

INSTITIÚID ÁRD-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 Financial Year

1964-65

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

Summary of Annual Report  
of the work of the Constituent Schools  
for the year 1964-65

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School of Celtic Studies

Professor Binchy held the seminar again this year reading the Bretha Déin Chécht, which he is editing for Ériu. He continued to transcribe law-tracts for the Corpus Iuris Hibernici.

The new Chair of Celtic at the University of California in Los Angeles was held by Professor Dillon for part of the year.

Five books were published during the year, of which perhaps A Grammar of Middle Welsh by Professor Evans is the most important. There are twenty-four volumes at the press of which several will appear in the coming year. Progress was made with volumes for all five series of the School's regular publications. The seventh volume of Celtica was sent to press.

School of Theoretical Physics

Professors Lanczos and Synge worked chiefly in the theory of relativity. Professor Lanczos continued investigations of a sub-microscopic metrical lattice, and Professor Synge (in collaboration with Dr. Florides and Rev. J. McCrea) studied the problem of gravitational radiation due to a sudden disturbance in a massive body. Professor Takahashi continued research on a Hamiltonian formalism with a linear supplementary condition. He also worked with Professor Lurié on the parity of mesons and the problem of normalization of the relativistic two-body wave function. Professor Ó Raifeartaigh, Dr. Gruber, Dr. Kamber and Dr. Straumann worked on the fundamental problems of group theory and its application to particle physics. Dr. Callan obtained an empirical mass formula of all the observed elementary particles. Dr. Wong continued his investigations of Gor'kov's theory of superconductivity. Dr. Yeh studied Feynman's path integral method in quantum theory, and the special unitary group.

Seminars were held weekly as usual, and there was a study group organized by Professor Lurié. A Mathematical Symposium was held in December 1964 (attendance 52). Professor Lanczos was on leave of absence for six months in the U.S.A. where he gave a number of lectures. Professor Synge lectured in Cork and London, and gave the Statutory Public Lecture on "The Early Work of Sir William Rowan Hamilton" in Trinity College. Professor Takahashi lectured in Oxford and Liverpool. Professor Ó Raifeartaigh commenced a two-year leave of absence at Syracuse University and read a paper in New York.

Four books were published, including one second edition and one translation into Polish. One Communication was published, and one was in the press; 23 papers were published, including one review, and 10 papers were in the press.

School of Cosmic Physics

Astronomical Section:

Dr. P. A. Wayman was appointed as Senior Professor on August 1, 1964, and from that time some progress has been made in re-commencing observational

work by the Dunsink Observatory at the Boyden Observatory, Bloemfontein, and some changes in the administration of that Observatory are being made. An exploratory programme on selected Milky Way fields was started in March 1965.

H $\alpha$  heliograph films from the Royal Observatory, Cape Town, were analysed for flare patrol purposes throughout the year and the results distributed. Several studies of special periods of solar activity that occurred during 1963 were completed.

Considerable progress was made with the numerical work for the analysis of high-resolution solar spectra with respect to the fine details of the Doppler shifts due to chromospheric motions.

Six communications from Dunsink Observatory were published during the year, as well as contributions presented at five symposia outside Ireland.

#### Cosmic Ray Section:

Professor Ó Ceallaigh remained a member of the British Emulsion Committee at N.I.R.N.S., Harwell, and the Emulsion Experiments Committee, CERN, Geneva and attended meetings.

Professor Ó Ceallaigh studied the variation of ionization of a particle passing through condensed media.

Professor Imaeda studied the energy estimation of cosmic ray jets, and together with Mr. Shah, the method was applied. He worked with Mr. Avidan on the  $P_t$  distribution of the secondary of jets. Miss Kazuno studied isobar production in cosmic ray jets.

The European  $K^-$  Collaboration (Messrs. O'Sullivan, Shah and Thompson) continued throughout the year and investigated the interactions of low energy  $K^-$  mesons with protons and the production of hyperfragments by 3 GeV/c and 5 GeV/c  $K^-$  mesons in nuclear emulsion.

Professor Imaeda, with the aid of Mr. Daly, built an emulsion chamber to study cosmic ray jets which was sent to India for balloon flight during the International Quiet Sun Year Balloon Expedition. The flight and recovery were successful.

#### Geophysical Section:

The work on the small gravity anomalies was continued in Central Ireland, Kerry and Cork. It is thought that the cause has now been established and the unusual phenomenon is being studied by geologists. The work in Co. Cork has shown remarkable gravity features and the results have been prepared for publication.

The collaboration with Dr. A. Lees of Reading University on the structure of the Central Plain was continued.

Assistance was given to members of Durham University carrying out geophysical work in the Irish Sea.

The work on rock magnetism in collaboration with Professor J. H. Poole and Dr. I. R. McAulay of Trinity College was continued.

An investigation of wind frequencies at Dublin City was commenced.

Professor Murphy attended the summer meeting of the European Association of Exploration Geophysicists at Liège and the Symposium on Experimental Seismology at the Royal Society London.

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

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Annual Report of the work of the Institute and  
its Constituent Schools presented by the Council  
for the Financial Year 1964-65

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In accordance with the provisions of Section 29 of the Institute for Advanced Studies Act, 1940 (No.13 of 1940), the Council of the Institute has the honour to present to the Minister for Education for submission to the Government a report of the work and activities of the Institute and its Constituent Schools for the financial year ending 31st March, 1965.

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, 1940 (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 March 1965.

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 March, 1965.
- 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 March 1965.

1. THE COUNCIL OF THE INSTITUTE

Chairman:

Professor Edward J. Conway, M.D., D.Sc., F.R.S., F.R.C.P.I.

Ex-Officio Members:

Mr. J. J. Hogan, M.A., B.Litt. (Oxon.), President, University College, Dublin; Dr. Albert J. McConnell, M.A., M.Sc., Sc.D., Provost, Trinity College, Dublin; Professor Joseph Doyle, B.A., D.Sc., President, Royal Irish Academy.

Members appointed by the Governing Boards of Constituent Schools:

Right Reverend Monsignor Patrick Boylan, D.D., M.A., D.Litt.; Professor Myles Dillon, M.A., Ph.D.; Professor Felix E. W. Hackett, M.A., M.Sc., Ph.D.; Professor John L. Synge, M.A., Sc.D., F.R.S.C., F.R.S.; Professor John H. J. Poole, M.A., B.A.I., Sc.D.; Professor Cormac Ó Ceallaigh, M.Sc., Ph.D.

2. THE GOVERNING BOARD OF THE SCHOOL OF CELTIC STUDIES

Chairman:

Right Reverend Monsignor Patrick Boylan, D.D., M.A., D.Litt.

Senior Professors:

Daniel A. Binchy, M.A., Ph.D., B.L.; Myles Dillon, M.A., Ph.D.

Appointed Members:

Tomás de Bhaldraithe, M.A., Ph.D., D.Litt.; Éamonn Mac Giolla Iasachta, M.A., D.Litt.; Reverend John Ryan, S.J., M.A., D.Litt.; Reverend Francis Shaw, S.J., M.A.; Ernest Gordon Quin, M.A., F.T.C.D.; Liam Price, M.A., B.L.

3. THE GOVERNING BOARD OF THE SCHOOL OF THEORETICAL PHYSICS

Chairman:

Felix E. W. Hackett, M.A., M.Sc., Ph.D.

Senior Professors:

John L. Synge, M.A., Sc.D., F.R.S.C., F.R.S.; Cornelius Lanczos, Ph.D.

Appointed Members:

David R. Bates, D.Sc., F.R.S.; John Stephen Roy Chisholm, M.A., Ph.D.; George R. Keating, M.Sc.; Albert J. McConnell, M.A., M.Sc., Sc.D.; Reverend James R. McConnell, D.Sc.; Máirtín Ó Tnúthail, D.Sc.; Patrick Quinlan, B.E., M.Sc., Ph.D.

4. THE GOVERNING BOARD OF THE SCHOOL OF COSMIC PHYSICS

Chairman:

John H. J. Poole, M.A., B.A.I., Sc.D.

Senior Professors:

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

Appointed Members:

Cyril F. G. Delaney, M.A., Ph.D.; Eric M. Lindsay, M.A., M.Sc., Ph.D.; John J. McHenry, M.A. (Cantab.), D.Sc.; Right Reverend Monsignor Patrick J. I. McLaughlin, D.Sc.; Thomas Edwin Nevin, D.Sc.; Patrick J. Nolan, Ph.D., D.Sc.; Cilian Ó Broilcháin, M.Sc.; Ernest T. S. Walton, M.A., M.Sc., Ph.D., F.T.C.D.

5. ADMINISTRATIVE STAFF

Registrar:

Patricia O'Neill.

Senior Clerk:

Maura Devoy.

Clerks:

Mary A. O'Rourke; Janet Dowling; Desmond Pender.

II - Report of the Governing Board of the School of Celtic Studies

adopted at its meeting on 30th June 1965.

1. STAFF, SCHOLARS AND EXTERN RESEARCH WORKERS

Senior Professors:

Myles Dillon, Director of the School; Daniel A. Binchy.

Professors:

James P. Carney; Miss Cecile O'Rahilly (retired 18 December 1964).

Assistant Professors:

Louis Paul Nemo (Roparz Hemon); Gearóid S. Mac Eoin; Rev. Pádraig Ó Súilleabháin, O.F.M. (appointed 1 January 1965).

Assistant (Part-time):

Mrs. Nessa Doran.

Research Associates:

Heinrich Wagner; Liam Price.

Technical and Clerical Staff:

Máire Breatnach; Máire Bean Uí Chinnsealaigh.

Scholars:

Rolf Baumgarten (to December 1964); Máire Próinséas Ní Chatháin; Miss Meinir Lewis (to September 1964); Kenneth Nicholls (to September 1964); Bruce Boling (appointed 1 October 1964); Miss Winifred McEnery (appointed 1 October 1964).

Extern Research Workers commissioned by the School:

Rev. Anselm Faulkner, O.F.M.; Rev. Bartholomew Egan, O.F.M.; Dr. R. B. Breatnach; Dr. L. Bieler; Gordan Mac Lennan; Professor D. Simon Evans; Professor Séamus Ó Néill; Mrs. Ruth Lehmann; An tAthair Pádraig Ó Fianachta; Dr. Wolfgang Meid; Caitlín Ní Maol-Chróin; Eamonn Mhac an Fhailigh; Professor J. J. Tierney; I. P. Sheldon-Williams; Professor David Greene; Professor Proinsias Mac Cana; Professor Brian Ó Cuív; Dr. R. L. Thomson.

2. RESEARCH

Professor Dillon was Visiting Professor at the University of California in Los Angeles from February to June 1964. During the year the final revision of Volume IV of the Book of Leinster was completed and the book is now being printed off. Work was continued on The Celtic Peoples which is to appear as a Volume of the History of Civilisation (Weidenfeld). Work was done on the edition of a tract on the 'Rights of O'Neill' from Leabhar Clainne Aodha Buidhe. Celtica VII was edited and is now at the press.

Much time was spent on reading typescript and proofs of work to be published by the School. In July 1964 an honorary degree of D.Litt. was conferred on Professor Dillon by the University of Wales at Bangor.

Professor Binchy held a Seminar on an Irish law-tract (to be published shortly) during Michaelmas and part of Hilary Terms. He continued to transcribe MSS. for the Corpus Iuris Hibernici, and revised the first proofs of Volume V of the Book of Leinster. He also edited and sent to the printers Volume XX of Ériu, to which he contributed two articles.

Professor Carney worked on an edition of Thomas Davis lectures on Early Irish Lyrics, the text of which has been sent to the printers. In co-operation with Professor David Greene he edited a memorial volume to the late Professor Angus Matheson to which he contributed an article on 'Two poems in Accallam na Senórach'. Professor Carney also supervised the reprinting of Miss Eleanor Knott's Irish Classical Poetry and Gerard Murphy's two booklets on the Mythological Cycle and on Ossianic and Romantic Tales. This material is at the printers. An edition of 40 poems (Irish or Hiberno-Latin) with translations, notes and lengthy introduction is being published by the Dolmen Press. A volume of the Poems of Blathmac, son of Cú Brettan (Volume XLVII, ITS) was published in March 1965.

Professor O'Rahilly completed the preparation of the text and translation of LL- Táin Bó Cuailnge. This material was sent to press but was lost in a fire at the premises. Miss O'Rahilly has since submitted a second copy to the printer. Preparation of Notes and Introduction for this work continued. Two notes were accepted for Celtica VII - (1) on Mid. Ir. conataig; (2) on Marcach. A note on Tecosc was accepted for Éigse. In December 1964 Miss O'Rahilly retired from the post of Professor at the Institute but continues to work as Co-Editor on the Dictionary of Classical Modern Irish.

M. Louis Paul Nemo worked on his Historical Dictionary of Breton, the 9th volume (Fled-Ganded) of which was published in December 1964. Work is continuing on an edition of the fragments of the Middle Breton play, The Destruction of Jerusalem and on another play from a manuscript now in the Municipal Library in Rennes.

Dr. Gearóid S. Mac Eoin continued the revision of R. A. S. Macalister's

Annals of Tigernach and continued to work on various problems in Middle Irish religious literature. He edited Volumes IV and V of Studia Hibernica.

He prepared an edition of a poem by Airbertach mac Cosse Dobráin for publication in Ériu XX. The texts of the unpublished tale 'Imthechta na nÓinmhideadh' were transcribed with a view to a future edition.

Rev. Pádraig Ó Súilleabháin, O.F.M. worked on the preparation of the text Buaidh na Naomhchroiche. This material should shortly be ready for the printer. Final proofs of the late Fr. Canice Mooney's edition of Seanmóna Chúige Uladh and of all Franciscan Texts going through the press were checked. An article on 'Brenan, Carew, and their ecclesiastical histories' was prepared for Archivium Hibernicum. An article entitled 'Roinnt teagasc críostaí Gaeilge' was accepted for Éigse.

Mrs. Nessa Doran made necessary alterations and additions to Fasciculus I of the Catalogue of Irish MSS. in the National Library of Ireland and prepared the typescript for the printer. Before proceeding with Fasciculus III she is completing an edition of Tóraigheacht Dhiarmada agus Ghráinne and has made a survey of the folk versions of the tale which is being included in the Introduction. An article entitled 'Notes on some Scribal Terms' was prepared for the forthcoming Contributions in Memory of the late Professor A. Matheson.

Professor Heinrich Wagner checked proofs of Volume III of the Linguistic Atlas and Survey of Irish Dialects. Printing of this volume is almost complete and publication is expected during 1965. Preparation of the material which is to appear in Volume IV is continuing. Final proofs of an Appendix to Volume IV which will appear in the next issue of Lochlann were checked.

Mr. Liam Price continued to work on the archives of Irish place-names.

Mr. Rolf Baumgarten assisted Mr. Price in the Place-Names Archives. He attended a Place-Names Conference at Edinburgh in April 1964. Mr. Baumgarten was granted leave of absence from October to December 1964 to allow him to commence work for his Ph.D. at Bonn.

Máire Próinséas Ní Chatháin completed the preparation of the Vocabulary and Introduction to the Latin Text of Betha Muire and continued work on the Irish grammatical introduction. Work on a thesis on Irish syntax - under the direction of Professor Jackson - is almost completed. She attended

Dr. Binchy's Seminar on 'Bretha Déin Chécht' and Mr. Boling's Seminar on 'Comparative Indo-European Grammar'. She continued to attend Mr. Gordon Quin's lectures in Vedic Sanskrit at Trinity College, Dublin.

Miss Meinir Lewis attended lectures on Old and Medieval Irish at University College, Dublin. She was awarded a certificate (pass, class I) in the examination at the end of the academic year.

Mr. Kenneth Nicholls carried out some field work in place-names research. He continued to work on the political geography of Ireland in the last century of the Gaelic order and on the genealogies of the ruling families of Ireland, 13th-17th centuries.

Mr. Bruce Boling's efforts have been largely expended in gathering material for a treatise on the Indo-European origins of Celtic noun formation to be presented to the faculty of Harvard University in partial fulfilment of the requirements for the degree of Doctor of Philosophy in Linguistics. He held a seminar on historical and comparative Indo-European grammar, dealing with the theoretical bases of the comparative method and the grammatical categories of Indo-European with particular reference to their development in the Celtic languages.

Miss Winifred McEnery has been working under the direction of Professor Mulchrone on semantics - the change of meaning brought about by the preverb on the verb in Old Irish. She is also working on the text 'In Tenga Bithnua' and excerpting for the Dictionary of Classical Modern Irish.

Rev. Anselm Faulkner, O.F.M. checked final proofs of the Text of An Bheatha Dhiadha. Preparation of the Introduction, Notes and Vocabulary has been completed and with the Printer for some time. The preparation of the Text of An Bheatha Chrábhaidh is now complete and this will be submitted shortly. Notes and Vocabulary are in an advanced state of preparation. Work on An Spáthán Spioradálta is proceeding.

Rev. Bartholomew Egan, O.F.M. checked final proofs of the Text of Grainéir Ghaeilge na mBráthar Mionúr. Galley proofs of the Introduction and Notes were checked and returned for revise.

Dr. R. B. Breatnach's field work in connection with the morphology of Déise Irish terminated in September 1964. Work on the material collected will proceed during the next year.

Dr. Ludwig Bieler supervised the preparation of Texts and checking of

proofs for the Hiberno-Latin Texts Series.

Mr. Gordon Mac Lennan prepared the material for Notes and Indexes for his book Gaidhlig Uidhist a Deas. The typescript of the Vocabulary was sent to press in October 1964.

Professor D. Simon Evans' edition of A Grammar of Middle Welsh was published in March 1965.

Professor Séamus Ó Néill has completed work on the glossary of his edition of Bishop Gallagher's Sermons.

Mrs. Ruth Lehmann's edition of Fled Dúin na nGéd (Mediaeval and Modern Irish Series, Volume XXI) was published in December 1964.

An tAthair Pádraig Ó Fiannachta checked final proofs of his edition of Táin Bó Cuailgne.

Dr. Wolfgang Meid checked page proofs of his edition of Táin Bó Fraích and these were sent for revise in book form.

Professor Caitlín Ní Maol-Chróin worked on proofs of the Apparatus Criticus and the Glossary of her edition of Caithréim Cellaig.

Éamonn Mhac an Fhailigh checked and returned first proofs of his phonemic study of The Irish of Erris, Co. Mayo.

Professor J. J. Tierney corrected and returned first proofs of the Introduction, Latin Text and Translation of his edition of Dicuil's De mensura orbis terrae.

Mr. I. P. Sheldon-Williams worked on the preparation of the Johannes Scottus Eriugena text Periphyseon (De diuisione naturae). This material was submitted to the Printer in March 1965.

Professor David Greene prepared for the press Dr. Bergin's lecture on Bardic poetry and his Unpublished Bardic Poems, collating the latter with the MSS. This work was destroyed by fire at the Printer's premises and all the collation will have to be done again. Proofs of the Text and Translation of Duanaire Mhéig Uidhir were checked and returned for revise. Notes and Vocabulary for this volume were submitted to the Printer.

Professor Proinsias Mac Cana checked the typescript of R. L. Thomson's edition of Owein which is to appear as Volume III of the Mediaeval and Modern Welsh Series. He also read the final proofs of A Grammar of Middle Welsh. Work is continuing on the proofs of Sean Mac Airt's edition of The Annals of Ulster.

Dr. R. L. Thomson prepared an edition of Owein for the Mediaeval and Modern Welsh Series. This material is now ready for press.

Dictionary of Classical Modern Irish: Miss O'Rahilly continued to work on the Dictionary. Throughout the year the following works were excerpted: Lorgaireacht an tSoidhigh Naomhtha; Scél Saltrach na Rann; Two Irish translations of De Passione Christi; Penitential Psalms in Irish Verse; Stair Nuadat Find Femin. Work has begun on Bedell's Old Testament (1685). Miss O'Rahilly supervised and checked Miss Winifred McEnery's excerpting of Sdair na Lumbardach (Studia Hibernica) and of Smaointe Beatha Chríost.

Place-Name Research: During the year the cards made from the Fiants of Henry VIII, Edward VI, and Philip and Mary, and some from the Fiants of Elizabeth, have been sorted into the indexes. The work of excerpting the Fiants of Elizabeth is continuing; this is a long series, and it will take some time to finish the job. All the cards made last year from the surveys of Laois and Offaly and from the lists of grantees of the forfeited lands have been put into place in the indexes (except a few not yet identified); to do this it was necessary to locate a great many local names now obsolete by making tracings from the OS maps on which local boundaries could be drawn.

Mr. Nicholls spent some weeks collecting local Irish names in South Carlow, particularly on the western side of the Blackstairs Mountains. He identified the names for the rocks called Brans which lie along the ridge of the mountains. An interesting name which he found still in use is Stoolyeen: this is Stuch Laighean, the mediaeval name of Mount Leinster. Mr. Nicholls also made excerpts from micro-films in the National Library of lands of the earl of Kildare and others, forfeited in 1540, and of some uncalendared Carew manuscripts.

Mr. Price attended the meeting of the Council for Name Studies in Great Britain and Ireland which was held at Nottingham University on the 13th March 1965 at which short reports on the work being done in the different centres were read.

Hiberno-Latin Texts Series: Professor J. J. Tierney's edition of Dicuil's De mensura orbis terrae was prepared and sent to press. First

proofs are being checked and returned. Professor Ludwig Bieler supervised the preparation of Mr. I. P. Sheldon-Williams' edition of Johannes Scottus Eriugena's Periphyseon (De diuisione naturae). The typescript of this volume was sent to the Printer in February 1965.

### 3. STATUTORY PUBLIC LECTURE

A Statutory Public Lecture entitled Finding the Celts was delivered by Professor Myles Dillon at University College, Dublin on 16 December 1964.

### 4. SEMINARS

Professor Binchy held a Seminar on an Irish law-tract.

Mr. Bruce Boling held a Seminar on historical and comparative Indo-European grammar.

### 5. EXTERNAL ACTIVITIES

Professor Dillon delivered lectures at Western College, Ohio, and at the University of Wisconsin in April and May 1964. In November 1964 he attended a meeting of UNESCO in Paris. He lectured to the National University of Ireland Club in London on Indo-European Heritage of the Celts, in November 1964.

Professor Binchy delivered a public lecture on Celtic and Anglo-Saxon Kingship at the invitation of the Department of Anglo-Saxon Studies in the University of Cambridge, on 3 March 1965.

Dr. Gearóid S. Mac Eoin delivered a lecture on the Study of Irish Literature to Cumann na Scríbhneoirí in Dublin and to An Cumann Caidrimh in Galway.

### 6. PUBLICATIONS

#### a. Books:

Linguistic Atlas and Survey of Irish Dialects, Vol.II. By Heinrich Wagner. Price 75s. pp.xix + 306. Published September 1964.

Fled Dúin na nGéd. Edited by Ruth Lehmann. (Mediaeval and Modern Irish Series, Vol.XXI). Price 8/6d. pp.xxiv + 80. Published December 1964.

A Grammar of Middle Welsh. Edited by D. Simon Evans.  
(Supplementary Volume, Mediaeval and Modern Welsh Series).  
Price 17/6d. pp.xliv + 265. Published March 1965.

Dictionnaire historique de Breton. By Roparz Hemon.  
Rann 9: (Fled-Ganded). Chataulin, Etienne, 1964.

Poems of Blathmac, son of Cú Brettan. Edited by James P. Carney.  
(Irish Texts Society, Vol.XLVII, 1964).

b. Contributions to Periodicals:

James Carney: Old Ireland and her Poetry.  
Old Ireland, 147-172. M. H. Gill and Son. 1965.

Sedulius Scottus.  
ibid. 228-250.

Pádraig Ó Súilleabháin, O.F.M.: Tuilleadh faoi 'Stair an Bhíobla'.  
Éigse, XI, 51-56.

Catholic books printed in Ireland  
1740-1820 containing lists of  
subscribers.  
Collectanea Hibernica, 6 and 7, 231-33.

The library of a parish priest of the  
penal days.  
ibid. 234-44.

Maynooth's first professor of Scripture.  
IER. February 1965, 88-92.

Leabhair urnaithe an ochtú haois déag.  
ibid. May 1965, 299-302.

III - Report of the Governing Board of the School of Theoretical Physics

adopted at its meeting on 14th July, 1965.

1. STAFF AND SCHOLARS

Senior Professors:

John L. Synge, Director of the School, appointed for three years from 16 May, 1962; Cornelius Lanczos.

Professors:

Yasushi Takahashi; Lochlainn Ó Raifeartaigh.

Visiting Professor:

David Lurié.

Research Associates:

L. Bass; D. Judge; P. S. Florides.

Scholars:

B. Gruber (left 31 August, 1964); T. Yukawa; P. Carragher (left 31 August, 1964); H. Yeh; F. Cktem (left 31 August, 1964); F. Kamber (appointed 3 April 1964, left 29 April 1964); N. Straumann (appointed 3 April 1964, left 20 April 1964); Rev. J. McCrea (appointed 1 October 1964); E. J. Callan (appointed 1 October 1964); M. Wong (appointed 1 October 1964).

Technical Assistant:

Miss Evelyn Wills.

2. STUDY AND RESEARCH

In collaboration with Dr. Florides and Rev. J. McCrea, Professor Synge studied the problem of finding, by successive approximations, the gravitational waves due to a sudden disturbance inside a massive body at rest. The method is similar to that successfully employed to find the stationary fields of bodies at rest or in steady rotation, but it is not yet sure whether it will work in the present case. Professor Synge wrote a Communication on the Petrov classification of gravitational fields, and also a short paper on the escape of photons from very massive stars. He also studied the geometry of networks of null lines in flat space-time, obtaining some closed symmetric networks. This work is still in progress. He directed the work of Mr. Yukawa, described below, and had discussions with Dr. Yeh.

Professor Lanczos continued his investigations of a submicroscopic metrical lattice, particularly in view of the discrepancy existing between

a genuine Riemannian and a Minkowskian type of geometry. Einstein's tetrad geometry provides an eminently adequate basis for the study of a purely geometrical action principle. While, however, Einstein assumed a weak perturbation of a flat space, Professor Lanczos now interposed the metrical lattice between empty space and perturbation. The Lagrangian of the perturbation field becomes proportional to  $E^2 - H^2$ , which leads to the Maxwellian equations, although the basic geometry is purely Riemannian and the Minkowskian interpretation comes about because the perturbation Lagrangian is now considered to be an invariant of an apparently flat space.

Professor Takahashi proposed a Hamiltonian formalism for a system with a linear supplementary condition, and quantized this system. An application of this theory to the polaron problem was considered. Professor Takahashi also applied his theory on broken symmetries, developed while in Japan last year, to the four-fermion interaction of octet baryons in order to derive the mass formula; he found a Lagrangian formalism and the Green's function for the Bargmann-Wigner field with spin  $3/2$ , and is now extending the formalism more generally.

Together with Professor Lurié, Professor Takahashi investigated the relativistic two-body problem by Bethe-Salpeter, and derived a normalization condition of the Bethe-Salpeter wave function; they also studied the problem of the intrinsic parity of the meson composed of quark and anti-quark, using the Bargmann-Wigner equation. The parity of the composite meson was determined to be negative in both  $SL(6)$  and  $\tilde{U}(12)$  groups. They also began a programme of research on non-local field theory, whose purpose is to attempt to clarify the connection which seems to appear, via the  $Z_3 = 0$  condition for composite bosons, between the wave function range of a composite boson and the range of the cut-off function at small distances ( $\sim 10^{-13}$  cm).

In collaboration with Dr. E. G. P. Rowe, Professor Lurié began an extension of previous work of his and Professor MacFarlane's, on the equivalence between four-fermion and Yukawa theories, to the case of mixtures of pseudo-scalar and pseudovector interactions.

Professor Lurié organized a study group on particle physics during the winter terms.

Professor Ó Raifeartaigh collaborated with Dr. J. C. Guillot and W. Jaus in work on the Heitler-Arnous non-local field theory, and with Dr. Gruber on

the construction of the invariants of the semi-simple Lie groups. Professor Ó Raifeartaigh also worked on an attempt to solve the so-called "state-labelling" problem for the semi-simple Lie groups, and on the problem of combining internal symmetry and Lorentz invariance in elementary particle physics, and has shown that any such combination can not be a symmetry in the usual sense (i.e. must be either an approximation, or else characteristic of particular solutions), and that such a combination cannot explain the observed mass-differences of the elementary particles. These results are either published or now in the press. With Professors MacFarlane and Sudarshan, Professor Ó Raifeartaigh worked on the theory recently put forward by Delbourgo, Salam and Strathdee (Proceedings of the Royal Society), and obtained the same main results within the context of a much smaller group, namely one which uses isotopic spin symmetry rather than  $SU_3$  symmetry. Also with Professor MacFarlane, Professor Ó Raifeartaigh worked on the algebraic problem of finding operators which label the representations which occur in the decomposition of the direct product of the two representations of a semi-simple group. They found these operators, and called them polarized Casimir operators. Finally, with Drs. R. Musto and S. Rao, he has been engaged in extending the Smushkeirch principle to the case of vector mesons interacting with themselves.

Mr. Judge worked on generalized eigenfunctions of position and momentum, and also on conjugate variables in classical and quantum mechanics.

Dr. Callan studied elementary particle properties, particularly the question of particle masses. He obtained good agreement between calculated and experimental masses on the basis of particle masses fitting an exponential formula described by two quantum numbers, one distinguishing lepton, meson and baryon classes of particles and the other varying with the particular particle. He also continued previous studies on Auger transitions and on hypergeometric functions.

As well as his work with Professor Ó Raifeartaigh, mentioned above, Dr. Gruber studied the theory of semi-simple Lie groups and their applications to elementary particle physics.

Dr. Kamber and Dr. Straumann investigated the problem of group extensions, and gave a series of informal talks on the problem. They also took part in informal discussions concerning Lie algebras, particularly with regard to the

associated universal algebras and Dynkin algebras.

Dr. Oktem's researches concerned especially certain affine field theories. A given affine connection  $\overset{m}{\Gamma}_{ab}$  is subjected a priori to (algebraic or differential) tensor equations. A variational principle can then be formulated if these equations are taken as side conditions; Dr. Oktem thus obtained the complete field equations of the theory, and showed that this method can be used to derive the Einstein gravitational field equations in empty space-time, and those of the Einstein-Schrödinger unified field theory. Dr. Oktem also discussed with Professor Synge a geometrical classification of the Weyl tensor.

Dr. Wong worked on the Wigner coefficient of  $SU_3$ .

Dr. Yeh studied Feynman's path integral method in quantum theory, and the special unitary group in field theory ( $SU_6$  and  $SU_{12}$ ).

Mr. Yukawa studied the gravitational field of a stream of dust particles in equilibrium, moving radially out, and falling back toward the central sphere, and he obtained differential equations and approximate integrations. He included the case where the particles are of zero rest mass (photons or neutrinos).

### 3. SEMINARS AND LECTURES

As in previous years the seminar lectures throughout the year were attended by members of staff and students from Trinity College, Dublin, University College, Dublin, and St. Patrick's College, Maynooth, as well as by members of the School of Cosmic Physics.

The following seminar lectures were given:

Professor J. Hamilton (University College, London):

Dispersion relations and elementary particle resonances.

Professor T. J. Jordan (University of Syracuse):

Lorentz invariance and Hamiltonian theories of interacting particles.

Quantum field theory of optical interference.

Professor J. B. Keller (New York University):

The geometrical theory of diffraction.

Professor H. Lustig (City College of New York, and University College, Dublin):

Simple theory of the Mössbauer effect (2 lectures).

Professor M. Mizushima (University of Rennes):

Higher order radiation processes.

- Rev. Professor J. McConnell (Maynooth):  
Group theoretical study of elementary particles (11 lectures).
- Professor W. H. McCrea, F.R.S. (Royal Holloway College, London):  
Some current problems in cosmology.
- Professor L. Ó Raifeartaigh: Construction of the invariants of the simple Lie groups (2 lectures).
- Professor J. L. Synge: Stationary gravitational fields (2 lectures).  
Some basic concepts in general relativity (3 lectures).
- Professor Y. Tahahashi: A Hamiltonian formalism with a linear supplementary condition and its application to field theory and many-body problem (2 lectures).

#### 4. STATUTORY PUBLIC LECTURE

A Statutory Public Lecture, under the auspices of the School, was delivered in Trinity College, Dublin, on 25 February 1965, by Professor Synge. His subject was "The Early Work of Sir William Rowan Hamilton".

#### 5. VISITING PROFESSOR

Dr. D. Lurié (University of Rochester) was appointed Visiting Professor from 1st September 1964.

#### 6. VISITORS TO THE SCHOOL

- Professor T. F. Jordan (University of Bern) from 20 to 30 April, 1964.
- Professor M. Mizushima (University of Rennes) from 5 to 9 May, 1964.
- Professor J. B. Keller (New York University) from 19 to 23 May, 1964.
- Professor J. Hamilton (University College, London) from 20 to 21 May, 1964.
- Dr. M. Sachs (Boston University) from 15 June to 13 July, 1964.
- Dr. J. T. Lewis (Brasenose College, Oxford) from 26 to 29 June, 1964.
- Professor W. H. McCrea, F.R.S. (Royal Holloway College, London) from 27 to 29 January, 1965.
- Dr. E. G. P. Rowe (University of Durham) from 23 to 27 February, 1965.

#### 7. SYMPOSIUM

A Mathematical Symposium was held on 21 - 22 December 1964. The attendance was 52; this included Professors, Lecturers and Graduate Students from the several Irish Universities.

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

Dr. P. D. Barry (University College, Cork): Subharmonic function analogues of polynomials

Mr. T. T. West (Glasgow): Superdiagonal forms.

Dr. J. T. Lewis (Oxford): Fibre bundles and Hamiltonian mechanics.

Dr. A. M. Arthurs (York): Path integrals in dynamics.

Mr. D. Judge (University College, Dublin, and D.I.A.S.): Fractional powers of  $\delta$  and  $\nabla$  functions.

Professor F. R. Keogh (Royal Holloway College): On a spherical Fejér-Riesz theorem.

#### 8. EXTERNAL ACTIVITIES

Professor Synge lectured on "George Boole and the calculus of finite differences" at the Boole Centenary Meeting of the Royal Irish Academy, held at University College, Cork, on 25 May 1964; he also gave a course of three Special University Lectures at King's College, London, on 21, 22, and 23 October 1964, on "Hamiltonian theory of rays and waves".

Professor Lanczos lectured to the Irish Mathematics Teachers' Association on 4 April 1964, on "The meaning of mathematics". He was in the U.S.A. from 1 September 1964 to 11 March 1965 on leave of absence from the School. During this time he organized weekly relativity seminars at the Scientific Laboratories of the Ford Motor Co. in Dearborn, Michigan, in collaboration with Dr. R. Penny and Professor G. Y. Rainich. He also gave the following talks at Dearborn: "Orthogonal expansions" (4 Nov.), "Well-posed and ill-posed problems" (11 Nov.), "The Klein-Gordon equation in  $n$  dimensions" (18 Nov.), "The cosmological constant" (25 Nov.), "The quadratic action principle of relativity" (13 Jan.), "The tetrad approach to Riemannian geometry" (3 Feb.), "Microscopic and macroscopic geometry" (17 Feb.). He also lectured on "Orthogonal expansions" at Wayne University (29 Oct.), University of Windsor, Canada (6 Nov.), U.S. Army Mathematics Center, Madison, Wisconsin (21 Dec.), University of Michigan (21 Jan.), and Argonne National Laboratory (4 Feb.); on "Relativity in strongly curved Riemannian spaces" at Boston University (16 Dec.); "Klein-Gordon equation in  $n$  dimensions" at Michigan State University (11 Jan.); "Quadratic action principle of relativity" at Yale University (15 Feb.); "Data analysis by Fourier

analysis" at Illinois Institute of Technology (18 Feb.); "Rationalism and the physical world" at the Spring Colloquium of the Philosophy of Science at Boston University (8 March).

With Mr. Judge, Professor Lanczos attended the Edinburgh Mathematical Society Colloquium, at St. Andrew's, from 15 to 20 July 1964. Mr. Judge gave a lecture on "Generalised eigenfunctions of position and momentum" at the Mathematical Institute, Oxford, on 11 February 1965.

Professor Takahashi lectured at Oxford University on 22 October 1964 on "A Hamiltonian formalism with a linear supplementary condition", and at Liverpool University on 18 February 1965 on "Mass levels and inequivalent representations".

Professor Ó Raifeartaigh attended a Conference on High Energy Physics held from 15 - 17 April 1964 at the Rutherford High Energy Laboratory, Chilton, Didcot, Berks, England, under the auspices of the Institute of Physics and the Physical Society, and gave a short talk there on the "Origin of unitary symmetry". He went to Syracuse University on 1 September 1964 to commence two years' leave of absence from the School. He attended the New York meeting of the American Physical Society from 27 to 30 January 1965, and presented a paper on "Origin of symmetry and self-coupling of vector mesons".

Dr. Yeh attended the International School of Physics "Ettore Majorana", held at Eryx (Sicily) from 27 August to 7 September 1964.

Professor Lurié lectured at Edinburgh University on 19 February and at Imperial College on 9 March 1965, on " $Z_3=0$  for composite bosons".

Dr. Florides participated in the Summer Institute in Theoretical Physics at Brandeis University from 20 June to 31 July 1964, giving a talk there on "Rotating fluids in general relativity". He also gave a talk at Royal Holloway College (London) on 20 March 1965, on "Gravitational fields due to single bodies to any order of approximation".

Dr. Bass lectured on his work in continuum theory in a seminar at Manchester College of Science and Technology in May 1964.

9. PUBLICATIONS

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

a. Books:

Published:

- \* Relativity: the Special Theory. By J. L. Synge. 2nd edn., North-Holland Publishing Co., 1965.
- Rachunek Tensorowy. By J. L. Synge and A. Schild. (Tensor Calculus, University of Toronto Press, 1949, translated into Polish by S. Bazanki). Warsaw, 1964.
- \* Albert Einstein and the Cosmic World Order. By C. Lanczos. Interscience Publishers, 1965.
- Local Lie Groups and their Representations. By L. Ó Raifeartaigh. Mat-science Report 25, Inst. Math. Sci., Madras, 1964.

In the press:

- \* The Fourier Series and its Applications, Vol.I. By C. Lanczos. Oliver & Boyd.

b. Communications of the Dublin Institute for Advanced Studies, Series A, Physics:

Published:

No.15. The Petrov Classification of Gravitational Fields. By J. L. Synge. Price 10s. pp.51 + errata. Published 8 January 1965.

In the press:

No.16. Introduction to the Group Theory of Elementary Particles. By J. McConnell.

c. Contributions to periodicals and other publications:

(i) Published:

J. L. Synge:

- \* Classical statistical mechanics and the one-dimensional oscillator. Proc. R.I.A. 64 A (1964), 1-15.

A Klein-Gordon model particle. Proc. Roy. Soc. A 283 (1965), 14-17.

Relativistic interpretation and modification of newtonian models. "Proceedings on Theory of Gravitation", Gauthier-Villars, Paris / PWN, Warsaw, 1964 (Warsaw Conference, 1962, Director: Infeld).

- \* Introduction to General Relativity. Relativity, Groups and Topology, Les Houches, 1963. Ed. C. de Witt and B. de Witt, Gordon and Breach, 1964, pp.1-88.

P. S. Florides and J. L. Synge:

- \* Stationary gravitational fields due to single bodies. Proc. Roy. Soc. A 280 (1964), 459-465.

P. S. Florides, J. L. Synge and T. Yukawa:

Stationary gravitational fields due to symmetrical systems of bodies. Proc. Roy. Soc. A 284 (1965), 32-39.

C. Lanczos:

- \* Methodes locales et globales pour l'intégration des problèmes de trajectoires. Colloque sur l'Analyse Numérique, Mons, 1961. Centre Belge, Louvain, 1961, 37-39.
- \* Signal propagation in a positive-definite Riemannian space. Phys. Rev. 134 B (1964), 476-480
- \* A precision approximation of the gamma function. J. Soc. Industrial Appl. Math. Numer. Anal. B 1 (1964), 86-96.
- \* Evaluation of noisy data. J. Soc. Industrial Appl. Math. Numer. Anal. B 1 (1964), 76-85.
- \* The inspired guess in the history of physics. Studies, 53 (1964), 398-412.

Y. Takahashi:

A Hamiltonian formalism with a linear supplementary condition and its application to field theory and many-body system. Physica 31 (1965), 205-221.

L. Ó Raifeartaigh;

- \* Review: Man and Science. By W. Heitler. Oliver & Boyd, London & Edinburgh, 1963. Studies 53 (1964), 206-208.
- Internal symmetry and Lorentz invariance. Phys. Rev. Lett. 14 (1965), 332-334.

B. Gruber and L. Ó Raifeartaigh:

S-theorem and construction of the invariants of the semi-simple Lie algebras. J. Mathl. Phys. 5 (1964), 1796-1804.

E. C. G. Sudarshan, T. S. Santhanam and L. Ó Raifeartaigh:

- \* Origin of unitary symmetry and charge conservation in strong interactions. Phys. Rev. 136 B (1964), 1092-1096.

D. J. Judge:

Position and momentum eigenfunctions - square roots of nu and delta. Phys. Lett. 13 (1964), 138-9.

C. Ryan:

- \* Inelastic  $\mu^- + p$  scattering with the production of a single neutral pion. Internal Report for Particle Physics Lab., Univ. of Rochester, 1964.

R. E. Marshak, C. Ryan, T. K. Radha and K. Raman:

- \* Universal theory of semi-weak interactions. Nuovo Cim. 32 (1964), 408-432.

C. Ryan and S. Okubo:

- \* On the equivalence of the Majorana and two component theories of the neutrino. Suppl. to Nuovo Cim. 2 (1964), 234-242.

C. Ryan, S. Okubo and R. E. Marshak:

The intermediate boson - unitary triplet or octet?  
Il Nuovo Cim. 34 (1964), 753-8.

S. Okubo, C. Ryan and R. E. Marshak:

The triality quantum number in  $SU_3$  and  $U_3$  symmetry and  
its application to weak interactions. Il Nuovo Cim. 34  
(1964), 759-767.

D. Lurié and A. J. MacFarlane:

Equivalence between four-fermion and Yukawa coupling and  
the  $Z_2=0$  condition for composite bosons. Phys. Rev. 136  
B (1964), 816-29.

(11) In the Press:

J. L. Synge:

What is Einstein's theory of gravitation? Hlavaty Fest-  
schrift, Univ. of Indiana Press.

Application of the Laplace transform to the inhomogeneous  
Klein-Gordon equation. J. Lond. Math. Soc.

The escape of photons from gravitationally intense stars.  
Mon. Nots. Roy. Astron. Soc.

F. Öktem:

On affine field laws. Proc. R.I.A.

L. Ó Raifeartaigh:

Mass differences and Lie algebras of finite order.  
Phys. Rev. Lett.

J. C. Guillot, W. Jaus and L. Ó Raifeartaigh:

A survey of the Heitler-Arnous non-local field theory.  
Proc. R.I.A.

A. J. MacFarlane, L. Ó Raifeartaigh and E. C. G. Sudarshan:

Nucleon magnetic moments in covariant version of Wigner's  
supermultiplet theory. Phys. Rev. Lett.

D. Lurié and Y. Takahashi:

Intrinsic parity of mesons as quark-antiquark composites.  
Phys. Rev. Lett.

D. Lurié, J. G. Kuriyan and A. J. MacFarlane:

Algebraic tabulation of Clebsch-Gordan coefficients of  
 $SU_3$  for the product  $(\lambda, \mu) \otimes (1,1)$  of representations  
of  $SU_3$ . J. Mathl. Phys.

M. Wong:

On the Mössbauer effect. Proc. Phys. Soc.

IV - Report of the Governing Board of the School of Cosmic Physics  
adopted at its meeting on 13th December, 1965.

A. Astronomical Section.

1. STAFF AND SCHOLARS

Senior Professor:

P. A. Wayman (appointed 1 August, 1964).

Chief Assistant:

J. H. Reid.

Assistant:

Miss S. M. P. McKenna.

Scholars:

I. Elliott; C. J. Butler (from 1 November, 1964).

Clerical and Technical Staff:

Miss M. Callanan; Mr. P. Murphy.

Miss S. M. P. McKenna was granted one year's leave of absence for work with the University of Michigan, McMath-Hulbert Observatory, from 1 January, 1965.

2. LYOT HELIOGRAPH AT THE CAPE

This instrument, owned by the British Admiralty and operated by the staff of the Royal Observatory, Cape Town, has now been in continuous operation for six years. Films in hydrogen-alpha light, providing a cinematographic patrol of solar activity, were received throughout the year in accordance with arrangements made by the late Professor M. A. Ellison and subsequently by Dr. J. H. Reid with the British National Committee for Geophysics.

During 1964 heliograph films are available for 294 days, with a total observing time of 1840 hours, representing an increase of 8% over the previously highest recorded hours in any one year. As in previous years the films have been developed at the Cape and analysed at Dunsink. No major maintenance work on the heliograph was necessary during the year.

Sunspot minimum occurred during 1964, around October. September 1964 was the first month in which no flares were found on the Cape films. The

decline of solar activity can be illustrated by the decreasing number of flares found per hour of observation over the years.

	1959	1960	1961	1962	1963	1964
No. of flares	849	676	294	137	141	44
No. per hour of obs.	0.605	0.435	0.178	0.087	0.083	0.024

Results have been distributed to the World Data Centres. The kind co-operation of H. M. Astronomer at the Cape and his staff for their efficient operation of the heliograph is gratefully acknowledged.

### 3. SOLAR - TERRESTRIAL RELATIONSHIPS

Acting as World Data Centre C reports of Sudden Ionospheric Disturbances from 31 stations, either directly or through World Data Centre A (Boulder), are being received during the International Years of the Quiet Sun. Fifteen copies of original records for 1964 March 16 were obtained specially. Two catalogues of these data covering 1964 have been issued.

Several studies of periods of solar activity and the associated terrestrial effects during 1963 were completed during the year and the results published.

### 4. SOLAR ABSORPTION LINES

High resolution solar spectra taken at Sacramento Peak, New Mexico, in 1963 by Mr. Elliott have been subject to analysis for Doppler shifts in the Balmer lines. Measures of line shifts made at Sacramento Peak were recorded automatically on punched cards and the results were studied by the use of the IBM 1620 computer at University College, Cork. Three aspects of the Doppler shifts are being studied with a view to providing information on the non-steady properties of the chromosphere. These are (i) the amplitude of the Doppler shifts, which decreases steadily from the line centres towards the wings; (ii) cross-correlations of the shifts at different parts of the same line and between different parts of different Balmer lines; (iii) time-series behaviour of the shifts in  $H_{\beta}$  at 0.4A from the line-centre, which indicate regular oscillations with a period of 4 minutes.

## 5. GALACTIC RESEARCH

Some direct and objective prism plates have been taken with the ADH telescope at the Boyden Observatory, Bloemfontein, in starting a programme covering nine Milky Way fields for obtaining information on stellar associations and obscuring clouds.

## 6. INSTRUMENTS

The design for a chamber for the new aluminising plant to take mirrors up to 30 ins. in diameter was completed and an order placed with C. A. Parsons of Ireland Ltd. of Howth.

An offset photometer head for use at the Newtonian focus of the 60-inch reflector at the Boyden Observatory was designed and constructed and taken to Bloemfontein. Photoelectric equipment using an EMI 9558 tri-alkali photomultiplier and a General Radio amplifier is being constructed for use at Boyden. Tests on the photomultiplier, made in part at Trinity College, Dublin, indicate a favourably small dark current and good uniformity of the cathode.

## 7. STATUTORY PUBLIC LECTURE

The Statutory Public Lecture was delivered by Professor Wayman in University College, Dublin, on 3 March, 1965. His subject was "The Formation of Stars".

## 8. LECTURES, CONFERENCES AND VISITS

Mr. Elliott gave a course of lectures on general astronomy in Trinity College, Dublin in the Hilary Term, 1965.

Professor Wayman, Dr. Reid, Miss McKenna and Mr. Elliott attended the International Astronomical Union Meetings in Hamburg, August 1964.

Professor Wayman attended meetings of the Boyden Administrative Council in Hamburg in August 1964 and in Brussels in March 1965.

Dr. Reid contributed to the Geophysical Discussion of the Royal Astronomical Society in London, April 1964, and to the Second National Astronomical Convention, Leicester, September 1964.

Miss McKenna visited the McMath-Hulbert Observatory in April 1964 and contributed to the International Symposium on the History of Astronomy and the Inter-Union Commission on Solar-Terrestrial relationships in Hamburg, August 1964.

Mr. Elliott attended the Summer School in Plasma Physics at Culham Laboratories (U.K.A.E.A.) in July 1964 and Miss McKenna attended the Symposium on Sunspots at Arcetri Observatory, Florence, in September 1964.

9. BOYDEN OBSERVATORY, BLOEMFONTEIN

At Hamburg in August 1964 and in Brussels in March 1965 active discussions for improving the financing and organisation of the Boyden Observatory were held. Proposals include close co-operation with the University of the Orange Free State in Bloemfontein. Professor Wayman visited the Boyden Observatory for six weeks from March 20, 1965 and negotiated with the University and other South African authorities on behalf of the Boyden Council.

10. PUBLICATIONS

M. A. Ellison and J. H. Reid:

Solar Flares. Research in Geophysics, Vol.I, p.43, M.I.T. Press, 1964.

M. A. Ellison, F. N. Byrne and J. H. Reid:

A survey of Solar Flare Phenomena. Space Science Reviews, 3, 319, 1964.

J. H. Reid:

A radio method of detecting solar flares. Jour. Atm. Terr. Physics, 27, 127, 1965.

I. Elliott and J. H. Reid:

The Class 3 flare of 26 September 1963 and its centre of activity. Planetary and Space Science, 13, 163, 1965.

S. M. P. McKenna:

A correlation between the optical and radio aspects of a Class 3 flare. Monthly Notices of the Royal Astronomical Society, 129, No.4, 1965.

S. M. P. McKenna:

Optical and Radio Studies of the planets. Irish Astronomical Journal, 6, No.6, 1964.

B. Cosmic Ray Section.

1. STAFF AND SCHOLARS

Senior Professor:

C. Ó Ceallaigh.

Professor:

K. Imaeda.

Assistant Professor:

Vacant.

Assistant:

Miss M. Kazuno.

Technical and Clerical Staff:

Miss C. Inight (Mrs. Halpenny); Mr. J. Daly; Miss N. Leahy; Miss M. McGovern (Mrs. Collins); Miss E. Cullen (to 13 November, 1964); Miss E. Magee; Miss A. Smyth (from 1 February, 1965).

Scholars:

A. Thompson; J. Avidan (to 10 August, 1964); T. P. Shah; D. O'Sullivan.

2. RESEARCH WORK

Professor Ó Ceallaigh studied the variation of ionization with the velocity of particles traversing condensed matter and various experimental data were compared with the theoretical predictions given by Sternheimer. The results were communicated to the 1965 CERN Easter School and will be published in its Proceedings.

Professor Imaeda, assisted by Mr. Avidan and Mr. Shah, studied the cause of over-estimation of the primary energy of cosmic ray jets. Calculations were carried out using  $P_t$  and angular distributions of the secondary particles. Using the electronic computer in Trinity College, Dublin, detailed calculations were performed both for cosmic ray and accelerator energy regions.

Miss Kazuno, by extending the analysis of the isobar decay products among the secondary particles of cosmic ray jets previously worked out with Professor Imaeda, was able to confirm the decay products. The contribution of the decay products to the angular distribution was established.

An emulsion chamber to study very high energy cosmic ray jets designed by Professor Imaeda and constructed by Mr. Daly was sent to India for flight in the IQSY - EQEX Balloon Expedition in March 1965. Participation in this Expedition was initially arranged by Professor Ó Ceallaigh on a visit to Washington following the Texas Symposium in December 1964. The flight and recovery were successful.

European  $K^-$  Collaboration: Messrs. O'Sullivan, Shah and Thompson, assisted by Misses Cullen, Leahy, Magee and McGovern.

The collaboration has continued successfully throughout the year and has been enlarged by the admission of the nuclear emulsion section of the Institute of Physics, Zeuthen, Berlin.

Research has proceeded in two main fields (a) the interactions of low energy  $K^-$  mesons with protons, and (b) the production of hyperfragments by the interaction of high energy (3 and 5 GeV/c momentum)  $K^-$  mesons with light and heavy nuclei. In the first field, the  $K^-$  meson elastic scattering cross section with free protons as well as the ratio of the cross sections for the processes  $K^- + P \rightarrow \Sigma^- + \pi^+$  and  $K^- + P \rightarrow \Sigma^+ + \pi^-$  were measured down to  $K^-$  meson momenta of 50 MeV/c. In the second field it was found that the general features of hyperfragment production at  $K^-$  momentum of 3 and 5 GeV/c were similar to those at lower  $K^-$  momenta (which had been investigated previously by the collaboration).

Collaboration meetings took place at the following centres and were attended by representatives of the Cosmic Ray Section named in brackets: London, June 1964 (T. P. Shah, A. Thompson); Prague, October 1964 (C. Ó Ceallaigh, A. Thompson); Dublin, February 1965 (D. O'Sullivan, T. P. Shah, A. Thompson).

### 3. CONFERENCES AND COMMITTEES

The following international conferences and symposia were attended by members of the Section:

The 1964 CERN Easter School, Herceg-Noví, Yugoslavia, May 1964 (A. Thompson).

The 5th International Conference on Nuclear Photography, CERN, Geneva, September 1964 (D. O'Sullivan).

Meeting of the Sub-Committee for Automation of Microscope Measurements in Nuclear Emulsion Physics, University College, London, September 1964 (J. Daly).

The Second Symposium on Relativistic Astrophysics, Austin, Texas, U.S.A., December 1964 (C. Ó Ceallaigh).

Professor Ó Ceallaigh attended, by invitation, the formal opening of the new Hamburg electron synchrotron in November 1964 and availed of the opportunity this afforded to initiate arrangements for plate exposures on behalf of collaborating groups. He continued to act as a member of the British Emulsion Committee at N.I.R.N.S., Harwell and of the CERN Emulsion Experiments Committee at Geneva and attended all meetings of both committees held during the year.

#### 4. LECTURE

Dr. W. O. Lock (CERN, Geneva) visited the School and delivered a seminar lecture on Recent Experiments at the CERN Proton Synchrotron on 30 September 1964.

#### 5. PUBLICATIONS

K. Imaeda and J. Avidan:

$P_t$  distribution of the Secondary Particles of Cosmic Ray Jets.  
Nuovo Cimento, 32, 1497, 1964.

K. Imaeda:

Determination of Primary Energy of Jets by Transverse momentum and Angular Distributions of the Secondary.  
Nuovo Cimento, 36, 1376, 1965.

M. Kazuno:

Isobar Decay Products in High-Energy Nuclear Interactions caused by Cosmic Rays.  
Nuovo Cimento, 34, 303, 1964.

D. O'Sullivan, T. P. Shah, A. Thompson (with others):

The Decay of Heavy Hypernuclei.  
Nuclear Physics, 60, 97, 1964.

D. O'Sullivan, T. P. Shah, A. Thompson (with others):

The Production of Light Mesonic Hyperfragments and  $Li^8$  Fragments from the Interactions of  $K^-$  mesons of 1.3 and 1.5 GeV/c Moments with Emulsion Nuclei.  
Acta Physica Polonica, 27, 329, 1965.

In the Press:

C. Ó Ceallaigh:

Variation of Ionization with Velocity.  
Proceedings of the 1965 CERN Easter School.

K. Imaeda and T. P. Shah:

Primary Energy Estimate for "Jets" based on the Momentum and Angular Distributions of the Secondaries.  
Nuovo Cimento.

D. O'Sullivan, T. P. Shah, A. Thompson (with others):

The Interactions of Low Energy  $K^-$  Mesons with Protons.  
Physics Letters.

C. Ó Ceallaigh:

The Frequency Function of the Gaps Defined by Points Placed at Random on the Circumference of a Circle.  
Comm. Dublin Inst. Adv. Studies, Series B, No.2.

C. Ó Ceallaigh:

The Frequency Function of Arc Length defined by Points distributed independently on the Circumference of a Circle following a prescribed law.  
Comm. Dublin Inst. Adv. Studies, Series B, No.3.

In preparation:

D. O'Sullivan, T. P. Shah, A. Thompson (with others):

Production of Hyperfragments from the Interactions of 3 and 5 GeV/c  $K^-$  Mesons with Emulsion Nuclei.

6. PERSONAL

Mrs. Carmel Halpenny (née Inight) held the permanent post of Clerk up to her resignation on marriage on 22 September 1964; she was re-appointed in a temporary capacity from 26 October 1964. Mrs. Collins (née McGovern) continued in her post as Scanner subsequent to her marriage on 5 October 1964. The degree of Ph.D. was conferred on Mr. J. Avidan by Dublin University in October 1964.

C. Geophysical Section.

1. STAFF AND SCHOLARS

Senior Professor:

Thomas Murphy.

Professor:

Vacant.

Research Assistant:

Vacant.

Senior Technical Assistant:

Thomas J. Morley.

Technical and Clerical Staff:

Miss Brenda Kennedy; Miss Ann Nolan; Mr. Kevin Bolster; Mr. Martin Cotter (to 12 March, 1965).

2. EXPERIMENTAL AND FIELD WORK

a. Gravity (T. Murphy):

The work on the small gravity anomalies was continued in Central Ireland, Kerry and Cork. It is thought that the cause has now been established and the unusual phenomenon is being studied by geologists. In this connection, field trips were made to Wales and Derbyshire in the company of P. Walsh of Enfield College of Technology to visit silica deposits in Carboniferous Limestone.

The work in Co. Cork has shown remarkable gravity features and the results have been prepared for publication.

The collaboration with Dr. A. Lees of Reading University on the structure of the Central Plain was continued.

Assistance was given to members of Durham University carrying out geophysical work in the Irish Sea.

b. Magnetism (T. Murphy):

The work on rock magnetism in collaboration with Professor J. H. Poole and Dr. I. R. McAulay of Trinity College was continued. Oriented samples of a magnetic limestone were collected and their magnetic properties analysed.

c. Meteorology:

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

An investigation of wind frequencies at Dublin City was commenced.

3. PUBLICATIONS

T. J. Morley:

The Climate of Dublin City, Part II, Temperature at Trinity College, Dublin, 1904-63. Geophysical Bulletin, No.23 of the School of Cosmic Physics.

In the Press:

T. Murphy:

Deep alteration of Carboniferous strata in the Middleton Co. Cork district as detected by gravity surveying.

4. CONFERENCES

Professor Murphy attended the summer meeting of the European Association of Exploration Geophysicists at Liège and the Symposium on Experimental Seismology at the Royal Society, London.

EDWARD J. CONWAY  
CHAIRMAN

22nd December 1965