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

ANNUAL REPORT
1975

10 Burlington Road, Dublin 4

Prl.5645

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 1975

Prl.5645

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 1975

School of Celtic Studies

The year saw the death of Rev. Pádraig Ó Súilleabháin, O.F.M., who as Assistant Professor had been a most devoted research-worker, the retirement of Professor D. A. Binchy, who had been a Senior Professor since 1949, the appointment of Professor James Carney as Senior Professor and of Rolf Baumgarten as Assistant Professor, and the addition of five new members to the Governing Board for the quinquennium 1975-1980. One of the first acts of the new Governing Board was to establish a committee to consider what special steps might be taken by the School, in conjunction with university institutions, to advance the study of Modern Irish.

Research work continued in a wide variety of fields as in previous years, and there was some improvement in the progress of publications.

The Summer School, held in July, attracted a record number of students, and the Annual Symposium, held in March, and the weekly seminars were also well attended.

The Statutory Public Lecture, entitled 'Settler and Native in 17th century Ulster', was given in Trinity College in December by Professor Breandán Ó Buachalla.

School of Theoretical Physics

A summer seminar on Current Problems in Probability and the Physical Sciences was held and attracted twenty-four visitors from abroad as well as local mathematicians and physicists. A symposium to commemorate the scientific work of Arthur William Conway (1875 - 1950) was held jointly with University College, Dublin.

The School continued its research in the areas of general relativity, statistical mechanics, Lie groups and high-energy physics. Two numbers of Series A of the Communications of the Institute and thirty-one papers were published during the year. Members of the School attended sixteen international conferences and gave sixteen lectures in other institutions. Thirty-eight scientists from abroad visited the School (apart from visitors attending the summer seminar).

Events which were continued from the previous year were the Wednesday seminars, the Christmas and Easter symposia, and various weekly meetings held jointly with the universities. The joint UCD-TCD-Maynooth-DIAS postgraduate course was continued. In addition, a symposium for teachers of physics and mathematics in the regional technical colleges was held and attracted fifty participants.

The Statutory Public Lecture was given in University College, Dublin on 31 October 1975 by Professor T. E. Nevin as part of the Conway Centenary Symposium.

School of Cosmic Physics

Astronomy Section:

Photographic light curves have been derived for 175 variable stars (LMC I region), mostly cepheid variables, in U,B,V, R. This work completes the basic reduction of material on Magellanic Cloud variable stars commenced in 1966.

Using various data, distant blue stars have been investigated so as to give information on galactic structure and the density-wave theory of spiral arms.

Investigations of X-ray sources, magnetic variable stars, and the luminosity function of galaxies has continued. Instrumental developments included preparation for observing asteroid infrared brightness.

Computer Section: The dual-CPU Data General computer installation was improved greatly by the addition of a moving-head disk unit and a rack mounting to enable flexible operation for two users.

Cosmic Ray Section:

The main lines of research included further studies of the nuclear composition and energy spectra of heavy cosmic ray particles, and a number of experimental and theoretical investigations of high energy nuclear interactions.

The detectors flown from Sioux Falls, South Dakota, in 1974 were processed and scanned. Several hundred nuclei, including 20 ultra heavy candidates, were subjected to analysis.

A detailed investigation of the isotopic composition in the Fe region was undertaken and preliminary results indicate a large spread of mass values. The effect of solar modulation on the chemical composition of cosmic rays was estimated.

Further studies on the charge and energy spectra of nuclear fragments emitted from the interactions of high energy protons in a gold target revealed unexpectedly high cross sections even below the hard sphere Coulomb barrier. This phenomenon cannot be understood in terms of existing theories of high energy interactions.

Preliminary estimates of multiple Coulomb scattering parameters were obtained in nuclear emulsions exposed to high energy heavy ions.

The quaternionic formulation of electrodynamics has been extended to tachyons and the relation between tachyons and magnetic monopoles has been studied.

Geophysics Section:

The main studies undertaken were concerned with Continental margin. Magnetic data supplied by the University of Wales were combined with other data but discrepancies presumably due to navigational uncertainties limited their application. Nevertheless, from an analysis it is now thought that parts of the shelf are covered by sheet basalts.

In cooperation with Durham University seismic experiments were carried out, recordings being made on Inishowen. The analysis was not complete.

The Statutory Public Lecture, entitled 'Nuclear Particles from Outer Space' was delivered by Professor C. Ó Ceallaigh at University College, Dublin, on 17 December 1975.

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
for the year ended 31 December 1975

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 1975.

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 31st December 1975.

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 31st December 1975.
- 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 31st December 1975.

1. THE COUNCIL OF THE INSTITUTE

Chairman:

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; David Greene, M.A., President, Royal Irish Academy.

Members appointed by the Governing Boards of Constituent Schools:

Professor Brian Ó Cuív, M.A., D.Litt.; T. K. Whitaker, D.Econ.Sc.; Professor J. T. Lewis, B.Sc., Ph.D.; Dr. A. J. McConnell, M.A., M.Sc., Sc.D., F.T.C.D.; Professor T. Murphy, D.Sc.; Professor E. F. Fahy, M.Sc., Ph.D.

2. GOVERNING BOARD OF THE SCHOOL OF CELTIC STUDIES

Chairman:

Proinsias Mac Cana, M.A., Ph.D.

Senior Professors:

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

Appointed Members:

Máirín Bean Uí Dhálaigh, M.A., D.Litt.Celt.; Tomás de Bhaldraithe, M.A., Ph.D., D.Litt.; James H. Delargy, M.A., D.Litt., Litt.D.; Gearóid Mac Eoin, M.A., Ph.D.; Edward MacLysaght, M.A., D.Litt.; Monsignor Tomás Ó Fiaich, M.A., Lic.Hist.Sc.; 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:

Michael A. Hayes, M.Sc., Ph.D.; Thomas E. Nevin, D.Sc.; Patrick Quinlan, B.E., D.Sc., Ph.D.; Thomas D. Spearman, M.A., Ph.D. (Cantab.); Seán Seosamb Tóibín, M.Sc., Ph.D.; William Wright, M.A., Ph.D., Sc.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 COSMIC 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:

Patrick M. A. Bourke, M.Sc.; Peter Kevin Carroll, M.Sc., Ph.D.; 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.; Ernest T. S. Walton, M.A., M.Sc., Ph.D., D.Sc., F.T.C.D.

5. ADMINISTRATIVE STAFF

Registrar:

Patricia O'Neill.

Senior Clerk:

Maura Devoy.

Accounts Clerk:

Mary A. O'Rourke.

Clerks:

Angela Stubbs; Noreen Granahan (née Madden); Desmond Pender.

II - Annual Report of the Governing Board of the School of Celtic Studies for the year ended 31 December 1975 adopted at its meeting on 4 May 1976.

1. STAFF, SCHOLARS AND EXTERN RESEARCH WORKERS

Senior Professors:

David Greene, Director of the School to 30 September 1975; Daniel A. Binchy (retired 3 June 1975); Brian Ó Cuív, Director of the School from 1 October 1975; James Carney (appointed 1 July 1975).

Professors:

James P. Carney (to 30 June 1975); Breandán Ó Buachalla.

Assistant Professors:

Rev. Pádraig Ó Súilleabháin, O.F.M. (died 11 March 1975); Pádraig de Brún; Fergus Kelly; Rolf Baumgarten (appointed 1 August 1975).

Visiting Research Associate:

Joan N. Radner (October 1975 - December 1975).

Assistants (Part-time):

Mrs. Nessa Doran; Mrs. Anne O'Sullivan.

Research Assistants:

Rolf Baumgarten (to 31 July 1975); Mícheál Ó Siadhail.

Research Associates:

Proinsias Mac Cana; Heinrich Wagner; Gearóid Mac Niocaill.

Technical and Clerical Staff:

Máire Breatnach; Máire Bean Uí Chinnseala.

Scholars:

Katharine Simms (to 30 September 1975); Tadhg Ó Dúshláine; Liam Breatnach; Malachy McKenna; Anders Ahlqvist; John Armstrong III; Kay Muhr (re-appointed 1 June 1975); Pádraig Ó Ciardha (appointed 1 October 1975); Liam Ó Murchú (appointed 1 October 1975).

Extern Research Workers:

Dr. Cecile O'Rahilly; M. Louis Paul Nemo (Roparz Hemon); Dr. Ludwig Bieler; Mr. Brynley Roberts; Rev. Fearghal Mac Raghnaill, O.F.M.; Rev. Martin McNamara, M.S.C.; Tomás Ó Cathasaigh; Mr. Ronald Black; Dr. Brian Murdoch; Mr. Eury Rowlands.

Professor D. A. Binchy retired as Senior Professor in June and was accorded the title Professor Emeritus. The vacancy caused by his retirement was filled by the appointment of Professor James Carney in July. The death in March of Rev. Pádraig Ó Súilleabháin, O.F.M., who had been one of the School's most devoted and diligent research workers, left a vacancy as Assistant Professor and this was filled by the

promotion of Rolf Baumgarten. No expansion of the staff has been allowed, nor has it been found possible to make even preliminary arrangements for the appointment of a Visiting Professor. It is several years now since the urgent need for an additional clerk was pointed out, and the situation is getting progressively worse with the growing volume of work in connection with publications. In another area, too, the School suffered a severe set-back when, at a very late date, the Director was informed that the Department of Education would not make funds available as it had done on previous occasions for study-grants to students attending the Summer School. Were it not for a most generous donation from a private source the Summer School would probably have had to be abandoned.

The progress of publications improved during the year and in all twenty-four volumes were published, eighteen of which were ordinary reprints. However, the increases in charges for printing have added immensely to the difficulties of publication.

Following the appointment of the Governing Board for the quinquennium 1975-80 a committee of the Board was established to consider what special steps might be taken by the School, in conjunction with university institutions, to advance the study of Modern Irish.

2. RESEARCH AND EDITING

Professor David Greene continued his work on Saltair na Rann; in collaboration with Fergus Kelly an edition of The Irish Adam and Eve Story from Saltair na Rann was prepared and sent to press. A paper on 'Archaic Irish' was prepared for delivery to a Colloquium of the Indo-germanische Gesellschaft in February 1976. An article entitled 'The Diphthongs of Old Irish' was accepted for publication in Ériu XXVII. See also sections 4, 5, 7 and 8.

Professor D. A. Binchy continued the revision of proofs and the provision of cross-references in Corpus Iuris Hibernici. Some further legal material discovered by Dr. Anders Ahlqvist in a manuscript in TCD Library was transcribed and sent to the printer. Dr. Binchy completed the first of two long articles which are to appear in the next two numbers of Studia Hibernica and are intended as a substitute for the introductory volume of the Corpus Iuris Hibernici which had formed part of the original plan. See also section 5.

Professor Brian Ó Cúiv continued work on (i) linguistic and metrical topics; (ii) editing: (a) some unpublished work by An tAthair Peadar Úa Laoghaire, (b) a number of Middle Irish and Modern Irish poems; (iii) material to be published in A New History of Ireland. He completed the editing of one issue of Éigse and, in association with Professor David Greene, saw Celtica XI through the various proof stages. Proofs of Dán na mBráthar Mionúr II, on which the late Fr. Pádraig Ó Súilleabháin had

been working prior to his final illness, were fully revised. The following articles were accepted for publication: (i) 'Three Middle Irish Poems' and (ii) 'Two Notes' (Éigse); (iii) 'An Elegy on Art Óg Ó Néill' (Seanchas Ard Mhaca). See also sections 4, 5, 7 and 8.

Professor James Carney did some general research into early Irish literature. A book on this subject is in course of preparation. An article entitled 'The earliest Bran Material' was accepted for publication in a Festschrift to be presented to Ludwig Bieler. See also sections 4, 5, 7 and 8.

Professor Breandán Ó Buachalla continued his survey of sources for the history of Irish in Ulster and completed a study of Ní and cha in Ulster Irish. An article entitled 'Nótaí ar Ghaeilge an Tuaiscirt' was accepted for publication in Éigse. See also sections 3, 4, 5 and 8.

Rev. Pádraig Ó Súilleabháin, O.F.M. excerpted some works for the Dictionary of Early Modern Irish and worked on the Vocabulary of Cuthbert McGrath's edition of Dán na mBráthar Mionúr II up to the time of his death on 11 March 1975.

Pádraig de Brún worked on a catalogue of Irish manuscripts in Cambridge (in association with Máire Herbert) and on the poems of Piaras Féirtéar. An article entitled 'Irish manuscripts in King's Inns Library - Addendum' was accepted for publication in Éigse XVI.

Mr. Fergus Kelly wrote a linguistic introduction to Ludwig Bieler's edition of the Patrician documents in the Book of Armagh. Work continued on an edition of Bechbretha. In collaboration with Professor David Greene an edition of The Irish Adam and Eve Story from Saltair na Rann was prepared for press. A vocabulary of the first 2,700 lines of Saltair na Rann was compiled. See also sections 5, 7 and 8.

Mr. Rolf Baumgarten continued to arrange and collect entries towards the completion of the Bibliography of Irish Linguistics and Literature 1942-71. Compilation of lists of 'Irish Studies Theses' for annual publication in Éigse commenced. See also sections 7 and 8.

Mícheál Ó Siadhail collected words for a house and domestic vocabulary in Inis Meáin and worked on the preparation of an introduction to Cois Fhairrge Irish for beginners. The following articles were accepted for publication: (i) 'Liosta focal faoi thógáil tí as Inis Meáin' (Éigse XVI); (ii) Review of Liosta Focal as Ros Muc by T. S. Ó Máille (Celtica XII). See also section 5.

Mrs. Nessa Doran continued her work on the preparation of Fasciculus IV of Catalogue of Irish Manuscripts in the National Library of Ireland, completing MSS. G 141-160. First proofs (58 galleys) of Fasciculus III were checked and returned for revise.

Mrs. Anne O'Sullivan finished some further work on the proofs of Professor Binchy's edition of Corpus Iuris Hibernici. Transcription of the remaining part of the Book of Leinster was completed and checked

with the manuscript and is being prepared for publication. See also section 7.

Dr. Joan N. Radner, who worked in the School while on leave of absence from the Literature Department of The American University, Washington, D.C., completed the preparation of text, translation, preface, commentary and indexes of an edition of Fragmentary Annals of Ireland from Brussels MS. 5301-5320, with the assistance of the Senior Professors of the Institute. She worked on an English translation of Scéal Cano meic Gartnáin and began work on an edition and translation of Mionannála from Eg. 1782 and on a study of the poetry and saga material relating to the Síl nÁeda Sláine.

Miss Katharine Simms completed the final draft of a Ph.D. thesis entitled 'Gaelic Lordships in Ulster in the later Middle Ages' to be presented to the Medieval History Department at Trinity College, Dublin. She assisted Professor Ó Cuív in compiling an index to the manuscript sources of bardic poetry. See also sections 7 and 8.

Tadhg Ó Dúshláine worked on an article entitled 'Athléamb ar Aodh Mac Aingil' which was accepted for publication in Irisleabhar Mhá Nuad.

Liam Breatnach continued his work on an edition of the Middle Irish text Tochmarc Lúaine ocus Aided Athairni. An article entitled 'The Suffixed Pronouns in Early Irish' was accepted for publication in Celtica XII. See also section 5.

Dr. Malachy McKenna completed his study on phonology and stress in the Breton of Guémené/Scorff; work progressed on the morphological study. An article entitled 'Passion ha Marhue hon Salver Jesus Christ - A Mystery Play in the Vannes Dialect of Breton' was accepted for publication in Zeitschrift für Celtische Philologie. See also section 7.

Dr. Anders Ahlqvist continued research on Auraicept na nÉces by preparing a memorandum on Latin quotations in this text. A preliminary transcript of the text as transmitted in TCD MS. E.3.3 was completed and a list of Auraicept MSS. was compiled and the collation of these with the text as printed by Calder was begun. Some minor topics were also researched and lectures prepared. The following articles were accepted for publication: (i) 'On the Position of Pronouns in Irish' (Scottish Studies); (ii) 'On Preposed Adverbials (Scottish Gaelic Studies); (iii) 'Old Irish imbúaruch "this morning", imbáarach "tomorrow morning"' (Celtica); (iv) 'On Adverbs of Place in Irish' (Zeitschrift für Celtische Philologie). See also sections 6, 7 and 8.

Mr. John Armstrong continued to work on his Ph.D. thesis on 'Syntax of the Verbal Noun in Early Modern Irish Prose (1600-1650)' which is to be presented at the Linguistics Department of Harvard University. Several hitherto unpublished Irish grammatical tracts and related material were transcribed and prepared for edition with commentary. Certain already published tracts were collated and miscellaneous research

work was done on Classical Modern Irish grammar and metrics. The following article was accepted for publication in Ériu XXVII: 'Phonological Irregularity in Compound Verb Forms in the Würzburg Glosses'. See also sections 7 and 8.

Miss Kay Muhr commenced work on an edition, with commentary, of the various versions of the origin-legend of Lough Neagh and continued work for Ph.D. thesis (University of Edinburgh) on style in Gaelic traditional narrative literature. See also section 7.

Pádraig Ó Ciardha worked on the manuscript and published sources of the poetry of Toirdhealbhach Ó Cearbhalláin. He investigated some published catalogues of manuscripts and some uncatalogued manuscripts in the National Library of Ireland.

Liam Ó Murchú worked on the 18th century poem 'Cúirt an Mheadhón Oidhche' with a view to producing a definitive text. A list of approximately one hundred manuscript copies of the poem, including one which circumstantial evidence suggests to have been written by the poet himself, has been compiled. Reading and comparison of the manuscripts texts is progressing. A study of the general social and literary background of the poem has been undertaken with a view to incorporating it in the final edition.

Dr. Cecile O'Rahilly checked proofs of the Introduction, Text and Translation of her edition of Táin Bó Cúailnge Recension I and these were passed for press in December 1975. First proofs of the Notes to Text and the Indexes were checked and returned to the printer for revise. 'Three short notes' was accepted for publication in Celtica XII. See also section 8.

M. Louis Paul Nemo (Roparz Hemon) continued to work on the Historical Dictionary of Breton. Preparation of the Middle Breton text Doctrin an Christenien, which is to be published in the Medieval and Modern Breton Series, was completed. See also section 8.

Professor Proinsias Mac Cana, General Editor of the Medieval and Modern Welsh Series, checked final proofs of Brynley Roberts's edition of Cyfranc Lludd a Llefelys which was published in June 1975. He supervised the preparation of Eurys Rowlands's edition of Poems of the Cwyddwyr and read the first proofs.

Dr. Gearóid Mac Niocaill checked and returned for revise galley proofs of The Annals of Ulster. Preparation continued on an edition of Chronicon Scotorum.

Dr. Ludwig Bieler, General Editor of Scriptores Latini Hiberniae, submitted the typescript of his edition of The Patrician Texts in the Book of Armagh for publication in this Series. The Commentary is being read by Mr. Fergus Kelly for the purpose of making some technical revision in order to avoid duplication with his own contribution to the edition.

Mr. Brynley Roberts checked final proofs of his edition of Cyfranc Lludd a Llefelys which was published in June 1975 as Volume VII in the Medieval and Modern Welsh Series.

Rev. Fearghal Mac Raghnaill, O.F.M. checked revised proofs of the Text of his edition of Ó hEódhusa's Teagasg Críósduidhe which is to be published as Volume XI of Scríbhinní Gaeilge na mBráthar Mionúr. First proofs of Notes, Vocabulary and Indexes were checked and returned for revise.

Rev. Martin McNamara, M.S.C. checked revised proofs of The Apocrypha in the Irish Church which was published in June 1975.

Tomás Ó Cathasaigh read revised proofs of The Heroic Biography of Cormac Mac Airt. Preparation of the Index progressed.

Mr. Ronald Black continued his work of cataloguing the Gaelic manuscripts in the National Library of Scotland. He made a close study of the Red and Black Books of Clanranald. Descriptions of these and of Adv. MSS. 72.1.41, 72.1.47, 72.2.9, 72.2.11 and 72.2.14 were submitted to the Institute.

Dr. Brian Murdoch prepared for press the Commentary on the Irish Adam and Eve Story from Saltair na Rann. The Commentary will be published as Volume II in conjunction with the Greene/Kelly edition of the Text.

Mr. Eurys Rowlands's edition of Poems of the Cywyddwyr went to press in June 1975. First proofs of the entire work (pp. liii + 135) were checked and returned for revise.

3. STATUTORY PUBLIC LECTURE

A statutory lecture entitled 'Settler and Native in 17th Century Ulster' was delivered by Professor Breandán Ó Buachalla in Trinity College, Dublin, on 9 December 1975.

4. SEMINARS

Professor David Greene's weekly seminar on Saltair na Rann was held during Hilary and Michaelmas terms 1975.

Professor James Carney conducted a seminar on 'The earliest Bran material' in March 1975.

Professor Breandán Ó Buachalla held a weekly seminar on 'Ní/cha i nGaeilge an Tuaiscirt' during Michaelmas term 1975.

Professor Brian Ó Cúiv held a weekly class on Manuscript Reading and Textual Editing during Michaelmas term 1975.

5. SUMMER SCHOOL

A Summer School in Irish Language and Literature was held at the Institute from 7 to 25 July 1975, under the direction of Professor Breandán Ó Buachalla.

The courses included lectures on Old Irish (David Greene and Fergus Kelly); The historical development of Irish (David Greene); Irish history and Irish law (D. A. Binchy); Irish Folklore (K. Danaher); Modern Irish (Mícheál Ó Siadhail and Breandán Ó Buachalla); Classical Irish (Brian Ó Cuív); Irish literature (James Carney and Breandán Ó Buachalla).

The School was attended by 89 students, 54 of whom came from overseas:- Britain 22; Canada 1; Denmark 2; Germany 7; Italy 1; Netherlands 2; Sweden 4; U.S.A. 15.

Twenty-five overseas students were awarded Study Grants ranging in value from £30 to £110. Funds were not made available for this purpose by the Department of Education but a generous donation from Sir John Galvin made it possible to make these awards.

On Monday 7 July, the School was officially declared open by the President of Ireland, Cearbhall Ó Dálaigh, at a reception held at Newman House, Dublin. The reception was attended by 150 guests including representatives of the British and Italian embassies.

Excursions to places of historical and cultural interest were arranged: on Saturday 12 July some members of the School took part in a tour of Glendalough and on Saturday 19 July the School toured the Boyne Valley and Cooley district of Co. Louth.

6. SYMPOSIUM

On March 14 and 15 1975 a symposium was held for university and college staffs and research workers. The following papers were read:-

Alan Harrison: Nótaí ar chainteanna béarlagrach i bPárlaimint Chloinne Tomás

Domhnall Ó Baoill: An den teaghlach amháin an guta cúnta, réamhanáilú ...?

Gearóid Mac Eoin: Cuimíne Fota agus Cluain Fearta

Seán Ó Tuama: Na Cárthaigh, na Brúnaigh agus Aogán Ó Rathaille

Séamus Mac Mathúna: (i) on the particle a before numerals
(ii) on the double article

Anders Ahlqvist: Preposed Adverbials.

7. EXTERNAL ACTIVITIES

Professor David Greene delivered the G. J. Williams Memorial Lecture

'Makers and Forgers' at University College, Cardiff on 7 March
May 1975 he gave a discourse to the Royal Irish Academy on 'Foc
na Nua-Ghaeilge'.

Professor James Carney delivered the following lectures:- (i)
Gaelic Tradition' (School of Irish Studies, Dublin) 24 January 1975
(ii) 'The Date and Invention of Ogham' (Cumann Arsufochta, Univers
College, Cork) 9 December 1975.

Mr. Fergus Kelly lectured on 'Early Irish Agriculture and Husb
to the Medieval Society, Dublin, on 15 January 1975.

Mr. Rolf Baumgarten attended the 12th International Congress of
Onomastic Sciences, held at Bern from 25 to 28 August 1975.

Miss Katharine Simms delivered the following lectures:- (i) 'The
Pattern of Gaelic Settlement' (to 2nd year History and Geography studen
at University College, Dublin) on 14 April 1975; (ii) 'Guesting and
feasting in Gaelic Ireland' (to the Royal Society of Antiquaries of
Ireland, Dublin) on 24 April 1975; (iii) 'The claim of the medieval
O'Donnell Chiefs to the overlordship of Sligo' (to Éigse Mhic Fhirbhisigh,
Sligo) on 27 September 1975.

Dr. Anders Ahlqvist attended the Visigothic Colloquy held at
University College, Dublin from 14 to 17 May 1975.

The International Congress of Celtic Studies held at Penzance from
6 to 12 April 1975 was attended by the following members of the Institute:
Professor David Greene, Professor Brian Ó Cuív, Fergus Kelly, Mrs. Anne
O'Sullivan, Liam Breatnach, Malachy McKenna, Anders Ahlqvist, John
Armstrong and Kay Muhr. Papers were read by:- Fergus Kelly; Malachy
McKenna on 'Stress in northern bas-vannetais (Huéméné-sur-Scorff)';
Anders Ahlqvist on 'Old Irish imbúaruch "this morning", imbáarach
"tomorrow morning"; Kay Muhr on 'Sacred Trees in Mediaeval Irish
Tradition'.

8. PUBLICATIONS

(a) Books published by the Institute:

Córas Fusimeanna na Gaeilge. By Mícheál Ó Siadhail and Arndt Wigger.
pp.189. Price £1.50. Published March 1975.

Lexique Étymologique de l'Irlandais ancien R-S. By J. Vendryes.
pp.viii + 206. Price £6.75. Published jointly by the Institute
and the Centre National de la Recherche Scientifique, Paris, in
March 1975.

A Historical Morphology and Syntax of Breton. By Roparz Hemon.
pp.xv + 328. Price £6.00. Published April 1975.

Cyfranc Lludd a Llefelys (Medieval and Modern Welsh Series, Vol.VII).
Edited by Brynley F. Roberts. pp.xliiii + 37. Price £1.50.
Published June 1975.

The Apocrypha in the Irish Church. By Martin McNamara, M.S.C.
pp.xi + 159. Price £2.70. Published June 1975.

The Impact of the Scandinavian Invasions on the Celtic Speaking Peoples
c. 800-1100 A.D. (reprinted from The Proceedings of the International
Congress of Celtic Studies, Dublin, July 1959, with new Preface by
the Editor, Brian Ó Cuív). pp.v + 132. Price £1.80.

(b) Books published outside the Institute:

David Greene:

Makers and Forgers: the G. J. Williams Memorial Lecture.
Published by University of Wales Press, Cardiff, 1975.

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

Brian Ó Cuív:

Éigse XV, Part iv. Published by the National University of
Ireland and edited by Brian Ó Cuív.

Breandán Ó Buachalla:

Cathal Buí: amhráin. Published by An Clóchomhar Teoranta, 1975.

Roparz Hemon:

Historical Dictionary of Breton: Rann 23. (Merennañ - Moustrouzal)
Rann 24. (Mouz - Orget).

Published by Etienne, Paris.

(c) Reprints:

1. Bergin: Irish Bardic Poetry
2. Stokes and Strachan: Thesaurus Palaeohibernicus Vol.I
3. Stokes and Strachan: Thesaurus Palaeohibernicus Vol.II
(with Supplement).
4. Thurneysen: A Grammar of Old Irish (with Supplement)
5. Thurneysen: Old Irish Reader (without Supplement)
6. Williams: The Poems of Taliesin
7. Thomson: Owein
8. de Bhaldraithe: The Irish of Cois Fhairrge, Co. Galway
9. Ó Cuív: The Irish of West Muskerry, Co. Cork
10. Price: The Place-Names of Co. Wicklow, Vol.V
11. Price: The Place-Names of Co. Wicklow, Vol.VI
12. Thurneysen: Scéla Mucce Meic Dathó
13. Knott: Togail Bruidne Da Derga
14. Vendryes: Airne Fíngéin
15. Greene: Fíngal Rónáin
16. Binchy: Scéla Cano Meic Gartnáin
17. O'Rahilly: Cath Finntrágha
18. Meid: Táin Bó Fraích

(d) Contributions to periodicals and other publications:

David Greene:

Varia III. Ériu XXVI, 175-181.

A recent semantic shift in Insular Celtic. Zeitschrift für
Celtische Philologie XXIV, 43-59.

Brian Ó Cúiv:

A Sixteenth-century Political Poem. Éigse XV, 261-76.

A Mark of Gold. ibid. 333-44.

Three Middle-Irish Poems. Éigse XVI, 1-17.

James Carney:

The Invention of the Ogom Cypher. Ériu XXVI, 53-65.

Pádraig de Brún:

A census of the parishes of Prior and Killenlogh, December 1834.
Journal of Kerry Archaeological and Historical Society 8, 114-35.

Scéal Gaeilge ón Tochar. ibid. 136-74.

Fergus Kelly:

Tiughraínd Bhécáin. Ériu XXVI, 66-98.

Rolf Baumgarten:

A Crux in Echtrae Conlaí. Éigse XVI, 18-23.

Katharine Simms (in collaboration with Dr. C. A. Empey):

The Ordinances of the White Earl and the Problem of Coign in the
later Middle Ages. Proceedings of the Royal Irish Academy,
Vol. LXXV, Section C, 161-187.

Anders Ahlqvist:

Two Ethnic Names in Ptolemy. Bulletin of the Board of Celtic
Studies XXVI, 143-146.

A note on Old Irish ro. Ériu XXVI, 162-167.

John Armstrong:

A Note on Initial Mutation in Modern Irish. Linguistic Inquiry
VI, Part 1.

Phonological Irregularity in the Würzburg Glosses. Indo-European
Studies II.

Cecile O'Rahilly:

Ferda sin! Ferda écin! Éigse XV, 327.

On some passages in the O'Curry MS. TBC. ibid. 333-6.

III - Annual Report of the Governing Board of the School of Theoretical Physics for the year ended 31 December 1975 adopted at its meeting on 27 February 1976.

1. STAFF AND SCHOLARS

Emeritus Professor:

John L. Synge.

Senior Professors:

John T. Lewis, Director from 1 January 1975; Rev. James R. McConnell; Lochlainn S. O Raifeartaigh.

Visiting Professors:

G. A. C. Graham, for the academic year 1974-75; G. W. Ford, 28 July - 1 September; M. Kac, 19-31 August; G. dell'Antonio, 20-31 August; R. F. O'Connell, July, August, December; A. Papapetrou, 9-20 November.

Assistant Professor:

W. G. Sullivan.

Research Associates:

D. Judge, Rev. D. McCrea, S. Dineen (UCD); P. S. Florides, B. K. P. Scaife (TCD); P. D. McCormack (UCC & NSC); A. I. Solomon (Open University); D. R. Tchrakian (Maynooth); J. M. Golden (Foras Forbartha); T. Garavaglia (Kevin St. College of Technology).

Scholars:

E. Manoukian, G. Parravicini, S. Browne; T. N. Sherry, W. T. Coffey, to 30 September; R. H. Critchley, to 31 October; R. Wilson, T. H. Yao, D. E. Evans, from 1 October.

Research Students without stipend:

B. Goldsmith, A. Barnes.

Secretary and Assistant Librarian:

E. R. Wills.

2. GENERAL

A working seminar on Current Problems in Probability and the Physical Sciences was held at DIAS from 25 to 29 August. It was attended by approximately twenty-four participants from abroad, who were accommodated at Trinity Hall, as well as local mathematicians and physicists.

A symposium to commemorate the scientific work of Arthur William Conway (1875-1950), first Chairman of the Governing Board of the School, was held jointly by the Institute and University College Dublin on 31 October. The morning session was held at the Institute and the afternoon session at University College.

The following lectures were given at the Institute:

- Professor I. N. Sneddon (Glasgow): Arthur Conway and the equations of mathematical physics.
- Professor R. Penrose (Oxford): Conway's contour integration and recent developments in relativity.
- Professor W. B. Bonnor (Queen Elizabeth College, London): The equations of motion for a radiating particle.

The following lectures were given at UCD:

- Professor D. J. Bradley (Imperial College, London): Non-linear optics with atoms.
- Professor T. E. Nevin (UCD): The scientific era of A. W. Conway.

3. STUDY AND RESEARCH

Professor Synge corresponded with Dr. A. M. Arthurs on the connection between the hypercircle method and other methods of bounding solutions of boundary value problems; and with Professor G. V. Ramanathan on the problem of the maximum number of collisions of elastic particles. He developed a simple proof of Poncelet's theorem for a system of coaxial circles, and studied (as a mathematical problem) the differential equations governing the precession of the equinoxes.

Professor Lewis continued his work on statistical mechanics. He collaborated with Professors Ford, McConnell, and Scaife, and Dr. Critchley on various aspects of rotational Brownian motion, and with Dr. Critchley on mathematical problems arising from their study of Bose condensation. With Dr. Pulè and Dr. Thomas he worked on models of quantum stochastic processes; with Dr. Evans he investigated mathematical problems arising in the theory of such processes.

Professor McConnell continued his investigations with Professors Lewis and Scaife on the rotational Brownian motion of a sphere, using a Langevin equation. He collaborated with Professors Ford and Lewis in developing, for this problem, a graphical method to calculate the auto-correlation function to a higher degree of approximation. He also collaborated with Professor H. O. Foulkes and Dr. M. J. Newell in the study of symmetric functions and their relations to Young diagrams.

Professor Ó Raifeartaigh continued his research on supersymmetry, and constructed one of the first models with a spontaneous breakdown of supersymmetry without the use of gauge fields. With Drs. Browne and Sherry he showed that, in contrast to the non-supersymmetric case, the introduction of a supersymmetric potential for the use of matter-fields does not disturb the asymptotic convergence of the gauge coupling, and may improve the infra-red behaviour. Later, with Dr. Parravicini, he showed that the minima of the supersymmetric potentials are not changed

by radiative corrections. This result led to work on the effective potential for any kind of quantized field, and this work is still in progress.

Professor Sullivan continued his study of Markov processes associated with infinite particle systems of the lattice type. He gave a series of lectures in the spring term and these formed the basis for a monograph which has now appeared in the Communications of DIAS. This work led Dr. Sullivan on to his present study of certain problems regarding specific information gain.

Professor Graham worked on the solution of viscoelastic boundary problems.

Dr. McCrea completed some work on static axially symmetric gravitational fields with shell sources; this work has been accepted for publication. He is now applying Synge's method to the motion of two spherical bodies with comparable mass and spin. As a first step, he has examined the case of a spinning test-particle in the field of a larger body, a case already dealt with by Papapetrou and others using a different approach. Although the angular momentum equations obtained differ from those of Papapetrou, the equation for the spin precession (the only quantity experimentally observable in the proposed gyroscope experiment) obtained by Dr. McCrea is the same as that of Papapetrou.

Dr. Florides worked on interior Nordström solutions, and on a model of the McClaurin spheroid in general relativity (with R. L. Jones); papers on both of these topics are now being prepared for publication.

Drs. Solomon and Critchley completed work already started on a variational model for superfluidity, and prepared the work for publication. Dr. Solomon also worked with Dr. W. Montgomery on the application of Lie algebraic methods to the solution of lattice models for phase transitions, and this work is now being prepared for publication.

During the first part of the year Dr. Tchrakian worked in collaboration with his student, P. O'Sullivan, on the formulation of a Higgs-Kibble mechanism for a spin-2 gauge field. In the course of this work it became necessary to investigate the mass-stability of arbitrary spin wave equations. During the second part of the year Dr. Tchrakian worked on a search for supersymmetric Lagrangian densities constructed out of higher spin superfields (which Dr. Tchrakian had introduced previously).

Dr. Manoukian's main fields of study were the elementary derivation of the infinite-order-zero nature of the eigenvalue condition in quantum electrodynamics and the connection of Lorentz covariance and the self-stress of a particle in the language of renormalization groups. He studied also the stability of the ground-state energy density in quantum electrodynamics as a function of a large ultraviolet cut-off, and the behaviour of the magnetic form factors at high energy in any renormalizable

field theory at various fixed points.

From January to September Dr. Browne worked on supersymmetry, mainly in collaboration with Professor Ó Raifeartaigh and Dr. Sherry. He also completed work, commenced earlier in collaboration with Professor L. Staunton, on an analysis of the classical limit of certain quantum theories and prepared the work for publication. Dr. Browne also completed work, commenced earlier in collaboration with Dr. Dj. Šijački, on the Lorentz group and this work also was prepared for publication. From October Dr. Browne has been collaborating with Professor V. McBrierty on a new method for handling nuclear magnetic resonance data. This work is now being prepared for publication.

Dr. Sherry worked on renormalizable theories with spin-1 particles, and also, in collaboration with Professor Ó Raifeartaigh and Dr. Browne, made a search for supersymmetric models which are both asymptotically free and infra-red convergent.

Dr. Coffey completed some work on the theory of dielectric saturation in polar fluids, and then began working on rotational Brownian motion.

Dr. Critchley continued his study of algebraic statistical mechanics, in particular the role and properties of quasi-free states (working with Professor Lewis and Dr. Solomon), and considered some of the mathematical problems arising from them. He studied Brownian motion, in particular the problem of relating the solutions of certain ordinary differential equations to those of certain stochastic differential equations, relating these also to the problem of modelling the motion of bodies acted on by small random forces.

Dr. Yao proved a Riemann-Lebesgue theorem for $SL(2\mathbb{C})$ and investigated the relationship between Markov fields and quantum fields. He also studied some eigenfunction expansions, and the quantum mechanical two-body and three-body problem for non-local two-body potentials.

Dr. Goldsmith worked on elongations of abelian groups, and on essentially indecomposable modules over a complete discrete valuation ring.

Dr. Garavaglia continued his investigation of the theory of electromagnetic interactions, and also his work with J. Gomatam in quantum biology and quantum chemistry.

Dr. Parravicini studied the behaviour of the effective potential beyond the tree approximation for supersymmetric scalar theories, and this work is continuing.

Dr. Evans worked on C^* -algebras.

Dr. Wilson worked on the derivations of the representation functions of the orthogonal groups $SO(2,1)$, $SO(3,1)$ and $SO(4)$, and the Euclidean groups $E(2)$ and $E(3)$, which are among the important physical subgroups of the larger conformal group $SU(2,2)$ (approximately $SO(4,2)$.) In order to adopt a unified approach, Dr. Wilson is using the properties

of generalized functions (Gel'fand, Graev and Vilenkin). He has already derived some of these functions and is preparing a paper for publication. All these functions must be known exactly for the construction of an algebraic model to explain experimental data on the electromagnetic structure of hadrons.

During the year Dr. Golden worked on the problem of a mathematical model of surface wear, and on the problem of a model of hysteretic friction within the framework of linear viscoelasticity.

4. SEMINARS AND REVIEW LECTURES

Review and seminar lectures were held throughout the year and as in previous years they were attended by members of staff and students from Trinity College, Dublin, University College, Dublin, St. Patrick's College, Maynooth, Kevin Street College of Technology, An Foras Forbartha and other centres of research as well as by members of the Civil Service and of the School of Cosmic Physics.

The following review and seminar lectures were given:

- Dr. A. M. Arthurs (York): Dual approximation principles in mathematical physics.
- Dr. R. Bates (Met. Service): The dynamics of rotating fluids.
- Professor B. Bertotti (Pavia): Problems of detection of gravitational waves.
- Dr. W. T. Coffey (DIAS): Molecular motion and biomolecules: A report on the 1975 Dielectrics Society Meeting.
- Dr. R. H. Critchley (DIAS): Recent work on Bose gases.
- Dr. J. Ellis (CERN): e^+ , e^- collisions and the new particles.
- Dr. D. B. Fairlie (Durham): Present status of dual models.
- Professor G.W. Ford (Michigan & DIAS): Circular polarization of radiation from a plasma.
- Professor H. O. Foulkes (Swansea): Newcomb's problem and Young tableaux.
- Dr. J. M. Golden (AFF & DIAS): A molecular theory of adhesive rubber friction.
- Dr. P. Hogan (TCD): The Kerr solution - a geometrical construction.
- Professor G. F. Imbusch (UCG): Spectroscopic studies of magnetic materials.
- Dr. R. Israel (Bures & Princeton): Analyticity in classical lattice systems.
- Professor B. Kostant (MIT & IHES): New results in quantization theory.
- Professor E. Leader (Westfield College, London): Spin structure in proton-proton scattering.
- Professor J. T. Lewis (DIAS): Fluctuating magnetic fields.
- Professor J. Lukierski (Warsaw): Global scale transformations for renormalized field operators.
- Professor J. R. McConnell (DIAS): Rotational Brownian motion.
- Professor G. C. McVittie (Kent): Radar distance in general relativity.

- Professor R. F. O'Connell (Louisiana & DIAS): Strong magnetic fields in physics and astrophysics.
- Dr. D. Ó Mathuna (US Dept. Transportation & DIAS): Orbit prediction for earth satellites.
- Professor A. Papapetrou (Inst. H. Poincaré & DIAS): The problem of gravitational radiation.
- Professor G. de B. Robinson (Toronto): Representations of representations.
- Dr. S. Sen (TCD): Phase transitions at high energies.
- Dr. T. N. Sherry (DIAS): The Ward-Takahashi identities: A survey.
- Professor D. Speiser (Louvain): Dirac's new theory.
A new elementary approach to general relativity.
- Professor R. Streater (London): Superselection rules of sine-Gordon equations.
- Dr. D. G. Sutherland (Glasgow): $J(\psi)$ particles - a review.
- Dr. D. Tchrakian (Maynooth & DIAS): Superfields in Lagrangian field theory.
- Dr. L. Thomas (Manchester): How to run a library efficiently.
- Dr. R. Wilson (DIAS): Infinite component fields.

5. COURSES

During the spring and summer terms Professor Ó Raifeartaigh continued giving the M.Sc. course on 'Symmetry groups in quantum theory' which he had begun in the previous autumn term as part of the M.Sc. courses provided jointly by the universities in the Dublin area and the Institute. A course by Professors Lewis and McConnell on Statistical Physics, for beginning graduate students, commenced in Michaelmas term. In the spring and summer terms Professor Sullivan gave a course of lectures on 'Markov processes for random fields', and in Michaelmas term a series of informal seminars on stochastic differential equations, conducted by Professors Lewis and Sullivan, was begun. In November Professor Papapetrou gave a short course on the non-existence of periodic fields in general relativity and Drs. Dineen and Josefsen gave a short course on infinite dimensional holomorphy.

6. STATUTORY PUBLIC LECTURE

The Statutory Public Lecture on "The scientific era of A. W. Conway" was delivered by Professor Nevin at University College, Dublin, on 31 October as part of the Conway Centenary Symposium.

7. SYMPOSIA

Two mathematical symposia were held during the year - on 24-25 March

and on 18-19 December. The attendances (37 in March, 53 in December) included professors, lecturers and graduate students from the several Irish universities.

In addition to the short communications (previews), the following lectures were delivered:

March:

- Dr. M. Mortell (UCC): An extension of the Poincaré-Linstedt perturbation technique.
Dr. A. I. Solomon (OU & DIAS): A variational approach to superfluidity.
Dr. T. C. Hurley (UCD): The finite basis problem.
Professor M. Hayes (UCD): Boundary-value problems for internally constrained media.
Dr. R. Harte (UCC): The exponential spectrum in Banach algebras.

December:

- Dr. R. Aron (TCD): The basis problem.
Professor D. J. Simms (TCD): Representing functions on symplectic manifolds by operators.
Dr. D. J. McCrea (UCD & DIAS): Shell sources in general relativity.
Dr. T. T. West (TCD): The spectral radius formula.
Professor J. T. Lewis (DIAS): Von Neumann and the canonical commutation relations.

In addition to the regular symposia, a symposium for teachers of physics and mathematics in the regional technical colleges was held on 26-27 March. The attendance was 50, and the programme included:

- Dr. A. I. Solomon (OU & DIAS): Talk and presentation of films on the teaching of mechanics and mathematics at the Open University.
Professor L. Ó Raifeartaigh (DIAS): Lecture - The theory of relativity.
Professor E. F. Fahy (UCC): Talk on a first level approach to the teaching of electromagnetism: discussion.
Dr. A. Scott (UCD): Talk on equipment for a school physics laboratory.
Dr. A. Montwill (UCD): Lecture - Conservation laws.
Dr. S. McGuinness (TCD): Talk on techniques of examination.
General discussion.

8. WORKING SEMINAR

A Working Seminar on Current Problems in Probability and the Physical Sciences was held in the School from 25 to 29 August. The number of participants from abroad was 24, and they were accommodated in Trinity Hall, Dublin 6. There were 16 local participants.

The programme consisted of courses and lectures as follows:

- Professor M. Kac (The Rockefeller Univ.): Discrete scattering theory and some related nonlinear problems in dynamics (5 lectures).
- Professor G.C. Papanicolaou (Courant Inst., New York Univ.): Some probabilistic problems and methods in singular perturbations (3 lectures).
- Dr. E. B. Davies (Math. Inst., Oxford): Master equations (3 lectures).
- Professor P. van Moerbeke (Stanford Univ.): Nonlinear vibration problems: Toda lattices (2 lectures).
- Professor G. W. Ford (Univ. of Michigan): Remarks on stochastic evolution equations.
- Dr. J. V. Pulè (Royal Univ. of Malta): Langevin equations.
- Dr. R. Hudson (Univ. of Nottingham): A quantum mechanical central limit theorem and the approach to equilibrium.
- Professor R. J. Elliott (Univ. of Hull): Some recent work on stochastic differential equations.

9. VISITORS

For lectures given by Visiting Professors and other Visitors, see sections 4, 5, 6 and 8.

- Professor G. dell'Antonio (Rome) 20-31 August.
- Dr. A. M. Arthurs (York) 10-11 December.
- Professor B. Bertotti (Pavia) 9-10 April.
- Professor W. B. Bonnor (Q. Elizabeth Coll., London) 31 October.
- Professor D. J. Bradley (Imperial Coll., London) 31 October.
- Dr. E. B. Davies (Math. Inst. Oxford) 25-29 August.
- Dr. J. Ellis (CERN) 14 May.
- Professor R. J. Elliott (Hull) 23-28 August.
- Professor E. F. Fahy (UCC) 26-27 March.
- Dr. D. B. Fairlie (Durham) 12-14 March.
- Professor G. W. Ford (Michigan) 28 July - 1 September.
- Professor H. O. Foulkes (Swansea) 19-22 May.
- Dr. J. Gomata (Glasgow Coll. Tech.) 6 August - 3 September.
- Professor G. A. C. Graham (Vancouver), academic year 1974-75.
- Dr. R. Hudson (Nottingham) 25-29 August.
- Professor G. F. Imbusch (UCG) 5 March.
- Dr. R. Israel (Bures & Princeton) 30 May - 3 June.
- Dr. B. Josefson (Uppsala) 5 November - 3 December.
- Professor M. Kac (Rockefeller) 19-31 August.
- Professor B. Kostant (MIT) 28 January - 2 February.
- Professor J. Kuelbs (Wisconsin) 26 November - 1 December.
- Professor E. Leader (Westfield Coll., London) 2 December.
- Professor J. Lukierski (Warsaw) 28-29 May.

Dr. O. McBryan (Rockefeller) 15-26 July.
Professor G. C. McVittie (Kent) 7 May.
Dr. D. Ó Mathúna (U.S. Dept. of Transport) 1-31 May.
Professor P. van Moerbeke (Stanford) 25-29 August.
Dr. N. Ó Murchadha (Cardiff) 18 August - 1 October.
Professor R. F. O'Connell (Louisiana State, Baton Rouge), July,
August, December.
Professor G. C. Papanicolaou (Courant Inst., New York) 24-30 August.
Professor A. Papapetrou (Inst. H. Poincaré, Paris) 9-20 November.
Professor R. Penrose (Math. Inst. Oxford) 31 October.
Dr. J. V. Pulé (Royal Univ. Malta) 6-28 August.
Professor G. de B. Robinson (Toronto) 27 February - 1 March.
Professor I. N. Sneddon (Glasgow) 31 October.
Professor D. Speiser (Louvain) 1-3 June.
Professor R. F. Streater (Bedford Coll. London) 17-19 June.
Dr. D. Sutherland (Glasgow) 28-29 October.
Dr. L. C. Thomas (Manchester) 3-7 June.

10. EXTERNAL ACTIVITIES

Professor Synge gave a discourse to the Royal Irish Academy on 2 October entitled "A. W. Conway (1875): In Memoriam".

Professor McConnell attended the IUPAP International Conference on Statistical Physics, at Budapest, 25-29 August; he contributed a paper on inertial effects in rotational Brownian motion. He visited the physics department of the Eötvös Lorand University and the Central Research Institute for Physics, Budapest. From 9-12 September he attended the European Physical Society's Third General Conference held at Bucharest.

Professor Ó Raifeartaigh gave a talk on the foundations of relativity to the Electrical Engineering Society of UCD in March, and on the role of Professor Lanczos in science to the Irish-Israel Friendship League in May. Until September he was a member of the organizing Committee for the International Conference on Physics in Industry, to be held in Dublin in March 1976. He gave talks on supersymmetry in Oxford, Canterbury and London (Bedford College) in February, at Edinburgh and Durham in May, at the Scandinavian Winter School in Göteborg, at the Triangle (Austria-Czechoslovakia-Hungary) Meeting in Vienna in May, at the Nijmegen Conference on Group Theory in Physics in June, and at the French Physical Society's Meeting in Dijon in July. For the Nijmegen Conference he was a member of the advisory committee. He was invited to spend a year at the Institut des Hautes Études Scientifiques, Bures-sur-Yvette, and in September he began a year's leave of absence there; he lectured there and in Paris on effective potentials.

Professor Lewis was a visiting lecturer at the Research Institute for Fundamental Physics, Kyoto, 17-31 January. He gave talks on the dynamical theory of Brownian motion at the International Symposium on Mathematical Problems in Theoretical Physics, Kyoto, 23-29 January, and at the 40th Session of the International Statistical Institute in Warsaw, 1-9 September; at the Warsaw meeting he was Chairman of the sessions on Statistical Physics. He gave talks on various aspects of his research on stochastic processes in Leuven, in Edinburgh and at the symposium on statistical mechanics at the Open University on 11 April.

Dr. Sullivan gave a talk on "Exponential convergence in dynamic Ising models with distinct phases" at the Open University Conference in April, and from there went to the Institut des Hautes Études Scientifiques, Bures-sur-Yvette, where he spent two weeks. He was invited to an International Conference on Dynamical Systems in Mathematical Physics, held at Rennes from 14-21 September.

Professor Graham attended the 17th British Theoretical Mechanics Conference in Manchester, 8-11 April.

Dr. Solomon organized (with O. Penrose) a one-day national symposium on statistical mechanics, at the Open University on 11 April. He attended the Conference on Group Theory in Physics at Nijmegen 23-26 June and gave a short talk on "Coherent states in superfluidity"; he also attended the IUPAP International Conference on Statistical Physics, Budapest, 25-29 August and gave two talks there, on "Variational approach to superfluidity" and on "Generalized x-y model".

Dr. Garavaglia was representative of the Dublin Particle Theory Group at a Meeting on Particle Physics at the Rutherford Laboratory, 6-8 January, and at the EPS International Conference on High Energy Physics, held at Palermo, 23-28 June.

Dr. Tchraikian attended the Rutherford Laboratory meeting 6-8 January and the International Symposium in Mathematical Physics in Istanbul in July; he gave some lectures at the Istanbul Conference.

Dr. Manoukian lectured in June (Sussex Univ.) on "Vacuum polarization and eigenvalue condition for the fine structure constant α ", and in November on "Polarization du vide et la condition sur la constante de structure fine α " at Montreal and at Sherbrooke.

Dr. Browne attended the EPS International Conference on High Energy Physics at Palermo, 23-28 June.

Dr. Sherry attended the Rutherford Laboratory Meeting, 6-8 January, the Nijmegen Conference on Group Theory in Physics, 23-26 June, and the Congrès de la Société Française de Physique at Dijon, 30 June - 4 July.

Dr. Parravicini attended the Conference on Group Theory in Physics at Nijmegen, 23-26 June.

Dr. Coffey attended the meeting of the Dielectrics Society on

"Molecular motion and biomolecules", 8-10 April, and a Conference on Dielectric Materials, Measurements and Applications at Churchill College, Cambridge, 21-25 July.

Dr. Critchley gave a seminar on "Entropy density of quasi free states" at the Statistical Mechanics Conference at Open University on 11 April. With Professor Sullivan he attended the International Conference on Dynamical Systems in Mathematical Physics, at Rennes, 14-21 September.

Dr. Evans gave a lecture on some spectral properties of one-parameter groups on C^* -algebras at the RIA Symposium on Harmonic Analysis held at TCD, 15-18 December.

Dr. Florides lectured at York on "Interior Nordström solutions" in March, and on "A rotating spheroid as a possible source of the Kerr metric" at Canterbury (Kent) in December.

11. PUBLICATIONS

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

(1) Communications of the Dublin Institute for Advanced Studies, Ser. A (Theoretical Physics):

Published:

No.22 Lecture notes on supersymmetry. By L. Ó Raifeartaigh.
Price £2.10. pp.77. Published 17 April 1975.

No.23 Markov processes for random fields. By Wayne G. Sullivan.
Price £2.10. pp.1 + 75. Published 22 August 1975.

(2) Contributions to periodicals and other publications:

Published:

C. Lanczos:

* Gravitation and Riemannian space. Found.Phys. 5 (1975) 9-18.

J. L. Synge:

* On the present status of the electromagnetic energy tensor.
Hermathena No.117 (1974) 80-84.

* Note on a paper by Anderson and Arthurs. Quart.Appl.Math. 33
(1975) 91-92.

J. R. McConnell:

* Critical Notice: Fields of Force: the development of a world view from Faraday to Einstein, by W. Berkson, Routledge & Kegan Paul, 1974. Phil. Studies 23 (1975) 235-239.

J. T. Lewis, J. McConnell & B. K. P. Scaife:

Inertial effects in rotational Brownian motion. IUPAP Internat. Conf. Statist. Phys., Budapest 1975. Abs. Commun., p.33.

J. T. Lewis & L. C. Thomas:

*How to make a heat bath. Functional integration and its applications. Proc. Conf., London 1974. Ed. by A. Arthurs. Oxford Univ. Press, 1975. pp.97-123.

*On the existence of a class of stationary quantum stochastic processes. Ann.Inst.H.Poincaré 22 A (1975) 241-248.

J. T. Lewis & J. Pulè:

*The free boson gas in a rotating bucket. Comm.Math.Phys. 45 (1975) 115-131.

Dynamical theories of Brownian motion. Internat.Sympos. on Math. Problems in Theor.Physics, Kyoto 1975, ed. H. Araki, Springer 1975. pp.516-519.

R. H. Critchley & J. T. Lewis:

On the free boson gas with spin. Comm.Math.Phys. 44 (1975) 107-124.

J. T. Lewis & P. N. M. Sisson:

A C^* -algebra of the two-dimensional Ising model. Comm.Math.Phys. 44 (1975) 279-292.

L. Ó Raifeartaigh:

Weight diagrams for superfluids. Nuclear Phys. 89 B (1975) 418-428.

Spontaneous breakdown of internal symmetry in internal symmetry @ supersymmetry. Phys.Lett. 56 B (1975) 41-44.

Spontaneous symmetry breaking for chiral scalar superfluids. Nuclear Phys. 96 B (1975) 331-352.

G. B. Mainland & L. Ó Raifeartaigh:

*Point transformations and renormalization in the unitary gauge for non-Abelian fields. Phys.Rev. 12 D (1975) 489-502.

S. Browne, L. Ó Raifeartaigh & T. Sherry:

Asymptotic freedom, infrared convergence and supersymmetry. Nuclear Phys. 99 B (1975) 150-166.

L. P. Staunton & S. Browne:

Classical limit of relativistic positive-energy theories with intrinsic spin. Phys.Rev. 12 D (1975) 1026-37.

W. G. Sullivan:

*Mean square relaxation times for evolution of random fields. Comm.Math.Phys. 40 (1975) 249-258.

*A unified existence and ergodic theorem for Markov evolution of random fields. Z. Wahrscheinlichkeitstheorie verw. Gebiete 31 (1974) 47-56.

Exponential convergence in dynamic Ising models with distinct phases. Phys.Lett. 53 A (1975) 441-442.

W. Coffey & B. K. P. Scaife:

*On the solution of some potential problems for a non-linear dielectric. J. Electrostatics 1 (1975) 193-208.

W. T. Coffey:

On the analysis of electrical conduction in polyethylene terephthalate at high fields. J.Phys. D: Appl.Phys. 8 (1975) L186-L188.

- E. B. Manoukian:
High Energy behaviour in Abelian gauge theory, application to γ^* decay, and high energy estimates for form factors. *Phys.Rev.* 11 D (1975) 3616-3625.
Self-stress and renormalization group. *Phys.Rev.* 12 D (1975) 1199-1200.
- P. S. Florides:
*Rotating spheroid as a possible source of the Kerr metric. *Il Nuovo Cim.* 25 B (1975) 251-278.
- D. H. Tchrakian:
"Electric" and "Magnetic" gravitational fields in vacuum. *GRG* 6 (1975) 151-156.
- D. H. Tchrakian & P. O'Sullivan:
Higgs-Kibble mechanism for a spin-2 gauge field. *Phys.Lett.* 59 B (1975) 150-152.
- J. M. Golden & P. F. Frain:
The diffusion of small ions in air containing absorbing nuclei. *Proc. RIA* 75 A (1975) 1-10.
- T. Garavaglia & J. Gomatam:
*The Schrödinger equation in helical coordinates. *Ann.Phys.* 89 (1975) 1-10.
- B. K. P. Scaife:
On the analysis of thermally stimulated depolarization phenomena. *J. Phys. D: Appl.Phys.* 7 (1974) L171-L173.
On the analysis of thermally stimulated depolarization phenomena - a reply to some criticisms. *J.Phys. D: Appl.Phys.* 8 (1975) L72-L73.
- In the Press:
- B. Gellai & C. Lanczos:
Fourier analysis of random sequences. *Computers & Math.Appl.*
- J. T. Lewis, J. R. McConnell & B. K. P. Scaife:
Relaxation effects in rotational Brownian motion. *Proc.RIA.*
- J. R. McConnell:
Cornelius Lanczos in Dublin (1953 - 1974). *Computers & Math.Appl.*
- J. T. Lewis & M. E. Muldoon:
Monotonicity and convexity properties of zeros of Bessel functions. *SIAM J.Math.Anal.*
- B. Durand & L. Ó Raifeartaigh:
Rapidly amplitudes and their Fourier transforms. *Phys.Rev. D.*
- R. H. Critchley & A. I. Solomon:
A variational approach to superfluidity. *J.Statist.Phys.*
- W. T. Coffey & B. K. P. Scaife:
On the calculation of electric fields in a non-linear dielectric. *Proc. IEE Conf. on Dielectric Materials, Measurements, & Applications, Cambridge 1975.*

W. T. Coffey:

Rapporteur's report on session on biological materials at DMMMA Conf., Cambridge 1975.

E. B. Manoukian:

On the fundamental identity for the infinite-order-zero nature in quantum electrodynamics. Phys.Rev. D.

G. A. C. Graham:

Quasi-static crack growth in linear viscoelastic bodies that are acted upon by alternating tensile and compressive loads. Proc.RIA.

D. J. McCrea:

Static axially symmetric gravitational fields with shell sources. J.Phys. A.

W. G. Sullivan:

Processes with infinitely many jumping particles. Proc.Amer. Math.Soc.

D. E. Evans:

Positive linear maps on operator algebras. Comm.Math.Phys.

On the spectrum of a one-parameter strongly continuous representation. Math.Scand.

(3) Research Reports:

Research work was written up during the year in the first instance as research reports. Two lists of titles of these reports (preprints) were circulated to approximately 250 research institutes and university departments throughout the world where work in similar fields is being done; where available, copies of preprints were supplied to research workers in these institutes and departments on request.

- DIAS-TP-75-1: S. Browne & D. Šijački: Minimal algebras for relativistic wave equations.
- 2: J. T. Lewis & P. N. Sisson: A C^* -algebra of the two-dimensional Ising model.
 - 3: G. A. C. Graham: Quasi-static crack growth.
 - 4: J. R. McConnell: Cornelius Lanczos in Dublin (1953-1974).
 - 5: B. Goldsmith: A note on elongations of Abelian groups.
 - 6: S. Browne: On the non-uniqueness of the Lagrangian.
 - 7: W. Sullivan: Exponential convergence in dynamic Ising models with distinct phases.
 - 8: J. T. Lewis & J. Pulè: Dynamical theories of Brownian motion.
 - 9: L. Ó Raifeartaigh: Spontaneous symmetry for chiral scalar superfields.
 - 10: E. Manoukian: On the fundamental identity for the infinite-order-zero nature in quantum electrodynamics.
 - 11: L. Ó Raifeartaigh: Lecture notes on supersymmetry.

- DIAS-TP-75-12: L. P. Staunton & S. Browne: The classical limit of relativistic positive energy theories with intrinsic spin.
- 13: W. Montgomery & L. Ó Raifeartaigh: Simultaneous algebraic classification of the unitary representations of the Poincaré and de Sitter groups.
- 14: E. B. Manoukian: Self-stress and the renormalization group.
- 15: D.H. Tchrakian and P. O'Sullivan: Higgs-Kibble mechanism for spin-2 gauge field.
- 16: S. Browne, L. Ó Raifeartaigh & T. N. Sherry: Asymptotic freedom, infra-red convergence and supersymmetry.
- 17: J. R. McConnell: Reordering of non-lattice permutations.
- 18: R. H. Critchley & A. I. Solomon: A variational approach to superfluidity.
- 19: W. T. Coffey & B. K. P. Scaife: On the calculation of electric fields in a non-linear dielectric.
- 20: W. T. Coffey & B. K. P. Scaife: On the solution of some potential problems for a non-linear dielectric.
- 21: P. O'Sullivan & D. H. Tchrakian: On the unique mass definite parity Joos-Weinberg field equations.
- 22: R. H. Critchley & J. T. Lewis: The entropy density of quasi-free states.
- 23: J. T. Lewis, J. R. McConnell & B. K. P. Scaife: Relaxation effects in rotational Brownian motion.
- 24: G. A. C. Graham: Extension, torsion and flexure of ageing viscoelastic beams that have two relaxation functions.
- 25: J. T. Lewis & M. E. Muldoon: Monotonicity and convexity properties of zeros of Bessel functions.
- 26: S. Browne & D. Šijački: On the representations of the Lorentz group.
- 29: W. G. Sullivan: Markov processes for random fields.
- 32: S. Browne: Spontaneous breakdown and finiteness of supersymmetry in 2-D.
- 33: W. T. Coffey: On the analysis of electrical conduction in polyethylene terephthalate at high fields.
- 34: L. Ó Raifeartaigh: Present status of supersymmetry.
- 36: B. Gellai & C. Lanczos: Fourier analysis of random sequences.
- 37: D. H. Tchrakian: On higher spin superfluids.
- 38: B. Durand & L. Ó Raifeartaigh: Rapidity amplitudes.
- 39: D. E. Evans: Positive linear Maps on operator algebras.
- 40: D. E. Evans: On the spectral type of one-parameter groups on operator algebras.
- 41: D. E. Evans: On the spectrum of a one-parameter strongly continuous representation.
- 42: D. E. Evans: Smooth perturbations on non-reflexive Banach spaces.
- 43: D. E. Evans: Scattering in the CAR algebra.
- 44: D. E. Evans: Time-dependent perturbations and scattering of strongly continuous groups on Banach spaces.

- DIAS-TP-75-45: D. E. Evans: Completely positive, bounded, linear maps.
- 46: D. E. Evans: Unbounded completely positive linear maps on C^* -algebras.
- 47: W. G. Sullivan: Specific information gain for interacting Markov processes.
- 48: D. E. Evans: Complete positivity and asymptotic Abelianness.
- 49: E. B. Manoukian: Boundedness of electromagnetic form factors in field theory.
- 50: T. Garavaglia: On gauge invariance and regularization.
- 51: J. R. McConnell: A letter from Lewes Jail, 1917.
- 52: W. Ford, J. T. Lewis & J. R. McConnell: Graphical study of rotational Brownian motion.
- 53: D. H. Tchrakian: A comment on "Superfields and Fermi - Bose Symmetry".
- 54: E. B. Manoukian: Vacuum energy-density in quantum electrodynamics.
- 55: B. Goldsmith: Essentially indecomposable modules over a complete discrete valuation ring.

12. LIBRARY

The library stock continued to increase and is now approximately 9,500 items, including approximately 4,200 textbooks and 200 current periodicals. Holdings of periodicals were regularly scrutinized with regard to greatest needs, availability elsewhere in Dublin, and cost; a small number of subscriptions was dropped and a small number of essential new subscriptions taken out. Contact with the RIA Library, the Depts. of Mathematics and Mathematical Physics of UCD and the School of Mathematics of TCD concerning holdings of mathematical periodicals was increased. Material required by members of the School but not available in the library, was sought in libraries at home and abroad, and in most cases obtained. Non-members of the School using the library included members of Departments of Mathematics, Mathematical Physics, Physics, Engineering and Computer Science of the Irish universities, especially of TCD and UCD. The updating of the classification was continued and completed in the case of textbooks.

A letter written in 1917 to the late A. W. Conway by the late President, Éamon de Valéra, was presented to the School by Mrs. May Conan, daughter of Professor Conway. The letter was written while Mr. de Valéra was a prisoner in Lewes Jail and tells of his attempts to study mathematics and astronomy in difficult circumstances, and puts forward some criticisms of a new theory on the nature of the conical motion of the earth's axis about the pole of the ecliptic which had been suggested by a Major-General Drayson.

Gifts were received from Mr. R. Anderson, Professors Synge, McConnell and Ó Raifeartaigh, Drs. Coffey and Sherry, Dr. Mizrahi, the executors of the late Professor Lanczos, Daresbury N.P.L., French Embassy (Service Culturel), ICIP (Trieste), GIFT (Spain), ICI, KEK (Japan), National Bureau of Standards, IEEE (New York), the RIA and Dunsink Observatory. Established exchanges were continued and added to - approximately 80 periodicals are now being obtained by exchange.

IV - Annual Report of the Governing Board of the School of Cosmic Physics for the year ended 31 December 1975 adopted at its meeting on 29 April 1976.

A. Astronomy Section

1. STAFF AND SCHOLARS

Senior Professor:

P. A. Wayman.

Professor:

T. Kiang.

Research Assistants:

I. Elliott; P. B. Byrne.

Experimental Officer:

B. D. Jordan.

Research Associate:

Dr. M. Hoey.

Technical and Clerical Staff:

Miss A. M. Callanan; Mr. R. P. Murphy; Mr. Wm. Dumpleton;
Mrs. V. Bond (part-time to 30 June).

Scholars:

M. J. Stift (to 30 September); A. E. Lynas-Gray.

Mr. Lynas-Gray (appointed to a scholarship on 1 January) worked at Boyden Observatory from 18 July to 24 September and Dr. Byrne worked there from 13 September to 5 December.

The National Science Council of Ireland supported Dr. Byrne's salary as Research Assistant throughout the year.

R. J. Wayman was a Vacation Student for six weeks during August and September.

2. RESEARCH WORK

Photographic Photometry: P. A. Wayman, M. J. Stift.

Considerable progress was achieved during the year in the task of reducing the 'Galaxy' measures of variable stars in the LMC I region of the Large Magellanic Cloud. At the beginning of the year preliminary magnitudes were available for 451 variable stars (or suspected variables) on 91 ADH plates. By the end of the year period-finding had been

carried out for each of these stars and periods found for 175 of them. The remainder were about equally divided between stars showing, in effect, constant brightness and stars for which no satisfactory periodicity has been established. The total of 175 is equal to the total for the two similar Magellanic Cloud regions completed earlier by C.J. Butler. The light curves in B and V, and usually in U and R also, are well determined in most cases and the parameters describing the characteristics of these curves are being used to establish a detailed comparison of the cepheid population of the three separate regions of the Magellanic Clouds. A comparison of the periods determined now with the periods determined by Payne-Gaposchkin from 50-year-old photographs for some of these stars will permit a discussion on the statistics of changing periodicities in cepheids.

Narrow-band photometry - A. E. Lynas-Gray
and Stellar Spectroscopy

Identification of possible luminous OB stars in the Magellanic Stream was attempted during July and August but only a small amount of data was successfully obtained, the 60-inch Cassegrain photometer being used for the first time. This work supplemented Lynas-Gray's work with P. W. Hill (St. Andrews University Observatory) on OB stars in Northern Hemisphere regions, including stars at intermediate galactic latitudes. Tabulation of Lynas-Gray's data, giving stellar distances and approximate space motions for about 180 stars, has been completed. The distance for the cluster NGC 1502 was derived and information on interstellar material from the absorption of light from the stars indicates, in combination with 21cm data, a low-absorption region at $l = 101^\circ$ and high absorption at $l = 99^\circ$, $b = +10^\circ$. HD 199739 is apparently a "cocoon" star, from an anomalously high value of $E(B-v) = 0.69$. Some of the early type stars apparently possessing high space motions have high reddening; it is suspected that they are not sub-luminous and that corresponding HI clouds with high space motions may exist.

Observations of further faint OB stars at intermediate galactic latitudes were made using the Isaac Newton Telescope at the Royal Greenwich Observatory in October and December 1975 in conjunction with P. W. Hill and C. P. Blackman. 50 spectra of 11th magnitude stars were obtained with the image-tube spectrograph and 4 photographic spectra.

Binary X-ray Sources: P. B. Byrne

The region of LMC X-5 was examined on ADH plates loaned by Armagh Observatory. Radcliffe star R99 was found to have a spectrum indicating that it may correspond to the X-ray source; alternatively, the adjacent

HII region N44 may be the source. The radio spectral index of N44 is similar to that of many known supernova remnants and there is a ring-like structure, as in the case of LMC X-1.

Magnetic Variable Stars: M. J. Stiff.

A generalized, non-axisymmetric decentred dipole model was proposed to explain magnetic variations and phase shifts in magnetic stars. Detailed models were derived for HD 126515 and HD 137909 and observed variations of all well-known magnetic stars except for HD 65339 have now been represented. It was further shown that the (maximum field strength) - (pulsation period) relation adopted by Weiss is almost certainly spurious and a note has been accepted for publication.

Statistical Astronomy: T. Kiang.

Monte Carlo methods were developed to complement the analytical study of the random occurrence of multiple systems in a distribution of "stars" on the sky, as reported last year. The smallest "square" that contains m stars, with $m = 2, 3, \dots, 10$ in a random sky of N stars ($N = 10, 20, \dots, 60$) was determined for 1000 random skies. M. J. Stiff and R. J. Wayman assisted with the calculations required.

A serious error in some authors' determinations of the luminosity function of galaxies has overlooked the fact that interstellar absorption, besides dimming extragalactic objects, also reduces the volume of survey. Allowing for this effect largely removes the discrepancy between recent results and those obtained by Kiang in 1961. The nature of the error is the subject of a communication to the Royal Astronomical Society and it is found that the luminosity in the local region of the universe amounts on average to just over $5.10^8 L_{\odot}$ per cubic Megaparsec.

Interferometric Observations (National Science Council Project):

M. J. Hoey, P. A. Wayman, P. B. Byrne.

The design of a Fabry-Perot interferometer utilising a Spectracon image tube was completed and construction was effected by the workshop of the Physics Department, University College, Dublin. An image of the sky covering 6×1.2 arc-minutes is recorded when the equipment is mounted on the 60-inch reflecting telescope at Boyden Observatory. The record is of the light passed by an interference filter and a Fabry-Perot interferometer. After some delay, an acceptable image tube was finally delivered by the manufacturers in July and the instrument was used at Boyden Observatory from September to December. Due to repeated tube failures, and in spite of two further tubes being made available by the manufacturers, only limited Spectracon material was obtained. A number

of H α and O III fringes of the Orion Nebula were recorded photographically.

Asteroid Radiation: T. Kiang, B. D. Jordan.

In collaboration with the Infrared Astronomy Group of Imperial College, London, a programme of observing brighter asteroids in visual and infrared wavelengths has been prepared. The observations are scheduled for the 60-inch Flux Collector at Mount Teide, Tenerife, in January 1976. It is proposed to derive from the measurements both the diameter and albedo of some asteroids, separating reflected radiation from the thermal emission. In preparing this project a numerical scheme for calculating the precise position of any object in the solar system, allowing for all the perturbing forces and mutual interactions of the major planets, was implemented on the Nova computer.

3. INSTRUMENTS, ETC.

Photometric Instruments: B. D. Jordan, P. B. Byrne.

The two-channel Cassegrain Photometer and Controller were received back from Boyden Observatory and the system was modified to incorporate an ASR 33 teletype. A matched pair of EMI 9558 QA photomultiplier tubes in CO₂-cooled housings was provided and the system tested before being reconsigned to Bloemfontein in July. UBVR and uvby β filters have been purchased.

The units to control the Spectracon tube of the Fabry-Perot interferometer were tested and a temperature controller provided.

A single-channel photometer on loan from Armagh Planetarium was adapted at short notice for visual photometry on the 60-inch Flux Collector in Tenerife. A tuning-fork chopper was incorporated and a set of UBVR filters was installed. A high quality copper sulphate crystal was grown, cut and polished in order to eliminate the red leak in the U filter.

Computer Installation: I. Elliott, B. D. Jordan.

16K Core Storage and a Moving-head Disk Unit were added to the Nova 2/10 installation. The two Central Processor Units and associated rack-mounted units are now in one rack. Peripherals are available for use with either CPU as follows: Teletype, Paper tape equipment, Visual Display Unit. The Disk Unit is used only with the Nova 2/10 and the Cartrifile Unit only with the Nova 1220. Data modems and "dedicated" lines for access to the Nova installation from No.5 Merrion Square have been leased from the Department of Posts and Telegraphs. It has been

necessary to design and test a level changer and a current loop interface before this service can be utilised.

The Data General RDOS 32K Operating System has been implemented and the assembly and testing of FORTRAN programs has been greatly improved. RDOS 3.03 has now been replaced by RDOS 4.02 through the Data General Software Subscription Service, and procedures have been adopted for initialisation of disks from paper tape and salvage of data if hardware malfunction were to occur. A series of hardware faults arose following the re-installation of the equipment but development continued successfully in the latter part of the year. Fast Fourier Transforms, Packing and Unpacking routines, and Symbolic and Algebraic Calculations, were three types of data handling entered into during the year.

4. EXTERNAL ACTIVITIES

Professor Wayman addressed the Irish Physics Students Association Meeting at Jordanstown Polytechnic, Co. Antrim, 1-4 January 1975 on "Real-Time Computing in Astronomy".

Dr. Byrne contributed a review of Binary X-ray Sources at the meeting of the Irish Astronomy Group in Queen's University, Belfast, on 9 January 1975.

Dr. Elliott and Professor Wayman attended a Conference on Image Processing Techniques in Astronomy, 24-27 March 1975, at Utrecht, The Netherlands, and Professor Wayman read a paper by himself and Dr. Stift entitled "Handling of 'Galaxy' Photometry".

Professor Kiang attended a Conference on the Structure and Origin of Comets, 25-26 March, 1975 at the University of York.

Professor Wayman contributed a paper on "Some Snags in Stellar Photometry" at the 19th Herstmonceux Conference, 9-10 April 1975, of the Royal Greenwich Observatory.

Professor Wayman attended the Tercentenary Symposium at the Royal Greenwich Observatory, 22-25 July 1975, on "The Galaxy and the Local Group".

Professor Kiang contributed a paper entitled "A Preliminary Estimate of the Mean Density of Matter in the Universe", at the European Conference on Astronomy, 12-18 August 1975, at the University of Leicester.

Professor Wayman attended a Conference on Multiply Periodic Variable Stars at Budapest, 1-5 September 1975.

Dr. Elliott attended a Conference on On-Line Computers in Laboratory Use, 11-12 September 1975, at Imperial College, London.

Professor Wayman gave eight lectures on "Radiation in Astrophysics" to 4th Year Physics students at Trinity College, Dublin in the Hilary Term.

5. VISITORS

Visitors to the Astronomy Section during the year included Dr. J. V. Jelley, Professor G. C. McVittie, Professor J. Ring, Dr. L. Paffrath, Professor O. Gingerich, Dr. T. L. Hankins and Professor M. Kac.

6. PUBLICATIONS

The following publications relating to the work of the Section have appeared:

T. Kiang:

Observational Selection and Statistics of Asteroids. Proc. IAU Colloquium No.22, pp.35-38, 1974.

A Note on a Peculiarity in the Distribution of the Argument of Perihelion. Proc. IAU Colloquium No.22, pp.133-134, 1974.

The Past Orbit of Halley's Comet. Proc. IAU Colloquium No.22, pp.171-174, 1974.

J. Patrick & C. J. Butler:

On the interpretation of the Carnac Menhirs and Alignments. Irish Archaeological Research Forum, Vol.1, 29, 1974.

P. A. Wayman:

Dunsink Observatory, 1968-73. Irish Astron. J. 11, 173-179, 1974.

A Teachers' Course in Astronomy. *ibid.* 180-186.

M. J. Stift:

A Non-Axisymmetric Rigid Rotator Model for Magnetic Stars. Mon.Not.R.Astr.Soc. 172, 133-39, 1975.

The Magnetic Fields of Pulsating Variables. Astronomy and Astrophysics, 45, 227-228, 1975.

P. A. Wayman & M. J. Stift:

Handling of 'Galaxy' Photometry. Image Processing Techniques in Astronomy (Reidel 1975), 335-340.

P. B. Byrne & P. A. Wayman:

A Search for Optical Pulses from the Galactic Centre. Mon.Not. R.Astr.Soc. 173, 537-552, 1975.

D. Kilkenny, C. E. J. Hilditch, R. W. Hilditch, P. W. Hill and A. E. Lynas-Gray:

H γ Photometry in M39. Mon.Not.R.Astr.Soc. 172, 5p, 1975.

Obituary Notice of Eric Mervyn Lindsay, by P. A. Wayman in the Quarterly Journal of the R. Astr. Soc. 16, 215-217, 1975.

Reports from Observatories, "Dunsink Observatory", Quarterly Journal of the R. Astr. Soc. 15, 487-492, 1974.

6. MISCELLANEOUS

Boyden Observatory

Professor Wayman attended a meeting of the Boyden Observatory Council in Bloemfontein on 20-21 May 1975. Arrangements were made for transfer of ownership of the Boyden Observatory from the Smithsonian Astrophysical Observatory to the University of the Orange Free State. It is understood that the Boyden Council, an informal organisation in existence since 1955, will cease to exist from 1 July 1976. The University of the Orange Free State has undertaken to ensure continuation of Boyden as an astronomical institution at any rate until 30 June 1979. Agreement to the terms of transfer of ownership has been secured from each of the current members of the Boyden Observatory Council and the Council of the Institute, in particular, has approved these terms. No formal steps with regard to ownership or future operation of the Armagh-Dunsink-Harvard telescope have been taken at this time, pending appointment of a director of Armagh Observatory. No commitment, informal or otherwise, has been entered into by the Section with respect to financial contributions to Boyden Observatory beyond 30 June 1976.

Public Open Nights, etc.

In addition to the lectures to scientific meetings and third-level educational groups noted in section 4, staff members made radio or television broadcasts or addressed groups of the public or from societies, clubs, etc. on upwards of fifty occasions during the year. These groups included Extra-Mural Classes (UCD), undergraduate societies, amateur astronomical societies, youth groups and adult groups visiting Dunsink Observatory, and the regular Public Open Nights held at Dunsink.

Arrangements have been made to hold Public Open Nights on two Saturdays each month from September to March and to issue admission tickets by post for attendance without charge. The former degree of overcrowding has been eliminated and a better standard of presentation is now achieved.

These services to the public, forming only a marginal part of the work of the Section, are constantly in demand, and staff are anxious to respond if it is possible to do so. On each Public Open Night one member of the academic staff or a scholar and Mr. W. Dumpleton, Technical Assistant, are in attendance.

Slide sequences and associated sound tracks have been used very successfully and one set has been duplicated by Aer Lingus for use at the January 1976 Young Scientist Exhibition and for subsequent use at Dublin Airport.

The British Broadcasting Corporation made a television recording at Dunsink Observatory on 17 October 1975 in connection with an "Open University" Mathematics series. The work of Sir William Rowan Hamilton on non-comutative algebra was described.

Irish Astronomical Journal

Dating from an agreement between the late Dr. E. M. Lindsay of Armagh Observatory and the late Professor M. A. Ellison, publication of the Irish Astronomical Journal under the joint management of Armagh and Dunsink Observatories continues as in previous years. All editorial matters are handled at Armagh Observatory with Dr. E. J. Opik as Editor. Eight numbers per bi-annual volume are normally produced, the number of pages printed for the last six volumes being as follows:

Vol.	Years	No. of pages
6	1963-64	316
7	1965-66	268
8	1967-68	292
9	1969-70	322
10 Special Issue	1971-72	306 + 92
11	1973-74	268

Building Award

The renovation of the Meridian Room carried out during 1974 was entered by the Architects for the Architectural Heritage Year Competition of the Royal Institute of Architects of Ireland and was "Commended".

B. Cosmic Ray Section

1. STAFF AND SCHOLARS

Senior Professor:

C. Ó Ceallaigh.

Professor:

K. Imaeda.

Assistant Professors:

D. O'Sullivan; A. Thompson.

Research Assistant:

Y. V. Rao.

Experimental Officer:

J. Daly.

Technical and Clerical Staff:

Miss D. Molloy (to 30 September - on special unpaid leave of absence to work with the Arts Council); Mrs. E. Clifton (from 1 October - temporary replacement for Miss D. Molloy); Miss H. O'Donnell; Miss E. Rankin; Miss M. Cahill; Mrs. R. Horan; Miss C. Murphy; Miss R. Toner (from 5 May).

2. RESEARCH WORK

Ultra Heavy Cosmic Ray Nuclei

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

The Collaboration with Professor Fowler's Group at Bristol University continued successfully during the year. Calibration of the DIAS share of the nuclear emulsion batches used in the Cokato, Mississippi and Cherry Creek stacks was carried out by following back about 200 Fe-group nuclei from Lexan into emulsion and by using microdensitometer equipment to carry out extensive ionisation measurements on each track. In addition, detailed ionisation measurements were made on the emulsion tracks of all ultra-heavy cosmic ray nuclei in the Cokato and Mississippi stacks.

The Lexan from the Cherry Creek stack was processed, ammonia-scanned and cylinder-scanned during the year. Optical scanning of the nuclear emulsion from this stack is still in progress. A total of twenty stopping ultra heavy candidates were found by cylinder-scanning. Selective etching of the Lexan and all relevant measurements have been completed. Several hundred Fe-group nuclei were located and measured in order to calibrate the Lexan used in the Cherry Creek stack.

During the year, a new ionisation parameter for Lexan $G = (V_t)^{-1} d/dr(V_t)$, has been developed. The main advantage of this modified parameter is that its use for charge identification is independent of residual range. It is intended to re-analyse all ultra heavy cosmic ray nuclei found to date, employing the new parameter and other improvements.

Production of Nuclear Fragments from the Interactions of 24 GeV/c Protons in a gold Target.

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

The study of the charge and energy spectra of the fragments emitted in the interaction of 24 GeV/c protons in a gold target was completed. Over 5000 individual low energy nuclear fragments were examined, using Lexan polycarbonate track detectors. The charge and energy of each fragment were determined by the two-parameter ultraviolet technique, in conjunction with heavy ion calibration material exposed at the Manchester Linear Accelerator. The differential energy spectra for all nuclear fragments from carbon to phosphorus were determined in the energy interval ranging from ≈ 0.8 MeV/amu up to ≈ 5 MeV/amu.

The outstanding feature of the results was that the production rate of fragments increased, even when their kinetic energies were far below the hard-sphere Coulomb Barrier. This phenomenon cannot be understood in terms of existing models of high energy interactions. We find that the effective Coulomb Barrier must be reduced to about 1/4 of the normal hard sphere value to account for the results.

An important feature of the experiment was that we were able to study nuclear fragments down to \approx MeV/amu which is not possible with semiconductor detectors. Consequently, most of our data were in a hitherto unexplored region.

The observed relative abundances normalised to oxygen were found to be in good agreement with those at somewhat higher energies of Poskanzer et al. (Lawrence Berkeley Laboratory).

In view of recent publications dealing with superheavy element production, a search for high energy fragments with $Z > 10$ and Energy > 15 MeV/amu was also completed. No events were found, thus setting an upper limit of $\approx .01 \mu\text{B}$ for the formation cross-section of such fragments.

Isotopic Composition of Cosmic Ray Nuclei in the Iron Group.

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

Recent studies of the isotopic composition of cosmic rays with $A \geq 4$, have shown that the abundance ratios for the isotopes of some elements differ from the solar system values. In the Iron-Group region, there is some indication that the cosmic ray abundances of Fe^{54} , Fe^{56} and

Fe^{58} are of the same order, although Fe^{56} predominates in the solar system ($\approx 92\%$). However, no firm conclusion can be drawn from the results published to date amongst which there is considerable disagreement.

During the first year, we completed the first phase of a project to study the isotopic composition in the Fe region by means of Lexan Polycarbonate track detectors. Employing a stack of Lexan which was flown from Sioux Falls in 1973, a sample of about 1500 stopping nuclei, found by ammonia-scanning, was subjected to a preliminary analysis. A mass resolution of < 2.0 amu was obtained for Iron Group nuclei in the energy region 250 to 500 MeV/amu corrected to the top of the atmosphere.

The essential aim of the method of computation adopted was to fit for each nucleus a power law curve to all values of etching rate and residual range. The intercept (of a given curve of best fit) with the ordinate at residual range 1000 μm was then taken as a single parameter of mass and charge for the relevant nucleus.

Our results indicate that the Iron Group isotopes do indeed have a large spread of mass values. Preliminary values for the relative abundances $Fe^{54} : Fe^{56} : Fe^{58}$ and $Cr^{50} : Cr^{52} : Cr^{54}$ are 30:50:20: and 35:55:10 respectively.

We intend to proceed to the second phase of this project by carrying out an optical scan for the lower charge-groups. It is hoped to determine the Calcium peak very accurately and to study the resolution in the neighbourhood of Silicon, obtaining thereby the most appropriate value of K to be used in the Bethe-Bloch-Sternheimer expression for ionisation. This will determine the most likely mean mass of the Iron peak in terms of the masses of Silicon and Calcium.

A Study of Quaternions and Tachyons

K. Imaeda.

The quaternionic formulation of electrodynamics has been extended to tachyons (particles moving faster than light) using a superluminal Lorentz transformation (a transformation from a system to another which is moving with a velocity greater than light, with respect to the first system).

The theory shows that tachyons are a sub-class of a larger family of particles which have complex physical quantities, such as a complex coordinate and a complex momentum and cannot simply be characterised as particles faster than light. This conclusion has an important bearing upon current attempts at the experimental detection of the particles.

Several apparent misconceptions concerning tachyons have been discussed and corrected.

Further, the relation between tachyons and magnetic monopoles has

been studied. The theoretical grounds for the conjecture that an electrically charged particle moving faster than light may manifest itself as a magnetic monopole has been discussed. A condition in which the conjecture may be valid has been defined.

The Study of a New Formulation of Classical Electrodynamics.

K. Imaeda.

The study has been continued and the quaternionic formulation extended so as to cover an electromagnetic field in space and its propagation. Theorems on a series expansion and an integral theorem corresponding to the Fourier integral theorem are obtained in quaternionic form.

Solar Modulation and the Chemical Composition of the Cosmic Radiation.

Y. V. Rao (with P. S. Young and R. Fukui).

At the Budapest Conference on Cosmic Rays (1969), Price, Ó Ceallaigh et al. presented results on the charge spectrum of low energy cosmic rays with good statistics extending from $Z = 12$ to 28. These were the first measurements which indicated the presence of a surprisingly high abundance of Cr and Mn, each having $\approx 40\%$ the abundance of Fe. Since then several groups reported abundances of Cr and Mn in the low energy band. However, the abundances of these elements relative to iron at low energies differs widely among different experiments. Waddington advanced arguments to suggest that the large variation in the abundances of Cr and Mn is due to modulation. Recently Fleischer, Price and Walker have discussed several possibilities for large Cr and Mn abundances, namely

- (1) the Cr and Mn might have been synthesized during a supernova explosion and accelerated to cosmic ray energies;
- (2) the Cr and Mn might be low-energy-spallation products of Fe;
- (3) the Fe might be dominantly ^{54}Fe , which would cause its signal (etch rate versus residual range in plastics) to be more nearly like ^{55}Mn and made it more difficult to separate Mn and Fe than if it were dominantly ^{56}Fe .

Data for Cr and Mn abundances for all flights between 1967 and 1972 were compiled. It is suggested that when the effects of fragmentation production processes and degree of modulation on Cr and Mn are taken into consideration, certain conflicting results in the literature may be resolved. Quantitative estimates were made of the magnitude of the expected variations in abundances that might result. The expected percentage abundance-changes in Mn at 300 MeV/amu for various modulation potentials was estimated. The calculations suggest a variation of 29%

in abundance for Mn between solar maximum and solar minimum. Recent Skylab data indicate a very high abundance of Cr which would further support the arguments. (This work was done in collaboration with Dr. P. S. Young of Mississippi State University and Dr. K. Fukui of Air Force Cambridge Research Laboratories.)

Multiple Coulomb Scattering Parameters in Emulsions Exposed to High Energy Heavy Ion Beams.

Y. V. Rao. (With P. S. Young and R. Fukui).

Preliminary estimates of multiple Coulomb scattering parameters in nuclear emulsions exposed to high energy heavy ion beams have been obtained. With the availability of heavy ion beams at the Lawrence Berkeley Laboratory Bevatron, it has become possible to make reliable multiple scattering measurements in nuclear emulsions. The nuclear stacks used in this experiment consisted of

- (a) Ilford G5 with pellicle dimensions 75 x 75 x 0.6 mm exposed to a beam of 2.1 GeV/amu ^{14}N ions, and
- (b) Ilford K5 emulsions 105 x 105 x 0.4 mm exposed to a beam of 2.1 GeV/amu ^{16}O ions.

Using the coordinate method, multiple scattering measurements were made on the beam tracks over a total track length of 10.5 metres. By confining measurements in selected regions virtually free from distortion, it has been possible to obtain reliable values of the scattering constant (K) for cell lengths 2 mm and 3 mm. The estimation of K at these cell lengths, suggests that it is fairly constant in this region and lies below the theoretical curve. It is shown that the distribution of second differences with $4\bar{D}$ cut-off is Gaussian (as expected from theory) over the entire range of cells considered. The correlation ratio of second and third differences for Coulomb scattering is found to be about 10% higher than the theoretical value.

3. WORKSHOP AND TECHNICAL DEVELOPMENT - J. Daly.

As in former years, the workshop continued the maintenance of the diverse pieces of equipment (chemical, electronic and mechanical) used for carrying out the various experiments within the Section.

Work has begun on the construction of apparatus to provide uniform high-intensity UV irradiation of areas of Lexan much larger (x 100) than those irradiated hitherto.

Part of the basement in No.5 has been modified and converted into a computer room. Two remote access terminals and associated equipment have been installed. One terminal, that of Time Sharing Ltd., has been

in successful operation for some time. It is planned to connect the other terminal to the Data General computer complex at Dunsink Observatory via Modems and a private line.

4. COMPUTING FACILITIES

During the year a new telephone system was installed in No.5. This eliminated the problems and difficulties which had prevented effective use of the remote access terminal of Time Sharing Ltd. In addition, a new automatic multiplexer was installed in the Dublin Time Sharing office, which greatly improved access to the PDP 10 computers in London. Since the improvements were made, the service provided by Time Sharing Ltd. has been most satisfactory and the availability of line printer facilities has been particularly useful.

It is hoped that the planned link between No.5 and the Data General configuration at Dunsink via a dedicated line will come into operation next year.

5. EXTERNAL ACTIVITIES

As a member of the Scientific and Technical Committee of Euratom and one of its representatives on the Groupe de Liaison Fusion, Professor Ó Ceallaigh attended meetings at Cadarache, France (13-14 March 1975), Utrecht, Holland (4-5 November 1975), Brussels, Belgium (19-20 January, 29-30 April, 2 July 1975), Dublin (15-16 July 1975), Ispra, Italy (16-17 October 1975). As a member of the Physics III Committee of CERN he attended meetings at Geneva on 5 and 6 March, 30 June to 1 July, 29 September, and 1 December 1975.

Professor K. Imaeda attended the 8th European Conference on Physics and Chemistry of Complex Nuclear Reactions at Frostavallen, Sweden from 12 to 17 September 1975.

Professors D. O'Sullivan and A. Thompson and Dr. Y. V. Rao attended the 14th International Cosmic Ray Conference at Munich, Federal Republic of Germany. Professors O'Sullivan and Thompson represented the Dublin-Bristol Collaboration and presented recent results of the joint programme. Dr. Y. V. Rao presented a paper entitled Solar Modulation and Chemical Composition of Cosmic Radiation.

Several working visits by members of the Academic and Technical Staff were made to the Physics Department, Bristol University during the year in furtherance of the Bristol-Dublin Collaboration.

Professor A. Thompson delivered an invited lecture entitled Current Developments in Heavy Nuclei at UCD in June 1975.

A course of 18 lectures on Nuclear and Particle Physics was delivered to final year physics students at University College Galway by Dr. D. O'Sullivan during Hilary Term 1975.

6. STATUTORY PUBLIC LECTURE

The Statutory Public Lecture entitled Nuclear Particles from Outer Space was delivered by Professor C. Ó Ceallaigh at University College, Dublin on 17 December 1975.

7. PUBLICATIONS

Published:

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

Isotopic Composition of Cosmic Ray Nuclei in the Iron Group. Proceedings of the 14th International Cosmic Ray Conference, Munich, Germany, Vol. 12, 4128 (1975).

K. Fukui, Y. V. Rao and P. S. Young.

Correlation Coefficients for Higher Order Differences in Multiple Scattering. Acta Physica Hungarica, 37, 13 (1974).

Solar Modulation and the Chemical Composition of the Cosmic Radiation. Proc. 14th International Cosmic Ray Conf. Munich, 3, 1005 (1975).

In the Press:

K. Imaeda:

A New Formulation of Classical Electrodynamics. Il Nuovo Cim. On Quaternionic Form of Superluminal Transformations. Lettere al Nuovo Cimento.

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

Production of Nuclear Fragments from the Interactions of 24 GeV/c Protons in a Gold Target. Nuovo Cimento.

Y. V. Rao:

Rising Inelastic Cross Section and its Contribution to Steepening of the Cosmic Ray Energy Spectrum. Annalen der Physik.

In Preparation:

K. Imaeda:

The Electromagnetic Field of Tachyons and Magnetic Monopoles.

R. Fukui, Y. V. Rao, P. S. Young:

Multiple Coulomb Scattering Parameters in Emulsions Exposed to High Energy Heavy Ion Beams.

Geophysics Section

1. STAFF AND SCHOLARS

Senior Professor:

T. Murphy.

Professor:

Vacant.

Research Assistant:

Vacant.

Research Associates:

Rev. G. McGreevy (Maynooth College); K. W. Robinson (Geological Survey).

Technical and Clerical Staff:

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

Scholar:

D. W. Howard (from 1 December 1975).

The situation regarding the shortage of staff continued throughout the year, the Section operating with only one staff member. Negotiations regarding the redesignation of a post as Experimental Officer proceeded without any decision being reached.

The re-advertisement of the post of Professor or Assistant Professor appearing in January resulted in four applications. A suitable candidate was chosen for the post of Professor on 26 June but sanction was not given for this appointment by the Department until 29 October.

An advertisement for Research Assistant appeared in August and six applications were received. Several of these would have been acceptable but on 29 October the day before a selection was to have been made a condition was insisted upon by the Department that the post was not to be filled if the post of Professor was filled.

The resulting uncertainty in the filling of posts has been a deterrent to starting any new work and some work in progress had to be curtailed.

Several candidates applied for scholarships and two proved acceptable. One later declined and one (postdoctoral) accepted.

2. RESEARCH WORK

(a) Gravity:

Some areas in Co. Tipperary were surveyed by Misses Ryan and Ward

as part of the general survey.

Interest in base metal prospecting by gravity methods became apparent and several companies were given assistance in their efforts by the provision of data. In return considerable gravity material has been given which after checking will be incorporated, if possible, in our publications.

(b) Magnetics:

A study of the magnetic anomaly field over the western Continental Margin was undertaken in conjunction with geological studies by Drs. Phillips and Stillman of Dublin University, using the data from Communication D 34 by Riddihough and from the various cruises undertaken by the University of Wales. However, large discrepancies well outside acceptable limits became apparent between the two sets of data in certain areas and the accuracy of all the data became questionable. The most likely explanation arrived at was that the positional data was at fault. In two instances misfits of over 5 kilometres could explain certain discrepancies. This type of explanation will not cover all discrepancies. Thus, unfortunately, these data can only be used to a limited extent and hence the study was discontinued for the time being, at least until the diurnal variation at sea could be investigated in the search for a possible cause. There are other areas, however, where the agreement is very good.

Following this discovery, a total field recording magnetometer was operated at the Meteorological Station at Belmullet by kind permission of the Meteorological Service in July and August while the summer cruise by the University of Wales was in progress at the northern end of the Porcupine Trough. The new data did not help solve the discrepancies, in fact it introduced more, but uncertainties in the diurnal variation were eliminated as a possible cause. However, it is now apparent that in certain areas the magnetic field is very complex, suggesting that sheet basalts may be occurring. This is being followed up.

(c) Meteorology:

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

(d) Seismology:

In July and August seismic recordings were carried out on the Inishowen peninsula, eight sites being occupied simultaneously, during the Hebridean Margin Project of the University of Durham. Remarkably strong

signals were received from 136 kilogram charges at distances up to 340 kilometres.

During this period the siting of the seismometers proved the greatest problem with the final result that an assessment cannot be made of a site visually. A full test has to be resorted to which necessitates the play-back equipment being brought on fieldwork.

An unexpected source of seismic signals was detected and circumstantial evidence pointed to a vessel known to have been anchored about 15 kilometres north of the Malin Meteorological Station for a period of three months. Extensive enquiries failed to ascertain the type or nationality of the ship. No suggestion can be offered as to the source of the signals. However, the latter proved of use and a velocity of 5.9 kilometres per second has been deduced for the P wave in the upper strata on Inishowen.

On return from the field the play-back equipment was altered and partly re-equipped before paper and ink records of the results were started. These were not completed and hence an analysis was not attempted.

A request was made by the E.S.B. for the Section to undertake a seismic assessment of the site for a projected Atomic Power Station at Carnsore Point, Co. Wexford, but this had to be turned down for lack of staff. Instead, facilities, assistance and access to the records were given to a member of their staff to carry out a study of the literature with practical work to follow when staff and suitable equipment become available.

3. LECTURES AND FIELD EXERCISES

The series of eight weekly lectures on geophysics for geological students from the universities was given during Michaelmas term. Students from both Dublin Colleges and three from University College, Cork attended. The numbers were up to thirty.

The field geological exercise for Trinity College students took place in the Ox Mountains around Lough Talt. Magnetic and gravity anomalies were traced out in particular and the use of various geophysical equipment demonstrated.

A lecture to engineering and physics students was given in University College, Galway.

4. EXTERNAL ACTIVITIES

Professor Murphy attended the following meetings:

- (a) The European Society of Exploration Geophysicists, Bergen, 17-20 June.

- (b) International Union of Geodesy and Geophysics, Grenoble, 25 August - 4 September.
- (c) At Bundesanstalt für Bodenforschung, Hannover, West Germany to discuss plans for International Co-operation on behalf of the National Science Council, 18 and 19 September.
- (d) Marine Science Group of Geological Society, London, 3 December.

5. PUBLICATIONS

Published:

D.W. Howard:

Deep seated igneous intrusives in Co. Kerry, Ireland. Proc.RIA, Vol.75, B, No.7, 173-183, 1975.

R. P. Riddihough:

A Magnetic Map of the Continental Margin West of Ireland including part of the Rockall Trough and the Faeroe Plateau. Communications of the Dublin Institute for Advanced Studies, Series D, No.33.

R. P. Riddihough:

A Magnetic Anomaly Map of the Area 51° - 55° N, 10° - 16° W. Communications of the Dublin Institute for Advanced Studies, Series D, No.34.

In the Press:

D. W. Howard & G. Wallace:

Rock Susceptibility Meter. Journal of Scientific Instruments.

15th July, 1976.

W. B. Stanford
CHAIRMAN.