, and a reconstruction of the photometric work done with the Isaac Roberts telescope between 1906 and 1919. Nine of the thirteen chapters of the 'History' have been completed and all the remainder are largely complete. Publication will be in the series 'Historical Studies in Irish Science and Technology' of the Royal Dublin Society. The assistance of H.A. Brück (Emeritus Professor) is gratefully acknowledged. Manuscript material at the Oxford Museum for the History of Science provided information on the period 1885-1895.

5 DUNSINK BICENTENARY YEAR

The bicentenary of the completion of the building of Dunsink Observatory in August 1785 was marked by the Inaugural Lecture of Professor Wayman, Tenth Andrews' Professor of Astronomy in the University of Dublin, held in Trinity College on 14th March. This lecture "The Andrews Chair of Astronomy and Dunsink Observatory, 1785-1985", took place on the day of issue of a postage stamp by An Post, commemorating the bicentenary. An exhibition of items illustrating the work of the observatory over 200 years was mounted in the Long Room of Trinity College Library from 14th March to 20th May.

The bicentenary was also marked by the holding of the Dunsink Bicentenary Colloquium, 'Circumstellar Material: Late-type Stars', 3-6 September, in two venues, at 10 Burlington Road (1 day) and at Dunsink Observatory (3 days). On the first day general reviews were given by six invited speakers as follows:

- |              |              |  |
|--------------|--------------|--|
| B.M. Haisch  | (Palo Alto): | Coronae on Stars   |
| P.B. Byrne   | (Armagh) :   | Heating of the Outer Atmosphere of Flare Stars and Spotted Stars |
| C. Jordan    | (Oxford) :   | Wave-driven winds from Fool Stars; Progress and Problems         |
| M. Cohen     | (Berkeley) : | The Exciting Stars of Herbig-Haro Objects                        |
| L.A. Willson | (Iowa) :     | Pulsation and Mass Loss  |
| D.J. Mullan  | (Delaware) : | Summary and Overview   |

At Dunsink Observatory, 4-6 September, with a smaller attendance, more specialized contributions with extended discussion were given by twenty-one speakers from Ireland, United Kingdom, USA, Netherlands, USSR, and Israel. Contributions from the Astronomy Section included:

- |            |   |  |
|------------|---|--|
| H.P. Deasy | : | Mass-Loss Estimates for Cepheid Variable Stars   |
| P.B. Byrne | : | The Emission-line Star HDE 319139 (Poster Paper) |

The Programme Committee for the Colloquium comprised P.A. Wayman, D.J. Mullan (Delaware), C. Jordan (Oxford), K.-H Böhm (Seattle), P.B. Byrne (Armagh). The attendance from outside Ireland was 25 persons; the maximum capacity for 38 persons at Dunsink Observatory was reached. The opening of the Colloquium was performed by Mr. Austin Deasy T.D., Minister for Agriculture, acting on behalf of Mrs Gemma Hussey T.D., Minister for Education. The Colloquium was supported financially by the U.S.-Ireland Co-Operative Science Program of the U.S. National Science Foundation, on a proposal by Dr. D.J. Mullan, Bartol Research Foundation,

University of Delaware. The Colloquium papers have been prepared for publication in the March 1986 issue of the Irish Astronomical Journal, which will be a 'Dunsink Bicentennial Commemorative Issue'.

The year 1985 was the bicentennial year also of the founding of the Royal Irish Academy and the Evening Discourse of 8th July, on the occasion of the Joint Meeting of the Academy and the British Society for the History of Science, was by T.L. Hankins (Seattle), "Sir William Rowan Hamilton - a Portrait on Paper". On 10th July, at the Joint Meeting, P.A. Wayman contributed a paper "The Founding of the Astronomical Society of London, the Presidency of Bishop Brinkley, the Royal Charter of the Society, and Sir James South".

Other events in connection with the bicentenary were the holding of the Annual General Meeting of the Irish Astronomical Society at Dunsink Observatory on 22nd June, a meeting of the Old Dublin Society at Dunsink on 24th August, and the Autumn meeting of the Astronomical Science Group of Ireland at 10 Burlington Road on 2nd September, one day prior to the opening of the Bicentenary Colloquium.

#### 6. ELECTRONICS LABORATORY : B.D. Jordan, M. Smyth

1. CCD Camera. This instrument was completed in January jointly with the physics Dept. U.C.D., and was used successfully on the Kapteyn telescope, La Palma in February. On return to Dublin several modifications to the system were carried out and a precision timer was constructed to control the shutter, giving integration times 0.1 to 10,000 seconds.

2. EPA Ground Support Equipment An Apple 11 computer and a Commodore high-density disk drive, together with a C-170H printer were installed at 5 Merrion Square to provide 'quick look' facilities for EPA (Epona) data from the European Science Operations Centre, Darmstadt (Giotto vehicle).

3. SLED Experiment Work on the development of the digital electronics for the SLED experiment to be flown on the Phobos mission of the Soviet Union, in conjunction with the Experimental Physics Department, Maynooth, the Max Planck Institute for Aeronomy (Lindau) and the Hungarian Central Research Institute for Physics (Budapest), began in July. Wirewrap prototype boards were designed and constructed and initial tests of the system were carried out successfully. Contracts for software system and for printed circuit artwork design were drawn up. The analog electronics and instrument housing are under construction at Maynooth.

7. COMPUTER INSTALLATION: I. Elliott, B.D. Jordan

The computing needs of the Astronomical Section were met by continued use of the Starlink application programs on the VAX 11/780 at the UCD Computer Centre and by access to the Starlink network in the UK via HEANET. Additional on-line storage at UCD was provided through purchase of a Systems Industries Type 9751 Winchester disk drive with 414MB Capacity. The Starlink Software Collection was updated once during the year and close liaison was maintained with UCD Computer Centre and the Rutherford-Appleton Laboratory.

The data link between Dunsink and the UCD Computer Centre was upgraded by replacing the 1200 baud dial-up modem by a leased line, a high-speed modem and a four-way multiplexer. This arrangement allows up to four persons at Dunsink to use the UCD facilities simultaneously at 4800 baud. Dunsink House was wired so that the terminals could be used in individual offices. Two Pericom MG-200 graphics visual display units were purchased and are proving very satisfactory. Although the new data link came into regular operation in July, the leased line connection has been interrupted from time to time by faults in the overhead cable.

Successful connections were made via packet switching networks to the SIMBAD astronomical data base of the Strasbourg Astronomical Data Centre; on-line interrogation of this data base provides a valuable tool for many research programmes.

8. LECTURES, CONFERENCES, ETC.

I. Elliott gave a course of sixteen lectures on Introductory Astrophysics to Junior and Senior Sophister honours students in physics in Trinity College during the Michaelmas Term.

In addition to the Bicentenary Colloquium, with twenty-seven contributors, the following colloquium was arranged:

S.P. Xiang - "Superluminal Velocities from Sources around a Rotating Black Hole",  
21 March (in UCD, Belfield).

Contributions to the Irish Astronomical Science Group meetings in Armagh (2nd April) and Dublin (2nd September) were made by T.P. Ray, B. McBreen, M. Redfern, P.A. Wayman and I. Elliott. By invitation, A.A. Boyarchuk (Crimea) spoke in Dublin on 'Symbiotic Stars' and D.W. Dewhirst (Cambridge) on the 'Birr Castle observations of Nebulae, 1840-1860'.

P.A. Wayman gave an opening address of welcome at the Institute Lecture Room to the Fourth Dublin Summer School in Physics on Fibre Optics on 24th June, and gave a lecture to the School, "Information Theory", on 25th June.

T.P. Ray presented results on "Jets from Young Stars", at the meeting of the Royal Astronomical Society, London, held on 8th November.

Some twelve outside lectures were given by staff members to Societies and other groups in Ireland during the year, including talks on Halley's Comet by T. Kiang to the Dublin University Physical Society on 27th November, and by I. Elliott to the Western Regional Scientific Council, Galway, on 7th May. I. Elliott spoke on "Solar Research" to the Solar Energy Society in Dublin on 4th December, P.A. Wayman addressed the UCD Archaeological Society on "Sky Movements" on 10th January, and gave talks on the history of the observatory to several groups including the Irish Astronomical Association in Belfast on 9th October.

The following scientific conferences were attended by members of the Astronomy Section:

- P.A. Wayman : 19th General Assembly, International Astronomical Union, New Delhi, 17-29 November; where he was Adviser to the Executive Committee.
- T. Kiang : Structure and Evolution of Active Galactic Nuclei, Trieste, 10-13 April, where he presented a paper on Cerenkov Line Radiation
- I. Elliott : European Science Foundation Meeting on Astronomical Data Network, Strasbourg, 7-8 November.
- 19th General Assembly, IAU, New Delhi, 18-29 November, as National Representative from Ireland.
- H.P. Deasy : 19th General Assembly, IAU, New Delhi, 18-29 November where he presented a paper on IRAS data for cepheid variable stars.

Nineteen Public Open Nights were held at Dunsink during the year, including five extra nights, 9-13 December, for possible observation of Comet Halley. Including clear open nights on 16th November and 7th December, about 1600 members of the public were able to view the comet through a telescope. A total of about 3500 visitors was received during the year; apart from viewing the comet with the telescope, a Video tape, "A Comet called Halley",



produced from the Armagh Planetarium, was used for public showing at Dunsink. Assistance by members of the Dublin Centre of the Irish Astronomical Society in connection with the Public Open Nights has been extremely valuable during 1985.

Special visits for viewing Comet Halley were made by several societies or groups during the year including The Geography Teachers of Ireland, 6 Dec., and the Nautical Institute, 17 Dec. Groups received earlier in the year were, among others, from the UCD Archaeological Society, 24 Feb., the Antiquarian Horological Society, 25 May, the West Yorkshire Astronomy Society, 28 May, the Royal Dublin Society Youth Week, 4 July, and the Seminar on Surveying by Satellite, 20 Sept. A party from the Joint Meeting of the R.I.A. and the B.H.S.S. visited on 11th July.

Other visitors during the year included T.C. Weekes, A.E. Lynas-Gray, Mrs Beatrice Copson (daughter of E.T. Whittaker), J. O'Regan, M.O'Regan, Snr., M. O'Regan Jnr. (descendants of Sir William Rowan Hamilton), T.L. Hankins, Professor and Mrs H. A. Brück, Rev. C.C. Ellison, P. Murdin and Dr. L.O'C. Drury. A private visit by President and Mrs Patrick Hillery took place on 17th December.

## 9 PUBLICATIONS

The Irish Astronomical Journal, published jointly with Armagh Observatory, was issued as Volume 17, Nos. 1 and 2 (pp. 166) during the year. Arrangements were made for Volume 17, No. 3, March 1986, to commemorate the Bicentenary of Dunsink Observatory. The papers presented at the Astronomical Science Group meeting of September 2nd, and at the Dunsink Bicentenary Colloquium, 3-6 September, were prepared for publication in that issue.

The death occurred on 10th September in his 92nd year, at Bangor, Co. Down, of Ernst Julius Opik, Astronomer Emeritus of Armagh Observatory, Editor of the Irish Astronomical Journal from its inception in 1950 until 1981.

A translation journal, Chinese Astronomy and Astrophysics, edited by T. Kiang, was issued as Vol. 9, Nos 1-4, pp.350, during the year.

The following papers were prepared for publication in other journals:

J.H. You, T. Kiang, F.Z. Cheng and C.H. Cheng:

"Cerenkov Line Emission : The  $L_{\alpha}/H\beta$  ,  $H_{\alpha}/H\beta$  ,  $P_{\alpha}/H_{\alpha}$   
Intensity Ratios of Quasars"  
Astrophys. Sp. Sci. 114: 395-400, 1985

T. Kiang, J.H. You, F.Z. Cheng and F.H. Cheng:

"A New Explanation of the Balmer Decrement in Quasars",  
Phys. Lett. 109A: 408-410, 1985.

T. Kiang:

"Cerenkov Line Emission: A New Interpretation of the  
Emission Line of Quasars"  
Irish Astronomical Journal, 17 : 11-15, 1985

H.P. Deasy :

"Classical Cepheids : Period Changes and Mass Loss" in  
'Cepheids: Theory and Observation', Edit: B. Madore,  
IAU Colloquium  
No. 82, Toronto. Cambridge U.Pr. 1985, pp. 67-70.

P.B. Byrne and P. Panagi:

"Spots and Plages on II Peg during 1984", in Proceedings,  
4th Cambridge Workshop on Cool Stars, Santa Fe,  
1985, for publication.

H.P. Deasy and C.J. Butler:

"Evidence of Mass Loss in Cepheids from IRAS Observations",  
Nature, 1986, for publication.

T.P. Ray and A.I. Ershkovich:

"Kelvin-Helmholtz Instabilities in a Magnetised  
Compressible Plasma" in "Unstable Current Systems and  
Plasma Instabilities in Astrophysics", eds. M.R. Kundu  
and G.D. Holman, Reidel 1985, p. 375.

L. Mestel and T.P. Ray :

"Disc-like magneto-gravitational equilibria" Mon.Not.  
R.Astr.Soc., 212 : 275-300, 1985.

#### Dunsink Bicentenary Publications

Three articles by P.A. Wayman, one by I. Elliott and one by H.P. Deasy were prepared for publication in Irish Astronomical Journal, Vol. 17, No. 3, March 1986 in connection with the Dunsink bicentenary. Two historical research articles were prepared but not yet communicated by P.A. Wayman, as were a further five minor notes in various forms, in connection with the bicentenary including:

P.A. Wayman :

"Dunsink Observatory, 1785-1985", Ireland Today, Bulletin of the Dept. of Foreign Affairs, No. 1022, pp. 4-6, Oct. 1985.

and

P.A. Wayman :

"Exhibition Guide, Dunsink Observatory 1785-1985, The Andrews Professors of Astronomy in the University of Dublin", Trinity College Library, March-May 1985.

Six minor notes on the bicentenary by external authors were noticed including contributions by M. de Groot to the Belfast Telegraph, 28th September 1985, by G.E. Ryan to the Boston Irish News, October 1985, and a note on the An Post postage stamp in Sky and Telescope, July 1985.

#### Irish Astronomical Journal:

The following minor articles, reviews, etc. appeared during 1985, relevant to the work of the Section, including that of Research Associates:

Vol. 17, Nos 1 & 2, 1985:

- p.31 R.M. Redfern: EXOSAT - Present Status and Future Prospects
- p.47 P.A. Wayman : Scheduled Observations at La Palma
- p.61 P.A. Wayman : Dunsink Observatory in 1983
- p.74 I. Elliott : Daytime Star. The Story of our Sun (Review)
- p.103 T.P. Ray : Does the Sun have a Companion?
- p.128 M. Redfern : Intriguing Features in X-ray Burster Emission
- p.145 P.A. Wayman : Dunsink Observatory in 1984
- p.152 I. Elliott : Stellar Seismology
- p.160 I. Elliott : The Cosmic Code : Quantum Physics as the Language of Nature (Review)
- p.160 I. Elliott : Powers of Ten (Review)
- p.163 I. Elliott : The Star Book (Review)



The Advisory Committee, La Palma Project, issued Information Bulletins Nos. 10, 11 and 12 during the year.

## 10 MISCELLANEOUS

### Geodesy by Satellite

An outstanding achievement during the year was the securing by the Geophysics Section (see C below) of a geodetic tie-in of the centre of the dome on the main building with Ordnance Survey trigonometric stations on Kippure, Lyons Hill, Howth Head and Skreen Church Tower. Equipment, by Magnavox, giving co-ordinates by survey satellite radio transmissions, permitted location with respect to internationally defined geodetic frames. An accuracy of the order of 10cm (.003 arc-seconds of latitude) is sought. It is proposed that the definition of the Dunsink Observatory mark be incorporated the principal reference point in a new definition of the Irish geodetic survey. Part of this work was carried out by the Department of Surveying, Dublin College of Technology, Bolton Street.

### Buildings and Grounds, Dunsink Observatory

The shutters of the South dome, damaged by storm in November 1984, were repaired and thoroughly overhauled, as was the dome-rotation mechanism.

Reconstruction of part of a boundary wall, redashing and recapping of some internal walls, and some external painting was carried out. The kitchen of Observatory House was renovated and the kitchen area of Dunsink House refurbished for use by staff.

### Comet Halley

CCD frames of Comet Halley, then around 12th magnitude, were secured at La Palma on 17th September, using the Isaac Newton telescope. The comet was first seen with the South telescope on 2nd November. It was not seen clearly from Dunsink with the naked eye during 1985.

B COSMIC RAY SECTION

1 STAFF, SCHOLARS AND EMERITUS PROFESSOR

Senior Professor:

Vacant

Professor:

Vacant

Assistant Professor:

D. O'Sullivan, A. Thompson

Research Assistant:

Vacant

Experimental Officer:

J. Daly

Scholar:

C. Domingo

Technical and Clerical Staff:

G. Broderick, E. Clifton, E. Flood, A. Grace-Casey,  
A.M. Larkin (to 7 May) S. Ledwidge, H. Sullivan.

Emeritus Professor:

C. Ó Ceallaigh

P.W. Wayman (Senior Professor, Astronomy Section) continued as Acting Head of the Cosmic Ray Section during the year. A. Thompson continued as secretary of the National Committee for Physics and as a member of the Royal Irish Academy Committee for Space Research. He represented Ireland on the Council of the European Physical Society during the year. D. O'Sullivan was a member of the Scientific Committee of the 13th International Conference on Solid State Nuclear Track Detectors held in Rome and

he continued as a member of the Editorial Board of the Nuclear Tracks and Radiation Measurements Journal. A. Thompson and D. O'Sullivan continued as members of the NASA HNC Science Steering Committee for the LDEF-1B Mission. C. Domingo (Universidad Autonoma de Barcelona) was appointed as a research scholar from 4 February.

## 2 RESEARCH WORK

### The EPA Experiment on the Giotto Mission to Comet Halley

D. O'Sullivan, A. Thompson with S. McKenna-Lawlor (SPCM)  
E. Kirsch (MPAe), D. Melrose (Sydney) and K.-P. Wenzel (ESTEC)

Following successful testing and calibration of the EPA instrument which were completed at MPAe and Heidelberg early in 1985, the flight model, flight spare and ground support equipment were shipped to the ESA launch site at Kourou in March/April. Launch took place on schedule on July 2nd and EPA was activated on August 22nd when the Giotto spacecraft was approximately 13 million kilometers from earth.

Preliminary analysis of the first data was carried out at DIAS. Subsequently A. Thompson and D. O'Sullivan spent a period at the European Space Operations Centre (ESOC) in Germany, where they carried out extensive investigations of the instrument's performance and monitored real time data both at full (F1 format) and at reduced data rate (F3 format). Further visits were made to ESOC to undertake an encounter rehearsal in October and to monitor several real time telemetry passes.

In August the Giotto Project decided to increase the frequency of real time transmissions with the result that between August and the end of 1985 approximately thirty real time telemetry passes of several hours duration were achieved for the EPA experiment.

The final phase of the EPA quick-look software was agreed at a meeting between DIAS and IDA (Braunschweig) representatives in March and a preliminary version was available on schedule for analysis of the early telemetry passes on the level-3 experiment ground support computer systems installed at ESOC and DIAS. Further improvements were made in the light of experience with the data operations and an updated version was produced in November.

In December, a second EPA level-3 system was installed at ESOC, at the request of the Giotto Project. This system will be used in the Giotto Science Centre being built by ESA to accommodate media personnel invited to attend the Encounter Activities. It will allow observation of the progress of the encounter without interfering with scientists working on the project.

Between August and the end of October the EPA instrument recorded several solar particle enhancements and tests carried out in real time and storage modes indicated that its operation was very reliable. During December, as the solar aspect angle increased, causing light to affect one of the three telescopes adversely and as the instrument temperature rose to nearly 30 C because the spacecraft was getting progressively closer to the sun (closest approach on 31st December 1985), it was decided to switch the instrument off. This was done on December 20th at 3.45 UT during a period of real time passes monitored by D. O'Sullivan and A. Thompson. The instrument will be switched on again, late in January 1986, when more favourable conditions will prevail.

#### The SLED Experiment on the Phobos Mission to Mars

A. Thompson, D. O'Sullivan, B. Jordan with S. McKenna-Lawlor (SPCM), E. Keppler (MPAe), E. Kirsch (MPAe) and A.K. Richter (MPAe)

Following the successful development of the EPA experiment for the ESA Giotto Mission to Comet Halley, an invitation was received from the Soviet Space Agency, Intercosmos, to participate in the international Phobos Mission to Mars and its moons.

A proposal to the NBST seeking partial funding (£30,000) for an experiment using a Solar Low Energy Detector (SLED), consisting of two semiconductor particle telescopes for counting electrons, protons, and heavy ions was successful and a SLED steering committee was convened during October, under the Chairmanship of P.A. Wayman.

The roles and contributions of DIAS, SPCM and MPAe with regard to SLED were generally agreed during the year. In particular, with regard to the instruments, DIAS will be responsible for digital electronics and SPCM will be responsible for analogue electronics. Physicists from all three institutions will be jointly responsible for the scientific aspects of the experiment.

By the end of the year considerable progress had been made in circuit design, onboard software (subcontracted to Captec Ltd., Dublin), component acquisition and construction of the SLED thermal model.

The First Long Duration Exposure Facility (LDEF-1A) Mission

D. O'Sullivan, A. Thompson, J. Daly with V. Domingo (ESTEC) and K.-P. Wenzel (ESTEC).

The LDEF-1A (formerly LDEF-1) spacecraft, which was deployed from the Space Shuttle Challenger in April 1984 with the DIAS/ESTEC Ultra Heavy Cosmic Ray Experiment on board, remained in earth orbit during 1985.

The LDEF-1B Mission (formerly LDEF-2)

A. Thompson, D. O'Sullivan with J.H. Adams (NRL, Washington DC), J.F. Ormes (Goddard), P.B. Price (Berkeley), G. Tarlé (Michigan), C.J. Waddington (Minnesota) and J.P. Wefel (Louisiana).

During the year the plans for launch of the Heavy Nucleus Collector Experiment (HNC) aboard the LDEF-1B spacecraft progressed steadily. At a meeting of the HNC Steering Committee attended by A. Thompson in August it was announced by NASA that the spacecraft will be launched by Shuttle Mission 71K (Challenger) in May 1987 with a planned orbital altitude of 455 km and 57° orbital inclination. The inclusion of polyester (Cronar) detector elements, with the already selected Tuffak polycarbonate and CR-39 detectors, was agreed.

Because of difficulties experienced at the Lawrence Berkeley Laboratory in manufacturing space qualified pressure vessels and event thermometers for the detectors, the HNC hardware is now being manufactured at the NASA Langley Research Center in Virginia.

Nuclear Track Detector Studies

D. O'Sullivan, A. Thompson and C. Domingo

Several areas of study concerning the identification of ultra heavy nuclei by means of solid state nuclear track detectors continued during the year. Stacks of Tuffak polycarbonate exposed to several types of ultra heavy nuclei at the Berkeley Bevalac in 1984 were used in these investigations. Preliminary results showed that a Bethe-Bloch type restricted energy loss function relating velocity and charge to ionisation provided the most satisfactory fit to the data.

Studies on aging characteristics of the latent image of medium and low energy ultra heavy nuclei in track detectors were initiated, using the 1984 Bevalac material also. These investigations are relevant to space missions similar to LDEF-1B where high inclination orbits and long duration experiments will require a detailed knowledge of latent image behaviour over a wide spectrum of ionisation and exposure time.

A series of studies on the role of chemical processing conditions on the resolving power of Lexan polycarbonate were undertaken. Detectors exposed to 1.0 GeV/N gold nuclei at the Berkeley Bevalac were etched at different temperatures and etchant concentrations in order to determine the optimum conditions for gold and other ultra heavy nuclei.

#### Registration Temperature Effect

A. Thompson, D. O'Sullivan and C. Domingo

Detailed investigation of the registration temperature effect (RTE) in solid state nuclear track detectors continued during the year. Processing and measurement were largely concerned with the response of doped allyl diglycol carbonate polymers to intermediate energy iron ions and high energy uranium ions.

During the year another RTE phenomenon was identified in DIAS when it was established that the fractional change in signal strength appears to be an increasing function of charge for a given value of ionisation in all polymers under study, suggesting a sensitivity to the spatial distribution of energy loss by ionisation. This variation is superimposed on the ionisation dependence of the RTE (discovered in DIAS in 1983/1984) for a given polymer at a given registration temperature, which was listed in last year's Annual Report.

It was found that all the present RTE data in polycarbonate are well fitted by a model which expresses the rate of change of signal strength with temperature as a power law function of the rate of energy loss by primary ionisation.

Apart from the provision of insights into fundamental mechanisms of latent track formation, these RTE results form a basis for the data rectification procedures which will be required for the data analysis of the HNC experiment on the LDEF-1B spacecraft to be launched in May 1987.



3 LABORATORY AND WORKSHOP: J. Daly

The maintenance of the equipment was carried out throughout the year. The registration of temperature to  $0.1^{\circ}\text{C}$  of the existing etching tanks was redesigned and was recommenced during the year. Construction of a third etching tank was nearly completed.

4 LECTURES, CONFERENCES, WORKING VISITS, ETC.

D. O'Sullivan attended the 13th International Conference on Solid State Nuclear Track Detectors in Rome, 21-29 September. He was chairman for two of the sessions and delivered three papers on behalf of the DIAS group. He delivered a lecture on Cosmic Rays to the Trinity College, Dublin, Mathematics Society in January and addressed participants at the Royal Dublin Society Science Week and the University College Galway Astronomical Society on topics concerned with space missions.

A. Thompson attended the 19th Cosmic Ray Conference, La Jolla, USA during August and also the LDEF-1B HNC Science Steering Committee meetings which were held at La Jolla during the same period.

A. Thompson represented the Royal Irish Academy at the West Berlin Council Meeting of the European Physical Society (22nd - 23rd March).

A. Thompson and D. O'Sullivan attended the Irish Astronomical Science Group meeting in Armagh in April.

Working visits were made by D. O'Sullivan and A. Thompson to the following centres in furtherance of their work on ESA and NASA space missions: MP Ae Lindau, IDA Braunschweig and ESOC (March 26-29); MP Ae Lindau (May 19-22); ESTEC, ESOC (September 3-10); ESOC (DO'S) (September 29 - October 3); ESOC, University of Siegen (October 12-19); ESOC, MP Ae (December 15-21).

Professor Peter Fowler FRS delivered a lecture on Ultra Heavy Cosmic Rays at DIAS, Burlington Road, on April 1st.

Visitors to the Section during the year included Dr. T.C. Weekes (Whipple Observatory, Arizona), Professor P.H. Fowler FRS (Bristol University), Dr. E. Page (ESTEC), Dr. I. Glass (South African Astronomical Observatory), Dr. A. Boyarchuk (Crimea Astrophysical Observatory), Dr. J.H. Adams (Naval Research Laboratory, Washington DC) and Dr. A. Vidal-Quadras (Autonomous University of Barcelona).

5 PUBLICATIONS

A. Thompson, D. O'Sullivan and C. Domingo

The Ionisation Dependence of the Registration Temperature Effect in Solid State Nuclear Track Detectors. Proceedings of the 13th International Conference on Solid State Nuclear Track Detectors, Rome, 23 - 27 September 1985.

D. O'Sullivan, A. Thompson and C. Domingo

The response of Tuffak Polycarbonate to High Energy Xenon, Holmium, Gold and Uranium Nuclei. Proceedings of the 13th International Conference on Solid State Nuclear Track Detectors, Rome 23 - 27 September, 1985.

C. Domingo, D. O'Sullivan and A. Thompson

The Influence of Etching Conditions on the Resolving Power of Lexan Polycarbonate for Ultra Heavy Ions. Proceedings of the 13th International Conference on Solid State Nuclear Track Detectors, Rome 23 - 27 September 1985.

S. McKenna-Lawlor, E. Kirsch, D. O'Sullivan, A. Thompson and K.-P. Wenzel.

An Energetic Particle Experiment for Giotto. Proceedings of the International Workshop on Field, Particle and Wave Experiments on Cometary Missions, Graz, Austria, 21 - 23 October 1985.



C GEOPHYSICS SECTION

1 STAFF AND SCHOLARS

Senior Professor:

T. Murphy

Professor:

A.W.B. Jacob

Research Assistant:

P.W. Readman

Experimental Officer:

T.A. Blake

Research Associate:

N.P. Murphy

Scholars:

C.P. Lowe, C. Bean (from April 29)

Technical and Clerical Staff:

K. Bolster, A. Byrne, C. Horan (from October 21),  
E. Ryan (until July 24), G. Wallace, V. Ward.

Vacation Students:

G. Kinsella (June 24 - August 16), I. McCamley (June 12 -  
August 9), AnCo trainee: G. Kinsella (May 13 - June 14).

## 2 RESEARCH WORK

### (a) Gravity

The fieldwork was continued to bring the density of readings up to the required standard of one station per three square kilometres.

A start was made on the publication of the results on the 1:126720 scale. The first map in the press is of the Wicklow-Kildare area in the form of an overprint on a subbed colour line map, sheet 16 of the Ordnance Survey. The data consist of readings taken at 1500 stations.

### (b) Geodesy

In order to carry out certain geodetic measurements alterations were made to the large Observatory Dome at Dunsink. A sliding hatch approximately one metre square was fitted on the top of the dome and a "trigonometrical pillar" in the form of a steel pipe erected at the centre on the remaining part of the telescope mounting.

This station became one of a network of three "Doppler" stations in Ireland and observations were carried out 23rd to 30th August. The Ordnance Survey later carried out microwave measurements to selected surrounding trigonometrical stations.

One of the other stations, Skreen Church Tower is visible from Dunsink and provides a baseline for geodetic studies.

The final results for Dunsink give a geographical positional accuracy of  $\pm 0.021$  m in latitude and  $\pm 0.041$  m in longitude, an altitude accuracy of  $\pm 0.026$  m and azimuthal accuracy of  $\pm 0.5$  second of arc.

### (c) Cartography

A method has been evolved to enable the rectangular coordinates of a point on a 1:10560 "6" inch series sheet map to be deduced which enables the position to be transferred to the 1:126720, "1/2" series with an accuracy of  $\pm 1$  m except for the larger counties Cork and Galway. This is quite sufficient for most of our purposes.

It is intended to publish the details.

(d) Meteorology

Routine observations of the meteorological elements were continued throughout the year, autographic records tabulated and results published. Normals for temperature, rainfall and sunshine for the station have been computed for thirty years 1951-1980 (WMO direction and are now used in our Bulletins). There is a steady demand from scientific and commercial interests in the results.

(e) Palaeomagnetism of lake sediments

The interpretation of the results from Danish lake sediments was significantly enhanced by the acquisition of 12 additional radiocarbon dates from two cores in lake Skanderborg (performed by H. Tauber, Radiocarbon Laboratory, Danish National Museum). Previous dating from Skanderborg was restricted to a core in which the rate of sedimentation was rather rapid so that only the last 3000 years was covered. The new dates stretch back in time to ~9000 B.P., and apart from a slight reinterpretation towards the base of one of the cores, confirm our earlier correlation based on palaeomagnetic and rock magnetic parameters of the cores, and with data from another lake (Soroso). Exact correlation with the geomagnetic record from the U.K. is difficult, for although some of the main features are detected the age from the U.K. records seems to be significantly, i.e. up to 1000 years, older and also additional features are observed possibly as a result of the higher sedimentation rate. This work has been performed in collaboration with Dr. Niels Abrahamsen of the Geophysics Laboratory, University of Aarhus, Denmark.

(f) Workshop

A major project was the design and development of new seismic field recorders. The old equipment, which had been in use for about 10 years, had to be replaced. The new stations are also based on an analogue FM system but with many improvements. The dynamic range is much greater and an important addition is the provision of a programmable automatic start system which is based on commercially available equipment. This makes it relatively cheap and, with extensive modification, it has proved very reliable. The equipment has also been made lighter and more compact. It can now be easily carried by one person. Everything except the seismometer fits into a light plastic toolbox. The equipment has attracted favourable interest from other groups and it is a factor in proposals for our involvement in future work in other countries. 15 sets have been built and it is intended to increase this number to 20.

(g) Seismic Network

The seismic network continued to operate in 1985 though the stations based near Dublin were seriously affected by a lightning storm in July which knocked out the central station at DLE. This was severely damaged and out of action for the remainder of the year. The station at DKM has been closed as the site is very exposed and has suffered from vandalism. The Dunsink station was damaged in an accident involving a JCB.

Processing of network data continued as usual with data being supplied, normally by telex, to the international agencies and to the groups with which we exchange data.

The year has been a relatively quiet one as far as local seismicity is concerned, though activity has continued in the neighbourhood of the large 1984 earthquake and, towards the end of the year, there were interesting developments in the Irish Sea. These included an event not far off the coast of Wicklow. To improve the study of this relatively active area there have been discussions with the British Geological Survey and it may be possible to exchange the output from stations on opposite sides of the sea. This would allow much greater control in areas of mutual interest.

Many enquiries were dealt with during the course of the year.

(h) Explosion Seismology

After many problems in the planning stages, the dominant problem being financial, a major geophysical experiment was carried out in the summer of 1985. The experiment was called the Celtic Onshore-Offshore Lithospheric Experiment (COOLE). A total of about 2000 km of seismic profiling was carried out and, in addition, a dense pattern of gravity and magnetic survey lines was executed off the coasts of Clare, Kerry and West Cork.

Detailed preparation for the seismic work had to begin early in 1985. Many different strands had to be successfully brought together in early July. The development of a new and improved field recording system had, in fact, started in 1984 (see appropriate section - workshop). These automatic stations were crucial since a very large and complex experiment was to be carried out by a minimum number of field operators. Another job that had to be started early was the surveying and establishing of about 180 seismic sites on the three land lines (I, II, and III in Figure). When these lines were chosen a map-search was carried out to establish the most likely seismic sites. These were required at approximately 5 km intervals. They then had to be surveyed on the ground and permission sought from the owners.

The next stage was to instal concrete plinths, normally on a rock base and with the profile directions marked on them. This second pass allowed us to move some sites where there were particular difficulties or where the originally chosen point did not fit in well enough with the trend of its immediate neighbours. This whole process took many months.

At the same time, preparations had to be carried out for the work at sea. Some of the profiles were wholly at sea (6,7 and 8 for example) and were to be carried out by the large German research vessel, F.S. VALDIVIA. For the seismic work the VALDIVIA employed both explosives and airgun sources. Sea bottom seismic stations, which operate unattended for a few days and then surface at a prearranged time, were used on the offshore lines. The positioning of the lines had to be planned in great detail, especially where they passed through hydrocarbon exploration blocks in the Celtic Sea Basin. There was liaison with many different offices and with the oil companies concerned. Some of the offshore shots fired by VALDIVIA were for the onshore lines too, particularly lines II and III. Line I was served by many shot points. Some of these were quarries, Thurles, for example. The central shot point was established by DIAS and was in a disused flooded quarry. The shots in Donegal Bay were fired from a chartered vessel and those at the southern end, off Ardmore and about 50 km further south, were fired from the Irish research vessel, the LOUGH BELTRA. This was a new departure for the LOUGH BELTRA and the first time the ship has been used for such work. DIAS organized a shot-firing and timing party for all these shots. Licences, the supply of explosives, escorts, etc. had all to be arranged. The experiment as a whole was quite a complex operation with up to eight vehicles and nearly 50 sets of equipment on land and three vessels at sea.

What promises to be a lengthy process of data processing and interpretation was embarked on in the autumn of 1985. In spite of weather that was frequently more like the depths of winter a large amount of data has been gathered and our knowledge of the crustal structure of Ireland and its surrounding continental shelf will greatly increase as a result of this work. The experiment was carried out in cooperation with Trinity College and the German Universities of Hamburg and Karlsruhe. The Geological Survey gave us crucial assistance in allowing us to use part of one of their cruises on the LOUGH BELTRA. Financial assistance came from a number of oil and exploration companies, from the Department of Energy and from NBST. Funding for the F. S. VALDIVIA (operated by the University of Hamburg) came from BMFT (German Ministry of Research and Technology).

The onshore seismic data was digitized without charge in the British Geological Survey, Edinburgh, to whom we are extremely grateful.

Personnel involved

<u>Principal</u>	<u>Group</u>	<u>Number</u>
B. Jacob	DIAS onshore/offshore	16
J. Neuberg	Karlsruhe University	5
J. Makris	Hamburg University	2
C. Moore	Shot firers	2
J. Parkinson	M.F.V. Sinbad	2
-	Garda and Army Escorts	6
J. McLoughlin	R.V. Lough Beltra	4
R. Keary	Geological Survey	3
W. Klaassen (Captain)	F.S. Valdivia	26
K-H Todt	Hamburg University	8

(i) Marine Surveys

During intervals of the seismic experiment described under (h) extensive magnetic and gravity surveys were carried out by the Valdivia in which DIAS and Hamburg University collaborated.

In the first phase of the cruise 7-19 July the area covered was off the SW corner of Ireland (see Figure) with a line spacing of 4 km. In the second phase an area with grid spacings 16 km (E-W) 9 km (NS) was covered east of Co. Clare.

Work on the data has commenced and P. W. Readman paid a visit to Hamburg to assist.

3 EEC STIMULATION PROGRAMME

An application was submitted, with the Geophysical Institute of the University of Karlsruhe, to the EEC. In September we were awarded a Twinning contract to carry out joint work with Karlsruhe over the next three years. The total contract is for about IRE145,000 with about IRE89,000 coming to the Geophysics Section. A significant part of this will be for computing in our case. The programme funds interchange of staff between the two institutes and allows us to work closely together on the development of theoretical and inversion techniques.



4 COMPUTER

The large System Industries Winchester disk was successfully incorporated into the Data General Eclipse system and has led to considerable improvement in operation.

5 STATUTORY PUBLIC LECTURE

The Statutory Public Lecture was given by:

Dr. D.H. Matthews F.R.S., University of Cambridge in University College Belfield on February 27th entitled:

"Seismic reflection profiles of the crust and upper mantle around Ireland".

6 OTHER ACTIVITIES

a) Conferences

T. Blake, A.W.B. Jacob, C. Lowe, T. Murphy and P.W. Readman attended the 9th United Kingdom Geophysical Assembly held in Norwich April 15-17.

T. Murphy attended the Inauguration Ceremonies of the European telescopes on the Canary Islands June 28 and 29.

A geophysical field study in the grounds of U.C.D. Belfield (magnetic, gravity and seismics) was given by members of the staff November 8-10.

Demonstration of geodetic instruments etc. at Dunsink as part of "International seminar on surveying for the developing world" September 19.

A.W.B. Jacob was a member of a COST Ad-hoc Working party on earthquake research which met four times in Brussels between February and June and submitted a report in August. Following this he was also a member of the Irish delegation to an EEC CGC meeting on Environment and Climatology at Ispra, Italy in late November.

A.W.B. Jacob attended the two meetings of the Royal Society Working Group on Explosion Seismology (17 April and 16 October).

A.W.B. Jacob was Chairman of the Marine Geophysics Group in the German/Irish Workshop on co-operation in Marine Science and Technology held on 25/26 November under the auspices of NBST.



(b) Lectures

- August 8 A.W.B. Jacob, on board F.S. VALDIVIA  
"COOLE Project".
- October 9 T. Murphy and A.W.B. Jacob seminar for  
Geography Teachers, 5 Merrion Square.
- February 27 N. Murphy, Mining Society, R.T.C. Athlone
- February 7 A.W.B. Jacob, Joly Society, T.C.D.  
"Earthquakes and Ireland".

(c) P.W. Readman acted as co-editor for a special issue of Physics of the Earth and Planetary Science Interiors based upon the proceedings of the European Geophysical Society Workshop "Palaeomagnetism, Age dating and Sedimentology of young sediments".

PUBLICATIONS

N.P. Murphy and A.W.B. Jacob:

"Detailed S-wave structure in the Dublin Basin and its northern margin". Geophys. Jour. 83, 803-807, 1985.

A.W.B. Jacob, W. Kaminski, T. Murphy, W.E.A. Phillips and C. Prodehl:

"A crustal model for a NE/SW profile through Ireland" Tectonophysics, 113, 75-103, 1985.

T. Murphy:

"Gravity Anomaly Map Wicklow-Wexford" in press, Comm. DIAS, Series D.

T. Turbitt, et al., with A.W.B. Jacob, E. Ryan and V. Ward:

"The North Wales earthquake of 19 July 1984" J. Geol. Soc. London, Vol. 142, Part 3, 567 (1985).

DIAS

Monthly 'Meteorological Bulletin for Dublin City' 1985.

Reports

A.W.B. Jacob Cruise Report L. BELTRA 15/85

"Seismic Work 10 and 13 July 1985".

A.W.B. Jacob "ENET: Short Period Seismic Network based on Carnsore".

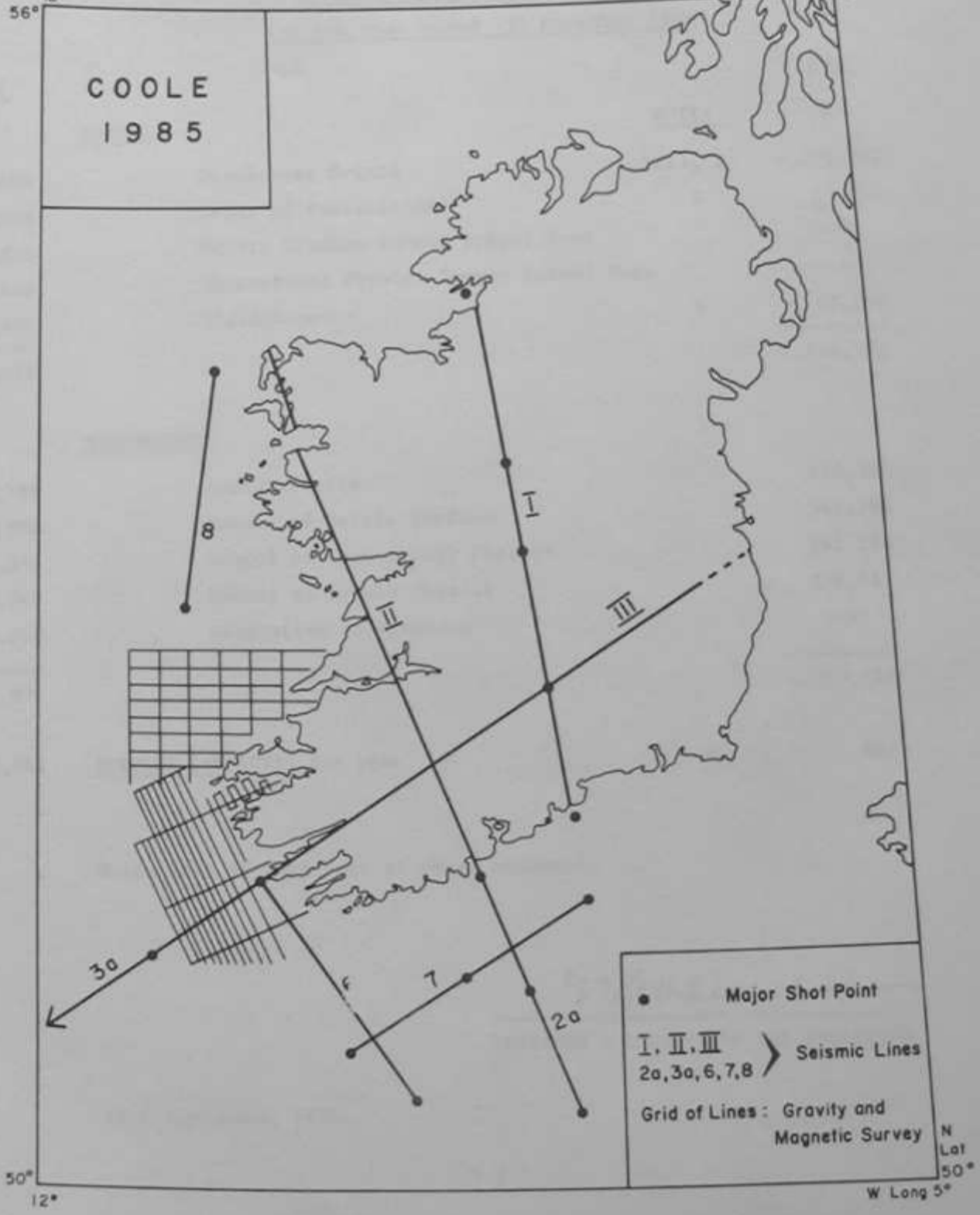
Abstract

"Geomagnetic secular variations from Danish Lake sediments"  
by P.W. Readman and N. Abrahamsen.  
Geophys. J. Roy. Astr. Soc., 81, 320 (1985) presented at UKGA-1X.

56° 12'

5° 56'

# COOLE 1985



- Major Shot Point
- I. II. III > Seismic Lines
- 2a, 3a, 6, 7, 8 > Seismic Lines
- Grid of Lines: Gravity and Magnetic Survey

50° 12'

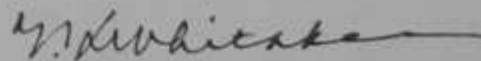
W Long 5°  
N Lat 50°

INSTITIUID ARD-LEINN BHAILE ATHA CLIATH  
(Dublin Institute for Advanced Studies)

Income and Expenditure Account  
for the year ended 31 December 1985

<u>1984</u>		<u>NOTES</u>	<u>1985</u>
£	<u>INCOME</u>		£
1,527,000	Oireachtas Grants	1(a), 2	1,613,000
48,603	Sales of Publications	3	43,912
6,838	Celtic Studies Summer School Fees		----
1,696	Theoretical Physics Summer School Fees		----
50,695	Miscellaneous	4	57,260
<u>1,634,832</u>			<u>1,714,172</u>
	<u>EXPENDITURE</u>	5	
414,789	Administration		458,343
339,982	School of Celtic Studies		341,791
225,978	School of Theoretical Physics		242,750
545,764	School of Cosmic Physics		670,641
2,458	Adaptation of Premises		----
<u>1,528,971</u>			<u>1,713,525</u>
105,861	<u>SURPLUS (DEFICIT) for year</u>	6	647

Notes 1 to 10 form part of these accounts.



CHAIRMAN - COUNCIL OF THE INSTITUTE

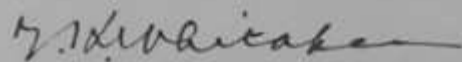
18th September, 1986.

INSTITIUID ARD-LEINN BHAILE ATHA CLIATH  
(Dublin Institute for Advanced Studies)

Balance Sheet at 31 December 1985

<u>1984</u>		<u>NOTES</u>	£	<u>1985</u>
£	<u>CURRENT ASSETS</u>			£
349,815	Cash on hands and at Bank			351,804
51,044	Debtors and Prepayments			55,430
<u>400,859</u>				<u>407,234</u>
	Less			
	<u>CURRENT LIABILITIES</u>			
35,730	Creditors and accruals		39,759	
<u>15,005</u>	Vernam Hull Bequest	7	<u>16,704</u>	56,463
50,735				
<u>350,124</u>	<u>NET CURRENT ASSETS</u>			<u>350,771</u>
	Represented by	6		
<u>350,124</u>	INCOME and EXPENDITURE - Accumulated Surplus			<u>350,771</u>

Notes 1 to 10 form part of these accounts.



T. K. WHITAKER  
CHAIRMAN - COUNCIL OF THE INSTITUTE

18th September, 1986.

INSTITIUID ARD-LEINN BHAILE ATHA CLIATH  
(Dublin Institute for Advanced Studies)

NOTES TO THE ACCOUNTS

1. Accounting policies

- (a) Oireachtas Grants:- Income shown in the Accounts as Oireachtas Grants is the actual cash received in the period of the Account and includes £59,000 for increases in remuneration.
- (b) Premises:- The premises occupied by the Institute are leased from the Office of Public Works.  
Expenditure on additions to such premises is written off in the Income and Expenditure Account.
- (c) Furniture and Equipment:- Expenditure on furniture and equipment is written off in the year in which it is incurred. The estimated value of these assets for insurance purposes is £1,000,000.
- (d) Library:- Expenditure on library books and materials is charged to the Income and Expenditure Account. The current value of such books and materials is estimated at £368,000.
- (e) Publications:- Expenditure on publications is written off in the year in which it is incurred. The estimated value of such publications on hand at 31 December 1985 was £478,000.

2. Oireachtas Grants

Grants voted to the Institute have been allocated under the following headings:

<u>1984</u>		£	£
408,600	Administration	404,600	
294,100	School of Celtic Studies	321,250	
234,750	School of Theoretical Physics	264,000	
589,450	School of Cosmic Physics	623,050	
100	Adaptation of Premises	100	1,613,000
1,527,000			

3. Sales of Publications

48,100	School of Celtic Studies	43,773	
476	School of Theoretical Physics	111	
27	School of Cosmic Physics	28	43,912
48,603			

4. Miscellaneous Income

46,688	Administration	52,430	
---	School of Celtic Studies	244	
---	School of Theoretical Physics	840	
1,007	School of Cosmic Physics	3,746	
3,000	Adaptation of Premises	---	57,260
50,695			

INSTITIUID ARD-LEINN BRAILE ATHA CLIATH  
(Dublin Institute for Advanced Studies)

NOTES TO THE ACCOUNTS

5. Analysis of Expenditure

1984	Total	Administration	School of Celtic Studies	School of Theoretical Physics	School of Cosmic Physics	
£	£	£	£	£	£	
978,067	Salaries, Wages & Superannuation	1,069,564	217,045	355,612	159,791	437,116
49,629	Scholarships	67,644	-	20,428	28,836	18,380
275	Honoraria	401	-	200	100	101
54,692	Library	55,482	-	9,146	29,471	16,865
68,522	Publications	34,680	875	31,056	1,265	1,484
49,084	Furniture & Equipment	98,279	12,453	16,394	3,457	45,975
181,154	General Administration <sup>B</sup>	209,367	209,367	-	-	-
56,280	Travel, Survey & COOLE Expenses	58,727	1,318	1,235	6,476	49,698
17,177	Symposia, Colloquia and Seminar Expenses	8,963	-	159	3,767	5,037
24,470	Consumable Equipment	35,994	-	-	-	35,994
3,189	Special Commitments & Projects	16,097	-	-	-	16,097
43,974	General Expenses	58,347	17,305	7,561	9,587	23,894
1,526,513		1,713,525	458,343	341,791	242,750	670,641
2,458	Adaptation of Premises	---				
1,528,971		1,713,525				

6. Surplus/Deficit Position

	Balance 1/1/85	Year to 31/12/85	Balance 31/12/85
Administration	116,101	(1,313)	114,788
School of Celtic Studies	95,384	23,476	118,860
School of Theoretical Physics	10,670	22,201	32,871
School of Cosmic Physics	109,850	(43,817)	66,033
Adaptation of Premises	18,119	100	18,219
	350,124	647	350,771

7. Vernam Hull Bequest

The project to be financed by this bequest to the School of Celtic Studies has not yet been decided on. The funds are held on deposit.

8. General Administration Expenses

	£	£
69,162	Rent, Rates & Insurance	72,709
47,391	Premises Maintenance	64,989
30,729	Postage & Telephones	32,079
28,882	Fuel, Light & Power	34,072
4,990	Sundry Supplies	5,498
		209,347
181,154		



INSTITIUID ARD-LEINN BHAILE ATHA CLIATH  
(Dublin Institute for Advanced Studies)

NOTES TO THE ACCOUNTS

9. Superannuation

Salaries are charged net of pension contributions. Expenditure arising under the Institute's superannuation schemes is met out of Oireachtas Grants in the year of payment. No provision has been made in these accounts for future superannuation commitments.

10. Seismic & Space Research Programmes

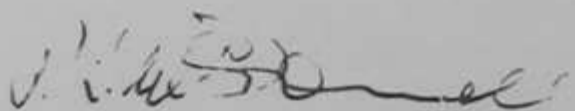
Contributions received from external sponsors and agencies have been set off against the expenditure of the Institute's School of Cosmic Physics. These contributions were as follows:-

	<u>Contributors</u>	<u>Research Project</u>	<u>Amount</u>
1984			£
---	(i) Dept. of Energy; NBST; Oil Industry.	COOLE Celtic Onshore- Offshore Lithospheric Experiment)	24,985
---	(ii) NBST	SLED (Solar Low Energy Detector Experiment)	10,000
300	(iii) ESB	Seismic Survey at Carnsore	300
307	(iv) Institute of Geological Sciences, Edinburgh	Seismic Data Collection	---
---			<hr/>
607			35,285

Institiúid Ard-Léinn Bhaile Átha Cliath  
Report of the Comptroller and Auditor General

I have examined in accordance with approved auditing standards the Accounts set out on Pages 1 to 5 which are in the form approved under the provisions of Acht um Institiúid Ard-Léinn, 1940. I have obtained all the information and explanations which I considered necessary for the purpose of my audit.

In my opinion proper books of account have been kept by an Institiúid and the Accounts, which are in agreement with them, give a true and fair view of the state of its affairs at 31 December 1985 and of its transactions for the year then ended.

  
Comptroller and Auditor General

1 October 1986