



# DIAS

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

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

**ANNUAL REPORT**  
**1980**

10 Burlington Road, Dublin 4

Pr1.150

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 1980

Pr1.150

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

Summary of Annual Report  
of the work of the Constituent Schools  
for the year ended 31 December 1980

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School of Celtic Studies

The death of Dr. Cecile O'Rahilly on 2 May was a serious loss to the School. Although she had retired from her post as Professor in 1964, she had continued to work up to the day of her death, leaving unpublished her final thoughts on the transmission of Táin Bó Cúailnge, the work on which she had become the unquestioned authority.

Both the Junior Research Assistants left to take up posts in Dublin University, Liam Breatnach in May and Katharine Simms in September. Since it proved impossible to get permission from the Department of Education to replace these workers, the activities of the School have been further reduced. The appointment of Mícheál Ó Siadhail to the personal rank of Assistant Professor was a welcome recognition of his work, but it was made on the condition that his former post as Research Assistant would not be filled. The staff situation is thus worse than ever.

Three books were published during the year and six others were in course of printing. Six of the Schools publications were reprinted. Members of the staff and scholars contributed nineteen articles to learned journals.

School of Theoretical Physics

Two Summer Working Seminars were held: The first, on Non-Linear Continuum Mechanics, with 30 participants, was held from 12-16 May, and the second, on Models of Fundamental Interactions, with 41 participants, from 1-5 September; the participants came from abroad, and from Irish universities and other institutes of higher education and/or research.

The use of the School's facilities for research continued to increase; twenty-seven research workers from the universities and other institutes of higher education and/or research were admitted to research associate-ships with the School. Forty-four scientists from abroad visited the School during the year.

The Christmas and Easter Symposia were held as in previous years; seminars at DIAS and joint seminars (with UCD, TCD, Maynooth) in special subject areas were continued. Three courses, including one for final year undergraduates (and first year graduates) from the Dublin area, were given at DIAS; one course was given at UCD, and one seminar at each of TCD, UCC and UCG. The Statutory Public Lecture was given at TCD on 4 December by Professor Lewis; his subject was 'The Place of Mathematics in Physics'.

The School continued its research: the prime areas of research were theoretical particle physics, classical statistical mechanics, quantum statistical mechanics, and the theory of wave propagation; secondary areas were general relativity and gravitation, measurement theory, and applied mechanics. One book and forty-one contributions to journals or scientific proceedings were published.

Members of the School attended thirty-nine international conferences abroad; they gave courses and/or seminars, and/or chaired sessions at sixteen of these conferences, and they gave eighteen other lectures abroad. Two members attended and spoke at the Dublin Workshop in May.

#### School of Cosmic Physics

##### Astronomy Section:

Continuation of the research work of previous years has included reconsideration of selection criteria in exhibiting properties of Cepheid variable stars and new integrations of the long-term motion of Comet Halley over three millenia. Observational programmes of galaxies have been undertaken in Arizona and new limits to the interpretation of the value of the cosmological deceleration parameter have been derived from current literature on quasars.

##### Cosmic Ray Section:

Detector stacks and their polyurethane mountings were completed for the DIAS-ESTEC experiment for detection of ultra-heavy nuclear particles in cosmic rays. The Space Shuttle launch of the LDEF vehicle has been delayed to December 1983 and the calibration work is being revised accordingly. Balloon registration of iron peak detectors was commenced and a launch took place in September 1980. An energetic particle detector in connection with the 1985/86 Giotto Mission of ESA is under preparation as a joint proposal.

##### Geophysics Section:

Research work and surveys covering magnetics, gravity and seismology has shown several interesting results during the year. These include magnetic anomalies related to quartzite, a gravity anomaly yet to be interpreted, and detailed recording of small earthquake tremors. Work on propagation of surface waves was begun and new methods for registering seismic data using multiplexing were established.

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 1980

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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 1980.

The general purpose which it is hoped to accomplish is clearly stated in the Act establishing the Institute, namely, the Institute for Advanced Studies Act (No. 13 of 1940) and in the Establishment Orders establishing the three Constituent Schools, namely, the Institute for Advanced Studies (School of Celtic Studies) Establishment Order, 1940, the Institute for Advanced Studies (School of Theoretical Physics) Establishment Order, 1940, and the Institute for Advanced Studies (School of Cosmic Physics) Establishment Order, 1947, and need not be referred to here. It is deemed desirable, however, to include in the report for the purposes of record certain particulars about the constitution of the Council of the Institute and the membership of the Governing Boards of the three Constituent Schools on the 31 December 1980.

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 1980.
- 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.

I Constitution of the Council of the Institute and of the Governing Boards of the three Constituent Schools on the 31 December 1980

1 THE COUNCIL OF THE INSTITUTE

Chairman

Senator T. K. Whitaker, D.Econ.Sc. from 1 July 1980, succeeding Professor W. B. Stanford, M.A., Litt.D., S.F.T.C.D.

Ex-Officio Members

Thomas Murphy, M.D., D.P.H., B.Sc.Pub.H., President, University College, Dublin; Francis S. L. Lyons, M.A., Ph.D., Litt.D., F.B.A., Provost, Trinity College, Dublin; Proinsias MacCana, M.A., Ph.D., President, Royal Irish Academy.

Members appointed by the Governing Boards of Constituent Schools

Professor David Greene, M.A., D.Litt.; Professor Proinsias MacCana, M.A., Ph.D.; Professor J. T. Lewis, B.Sc., Ph.D.; Dr. A. J. McConnell, M.A., M.Sc., Sc.D., F.T.C.D.; Professor P. A. Wayman, Ph.D.; Professor E. F. Fahy, M.Sc., Ph.D.

2 GOVERNING BOARD OF THE SCHOOL OF CELTIC STUDIES

Chairman

Proinsias MacCana, M.A., Ph.D.

Senior Professors

James P. Carney, B.A., Fil.Dr., D.Litt.; David Greene, M.A., D.Litt.; Brian Ó Cuív, M.A., D.Litt.

Appointed Members

Tomás de Bhaldraithe, M.A., Ph.D., D.Litt.; Gearóid Mac Eoin, M.A., Ph.D.; Seán Ó Tuama, M.A., Ph.D.; Ernest Gordon Quin, M.A., F.T.C.D.; Gerard Victory, B.A., Mus.D.; Thomas Kenneth M. Whitaker, D.Econ.Sc.

3 GOVERNING BOARD OF THE SCHOOL OF THEORETICAL PHYSICS

Chairman

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

Senior Professors

John T. Lewis, B.Sc., Ph.D.; Reverend James R. McConnell, M.A., D.Sc.; Lochlainn Ó Raifeartaigh, M.Sc., Ph.D.

Appointed Members

James N. Flavin, M.Sc., Ph.D.; Michael A. Hayes, M.Sc., Ph.D.; Patrick Quinlan, B.E., D.Sc., Ph.D.; Thomas D. Spearman, M.A., Ph.D. (Cantab); Seán Seosamh Tóibín, M.Sc., Ph.D.; William Wright, M.A., Ph.D., C.Eng., F.I.C.E., F.Inst.Prod.E., F.I.E.I., F.R.S.E.

4 GOVERNING BOARD OF THE SCHOOL OF COSMIS PHYSICS

Chairman

Edward Francis Fahy, M.Sc., Ph.D.

Senior Professors

Cormac Ó Ceallaigh, M.Sc., Ph.D.; Thomas Murphy, D.Sc.; Patrick Arthur Wayman, Ph.D.

Appointed Members

Peter Kevin Carroll, M.Sc., Ph.D.; Mart de Groot, Ph.D.; Brian Henderson, B.Sc., M.A., Ph.D., F.I.P.; George F. Imbusch, Ph.D., D.Sc.; Reverend Thomas P. G. McGreevy, M.Sc., Ph.D.; Patrick Nolan, Ph.D., D.Sc.; Neil A. Porter, Ph.D.; P. K. Rohan, M.A.; Ernest T. S. Walton, M.A., M.Sc., Ph.D., D.Sc., F.T.C.D.

5 ADMINISTRATIVE STAFF

Registrar

Lt. Col. John P. Duggan

Senior Clerk

Maura Devoy

Accounts Clerk

Mary A. O'Rourke

Clerks

Angela Stubbs; Noreen Granahan; Desmond Pender.



11 - Annual Report of the Governing Board of the School of Celtic Studies for the year ended 31 December 1980, adopted at its meeting on 15 April 1981

1 STAFF AND SCHOLARS

Professor Emeritus

D. A. Binchy

Senior Professors

\* David Greene, Director of the School; James Carney; Brian Ó Cuív.

Professor

Heinrich Wagner

Assistant Professors

Pádraig de Brún; Fergus Kelly; Rolf Baumgarten; Mícheál Ó Siadhail (from 1 April).

Research Assistants

Mícheál Ó Siadhail (to 31 March); Malachy McKenna

Junior Research Assistants

M. Katharine Simms (to 31 August); Liam Breatnach (to 30 April)

Assistants (Part-time)

Mrs. Nessa Doran; Mrs. Anne O'Sullivan

Assistant Librarian/Clerk

Máire Breatnach

Secretary/Publications Officer

Máire Uí Chinnseala

Clerical Staff

Patricia Dunne

Scholars

Owenaél Leduc, Dáibhí Ó Cróinín, Robert Elsie (to 30 September); Muireann Ní Bhrolcháin, Diarmuid Ó Sé, Ian Hughes; George Broderick, John Carey, Johan Corthals, Mark Scowcroft (from 1 October)

\* Deceased 13 June 1981.

The death of Dr. Cecile O'Rahilly on 2 May was a serious loss to the School. Although she had retired from her post as Professor in 1964, she had continued to work up to the day of her death, leaving unpublished her final thoughts on the transmission of Táin Bó Cúailnge, the work on which she had become the unquestioned authority.

Both the Junior Research Assistants left to take up posts in Dublin University, Liam Breatnach in May and Katharine Simms in September. Since it proved impossible to get permission from the Department of Education to replace these workers, the activities of the School have been further reduced. The appointment of Mícheál Ó Siadhail to the personal rank of Assistant Professor was a welcome recognition of his work, but it was made on the condition that his former post as Research Assistant would not be filled. The staff situation is thus worse than ever.

Dr. Donncha Ó hAodha spent the Michaelmas term at the Institute as a Visiting Scholar.

## 2 RESEARCH AND EDITING

Professor D. A. Binchy checked and returned proofs of his article 'A pre-Christian survival in medieval Irish hagiography' for the Kathleen Hughes Memorial Volume. See also §6.

Professor David Greene continued the editorial work on the text of Saltair na Rann. Work began on (i) the Irish language section of The Celtic Languages, to be edited by Donald MacAulay for the Cambridge University Press, and (ii) The Irish Language, in Faber and Faber's Great Languages series, responsibility for which was transferred to Professor Greene in January 1980. The following articles were accepted for publication: 'Cro' and some allied words' for the Cecile O'Rahilly Memorial number of Celtica; 'The Neo-Celtic Languages and Faroese' in Proceedings of the First International Conference on Minority Languages. See also §§6, 7.

Professor James Carney worked on Early Irish verse and read and collated Mrs. Neans O'Sullivan's transcript of her edition of The Book of Leinster. An article entitled 'Linking Alliteration' was accepted for publication in Éigse. See also §§5, 6.

Professor Brian Ó Cuív continued the examination and cataloguing of the Irish manuscripts in the Bodleian Library in Oxford; revised proofs of Dán na mBráthar Cuid II and Celtica xiii and of articles for publication in outside periodicals; completed the following articles for publication: (i) 'A poem on the Second Earl of Antrim' (Scottish Gaelic Studies); (ii) 'A Middle-Irish Poem on Leinster Dynasties' (Études Celtiques); (iii) 'Topographical Elements in Irish Personal Names' (Bulletin of the Ulster Place-names Society); 'The Etymology of dia do bheatha' (Celtica); (iv) 'Vowel changes in the inflexion of cos, cas'; (v) 'The phrases \*cuirim in iul and \*ar aoiniúl' (Éigse); (vi) 'Medieval Irish Scholars and Classical Latin Literature'. See also §§6, 7.

Professor Heinrich Wagner did preparatory work on (i) Phonetic Texts from Dunquin (West Kerry) which is to be published as volume 6 in the series 'Studies in Irish Language and Literature' by the Institute of Irish Studies at Queen's University Belfast; (ii) Comparative Celtic Grammar; edited Zeitschrift für Celtische Philologie 38 and studied Manx Texts.

Dr. Pádraig de Brún continued the re-cataloguing of Irish manuscripts in TCD (with Mrs. O'Sullivan); the compilation of material relating to Bible Societies and their Irish teachers and Scripture-readers. An article entitled 'Lámhscríbhinní Gaeilge sa Mhuileann gCearr' was accepted for publication in Éigse; the following articles were accepted for publication in the Journal of the Kerry Archaeological and Historical Society: 'Kildare Place Society in Kerry: II. Schools and lending libraries, Kells-Waterville'; 'Kildare Place Society in Kerry: IIa. Schools-addendum'; 'A Ventry convert group 1842'. See also §7.

Mr. Fergus Kelly continued work on an edition of the Old Irish Triads and began the preparation of a course of 52 lectures in 'Early Irish Literature and Society' to be given in the University of Toronto September - December 1981. See also § 5.

Mr. Rolf Baumgarten worked on the printer's copy of the Bibliography of Irish Linguistics and Literature; received from two printers several specimen pages of two different sections of the bibliography; studied aspects of the future computerization of the bibliography.

Mícheál Ó Siadhail prepared the script for cassettes for Learning Irish, the co-production of the recording and edited the tapes; galley and page proofs of the book were corrected. An article entitled 'Irish Orthography: An Assessment' was accepted for publication in The Crane Bag. See also §§6, 7.

Dr. Malachy McKenna continued work on an edition of the Spiritual Rose and on a description of Omeath Irish based on The Linguistic Atlas and Survey of Irish Dialects. Recordings and transcripts of a number of folktales were made during a field-trip to Ros Guill, Co. Donegal; a native speaker from Rathlin Island, now residing in Belfast was interviewed. An article entitled 'Gutaí fada neamhaiceanta in Oirdheisceart Uladh' was accepted for publication in Éigse. See also §6.

Dr. M. Katharine Simms continued research on a comprehensive catalogue of bardic poetry (c. 1200-1660) with a view to producing a descriptive list of surviving corpus (c. 2,000 poems) and a computer analysis of distribution by authors, patrons, areas, metrics, motifs etc. Work began on revising the first section of her Ph.D. thesis for publication as a book in the series 'Studies in Celtic History' ed. D. Dumville. An article entitled 'The King's Friend' - O'Neill, the Crown and the Earldom of Ulster' was accepted for publication in Anglo-Irish Relations in the late Middle Ages (essays presented to Prof. A. J. Otway-Ruthven) ed. J. F. Lydon. See also §§6,7.

Liam Breatnach continued work on an edition of the Old Irish text 'The Caldron of Poesy'. See also §§4, 6, 7.

Mrs. Nessa Doran catalogued manuscripts G 297 - G 327 for the Catalogue of Irish Manuscripts in the National Library of Ireland and checked the proofs of Fasc. VI of the Catalogue which was published during the year. See also §6.

Mrs. Anne O'Sullivan completed her work on the transcript of her edition of The Book of Leinster Volume VI. The re-cataloguing of the Irish manuscripts in the Trinity College Library was resumed; mss. 1283, 1310, 1315, 1326, 1343, 1432, 1435 were completed. An article on 'Breacan of Clare' was accepted for the Cecile O'Rahilly Memorial Volume of Celtica.

Mr. Gwenaél Leduc continued work on his doctoral thesis and on the catalogue of Breton manuscripts at D.I.A.S.; several manuscripts have been transcribed; completed his edition of the Mirror of Confessions. He was awarded the Prix du Meilleur Mémoire 1980 by the Société d'Histoire et d'Archéologie de l'Arrondissement de St. Malo for his book Vie de Saint Malo; organised an exhibition of the Breton manuscripts in the Long Room of TCD Library for the 3rd International Colloquium on Medieval and Popular Theatre. See also §7.

Dáibhí Ó Cróinín completed the preparation of a critical edition of the Middle-Irish historical tract Sex Aetates Mundi (text, translation, historical introduction and commentary). The following articles were accepted for publication:- 'Mo-Sinu maccu Min and the Bangor Computus' (Peritia - a new Irish journal of Medieval Studies); 'An Irish gloss in the Munich Computus' (Éigse); 'The oldest Irish names for the days of the week?' (Ériu). See also §§6, 7.

Dr. Robert Elsie worked on a lexical survey of Irish and Scottish dialects, collecting and re-organising material from informants. The following articles were accepted for publication:- 'Lexicostatistics and its application to Brittonic Celtic' (Studia Celtica); 'Proto-Brittonic Celtic and Dispersion in the Indo-European Lexicon' (Zeitschrift für Celtische Philologie).

Mr. Mark Scowcroft continued work on his doctoral thesis 'The Hand and the Child'. Chapter IX ('Fire and Light') was completed and Chapters I - III ('Essays on Celtic Tradition') were re-written.

Muireann Ní Bhrolcháin was awarded the degree of Ph.D. by N.U.I. for her thesis on the prose Banshenchas. She began work on the 'Name Index of Saltair na Rann'; the personal names in the Banshenchas and other texts; and on the poetry of Gilla Mo-Duta Ó Caiside. Articles accepted for publication: 'A Possible Source for Keating's Forus Feasa ar Éirinn' (Éigse); 'A Bansheanchas' (Léachtaí Cholm Cille, Má Nuadh). See also §§5, 6, 7.

Diarmuid Ó Sé worked mainly on his Ph.D. thesis and on organizing his collection of material. Ten weeks were spent in field-work. Work progressed on phonetic and morphophonemic description including stress, syllabification, consonant sequences, boundary modifications (sandhi) and noun plural formation. Drafts of two articles were completed.

Mr. Ian Hughes completed work on the text and translation of his edition of 'The Gospel of Nicodemus'; work on the apparatus and comparison with the Latin original progressed. Since the beginning of the academic year Mr. Hughes lectured at the extra mural course in Welsh at UCD.

George Broderick worked on the analysis of the lexical items drawn from texts of native Manx speech with regard to their phonology in relation to their counter-parts in Irish and Scottish Gaelic dialects and their development from Old Irish (in association with Professor Wagner). Work progressed on his Ph.D. thesis on native Manx speech. An article on Manx Gaelic texts, with translation and commentary, was prepared for publication in Celtica.

Mr. John Carey worked on the editing of the first recension of Leabhar Gabhála from the Book of Leinster, the Book of Fermoy, and Mullingar Gaelic MS 6. An article entitled 'The Name Tuatha De Danann' was accepted for publication in Éigse.

Dr. Johan Corthals worked on the Introduction and part of the commentary of his edition of Táin Bó Regamna.

### 3 STATUTORY PUBLIC LECTURE

A statutory lecture entitled 'The Standardization of Irish Orthography: a reassessment' was delivered by Mícheál Ó Siadhail at University College, Dublin 28 November 1980.

### 4 SEMINARS AND LECTURE

The following weekly seminars were held:-

Professor Heinrich Wagner: 'Irish Dialects' (Hilary term)  
Liam Breatnach: 'The Cauldron of Poesy'  
Professor James Carney: 'Early Irish Poetry'

Professor Breandán Ó Madagáin of University College, Galway, delivered a lecture entitled 'An Ceol ina gcantaf Dánta na Scol' on 22 May 1980.

### 5 SYMPOSIUM

On 7-8 March 1980 a symposium was held for university and college staff and research workers. The following papers were read:-

Jenny Rowland : Mor Iwerydd: The Irish Sea?  
Aingeal de Búrca : Dánta ar na Trí Mhuire

P. L. Henry	:	The <u>Táin</u> Rhetorics
Jeffrey Kallen	:	Initial mutation in Irish, arguments from generative theory
Muireann Ní Bhrolcháin	:	Sources of the prose <u>Ban-Sheanchas</u>
Fergus Kelly	:	Units of value in the Irish Laws
Donald Meek	:	The banners of the Fian
Virginia Blankenhorn	:	A new approach to modern Irish accentual metres

#### 6 EXTERNAL ACTIVITIES

Professor D. A. Binchy attended a reception in Aberystwyth during September in celebration of his 80th birthday which took place on 3 June. He was presented with a copy of The Welsh Law of Women a work which is dedicated to him and contains contributions from Welsh scholars including some former students of his.

Professor David Greene lectured on 'Celtic Forgers' in Aberdeen University on 13 May; on September 8, at Glasgow, he lectured on 'The Neo-Celtic Languages and Faroese' at the First International Conference on Minority Languages.

Professor Brian Ó Cuív attended the 12th Conference of the Council for Names Studies in Great Britain and Ireland in Keele, 22-24 March.

Mrs. Nessa Doran lectured to the National Library of Ireland Society on 'The Irish Manuscript Tradition' at the National Gallery in November.

Mícheál Ó Siadhail attended the First International Conference on Minority Languages held in Glasgow from 8-13 September.

Dr. Malachy McKenna lectured on The Spiritual Rose and some aspects of S.E. Ulster Irish at University College, Dublin on 15 February.

Dr. M. Katharine Simms lectured to (i) TCD History Society on 'Bardic Poetry of the Seventeenth Century' on 10 January; (ii) TCD Postgraduate Seminar on 'Bardic Poetry as a historical source' on 13 February; (iii) UCD M.Phil. Seminar on 'Images of Warfare in Bardic Poetry'; (iv) Clogher Historical Association on 11 March, at Clones, on 'Origins of the Diocese of Clogher'.

Liam Breatnach lectured on 'The Caldron of Poesy' at University College, Galway on 25 January.

Dáibhí Ó Cróinín lectured on 'The Irish in Europe in the early Middle Ages' to the Cashel Historical Society at Cashel on 19 April; in January, at Milltown Park, he delivered a lecture entitled 'Na mainistreacha agus an Léann' as one of a series commemorating the 800th anniversary of the death of Lorcan Ua Tuathail.

Muireann Ní Bhrolcháin lectured on 'Women in Early Irish Myths and Sagas' to the Canon Sheehan Literary Society on 27 February and on 'Aspects of the Banshenchas' to the Historical Society, University College, Cork on 6 March.

7 PUBLICATIONS

(a) Works in course of Printing

Dán na mBráthar Mionúr Cuid II edited by Cuthbert Mhág Craith, O.F.M.: final proofs of this work which consists of Translation, Notes and Indexes to Cuid I were passed for press during the year.

The Annals of Ulster edited by Seán Mac Airt/Gearóid Mac Niocaill: proofs of Text and Translation (245 galleys) were corrected and returned to the printer for revise.

Iohannis Scotti Erivgenae: Periphyseon Liber III (Scriptores Latini Hiberniae Vol. XI) edited by I. P. Sheldon-Williams and seen through the press by Professor J. J. O'Meara who completed the checking of proofs which were passed for press in November.

Párlament Chloinne Tomáis edited by N. J. A. Williams who checked the final proofs which were passed for press in November.

Learning Irish by Mícheal Ó Siadhail. Final proofs were corrected and passed for press during the year.

Catalogue of Irish MSS. in National Library of Ireland Fasc. VI by Nessa Ní Sheaghda who completed the checking of final proofs in December.

(b) Books published by the Institute

Clár Lámhscríbhinní Gaeilge : Leabharlanna na Cleire agus Mionchnuasaigh, Fasc. II.	Pádraig Ó Fiannachta viii + 239 pp.	£10
Celtica Vol. XIII	Brian Ó Cuív 203 pp.	£9
The Learned Tales of Medieval Ireland.	Proinsias Mac Cana ix + 159 pp.	£4.50

(c) Books published outside the Institute

Ériu XXXI Published by the Royal Irish Academy and edited by David Greene and Proinsias Mac Cana.

A Literary History of Ireland by Douglas Hyde (containing revised bibliography by Brian Ó Cuív.)

(d) Reprints:

- 1 The Irish of Erris
- 2 Celtica Vol. VI
- 3 The Book of O'Hara
- 4 The Place-Names of Co. Wicklow, Part 1.
- 5 Irish Dialects and Irish-Speaking Districts
- 6 A Grammar of Old Irish

(e) Contributions to periodicals and other publications:

David Greene

Modern Irish cailleann and coilleann  
Zeitschrift für Celtische Philologie 37 5-9

Brian Ó Cuív

Some Gaelic Traditions about the Wren. Éigse XVIII 43-66

Metrics and Irish Phonology. Occasional Papers in Linguistics and  
Language Learning No.6: Papers in Celtic Phonology 108-23

A Mediaeval Exercise in Language Planning.

Studies in the History of Linguistics Vol. 20 (Amsterdam Studies  
in the Theory and History of Linguistic Science III) 23-34

A Reformed Lover. Celtica XII 78

The Verbal Noun Ending - áil and Related Forms. ibid 125-45

Is tré fír flathemon : An Addendum. ibid 146-9

Irish Words for 'Alphabet' Ériu XXXI 100-110

Some Versions of the Sixth Petition in the Pater Noster.  
Studia Celtica XIV-XV 212-22

Pádraig de Brún

An extract from the Civil Survey: Journal of the Kerry  
Archaeological and Historical Society 12. 9-18

Kildare Place Society in Kerry: I. School and lending libraries,  
Aglissh-Gunsborough. ibid 63-118

Mícheál Ó Siadhail

Diabhal (deamhan 7 rí) mar dheis chomhréire sa nGaeilge.  
Ériu XXXI 46-58

Múineadh na Gaeilge do Dhaoine Fásta  
Guth agus Tuairim I 21-27



M. Katharine Simms

- Gabh umad a Fheidhlimidh - a fifteenth-century inauguration ode?  
Ériu XXXI 132-45
- The O'Reillys and the kingdom of East Breifne.  
Breifne 305-19
- The Origins of the Diocese of Clogher. Clogher Record 180-98

Gwenaél Leduc

- Les gloses en Moyen-Breton au Liber Vocabulorum.  
Études Celtiques XVII

Muireann Ní Bhrolcháin

- Women in Early Irish Myths and Sagas The Crane Bag. 12-19

Dáibhi Ó Cróinín

- Review of Fragmentary Annals of Ireland (ed. J. N. Radner).  
Éigse XVIII 143-5

III Annual Report of the Governing Board of the School of Theoretical Physics for the year 1980 adopted at its Meeting on 15 May 1981.

1 STAFF, SCHOLARS, FELLOWS, RESEARCH ASSOCIATES, VISITING SCIENTISTS

Emeritus Professor

John L. Synge

Senior Professors

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

Visiting Scientists

L. Accardi, 27 May - 1 June; A. Aurelia (Trieste), 3-29 July; M. van den Berg (Groningen), 1-31 March, and 8-29 November; C. Cecchini (Genoa), 16 September - 1 October; G. Chantry (NPL, Teddington), 18 - 21 March; R. H. Cole (Providence, RI), 17-20 September; T. Dereli (Lancaster), 28-31 May; D. E. Evans (Warwick), 24-28 March; G. W. Ford (Ann Arbor), 18 May - 12 June; H. Fröhlich (Liverpool), 1-4 December; P. Green (Oxford), 21-28 April; B. Kuper Schmidt (Ann Arbor), 5 May - 3 June; L. Landau (Bedford Coll., London), 7-9 January; G. W. Mackey (Harvard), 23 May - 14 June; A. J. O'Connor (Oxford & Brisbane), 8-13 September; G. Parravicini (Milan), 1-11 January; J. H. Rawnsley (Warwick), 4-8 February; Y. Takahashi (Edmonton), 2-31 July; M. Wellner (Syracuse), 18 July - 22 December; C. de Witt (Santa Barbara), 25-30 May.

Assistant Professors

A. Frigerio to 30 September; S. Ciulli from 1 October.

Research Associates

S. Dineen, P. A. Hogan, D. J. Judge, Rev. J. D. McCrea, J. V. Pulè, W. Sullivan (UCD), R. K. Dodd, P. S. Florides, H. C. Morris, B. K. P. Scaife (TCD), C. Nash, A. O'Farrell, Rev. J. Spelman, D. H. Tchakian (St. Patrick's Coll., Maynooth), J. M. Golden (An Foras Forbartha), A. I. Solomon (Open Univ.), T. Garavaglia, B. Goldsmith (DIT, Kevin St.), M. J. Conneely, M. J. Newell, R. A. Ryan (UCG), J. Adam, P. McGill (NUU); New appointments: R. Ward (TCD) from January, R. Gow (UCD) and T. N. Sherry (UCG) from June; all appointments to run to 31 December 1981. J. D. Gibbon (UCG) moved to Imperial Coll. (London) from 1 October.

Scholars

Y. Fujimoto to 31 August; P. Houston, D. Pottinger to 30 September; A. Fordy, J. Gibbons; L. P. Singh, S. Rouhani from 1 October; J. A. Kinsella 1 October to 30 November.

NBST Research Fellow

B. Lenoach from 1 October

European Exchange Fellow (Royal Society)

K. McFarlane, one year, 14 January 1980 to 13 January 1981.

Librarian-Executive

Evelyn R. Wills

Clerk

Mary Farrelly.

2 GENERAL

Two working seminars were held at DIAS during the year: on Non-Linear Continuum Mechanics, from 12-16 May, and on Models of Fundamental Interactions, from 1-5 September. There were thirty participants (including nine from abroad, eight from Ireland other than Dublin) in the May Seminar, and forty-one (fourteen from abroad and twenty-seven from the Dublin area) in the September Seminar. Visiting scientists were accommodated in the Mount Herbert Hotel (May) and Trinity College Dublin (September).

At the September Seminar a particular pleasure was the participation of Professor Sheldon Glashow, a Nobel Prize Winner for Physics in 1979. Professor Glashow was interviewed by A. Byrne on the RTE 1 programme 'Discovery' on 2 September; he spoke of the value of pure science in the search for understanding of the Universe.

In addition to the use made by the Staff of the School in its primary research activities, much use was made by visitors and research associates during the year, particularly during the summer months, of the School's facilities for research - especially the opportunities for informal discussions, and the library resources. Twenty-seven research workers from the universities and other institutes of research or higher education were admitted to research associateships with the School. For details of Visitors to the School see §8.

3 RESEARCH AND STUDY

Primary areas -

a) Theoretical Particle Physics

Gauge Theories, Monopoles

Professor O'Raifeartaigh recommenced work on the effective potential, in collaboration with G. Parravicini, W. Lang, and Y. Fujimoto. They reduced previous proofs of the "vacuum-graph formula" for the effective potential to a simple group theoretical argument, and clarified the role played by convexity in keeping the expression real. They generalized and clarified results concerning the relationship between the effective potential and the renormalization group, supersymmetry, and the generation of spontaneous symmetry breaking. Some of these results were presented

in an Invited Paper at the Ninth International Meeting on Group Theoretical Methods in Physics, Mexico, and a paper combining all the results is in preparation. Professor O'Raifeartaigh also continued work in collaboration with Dr. Houston on magnetic monopole solutions of the Yang-Mills-Higgs equations of unified gauge theory; they considered in particular the case of axially symmetric systems. The most important of the results they obtained were the discovery that axially symmetric systems could describe only superimposed monopoles (and not, for example, two separated monopoles), and that there existed a potential function from which all the (axisymmetric) gauge invariants could be obtained by differentiation. As well as his work in collaboration with Prof. O'Raifeartaigh, Dr. Fujimoto's work was concerned with (1) Anomaly and point-splitting, (2) Spontaneous breaking in  $SU(N)$ , and (3) Supersymmetry and in-field transformation. Dr. Rouhani worked with Prof. O'Raifeartaigh in a study of classical solutions of Yang-Mills gauge theories. Dr. Pottinger continued his investigations of gluon condensation and quantum chromodynamics; his approach follows closely the approach initiated by A. B. Migdal, and has aroused considerable interest. Dr. Tchakian spent the first part of the year in a search for a Yang-Mills-Higgs system with monopoles of charge higher than one, and the second part on the formulation of the problem of monopoles in a geometric theory, namely a Palatini-Cohen theory. Professor Wellner's research was on gauge covariance in quantum electrodynamics.

#### Scattering Theory

Professor Ciulli collaborated with T. D. Spearman (TCD) in work on a class of minimal distance functional problems, relevant in analytic scattering theory. They found an explicit construction for harmonic functions assuming specified values at some given set of points, where the functions, or their normal derivatives, have been subjected to an  $L^2$ -minimum condition, and are now working on an extension of this construction to take account of the given scattering process. Dr. Singh studied the problem of weak radiative decay widths of baryons, using the bag model. Dr. Kinsella completed previous work on sum rules for partial waves in particle production. Dr. Garavaglia continued his work on electro-weak interactions.

#### b) Classical Statistical Mechanics (Non-Equilibrium)

##### Brownian Motion and Dielectric Phenomena

Professor McConnell continued to work on rotational Brownian motion and dielectric phenomena. In collaboration with J. Birch and G. W. Chantry (NPL, Teddington) he investigated whether the absorption observed experimentally in the submillimetre region could properly be interpreted as the superposition of two effects, one of these being dielectric relaxation due to reorientation. A preliminary report on these investigations was presented to the Conference on Physics of Dielectric Solids at Canterbury. In collaboration with H. Fröhlich (Liverpool) he studied polaron theory and resonance absorption. He collaborated with B. K. P. Scaife in a study of the Paley-Wiener theorem and on the microscopic theory of permittivity.

#### Stochastic Equations of Evolution

The averaging method, used by Ford, Lewis and McConnell in their study of the rotational Brownian motion of molecules, was investigated further by Professors Frigerio and Lewis in collaboration with Dr. Pulè. Error estimates were obtained; a report on the results has been prepared for publication.

#### Phase Transitions in Lattice Systems

Dr. Solomon continued previous work on the spectrum-generating algebra of an anisotropic superfluid fermion system, and is now considering experimentally observed phases in terms of subalgebras.

Professor Lewis continued his collaboration with M. Winnick (Groningen) in the Clifford algebra formulation of the two-dimensional Ising model.

Dr. Sullivan collaborated with R. Flood (NIHE, Dublin) in work on the relation between the grand canonical ensemble and Gibbs states on lattice systems.

#### c) Quantum statistical mechanics

#### Asymptotic Evolutions of Open Systems

The long-time behaviour of a quantum system coupled to a heat-bath has been studied in two investigations:

Professors Frigerio and Lewis, and Dr. Pulè, extended to quantum open systems their work on error estimates for the averaging method; and

Professor Lewis with G. W. Ford (Ann Arbor) used the averaging method to calculate the Lamb shift for an oscillator coupled to a thermal radiation field.

#### Quantum Stochastic Processes

L. Accardi (Milan) continued his collaboration with Professors Frigerio and Lewis in an attempt to organize into a coherent system their current knowledge of the evolution of quantum open systems. Some models introduced by Hepp and Lieb provide examples of a quantum Markov process; the well-known Ford-Kac-Mazur model provides an example of a quantum Gaussian process which satisfies a quantum Langevin equation. Two papers and two review articles have been submitted for publication.

#### Boson Condensation

Dr. Pulè and Professor Lewis have been collaborating with M. van den Berg (Groningen) in an investigation of the effect of a weak external field on a free Boson gas. A weak field induces condensation in a two-dimensional gas and changes drastically the critical behaviour of a three-dimensional gas. A possible application to the Lambda-transition in He is being investigated. A paper will appear shortly.

d) Theory of Wave Propagation

Heterogeneous Media

Professors Synge and Lewis continued their investigations of wave-propagation in a heterogeneous medium.

Mr. Lenoach began work in the collaboration between the School and the Mathematical Physics Department of UCD, organized by Professor Hayes (UCD) and Professor Lewis, and funded by the NBST. Mr. Lenoach is applying the averaging method to study the propagation of seismic waves in a random medium.

Integrable Systems

Drs. Fordy and Gibbons collaborated in work on the factorization of Lax operators. They discovered an integrable  $n$ -field generalization of the sinh-Gordon equations, and then further generalized these equations by exploiting the Cartan-Weyl theory of simple Lie algebras. Prof. Kupershmidt collaborated with them in this work during his visit to DIAS-STP. With B. Kupershmidt they also began work on deformations of integrable systems; this work generalizes B. Kupershmidt's construction, and is applicable to any matrix eigenvalue problem. Dr. Gibbons considered various results on Vlasov equations, and conjectured, correctly as he has since shown, that the many-body system of Calogero and Moser, the derivative nonlinear Schrödinger equation, and the nonlinear Schrödinger equation are all related.

Secondary areas -

e) General Relativity and Gravitation

Dr. McCrea investigated the structure of normal-dominated singularities in static space-times and in particular the asymptotic Petrov type of such space-times near the singularity. He began work on the construction of shell sources for stationary cylindrically symmetric fields with a view to tackling the more general problem of sources for stationary axially symmetric fields. Dr. Hogan has constructed an accelerating instanton solution of the Yang-Mills equations, and is now working on an approach (due to A. Trautman) to the construction of sourceless gauge fields, using Stiefel bundles. Dr. Florides investigated the complete field of charged perfect fluid spheres and other spherically symmetric, static, distributions of charge. He is now working on a generalization of his previous work on the Robertson-Walker metrics.

f) Measurement Theory

Dr. McFarlane continued his study begun at St. Andrews with K. K. Wan of quantization on a Riemannian manifold, and made further investigations into the measurement-theoretic concept of global measurability and its relation to the geometric quantizability proposed by G. Mackey.

g) Applied Mechanics

Dr. Golden continued his study of viscoelastic contact problems, and completed work on a model of road/tyre friction. He began investigations into aspects of multi-layer elastic theory.

Research Reports

Research work during the year was written up in the first instance in research reports. Three lists of titles of these reports (preprints) were prepared and circulated to a list of approximately 250 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 these reports appeared as publications, or were in press at the end of the year (see §10).

- DIAS-STP-80-01: J. R. McCONNELL: Spectral densities of spherical harmonics for rotational Brownian motion.
- 02: A. FRIGERIO & J. T. LEWIS: Non-commutative Gaussian processes.
- 03: A. P. FORDY & J. GIBBONS: Integrable nonlinear Klein-Gordon equations in many dependent variables.
- 04: A. FRIGERIO: Quantum stochastic processes, II.
- 05: J. L. SYNGE: On the vibrations of a heterogeneous string.
- 06: L. ACCARDI & A. FRIGERIO: On the Markovian cocycles.
- 07: J. T. LEWIS: Quantum stochastic processes, I.
- 08: J. T. LEWIS: The heterogeneous string: Coupled helices in Hilbert space.
- 09: A. P. FORDY & J. GIBBONS: Factorisation of operators II.
- 10: T. GARAVAGLIA: A covariant formulation for polarized electron (muon) scattering on spin zero and polarized spin 1/2 targets.
- 11: B. GOLDSMITH: A topological approach to a problem of Nunke - comments and corrections.
- 12: J. V. PULÉ: A unified approach to classical and quantum KMS theory.
- 13: K. McFARLANE: On the appearance of the relativistically rotating disc.
- 14: P. HOUSTON & L. O'RAIFEARTAIGH: On the zeros of the Higgs field for axially symmetric multi-monopole configurations.
- 15: Y. FUJIMOTO: Universal Yukawa coupling in SU(2) by U(1) model.
- 16: P. HOUSTON & L. O'RAIFEARTAIGH: On the charge distribution of static axial and mirror symmetric monopole systems.

- DIAS-STP-80-17: J. L. SYNGE: A matter of chance.
- 20: P. S. FLORIDES: The Robertson-Walker metrics expressible static form II.
- 21: J.R. McCONNELL: Rotational motion and dielectric theory.
- 22: J. GIBBONS: The hard-sphere Boltzmann equation and the Benney moment equations.
- 23: J. D. GIBBON & M. J. McGUINNESS: A derivation of the Lorenz equations for some unstable dispersive physical systems.
- 24: J. R. McCONNELL: Modified Rocard relation for complex permittivity.
- 25: Y. FUJIMOTO & P. SODANO: Comments on SU(9) grand unified theory.
- 26: J. GIBBONS & B. KUPERSHMDT: A linear scattering problem for the finite depth equation.
- 27: W. LANG, L. O'RAIFEARTAIGH & G. PARRAVICINI: Group theory of the effective potential.
- 28: P. HOUSTON & L. O'RAIFEARTIAGH: On axially-symmetric finite-energy monopole configurations.
- 29: L. ACCARDI, A. FRIGERIO & J. T. LEWIS: Quantum stochastic processes.
- 30: A. FORDY & J. GIBBONS: Nonlinear Klein-Gordon equations and simple Lie algebras.
- 31: K. McFARLANE & K. K. WAN: The quantization and measurement of momentum observables II.
- 32: P. HOUSTON & L. O'RAIFEARTAIGH: On monopole systems with weak axial symmetry.
- 33: A. FRIGERIO, J. T. LEWIS & J. V. PULÉ: The averaging method for asymptotic evolutions I: Stochastic equations.
- 34: K. McFARLANE & K. K. WAN: On certain local observables generated by the momenta.
- 35: K. MacFARLANE & K. K. WAN: On the quantization and meaning of the observables linear in momentum.
- 36: K. McFARLANE & K. K. WAN: On the quantization of multi-linear momentum observables.
- 37: A. I. SOLOMON: Phases and conjugacy classes.
- 38: J. V. PULÉ: Positive maps of the CCR algebra with a finite number of non-zero truncated functions.
- 39: M. WELLNER: Manifest gauge and Poincaré covariance.
- 40: B. GOLDSMITH: A note on products of infinite cyclic groups.



- DIAS-STP-80-41: J. D. McCREA: The Petrov type of a static vacuum space-time near a normal-dominated singularity.
- 42: L. O'RAIFEARTAIGH: Gauge theory of the fundamental interactions.
- 43: J. KINSELLA: Sum rules for partial waves in production processes.
- 44: A. FORDY: Projective representations and deformations of integrable systems.
- 45: J. R. McCONNELL: Theoretical and experimental studies of high-frequency dielectric relaxation.
- 46: M. van den BERG & J. T. LEWIS: On the free boson gas in a weak external potential.
- 47: T. GARAVAGLIA: Gauge theory predictions for polarized electron scattering.

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

Review and seminar lectures, series and courses in specialized areas of physics and/or mathematics, were held throughout the year, and as in previous years were attended by members of staff and students from the universities and other third-level institutes in the Dublin area, and by members of the scientific schools of DIAS.

a) Review and Seminar Lectures were given at DIAS-STP by visitors, as follows:

- Dr. L. ACCARDI (Milan): Quasi-conditional expectations.
- Dr. C. CECCHINI (Genoa): Quasi-conditional expectations: Progress report.
- Dr. G. CHANTRY (Teddington): A model for Poley type absorption in polar and nonpolar liquids.
- Prof. R. H. COLE (Brown Univ., Providence, RI): Molecular response functions for the Kerr effect (Birefringence).
- Dr. C. COLEMAN (Oxford): How many limit cycles? (Hilbert's 16th problem).
- Dr. T. DERELI (Lancaster): Supersymmetry.
- Dr. D. E. EVANS (Warwick): Quantum dynamic semigroups. Markov chains and  $C^*$  - algebras.
- Prof. H. FRÖHLICH (Liverpool): Macro/Micro-physics.
- Dr. P. GREEN (Oxford): Gribov ambiguities.
- Prof. B. KUPERSHMITZ (Ann Arbor): Deformations of integrable systems. What is the Hamiltonian formalism?
- Dr. L. LANDAU (Bedford Coll., London): The connection between classical and quantum statistical mechanics.
- Prof. G.W. MACKEY (Harvard): The permutation group and Weyl's perturbation theory (2 lectures).

- Dr. A. J. O'CONNOR (Oxford & Brisbane): Heat-conduction and solitons.
- Dr. V. POENARU (Paris): Probabilistic ideas in dynamical systems and topology.
- Dr. C. PRESTON (Bielefeld): The grand canonical ensemble.
- Dr. J. H. RAWNSLEY (Warwick): Orbit method in representation theory.
- Dr. A. B. TAYLER (Oxford): Waiting-time solutions of a nonlinear diffusion equation.
- Prof. M. WELLNER (Syracuse): Gauge and Lorentz invariance: Can we have both?
- Prof. C. de WITT (Santa Barbara, CA): Differential geometry and Feynman path integrals.

b) Review and Seminar Lectures were given at DIAS-STP by speakers from the scientific Schools of DIAS, from the Universities, or from other third-level institutes in the Dublin area, as follows:

- Prof. S. CIULLI (DIAS-STP): New results in Borel summability of perturbative graphs.
- Dr. R. K. DODD (TCD & DIAS-STP): Hopf bifurcation and delay equations.
- Prof. M. HAYES (UCD): Elastic plane waves (2 lectures).
- Prof. B. JACOB (DIAS-SCP (Geophysics)): Some practical seismology: What actually happens.
- Mr. N. MURPHY (DIAS-SCP (Geophysics)): Inversion techniques in geophysics.
- Prof. T. MURPHY (DIAS-SCP (Geophysics)): Energy propagation in granular material - the Malin problem.
- Prof. L. O'RAIFEARTAIGH (DIAS-STP): Construction of Yang-Mills fields using the Atiyah-Ward Ansatz. (3 lectures).
- Dr. D. POTTINGER (DIAS-STP): Properties of an Ansatz for QCD vacuum state.
- Dr. S. ROUHANI (DIAS-STP): Quantization of Solitons.
- Dr. R. WARD (TCD & DIAS-STP): Construction of monopole solutions with magnetic charge greater than one.

c) Courses and Series given at DIAS-STP:

- Prof. B. KUPERSHMITZ (Ann Arbor): Course of ten lectures on integrable 2-D systems.
- Prof. J. T. LEWIS (DIAS-STP): The one-year course for graduate students from the Dublin area, on Statistical Mechanics, which began in October 1979, was continued through to June.
- Series of Seminars on Stability and Bifurcation: Two lectures each were given by Dr. J. D. GIBBON (UCD & DIAS-STP), Dr. A. FOWLER (TCD), and Dr. J. V. PULÉ (UCD & DIAS-STP).

d) Other lectures, Seminars, and Courses given in Ireland by members of staff of DIAS-STP:

Prof. J. T. LEWIS: Course of five lectures on Stochastic Differential Equations, in the Series of Short Mathematical Courses for Engineers, at UCD.

Seminar on Wave Propagation in a Heterogeneous Medium: given at UCC.

Prof. L. O'RAIFEARTAIGH: Seminar on Unified Theory of the Fundamental Interactions - given on 14 February at TCD, and on 26 February at UCC.

Contributions to the Journals' Club (joint TCD-UCD-Maynooth-DIAS Patricle Group, meeting at TCD):

Dr. D. POTTINGER: Some aspects of non-perturbative QCD.

Prof. L. O'RAIFEARTAIGH: Monopoles.

Dr. Y. FUJIMOTO: Grand unification.

Dr. L. SINGH: Goldberger-Treiman relations,  $\pi$  branching ratio and neutrino oscillations.

Dublin Workshop on Nonlinear Evolution Equations, TCD. May 1980: DIAS-STP contributions:

Dr. A. FORDY: Nonlinear Klein-Gordon equations and simple Lie algebras (Seminar).

Dr. J. GIBBONS: Completely integrable Vlasov equations.

For Lectures etc. given abroad by members of DIAS-STP staff see §9.

#### 5 STATUTORY PUBLIC LECTURE

A Statutory Public Lecture, with illustrations, was delivered under the auspices of the School by Prof. J. T. LEWIS (DIAS-STP) on 4 December, in Trinity College, Dublin; the title of the lecture was 'The Place of Mathematics in Physics'.

#### 6 SYMPOSIA

Two Mathematical Symposia were held during the year, 2-3 April, and 17-18 December. The attendances (37 in April, 45 in December) included professors, lecturers, and graduate students from the Irish universities and other third-level institutions, and from institutions abroad.

The following lectures (in addition to the short communications (previews)) were delivered:

#### APRIL:

Dr. C. L. THOMPSON (Southampton): Non standard analysis: an axiomatic approach.

- Prof. M. HAYES (UCD): Trains of inhomogeneous plane waves.  
Dr. P. DOLAN (Imperial Coll., London): Relative energy of test particles in general relativity.  
Dr. R. RYAN (UCG): Tenson products - A review.  
Prof. M. McCARTHY (UCG): Electrical response of Piezoelectrical crystals.  
Dr. M. IMAEDA (UCD): Lienard Weichert fields in general relativity.  
Dr. B. Quigley (ICD): Prolonged Lie algebras.

DECEMBER:

- Dr. R. GOW (UCD & DIAS): Partition functions and representation theory.  
Dr. T. LAFHEY (UCD): Some questions in matrix theory.  
Dr. P. HOGAN (UCD & DIAS): The two-body problem in linearized gravity.  
Dr. B. GOLDSMITH (DIT, Kevin St. & DIAS): Model theory and algebra.  
Prof. D. L. WEAIRE (UCD): Anderson localisation.  
Prof. D. JUDGE (UCD & DIAS): Boundary values and unbounded infinite matrices.

7 WORKING SEMINARS

Two working Seminars were held in the School during the year. The first, on Non-Linear Continuum Mechanics, with 30 participants, was held from 12-16 May, and the second, on Models of Fundamental Interactions, with 41 participants, was held from 1-5 September. For the May Seminar the visiting scientists were accommodated in the Mount Herbert Hotel, and for the September Seminar in Trinity College Dublin. Opening Receptions were held on 12 May in the Mount Herbert Hotel and on 1 September in Trinity College; Conference Dinners were held on 14 May at Slane Castle, and on 3 September at St. Patrick's College, Maynooth.

The Seminar Programmes included lectures and short communications, as follows:

Problems in Non-Linear Continuum Mechanics:

Main Lectures:

- R. S. RIVLIN (Lehigh): Non-linear continuum mechanics as I see it -  
1: Mainly finite elasticity theory.  
11: Non-Newtonian fluid mechanics.  
D. D. JOSEPH (Minnesota): Free surfaces and normal stress effects in fluids.  
Free surfaces and normal stress effects in solids.  
F. M. LESLIE (Strathclyde): Continuum theory for liquid crystals.  
Applications of continuum theory for liquid crystals.  
A. C. PIPKIN (Providence, RI): Elementary boundary-integral problems for inextensible materials.  
Some unsolved boundary-integral problems.

- A. J. M. SPENCER (Nottingham): Formulation of constitutive equations for anisotropic solids.  
The double-shearing model for flow of granular material.

Short Communications (30 minutes) were given by G. F. Smith (Lehigh), P. M. Quinlan (UCC), M. McCarthy (UCG), F. Buckens (Louvain), J. Dunwoody (QUB), N. Dunwoody (NUU), M. Hayes (UCD), A. Fowler (TCD), M. Mortell (UCC), J. T. Lewis (DIAS), M. Quinlan (UCC), J. Flavin (UCG), A. Rigolot (Reims), L. Crane (TCD), and J. D. Gibbon (UCD).

Models of Fundamental Interactions:

Main Lectures:

- R. H. DALITZ, FRS (Oxford): The Quark model (3 lectures).  
S. GLASHOW (Harvard): Beyond  $SU(2) \times U(1)$  (3 lectures).  
R. JACKIW (MIT): Semi-classical considerations (3 lectures).  
H. LEUTWYLER (Bern): Colour and flavour (3 lectures).  
C. TAUBES (Harvard): Existence of static multi-monopole systems (2 lectures).

Short Communications (20 minutes) were given by R. Ward (TCD & DIAS), Y. Fujimoto (DIAS), D. Crosser (DESY, Hamburg), A. C. Hirshfeld (Dortmund), P. Horva'thy (Marseille), V. F. MÜLLER (Kaiserslautern), S. Y. Pi (SLAC, Stanford, CA), J. Pestieau (Louvain), and D. Pottinger (DIAS).

8 VISITORS

For lectures given by visitors, see §§4, 7.

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

Short visits (1-6 days) were made by

- L. Landau (Bedford Coll., London), 7-9 January.  
J. H. Rawsley (Warwick), 4-8 February.  
G. Chantry (NPL, Teddington), 18-21 March.  
D. E. Evans (Warwick), 24-28 March.  
C. de Witt (Santa Barbara, CA), 25-30 May.  
L. Accardi (Milan), 27 May - 1 June.  
T. Dereli (Lancaster), 28-31 May.  
A. J. O'Connor (Oxford & Brisbane), 8-13 September.  
R. H. Cole (Providence, RI), 17-20 September.  
H. Fröhlich (Liverpool), 1-4 December.  
F. Cooperstock (Victoria, BC), 12 December.

Longer visits (1 week to 6 months) were made by

- G. Parravicini (Milan), 1-11 January.
- M. van den Berg (Groningen), 1-13 March, and 8-29 November.
- P. Green (Oxford), 21-28 April.
- B. Kupersmidt (Ann Arbor), 5 May - 3 June.
- G. W. Ford (Ann Arbor), 18 May - 12 June.
- G. W. Mackey (Harvard), 23 May - 14 June.
- D. Bourgin (Austin, TX), 26 May - 4 June.
- D. Froot (Lakehead, Ont.), 4 June - 22 July.
- Y. Takahashi (Edmonton), 2-31 July.
- A. Aurelia (Trieste), 3-29 July.
- R. F. O'Connell (Louisiana State, Baton Rouge), 7-21 July.
- M. Wellner (Syracuse), 18 July - 22 December.
- C. Cecchini (Genoa), 16 September - 1 October.

Short visits in connection with the Working Seminars were made by

- (12-16 May) F. Buckens (Louvain), J. Dunwoody (QUB), N. Dunwoody (NUU), D. D. Joseph (Minnesota), F. M. Leslie (Strathclyde), A. C. Pipkin (Providence, RI), A. Rigolot (Reims), R. S. Rivlin (Lehigh), G. F. Smith (Lehigh), and A. J. M. Spencer (Nottingham),
- and (1-5 September) R. H. Dalitz, FRS (Oxford), S. Glashow (Harvard), D. Grosser (DESY, Hamburg), A. C. Hirshfeld (Dortmund), P. Horva'thy (Marseille), R. Jackiw (MIT), H. Leutwyler (Bern), V. F. Müller (Kaiserslautern), J. Pestieau (Louvain), and S. Y. Pi (SLAC, Stanford, CA).

#### 9 ACTIVITIES ABROAD

Professor McConnell spent six weeks, 8-29 February, and 1-23 November, at the University of Salford as Visiting Professor, and in discussions with Prof. H. Fröhlich, Prof. J. H. Calderwood, Prof. R. A. Sach, and Dr. G. W. Chantry. From Salford, in February, he visited University College of Wales (Aberystwyth), the University of Liverpool, and King's College, London. In April he visited the University of South Florida, Tampa; from 25 July - 1 August he attended the Gordon Conference on Dielectric Phenomena, Plymouth, New Hampshire, as a Speaker, and visited MIT. From 1-16 September he visited Warsaw Technical University, Warsaw University, the Jagellonian University (Krakow), and the Silesian University, Katowice; he attended the Seminar on Molecular Reorientation in Condensed Matter, Kokotek, as a Speaker.

Professor Lewis visited the Universities of Groningen (14-20 April), Leuven (20-25 April), Warwick (20-27 April, and 8 December), Cambridge (27-29 April), and Oxford (10 December). He attended the Summer School for Theoretical Physics of the University of Grenoble, at Les Houches, as a Lecturer, and chaired the Session on Quantum Probability. He participated in the Durham Symposium of the London Mathematical Society, on Stochastic Differential Equations, 8-17 July, and in the Conference on Statistical Mechanics at the Open University, 8-10 December.

Professor O'Raifeartaigh attended the Annual Conference of the Belgian Particle Physics Group at the University of Liège, 23-26 January, as Distinguished Foreign Speaker, and the 8th Winter Meeting of the Mathematical Sciences Faculties of the Charles University, Prague, on Abstract Analysis, 27 January - 3 February. From 27-30 April he visited the University of Louvain-la-Neuve. He attended the 1980 Latin-American Summer School, Mexico City, 2-20 June; as a Speaker he attended, and chaired the Session on Gauge Theory at the 9th International Conference on Group Theoretical Methods in Physics, Mexico City, 23-27 June. Prof. O'Raifeartaigh and Dr. Tchrakian attended the Annual Conference and Workshop on Differential Geometry in Physics, Clausthal, 22-29 July, and Dr. Tchrakian visited the Universities of Bonn and Karlsruhe during July.

Dr. Hogan visited the University of Warsaw 1-6 June, for discussions with Prof. Trautman; Prof. Florides, Dr. McCrea and Dr. Hogan attended the International Conference on General Relativity and Gravitation, Jena, 14-19 July.

Dr. Fujimoto visited the Universität Dortmund, 4-6 February, and the University of Salerno in April. He attended the 20th International Conference on High Energy Physics, Madison, WI, 17-23 July, and the Scottish Universities' Summer School, Edinburgh, 10-30 August.

Dr. Pottinger visited the Niels Bohr Institute (Copenhagen) for 10 days in April, and Southampton University for 10 days in May, for discussions. He attended the International Symposium on the Statistical Mechanics of Quarks and Hadrons, Bielefeld, 23-30 August, as a Speaker, and the First UK Workshop on Theoretical High Energy Physics, St. Andrews, 16-28 September.

Dr. Houston visited ICTP, Trieste, for two months (June/July).

Drs. Fordy and Gibbons attended the 22nd British Theoretical Mechanics Colloquium, Cambridge, 25-28 March, and the Conference on Nonlinear Evolution Equations, Culham, 9-11 April. Dr. Fordy, as a Speaker, and Dr. Gibbons attended the Conference on Non-linear Evolution Equations to Dynamical Systems, Chania (Crete), 9-23 July.

Drs. Tchrakian, Garavaglia, Rouhani, and Singh attended the Rutherford High Energy Meeting, 17-19 December.

Dr. Solomon attended the Bedford Many-Body Theory Conference, 16 May, and the 9th International Conference on Group Theoretical Methods in Physics, Mexico City, 23-27 June.

#### Seminars and Courses Given Abroad

Professor McCONNELL -

King's College, London - Address to Experimentalists - Proposals to Verify the Theory of Rotational Brownian Motion.

Gordon Conference on Dielectric Phenomena - Lecture - On Recent Developments in Theory and Experiment for Dielectric Relaxation.

Jagellonian University, Krakow - Seminar - On Rotational Brownian Motion.

Seminar on Molecular Reorientation in Condensed Matter, Koketek -

Lecture - Molecular Reorientation and Dielectric Relaxation.

Professor LEWIS -

Seminar - The Averaging Method for Asymptotic Random Evolutions -  
given at

Institute for Theoretical Physics, State University of Groningen, 19 April;  
Institute for Theoretical Physics, Catholic University of Leuven, 23 April;  
Cavendish Laboratory, University of Cambridge, 28 April;  
Mathematical Institute, University of Warwick, 8 Decmeber;

Seminar - Non-Commutative Stochastic Processes -  
given at

Mathematical Institute, University of Warwick, 25 April;

Two Lectures - Quantum Stochastic Processes -  
given at

Les Houches Summer School.

Lecture - The Boson Gas -  
given at

Conference on Statistical Mechanics, Open University.

Professor O'RAIFEARTAIGH -

Belgian Particle Physics Group - Lecture - Monopoles.

8th Winter Meeting at Prague - Two Seminars - Monopole Theory.

University of Louvain-la-Neuve-Two Seminars -

(1) The Effective Potential. (2) Monopoles.

Latin-American Summer School - Two-Week (12 lectures) Course - Gauge Theory  
of the Fundamental Interactions.

9th International Conference on Group Theoretical Methods in Physics -  
Lecture - Group Theory of the Effective Potential.

Annual Conference and Workshop, Clausthal - Report - Results for Axially  
Symmetric Monopoles.

Dr. TCHRAKIAN -

Bonn University - Seminar - Instantons on N-dimensional Manifolds.

Karlsruhe University - Seminar - Einstein-Cartan Formulation for Monopoles.

Dr. HOGAN -

Warsaw University - Seminar - On Equations of Motion.



Dr. FUJIMOTO -

Dortmund University - Seminar - Is There Further Unification?  
University of Salerno - Two Seminars on his Research Work.

Dr. POTTINGER -

Niels Bohr Institute - Seminar - Yang-Mills Instabilities and Gluon  
Condensation.  
Southampton University - Seminar - Gluon Condensation.  
International Symposium, Bielefeld - Speaker - Gluon Condensation.  
First UK Workshop, St. Andrews - Seminar - Gluon Condensation.

Dr. FORDY -

Conference on Nonlinear Evolution Equations, Culham - Speaker -  
Factorisation of Scattering Operators.  
Conference on Nonlinear Evolution Equations and Dynamical Systems, Crete  
- Speaker - Nonlinear Klein-Gordon Equations and Simple Lie Algebras.

Dr. GIBBONS -

22nd British Theoretical Mechanics Colloquium - Lecture - Factorization of  
Operators and Nonlinear Klein-Gordon Equations.  
Conference on Nonlinear Evolution Equations and Dynamical Systems, Crete -  
Seminar - Completely Integrable Vlasov Equations.

Dr. SOLOMON -

9th International Conference on Group Theoretical Methods in Physics -  
Lecture - Phases and Conjugacy Classes.  
York University - Lecture, 10 December - The Application of Lie Groups to  
Many-Body Problems.

#### 10 PUBLICATIONS

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

(1) Book:

Published:

- \* J. R. McConnell. Rotational Brownian motion and dielectric theory.  
Academic Press 1980 xiv + 300 pp.

(2) Contributions to periodicals and other publications:

J. R. McConnell:

Spectral densities of spherical harmonics for rotational Brownian motion. *Physica* 102A (1980), 539-546.

J. R. McConnell, J. R. Birch, J. H. Calderwood, & G. W. Chantry:

Theoretical and experimental studies of high frequency dielectric relaxation. IOP Conf. Physics of Dielectric Solids, Canterbury, 1980. Paper 3(5), Abstracts of Contributed Papers, p. 35.

M. Scheunert:

Generalized Lie algebras. *Group Theoretical Methods in Physics, Proceedings, Austin, 1978*, Eds. W. Beiglböck et al. Springer 1979, LNP 94, 450.

R. A. Matzner:

Gravitational radiation and the equivalence principle by the technique of virtual quanta. Working Seminar on Current Problems in General Relativity, Dublin 1979. DIAS, 1980, 45 pp + 5 figs.

A. Frigerio, V. Gorini, & J. V. Pulè:

\* Open quasi-free systems. *J. Statist. Phys.* 22 (1980), 409-433.

J. V. Pulè:

Positive maps of the CCR algebra with a finite number of non-zero truncated functions. *Ann. Inst. H. Poincaré* 33A (1980), 395-408.

W. Lang, L. O'RaiFeartaigh, & G. Parravicini:

Group theory of the effective potential. *Group Theoretical Methods in Physics, Proceedings, Cocoyoc, Mexico, 1980*, Ed. K. B. Wolf. Springer 1980, LNP 135, 22-32.

L. O'RaiFeartaigh, S. Y. Park, & K. C. Wali:

On the long-range interaction of topologically charged monopoles. *Geometrical and Topological Methods in Gauge Theories, Proceedings, Montreal, 1979*, Eds. J. P. Harnad & S. Shnider. Springer 1980, LNP 129, 89-95.

L. O'RaiFeartaigh, S. Y. Park, & K. C. Wali:

\* Remarks on the algebraic structure of spontaneous symmetry breaking in unified gauge theories. *Symmetries in Science, Proc. Einstein Centennial Celebration Science Symposium, Carbondale, 1979*, Eds. B. Gruber & R. S. Millman. Plenum, 1980, 265-278.

L. O'Raifeartaigh:

- \* Gauge theories with hidden symmetry. Proc. Schweiz. Inst. f. Nuklearforsch. Spring School on Weak Interactions and Gauge Theories, Zuoz, 1978, Ed. M. P. Locher. SIN-Doc., 1979, 1-60.

P. Houston & L. O'Raifeartaigh:

- \* On monopoles with axial and mirror symmetry. Proc. Internat. Seminar, Group Theoretical Methods in Physics, Zvenigorod, Moscow, 1979. Izdatelstvo Nauka (Moscow), 1980, Vol. II, 241-247.

P. Houston & L. O'Raifeartaigh:

On the zeros of the Higgs field for axially symmetric multi-monopole configurations. Phys. Lett. 93B (1980), 151-154.

On the charge distribution of static axial and mirror symmetric monopole systems. Phys. Lett. 94B (1980), 153-156.

P. Houston & D. Pottinger:

Gluon condensation for arbitrary colour gauge groups. J. Phys. G: Nucl. Phys. 6 (1980), 1453-1458.

P. Houston & J. Kennedy:

- \* Vector-meson contributions to nucleon form factors. J. Phys. G: Nucl. Phys. 6 (1980), 415-422.

Y. Fujimoto:

- \* Renormalization effects in SU(6), SO(10) and E(6) models. Phys. Lett. 89B (1980), 347-351.

The generalized Kobayashi-Maskawa mixing matrix. Nuovo Cim. Lett. 29 (1980), 283-288.

Y. Fujimoto & P. Sodano:

Universal Yukawa coupling in the  $SU_2 \times U_1$  model. Nuovo Cim. Lett. 28 (1980), 377-380.

T. Garavaglia:

A covariant formulation for polarized electron (muon) scattering on spin-zero and polarized spin- $\frac{1}{2}$  targets. Nuovo Cim. 56A (1980), 121-128.

Gauge theory predictions for polarized electron-neutrino scattering. Nuovo Cim. Lett. 29 (1980), 572-576.

D. H. Tchrakian:

- \* N-dimensional instantons and monopoles. J. Math. Phys. 21 (1980), 166-169.

- \* 't Hooft electromagnetic tensor for Higgs fields of arbitrary isospin. Phys. Lett. 91B (1980), 415-416.

A. I. Solomon:

- \* Group theory and superfluid systems. *Ann. N. Y. Acad. Sci.* 337, (1980), 161-166.
- \* The general Bogoliubov transformation. *Ann. Israel Phys. Soc.* 3 (1980).  
Phases and conjugacy classes. *Group Theoretical Methods in Physics, Proceedings, Cocoyoc, Mexico, 1980*, Ed. K. B. Wolf. Springer, 1980, LNP 135, 42-45.

P. S. Florides:

- \* The Robertson-Walker metrics expressible in static form. *GRG* 12 (1980), 563-574.

P. A. Hogan:

- \* Plane gravitational waves. *Proc. RIA* 80A (1980), 85-92.
- \* Equations of motion in linearized gravity: III Radiation of 4-momentum. *J. Phys. A: Math. Gen.* 13 (1980), 1741-1746.  
A note on the two-body problem in linearised gravity. *J. Phys. A: Math. Gen.* 13 (1980), L235-L237.  
The motion of a charged mass in linearised gravity. *Proc. RIA* 80A (1980), 155-165.

G. M. O'Brien:

- \* Equations of motion in linearized gravity: Charged rotating sources. *J. Phys. A: Math. Gen.* 13 (1980), 1747-1754.  
A note on twisting type-N solutions. *J. Phys. A: Math. Gen.* 13 (1980), L143-L145.  
An Einstein-Maxwell field with null fluid present. *Phys. Lett.* 77A (1980), 105-106.

A. P. Fordy & J. Gibbons:

- \* Some remarkable nonlinear transformations. *Phys. Lett.* 75A (1980), 325.
- \* Factorization of operators I. Miura transformations. *J. Math. Phys.* 21 (1980), 2508-2510.  
Integrable nonlinear Klein-Gordon equations and Toda lattices. *Commun. math. Phys.* 77 (1980), 21-30.

J. Gibbons & B. Kupershmidt:

A linear scattering problem for the finite depth equation. *Phys. Lett.* 79A (1980), 31-32.

J. D. Gibbon & M. J. McGuinness:

A derivation of the Lorenz equations for some unstable dispersive physical systems. *Phys. Lett.* 77A (1980), 295-299.

R. Critchley:

Approximate equilibrium states for two models of an interacting boson gas. *J. Math. Phys.* 21 (1980), 359-363.

J. M. Golden:

- \* Percolation theory and unsaturated flow through porous media. *Water Resources Res.* 16 (1980), 201-209.
- \* Hysteresis and lubricated rubber friction. *Wear* 65 (1980), 75-87.

In the press

J. L. Synge:

On the vibrations of a heterogeneous string. *Q. appl. Math.*  
A matter of chance. Invited Contribution to Yourgrau Memorial  
Volume - Old and New Questions in Physics, Cosmology, Philosophy  
and Theoretical Biology.

J. R. McConnell:

Modified Rocard relation for complex permittivity. *Physica A.*

J. T. Lewis:

The heterogeneous string: Coupled helices in Hilbert space.  
*Q. appl. Math.*  
Quantum stochastic processes. I. *Physics Reports* (Special Issue,  
Les Houches Summer School).

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

The averaging method for asymptotic evolutions I: Stochastic  
differential equations. *Adv. appl. Math.*

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

On the free Boson gas in a weak external potential. *Communs. math.  
Phys.*

A. Frigerio:

Quantum stochastic processes. II. *Physics Reports* (Special issue,  
Les Houches Summer School).

L. Accardi & A. Frigerio:

Markovian cocycles. *Proc. RIA.*

P. Houston & L. O'Raifeartaigh:

On axially-symmetric finite-energy monopole configurations.  
Z. Phys. C.

On monopole systems with weak axial symmetry. Proc. Conf.  
Differential Geometric Methods in Mathematical Physics, Clausthal,  
1980.

L. O'Raifeartaigh:

Gauge theory of the fundamental interactions. Proc. Latin-  
American Summer School for Physics, Mexico City, 1980.

D. Pottinger:

Gluon condensation and QCD. Proc. Internat. Symposium on  
Statistical Mechanics of Quarks and Hadrons, Bielefeld, 1980.  
Plenum Pr.

D. H. Tchrakian:

A derivation of the Prasad-Sommerfeld solution. J. Phys. A:  
Math. Gen.

J. D. McCrea:

The Petrov type of a static vacuum space-time near a normal-  
dominated singularity. J. Phys. A: Math. Gen.

A. P. Fordy & J. Gibbons:

Factorisation of operators II. J. math. Phys.

Nonlinear Klein-Gordon equations and simple Lie algebras.  
Proceedings Dublin Workshop on Nonlinear Evolution Equations.

A. Fordy:

Projective representations and deformations of integrable systems.  
Proceedings Dublin Workshop on Nonlinear Evolution Equations.

J. M. Golden:

Approximate analytic treatment of the problem of a moving  
ellipsoidal punch on a viscoelastic half-space. Q. Jl Mech.  
appl. Math.

A model of wet road/tyre friction. Wear.

B. Goldsmith:

A note on products of infinite cyclic groups. Rend. math. Univ.  
Padova.

K. McFarlane:

On the appearance of the relativistically rotating disc. Int. J. theor. Phys.

K. McFarlane & K. K. Wan:

On certain local observables generated by the momenta. J. Phys. A: Math. Gen.

## 11 LIBRARY

Approximately 250 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 holdings of subscription periodicals were regularly scrutinized with regard to greatest needs, cost, and availability elsewhere in Dublin; a small number of subscriptions was dropped, and a small number of essential new subscriptions were taken up; the new subscriptions included one to the Science Citation Index, deemed to be an essential scientific research information tool. As the experiment, reported on in the previous Annual Report, of taking a small number of journals by "Contents Lists only" had been successful, an increased number of journals were "taken" in this way during 1980; an effective amount of shelf space was thus saved, in addition to financial saving, in comparison with the shelf-space required and cost of taking these journals in full. 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.

Gifts of books and journals, in addition to those received under exchange arrangements, were received from: Professors Syge and McConnell, Dr. Tchakian, Professor R. H. Dalitz, FRS, Dr. M. J. Kahn, Professor G. Mackey, and Dr. T. T. West: also from Roskilde University Library (Denmark), Hiroshima University, KEK (Japan), D. Reidel Publishing Co. (Netherlands), Academie Republicque Socialiste Roumainie (Romania), University of California at Davis, Johns Hopkins University, Virginia State University (USA), and "Higher School" Moscow (USSR).

III - Annual Report of the Governing Board of the School of Cosmic Physics for the year 1980, adopted at its meetings on 30 April and 24 June 1981.

A ASTRONOMY SECTION

1 STAFF AND SCHOLARS

Senior Professor

P. A. Wayman

Professor

T. Kiang

Research Assistant

I. Elliott

Experimental Officer

B. D. Jordan

Technical and Clerical Staff

A. M. Callanan, W. M. Dumpleton, P. Murphy, G. Tynan (to 6 June 1980).

Scholars

H. P. Murphy, F. H. Cheng (from 15 April 1980).

Professor Wayman served as General Secretary of the International Astronomical Union throughout the year. About 95 days were spent at the IAU Secretariat in Paris or out of Ireland on IAU business.

Professor Wayman ceased as Chairman of the National Committee for Astronomy in October 1980, having left the Library and Space Research Committees of the Royal Irish Academy in March. Dr. Elliott continued as Secretary of the National Committee, as Associate Editor of the Irish Astronomical Journal, and as Irish observer with JOSO.

Professor Kiang was elected as Vice-President of the Irish Astronomical Society during 1980-81.

Professor Wayman served from 1 November on the Ad Hoc Committee of the European Space Agency concerned with the Announcements of Opportunity for Hipparcos, the Astrometric Satellite.

B. D. Jordan worked at Royal Greenwich Observatory Instrument Development Department from January 20 to February 9.



D. Moore (UCD) and N. Smith (UCD) worked as Vacation Students in the Astronomy Section 1 July - 29 August. H. P. Murphy, Scholar, was awarded a Studentship for twelve months from 15 January 1980, enabling him to accept an invitation to work at the Smithsonian Astrophysical Observatory at Mount Hopkins, Arizona and at Cambridge, Massachusetts. A grant of IAU Commission 38 was awarded to cover travel cost.

## 2 RESEARCH WORK

### Cepheid Variable Stars: P. A. Wayman, with M. J. Stift (Vienna)

The material for cepheid variable stars in the region designated LMC I has been largely prepared for publication. Light curves and diagrams have been re-drawn and new Tables constructed using the Vienna Observatory computer equipment. The comparison of stars in common with four other observers has been completed and the remaining discrepancies have been largely resolved. Butler's criteria (for SMC and LMC II) for selecting the most regularly behaved cepheid variables gives results for the Period-Luminosity and Period-Colour relations and for the distance modulus of the Large Magellanic Cloud which are thoroughly in accord with other results. The aim of producing photographic photometry for both Clouds with similar standards has been achieved and demonstrated.

### Solar Velocity Fields: I. Elliott

Seven filtergrams taken in rapid succession at the centre of solar disk at different wavelengths across the H $\alpha$  absorption line were analysed. The filter, of Sacramento Peak Observatory, had a bandpass of 0.25Å. The Joyce-Loebl microdensitometer scans with an effective slit size 0.2 x 0.2mm recorded 128 x 85 points on each filtergram. Fast Fourier Transform subroutines were developed and tested in an interactive routine. Data on the variation with height of the size of the chromosphere structures have been obtained.

The same programs in one-dimensional form were used by the vacation students to analyse the whole series of Zurich Sunspot numbers; the characteristic periods at 9.8 and 10.7 years were clearly depicted.

### Solar System Dynamics: T. Kiang

A paper jointly with D. K. Yeomans (JPL, Pasadena) has been prepared for publication on the topic of the Long Term Motion of Comet Halley. The work of 1967-69 has been repeated with new integrations of the motion back to BC 1404. Non-gravitational (reactive force) effects were incorporated and corrections evaluated to the former estimates of times of perihelion passage. The ancient Chinese observations over nearly two millenia were successfully represented; it seems likely, from the adopted model, that the spin axis direction

and the strength of outgassing in Comet Halley has remained substantially constant over the whole observed interval.

Work on analytic methods for asteroid dynamics was described at a Workshop at Namur, Belgium. The extension of the methods of analysis of Halley's Comet residuals to the question of stability of orbits at the asteroid Jupiter resonances (Kirkwood Gaps) has not been uniformly accepted and it is now required to see whether a mathematical method closely related to the comet analysis (approximately 7:1 in mean motion compared with Jupiter) can be used to examine the 2/1 and 3/2 resonances.

Galaxy Photometry and Profiles: H. P. Murphy

In a thesis prepared for candidature of the M.Sc degree, it is shown that non-regularity of elliptical isophotes in galaxy photometry (i.e. change in orientation and variation in ellipticity) cannot reasonably be attributed to a supposed tri-axial form for these galaxies.

A paper communicated jointly with R. E. Schild and T. C. Weekes reports on CCD (Charge-coupled device) Camera observations of the brightest galaxies in nearby rich clusters of galaxies. 36 such clusters were observed in all and surface brightness profiles were derived. The purpose of the optical observations is to determine comparison with X-ray observations, where extended haloes have possible significance.

The earlier observations of galaxies were made with the Fairchild CCD camera (100 x 100 format) at Mount Hopkins Observatory. Later during the year work was done to start observations with an RCA CCD on fainter cluster members and this camera has also been used in an attempted detection of Cygnus X-3 and in a study of NGC 6240, a peculiar galaxy.

Observational Cosmology: T. Kiang, F. H. Cheng

The statistical problems in the use of an observed magnitude-redshift relation to assess the universal deceleration parameter  $q_0$  have been examined. The method of using a luminosity indicator for individual objects (usually quasars) is able in principle to discriminate between values of  $q_0$  when the results are transferred to the magnitude-redshift comparison. More probable values of  $q_0$  are associated with (1) smaller variances, and (2) absence of correlation between residuals and redshift. A scheme for evaluating the probability function of  $q_0$  on these two tests has been derived. The tests were applied to a set of 43 quasars with 53 measured line widths in Lyman  $\alpha$ , C IV and Mg II. The result is expressed by saying that  $\log q_0$  follows a normal distribution with mean value +0.27, standard deviation 0.135; such a value, if sustained, rules out an open universe ( $\log q_0 < -0.301$ ), unless the result is falsified by age effects in quasar luminosity. A by-product of this analysis was to

show, by the technique of partial correlation, that the correlation between line width and luminosity, discovered by Baldwin, is real.

Cerenkov Line Radiation: F. R. Cheng (with J. H. You)

Relativistic electrons with an isotropic distribution of velocities, when moving through a dense gas, could produce, by Cerenkov radiation, a broad atomic emission line with a markedly asymmetric profile. It has been examined by calculation as to whether such radiation could satisfactorily explain the emission-line spectra of some quasi-stellar objects.

Historical Astronomy: T. Kiang

The question of dates used to describe night observations in Chinese records has been clarified by the examination of records of occultations of stars by the moon. During the periods AD 300-500 and AD 1000-1250, use of 'new' dates are very rare; in other times, when they occur, they refer to observations after 3 a.m. Local Time. A paper has been communicated on this topic and the results were used to re-examine the times of perihelion passage ( $T_0$ ) of Comet Halley. Corrections to former (1971) values of  $T_0$  range from -0.75 to 2.35 days and error-bands for  $T_0$  now range from  $\pm 0.05$  to  $\pm 1.7$  days.

It has been considered whether Chinese records of lunar occultations can set constraints in the problem of determining the secular change in the rate of rotation of the Earth.

### 3 ELECTRONICS LABORATORY

The control unit for the Acquisition and Guiding Box of the Science Research Council (UK) 2.5m telescope reconstruction was completed during January and the unit was taken to RGO Herstmonceux, Sussex, for testing and software development. Simple machine code programs were written to test the functions of the unit in a static situation. Some defects were corrected. Final testing with the A & G Box is scheduled for early 1981. (This unit is the first item of equipment designed and constructed in the Astronomy Section for regular use on a modern telescope.)

The design of a coordinate measuring and plate-viewing machine, using television standards, was started during the year. A bench coordinatograph and linear encoders were purchased; these will form the basis of the design which will be linked to recording disks on a Nova 2 computer and CAMAC modules.

The Joyce-Loebl microdensitometer was completely overhauled and the illumination housing was provided with a sodium halogen light source and a new cooling fan to replace the tungsten light source.

4 CONFERENCES, LECTURES, ETC.

International Astronomical Union (IAU)

As General Secretary of the IAU, P. A. Wayman represented the Union at meetings of COSPAR in Budapest in July and of ICSU in Amsterdam in September. He also visited Greece in January and again in June in order to confirm the issuing of an invitation to the Union to convene its 1982 General Assembly in Patras, Greece. The 47th Executive Committee Meeting of the IAU was held in Amsterdam during August 1980. (It was noted at that meeting that the re-accession of the Peoples Republic of China to the IAU had been made final from May 1980, the arrangement being agreed to have China represented by adhering bodies in Nanking and in Taipei. This was the outcome of discussions in Peking in April 1979 and at the Montreal IAU General Assembly in August 1979.)

Lectures, Visits

Dr. J. V. Jelley (AERE Harwell/RCO) presented the Statutory Public Lecture of the School in Trinity College, Dublin: "Transient Phenomena in Astronomy", on 11 April 1980.

The following colloquium lectures were given during the year:

- 5 May: P. B. Byrne (Armagh) - Optical activity in Flare Stars.
- 22 August: P. Veron (Paris) - The Nature of Quasars.

On 19 December the Astronomical Science Group of Ireland held its winter meeting at Dunsink Observatory. Speakers were R. M. West (ESO, Munich), A. E. Lynas-Gray (UCL), D. McNally (UCL), R. Bates (Meteorological Service), and Cheng Fu-hua.

Other visitors to Dunsink Observatory during the year included M. van den Berg (Groningen), J-P. Rozelet (Pic-du-Midi), H. F. Corwin (Edinburgh), Nigel Calder (BBC), E. van Dessel (Brussels), M. Burger (Brussels) and I. Glass (Cape Town).

P. A. Wayman spoke to the Dublin Centre, Irish Astronomical Society, on the Viking Cameras on Mars on 18 February, on the Double Quasar on 1 December and on 'Waves in Space' on 15 December. He also spoke on the Viking Cameras at Armagh Observatory on 21 February, on the La Palma Observatory proposals to a meeting of the Institute of Physics of Ireland in Castlebar on 22 March, on the 'Life History of a Star' to the North-western Scientific Society, Sligo, on 5 November, and on 'Astronomy in China' to the Irish Astronomical Association, Belfast, on 20 February. He also attended the Aristarchus Symposium, Samos, Greece on 16 June and the Inauguration of Starlink, Didcot, on 24 October.

T. Kiang contributed material to the Workshop on Analytical Methods and Ephemerides, Namur, Belgium, 28-31 July. I. Elliott

attended the JOSO Board Meeting, Florence, 10-12 March and the Data General (UK) Users Group Meeting at RGO Herstmonceux, 18-19 September. I. Elliott spoke on general astronomy at the Dun Laoghaire College of Art and Design on 18 and 25 November.

P. A. Wayman visited Sir Howard Grubb Parsons and Company, Newcastle, on 19 May, and the Royal Observatory, Edinburgh, on 20 October.

## 5 PUBLICATIONS

Editorships: I. Elliott - Irish Astronomical Journal  
T. Kiang - Chinese Astronomy  
P. A. Wayman - IAU Publications

### Published 1980:

Irish Astronomical Journal Vol.13, No.7/8  
Vol.14, No.1/2  
Chinese Astronomy Vol.3, No.4  
Vol.4, Nos.1, 2, 3  
IAU Highlights of Astronomy Vol.5  
(D. Reidel Publishing Co. 1980, pp.viii+ 868)  
IAU Transactions Vol.XVIIIB, Proceedings of the  
17th General Assembly  
(D. Reidel Publishing Co. 1980, pp.x + 527)  
IAU Information Bulletin, Nos.43, 44.

### Journals etc.

T. Kiang:

"Hyperperiods and Kirkwood Gaps", *Vistas in Astronomy* 24, 17-37, 1980.

"Dates used in Chinese Historical Annals" (in Chinese), *Acta Astronomica Sinica*, 21, 323-333, 1980.

F. H. Cheng:

"Note on an Elementary Differential Geometry Problem" (in Chinese) - in press.

T. Kiang and F. H. Cheng:

"Statistical investigations of the magnitude-redshift relation of quasars, I" - submitted to *Astrophysical J.*

H. P. Murphy, R. E. Schild and T. C. Weekes:

"CCD Camera Observations of Nearby Rich Clusters, I" - to be submitted.

T. C. Weekes, H. P. Murphy, R. E. Schild, H. Gursky, J. Geary and  
T. Stephenson:

"More Absorption towards Cygnus X-3" - submitted to Publ. Astr.  
Soc. Pacific.

P. A. Wayman:

"Fitting Procedures for Positions on Schmidt Photographs",  
Irish Astr. Journ. 13, 226, 1978.

A4 documents, reviews, etc.

H. P. Murphy: M.Sc. Thesis, University College, Dublin 1980  
"A Study of Galaxy Photometry and Triaxiality  
in Elliptical Galaxies".

I. Elliott: Report to Registrar DIAS on provision of computer  
for Administration.

Review IAJ "In Search of Ancient Astronomies".

Review IAJ "Astronomy of the Ancients".

T. Kiang, F. H. Cheng: Chinese-English Astronomical Dictionary.

Advisory Board, La Palma Project, Information Sheet No.1, June 1980.

6 MISCELLANEOUS

The maker's testing of the One-metre La Palma Observatory  
telescope was completed. Except for some modification of the field  
lens system and re-design to adapt the control system to the tele-  
scope drive, the requirements of the specification have been met.  
For final matching of drive system with the control computer, the  
telescope is to be temporarily erected at the Royal Greenwich  
Observatory during 1981. The date of erection at Roque de los  
Muchachos, La Palma is postponed to late 1982.

The contract for repair of fire damage at Dunsink Observatory  
and associated work was completed during the year. The Meridian  
Room was re-opened as a Library and Meeting Room by the Chairman of  
Council of the Institute on 21 June 1980.

B COSMIC RAY SECTION

1 STAFF AND SCHOLARS

Senior Professor:

C. Ó Ceallaigh

Professor:

K. Imaeda

Assistant Professors:

D. O'Sullivan and A. Thompson

Research Assistant:

Vacant

Experimental Officer:

J. Daly

Technical and Clerical Staff:

Mrs. E. Clifton, Miss M. Cahill (to 31 April), Mrs. E. Rankin Brady, Mrs. H. Sullivan, Miss A. Grace, Miss G. Broderick (from 3 June), Miss A. Larkin (from 3 June), Miss E. Ryan (from 24 November).

2 RESEARCH WORK

Particle Detector Based Research: J. Daly, C. Ó Ceallaigh,  
D. O'Sullivan, A. Thompson.

(a) LDEF Project

Extensive work related to the Ultra Heavy Cosmic Ray Experiment (UHCRE) on the NASA Long Duration Exposure Facility (LDEF) continued during 1980. Construction of the detector stacks and Eccofoam (polyurethane isocyanate) enclosures in DIAS was completed on schedule during the year and the entire set was transported to the European Space Research and Technology Centre at Noordwijk (ESTEC). Production of the aluminium pressure vessels at ESTEC was completed in parallel and integration of the DIAS and ESTEC components began in early summer.

It was decided to load, seal and leak test 51 main pressure vessels which will be mounted in 17 LDEF trays, including one spare tray. The composition of the gas mixture chosen for the pressure vessels was 15% helium, 20% oxygen and 65% nitrogen. This mixture was required to 'extra dry' specifications, that is having a dew point less than  $-60^{\circ}\text{C}$ . The flight instrument will consist of 48 pressure vessels containing 192 detector stacks and having a total weight of 1250 kg.

Due to further delays in the NASA Space Shuttle development program the launch of the UHCRE has been rescheduled again. The current date is December 1983. However, an important potential advantage of the delay is that the LDEF schedule and the schedule of the Bevalac heavy ion accelerator are now such that the upgraded Bevalac should be operational at least one year before the UHCRE launch. Consequently, it is now realistic to consider the possibility of a fast ultra heavy beam calibration before the mission which would further enhance the scientific value of the experiment.

It was not possible to confirm the final thermal design of the UHCRE during the year because NASA was unable to carry out the overall LDEF thermal analysis on schedule. NASA has now promised this analysis before August 1981. The thermal design of the UHCRE will significantly affect the overall thermal history of the LDEF spacecraft since the UHCRE occupies about 20% of the LDEF surface. If the results of the NASA thermal analysis are favourable, the thermal properties of the UHCRE will be optimised by using single surface mirrors of 125  $\mu\text{m}$  silvered teflon as outer tray covers.

NASA has provided its updated vibration qualification test requirements and confirmed the requirement for M-axis high frequency (> 200 Hz) random vibration testing of the UHCRE. This will be carried out at ESTEC. It may be noted that the cost of all flight qualification testing will be borne by ESTEC.

During the year ESTEC provided storage and working facilities for the UHCRE and will provide clean room facilities for thermal surface work during 1981.

#### (b) Iron Peak Studies

A new project to study the cosmic ray iron peak in collaboration with the Naval Research Laboratory, Washington D.C. (NRL) began during the year. The scientific objectives are twofold. Firstly, an attempt will be made to resolve iron isotopes using a completely new technique of local calibration in temperature controlled CR 39 detectors. Secondly, absolute fluxes in the iron peak region will be measured during solar maximum. Such flux measurements are particularly important because at present there are no experimental data whatsoever of this type on record.

The experimental approach was based on a high altitude balloon flight exposure of solid state nuclear track detector stacks. A combination of CR 39 allyl diglycol carbonate polymer and Lexan polycarbonate resin detector elements was used for the stacks. For the first time active temperature control was employed and this was combined with a system for deploying the stacks at float altitude.

A Winzen 330,000 cubic metre balloon, constructed of 12.7  $\mu\text{m}$  Stratofilm, was selected to meet the load and altitude requirements. The gross weight was 1160 kg, the scientific payload weighed 334 kg.



The launch took place on 6 September 1980 at Pierre, South Dakota. The balloon system was allowed to float at altitude for 34 hours before the flight was terminated from the tracking aircraft. The gondola was safely parachuted and landed 30 km west of Buffalo, South Dakota. The effective mean float altitude during the flight was 3.4 mb. It may be noted that the full cost of the balloon, helium and flight operations (£20,000) and the cost of the purpose-built gondola with associated equipment was borne by the U.S. Navy. Processing, scanning, measurement and analysis are expected to continue through 1981. In addition, comprehensive heavy ion calibration is planned for 1981.

(c) Detector Response Studies

Work related to various track response experiments and detector development programs continued during the year. This work, which relied to a large extent on heavy ion exposures at the LBL Bevalac, was carried out on three fronts by DIAS alone, by the DIAS/Bristol University collaboration and by the DIAS/NRL collaboration. Significant further improvements in CR 39 detectors have been made by the development of new polymerisation cycles and considerable progress has been made in establishing the ionisation-response relationship in CR 39 polymers.

A major break-through in the field of solid state nuclear track detectors was achieved by the DIAS group in discovering a relationship between sensitivity and registration temperature in polymers. Apart from its value in contributing to the understanding of the fundamental mechanisms of track response, this discovery has very important applications to the use of track detectors for cosmic ray studies. In particular, it leads to techniques for attaining significantly improved resolution.

(d) Irish-German Collaboration

During the year a collaborative program was established with the Max Plank Institut für Aeronomie (Katlenburg-Lindau, Germany) and St. Patrick's College, Maynooth, to pursue space research applications of particle detector systems based on surface barrier semiconductor elements. A joint proposal for an energetic particle detector to be flown on the Giotto Mission to Comet Halley has been prepared and submitted to ESA. The proposed instrument would incorporate three surface barrier silicon detector elements to measure electrons, protons and particles with  $Z \geq 2$  in four sectors and nine different energy channels with one second and one hour time resolution during the encounter phase and the cruise phase, respectively, of the mission.

Other Research: K. Imaeda

(e) Study of the Einstein-Podolski-Rosen Paradox

Recently, Cramer, J. G. has presented an explanation of the Einstein-Podolski-Rosen (EPR) Paradox (Physical Review D, Vol.22, 362, 1980) by introducing the idea of 'a minimum emitter-absorber transaction'. He succeeded in giving a clear explanation of the non-separability aspect of the EPR paradox and of the result of the polarization measurement of a double photon decay experiment of Freedman and Clauser (Physical Review Letters, Vol.28, 938 (1972)) which tests the validity of local hidden variable theories. An attempt has been made to explain the EPR Paradox in the context of classical physics coupled with an extension of Cramer's idea of 'minimum transaction'. A certain measure of success has been achieved and it is hoped to present these results in the near future.

(f) Study of an Octonionic Formulation of "Quantum Chromodynamics"

An attempt has been made to extend the formulation of classical electrodynamics by quaternions to that of octonions to enable us to formulate quantum chromodynamics (interactions between coloured quarks) in terms of the theory of functions of an octonion variable. The algebraic formulation of quarks by octonions was established some years ago. Thus, it is worth while to formulate quantum chromodynamics in the octonion language by extending the concept of an analytic function in the theory of functions of a quaternion variable applied to electrodynamics (K. Imaeda, Nuovo Cimento, Vol.32A, 138 (1976)). A number of results have been obtained. However, the main difficulty in defining functions of an octonion variable still remains to be resolved; the removal of the associative law for multiplication in octonion algebra makes the theory much more difficult to deal with than in the case of quaternions.

### 3 EXTERNAL ACTIVITIES

During the year short working visits in furtherance of the LDEF program and other research projects were made by members of the staff as follows:

Bristol University (9-10 April) - A. Thompson  
ESTEC, The Netherlands (6-8 May) - J. Daly, D. O'Sullivan and  
A. Thompson  
NASA and LaRC, USA (27 May - 5 June) - D. O'Sullivan and  
A. Thompson  
MPAe, Germany (6-11 October) - D. O'Sullivan and A. Thompson  
Bristol University (29 October - 1 November) - D. O'Sullivan and  
A. Thompson

ESTEC, The Netherlands (16-17 November) - D. O'Sullivan and  
A. Thompson

In addition, J. Daly worked for a period of five weeks at the European Space Research and Technology Centre (ESTEC) in May and June in order to carry out integration of DIAS and ESTEC hardware components.

As a member of the Space Science Standing Committee of the European Science Foundation, C. Ó Ceallaigh attended meetings in Paris (15-16 April) and Rome (25-26 November).

D. O'Sullivan attended the Irish Astronomical Science Group meeting at Armagh in June.

#### 4 MISCELLANEOUS

During the year A. Thompson served as secretary of the National Committee for Physics, as a member of the Royal Irish Academy Committee for Space Research and as a member of the Scientific Committee for the International Solid State Nuclear Track Detector Conference.

Working visits to the Cosmic Ray Section during the year were made by Dr. Juan Sequeiros (Head of Cosmic Ray Section, National Institute of Aerospace Technology, Madrid), Dr. K-P. Wenzel (Head of Cosmic Ray Division, Space Science Department of ESA, ESTEC) and Dr. E. Kirsch (Max-Planck-Institut für Aeronomie, Katlenburg-Lindau, Germany).

In addition, the Cosmic Ray Section was visited by Professor Pierre Morel (Directeur General Adjoint, Centre National d'Etudes Spatiales, Paris) for cooperative discussions.

D. O'Sullivan gave a lecture at University College, Cork, University College, Dublin and Queens University, Belfast, during the year.

#### 5 PUBLICATIONS

D. O'Sullivan and A. Thompson:

The observation of a Sensitivity Dependence on Temperature during Registration in Solid State Nuclear Track Detectors. Nuclear Tracks (in press)

A. Thompson, D. O'Sullivan and C. Ó Ceallaigh:

An Improved CR39 Track Detector for Cosmic Ray Applications. Nuclear Tracks (to be published)

- C. Ó Ceallaigh, J. Daly, D. O'Sullivan and A. Thompson:  
The Ultra Heavy Cosmic Ray Experiment on the NASA Long Duration Exposure Facility.  
NASA Report (in press)
- A. Thompson, D. O'Sullivan and C. Ó Ceallaigh:  
Development Studies of CR39 for Cosmic Ray Work.  
Solid State Nuclear Track Detectors, edited by H. Francois et al, Pergamon Press Oxford and New York, 1980.
- D. O'Sullivan, A. Thompson, J. Daly and C. Ó Ceallaigh:  
A Solid State Track Detector Array for the Study of Ultra Heavy Cosmic Ray Nuclei in Earth Orbit.  
Solid State Nuclear Track Detectors, edited by H. Francois et al, Pergamon Press Oxford and New York, 1980.
- A. Thompson and D. O'Sullivan:  
The Effect of temperature-time cycles in the Polymerisation of CR39 on the Uniformity of Track Response.  
Solid State Nuclear Track Detectors, edited by H. Francois et al, Pergamon Press Oxford and New York, 1980.
- D. O'Sullivan, A. Thompson and C. Ó Ceallaigh:  
The Abundance of Zinc in the Cosmic Radiation.  
(In preparation)
- A. Thompson and D. O'Sullivan:  
The Registration-temperature/Sensitivity relationship in Polymer Track Detectors.  
(In preparation)
- K. Imaeda and T. Kiang:  
The Japanese Record of the Guest-star of 1408.  
Journal for the History of Astronomy, Vol.11, p.77, June 1980.
- K. Imaeda and Mari Imaeda:  
Wheeler-Feynman Absorber Theory, Einstein-Podolski Rosen Paradox and Stochastic electrodynamics.  
(In preparation)

C GEOPHYSICS SECTION

1 STAFF AND SCHOLARS

Senior Professor:

T. Murphy

Professor:

A. W. B. Jacob

Research Assistant:

P. W. Readman (from 11 January)

Visiting Scientists:

R. K. Fröhlich (30 July - 31 August); D. Hutton (16-20 June)

Experimental Officer:

J. C. Davies

Technical and Clerical Staff:

K. Bolster, Miss A. Byrne, Miss E. Ryan, Miss V. Ward,  
G. Wallace

Scholar:

N. Murphy

2 RESEARCH WORK

(a) Magnetics

A cruise was undertaken in the R.V. Lough Beltra in an area north of Lough Swilly. Considerable difficulties were encountered in the operation of the vessel which eventually broke down completely. This resulted in a curtailed program and the area covered was approximately 1500 sq km. Being incomplete, certain important check readings were not taken, the results leave many uncertainties. However, it was found that the interpretation of the geology by earlier workers is questionable, particularly the extension of the Fanad granite.

During this cruise Dr. D. Hutton participated in work, part of which was to be used later by some of his students in Trinity College.

The main results have been summarised as the outlining of certain areas of magnetic anomalies which he attributes to quartzite not granite, the absence of evidence for large faults and the surprising lack of Tertiary volcanic dykes although considerable volcanic activity indicates its presence.

Professor Fröhlich investigated the magnetic characteristics of the granite at Carnsore, Co. Wexford and some of the granites of North Donegal. He attributes changes in the magnetic character of the Carnsore granite to hydrothermal activity and suggests that this can be used to delineate faults. In Donegal his principal work was concerned with palimpsestic ghost structures in the Thorr granite and their possible use in the current investigation for economic deposits of certain strategic minerals.

(b) Meteorology

Routine observations of the meteorological elements were continued throughout the year, autographic records tabulated and the results published.

(c) Gravity

The gravity data collected to date has been transferred to magnetic tape and the Bouguer Anomaly for each station recomputed according to the 1971 Standardisation. With the commissioning of the plotter attachment to the computer a start has been made on drawing up the gravity results on a series of maps on a scale of 1:126 760 corresponding to the Ordnance Survey sheets.

Exploration of the gravity anomaly at Pipemakers Gorse was started but is not yet completed. Loose decomposed limestone was encountered as expected from the survey.

(d) Seismology

During the earlier part of the year certain happenings at the recording station at Kilmashogue made it desirable that the site be vacated. Through the kindness of the authorities of University College Dublin and Professor I. Gordon of the Faculty of Agriculture a derelict cottage in the grounds of Lyons Estate, Co. Kildare was placed at our disposal for housing the recording equipment. A site nearby on outcropping rock was prepared for seismometers becoming the three component station DLE. Radio links have been made with the other stations of the network and data from the five stations DMU (Kingscourt), DCN (Croghan), DDK (Dunsink), DKM (Kilmashogue) and DLE (Lyons) are recorded at Lyons on the same magnetic tape.

A new 3 component station was set up at Carnsore Point (ECP) early in June. This station improves our coverage of the Irish Sea

and Celtic Sea Areas. It is to be linked to at least one outstation.

The Carnsore Point station has already turned out to be an extremely important extension of our network because we have the first instrumentally recorded Irish earthquake on the 26th of December. The epicentre was located 2 km SW of Enniscorthy at 21<sup>h</sup> 42<sup>m</sup> 42.1<sup>s</sup>. As the magnitude was only  $M_L = 1.2$  it was not felt. Because of the existence of ECP the event fell within our network and this greatly increased the accuracy of location. There were good impulsive P and S arrivals, and this gave a good estimate for the origin time too, in spite of uncertainties in the seismic travel time curves for this region. Previous events felt in the Co. Wexford area and its environs include Courtown, 27th August 1881, Tinahely, 2nd January 1869, and Wexford Town, 16th March 1762.

Another very interesting seismic event occurred on the 13th of April 1980 near the Hebrides Terrace Seamount. This seamount lies in the eastern part of the Rockall Trough near the continental margin. This area is seismically very quiet and we had to investigate the possibility that the source might have been a large explosion. The detailed seismic evidence is that it was an earthquake. A paper on the subject has been prepared for publication.

We are continuing to transcribe and digitize our seismic data in Edinburgh (see last year's report). With the addition of a new recorder at ECP the volume of data has increased considerably.

N. Murphy commenced fieldwork on the surface wave project using mobile recording stations developed in the Section, in addition to the fixed stations, to record quarry blasts from the quarries at Platin and Runtstown. These are operated by Cement-Roadstone who have been extremely helpful in allowing shot times to be recorded at the sites and notifying us in advance of imminent blasts. Suitable records, after digitizing in Edinburgh are analysed using the computer and give data for the determination of the upper crustal structure of North Dublin.

A start was made on a region west of the above using the same quarries and in addition another, Deerpark near Slane. This is to help the interpretation of an unusual circular gravity anomaly centred on Kentstown, Co. Meath.

Up to December only vertical component seismometers were employed and a start was then made to employ three components at the mobile stations.

A system for multiplexing and demultiplexing seismic data was developed by G. Wallace who later constructed prototype models. These have useful applications both in transmitting over radio and telephone links and in recording multichannel data on single channel recorders.

(e) Palaeomagnetism

P. Readman continued his studies on the palaeomagnetism of lake sediments from Switzerland and Greece and a detailed pattern of the secular variations in declination and inclination for the past 13000 years in Europe is being elucidated. In collaboration with the Geology Institute of Aarhus University samples from Denmark are being studied and it is the intention to extend this work westwards in Ireland. The method is proving a useful tool in dating recent sediments.

In collaboration with Edinburgh University data from lagoonal deposits in Italy have yielded evidence that the geomagnetic event ca 100,000 B.P. named the Blake Event is probably worldwide and further studies on similar deposits is underway.

In the summer, working in Edinburgh University he investigated the nature of the magnetic minerals which provide the remanent magnetisation of sediments and the results to date indicate that the main magnetic mineral is detrital magnetite.

3 SEMINARS

February 18:	A. W. B. Jacob	"Current Seismic Research in Ireland"
March 7:	T. Murphy	"Seismic noise"
May 9:	A. W. B. Jacob	"Practical Seismology"
September 26:	T. Murphy	"Results of magnetic survey off North Donegal"
October 24:	N. Murphy	"Inversion Techniques"

4 EXTERNAL ACTIVITIES

T. Murphy gave a series of lectures on geophysics on two days in Cork to undergraduate students in February.

B. Jacob, P. Readman, N. Murphy and T. Murphy attended the United Kingdom Geophysical Assembly at Birmingham in April and B. Jacob the Royal Society Working Group on Explosion Seismology which followed.

A field demonstration of geophysical instruments was given to undergraduate students of Trinity College at Avoca Mines in April and short electrical, gravity and magnetic surveys were carried out by them.

N. Murphy attended Oxford University in September on a course on "Inversion Techniques in Geophysics".



P. Readman attended a Joint Association Meeting for Geophysics on "Squid Magnetometers and their Applications" at University College, Cardiff in December.

T. Murphy attended several meetings of the Technical Advisory Committee of the Department of Foreign Affairs in connection with the delimitation of the Continental Shelf between Ireland and Britain.

## 5 PUBLICATIONS

D. W. Howard and P. Morris:

A note on the remagnetisation of the Lower Carboniferous Rush Conglomerate, Rush, County Dublin.  
J. Earth Sci. R. Dubl. Soc. 3, 1980, 139-145.

P. W. Readman:

"Geomagnetic variations recorded in Older (> 23000 B.P.) and Younger Yoldia Clay (~ 14,000 B.P.) at Norre Lyngby, Denmark".  
Geophys. J.R. Astr. Soc. (1980) 62, 329-344 (with N. Abrahamsen).

P. W. Readman:

"Palaeomagnetic secular variation curves extending back to 13,400 years B.P. recorded by sediments deposited in Lac de Joux, Switzerland".  
J. Geophys. (1980) 48, 139-147 (with K. M. Creer, T. E. Hogg and C. Reynaud).

P. W. Readman:

"Palaeomagnetic and palaeontological dating of a section of Gioia Tauro, Italy: Identification of the Blake Event".  
Earth Planet. Sci. Lett. (1980) 50, 289-300 (with K. M. Creer and A. M. Jacobs).

### Abstracts:

A. W. B. Jacob:

"Lithospheric structure under Britain and Ireland".  
Geophys. J. R. Astr. Soc., 61, 1980, 198.

P. W. Readman:

"Palaeomagnetic declination and inclination variations in Europe since 13500 years B.P." (with K. M. Creer).  
Geophys. J. R. Astr. Soc., 61, 1980, 210.

P. W. Readman:

"Palaeomagnetism and magnetic mineralogy of a cave sediment"  
(with S. Papamarinopoulos, Y. Maniatis and A. Simopoulos).  
Geophys. J. R. Astr. Soc., 61, 1980, 213.

6 MISCELLANEOUS

Undergraduate students Julia Gibson and Ian Abernethy of Trinity College carried out research projects using (a) marine magnetic data collected off northwest Donegal and (b) gravity data in Meath around the Kentstown Anomaly as part of their course for degrees in Geology.

In the course of the year the Section has dealt with a large number of enquiries from members of the public and specialised commercial and scientific interests.

D COMPUTER INSTALLATIONS

J. C. Davies (Geophysics)  
I. Elliott (Astronomy)  
B. D. Jordan (Astronomy)

Eclipse S/130 (5 Merrion Square)

The Data General Eclipse S/130 system at 5 Merrion Square was heavily used during the year by the Cosmic Ray and Geophysics Sections. No major hardware or software additions were made to the system during the year, but the opportunity was taken to develop fully the major additions of 1979. Use was made of FORTRAN 5 facilities for accessing extended memory for programs larger than 32KW. Virtual overlays are a convenient way of placing subroutines into extended memory. Window mapping of large arrays is, however, limited by the amount of available extra core (14KW).

Nova 2/10 (Dunsink Observatory)

A Calcomp Model 81 plotter was installed at the secondary port and the appropriate software modified for the Nova and provided in the form of a Fortran library File.

The Smithsonian Astrophysical Observatory Star Catalogue was provided on magnetic tape and access for display on the console was programmed.

A Teksim ROM enables the Apple II computer to emulate a Tektronix 4010 graphics terminal in conjunction with the Nova 2/10.


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

Income and Expenditure Account

for the year ended 31 December 1980

<u>1979</u>			<u>1980</u>
£	<u>INCOME</u>	<u>NOTES</u>	£
868,000	Oireachtas Grant-in-Aid	1(a), 2	940,000
25,747	Sales of Publications	3	23,181
29,599	Fire Insurance Compensation	4	—
1,511	British Academy Grant		—
2,039	Working Seminar	5	1,778
27,459	Miscellaneous	6	26,614
<u>954,355</u>			<u>991,573</u>
	<u>EXPENDITURE</u>	7	
257,303	Administration		272,995
203,496	School of Celtic Studies		251,248
128,749	School of Theoretical Physics		154,725
340,631	School of Cosmic Physics		374,199
12,475	Adaptation of Premises		—
<u>942,654</u>			<u>1,053,167</u>
11,701	SURPLUS (DEFICIT) for year	8	(61,594)

Notes 1 to 13 form part of these accounts.

Signed: 

T. K. WHITAKER  
Chairman,  
Council of the Institute.

10th July, 1981.


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

Balance Sheet at 31 December 1980

<u>1979</u>		<u>NOTES</u>	<u>1980</u>
£	<u>CURRENT ASSETS</u>		£
144,719	Cash on hands and at Bank		86,472
32,820	Debtors and Prepayments		28,443
<u>177,539</u>			<u>114,915</u>
	Less		
	<u>CURRENT LIABILITIES</u>		
58,146	Creditors and accruals		57,116
<u>119,393</u>	<u>NET CURRENT ASSETS</u>		<u>57,799</u>
	Represented by		
119,393	INCOME and EXPENDITURE - Accumulated Surplus	8	57,799
<u>119,393</u>			<u>57,799</u>

Notes 1 to 13 form part of these accounts.

Signed:



T. K. WHITAKER  
Chairman,  
Council of the Institute.

10th July, 1981.

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

NOTES TO THE ACCOUNTS

1. Accounting policies

- (a) Oireachtas Grant-in-Aid: Income shown in the Accounts as Oireachtas Grant-in-Aid is the actual cash received in the period of the Account.
- (b) Furniture and Equipment: Expenditure on Furniture and Equipment is written off in the period in which it is incurred.
- (c) Publications: Expenditure on Publications is written off in the period in which it is incurred.

2. Oireachtas Grant-in-Aid

<u>1979</u>	Grant-in-Aid voted to the Institute has been allocated under the following headings:	£	£
£			
189,000	Administration	194,800	
207,400	School of Celtic Studies	231,550	
123,700	School of Theoretical Physics	148,100	
335,500	School of Cosmic Physics	365,450	
<u>12,400</u>	Adaptation of Premises	<u>100</u>	<u>940,000</u>
868,000			

£	3. <u>Sales of Publications</u>	£	£
25,367	School of Celtic Studies	22,815	
324	School of Theoretical Physics	330	
<u>56</u>	School of Cosmic Physics	<u>36</u>	<u>23,181</u>
25,747			

4. Fire Insurance Compensation

(a) Contents

Insurers paid £53,518 to the Institiúid in 1978 in settlement of "contents" claim arising from a fire at Dunsink Observatory in 1977. Expenditure in the period 1 October 1977 to 31 December 1979 amounted to £34,808 and expenditure in 1980 was £6,435. The balance on hands at 31 December 1980, namely £12,275, is included in the balance of the School of Cosmic Physics.

/(b)

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

NOTES TO THE ACCOUNTS

(b) Buildings

An interim payment of £48,000 was made by the Insurers in 1978 towards cost of re-instatement of the building destroyed by fire. Expenditure on rebuilding in the period October 1977 to 31 December 1979 amounted to £64,510 and was £23,361 in 1980 - Total: £87,871. Negotiations with Insurers are continuing and it is expected that a final settlement will be reached before the end of 1981.

5. Working Seminar

Included under this heading are fees from participants and the following grants: TCD - £200; St. Patrick's College, Maynooth - £100; UCD - £60; UCG - £60.

1979

£	6. <u>Miscellaneous Income</u>	£	£
26,537	Administration	25,357	
906	School of Celtic Studies	1,161	
16	School of Theoretical Physics	6	
	School of Cosmic Physics	90	26,614
27,459			

7. Analysis of Expenditure

1979		Total	Administration	School of Celtic Studies	School of Theoretical Physics	School of Cosmic Physics
523,516	Salaries, Wages & Superannuation	668,508	125,428	177,210	102,064	263,806
36,071	Scholarships	42,109	-	15,665	18,291	8,153
1,450	Honoraria	1,113	-	1,038	-	75
24,367	Library	34,713	-	3,429	17,383	11,903
38,057	Publications (Note 1c)	44,519	765	42,971	403	380
59,942	Furniture & Equipment (Note 1b)	24,014	394	2,091	1,848	19,681
104,917	General Administration (Note 9)	117,498	117,498	-	-	-
25,329	Travelling & Survey Expenses	26,583	449	3,377	3,892	18,965
4,656	Symposium & Seminar Expenses	8,902	-	488	6,414	-
28,061	Consumable Equipment	15,678	-	-	-	15,678
24,235	General Expenses	29,667	5,100	2,979	4,430	17,158
10,331	Special Commitments (Note 10)	11,965	-	-	-	11,965
	Fire Replacement:					
3,138	'Contence' (Note 4)	6,435	-	-	-	6,435
46,109	Buildings (Note 4)	23,361	23,361	-	-	-
930,179	Total:	1,053,167	272,995	251,248	154,725	374,199
13,673	Adaptation of Premises	811				
943,852	Total:	1,053,167				

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

NOTES TO THE ACCOUNTS

8. <u>Surplus/Deficit Position</u>	Balance 1/1/80	Year to 31/12/80	Balance 31/12/80
Administration	37,276	(52,838)	(15,562)
School of Celtic Studies	48,345	4,278	52,623
School of Theoretical Physics	325	(4,511)	(4,186)
School of Cosmic Physics	33,323	(8,623)	24,700
Adaptation of Premises	<u>124</u>	<u>100</u>	<u>224</u>
	119,393	(61,594)	57,799

This surplus is available towards meeting the Institute's expenditure on commitments outstanding at 31 December 1980 (see Note 13).

1979

£	9. <u>General Administration Expenses</u>	£	£
39,387	Rent, Rates & Insurance	42,105	
36,189	Premises Maintenance	34,658	
13,070	Postage & Telephones	17,133	
14,149	Fuel, Light & Power	21,343	
<u>2,122</u>	Sundry Supplies	<u>2,259</u>	117,498
104,917			

10. Special Commitments

The expenditure under this heading consisted of the second contribution by DIAS towards the capital cost of a 1-metre Telescope to be erected at La Palma, Canary Islands, in joint agreement with the Science Research Council (UK) and the National Board of Science and Technology.

£11,965

11. Superannuation

Expenditure arising under superannuation schemes is met out of Oireachtas Grant-in-Aid in the year of payment.

12. Vernam Hull Bequest

Included in the balance of the School of Celtic Studies (see Note 8) is an amount of £8,813 which is the value at 31 December 1980 of the Vernam Hull bequest to the School. The project to be financed by this bequest has not yet been decided on.



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

NOTES TO THE ACCOUNTS

13. Outstanding Commitments

The estimated cost of commitments outstanding at 31 December 1980, exclusive of Current Liabilities shown on the Balance Sheet, is as follows:

<u>31/12/79</u>		€
€		
38,000	Administration	25,600
51,000	School of Celtic Studies	54,000
750	School of Theoretical Physics	300
37,000	School of Cosmic Physics	24,000
<u>126,750</u>		<u>103,900</u>

INSTITIÚID ARD-LÉINN BHAILE ÁTHA CLIATH

Report of the Comptroller and Auditor General

I have examined the foregoing Income and Expenditure Account and Balance Sheet which, as required by Acht um Institiúid Árd-Léinn 1940, are in the form approved by the Minister for Education with the concurrence of the Minister for Finance. I have obtained all the information and explanations which I have considered necessary for the purpose of my audit.

In my opinion:-

- (a) proper books of account have been kept by An Institiúid and the Income and Expenditure Account and Balance Sheet are in agreement with them, and
- (b) the Income and Expenditure Account and Balance Sheet, together with notes 1 to 13 give, respectively, a true and fair view of the transactions of An Institiúid for the year ended 31 December 1980 and of the state of its affairs on that date.

SEÁN Mac GEARAILT  
Comptroller and Auditor General

4 Lúnasa 1981.