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Prl.1629

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 1969-70

Prl.1629

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 1969-70

School of Celtic Studies

In the report for 1968-9 mention was made of the Governing Board's plans for staff expansion over the quinquennium 1969-74 which were prepared and submitted to the Minister for Education in 1968, following a request from his Department. In the event no expansion was allowed in the year now under review, even at the lowest academic level of research assistant where there is only one full-time member of the staff. During the year 1969-70 efforts were made to obtain a meeting with the present Minister to acquaint him with the facts of the situation and with the view that it is essential for the continuity of research in our field that there should be an adequate flow of young graduates through the School and that an indefinite postponement of new appointments could have most serious consequences for the future of Celtic studies. As no such meeting had taken place before the end of the year there was consequent uncertainty concerning the future of the School. Nevertheless, plans were made for new activities in the years immediately ahead. In the meantime the School maintained its role of training research workers by awarding scholarships to students from Ireland and other countries. Five new scholars were appointed, so that in all ten scholars worked in the School during the year.

The Celtic Studies Summer School, in which nine courses were provided, was held in July-August 1969 and was attended by 69 students, of whom 48 came from overseas. The Department of Education contributed to the success of the School by making available funds for the provision of study-grants which were awarded to seventeen overseas students.

Weekly seminars were held by Professors Binchy, Greene and Ó Cuív, and the Statutory Public Lecture - entitled The Chariot in Early Irish Literature - was delivered by Professor Greene in Trinity College, Dublin on 21 November 1969.

The full report gives details of the work of research and editing carried out in their various fields by members of the School and by extern workers.

In the field of publications eleven books (including periodicals) were published, three of them being Institute publications. Members of the School contributed twenty-six papers or shorter items to books or periodicals published elsewhere.

Under the terms of the Will of Mrs. Mary B. O'Rahilly, who died in October 1969, a literary trust has been set up to deal with the published and unpublished works and writings of the late Professor Thomas F. O'Rahilly. The Will provides that the writings shall be deposited in the School of Celtic Studies for examination and study by scholars.

School of Theoretical Physics

In October 1969 the School initiated the provision of courses of lectures suitable for postgraduate university students in theoretical physics. The lectures were given by Professors McConnell and Ó Raifeartaigh, and were attended by students from Trinity College, Dublin, University College, Dublin and the School of Cosmic Physics. In addition Professor Balazs gave a concentrated introductory course in statistical mechanics to both undergraduate and postgraduate students.

Professor Synge studied the equations of motion of charged particles; using retarded distances and energy tensors he succeeded in eliminating

infinite self-energies. Professor McConnell developed a graph theory of multiplicities in weight diagrams and extended his previous investigation of the relations between Young tableaux and weight diagrams. Professor Ó Raifeartaigh in collaboration with several scholars worked on unitary representations of non-compact groups and on the saturation of current algebra at infinite momentum. Professor Solomon studied the implications of non-linear realizations of symmetry groups in particle physics and the application of group theory to superfluidity.

The Statutory Public Lecture "The Challenge of the New Math." was given by Professor Ó Raifeartaigh at University College, Dublin. The staff of the School gave invited lectures in Galway, London, Leeds, Liverpool, Manchester, Didcot, Geneva, Naples, Seattle and took part in scientific meetings and conferences abroad.

Distinguished scientists who spent some time at the School were Professors Balazs (Stony Brook), Fröhlich (Liverpool), Hamilton (Copenhagen) and Drs. Bell (Geneva), Huff (Los Angeles) and Picasso (Pisa).

Twenty-eight weekly seminars and lectures and three mathematical symposia were held.

Two books were published and three were in press. Twenty-two papers were published in learned journals and eleven were in press.

School of Cosmic Physics

Astronomical Section:

The practical work of the Section included continued work on data analysis by computer of material on solar velocity fields and stellar magnitudes in the Magellanic Clouds. Computation of periods for cepheid variables was pursued further, also photometry of clusters, flare stars and variable stars of other types. The computer was also extensively used for the development of perturbation studies of the orbit of Halley's Comet and for calculation of galactic orbits. Observations included work in South Africa on faint short-period variables in the Magellanic Clouds, using a 74-inch telescope.

Cosmic Ray Section:

Work of the K^- Collaboration during the year included consideration of the Σ^* hyperon in K^- captures. Work on cosmic ray primaries detected in plastics by the etching technique centred on the results from a preliminary assessment of heavy-element abundances and on the planning of new work in this field using balloon experiments in collaboration with Bristol University. Considerable progress was made in developing the technique of track measurement.

Emulsion work included study of the production of hypernuclei from K^- mesons and the fragmentation process.

The work on cross-sections of interactions and meson production in high-energy processes was continued. Energy relationships, fireball theory, fragmentation probability, resonances, interaction radius and computer analysis of reaction data were among the topics investigated.

Geophysical Section:

Gravity and magnetic readings were taken by several members of the Section, principally in Donegal, Mayo, Sligo and Dublin. Also magnetic readings around Lambay Island were made. The Donegal work has been interpreted in detail. Gravity anomalies in Co. Mayo were investigated and marine work included active co-operation with British groups in seaborne tests.

Work on daily magnetic variations was analysed and interpreted. Portable seismic recording was started with a view to co-operative schemes and palaeo-magnetism studies of limestone samples were continued.

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 for the Financial Year 1969-70

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, 1970.

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 1970.

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, 1970.

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 1970.

1. THE COUNCIL OF THE INSTITUTE

Chairman:

Professor M. A. Hogan, B.E., D.Sc., Ph.D., D.I.C.

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; Dr. Vincent C. Barry, D.Sc., F.R.I.C., President, Royal Irish Academy.

Members appointed by the Governing Boards of Constituent Schools:

Professor Brian Ó Cuív, M.A., D.Litt.; Dr. E. MacLysaght, M.A., D.Litt.; Professor Felix E. W. Hackett, M.A., M.Sc., Ph.D.; Reverend Professor J. R. McConnell, M.A., D.Sc.; Professor J. H. J. Poole, M.A., B.A.I., Sc.D.; Professor P. A. Wayman, 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.; David Greene, M.A.; Brian Ó Cuív, M.A., D.Litt.

Appointed Members:

Tomás de Bhaldraithe, M.A., Ph.D., D.Litt.; Edward MacLysaght, M.A., D.Litt.; Ernest Gordon Quin, M.A., F.T.C.D.; Reverend John Ryan, S.J., M.A., D.Litt.; Reverend Francis Shaw, S.J., M.A.

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.; Reverend James R. McConnell, M.A., D.Sc.; Lochlainn Ó Raifeartaigh, M.Sc., Ph.D.

Appointed Members:

George R. Keating, M.Sc.; Albert J. McConnell, M.A., M.Sc., Sc.D.; Thomas Edwin Nevin, D.Sc.; Patrick Quinlan, B.E., M.Sc., Ph.D.; Seán Seosamh Tóibín, M.Sc., Ph.D.; Thomas David Spearman, M.A., Ph.D. (Cantab.).

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, D.Sc.; Patrick Arthur Wayman, Ph.D.

Appointed Members:

Patrick M. A. Bourke, M.Sc.; Cyril P. C. 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.; Patrick J. Nolan, Ph.D., D.Sc.; Cilian Ó Brolcháin, 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; Susan Kealy; Desmond Pender.

II - Annual Report of the Governing Board of the School of Celtic Studies for the year 1969-70 adopted at its meeting on 18th June 1970.

1. STAFF, SCHOLARS AND EXTERN RESEARCH WORKERS.

Senior Professors:

Brian Ó Cuív, Director of the School; Daniel A. Binchy; Myles Dillon; David Greene.

Professor:

James P. Carney.

Assistant Professors:

Louis Paul Nemo (Roparz Hemon); Rev. Pádraig Ó Súilleabháin, O.F.M.; Gearóid Mac Niocaill.

Assistant:

Pádraig de Brún.

Assistants (Part-time):

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

Research Associates:

Heinrich Wagner; Proinsias Mac Cana.

Technical and Clerical Staff:

Máire Breatnach; Máire Bean Uí Chinnsealaigh.

Scholars:

Fergus Kelly; Donnchadh Ó Corráin (to 30 September 1969); Thomas Charles-Edwards (to 30 September 1969); Nicholas J. A. Williams (to 30 September 1969); John Cullen (appointed 1 October 1969); Tomás Ó Cathasaigh (appointed 1 October 1969); Patrick Considine (appointed 1 October 1969); Cáit Ní Dhomhnaill (appointed 1 October 1969); William Gillies (appointed 1 October 1969).

Extern Research Workers:

Dr. Cecile O'Rahilly; Rev. Anselm Faulkner, O.F.M.; Rev. Cuthbert McGrath, O.F.M.; Dr. Ludwig Bieler; Mr. I. P. Sheldon-Williams; Mr. Brynley Roberts; Mrs. Rachel Bromwich; Rev. Fergal Mac Raghnaill, O.F.M.

In the report for the year 1968-9 mention was made of the Governing Board's plans for staff expansion over the quinquennium 1969-74 which were prepared and submitted to the Minister for Education in 1968, following a request from his Department. In the event no expansion was allowed in the

year now under review, even at the lowest academic level of research assistant where there is only one full-time member of the staff. During the year 1969-70 efforts were made to obtain a meeting with the present Minister to acquaint him with the facts of the situation and with the view that it is essential for the continuity of research in our field that there should be an adequate flow of young graduates through the School and that an indefinite postponement of new appointments could have most serious consequences for the future of Celtic studies. As no such meeting had taken place before the end of the year there was consequent uncertainty concerning the future of the School. Nevertheless, plans were made for new activities in the years immediately ahead.

2. RESEARCH AND EDITING

Professor Brian Ó Cuív continued his work on the linguistic development of the Irish language, on metrics, and on the editing of texts. He completed an article on 'Some Declensional Patterns in Modern Irish' for the Alf Sommerfelt Memorial Volume, as well as editions of several short texts for publication in Celtica and Ériu. He did some preparatory work for (i) a monograph on Modern Gaelic Languages which is to be published by Mouton & Co., (ii) contributions on Irish language and literature to A New History of Ireland which is being produced under the auspices of the Royal Irish Academy. He also read and advised on works in course of publication by the School, including those in the series Scríbhinní Gaeilge na mBráthar Mionúr, Mediaeval and Modern Irish Series and Mediaeval and Modern Welsh Series. In conjunction with Professor Myles Dillon he made tape recordings of Irish dialects in Donegal in April, 1969. See also sections 4, 5, 6, 7 and 8.

Professor Daniel A. Binchy continued to transcribe Irish legal manuscripts for Corpus Iuris Hibernici of which 1,827 pages are now in print. He edited and translated an archaic legal poem which has been accepted for the Sommerfelt Memorial Volume. See also sections 4, 5, 6 and 7.

Professor Myles Dillon revised proofs of the Notes and Vocabulary

of Stories from the Acallam and wrote an article for the Sommerfelt Memorial Volume. He began work on a book about Indo-European origins. Excerpting for the Dictionary of Modern Irish was continued. Material for Celtica IX was prepared for press and final proofs of Stories from the Acallam were passed for press. See also sections 5 and 6.

Professor David Greene prepared for press, with the assistance of Mr. Fergus Kelly, Bergin's Irish Bardic Poetry. Some galleys have been received. The following articles were accepted for publication:- (i) 'The responsive in Irish and Welsh' for the Sommerfelt Memorial Volume, ed. H. Pilch; (ii) 'Modern writing in Irish' for Cultural Relations Committee; (iii) 'The Chariot in early Irish Literature' - paper read in January 1969 to conference of British Council for Archaeology and given as Statutory Lecture in November 1969. Galleys of this article have been received and corrected. Preparation was completed on 'The Celtic Numerals' an article accepted for publication in a volume edited by A. S. C. Ross and work progressed on 'Linguistic Evidence for the dating of Early Welsh Poetry' a paper to be delivered to the Conference of the Staffs of the Welsh Departments of the University of Wales. See also sections 3, 4, 5 and 6.

Professor James Carney worked on early Irish poetry and prepared an article on 'The so-called "Lament of Créidhe"' for publication in Ériu. He acted as supervisor for Ph.D. thesis of Nicholas Williams at The Queen's University, Belfast. See also sections 5, 6 and 7.

M. Louis Paul Nemo continued to work on the Historical Dictionary of Breton, the sixteenth volume of which is now ready for publication. Preparation of an edition of a text in Early Modern Breton, the miracle play Ar Varn Diwezhan (The Last Judgement) continued. See also sections 5 and 7.

Rev. Pádraig Ó Súilleabháin, O.F.M. corrected and returned final proofs of the Irish and Latin Texts of Buaidh na Naomhchroiche. He also read first proofs of part of the Vocabulary, the remainder of Vocabulary and Notes still being with the Printer. Preparation of Introduction is complete. The following articles have been accepted for publication:- (i) 'Smaointe Beatha Chríost' (Celtica IX); (ii) 'Searmóir ar

ghnáithchleachtadh an pheacaidh' (Éigse); (iii) 'Jeremiah Donovan's translation of the Roman Catechism' (The Past).

Dr. Gearóid Mac Niocaill continued to work on the annotation of the first volume of the Annals of Ulster and began work on the indexes. An article entitled 'Admissible and inadmissible evidence in early Irish law' was accepted for publication in Irish Jurist IV (1969). See also sections 5 and 6.

Pádraig de Brún continued to work on the preparation of the catalogue of 29 Irish manuscripts in the King's Inns Library. Twenty-seven MSS. have now been described. Descriptions of MSS. 11, 15 and 18 are not yet completed. The catalogued material has also been indexed and work is being done in preparation for an introduction. This has involved a search of the minutes of the King's Inns Library Committee, 1841-1920, and of a number of auction-catalogues. Some preparatory work has been done on the Munster section of an anthology of later Irish poetry. Mr. de Brún gave twice weekly lessons in modern Irish to Dr. Considine. He saw Journal of Kerry Archaeological and Historical Society No. 3 through the press. The following articles have been accepted for publication:- 'Caoine ar Mhac Pínín Duibh (Éigse XIII); 'A lament in Irish for John Stafford, coadjutor bishop of Ferns, (The Past VIII); 'Some Irish manuscripts with Bréifne associations, (Bréifne 1969); review of North Munster Studies [1967] (Studia Hibernica 9). See also section 7.

Mrs. Nessa Doran continued work on the preparation of Fasc. III of A Catalogue of Irish MSS. in the National Library of Ireland. King's Inn MSS. 14 (partly medical), 16, 17 and 18 were catalogued.

Mrs. Anne O'Sullivan continued to collate Professor Binchy's transcripts and proofs of the law texts with the manuscripts and did some further work on the inscriptions of the law manuscripts. She has completed for publication the group of fifteenth century elegies for Co. Tipperary lords - B.M. Add. 33993 providing both translations and historical notes. An article on the Bodleian MS. Laud Misc. 610 (in collaboration with W. O'Sullivan) has been accepted for publication in Celtica IX.

Professor Heinrich Wagner in collaboration with Dr. Colm O'Boyle

saw Volume IV of Linguistic Atlas and Survey of Irish Dialects through the press.

Professor Proinsias Mac Cana as General Editor of the Medieval and Modern Welsh Series read the final revised typescript of Mrs. Rachel Bromwich's edition of Armes Prydein which was sent to the Printer in September 1969. Final proofs of the Text of Brynley Roberts' edition of Brut Y Brenhinedd and 'copy' for the Preface, Vocabulary and Indexes were read.

Mr. Fergus Kelly continued work on an edition of Audacht Moraind, now in its final stages and on an article on Old Irish words for trees. Two articles were prepared for publication in Ériu 1971:- 'An Old Irish poem to Colam Cille' and 'The root clad-'. He assisted Professor Greene in the preparation for press of Bergin's Irish Bardic Poetry.

Donnchadh Ó Corráin continued his study of early Munster history and early genealogies. See also section 7.

Mr. Thomas Charles-Edwards wrote two chapters for his thesis on the Irish kindred and the Law of Neighbourhood (Comaithches). See also section 7.

Mr. Nicholas J. A. Williams completed his work on the reconstruction of the irregular verbs of Armagh/Louth Irish. The following articles have been accepted for publication:- (i) 'The etymology of Arsuighim'; (ii) 'Specimen of Drogheda Irish'; (iii) 'Short Texts from Omeath' (Éigse) and 'The etymology of Welsh diffoddi' (in collaboration with T. Charles-Edwards) (Bulletin of the Board of Celtic Studies). See also section 7.

Mr. John Cullen worked on the generative syntax of Modern Irish.

Tomás Ó Cathasaigh worked on Early Irish Origin Legends. As well as studying the texts he examined the methods used by folklorists and others in confronting traditional narrative and also the work which has already been done on Irish heroic tradition.

Dr. Patrick Considine devoted some time to improving his knowledge of Old and Modern Irish. He began work on editing a part of the New Testament section of the Biblical History in Leabhar Breac (pp. 146-150).

Cáit N' Dhomhnaill studied some tape recordings of Conamara, Aran and East Galway Irish. She noted words, unusual phrases, grammatical points and pronounciation used in the recordings with a view to comparing them with

the dialect of Carraroe. She completed the transcription of the Conamara tapes. Some work has been done on the change which has developed in the feminine a-stems of various cases from the Classical Irish period to the present day spoken language. From October to December she worked on a thesis - Gaeilge na Ceathrún Rua for the M.A. degree. An article on proverbs and phrases of Ceathrú Rua Irish was prepared for Béaloideas.

Mr. William Gillies worked under the direction of Professor Ó Cuív on an early Modern Irish prose text on the Harrowing of Hell. He prepared an edition of a 17th century bardic poem for publication in Ériu.

Dr. Cecile O'Rahilly excerpted from the following texts for the Dictionary of Classical Modern Irish:- Ériu XI and XII; Air Bhás Abel (Do Barra) from MS.; Fealsúnacht Aodha Mhic Dhomhnaill (ed. Colm Beckett); Book of Magauran (ed. McKenna); Aithris ar Chríost (transl. Peadar ua Laoghaire); Dán Dé.

Rev. Anselm Faulkner, O.F.M. continued to work on the preparation of his edition of An Sgáthán Spioradálta. All important early MSS. have been thoroughly examined and variants noted. Only two of the latest remain to be inspected. The basic text with variant readings is now in typescript.

Rev. Cuthbert McGrath, O.F.M. worked on the first proofs of the Vocabulary and Indexes of Part II of Dán na mBráthar Mionúr.

Rev. Pergal Mac Raghnaill, O.F.M. worked on the preparation of an edition of Ó hEódhasa's Teagasg Críostuighe.

Dr. Ludwig Bieler continued to act as General Editor of Scriptores Latini Hiberniae. He read and returned for revise first proofs of the Introduction, Text, Translation, Notes, Apparatus Criticus and Appendices of his edition of The Four Latin Lives of St. Patrick. The Indices were compiled from the proofs and sent to the Press.

Mr. I. P. Sheldon-Williams completed the preparatory work on the Text, Translation and Notes of Johannis Scotti Eriugenae Periphyseon Liber III which is to be published in Scriptores Latini Hiberniae.

Mr. Brynley F. Roberts corrected final proofs of the Introduction and Text of his edition of Brut y Brenhinedd which will be published as Volume V of the Medieval and Modern Welsh Series. 'Copy' for the Preface,

Vocabulary and Indexes were sent to the Printer in December 1969.

Mrs. Rachel Bromwich completed the preparation of her translation of Sir Ifor William's edition of Armes Prydein for the Medieval and Modern Welsh Series. All material was sent to the Printer in September 1969.

3. STATUTORY PUBLIC LECTURE

A Statutory Lecture entitled The Chariot in Early Irish Literature was delivered by Professor David Greene in Trinity College, Dublin on 21 November 1969.

4. SEMINARS

Professor Brian Ó Cuív continued his weekly seminar on the Irish Grammatical Tracts on Declension in April-May 1969. From October 1969 to March 1970 he held a weekly seminar on the first of the Irish Grammatical Tracts published by O. J. Bergin in Ériu VIII. He also held a weekly class on manuscript-reading and textual editing in which verse texts in Old Irish, Middle Irish and Early Modern Irish were read.

Professor Daniel A. Binchy held a weekly class on Early Irish texts which was attended by the Scholars of the Institute.

Professor David Greene held a weekly Seminar on 'The Irish Numerals' during the Michaelmas and Hilary terms.

A notable feature in connection with the 1969-70 seminars was the large attendance from outside the School, including staff-members and postgraduate students of the universities.

5. SUMMER SCHOOL

The Celtic Studies Summer School, which was held in St. Patrick's College, Drumcondra, from July 14 to August 1, 1969, was attended by 69 students. Of these 48 came from overseas: Austria (2), Australia (2), Denmark (1), England (8), Finland (1), Germany (7), Netherlands (2), New Zealand (22), Scotland (5), United States of America (14), Wales (4). Study-grants, provided from funds made available for the purpose by the Department of Education, were awarded to 17 overseas students.

The following courses were given: (1) Modern Spoken Irish (Brian Ó Cuív), (2) Elementary Old Irish (Myles Dillon), (3) Mediaeval Welsh (Proinsias Mac Cana), (4) Historical Development of the Irish Language (David Greene), (5) Advanced Old Irish (D. A. Binchy), (6) Early Modern Irish (Brian Ó Cuív), (7) Irish Literature (James Carney); (8) Mediaeval Irish History (Gearóid Mac Niocaill), (9) Breton Language and Literature (Roparz Hemon). The facilities of the College language laboratory were used in conjunction with the course on Modern Spoken Irish.

6. EXTERNAL ACTIVITIES

Professor Brian Ó Cuív took part in conferences of contributors to A New History of Ireland in April, July and October of 1969 and in January of 1970. In November 1969 he took part in a symposium in Dublin to mark the fiftieth anniversary of the death of Kuno Meyer. He attended the Place Name Conference and annual meeting of the Council for Names Studies in Great Britain and Ireland in Edinburgh in March 1970. He acted as extern examiner in Irish for the National University of Ireland. He continued his activities as a member of the Irish Manuscripts Commission.

Professor D. A. Binchy delivered the first R. I. Best Memorial Lecture at the Royal Irish Academy.

Professor Myles Dillon was appointed a Fellow of the Indian Institute of Advanced Study at Simla from September to December 1969. He delivered two lectures on Indo-European Origins at Deccan College in Poona in November 1969. In May 1969 he lectured on 'Celt and Hindu' to the University of Oxford.

Professor David Greene delivered public lectures, at the invitation of the Cultural Relations Committee, in the universities of Copenhagen, Aarhus, Odense, Oslo, Gothenburg, Leiden, Utrecht and Amsterdam during April-May 1969. In August 1969 he attended the Viking Congress at Uppsala.

Professor James Carney delivered lectures on Irish Literature at the Summer Schools organised by the School of Irish Studies and by the Language Centre of Ireland in July 1969.

Dr. Gearóid Mac Niocaill continued to give lectures on early Irish law

in University College, Dublin at the request of the Dean of the Faculty of Law, in the Easter term. He delivered a lecture on the Early Irish Annals to the Royal Society of Antiquaries of Ireland.

7. PUBLICATIONS

(a) Books published by the Institute:

La Destruction de Jerusalem. Edited by Roparz Hemon. pp. xxxii + 445. Price 63s. Published May 1969.

Linguistic Atlas and Survey of Irish Dialects. Vol. IV. By Heinrich Wagner and Colm Ó Baoill. pp. xx + 303. Price 75s. Published August 1969.

Catalogue of Irish MSS in the Franciscan Library, Killiney. By Myles Dillon, Canice Mooney, O.F.M. and Pádraig de Brún. pp. xxvi + 185. Price 42s. Published September 1969.

(b) Books published outside the Institute:

Brian Ó Cuív:

A View of the Irish Language published by the Stationery Office, Dublin, 1969 and edited by Brian Ó Cuív.

Éigse XIII, Parts I and II. Published by the National University of Ireland and edited by Brian Ó Cuív.

David Greene:

Ériu XXI. Published by the Royal Irish Academy and edited by David Greene.

Daniel A. Binchy:

Celtic and Anglo-Saxon Kingship. (The O'Donnell Lectures for 1967-8 delivered in the University of Oxford). Clarendon Press 1970.

Osborn Bergin (First Bergin Memorial Lecture). University College, Dublin, 1970.

Roparz Hemon:

Historical Dictionary of Breton, Rann XV. (Izelaat-Kaouen). Published Etienne, Paris, November 1969. pp. 1401-1500.

Pádraig de Brún:

Journal of Kerry Archaeological and Historical Society No. 3. 1970, edited by Pádraig de Brún.

(c) Contributions to periodicals and other publications:

Brian Ó Cuív:

The Changing Form of the Irish Language. A View of the Irish Language (see b), 22-34.

Irish in the Modern World. ibid., 122-32.

Ranna Aoir. Ériu XIII, 30.

An Invocation of Saints Peter and Paul, ibid., 52-8.

A Pilgrim's Poem. ibid., 105-9.

The numeral dóchad, dáchad. ibid., 110.

A Seventeenth-century Irish Manuscript. ibid., 143-52.

Review of publications. ibid., 77-80, 160-3.

David Greene:

In momento, in ictu oculi ... Ériu XXI 25-31.

Varia, ibid., 89-98.

The Irish Language Movement, Irish Anglicanism 1869-1969, edited by M. Hurley, S.J., 110-119.

James Carney:

Gas Lossa. Ériu XIII, 99-103.

The O'Cianáin Miscellany. Ériu XXI, 122-147.

Pádraig Ó Súilleabháin, O.F.M.:

Seanmóir ar an mBás. Ériu XIII, 11-25.

Nótaí ar roinnt focal i dTrí Bior-ghaoithe an Bháis. ibid., 26-29.

Pádraig de Brún:

Ar Shaorbhreathach Mhág Cárthaigh. Ériu XIII, 10.

Lámhscríbhinní Thorna - Addenda. ibid., 50-51.

Ranna fáin. ibid., 172.

'Journey to Kerry, July 1709' by Samuel Molyneux, edited with Introduction by K. Theodore Hoppen. Journal of Kerry Archaeological and Historical Society 3, 59-80.

An tAthair Brashie - nótaí breise. ibid., 172.

Nicholas J. A. Williams:

Middle Cornish cara 'to kiss'. Bulletin of the Board of Celtic Studies XXIII, 120-21.

Eachtra Áodh Mhic Goireachtaidh. Ériu XIII, 111-42.

Thomas Charles-Edwards:

Edryd, Edryf, Edfryd, Edrydd. Bulletin of the Board of Celtic Studies XXIII, 117-20.

Donnchadh Ó Corráin:

The later Eoganacht pedigrees. Journal of Cork Historical and Archaeological Society, 141-146.

Raigne, Roigne, Mac Raigni. Ériu XIII, 81-84.

8. O'RAHILLY TRUST

Under the terms of the will of Mrs. Mary B. O'Rahilly, who died in October 1969, a literary trust has been set up to deal with the published and unpublished works and writings of the late Professor Thomas F. O'Rahilly.

The will provides that the unpublished writings shall be deposited in the School of Celtic Studies for examination and study by scholars. The trustees named in the will are Professor Brian Ó Cuív, Miss Cecile O'Rahilly and Doctor Eleanor Knott, and the power of appointing additional trustees is vested in the Council of the Dublin Institute for Advanced Studies acting on the advice of the Governing Board of the School of Celtic Studies.

Report of the Governing Board of the School of Theoretical Physics, adopted at its meeting on 16 June 1970.

1. ACADEMIC STAFF AND SCHOLARS

Professor Emeritus:

Cornelius Lanczos

Senior Professors:

Rev. James R. McConnell (appointed Director of the School for three years from 9 January 1969); John L. Synge; Lochlainn S. O'Raifeartaigh.

Visiting Professors and Lecturers:

L. E. Picasso (May 1969); John S. Bell (June 1969); R. W. Huff (October 1969); Nandor Balazs (January 1970); H. Fröhlich (February 1970).

Assistant Professors:

M. Misra (left September 1969); A. I. Solomon (appointed October 1969).

Research Associates:

D. Judge, P. S. Florides, Rev. C. P. Ryan (appointments renewed for three years from September 1969); Rev. D. McCrea (appointed June 1969 to September 1972); B. K. P. Scaife (appointed January 1970 to September 1972.

Scholars:

I. Khan (left September 1969); F. Ando (left September 1969); E. Massa, W. Montgomery, U. Niederer, R. Ll. Jones (appointed October 1969).

Technical Assistant:

Evelyn R. Wills.

2. STUDY AND RESEARCH

Professor Lanczos's research activities were greatly curtailed by his severe illness in May to July, and by work on his book "Space through the Ages" (now in press with Academic Press). He studied a problem in numerical analysis, namely, the peculiar phenomenon that under certain circumstances the "tau method" gives much closer approximation if the Chebyshev polynomials are replaced by the Legendre polynomials. This work is now being pursued further with the help of the new electronic desk computer, the Olympia, purchased by the School.

Professor Synge studied the equations of motion of charged particles; modifying the method of Dirac (1938) by the use of retarded distance and additional energy tensors, he succeeded in eliminating infinite self-energy. Generalising a result of Vachaspati, he showed that the motion of a charged particle in a plane-wave electromagnetic field can be found by quadratures. He also studied a statistical problem, viz., to determine the average distance between the ends of a flexible string of given length, when thrown down at random on a table. The results of these researches will appear in three papers (see Publications in Press). Further work, not yet prepared for publication, dealt with the field of an electromagnetic particle (electric charge plus magnetic dipole) and with the definition of a Riemannian metric in classical phase-space, of interest because dimensional considerations suggest the inclusion of Planck's constant in the metric. He wrote a short semi-popular book with the title "Talking about relativity"; it deals with basic concepts and will be published by the North-Holland Publishing Company.

Professor McConnell continued his collaboration with Dr. D. J. Simms on a text-book dealing with aspects of algebra that are of special interest to physicists. About 150 typed quarto pages are in final form. He developed a graph theory for calculating the multiplicities in weight diagrams for semi-simple Lie algebras of rank two. In particular he obtained multiplicity rules for B_2 weight diagrams that have octagonal boundaries. He extended his previous investigation of the relations between Young tableaux and weight diagrams, and studied the reduction of general linear groups under B_2, C_2 and G_2.

Professor O'Raifeartaigh devoted his time to preparing three separate sets of lectures, which he delivered at the Royal Irish Academy Summer School on Group Theory in Trinity College, Dublin, July 1969, at the Battelle Institute Rencontres in Seattle, Washington, August 1969, and at the Annual High Energy Conference at the Rutherford Laboratory, Oxford, December 1969. He carried out research in pure mathematics with Mr. Montgomery, and with him will submit a paper to the Journal of Mathematical Physics. The paper is on the unitary representations of the groups SO(4,1), SO(3,2) and $P^{\uparrow}_{+}$, and is an extension of earlier work with S. J.

Chang on SO(3,1). Mr. Montgomery is also working on tensor operators in the Lorentz group, non-linear realizations of Lie algebras and applications of group theory in superconductivity and superfluidity. On the physical side, Professor O'Raifeartaigh, in collaboration with Drs. Khan and Niederer, investigated the problem of the saturation of current algebra at infinite momentum. They investigated solutions to the current algebra equations in the case where isospin is not factored out, and submitted a paper on this topic to the Royal Irish Academy. A second paper by Prof. O'Raifeartaigh and Dr. Niederer, analysing some recent work in the same direction by C. Pronsdal and H. Rashid, of the International Centre for Theoretical Physics, Trieste, is being written up, and will be submitted later to the Physical Review.

Dr. Misra's research was concerned with algebraically special fields, and also with singularities in general relativity.

Prof. Solomon considered two areas of interest. In the first he continued a previous study of the implications of nonlinear realisations of symmetry groups in particle physics, especially with reference to the existence of massless particles and parity doublets. In the second he showed how an application of the theory of groups to the problem of superfluidity enabled an elegant solution of this problem to be given. This latter work is being prepared for publication.

Rev. Dr. McCrea worked, in conjunction with Professor Synge, on the problem of constructing a general relativistic model of a sphere initially at rest, and acquiring a rotation purely by means of internal stresses. This was done using an approximation method of Professor Synge's. The model is satisfactory so far as it goes, but is perhaps a little too special, and Dr. McCrea now proposes to try a more general model.

Rev. Dr. Ryan studied a number of topics in high energy theory; in particular he studied (i) electromagnetic contributions to charge asymmetries in neutral kaon decays, and (ii) the SU(3) and SU(3) x SU(3) symmetry breaking mechanism.

Dr. Florides continued to work on the Kerr metric, examining the possibility that, as he has already shown in the case of the third

approximation, the fourth approximation to the Kerr metric may correspond to the metric of a rotating sphere.

Mr. Jones collaborated with Dr. Florides in the above work, and also worked on the development of a package of computer programs to manipulate complicated algebraic expressions in many variables.

Dr. Judge considered some problems concerning the eigenfunction transforms of distributions, generalizing the work of Zemanian, and also questions concerning phase variables in quantum mechanics.

Dr. Massa's research and study was concerned with the following topics: (i) study of the theory of Fourier transforms in $\mathcal{L}_1$ and $\mathcal{L}_2$; (ii) analysis of the structure of the problem of motion in general relativity; (iii) research in relativistic cosmology (partly in collaboration with Prof. G. Luzzatto, University of Genoa); (iv) an attempt to determine new solutions of Einstein's equations, mainly in connection with the problem of gravitational collapse; (v) a study of the foundations of modern differential geometry.

Dr. Ando continued and extended his work on Regge poles; he has sent a paper to Physical Review for publication. He also studied the compositeness of the nature of elementary particles, using the quark model; and he studied the Fadeev equation and numerical analysis.

3. 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, and St. Patrick's College, Maynooth, as well as by members of the School of Cosmic Physics.

The following Seminars were given:

Professor N. L. Balazs (Stony Brook): Band theory in WKB approximation.

Dr. J. S. Bell (Cern): Theoretical questions in current algrebra (2).
Hidden variable interpretation of quantum mechanics.

Professor H. Fröhlich (Liverpool): The derivation of macroscopic equations from microscopic physics (3)

Professor J. Hamilton (Nordita): New methods in pion-nucleon dynamics.

Dr. R. W. Huff (Los Angeles): A simplified treatment of the Lamb shift using algebraic techniques.
The relativistic 2-body problem.

Professor J. R. McConnell: Irreducible representations of the general linear group
Reduction of GL(4) under the Lie group C..

Dr. L. E. Picasso (Pisa): Difficulties with the description of approximate symmetries in quantum field theory.
Local and non-local symmetries: the theorum of Carruthers (2).

Dr. C. P. Ryan: Electromagnetic contributions to the charge asymmetry in the semi-leptonic decays of neutral kaons.
Theory of electromagnetic corrections in weak interactions.
On the Gell-Mann-Oakes-Renner theory of SU(3) x SU(3) symmetry breaking.

Professor B. Scaife: Inertial effects in dipole absorption of gases.

Professor A. I. Solomon: Non-linear realization of spontaneous symmetry breakdown.
Spontaneous symmetry breakdown.

Professor J. L. Synge: Point-particles and energy tensors (2).
Riemannian metric in Gibbsian phase space.

The following Review Lectures were given:

Dr. J. S. Bell: The nuclear shadow in weak and electromagnetic interactions.

Dr. R. W. Huff: The Hydrogen atom and infinite multiplets.

Professor H. Fröhlich: New concepts in solid state physics.

Dr. L. E. Picasso: Spontaneous breakdown of symmetries in physics.

Dr. C. P. Ryan: Introduction to the Veneziano model.

4. LECTURES FOR UNIVERSITY STUDENTS

From October the School provided courses of lectures suitable for postgraduate university students in theoretical physics. The first lecture was attended by President de Valera. Professor O'Raifeartaigh gave a course extending over Michaelmas Term on relativistic kinematics. Professor McConnell lectured throughout Hilary Term on rotations in quantum mechanics, on charge conjugation, parity and time reversal for Dirac spinors, and on Lie algebras of commoner groups.

In addition Professor Balazs gave during January a concentrated introductory course in statistical mechanics to both undergraduate and postgraduate students.

5. STATUTORY PUBLIC LECTURE

A Statutory Public Lecture, under the auspices of the School, was delivered in University College, Dublin, on 5 March 1970, by Professor O'Raifeartaigh. His subject was "The Challenge of the New Math.".

6. VISITORS TO THE SCHOOL

Professor M. Sachs (University of Buffalo) 23-26 January 1970;
Professor J. Hamilton (Nordita) 12-14 May 1969.

7. SYMPOSIA

Mathematical Symposia were held on May 27-28, 1969, and January 5-6 and March 23-24, 1970. The attendances were 47, 47 and 42, respectively; this included Professors, Lecturers, and Graduate Students from the several Irish Universities.

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

May: Dr. T. T. West (T.C.D.): Measures on Boolean algebras.

Prof. M. A. MacConaill (U.C.C.): The excitor-depressor group in neurology.

Dr. J. T. Lewis (Brasenose Coll. Oxford):
An operation approach to quantum probability.

Dr. E. Massa (D.I.A.S.):
On the mathematical structure of Einstein's equations in the mixed, initial and boundary value problems.

Mr. R. Ll. Jones (T.C.D): Orbits in the gravitational field of an oblate sun.

Mr. M. J. A. O'Callaghan (U.C.C.):
Potential problems in plane polygonal regions.

January: Dr. E. Ortiz (Imperial Coll., London): Lanczos and Clenshaw-Fox methods: a unifying approach.

Dr. D. J. Simms (T.C.D.): A difference equation related to Fourier analysis on symmetric spaces of non-compact type.

Mr. M. K. Crowe (St. Catherine's, Oxford):
Semantics, intuitionism and decidability.

Dr. T. Murphy (T.C.D.): In negative dimensions.

Dr. D. B. McAlister (Q.U.B.):
Finitely-generated commutative semi-groups.

Dr. F. Holland (U.C.C.): Happiness is star-shaped.

March: Prof. A. I. Solomon (D.I.A.S):
Application of non-compact groups to superfluidity.

Dr. P. D. McCormack (U.C.C.):
Velocity profiles in the presence of confined vortex rings.

Dr. P. Dolan (Imperial Coll. London): The twistor calculus.

Dr. S. O'Shea (U.C.C.): A class of positive polynomials.

Prof. M. Kennedy (U.C.D.): Nets and filters in topology.

Dr. F. J. Smith (Q.U.B): Lanczos and Clenshaw-Fox methods: collocation method.

8. EXTERNAL ACTIVITIES

At the invitation of Professor W. K. Hayman, Professor Lanczos gave a talk at Imperial College, London, on 5 February 1970, on "Legendre versus Chebyshev polynomials". He gave the lectures on geometry at a course "Mathematics through the Ages" arranged by the Institute of Science and Technology of the University of Manchester, lecturing on "Greek Geometry" on 30 October, on "Non-Euclidean Geometry" on 6 November, and on "Gauss, Riemann, Einstein" on 13 November. On 4 November, at the invitation of the Chancellor of the University of Leeds, he gave the Selig Brodetsky Memorial Lecture there, on "Judaism and Science".

The degree of D.Sc., honoris causa, was conferred on Professor Synge by the Queen's University of Belfast, on 8 July 1969. Professor Synge lectured to the Irish Physics Students' Association on "Momentum and energy in special relativity" on 9 January 1970.

Professor McConnell attended the inaugural conference, "Growth points in physics", of the European Physical Society, held at Florence, 8-12 April, 1969. He was a member of the first Council of the European Physical Society, and attended its meetings in Florence on 11 April, in Vienna on 14 July, and in Paris on 12-13 February. He also attended a meeting of the Committee for the Royal Society Exchange Programme in Paris on 31 October. He was re-elected Secretary of the Royal Irish Academy on 16 March. He delivered the Monsignor Pádraig de Brún Memorial Lecture on "Reflections on

physical theories" at University College, Galway, on 1 May. He gave a seminar on "Graph theory of multiplicities in SU(3) weight diagrams" at the University of Liverpool on 13 November.

Professor O'Raifeartaigh gave four lectures at the University of Naples, and one lecture at CERN, in April 1969, on current algebra. In July he attended the Royal Irish Academy's Summer School on Group Theory, held in Trinity College, and gave a course of eight lectures there on group theory and quantum mechanics. This Summer School was attended also by Drs. Ando, Khan, Niederer, and Massa, and Mr. Montgomery. Professor O'Raifeartaigh then attended the Battelle Rencontres 1969 in Seattle, Wash., in August, and gave a course of twelve lectures there on group theory. The Battelle Rencontres was attended also by Mr. Montgomery. In December, Professor O'Raifeartaigh, together with Professor Solomon, Dr. Niederer and Mr. Montgomery attended the Theoretical High Energy Physics Conference at the Rutherford High Energy Laboratory at Didcot, Berks, where Professor O'Raifeartaigh gave a review lecture on symmetry principles in high energy physics in recent years.

Rev. Dr. Ryan visited and lectured at the Centre de Physique Nucléaire at the University of Louvain for two weeks in May 1969 and for one week in February 1970; he spent the period mid-July to mid-August at the International Centre for Theoretical Physics, Trieste; and he attended the Lund International Conference on Elementary Particles from 25 June to 1 July 1969.

Rev. Dr. McCrea, Dr. Massa, and Mr. Jones attended a Two-day Seminar on General Relativity, at King's College, London, on 15-16 December, 1969. Dr. Massa gave two lectures on "A new approach to the problem of motion in general relativity" in September 1969, a set of six introductory lectures on classical differential geometry, in March, and a seminar on "Isotropic world models and de Sitter geometry" also in March, 1970; all of these were given at the University of Genoa.

Dr. Judge continued his leave of absence in the University of Alberta, Edmonton, until October 1969.

9. PUBLICATIONS

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

(1) Books:

Published:

* An introduction to field quantization. By Y. Takahashi. Pergamon Press, 1969.

* Theory of weak interactions in particle physics. By R. E. Marshak, Riazuddin and C. Ryan. Wiley 1969.

In the press:

* Space through the ages. By C. Lanczos. Academic Press.

Talking about relativity. By J. L. Synge. North-Holland Publishing Co.

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

In the press:

No. 19. Differential forms in general relativity. By W. Israel.

(3) Contributions to periodicals and other publications:

Published:

C. Lanczos:

* Quadratic action principle of relativity. J. Mathl. Phys. 10 (1969), 1057-65.

J. L. Synge:

* On the kinematics of particle interactions. Proc. Roy. Soc. 312^A (1969), 467-72.

Report on paper by G. R. Isaak; Improved limit on the absence of dispersion of the velocity of light. Nature 223 (1969), 161-2.

Equations of motion in general relativity. Proc. R.I.A., 69A (1970), 11-38.

J. R. McConnell:

* The general linear group GL(4) and the Lie group C_2 Proc. R.I.A. 68A (1969), 5-32

* Reflections on physical theories. Phil. Studies 18 (1969), 7-13.

Review of "Geometry and chronometry in philosophical perspective", by A. Grünbaum, Oxford, 1968. Phil. Studies 18 (1969) 232.

Graph theory of weight multiplicities. Proc. R.I.C. 69A (1970), 63-75.

Y. Takahashi:

* Quantization of higher spin fields. Boulder Summer Inst., Univ. of Colorado, 1967. Univ. of Colorado Press. Lectures in Theor. Physics 10A (1967), 351-431. Gordon & Breach, 1968.

Y. Takahashi & R. Gourishankar:

* Method of hyperquantization. II. Nuclear Phys. 12B (1969), 301-321.

W. Montgomery, L. O'Raifeartaigh & P. Winternitz:

* Two-variable expansions of relativistic amplitudes and the subgroups of the SU(2,1) group. Nuclear Phys. 11B (1969), 39-54.

S. J. Chang, R. Dashen & L. O'Raifeartaigh:

Properties of current algebra at infinite momentum. Phys. Rev. 182 (1969), 1805-18.

Momentum-transfer-independent angular relations and solutions to the isospin-factored current algebra. Phys. Rev. 182 (1969), 1819-36.

N. L. Balazs:

* One dimensional band theory in the WKB approximation. Ann. Phys. 53 (1969), 421-38.

* Reduction of the images of the Fermi-surface in the phonon spectra of metals by exchange forces. Proc. R.I.A. 68A (1969), 49-53.

M. Misra:

* On the generalized Goldberg-Sachs theorem. Nuovo Com. Lett. 1 (1969), 615-6.

A unified treatment of the Kerr and Vaidya solutions in general relativity. Proc. R.I.A. 69A (1970), 39-54.

D. Lurié & A. I. Solomon:

Chiral symmetry and the Goldstone theorem. Nuovo Cim. Lett. 3 (1970), 354-56.

H. Efinger:

* On flat gravitation as a useful model theory, I and II. Physica 44 (1969), 1-8, 9-18.

* An instructive model for the quantization of magnetic monopoles. Amer. J. Phys. 37 (1969), 740-1.

E. Massa:

A simple relation between the restricted Lorentz group $L_+^\uparrow$ and the unimodular group of order two. Nuovo Cim. Lett. 1 (1969), 806-8.

C. P. Ryan:

Electromagnetic contributions to the charge asymmetry in the decays if neutral kaons. Phys. Rev. D (1970), 299-306.

In the press:

C. Lanczos:

Judaism and science. Univ. of Leeds.

J. L. Synge:

The problem of the thrown string. Math. Gazette.
Point-particles and energy tensors in special relativity. Ann. di Mat.
Motion of a charged particle in a field of plane-wave electromagnetic radiation. Quart. Appl. Math.
Review of "Essay in the history of Mechanics", by C. Truesdell, Springer, 1968. Science.

L. O'Raifeartaigh:

Group theory. Group theory and quantum mechanics. Proceedings Battelle Rencontres, Seattle, 1969. Ed. V. Bargmann. Springer.

I. Khan, U. H. Niederer & L. O'Raifeartaigh:

On the saturation of non-factored current algebra at infinite momentum with simplified angular condition. Proc. R.I.A.

A. I. Solomon:

Does chiral symmetry imply parity doubled states? Nuovo Cim.

P. S. Florides & R. Ll. Jones:

On a static system consisting of many gravitating masses. Nuovo Cim.

D. J. Judge:

On Zemanian's distributional eigenfunction transforms. J. Math. Anal. Appl.

F. Ando:

Moving branch points in the angular momentum plane. Phys. Rev.

IV. Annual Report of the Governing Board of the School of Cosmic Physics adopted at its meetings on 18 June 1970 and 29 October 1970.

A. Astronomical Section

1. STAFF AND SCHOLARS

Senior Professor

P. A. Wayman

Professor

T. Kiang

Research Assistant

I. Elliott

Experimental Officer

B. D. Jordan

Technical and Clerical Staff

Miss A. M. Callanan, Mr. P. Murphy, Mr. D. Fitzsimons and Miss A. Downey

Scholars

C. J. Butler; J. K. Brady; M. V. Norris; A. D. Andrews (without stipend).

Professor Wayman served on the Council of the Royal Astronomical Society throughout the year and continued as External Examiner in Astronomy at Queen's University, Belfast. He also continued on the Board of Governors of Armagh Observatory, on the Management Committee of Armagh Planetarium, and as Chairman of the Irish National Committee for Astronomy.

Mr. M. V. Norris worked at the Radcliffe Observatory and the Boyden Observatory, South Africa, from 1969 October to 1970 March. Professor Wayman visited Pretoria, Bloemfontein and Cape Town in the months 1969 October to December to supervise observational and instrumental work and for planning purposes.

O. Browne (U.C.D.) and R. Gillman (T.C.D.) worked as Vacation Students at Dunsink in July and August 1969.

2. RESEARCH WORK

Solar Research: I. Elliott

Analysis of measurements of a sequence of 215 Hα chromospheric spectre by means of data on magnetic tape was continued. Fresh magnetic tapes with 9-track format had to be obtained from Sacramento Peak Observatory (to replace 7-track material), and they were successfully read on the IBM 360/44 computer at Trinity College. A wide range of physical data on velocity fields can now be obtained from Fourier techniques applied to this material. Direct comparison of earlier results with recent Russian radio-wavelength observations of coronal velocity fields has become possible and is of special interest in tracing the propagation of energy outwards to the corona.

Photometry of Stars: P. A. Wayman, C. J. Butler, M. V. Norris, A. D. Andrews.

Minor improvements in the iris-photometer reduction methods were effected to enable corrections to be applied for the background fog level over all magnitude ranges. The derived magnitudes show a reduction in scatter from individual plates. This improvement has meant that a more critical appraisal of the residuals "photographic minus potoelectric" was possible. A further comparison of results for areas in the two Magellanic Clouds showed that quality was lacking in certain cases of photoelectric measurements of stars with faint unsuspected companions made under poor seeing conditions. Recalibration of the sequences has therefore been necessary and a systematic change as large as several tenths of a magnitude has been incurred at the faint end. Objective-grating plates are now being used to check the photoelectric scales so far established and a satisfactory result has already been obtained for the V magnitudes.

Computation of periods for the cepheid variables in the LMC region has been virtually completed. Periods have been found for about 110 variables (as compared with 75 in SMC) of which 10 are long-period variables, two are short-period ($< 1^d$) and most of the remainder are normal cepheids. A preliminary analysis of the colours and magnitudes has been made with a view to determining a best distance-modulus for the Clouds but no final

figures are yet possible. It appears, however, that the data fit the empirical Sandage-Tammann hypothesis of a single Period-Luminosity-Colour relationship reasonably well. No physical correlation between departures from this relationship and other physical characteristics has so far been established.

953 stars in NGC 371, a large open cluster in the SMC, were the subject of a colour-magnitude analysis in the UBV system using nine ADH plates. Corrections for interstellar reddening were calculated but it was deduced that the basic material, owing to the plate-scale, was inadequate for a critical discussion of the properties of Magellanic Cloud clusters in crowded fields.

Photographic photometry of the flare stars in the Orion aggregate in the UBVR system showed, through the use of the (V, V-R) diagram, that by far the majority of flare stars must be associated with that aggregate and that much of the scatter in the (V, B-V) diagram in the lower main sequence must be due to spectral peculiarities rather than a wide scatter in bolometric magnitude against effective temperature. This has an important potential influence on pre-main-sequence evolutionary studies.

By courtesy of the Science Research Council of Great Britain, ten nights' observing with the 74-inch Radcliffe Observatory reflecting telescope in Pretoria, South Africa, in October, November and December, was made available to staff from Dunsink. The programme, as submitted to the Large Telescope Users' Panel, was designed to obtain photographic material suitable for discussing the magnitude of short-period variables in the Magellanic Clouds. Some plates were taken using the 5-magnitude objective grating. A total of 42 plates was obtained. About twenty of these were of NGC 1466 and a further 15 plates of NGC 1466 were borrowed from the Radcliffe plate files for subsequent work on the short-period variables in this cluster.

Objective-Prism spectra: C. J. Butler, M. V. Morris

The neodymium-chloride filter permits the radial-velocity criterion to be used for Magellanic Cloud membership from ADH objective-prism plates. However, the results on over 100 stars in a preliminary trial of

this method were subsequently found to be unsatisfactory following special observations by Fehrenbach (Marseilles) and Wood (Pretoria). The apparent separation of the stars into two velocity groups was partially vitiated through an appreciable number of low-velocity stars being spread over into the high-velocity group. From an analysis of the basic measurements it would appear that fine-grain plates give satisfactory results but that fast photographic emulsions are not suitable for this work.

Statistical Astronomy: T. Kiang

Principal component analyses have been made on multi-colour observations of stars and galaxies. When based on covariances, rather than correlations, the principal components define what may be called colour ellipsoids, or hyper-ellipsoids, and these may prove useful in astrophysics in a way analogous to the use of velocity ellipsoids in stellar dynamics. Application to flare stars in the Orion nebula and to cepheid variables is being considered.

Planetary system: T. Kiang

Following the examination of ancient Chinese records for comparison with pulsar positions, it appeared that the ancient records of Halley's comet, including one recently-discovered source, permitted ten observations of this comet during the return of 837 A.D., to be ascertained to about $0^{o}.5$ accuracy in right ascension, the time argument being accurate to a few hours. A program of recalculating the past orbit has been instigated. This will extend the well-known work of Cowell and Crommelin in two respects. The perturbations in all six elements have been computed and the variations in the orbital elements of the planets have been taken into account. A possible error in previous work has come to light in connection with the changeover, in the computations from a heliocentric frame (when the comet is near the sun) to a barycentric frame (at great distances). If this changeover is not limited by points spanning a whole multiple of the planetary period it is likely that the perturbations by

inner planets will be largely illusory. It is hoped that the present computations can be extended back to B.C. times.

Galactic Orbits: P. A. Wayman

A computer program to give 3-dimensional orbits of stars in the gravitational field of the Galaxy was written and a survey of orbital shapes in terms of local velocity at the Sun's distance from the centre was carried out. The program was based on a direct integration of the force-function of elemental ellipsoids, rather than on a table of potential functions, leading to a step-by-step integration of the path. It was possible to incorporate variation of the model parameters with time to examine the effect on the motions of changing mass as evidenced, perhaps, in the equivalent of the Bottlinger diagram of stellar motions. The past history of the Hyades and Praesepe motions has also been traced.

Miscellaneous Observations:

The advent of a bright meteor in Northern Ireland on 1969 April 25 involved the Section in calculation of the true path from numerous sightings in Ireland and Britain. The path was calculated with reasonable accuracy within a week or two of the fall. In the meantime meteorite fragments were recovered at two points in Northern Ireland, one of them being the second largest to be recorded in Ireland.

As well as six occultations observed with the South telescope, a grazing occultation was fully recorded at Collon, Co. Louth on 1970 February 10 using the 5-inch Plossl refractor. These occultations give corrections to the moon's latitude more accurately than other types of observations.

Photographs of Comet Bennett were taken in early 1970 with the ADH telescope and with a small camera at Dunsink in March 1970.

Some photographs taken in 1966/67 of the Large Magellanic Cloud have been designated the subject of a joint investigation with the Astrometric Dept., Royal Greenwich Observatory, on the properties of Sanduleak's

cluster foreground to the LMC. Photometric data will be obtained from these plates by the automatic measuring machine GALAXY of Royal Observatory, Edinburgh, and reductions performed at Dunsink.

3. INSTRUMENTS, ETC.

Electronics Laboratory: B. D. Jordan

The Video Comparator has been completed in a rudimentary form by providing amplifiers and mixer for the input signals and linearity of the flying-spot circuits has been improved. Preliminary tests of the system indicate that mechanical alignment is a difficulty that requires further work before a full test of the independent gain and black-level controls can be carried out.

Design work for a method of providing a digital readout for the Askania Iris Photometer has been completed and the development of the electronics required is continuing.

Armagh-Dunsink-Harvard Telescope: P. A. Wayman; M. V. Norris

In conjunction with Professor A. H. Jarrett, Director of Boyden Observatory, an examination of the mechanical condition of the ADH telescope was made in November 1969 and subsequently. Various improvements, etc. were clearly required and some of these have been carried out. An opportunity to carry out instrumental tests of the new drive-system of the 60-inch telescope at Boyden Observatory also occurred and some photoelectric work of calibration was done.

Electronic Computer: I. Elliott

Machine language programs for utility purposes were augmented considerably during the year and problems not suitable for FORTRAN were dealt with. The computer has been used nearly to maximum capacity during the year.

A survey of small modern computers suitable for use in Ireland as a replacement to the IBM 1620 has been made and a series of benchmark programs written to evaluate relative efficiencies.

Darkroom: I. Elliott

With the completion of new darkroom and photographic workroom, it was

possible to effect a revision in the Public Display of photographs, charts, etc. in the South Dome. Also, material illustrating the work of the Section was prepared for the Royal Dublin Society Science Exhibition in October 1969.

4. LECTURES, CONFERENCES, ETC.

Three lectures were given as part of a series of Astrophysics Seminars in U.C.D. arranged by the Irish National Committee for Astronomy in March / April 1970: -

P. A. Wayman : "Stellar Pulsations"

T. Kiang : "Density in Space of Galactic Material"

I. Elliott : "Waves on the Sun"

Professor Wayman addressed groups at the Boyden Observatory, the Radcliffe Observatory and the Royal Observatory, Cape Town, during his visit to South Africa.

Visitors to Dunsink Observatory during the year included the Netherlands Ambassador, Dr. S. C. B. Gascoigne and Dr. D. E. Osterbrock.

5. PUBLICATIONS

T. Kiang:

Possible Dates of Birth of Pulsars from Ancient Chinese Records. Nature, 223, 599, 1969.

A. D. Andrews, T. W. Rackham and P. A. Wayman:

The Meteorite of April 25, 1969. Nature, 222, 727, 1969.

P. A. Wayman:

Astronomical Time, Kosmos, No. 7, p. 18, 1969.

C. J. Butler and M. V. Norris:

A Method for Determining Magellanic Cloud Membership using an Objective Prism and an Absorption Filter. Monthly Notes of the Astronomical Society of Southern Africa, 28, 107, 1969.

B. Cosmic Ray Section.

1. STAFF AND SCHOLARS

Senior Professor:

C. O Ceallaigh

Professor:

K. Imaeda

Assistant Professor:

M. Kaxuno

Research Assistants:

Dr. A. Thompson; Dr. D. O'Sullivan (on leave of absence at University of California, Berkeley from 1 October 1969); Dr. Y. V. Rao (from October 1969)

Technical and Clerical Staff:

Miss A. Madden (to 31 Oct. 1969); Miss M. Dalton (from 10 Mar. 1970); Mr. J. Daly; Mrs. A. Coffey (from 2 Feb. 1970 to 2 Oct. 1970); Miss D. Molloy; Miss E. Byrne; Miss C. Doyle (to 16 May 1969); Miss L. Rogers (from 29 Sept. 1969); Miss M. Ryan; Miss E. Kee; Miss P. Batt (to 13 June 1969); Miss H. O'Donnell (from 23 June 1969)

Scholars

T. Cantwell; A. Curran; P. Fleming

2. RESEARCH WORK

European K^- Collaboration: T. Cantwell (with others).

The work, as outlined in the 1968-69 Annual Report, is continuing. To date, approximately 70 per cent of the data has been scanned, measured and analysed.

Since the most recent determinations of the lifetime of the Σ^--hyperon using the bubble chamber technique are in serious disagreement, it is of importance to have an estimate of the lifetime using an independent method. It was previously thought since an observational bias exists against the detection of Σ^+-hyperons which decay into a proton, that it would not be possible to use the data on K^- captures on free hydrogen in emulsion to estimate the lifetime. It is now proposed to overcome this difficulty by

using the values of the lifetime of the Σ^+-hyperon and the fraction of Σ^+-hyperons that decay into a π-meson, both of which are well-known, from bubble chamber experiments.

The value of the mass of the Λ^0-hyperon and preliminary results on the mass of the Σ^+-hyperon from the present stack were presented on behalf of the K^- collaboration by Dr. D. H. Davis of U.C. London to the International Conference on Hypernuclear Physics held at Argonne National Laboratory, May 5-7, 1969.

C. O Ceallaigh, A. Thompson, D. O'Sullivan (to August, 1969) and V. Rao (from September, 1969)

New data on the elemental abundances of cosmic ray primaries with $Z \geq 12$ and with energies below 250 MeV/nucleon have been obtained from a stack of Lexan Polycarbonate sheets. This stack was exposed over Fort Churchill in 1968 at a residual pressure of 1.8 mbar. The new abundance distribution is consistent with our previous work (Phys. Rev. Letters 21 630 (1968)) but the resolution is higher: $\Delta Z \approx 0.3$ charge units and $\Delta A \approx 2$ amu at the level of one standard deviation. The even Z to odd Z ratio was found to be somewhat larger (≈ 5.4) but the high abundance of Mn at low energy was confirmed. The data obtained in the region $Z \geq 30$ and $0.1 < \beta < 0.45$ were used to predict curves of response of Lexan to cosmic rays with $Z > 30$ and $\beta \leq 0.95$. This work was carried out in collaboration with Dr. P. B. Price's group at the General Electric Research and Development Center, New York, U.S.A.

The basic planning of a major new project to investigate cosmic ray primaries was completed. This project will be carried out in collaboration with Professor P. H. Fowler's group at Bristol University. It is planned to expose a very large stack ($\approx$ 20 square metres in area) of Lexan Polycarbonate, nuclear emulsion and other materials at high altitude in a region of intermediate geomagnetic latitude using a twenty million cubic feet polyethylene research balloon. This stack will be used (a) to study the composition of ultra-heavy cosmic ray primaries and (b) to attempt to detect transuranic elements (e.g. the hypothetical element having Z = 114) of extraterrestrial origin. The design studies for the stack itself, for

the gondola (the vehicle which varies the stack) and for the ancillary equipment have been carried out and much of the material has been ordered.

During the year considerable progress was made in the technique and precision of track measurement in Lexan Polycarbonate. Problems associated with slight variations of the standard voltages in the electronic units used for measurement (Daytronic control units for linear displacement transducers) have been overcome and the reproducibility of track displacement measurements is now of the order of 0.1 μm. Mr. J. Daly has played a major role in this development.

A. Thompson with other members of the K^- collaboration group

The production of hypernuclei by the interactions of Σ^- hyperons at rest with emulsion nuclei was studied using much larger statistics than hitherto. This process was compared in detail with the corresponding and much investigated production of hypernuclei by K^- mesons. The total Λ^0 trapping probability following Σ^- hyperon capture on a heavy (Br, Ag) nucleus was found to be $(16 \pm 3)\%$, very much less than the value obtained for K^- meson captures, while the corresponding Λ^0 hyperon trapping probability for light (C,N,O) nuclei was calculated to be $(8.5 \pm 0.5)\%$. The value of Q^- for heavy spallation hypernuclei was estimated to be 120 and the ratio $(\Sigma_p^- + \Sigma_e^-)/\Sigma_\sigma^-$ was found to be 3.25 ± 0.18.

A. Thompson and T. Cantwell

The production of hypernuclei from the interactions of 10.1 GeV/c momentum K^- mesons with emulsion nuclei was investigated. Apart from the expected decrease in emission rate and broadening of the range distribution the production characteristics were found to be the same as at 5.0 GeV/c K^- momentum. It was concluded that most of the short range hypernuclei are the heavy residual spallation products of Ag and Br, the mass numbers of which differ on the average from those of their parent nuclei by 35 nucleon masses. It was found that fragmentation continues to play an important role but that the fission process does not appear to make a significant contribution to hypernucleus production at 10.1 GeV/c.

A. Curran, P. Fleming, K. Inaeda and M. Kazuno

A study has been made of the phenomenological description of meson production in ultra-high energy cosmic jets. In view of the existence of various models aiming to describe these interactions, the relations between various quantities characterising these interactions such as the multiplicity, angular distribution of the secondaries, and primary energy has been investigated. These empirical relations serve as a guide to the plausibility of new interaction models. In particular, the relations between the following parameters of individual reactions have been investigated:

(1) Dispersion in the log tan theta plot and the log. γ in the centre of mass systems.

(2) Multiplicity-energy relationship.

(3) Variation with energy of parameters derived by the two-fireball theory and their frequency distribution.

A report on this was presented at the Budapest Conference on Cosmic Rays (1969).

K. Imaeda and P. Fleming

Characteristics of protons and alpha-particles produced in knock-on collisions by heavy cosmic ray nuclei have been studied. A method has been derived by means of which it is possible to separate the protons and alpha-particles produced by the knock-on mechanism from those that originate in the fragmentation process. Using this method, it is possible to improve the energy estimate given by the formula of Kaplon et al. The study also provides information about the fragmentation probability of high energy cosmic ray nuclei incident on C.N.O. atoms in nuclear emulsion.

M. Kazuno

Extrapolations from quark and SU3 theory were made on the nature of resonances in the cosmic-ray energy region, and these predictions were checked against the experimental data available from interactions in emulsion. The predictions of various models, including that derived from Regge Pole theory, relating to the production of heavy resonances (above 4 GeV/c) in cosmic-ray reactions has been investigated.

At cosmic ray energies, the theory predicts an average mass of baryon

resonances at primary energy of 10^{12} eV, about 5 GeV/c which is in good agreement with the experimental value (5.2 GeV/c) obtained from emulsion reactions.

K. Imaeda, M. Kazuno and P. Fleming

The total elastic cross-section of nucleon-nucleon collisions in the energy region above 100 GeV/c and the elastic interaction radius with increasing primary energy have been studied using nucleon-nucleus events having energies in the range 50-10,000 GeV/c. Although many experiments have been carried out in the accelerator energy region, very little work has been done at cosmic-ray energies. In view of this, we have selected about 100 events produced by cosmic-ray primaries in collisions with light nuclei in emulsion and measured the kinetic energy and space angle of the knock-on protons produced in the interactions. Although these parameters are difficult to measure at ultra-high energies, there is some prospect that some information will be obtained on the total elastic cross-section and on the increase of the interaction radius with energy. These quantities are of great interest in elementary particle theory.

A. Curran

Computer analysis of high-energy reaction data from cosmic-ray reactions in emulsion was continued. This work has now reached the following stage:

(1) An extensive computer program has been prepared to analyse cosmic-ray data obtained at ultra-high energies. As an aid to investigators, this program draws graphs and histograms of any desired quantities from the data. It is hoped that it will provide a foundation for an international analysis program associated with a data bank of cosmic-ray events (of which about 1,500 have been measured and are available from various sources) which can be used by any research worker having access to a medium-range computer. The card deck for the program will be distributed by the Computer Physics Library, Belfast, who have requested a paper on the program for their journal.

(2) Using these methods, two new effects have been found connected with

ultra-high energy reactions. These are:

(a) The slope of the mean values of the dispersion against the log. of the gamma factor in the centre of mass system is linear within the range of experimental errors. The numerical value of the slope is different for each incident particle, and is a characteristic of that particle.

(b) Clear evidence is found for azimuthal anisotropy using the large mass of data now available in the calculations. This can be interpreted as due to fireball emission or to phase space effects in the reactions. Both of these explanations are of interest: computer models simulating the relativistic kinematics have been set up to decide, if possible, which is the more consonant with experiment.

3. WORKSHOP AND TECHNICAL DEVELOPMENT - J. Daly

General maintenance of equipment was continued throughout the year.

A discrepancy discovered on remeasuring the plastic detectors after a period of a few months has been investigated and was traced to a variation in the value of the calibration voltage of the measuring apparatus. A technique has been devised, using standard plastics, in order to overcome the effects of this drift in sensibility. It has also been shown that this technique should eliminate error arising from other sources. Miss D. R. Molloy, also, has contributed to the investigation.

When at Bristol a visit was paid to the firm of Rank Precision Instruments at Leicester to investigate the possibility of using their type of displacement transducers on our microscopes. It has been decided to order this equipment and it should be delivered within a few months.

4. CONFERENCES, MEETINGS etc.

The following International Conferences and Meetings were attended by members of the Section:

International Conference on Nuclear Track Registration in Insulating Solids and Applications, Clermont-Ferrand, France, Mar. 1969 (C. Ó

Ceallaigh, A. Thompson and D. O'Sullivan).

The 11th International Conference on Cosmic Rays, Budapest, Hungary, August 1969. (K. Imaeda).

The International Summer School on Elementary Particle Physics, Herceg-Novi, Yugoslavia, September 1969. (T. Cantwell).

K^- Collaboration Meeting, Herceg-Novi, Yugoslavia, September, 1969. (T. Cantwell).

C. Ó Ceallaigh attended three meetings of the Physics 111 Committee at CERN, Geneva.

Three working periods in furtherance of the Bristol-Dublin Collaboration on Ultra-heavy Cosmic Ray Primaries were spent at the Physics Department of Bristol University as follows:

24-27 June, 1969: A. Thompson, D. O'Sullivan and J. Daly.

14-17 September, 1969: C. Ó Ceallaigh and A. Thompson.

3-7 January, 1970: C. Ó Ceallaigh, A. Thompson, V. Rao, J. Daly and Miss D. Molloy.

5. PUBLICATIONS

Published:

A. Thompson and T. Cantwell (and others):

"Production of Hypernuclei from the Interactions of 10.1 GeV/c K^- Mesons with Emulsion Nuclei". Nuovo Cimento 61A 525 (1969,.

C. Ó Ceallaigh, A. Thompson, D. O'Sullivan with P. B. Price, R. L. Fleischer and D. D. Peterson:

"Composition of Cosmic Rays of Atomic Number 12 to 30". General Electric R and D Centre Report No. 69-C-299 (1969).

C. Ó Ceallaigh and J. Daly:

"The Measurement of Cone Length and Range in Etched Plastics". Radiation Effects 5, 135 (1970).

M. Kazuno:

"Characteristic Differences of π^--N and N-N Interactions in the Cosmic Ray Energy Region". Lett. Nuovo Cimento 3, 182 (1970).

K. Imaeda and P. Fleming:

"Azimuth angle distribution of the secondary particles of cosmic-ray jets". Nuovo Cimento, 62, 439 (1969).

D. O'Sullivan and others:

"The binding energies of the ΛBe^7, ΛB^{10} and ΛB^{11} hypernuclei".

Nuclear Physics B12 (1969)

"The non-mesonic decay of Helium Hypernuclei". Nuclear Physics B16 (1970).

"Branching ratios for the π^- mesonic decays of the ΛH^3 and ΛH^4". Nuclear Physics B16 (1970).

"On the lifetime of the ΛH^3 hypernucleus". Nuclear Physics B16 (1970).

In Press:

A. Thompson (and others):

"Hypernucleus and Cryprofragment Production from the Interactions of Σ^- Hyperons at Rest with Emulsion Nuclei".

A. Curran, P. Fleming, K. Imaeda and M. Kazuno:

"A Study of Characteristic Features of Cosmic Ray Jets of Energy from 5×10^{10} to 10^{14} eV in Emulsion".

In Preparation:

K. Imaeda and P. Fleming:

"Multiple Particle Production in Collisions of Heavy Cosmic-ray Nuclei with Light Nuclei in Emulsion".

K. Imaeda:

"Statistical Thermodynamics of Hadron Gas and the Interpretation of Multiple Particle Production in Cosmic Ray Jets".

M. Kazuno:

"Baryon Resonances at the Cosmic Ray Energy Region".

T. Cantwell:

"The Lifetime of the Σ^- Hyperon".

C. Geophysical Section

1. STAFF AND SCHOLARS

Senior Professor:

T. Murphy.

Professor:

Vacant

Research Assistants:

R. P. Riddihough; D. G. C. Young.

Senior Technical Assistant:

T. J. Morley.

Technical and Clerical Staff:

Miss A. Byrne; Mrs. J. Gosling (to 3 October, 1969); Miss E. Ryan; Miss A Byrne (from 20 October, 1969 to 7 November, 1969); K. Bolster; J. Fay.

Scholars:

I. Dixon (to February, 1969); C. P. English; P. Morris; K. W. Robinson.

2. RESEARCH WORK

(a) Gravity and magnetic fieldwork:

Gravity and magnetic readings were taken by several members of the section principally in Donegal, Mayo, Sligo and around Dublin.

Mr. English assisted by Mr. Robinson started on the area centred on the Ox mountains in an effort to elucidate the structure of this region which has long been the subject of controversy among geologists and is crucial for our understanding of the processes at work at the oceanic limits of the Caledonian system. The magnetic readings have shown up a marked magnetic anomaly which may prove a link between the metamorphic areas of South Mayo and Scotland. The gravity results are complimentary to the magnetic ones. The gravity survey was not completed mainly due to instrument difficulties.

Mr. Robinson, taking as his subject of study the relationship of the Ordovician Volcanics on Lambay Island and southwestwards, carried out an

experimental magnetic survey at sea using a small boat, which was necessary because of shallow water. He has shown that the sea area between Lambay and the mainland is underlain by strongly magnetic rocks probably of the same type as that on Lambay. Inland the magnetic effects decrease and reappear in the Chair of Kildare area. When the Institute of Geological Sciences were carrying out geophysical work in the Irish Sea Mr. Robinson as an assistant aboard (see later) was able to make additional magnetic readings around Lambay.

Dr. Young published in our Communications, a gravity anomaly map of Donegal together with a short description upon the completion of his survey (see later). This incorporates the work in which he has been engaged for the past few years. A detailed interpretation concerning the granite masses has been prepared in collaboration with the geological studies of Liverpool University (Prof. Pitcher) and will be reported in a joint publication. It confirmed the geological speculation that the main masses are shallow structures but he discovered that the plutonic granite at Ardara also appeared to be a shallow body contrary to expectations. It is similar to a granite structure on Belmullet investigated by Mr. English and has given rise to work on other similar masses.

Dr. Young completed his survey of Donegal on the Inishowen peninsula and later he and Professor Murphy carried out additional work on the shores of Lough Foyle. This work has now proved the existence of a downfaulted block of mesozoic sediments at least 1.5 km thick which outcrops on the Donegal side a feature which has remained concealed due to wrong identification in the original geological survey. This trough belongs to a series which is being added to as the sea areas between these islands is being explored. The origin of these troughs is being actively pursued here and elsewhere.

Professor Murphy and Dr. Young carried out gravity readings in South Donegal, North Leitrim and North Sligo linking the Donegal area to that covered by Mr. English mentioned earlier. The preliminary results show a well-marked negative anomaly area running south from Barnesmore and ending abruptly on a NW-SE line through Coolaney. It covers the metamorphic belt

but is not related directly to it. As already mentioned, instrumental difficulties were encountered and some parts of this work will be repeated.

Dr. Young carried out a detailed gravity survey in the Bogganstown area, Co. Meath in co-operation with a mineral prospecting company. Small negative gravity anomalies of the order of a mgal were mapped. These were of the type which have been investigated here for some time. An extensive drilling programme had already been carried out and this gave us valuable corroborative evidence for our suggestion that such anomalies are caused by cavities in the limestone filled with clay of probably Tertiary age.

Mr. English completed the account of his work in Co. Mayo, presented a thesis and was awarded the degree of M.Sc. His conclusions were that the gravity anomaly in NW Mayo can in general be correlated with the near surface geology the main exception being the large areal gravity and magnetic low centred on Bellacorrick. This he suggested is caused by a downwarp in the pre-Moinian/Dalradian basement, possibly accompanied by faulting, and filled with large thicknesses of metasediments. He found also that the granite pluton at Termon, Belmullet, could be represented by a disc of 3 km diameter, 3 km thick. This was quite unexpected and as mentioned in connection with the Ardara granite has started a new line of research.

Arising from some of his measurements, Professor Murphy and Dr. Young carried out additional work in Co. Mayo and discovered some small negative gravity anomalies which seem to be related to a peculiar breakdown of the rock, in certain areas. Investigations are continuing on the line that these are associated with hydrothermal activity reported to occur in this part of the country.

Dr. Riddihough's work on the Ardara granite pluton was completed and showed that there is present an annular magnetic high surrounding a central flat area - the ring correlating with a mapped Tonalite. Samples of the various rock species present gave susceptibilities in agreement with this. The regional survey which he also carried out to the south of this area shows various types of anomalies which he considers are caused by magnetic materials below the exposed Dalradian. In particular, over the Lough Derg

complex a large negative anomaly was encountered which must result from polarised rocks at depth. This area has been shown earlier to give rise to a negative gravity anomaly. The results have been published in the Communications.

We have been actively co-operating with the University of Wales (Marine Laboratories, Menai Bridge) and the Institute of Geological Sciences, London in their marine work around Ireland and members of our section have participated in their cruises. The geophysical work has been so divided that we process the magnetic data for both concerns and to this end have on occasions installed continucusly recording magnetometers at various places principally at Valentia through courtesy of the Meteorological Service and at Dunsink.

Apart from its scientific value, this co-operation has been most beneficial in providing our members with experience in practical marine measurements and in the use of advanced apparatus and techniques not available in this country.

(b) Magnetism:

After publication of his work on the daily magnetic variation, Dr. Riddihough continued his comparative analysis of records which were taken in various parts of the country incidental to other fieldwork. This confirmed his earlier conclusions and shows that the effect of the shallow parts of the oceans cannot be neglected. Thus the diurnal variation at a particular place is not known with accuracy and hence gives rise to uncertainties in magnetic surveys. These have been estimated by Dr. Riddihough and assembled for publication

(c) Meteorology:

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

The continuous solarimeter recorder installed last year has operated satisfactorily throughout the year and comparisons have been made with the existing records from the Cambridge dot recorder.

(d) Seismology:

The portable seismic recording station developed here proved

satisfactory and has now been increased to three sets. These were used in the large scale co-operative geophysical experiment carried out in September. We set up and manned four recording stations at Waterford (previously used in 1957) Killaloe, Dublin and Caherciveen. Some records were lost due to instrument failure but in general they were good. The results have been sent to Birmingham University who organised the experiment. Many unusual features were noticed on the records and these are being investigated here.

(e) Palaeomagnetism:

Mr. Morris completed his A.C. demagnetising equipment and used it to 'clean' the samples of Carboniferous limestone and volcanics already measured in their natural state. Through the courtesy of Newcastle University he used their apparatus for thermal demagnetisation and high temperature susceptibility for measurements on his samples.

The rebuilt magnetometer has worked satisfactorily and an account of this has been incorporated in an article "Three new spinner magnetometers for Palaeomagnetism" and submitted for publication.

3. LABORATORY

The densities, susceptibilities and remanent magnetisations of large collections of rock samples have been carried out by various members from parts of the country in which they were interested. The results are being collected for publication.

A susceptibility bridge (after Collinson et al.) has been constructed for susceptibilities less than 10^{-5} e.mu/cc. While it can be operated satisfactorily it is not yet complete owing to the non-delivery of some correct parts.

4. CONFERENCES

The following International Conferences have been attended by members of the Section:-

General Scientific Assembly of IASPEI and IACA, Madrid, 1-12 September

1969 (Murphy and Riddihough).

Symposium on Basement Mapping by Magnetics, Aarhus, 27-30 October, 1969 (Murphy).

Irish Sea Conference, Aberystwyth, 6-8 January, 1970 (Murphy).

Symposium on Geology of the East Atlantic Continental Margin, Cambridge, 23-27 March, 1970 (Murphy).

5. STATUTORY PUBLIC LECTURE

The Statutory Public Lecture was delivered by Dr. A. H. Stride of the National Institute of Oceanography (Gt. Britain) on March 5, 1970 at Trinity College, entitled "SEA FLOOR SEDIMENTS on the continental shelf of Western Europe, particularly around Ireland, their geological significance and the exploration techniques".

6. PUBLICATIONS

A. W. B. Jacob:

Crustal phase velocities observed at the Eskdalemuir seismic array. Geophys. Journal 18, 189-197, 1969.

R. P. Riddihough:

A Geographical pattern of daily magnetic variation over north-west Europe. Annales de Geophysique, 25, 739-745, 1969.

Magnetic map of the Ardara granite and southern County Donegal, Bulletin 27.

D. G. G. Young:

The Gravity anomaly map of County Donegal, Bulletin 26.

M. A. Hogan
CHAIRMAN

19th November, 1970.