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

ANNUAL REPORT
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10 Burlington Road, Dublin 4

P1.7018

INSTITIÚID ARD-LÉINN BHAILE ÁTHA CLIATH
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Annual Report of the work of the Institute and its Constituent Schools presented by the Council to the Minister for Education in respect of the year ended 31 December 1988

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INSTITIÚID ARD-LÉINN BHAILE ÁTHA CLIATH

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Summary of Annual Report
of the work of the Constituent Schools
for the year ended 31 December 1988

School of Celtic Studies

The School of Celtic Studies made continuing progress on one of its most important statutory responsibilities, that of investigating Irish MSS: Fasciculus X of the Catalogue of Irish MSS in the NL was completed and published, and a further three fasciculi were completed in first draft; Dr de Brún's valuable survey Lámhscríbhinní Gaeilge: Treoirliosta was completed and published. In regard to the School's duty to edit and publish the contents of the Irish MSS tradition: L. Breatnach Uraicecht na Ríar was published as Vol. 2 of the Early Irish Law Series, and work continued on an edition of the Old Irish Bríathra and other texts for the series; editing K. Jackson Aislinge Meic Con Glinne continued; research for an edition of the work of the Bardic poet Fearghal Óg Mac an Bhaird was completed; with a view to its eventual publication, work began on making a computer copy of R. Plunket's 17th century Latin-Irish dictionary; Dr Breen continued work on editions of Hiberno-Latin materials, and Dr. Lapidge and Dr Sharpe agreed to become General Editors of the Scriptores Latini Hiberniae Series.

In regard to language study: work was completed on aspects of West Muskerry Irish and of Perthshire Gaelic; work continued on the editing of P. Russell Celtic Word- Formation; arrangements were made for the editing and publication of the University of Edinburgh's Gaelic Survey of Scotland archive.

In the wider field of Celtic Studies: G.C.G. Thomas A Welsh Bestiary of Love was published as Vol. 9 of the Medieval and Modern Welsh Series; Vol. XIX of Celtica and No. 2 of the Newsletter were published.

The School's annual Tionól was held on the 25-26 March and attracted a wide range of contributors; weekly seminars were conducted by P. Mac Cana, A. Watkins (UCD), and C. Ireland; F. Kelly delivered the Statutory Lecture at UCD on 'Early Irish Farming: the evidence of the 7th - 8th century law-texts'.

Through retirement, death, and resignation, 1988 brought a sharp reduction in the full-time permanent staff of the School, the total by the end of the year being 7; of the 9 scholars who were present for a whole or part of 1988, four were from overseas; the School continued to attract visiting academics to avail of its study and research facilities; and the practice of appointing Research Associates was resumed with the appointment of Drs Lapidge, Ó Dochartaigh, and Sharpe.

School of Theoretical Physics

Staff, Scholars, Research Associates, and Visitors made much use of the School's facilities in their primary and secondary research activities, especially of the opportunities for informal discussions, and of the library resources. Thirty-six research workers from the universities or other institutes of research or higher education (mainly in Ireland) were admitted as research associates of the School; thirty scientists from abroad visited the School during the year.

The Easter and Christmas Symposia were held as in previous years; seminars at DIAS and joint seminars (with UCD, TCD, Maynooth, NIHE-D) in special subject areas were continued. Fourteen seminars, one informal discussion, and two series/courses were given at DIAS, eight contributions were made to the Journal's Club, and seven lectures were given at Irish University and other Meetings during the year. The Statutory Public Lecture was given at TCD by Professor Lewis, his title was "Understanding Phase Transitions", and the lecture was illustrated by computer simulations based on a programme by Dr. Sullivan: a One-Day Workshop was held on Statistical Mechanics.

The School continued its research. The primary areas of research were theoretical particle physics, classical statistical mechanics, quantum statistical physics, and quantum electronics; secondary areas were general relativity and gravitation, applied mathematics, and pure mathematics. One book was published, and another was in press; forty-three contributions to scientific journals or conference proceedings were published.

Members of the School attended thirty conferences abroad, and gave lectures at seventeen of these. They gave twenty-one lectures and two courses/series of lectures at Universities or research labs abroad.

Dr. E. de Valera presented his father's and grandfather's collection of scientific books to the School Library, on permanent loan. Professor McConnell retired in February and was made Professor Emeritus; Ms Matthews went on a career break in August.

School of Cosmic Physics

General

The School occupies premises at 5 Merrion Square, Dublin 2, and at Dunsink Observatory, Castleknock, Dublin 15 . At the end of the year the Academic Staff numbered twelve, including two Senior Professors. Professor Thomas Murphy, Head of the Geophysics Section from 1964 and Director of the School for the period 1984-1987, retired during 1988 and responsibility for that Section has been undertaken for one year by Professor A.W.B. Jacob.

From its inception in 1947, the work of the School has been carried out under three Sections, within the areas now designated as Astronomy, Cosmic Rays, and Geophysics. There are areas of common interest, especially in the common ground of astrophysics and cosmic rays and in the provision of library, computing and workshop facilities. In the main Report, the research work in astronomy and cosmic rays is grouped together, but for the purposes of this summary, which is not all-embracing, each Section is reported on separately.

Scholars in each Section are able to register for higher degrees in the Irish Universities and the co-operation of the several academic departments involved is greatly appreciated. During 1988 six Scholars were availing of this provision. At the same time, some lecture courses in the Dublin universities, principally Trinity College, are reported for 1988.

Astronomy Section

Occupying a building long associated (since 1783) with the science of astronomy, the Section continues to fulfil a dual role. As well as providing research facilities in astronomical science based mainly on mathematics and physics for its own scientists and for Research Associates (and others) in the Irish universities interested in using those facilities, the Section acts non-statutorily as an authority on astronomical phenomena generally.

Legal enquiries on, e.g. lighting-up times fixed by the local time of sunrise and sunset, require careful attention. Also, by tradition, the 12-inch South Telescope is made available for public viewing twice per month from September to March and tickets are provided for up to 100 persons on each occasion. The renovation of the telescope in 1988, principally by Jeremiah Daly of the Cosmic Ray Section, has been an asset that was chosen as an Institute contribution to 'Dublin Millennium Year'.

The principal access to observational work in astronomy must, in the present day, depend either on work with scientific instruments on board space vehicles launched for specific purposes or on elaborate telescopic equipment erected on sites selected for climatic excellence. Modest equipment on mediocre sites is still in use, mainly for experimental and test purposes, but even this seems less than economic in Irish financial and climatic conditions. Access to first class facilities at high-altitude sites, however, as well as participation in space projects, is possible through international schemes of co-operation. In 1979 a formal agreement to participate with the UK Science and Engineering Research Council was signed by the Institute that has enabled Irish scientists to apply for telescope observing time on any of the SERC facilities principally on the island of La Palma in the Canary Islands, at the Spanish International Astrophysical Observatory (IAC), but also at Siding Spring, Australia, and on Mauna Kea, Hawaii. One example of a programme benefitting from the conditions on La Palma has been the securing during 1986-88 by a Cambridge-Brussels-Dublin observing team, in a relatively short period, of a very large number of double star measurements (relative brightness and position) badly needed by the forthcoming European Space Agency Hipparcos astrometric satellite project due for launch in 1989 and completion around 1995.

During 1988 the principal observational interest was in the setting up of joint work with University College, Galway, Physics Department (Dr R.M. Redfern), at the large (4.2-m diameter mirror) William Herschel Telescope on La Palma, which is still undergoing commissioning and which will not be completely commissioned until late in 1989. This telescope, for some five or six years, taking into account the quality of the site 2400 m. above sea level, must be regarded as one of the world's most powerful ground-based telescopes. With a superb site there is great interest, and indeed a scientific obligation, in investigating methods of overcoming some of the remaining deleterious effects of the earth's atmosphere, particularly in improving the angular

resolution, or image definition, attainable. The present experiments are intended to utilise real-time operation of standard PC computers, equipped with INMOS 'Transputer' circuitry, to distinguish moments of superior atmospheric quality and to record selectively the images received at those moments. The tests carried out in 1988 were promising but there is some way to go before profitable astronomical results are yielded.

The other (1-m. and 2.5-m) telescopes on La Palma were used for a variety of programmes, including work on 'Jets from Young Stellar Objects' by T.P. Ray of the Cosmic Ray Section in co-operation with individuals at the Heidelberg Max Planck Institut für Astronomie. Although star formation from the interstellar medium is certainly taking place, the mechanisms involved seem to incorporate little-understood processes and in their supposedly early stages of formation some stars emit jets of ionised material ('plasma') in two diametrically opposite directions. The behaviour of these fairly rare jets can be investigated from high-definition images taken through selected optical and infrared filters. Some good results have been obtained in 1987 and 1988; in due course this topic may benefit greatly from the high-resolution studies being started at the William Herschel Telescope.

In theoretical work, T. Kiang has been interested for some years in the problem of why asteroid (minor planet) orbits in the solar system show a non-random distribution in their semi-major axes (or in their energies). This is a little-understood phenomenon of resonance with the orbital period of Jupiter, causing some resonances to be over-populated and others to be vacated, the 'Kirkwood Gaps'. Although his work in this field has had some elaborate modelling, in 1988 Kiang made lengthy computations using many significant figures in order to determine whether a relatively simple dynamical model, previously thought to represent a stable solution in resonance, would, if sufficiently prolonged by numerical integration, exhibit the instability of the 2:1 resonance with Jupiter. After large amounts of computing time had been used, an inconclusive result was obtained, although the indication was that the model does not in fact exhibit the instability that exists at that resonance.

The electronics workshop of the Section, as well as completing, in 1988, the design and testing of the digital electronics used on the SLED space vehicle described below (Cosmic Ray Section), joined with Armagh Observatory and Queen's University, Belfast, in upgrading to common-user standard an echelle spectrograph designed for use on the 1-m telescope on La Palma. Other electronic work begun during the year concerns the design and construction of the photon-imaging-detector circuits intended for the image-enhancement programme with Galway. In this way, the Section is contributing to technical advances directed towards astronomy, but having parallels with other applications. This duality is a feature of astronomical methods (e.g., clocks, position-finding, optics) through the ages.

Cosmic Ray Section

The Cosmic Ray Section studies the universe around us through the detection and interpretation of charged particles. This involves, on the one hand, experimental programmes to measure the charged particle populations in situ by detectors on satellites and space probes, and on the other, theoretical studies to understand the observations in terms of models for particle acceleration and propagation.

The use of sheets of polymers to detect highly ionizing particles (solid state nuclear track detectors) is a technique which has been exploited in the Section for many years to study heavy and ultra-heavy particles in the cosmic rays. The advantage of the method is that it is insensitive to the protons and alpha-particles which constitute the bulk of the cosmic rays; thus only the heavy nuclei are detected. The disadvantage is that the polymer sheets have to be recovered, etched to reveal the tracks left by the cosmic ray particles, and then measured. The largest-ever experiment of this type was built by DIAS in collaboration with the European Space Agency's science and technology centre, ESTEC, and exposed in space on the NASA Long Duration Exposure Facility launched in 1984. Because of the tragic disruption of the Space Shuttle programme, this exposure has been much longer than intended, but this will greatly increase the value of the cosmic ray experiment, which is expected

to yield the first statistically significant sample of ultra-heavy cosmic ray nuclei. In preparation for the recovery (anticipated for the end of 1989) and subsequent analysis, a programme of fundamental studies on the long-term stability of the detectors is being carried out.

A more conventional technique is the use, at the much lower energies typical of solar system particles, of silicon barrier detectors. These were successfully employed in the EPA experiment on Giotto, the European mission to Halley's comet. The Institute was a partner in this experiment and analysis of the data obtained is continuing. The design of the EPA formed the basis for two SLED (Solar Low Energy Detector) instruments on the Soviet Phobos mission to Mars and its moons. These were the first space instruments to be almost completely built in Ireland and were constructed during 1986 and 1987 as part of a collaboration of the Astronomy and Cosmic Ray Sections with St. Patrick's College, Maynooth, ESTEC, the Max-Planck-Institut für Aeronomie, Lindau, the Central Research Institute for Physics, Budapest (KFKI), and the Space Research Institute, Moscow (IKI). The two spacecraft, Phobos-1 and Phobos-2, were launched early in July 1988, each carrying a SLED instrument towards Mars. Both operated satisfactorily after launch and data was obtained on solar energetic particles in the region between Earth and Mars, but contact with the first spacecraft was lost in early September. The second spacecraft, with its SLED instrument, continued to work throughout the year and reached Mars early in 1989.

Observations alone are of little use; to understand and interpret the data from experiments and to plan new observations, theoretical models and other calculations are needed. As part of his Ph. D. Peter Duffy has developed an analytical model for particle acceleration around comets which improves in several ways on existing models. This will be compared with the observations of energetic ions near Comet Halley made by the EPA and other instruments on Giotto. As part of a collaboration with former colleagues in Heidelberg, Luke Drury has developed theoretical models which strengthen the widely-held view that the bulk of galactic cosmic rays are produced in supernova remnants, the residue of exploded evolved giant stars.

The most widely-reported result of the year was unrelated to the main work of the Section, a study by Tom Ray of the astronomical significance of the megalithic tomb at Newgrange in the Boyne valley. His conclusion, that with high probability Ireland possesses the oldest known structure with a significant astronomical alignment, received international media coverage and a photograph of the solsticial sun shining down the passage of the tomb was used as the cover illustration for the issue of the journal Nature in which his article appeared.

Geophysics Section

The year 1988 was a busy one for the Section. Studies of the earth's lithosphere in and around Ireland continued. The lithosphere is the cool, relatively rigid, outer shell of our planet. In old continental areas, like Ireland, it may vary between 100 and 200 km thick, while under the younger, hotter conditions to be found under oceans, it is normally much thinner. It is particularly thin near mid-ocean ridges where there is an upwelling from the mantle and new oceanic lithosphere is being produced. The material cools as it moves away from the ridge and, as it cools, the lithosphere thickens. The generation of oceanic plates (as they are known) and the movement on the earth's surface is described by what is called plate tectonics.

Ireland is in a particularly interesting position, with the very large Eurasian continental landmass to the East and the expanding North Atlantic Ocean to the West. It is currently a 'passive' zone, but it has, buried within its present-day structures, the traces of major geological events in the past. These include the intercontinental collision (the Caledonian collision) at the closing of the previous 'Atlantic' around 400 million years ago, and the stretching and rifting which preceded the opening of the present Atlantic. These latter effects began around 200 million years ago. One result of this stretching is that there are many sedimentary basins around Britain and Ireland. These, and the mechanism of their formation, are very interesting problems in themselves. They also, of course, contain many structures that give us gas and oil today.

The Geophysics Section is carrying out research projects which examine a number of these topics. Most of this work is in cooperation with other groups, as each project is often beyond the resources of any one group.

Two seismic profiles completed in 1988 were part of the COOLE project. In particular, one studied the Caledonian collision zone in central Ireland. The very pronounced 'buckling' of deeply buried features over a belt some 60 km wide betrayed the horizontal forces involved in this collision. None of this shows at the surface, although there was a strong indication in the gravity data gathered by the Section over a period of about 30 years. The meaning of this was not clear until the seismic profile was carried out. Another striking result from this profile was the definition of a buried granite, a southwestern extension of the Leinster granites which appear at the surface in Co. Wicklow for example. This had been predicted in outline on the basis of earlier gravity work, but detailed confirmation was not possible without the seismic data.

The second seismic profile published in 1988 ran southwestwards from Co. Kerry into the Porcupine Seabight and the ocean beyond. This showed the rifting that produced the Seabight, the thinned continental crust under it, and the sharp transition to oceanic structure under water 4 km deep at the mouth of the Seabight. This was important new information.

A study of the North Celtic Sea Basin, which contains the Kinsale gas field, is also under way and making promising progress. Again there is evidence of crustal stretching, though not as severe as in the Porcupine Seabight.

Some of the most striking results have come from a much deeper study. This has used data recorded in Ireland from a pattern of seismic shots in the North Sea. The sources were not particularly big, but they have produced a magnificent set of seismic sections containing signals which have passed through the lower lithosphere down to depths approaching 100 km. This data, when combined with an earlier profile in Britain and another subsequent one in Ireland, has shown that the lithosphere in this area has layers where the seismic velocities vary with direction. This is known as anisotropy and we believe that it contains a record of localized heating and strain. This is a rapidly developing area in seismology and our data is the best of its kind recorded anywhere in the world. Our experience has allowed us to help in the design of a new programme to study these effects under Iberia.

Ireland is not in an active earthquake zone but events do happen from time to time. Only one occurred on-shore in 1988, between Wexford and Enniscorthy, but the Irish Sea was more active than usual, with about 20 events recorded and located by our stations. All these events were small. The aftershock sequence of the much larger event in July 1984 still continues, though now at a very low level.

Work has continued in both off-shore and on-shore gravity studies and new results should begin to come in 1989. Gravity studies tie in well with seismic work as rock density and seismic velocity generally correlate in a significant way. It can be very useful to interpret both data sets together. The delineation of the buried granite, mentioned above, is a good example.

Some geodetic work was carried out and meteorological observations continued at a reduced level. Further studies in the palaeomagnetism of lake sediments were also carried out. Recordings were made in New England as part of the preparation for a project in the East African Rift (Kenya) and the seismic field gear has been further developed to work in a remote, very hot, area. Perhaps the most exciting occurrence was the RAPIDS project in the North Atlantic in September/October. The weather was vile and conditions frighteningly bad at times, but a lot of good data was gathered and we hope to have much to report in 1989 from this examination of the Continental Shelf out over the Rockall Trough.

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(Dublin Institute for Advanced Studies)

Annual Report of the work of the Institute and its Constituent Schools presented by the Council for the year ended 31 December 1988

In accordance with the provisions of Section 29 of the Institute for Advanced Studies Act, 1940 (No. 13 of 1940), the Council of the Institute has the honour to present to the Minister for Education for submission to the Government a report of the work and activities of the Institute and its Constituent Schools for the year ended 31 December 1988.

The report is presented under the following principal heads:-

I - Constitution of the Council of the Institute and of the Governing Boards of the three Constituent Schools on the 31 December 1988.

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

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

IV Report of the Governing Board of the School of Cosmic Physics.

I Constitution of the Council of the Institute and of the Governing Boards of the three Constituent Schools on the 31 December 1988.

1 THE COUNCIL OF THE INSTITUTE

Chairman

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

Ex-Officio Members

Patrick Masterson, M.A., Ph.D., President, University College, Dublin; W.A. Watts, M.A., Sc.D., Provost, Trinity College, Dublin; J.C.I. Dooge, M.E., M.Sc., C.Eng., F.I.E.I., F.A.S.C.E., D.Agr.Sc., President, Royal Irish Academy.

Members appointed by the Governing Boards of Constituent Schools

M. Ó Murchú, M.A., Ph.D.; T. de Bhaldraithe, M.A., Ph.D., D.Litt.; J.T. Lewis, B.Sc., Ph.D.; A.J. McConnell, M.A., M.Sc., Sc.D., F.T.C.S.; P.A. Wayman, Ph.D.; E.F. Fahy, M.Sc., Ph.D.

2 GOVERNING BOARD OF THE SCHOOL OF CELTIC STUDIES

Chairman

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

Senior Professors

M. Ó Murchú, M.A., Ph.D.; P.Mac Cana, M.A., Ph.D.

Appointed Members

G. Mac Eoin, M.A., Ph.D.; S. Mac Mathúna, B.A., Ph.D. (Q.U.B.); M.P. Ní Chatháin, M.A., Ph.D. (Edin.); S. Ó Coileáin, M.A., Ph.D. (Harv.); P. Ó Fiannachta, M.A., Ph.D.; T. Ó Floinn, M.A.; S. Ó Tuama, M.A., Ph.D.; G. Stockman, M.A., Ph.D., Dip.Ed.; G. Victory, B.A., Mus.D.; T.K. Whitaker, D.Econ.Sc.

3 GOVERNING BOARD OF THE SCHOOL OF THEORETICAL PHYSICS

Chairman

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

Senior Professors

J.T. Lewis, B.Sc., Ph.D; L. Ó Raifeartaigh, M.Sc., Ph.D.

Appointed Members

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

4 GOVERNING BOARD OF THE SCHOOL OF COSMIC PHYSICS

Chairman

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

Senior Professors

P.A. Wayman, Ph.D.; L. O'C. Drury, B.A., Ph.D.

Appointed Members

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

5 ADMINISTRATIVE STAFF

Registrar

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

Senior Clerk

Maura Devoy, B.A.

Accounts Clerk

Mary A. O'Rourke, B.A.

Clerks

Angela Stubbs; Noreen Granahan; Caitríona Tubridy (on career break); Desmond Pender; Eibhlín Nic Dhonncha.

II - Annual Report of the Governing Board of the School of Celtic Studies for the year ending 31 December 1988, adopted at its meeting on 12 May 1989

1. STAFF AND SCHOLARS.

Professors Emeriti:

D.A. Binchy, James Carney.

Senior Professors:

Máirtín Ó Murchú (Director), Proinsias Mac Cana, Brian Ó Cuív (retired 20 November).

Professor:

Heinrich Wagner (died 11 September).

Assistant Professors:

Pádraig de Brún, Fergus Kelly, Rolf Baumgarten, Mícheál Ó Siadhail (career break from 1 October 1987).

Research Assistant:

Malachy McKenna

Assistant (part-time):

Nessa Doran

Junior Research Assistant:

Pádraig Ó Machaín (to 30 September).

Librarian Executive:

Máire Breatnach (retired 29 February).

Secretary/Publications Officer:

Máire Uí Chinnseala

Clerical Staff:

Karen Elson (resigned 1 July)

Temporary Library and Bibliographical Personnel:

Teresa Costelloe, Thomas Kearns, Brendan Teeling (appointed 17 November by arrangement with FÁS).

Scholars:

James Galvin (to 30 September); Aidan Breen, Kaarina Hollo, Colin Ireland, Seán Ua Súilleabháin, Jürgen Uhlich; Ursula Marmé, Pádraig Ó Macháin (from 1 October).

Research Associates:

Dr Michael Lapidge, Cambridge University, Dr Cathal Ó Dochartaigh, Bangor, Wales, Dr Richard Sharpe, Oxford University (appointed 18 November).

Visiting Research Associate:

Dr Mark Scowcroft, University of Virginia (to August).

Visitors to the School;

Aoife Nic Ghiollamhaith, M.A. (February to June), Dr Erich Poppe, University of Marburg, (August - September), Dr Nancy Stenson, University of Minnesota, (June to August), Dr Melita Cataldi, University of Turin (October).

2. RESEARCH AND EDITING

Professor Máirtín Ó Murchú worked on proofs of his forthcoming volume East Perthshire Gaelic and continued preparatory work on West Perthshire Gaelic. An article entitled 'Diglossia and Interlanguage Contact in Ireland' was accepted for publication in Language and Curriculum. See also §§6, 8(a).

Professor Proinsias Mac Cana worked on: (i) aspects of Old and Middle Welsh syntax; (ii) on an edition of Fled Bricrenn and (iii) the Early Irish Immacallam in dá Thuarad. The following articles were accepted for publication: (i) 'Word-order in Old Irish and Middle Welsh: an analogy' for a festschrift to Eric P. Hamp; (ii) 'On the uses of the conjunctive pronouns in Middle Welsh' for a festschrift to T. Arwyn Watkins. See also §§6, 8(d) 8(e).

Professor Brian Ó Cuív continued research on various aspects of Irish Language and literature. Works brought to an advanced stage of preparation include (i) an edition of two Irish versions of the Old Testament Book of Proverbs, those of William Bedell and Peadar Ua Laoghaire, and (ii) a chapter on 'Irish language and literature, 1845-1921' for A New History of Ireland Vol. VI. The following items were completed for publication: 'An ornamental device in Irish verse' (for Éigse 23), 'Two religious poems in Irish', '"Bróga ar nós Polónia"', and several book reviews (for Celtica 20), and 'Vowel hiatus in Early Modern Irish' (for a festschrift in honour of Eric P. Hamp). Editorial Work on Celtica xx, was brought to its final stages. See also §§6, 8 (e).

Professor Heinrich Wagner who died on 11 September had been working on the preparation of articles for publication in Zeitschrift für Celtische Philologie.

Dr Pádraig de Brún continued work on the Irish MSS in TCD, supervised and edited the preparation of catalogues of MSS in the National Library of Ireland, University College Cork and at Madison-Wisconsin. He prepared for press and completed his guide to locations of Irish MSS - Lámhscríbhinní Gaeilge: Treoirliosta. The following articles were accepted for publication: Bíobláir á chosaint féin' and 'The Irish Society's Bible teachers, 1818-27 V' (Éigse); 'Lament for Garret Pierse of Aghamore, slain at Liscarroll, 1642' [with John A. Pierse] (Kerry Archaeological and Historical Society Journal). See also §§7, 8(e).

Dr Fergus Kelly saw A Guide to Early Irish Law through the final stages of production. He commenced work on The Early Irish Farm: the evidence of the law-texts for the Early Irish Law Series and supervised Colin Ireland's edition of Senbríathra Fíthail for the above series. See also §§3, 8(e).

Mr. Rolf Baumgarten worked on the Bibliography of Irish Linguistics and Literature 1972-86. He edited and produced Scéla Scoil an Léinn Cheiltigh / Newsletter of the School of Celtic Studies no. 2; revised previously written and published (1968-) articles for Kindlers Neues Literatur Lexikon (1988-); acted as co-editor of Ériu. He instructed and supervised FÁS personnel (Teresa Costelloe, Thomas Kearns, Brendan M. Teeling) and began computerized indexes (with Brendan Teeling) to Celtica vols 1-20. See also §§ 6, 8(b), 8(e).

Dr Malachy McKenna continued work on The Spiritual Rose and prepared an article entitled 'Conjugation of the verb in East Ulster Irish' for publication. He began work on a register of School of Celtic Studies academic personnel for the period 1940-1990. See also §§6, 8(c), 8(e).

Mrs. Nessa Doran (Nessa Ní Shéaghdha) corrected a computer print-out of Catalogue of Irish MSS in the National Library of Ireland Fasc. XII (mss G 600-G 699) and described mss G 703-G 731, G 774-G 854 for Fasc. XIII An article entitled 'Irish Scholars and Scribes in Eighteenth-century Dublin' was accepted for publication in Eighteenth-century Ireland. See also §§6,7.

Pádraig Ó Macháin, whose period as Junior Research Assistant expired on 30 September, was appointed a scholar from 1 October. He completed work on his Ph.D. thesis on the Poems of Fearghal Óg Mac an Bhaird and continued work on a Catalogue of Irish MSS in Mount Melleray Abbey, Co. Waterford. Work on the revision of the glossary for Professor K.H. Jackson's edition of Aislinge Meic Con Glinne progressed. See also §6.

Mr. James Galvin submitted his thesis on 'The Syntax of the Article in Old Irish' to the National University of Ireland and was awarded the M.A. Degree.

Dr Aidan Breen submitted his thesis De XII abusivis to Trinity College Dublin and was awarded the degree of Ph.D. in June. He worked on a critical edition, with Introduction, Commentary and Indexes, of Aileran Interpretatio mystica ac moralis See also §8(e).

Miss Kaarina Hollo continued work on an edition of Loinges Mac nDuil Dermait from YBL.

Dr Colin Ireland continued work on his edition of Bríathra Flainn Fína for the Early Irish Law Series. The following articles were accepted for publication: 'Some Analogues of the O.E. Seafarer from Hiberno-Latin Sources' (Neuphilologische Mitteilungen) and 'Aldfrith of Northumbria and the Irish Genealogies' (Celtica) See also §§6, 8(e).

Dr Seán Ua Súilleabháin worked on: (i) the verbal system of the West; (ii) Plunket's seventeenth century Latin-Irish Dictionary; (iii) the Bardic poem 'Abair riom, a Éire ógh'. The following articles and reviews were accepted for publication: (i) Sgáthán an Chrábhaidh, foinsí an aistriúcháin' (Éigse xxiv); (ii) 'Deilbhíocht Bhriathra an Tarna Réimniú i nGaeilge Iarthar Mhúscraí'; Reviews: Séadna (ed. Ciarán Ó Coigligh); Bás Cearbhaill agus Fearbhlaidhe (ed. Siobhán Ní Laoire) Celtica xx. See also §8(e).

Mr. Jürgen Uhlich continued work on 'The morphology of compound personal names in Old Irish' for a Ph.D. thesis. See also 6.

Miss Ursula Marmé worked on the semantic value of the preverb in the Old Irish glosses.

Dr R. Mark Scowcroft of the Department of English, University of Virginia, completed his study of Leabhar Gabhála and began to write a book entitled The Hand and the Child: A Study in Narrative. An article entitled 'Leabhar Gahbála, Part II: The Growth of the Tradition' was accepted for publication in Ériu xxxix.

3. STATUTORY PUBLIC LECTURE

A Statutory Lecture entitled 'Early Irish Farming: The evidence of 7th-8th century law-texts' was delivered by Dr Fergus Kelly at University College, Dublin on 18 November.

4. SEMINARS

Professor Proinsias Mac Cana held a weekly seminar commencing 16 February on Fled Bricrenn.

Professor Proinsias Mac Cana and T. Arwyn Watkins held a weekly seminar commencing 18 February on Culhwch ac Olwen.

Dr Colin Ireland held a weekly seminar commencing 18 October on 'The Old Irish Bríathra: Wisdom ascribed to Fíthal and Flann Fína'.

5. TIONÓL

The annual Tionól was held on 25-26 March for University and College staff and research workers. The following papers were read:

Damien Ó Muirí	Gender of Monosyllabic Nouns in Old Irish
Donall Ó Baoill	Athruithe Fuaime agus Dátú i nGaeilge
Aidan Breen	The date, provenance and authorship of the pseudo-patrician canonical texts (Syn. I and II Patricii)
Colin Ireland	The Old Irish Bríathra
Iosóld Ní Dheirg	Foclóir Saincheirde ó Chontae Mhaigh Eo

Liam Mac Mathúna	:	Multi-referential patterns within the topographical lexicon of Irish
T. de Bhaldraithe	:	Foclóir an Phluincéadaigh mar fhoinse d'fhoclóirithe
Anthony Harvey	:	Compiling a Database and Dictionary of Celtic Latin
Máirtín Ó Briain	:	Diarmait mac Cerbaill agus na gcúigí in Acallam na Senórach
Alan Harrison	:	The Battle of the Books: The publication of Dermot O'Connor's translation of Keatings History
B. Ó Madagáin	:	The lullaby in Irish and Scottish Gaelic: a charm to protect the baby
Niall Buttimer	:	Oidheadh Chloinne Uisneach: New Lamps for Old?

6. EXTERNAL ACTIVITIES

Professor Máirtín Ó Murchú reviewed C. Nic Pháidín Cnuasach Focal ó Uíbh Ráthach on Radio na Gaeltachta in March; he read a paper on ' Contrasts of quantity in complex syllable nuclei: data from Perthshire Gaelic' at the Conference of the British Association of Academic Phoneticians held in Dublin in March. He attended the Maynooth Colloquium on Bilingualism and Language Minorities in May and read a paper on 'Diglossia and Interlanguage Contact in Ireland'.

Professor Proinsias Mac Cana was re-elected a member of the Keltische Kommission of the Austrian Academy of Sciences for the period 1 April 1988 to 31 December 1992; co-opted again to the Board of the Institute of Irish Studies, Queen's University Belfast for a three-year period commencing 1988-89; elected a member of the Rhŷs Trust, Oxford University; spent the Fall semester as Visiting Professor at Harvard University. In March he attended the Celtic Studies Conference at Nagoya, Japan where he delivered a lecture on 'The concept of the centre in Celtic ideology' and in Tokyo he lectured on 'Irish literary tradition' to Japan-Ireland Literary Society in the Irish Embassy. He delivered the O'Donnell Lecture on 'Centres in search of a circumference: further notes on Celtic ideology' at Oxford University in May; lectured on 'Ireland and Wales: medieval literary connections' at the Merriman colloquium in Cardiff in June and lectured on 'Literary connections between Ireland and Scotland in the middle ages' at the Irish Studies Summer School in Magee College Derry in July.

Professor Brian Ó Cuív attended the annual colloquium of the Henry Sweet Society in Oxford, 27-29 September, and a colloquium on 'Linguistics in the Middle Ages: a cross-cultural view', also in Oxford, 29-30 September; at the latter he read a paper on 'Linguistic Study and Teaching in Medieval Gaelic Ireland'. He joined the Editorial Board for the Corpus Apocryphorum Hiberniae publication project of the Irish Biblical Association and was chosen as Chairman. In March and May he broadcast on Radio na Gaeltachta two talks in a series on modern Irish history: 'Athbheochan chultúrtha agus an náisiúnachas nua in Éirinn: 1880-1916' and 'An Ghaeilge 1922-1966'. As a special examiner to the University of Edinburgh he read a dissertation on 'Poems by Fearghal Óg Mac an Bhaird' presented for the degree of Ph.D. by Pádraig O Macháin.

Mr Rolf Baumgarten represented (with Eibhlín Nic Dhonncha) the School of Celtic Studies (under the Dublin Institute for Advanced Studies label) at the Frankfurt Book Fair in October and attended seminars on 'Publishing' (CLÉ) and 'dBase IV'.

Dr Malachy mcKenna read a paper entitled 'Analytic Conjugation in Celtic and Basque: from inflection to periphrasis' at the Workshop on typology of languages of Europe held in Rome in January.

Mrs Nessa Doran (Nessa Ní Sheaghdha) lectured at: (i) the International Summer School in University College, Dublin and (ii) at the Institute of Irish Studies Summer School held in Trinity College, Dublin in July. She delivered a lecture entitled 'Irish scholars and scribes in eighteenth-century Dublin' to the Royal Society of Antiquaries of Ireland on 22 September.

Dr Colin Ireland attended the Modern Language Association Conference in New Orleans in December and read a paper entitled 'The Literary Legacy of Aldfrith of Northumbria'.

Mr Jürgen Uhlich attended seminars at Trinity College Dublin on 'Bretha Nemed' and 'Continental Celtic' during Hilary and Michaelmas terms.

7. CATALOGUING OF IRISH MANUSCRIPTS

Cataloguing of Irish manuscripts progressed under the general editorship of Pádraig de Brún:

National Library of Ireland: Nessa Ní Shéaghdha worked on fasciculi XIII and XIV of the catalogue and on the revision of fasciculus XII for publication.

Trinity College, Dublin: Pádraig de Brún and Aoibheann Nic Dhonnchadha continued the recataloguing of the collection.

Other collections: C.G. Buttimer, Catalogue of Irish manuscripts in the University of Wisconsin-Madison, and B. Ó Conchúir, Clár lámhscríbhinní Gaeilge Cholaiste Ollscoile Chorcaí: cnuasach Uí Mhurchú, were accepted for publication pending revision.

8. PUBLICATIONS

(a) Works in course of printing

Uraicecht na Ríar edited by Liam Breatnach

Catalogue of Irish MSS in National Library of Ireland Fasc. X compiled by Nessa Ní Shéaghdha.

A Welsh Bestiary of Love edited by Graham C.G. Thomas

Aislinge Meic Con Glinne edited by K.H. Jackson

East Perthshire Gaelic by Máirtin Ó Murchú

A Guide to Early Irish Law by Fergus Kelly

Celtica XX edited by Brian Ó Cuív

Lámhscríbhinní Gaeilge: Treoirliosta le Pádraig de Brún

(b) Books published by the Institute

Uraicecht na Ríar (E.I.L.S. vol. II)
ed. Liam Breatnach. pp. xii + 189. IR£16. ISBN 0 901282 89 8

Catalogue of Irish MSS in the National Library of Ireland
Fasc. X. MSS G434-G500.
Nessa Ní Shéaghdha. pp. 140. IR£15. ISBN 0 901282 85 5

Lámhscríbhinní Gaeilge: Treoirliosta
Pádraig de Brún. pp. 101. IR£6. ISBN 0 901282 97 9

A Welsh Bestiary of Love (M.M.W.S. Vol. IX)
ed. Graham C.G. Thomas. pp. xliii + 83. IR£8.
ISBN 0 901282 90 1

Scéala Scoil an Léinn Cheiltigh / Newsletter of the School of Celtic Studies, no., 2
ed. Rolf Baumgarten. pp. 36. No charge. ISSN 0790-9853.

(c) Books published outside the Institute

Proinsias Mac Cana (co-editor)

Ériu xxxix. pp. 204.
Royal Irish Academy.
Les Traditions celtes (Editions Robert Laffont, Paris), translation of Celtic Mythology.

Rolf Baumgarten (co-editor)
Ériu xxxix. pp. 204
Royal Irish Academy.

Malachy McKenna
A Handbook of modern spoken Breton. pp. vii + 310.
Niemeyer, Tübingen

(d) Reprint

The Irish of West Muskerry, Co. Cork by Brian Ó Cuív

(e) Contributions to periodicals and other publications

Máirtin Ó Murchú
Historical Overview of the Position of Irish
The Less Widely Taught Languages of Europe ed. L. Mac Mathúna N. French, E. Murphy (Dublin: IRAAL 1988) 77-88.

also in
Aspects of Bilingual Education, ed. M.W. Ó Murchú and H. Ó Murchú (Dublin: Bord na Gaeilge, 1988) 1-6.

Proinsias Mac Cana
Placenames and mythology in Irish tradition: places, pilgrimages and things
Proceedings of the First North American Congress of Celtic Studies, Ottowa 1986, ed Gordon W. Maclennan (Ottowa 1988) 319-41.

Myth into literature in early Ireland
Myth et folklore celtiques et leurs expressions littéaires en Irlande, Colloque 12-13 déc. 1986, Société Francaise d'Etudes Irlandaises, Université de Lille III, ed. R. Alluin et B. Escarbelt (Univ. de Lille III, [1988]) 31-43.

Review of J.F. Nagy The Wisdom of the outlaw
The Canadian Journal of Irish Studies 14, no. 1 (July 1988) 86-8.

Review of M. Lapidge, D. Dumville (eds) Gildas: new approaches in History of Religions (University of Chicago) 28, 2 (Nov. 1988).

Brian Ó Cuív
An item relating to the legent of Labraid Loingsech
Ériu xxxix 75-8

Pádraig de Brún
Dhá bhlogh de theagasc críostaí - ó ré Eilíse I (?)
Celtica xix 55-8.

Tralee voters in 1835
Kerry Archaeological & Historical Society Journal
19 (1986 [1988]) 73-9

Fergus Kelly
An Old Irish text in court procedure
Peritia 5 (1986 [1988]) 74-106.

Rolf Baumgarten
D. A. Binchy: a bibliography
Peritia 5 (1986 [1988]) 468-77.

The founding of the School of Celtic Studies
Newsletter 2 (1988) 7-8.

Irish Studies theses, 1987/88
ibid. 24-9.

Malachy McKenna
Heinrich Wagner (1923-88): an appreciation
Newsletter of the School of Celtic Studies no. 2 (1988) 10-11.

Aidan Breen
A new Irish Fragment of the Continuatio to Rufinus - Eusebius historia ecclesiastica
Scriptorium (1987 [1988]) 41-2

Colin A. Ireland
Boisil: An Irishman Hidden in the Works of Bede
Peritia 5 (1986) 400-03.

Seán Ua Súilleabháin
Review of Séadna by Peadar Ua Laoghaire
(ed. Liam Mac Mathúna) 1987.
Comhar (Feabhra 1988) 31-2.

III - Annual Report of the Governing Board of the School of Theoretical Physics for the year 1988 adopted at its meeting on 28 September 1989

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

Staff:

Senior Professors:

John T. Lewis, Director from 1 January 1975; James R. McConnell, retired 25 February; Lochlainn S. O'Raifeartaigh.

Assistant Professor:

G. Raggio, to 31 December.

Librarian-Executive:

E. R. Wills.

Secretary:

M. Matthews; on career break from 6 August.

Professors Emeriti:

John L. Synge; James R. McConnell from 26 February.

Scholars:

M. Vandyck (Belgium) left 30 September; W. Cegła (Poland); N. Gorman (Ireland); T. C. Dorlas (Netherlands); J. Balog (Hungary); M. P. Tuite (Ireland) on leave of absence from 1 October; L. G. Fehér (Hungary) from 1 October; R. Werner (Fed. Rep. Germany) from 1 October.

Research Associates:

Re-appointed to 31 December 1990:

TCD: D. J. Bradley, R.K. Dodd, P.S. Florides, B.K.P. Scaife, D. Weaire

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

St. Patrick's Coll. Maynooth: B. Dolan, C. Nash, A. O'Farrell, J.A. Slevin, J. Spelman, D.H. Tchrakian

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

DIT Kevin St: T. Garavaglia, B. Goldsmith, M.J. Tuite

DIT Bolton St: P. Houston

NIHE-D: E. Buffet, J. Burzlaff, D. Heffernan

NIHE-L: R.H. Critchley, J. Kinsella, B. Lenoach

Carlow RTC: D. Ó Sé

Dept of the Environment: J.M. Golden

Open University: A.I. Solomon

Oxford University: R.C. Flood

UC, Irvine: P. McGill

New appointments, to 31 December 1990:

DIT Kevin St: J. Burns

NIHE-D: M. Barman

Cork RTC: M. Vandyck

Visiting Scientists:

A. Amann (Zurich) 28 July - 29 Aug.; H. Araki (Kyoto) 11-15 July; Sir M. Atiyah (Oxford) 13 June; M. van den Berg (Heriot-Watt) 4-6 Jan., 29 Aug. - 25 Sept.; A.I. Burshtein (Novosibirsk) 6-24 June; J.G.B. Byatt-Smith (Edinburgh) 21-22 Dec.; H.-M. Chan (Rutherford) 18 Ap.; J.S. Cohen (Eindhoven) 20 May; H.G. Dales (Leeds) 29-30 Mar.; P.P. Divakaran (Bombay) 11-19 July; J.S. Dowker (Manchester) 11 May; N. Duffield (Heidelberg) 28 Nov. - 3 Dec.; G. Ellis (UCG) 29-30 Mar.; A.C. van Enter (Haifa & Austin TX) 20 June - 8 July; D.E. Evans (Swansea) 18-22 Ap., 13-27 June; G.W. Ford (Ann Arbor) 26 June - 30 July; P. Forgács (Budapest) 3 June - 1 July; G.A.C. Graham (Simon Fraser) 14 Sept. - 31 Aug. 1989; M.B. Green (Queen Mary, London): 10 May; P. Horváthy (Metz & Avignon) 3-18 May, 22-29 Sept, 2-16 Dec.; C. King (Cornell) 8-22 Sept., 21-31 Dec.; S.D. Mathur (Bombay) 19-26 June; R.F. O'Connell (Baton Rouge) 13-20 July; D. O Mathuna (Boston); D. Pottinger (IBM, Winchester (UK)) 28-31 Mar.; J. Rayski (Krakow) 13-20 Sept.; B. Sredniawa (Krakow) 16 Nov. - 7 Dec.; J.F. Toland (Bath) 21-22 Dec.; A. Wipf (MPI Munich) 12 June - 16 July; J.B. Zuber (Saclay) 28-30 Nov.

2. GENERAL

Dr E. de Valera presented his father's and grandfather's collection of scientific books to the School Library, on permanent loan, subject to certain conditions. The books (approx. 1200) include some rare works, and some interesting annotations.

Prof. McConnell retired on 25 February, and the title Professor Emeritus was conferred on him; Ms Matthews went on a career break on 6 August.

3. RESEARCH AND STUDY

Primary areas -

(a) Theoretical Particle Physics

Prof. O'Raifeartaigh continued work on 2-dimensional conformal invariance and on the structure of Kac-Moody algebras with N. Gorman and W. McGlinn (Notre Dame), giving a unified derivation of the centre-terms for Virasoro (conformal) and KM-algebras, and a systematic description of the Weyl group of automorphisms. He commenced work on string theory with J. Balog, L. Féher, and with P. Forgács (Budapest) and A. Wipf (MPI, Munich), giving an algebraic (stability algebra) description of string theory, and pointing out the difficulties with unitarity for non-compact group manifolds. He completed work on quantum mechanical supersymmetry in self-dual gauge-field backgrounds, with L. Féher and P. Horváthy (Avignon). In addition to the collaboration with Prof. O'Raifeartaigh and Dr. McGlinn mentioned above, Dr. Gorman commenced a study of the work of J. B. Zuber on conformal field theory.

Drs. Balog and M.P. Tuite collaborated in a study of Moore's Atkin-Lehner symmetric string models which ensure a non-trivial zero cosmological constant. They showed that for a very general class of lattice-compactified models such a symmetry violates basic physical principles, except for a special case in 2 space-time dimension.

Dr. Tchrakian worked in four main areas, viz.,
1) with G.M. O'Brien and R. Kerner (Paris, P. et M. Curie), on compactification (spontaneous), using generalised Yang-Mills-Higgs systems.
2) with G.M. O'Brien, on the construction of an SO(4) instanton of a non-Abelian Higgs model.
3) with Z.-Q. Ma (Beijing), on generalised gauge field systems on CP^n (and S^{2n}).
4) with R. Werner and G. Savvidy (Erevan), on (non) integrability of generalised Yang-Mills systems.
5) with H.J.W. Mueller-Kirsten (Kaiserslautern) on semiclassical quantisation around a generalised soliton.

Dr. Dolan studied extended objects as fundamental quantities in particular relativistic membranes as extensions to relativistic strings.

Dr. M.J. Tuite continued his studies of thermal field theories, and their application to gauge theories - in particular he studied the real-time formulation of such theories in the case of equilibrium. He began a study of the new techniques for the investigation of the non-equilibrium behaviour of quantum fields.

(b) Classical Statistical Mechanics

(i) Brownian Motion and Relaxation Phenomena

Prof. McConnell extended his nuclear magnetic relaxation studies to asymmetric molecules. In collaboration with A.I. Burshtein (Novosibirsk) he studied for gas mixtures and liquid solutions the effects of non-instantaneous molecular collisions on infrared and far-infrared spectra.

Prof. Scaife completed the ms. of his book on dielectrics and passed it to the publishers.

(ii) Phase Transitions in Lattice Systems

Dr. Solomon worked on applications of superalgebras to condensed matter, especially the theory of high-T_c superconductors. He also worked on the conventional Lie theory approach to many fermion systems.

(iii) Ferrofluids

Prof. Lewis and Dr. Dorlas collaborated with O. Penrose (Heriot-Watt) in the study of the statistical mechanics of ferrofluids.

(c) Quantum Statistical Mechanics

(i) Large Deviations

There were several new developments in the application of large deviation methods to quantum statistical mechanics.

Dr. Pulè and N. Duffield (UCD) combined the method of Cegła, Lewis, and Raggio with Bogoliubov's approximating hamiltonian method to obtain variational principles for the free-energy of inhomogeneous mean-field models. They used their method to solve the full BCS model and the Overhausen model. Dr. Raggio used their method to solve the inhomogeneous spin-boson model. This was an important advance.

Dr. Raggio (with D. Petz (Budapest) and A, Verbeure (Leuven)) investigated Varadhan's asymptotics in a non-commutative setting. On his return to Dublin he began a collaboration with Dr. Werner which resulted in a complete variational theory for non-commutative inhomogeneous mean-field systems. This is an elegant method of great power.

Prof. Lewis continued his collaboration with Dr. Dorlas and Dr. Pulè; together they succeeded in overcoming the technical problems they had encountered in proving second-level large deviation principles. They completed their proof of the Yang-Yang formula for the free-energy of bosons in 1-dimension with a delta-function interaction and Dr. Dorlas began apolying the method to other Bethe-ansatz problems. Together with M. van den Berg (Heriot-Watt) they completed their proof of a variational formula for the pressure in the perturbed mean-field model of interacting boson systems.

(ii) Quantum Langevin Equation

Prof. Lewis continued his collaboration under the NSF International Programme with G.W. Ford (Ann Arbor) and R.F. O'Connell (Baton Rouge) on applications of the quantum Langevin equation.

(d) Quantum Electronics

Dr. Garavaglia used the methods of quantum field theory to study quantum noise in electrical systems. He studied nonlinear Lagrangian methods, using the origin of squeezed quantum states, and attempted to relate this work to nonlinear gluon interaction and the origin of squeezed boson particle distributions in high energy scattering. Towards this end, he defined the characteristic function for the energy operator associated with a finite temperature squeezed quantum state, and thus found the related boson probability distribution.

Secondary areas -

(e) General Relativity and Gravitation

Dr. Vandyck continued his study of space-time symmetries in supergravity. He devised a formalism to translate the space-time results he had derived the previous year into superspace framework. This underlined the geometrical interpretation of his calculations, and showed that a space-time symmetry in supergravity may be considered as an ordinary gauge-field symmetry in superspace.

Dr. Dolan studied Ashtekar's canonical transformation in general relativity.

(f) Applied Mathematics

Prof. Graham worked in continuum mechanics, and on boundary value problems in elasticity and viscoelasticity.

Dr. Burzlaff continued his study of solitons and soliton-like objects. He investigated the relevance of optical solitons, and analysed a particular linear eigenvalue problem, with a view to answering questions about the injection of optical solitons into fibres. He also studied soliton-like objects, such as vortices in superconductors, and cosmic strings.

(g) Pure Mathematics

Dr. Goldsmith continued his studies of the application of lifting techniques to realization problems for some classes of Abelian groups.

Research Reports

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

DIAS-STP-88-01: J.T. LEWIS, V. A. ZAGREBNOV, & J.V. PULÈ: The large deviation principle for the Kac distribution.

-02: T. C. DORLAS & A.C. van ENTER: Example of a renormalization group fixed point peculiarity.

-03: G.A. RAGGIO: The free energy of the spin-boson model.

-04: N. GORMAN & T.D. SPEARMAN: Equivalence of stabilizing conditions for inverse problems.

-05: S. SEN & M.P. TUITE: A string motivated approach to the relativistic point particle.

-06: D.M. HEFFERNAN, J. O'GORMAN, J. McINERNEY, & P. PHELAN: Nonlinear dynamics of self-pulsing external cavity semiconductor injection lasers.

-07: J. McCONNELL: The theory of nuclear magnetic relaxation in liquids.

-08: T. GARAVAGLIA: Finite temperature field theory and quantum noise in inductively coupled LRC circuits.

-09: M. van den BERG, T.C. DORLAS, J.T. LEWIS, & J.V. PULÈ: A perturbed mean field model of a boson gas and the large deviation principle.

-10: M. van den BERG, J.T. LEWIS, & J.V. PULÈ: The large deviation principle and some models of an interacting boson gas.

-11: J. BURZLAFF: The optical soliton contents of some spectral input pulses.

-12: V. P. BELAVKIN: Multiquantum systems and point processes, I.

-13: N.G. DUFFIELD & J.V. PULÈ: A new method for the thermodynamics of the B.C.S. model.

-14: A. MONTORSI, M. RASETTI, & A.I. SOLOMON: Self-consistency and supersymmetry in a many fermion system.

-15: N.G. DUFFIELD & J.V. PULÈ: Thermodynamics and phase transitions in the Overhausen model.

DIAS-STP-88-16: Zh.-Qi MA & D.H. TCHRAKIAN: Dimensional reduction of higher-order topological invariants: the case CP^n.

-17: Zh.-Qi MA *et al.*: Gauge field systems on CP^n.

-18: J. McCONNELL: Further theoretical investigations on nuclear magnetic spin-rotational relaxation.

-19: M. van den BERG & J.T. LEWIS: Convex optimization and condensation in the free boson gas.

-20: G. O'BRIEN & D.H. TCHRAKIAN: A spherically symmetric SO(4) instanton of a non-abelian Higgs model in 4-dimensions.

-21: T. N. SHERRY & D.H. TCHRAKIAN: On the classical properties of gaugefield-Higgs models descended from generalized Yang-Mills systems.

-22: J.T. LEWIS: Probabilistic aspects of statistical mechanics.

-23: E. BUFFET & J.V. PULÈ: Gelation: The diagonal case revisited.

-24: M. VANDYCK: On the problem of space-time symmetries in the theory of supergravity. Part III.

-25: N. GORMAN, L. O'RAIFEARTAIGH, D. WILLIAMS, & W. McGLINN: A unified approach to the computation of central terms in Kac-Moody and Virasoro algebras.

-26: B. GOLDSMITH: On endomorphism rings of non-separable Abelian p-groups.

-27: G.W. FORD, J.T. LEWIS, & R.F. O'CONNELL: The quantum Langevin equation.

-28: J. McCONNELL: Theory of nuclear magnetic spin-rotational relaxation for asymmetric molecules.

-29: G.W. FORD, J.T. LEWIS, & R.F. O'CONNELL: Dissipative quantum tunneling: Quantum Langevin equation approach.

-30: M. FANNES, J.T. LEWIS, & A. VERBEURE: Symmetric states of composite systems.

-31: G.W. FORD, J.T. LEWIS, & R.F. O'CONNELL: Memory effects in transport theory: an exact model.

-32: G.W. FORD, J.T. LEWIS, & R.F. O'CONNELL: Comment on the exact calculation of the partition function for a quantum oscillator interacting with the radiation field.

-33: G.W. FORD, J.T. LEWIS, & R.F. O'CONNELL: Quantum oscillator in a blackbody radiation field, II. Direct calculation of the energy using fluctuation-dissipation theorem.

DIAS-STP-88-34: G. D'ARIANO, M. RASETTI, J. KATRIEL, & A.I. SOLOMON: Multiphoton and fractional-photon squeezed states.

-35: B. DOLAN: A Hamiltonian formalism for bosonic membranes.

-36: T. DORLAS: Large deviations and the Bethe-Ansatz soluble model.

-37: D. PETZ, G.A. RAGGIO, & A. VERBEURE: Asymptotics of Varadhan-type and the Gibbs variational principle.

-38: J. McCONNELL: Erwin Schroedinger Austro-Irish Nobel Laureate.

-39: T. DORLAS, J.T. LEWIS, & J.V. PULÈ: The Yang-Yang thermodynamic formalism and large deviations.

-40: J. BALOG & M.P. TUITE: The failure of Atkin-Lehner symmetry for lattice compactified strings.

-41: J. BALOG & L. O'RAIFEARTAIGH: Covariant light-cone algebra.

-42: T.C. DORLAS: The statistical mechanics of a Bethe Ansatz-soluble model.

-43: N. GORMAN, W. McGLINN, & L. O'RAIFEARTAIGH: Cartan-preserving automorphisms and the Weyl group of Kac-Moody algebras.

-44: N. GORMAN & T.D. SPEARMAN: Resonance pole determination in a quantum-mechanical model.

-45: J. BALOG, P. FORGÁCS, A. WIPF, & L. O'RAIFEARTAIGH: Consistency of string propagation on curved manifolds: an SU(1,1)-based counter-example.

-46: A. MONTORSI, M. RASETTI, & A.I. SOLOMON: Superalgebraic solution to the mean-field Hubbard model.

-47: A.I. BURSHTEIN & J. McCONNELL: Spectral estimation of finite collision times in liquid solutions.

-48: R.F. WERNER: An application of Bell's inequalities to a quantum state extension problem.

-49: G.A. RAGGIO & R.F. WERNER: Quantum statistical mechanics of general mean field systems.

-50: J. McCONNELL: Rotational diffusion theory of nuclear magnetic spin-rotational relaxation.

-51: J. McCONNELL: Dublin Institute for Advanced Studies: School of Theoretical Physics.

-52: R.F. WERNER: Inequalities expressing the Pauli principle for generalized observables.

-53: W. CEGŁA & M. KLIMEK: Criterion for the large deviation principle.

4. SEMINARS, REVIEW LECTURES, SERIES, COURSES

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

Seminars or lectures were given also at the Journals' Club and other Irish venues, by the School's members and visitors.

(a) Seminar and review lectures given at DIAS-STP:

Dr A. AMANN (Zurich): Group theoretical methods in algebraic quantum mechanics.

Prof. H. ARAKI (Kyoto): Wigner's theorem.

Sir Michael ATIYAH (Oxford): Yang-Mills fields.

Prof. H.-M. CHAN (Rutherford): Equations of motion for non-Abelian monopoles.

Dr J. S. COHEN (Eindhoven): Noise in semiconductor lasers.

Prof. D. D. DIVAKARAN (Bombay): Quantum symmetries - superselection rules and anomalies.

Prof. J. S. DOWKER (Manchester): Casimir effect around a cosmic string.

Prof. D. E. EVANS (Swansea): Critical phenomena and index of subfactors.

Dr P. FORGÁCS (Budapest): New heterotic strings in 10 dimensions.

Prof. C. KING (Cornell): Yang-Mills via stochastic differential equations.

Dr S. D. MATHUR (Bombay): Fusion coefficient characterization of two-dimensional conformally invariant field theory.

Prof. G. RAGGIO: Varadhan's asymptotic formula without large deviations: an example.

Prof. B. SREDNIAWA (Krakow): Beginnings of the theory of Brownian motion and fluctuations (Role of Smoluchowski and Svedberg).

Dr A. WIPF (Munich): Sphalerons, tunneling, and proton-decay.

Informal discussion, led by Prof. M. B. GREEN (Queen Mary Coll., London), on Strings.

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

The series of seminars on Probability and related topics was continued from the previous year; lectures were given as follows:

Prof. G. RAGGIO: The Gartner-Ellis-de Acosta theorem.

Dr T. DORLAS: Cluster expansions (3 lectures).

Dr. R. WERNER: An application of Bell's inequalities.

Prof. J. T. LEWIS began a (year's) course of lectures on Statistical Mechanics, for final year undergraduate and first-year graduate students.

(c) Contributions to the Journals' Club (Joint TCD-UCD-Maynooth-DIAS Meeting):

J. BALOG: Lattice classification of heterotic string theories.

The failure of Atkin-Lehner symmetry.

J. BALOG, N. GORMAN, M.P. TUITE, *et al.*: Reports on Munich Conference and St. Andrews' Summer School.

B. DOLAN: Relativistic supermembranes.

T. GARAVAGLIA: Squeezed quantum states and particle distributions.

L. O'RAIFEARTAIGH: Chester Meeting on Differential Geometry.

M.P. TUITE: A string motivated approach to point particles.

The absence of Atkin-Lehner symmetry in lattice compactified strings.

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

J. McCONNELL: Erwin Schroedinger: Austro-Irish Nobel Laureate. Dublin, Irish-Austrian Society, 14 April.

L. O'RAIFEARTAIGH: The importance of the path integral formulation of quantum mechanics. UCD Math. Soc. Inaugural Meeting, 20 Jan.

A world made of quarks. UCD Math. Phys Dept, 30 Nov.

Observable phases in quantum mechanics. NIHE-D, 1 Dec.

T. DORLAS: Renormalisation and critical phenomena. UCD, 14 April.

B. GOLDSMITH: Maximal order Abelian subgroups of symmetric groups. Galway, May.

G.A.C. GRAHAM: Asymmetric steady-state solutions for a crack in a visco-elastic field of pure bending. Irish Mechanics Soc. Meeting, Cork, 8 October.

5. ACTIVITIES OUTSIDE IRELAND

Prof. McCONNELL attended the Sixth Annual European Molecular Liquids Group (EMLG) Conference on "Reactive and Flexible Molecules in Liquids", at Nauplion (Greece), 23 Sept. - 2 Oct; he chaired meetings of committees during the conference.

Prof. LEWIS was an invited speaker at the Karpacz Winter School (Poland), 16-23 Jan. He visited Heriot-Watt University for discussions 29 Feb.-4 March. He attended a conference on Operator Algebras in Swansea, 3-6 May, as an invited speaker, and was an invited speaker at the conference "Mathematical Methods in Statistical Mechanics" at the Katholieke Univ., Leuven, 22-24 June. He represented the School at the IBM Schroedinger Lecture at Imperial Coll., London, 31 May; he visited Heriot-Watt for discussions 1-2 June, and the IBM Res. Labs, Winchester, for discussions, 3 June. He gave an invited lecture at the 17th Conference on Stochastic Processes in Rome, 27-30 June. He gave the IUPAP Public Lecture at the Congress of the Internat. Assoc. of Math. Physicists, 17-27 July. He took part in a workshop on Large Deviations at the Math. Inst. Oberwolfach, 31 July - 7 Aug. He attended a conference on Operator Algebras and their Applications in Swansea, 7-9 Oct., as invited speaker. He visited Kiev and Lwow as a guest of the Ukrainian Acad. Sciences, 10-26 Oct., and gave a seminar at the Inst. for Problems in the Transmission of Information of the Soviet Acad. Sciences, Moscow.

Prof. O'Raifeartaigh visited Cosener House (Rutherford Lab.) from 29-31 Jan., to attend the Meeting on "Berry Phase and Related Topics", and to Chair one of its sessions, and for discussions; he attended the XI Warsaw Symposium on "New Theories in Physics", 22-27 May, and the Zakopane Summer School (Poland), 1-10 June. He attended the IIIrd Symposium on Symmetries in Physics, Bregenz (Austria), 24-30 July, the XXIVth International Meeting on Particle Physics, Munich, 6-10 August, and the XVIIth Annual Conference on Differential Geometrical Methods in Physics, Chester, 14-18 August. He attended the XXIIth International Symposium on Particle Physics, Ahrenshoop (E. Germany), 17-21 Oct., and the Banach Workshop on "Gauge Theories of Fundamental Interactions", Warsaw, 22-30 October. Details of the lectures given at these Meetings by Prof. O'Raifeartaigh are set out the next sub-section.

Prof. Raggio was Visiting Professor at the Inst. Theor. Phys. of the Univ. Leuven for the 4-month period April to June. He attended the 9th Congress of the Internat. Association of Mathematical Physicists, Swansea, 17-27 July, and the 4th Workshop on Quantum Probability and Applications, Heidelberg, 26-30 Sept.

Dr. Vandyck visited Univ. Aberdeen 10-16 April for discussions and collaboration on mathematical aspects of supergravity with G. Hall, and to give a seminar. He visited Univ. Cath. de Louvain 16-22 June to give a lecture, and for collaboration with D. Speiser.

Dr. Dorlas was in the United States 19 March - 3 April, visiting Bell Labs 21 March for discussions with V. Elser and Rutgers Univ. 23 March for discussions with J.L. Lebowitz and with C. Maes, visiting and lecturing at Princeton Univ. 25 March, Univ. California at Irvine 31 March, and at Los Angeles 1 April (and for discussions with J. Chayes and L. Chayes), and at a Conference on Statistical Mechanics at Univ. California at Davis, 27-30 March. He attended and lectured at a Conference on Functional Integration and Applications, at Antwerp 28-29 June, and at the IAMP Congress, Swansea 17-27 July.

Dr. Gorman visited and lectured at Univ. Notre Dame 7-13 August, and attended the UK Inst. for High Energy Physics, at St. Andrews, 3-10 Sept.

Dr. M.P. Tuite attended the Cosener House Weekend String Theory Meeting at Rutherford Lab. 14-15 May, the UK Universities' Summer School at St. Andrews 24 Aug. - 7 Sept, and the Stefan Banach Workshop 15-30 Sept.

Dr. Tchrakian visited CERN 1-30 July, and Kaiserslautern 1-30 Aug.

Dr. M.J. Tuite attended the Workshop on Thermal Field Theories, at Case-Western Reserve Univ. 3-5 Oct.

Dr. Burzlaff attended and spoke at the International Conf. on "Solitons and Chaotic Behaviour in Optical Systems" in San José (USA) 6-7 Jan., and visited York Univ. (Canada) 11-12 Jan. and Yale Univ. 13-14 Jan. for talks. He visited Univ. Kaiserslautern 4-15 July, and again 12-23 December, giving a series of lectures on each occasion.

Dr. Balog was on leave from Oct.-Dec. at the Max Planck Institute, Munich, for collaborative work with P. Forgács and A. Wipf.

Dr. Dolan visited Glasgow Univ. for one week in August for discussions. He attended and lectured at the 9th UK Inst. for High Energy Particles, St. Andrews, 24 Aug. - 7 Sept., and the Stefan Banach Workshop, 15-30 Sept.

Dr. Garavaglia attended the Winter Meeting on Theoretical Physics at Rutherford Lab. 14-16 Dec.

Dr. Goldsmith visited the Univ. of Dar es Salaam for January and February, to give a series of staff seminars.

Seminars, Lectures, and Courses given abroad.

Prof. McCONNELL:

Lecture: Further theoretical investigations on spin-rotational relaxation. EMLG Conf.

Prof. J.T. LEWIS:

Lectures: Large deviations and statistical mechanics. Leuven Conf.

Large deviations in quantum statistical mechanics. 2 lectures, Karpacz Sch.

A tutorial on large deviations. Heriot-Watt.

The Yang-Yang trace formula. Swansea Conf., Moscow, Kiev.

Large deviations and the Yang-Yang trace formula. Rome Conf.

The paradox of relevance. Swansea Public Lect.

Large deviations in statistical mechanics. Oberwolfach Workshop.

The perturbed mean-field model of interacting bosons. Swansea Conf.

Large deviations and spin systems. Kiev.

Boson condensation. Lwow.

Prof. O'RAIFEARTAIGH:

Lectures: Weyl group for Kac-Moody algebras. Warsaw Sympos.

Manifest covariance in the light-cone-gauge of the bosonic string. Zakopane Summer School, Chester Conf.

Consistent string propagation on non-compact group manifolds: An SU(1,1)-counter example. Ahrenshoop Sympos.

Supersymmetric quantum mechanics in a self-dual gauge-field background. Bregenz Sympos.

Demystification of the Aharonov-Bohm effect. Banach Workshop.

Prof. RAGGIO:

Course: Statistical mechanics - exact results. Leuven.

Seminar: A large deviation technique in the statistical mechanics of quantum spin systems. Heidelberg.

Dr. VANDYCK:

Seminar: Space-time symmetries in N=1 and N=2 supergravity. Aberdeen.

Lecture: Superspace formalism and space-time symmetries in supergravity. Louvain.

Dr. DORLAS:

Lectures: The large deviation principle and a model of an interacting boson gas. Princeton, Irvine.

Renormalization of a simple hierarchical fermion model. Davis Conf., Los Angeles.

Large deviations and the Bethe Ansatz. Antwerp Conf.

The statistical mechanics of a Bethe Ansatz-soluble model. Swansea Conf.

Dr. GORMAN:

Lecture: Aspects of Kac-Moody and Virasoro algebras. Notre Dame.

Dr. TCHRAKIAN:

Lecture: Conformal invariant sigma-models in all even dimensions. Kaiserslautern.

Dr. BURZLAFF:

Lectures: The optical soliton content of some special input pulses. San José Conf.

The optical soliton eigenvalue problem. York, Yale.

Series of lectures: Group structure of gauge theories. Kaiserslautern, July.

Statics and dynamics of classical Yang-Mills-Higgs fields. Kaiserslautern, Dec.

Dr. DOLAN:

Lecture: A Hamiltonian approach to bosonic membranes. St. Andrews, Warsaw.

Dr. GOLDSMITH:

Lectures at Dar es Salaam: Endomorphism rings of Abelian groups.

Subgroups of the Baer-Specker group.

Transitive Abelian groups.

6. STATUTORY PUBLIC LECTURE

A Statutory Public Lecture under the auspices of the School was delivered by Professor J. T. LEWIS on 1 November in Trinity College, Dublin. The title was 'Understanding Phase-Transitions', and the lecture was illustrated by computer simulations, using a programme devised by Dr W. SULLIVAN.

7. SYMPOSIA

Two Mathematical Symposia were held during the year, 29-30 March, and 21-22 December. The attendance (41 in March, 45 in December) included professors, lecturers, and graduate students from the Irish universities and other third-level and research institutes, and from institutes abroad, and members of the scientific schools of DIAS.

Lectures were given as follows:

MARCH:

Review Lectures:

Prof. H. G. Dales (Leeds Univ.): Convolution algebras, semigroups and Laplace transforms.

Dr D. Pottinger (IBM): 3-D visualisation of scientific data.

Lectures:

Prof. A. G. O'Farrell (Maynooth): C^{∞} maps may increase C^{∞} dimension.

Dr M. Clancy (NIHED): Polar sets as critical submanifolds in compact symmetric spaces.

Prof. L. Beasley (Utah SU & UCD): Linear transformations on Boolean matrices.

Dr G. Ellis (UCG): Classification of maps.

Short Talks:

Prof. J. B. Twomey (UCC): Tangential boundary behaviour of the Cauchy integral.

Dr P. Dolan (Imperial Coll.): An interpretation of the Lanczos potentials in general relativity.

Mr P. Barry (Waterford RTC): Graphics standards and the teaching of mathematics.

Prof. J. T. Lewis: Counting without counting.

Dr A. I. Solomon (Open Univ. & DIAS): Supersymmetry in superconductivity.

Prof. J.N. Sheahan (Alberta & UCG): Applications of linear algebra to principal components analysis.

DECEMBER:

Review Lectures:

Prof. J.F. Toland (Bath): Topological degree theory for dynamical systems.

Prof. C. King (Cornell & Zurich): Knots.

Lectures:

Dr N.S. O Murchadha (UCC): When must stars collapse?

Dr R. Werner: An application of Bell's inequalities.

Dr J. G. Byatt-Smith (Edinburgh): Reflection of a solitary wave by a vertical wall.

Dr M. Klimek (UCD): Fractals.

Short talks:

Prof. F. Hodnett & Mr. T. Moloney (LU): Reformulation of the N-soliton solution of the Kdv equation.

Prof. J. Flavin (UCG): The method of cross-section for partial differential equations.

Prof. A. O'Farrell (Maynooth): Removable singularities.

Dr C. Nash (Maynooth): Topological quantum field theory.

8. WORKSHOP on STATISTICAL MECHANICS

A One-Day Workshop on Statistical Mechanics was held at DIAS on 4 January. The attendance was 8, and speakers and titles of lectures were:

Prof. G. Raggio: The approximating Hamiltonian method for the spin-boson model.

Dr N. Duffield (UCD): Thermodynamics of the full BCS model through large deviations.

Dr W. Cegła: Large deviation principle for product measures.

Dr J. V. Pulè (UCD & DIAS): Variational problems associated with the full BCS model.

Dr W. Sullivan (UCD & DIAS): Random walks on ordered graphs.

Dr M. van den Berg (Heriot-Watt): Entropy estimates and models of an interacting boson gas.

On a problem of Spitzer.

Prof. J.T. Lewis: A second-level large deviation principle and interacting boson models.

Dr T. Dorlas: A second-level large deviation principle and Kac potentials.

9. VISITORS

As in previous years, visitors from abroad came to the School for short or long periods, for discussions with School's members, to give seminars, and to avail of the School's library resources for their research work. For lectures given by Visitors, see §§ 4, 7, 8.

Short visits (up to one week) were made by

H. ARAKI (Kyoto), 11-15 July

Sir Michael ATIYAH (Oxford), 13 June

J. G. B. BYATT-SMITH (Edinburgh), 21-22 Dec.

H.-M. CHAN (Rutherford Lab.), 18 Ap.

J.S. COHEN (Philips Res. Lab., Eindhoven), 20 May

H.G. DALES (Leeds), 29-30 Mar.

J.S. DOWKER (Manchester), 11 May

G. ELLIS (UCG), 29-30 Mar.

M.B. GREEN (Queen Mary Coll., Lond.), 10 May

D. POTTINGER (IBM, Winchester), 28-31 Mar.

J. F. TOLAND (Bath), 21-22 Dec.

J. B. ZUBER (Saclay, Paris), 28-30 Nov.

Longer visits were made by

A. AMANN (ETH, Zurich), 28 July - 29 Aug.

M. van den BERG (Heriot-Watt), 4-6 Jan., 29 Aug. - 25 Sept.

A.I. BURSHTEIN (Novosibirsk), 6-24 June

P.P. DIVAKARAN (Bombay), 11-19 July

N. DUFFIELD (Heidelberg), 28 Nov. - 3 Dec.

A.C.D. van ENTER (Haifa & Austin, TX), 20 June - 8 July

D. E. EVANS (Swansea), 18-22 Ap. & 13-27 June

G.W. FORD (Ann Arbor), 26 June - 30 July

P. FORGÁCS (Budapest), 3 June - 1 July

G.A.C. GRAHAM (Simon Fraser, B.C.) 14 Sept. - 31 Aug. 1989

P. HORVÁTHY (Metz & Avignon), 3-18 May, 22-29 Sept., 2-16 Dec.

C. KING (Cornell), 8-22 Sept. & 21-31 Dec.

S. D. MATHUR (Bombay), 19-26 June

R. F. O'CONNELL (Baton Rouge), 13-30 July

D. O MATHUNA (Boston)

J. RAYSKI (Krakow), 13-20 Sept.

B. SREDNIAWA (Krakow), 16 Nov. - 7 Dec.

A. WIPF (MPI, Munich), 12 June -16 July

10. PUBLICATIONS

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

(1) Books:

Published:

J.M. Golden & G.A.C. Graham. Boundary value problem in linear viscoelasticity. Springer, 1 September 1988.

In the press:

B. K. P. Scaife. Principles of Dielectrics. Oxford, Clarendon Press: Monographs on the Physics and Chemistry of Materials.

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

None published.

(3) Contributions to periodical and other publications:

J. McConnell:

* Nuclear magnetic spectral densities for molecular models. Phys. Scripta 37 (1988), 401-406.

Theory of nuclear magnetic spin-rotational relaxation for asymmetric molecules. Physica 152A (1988), 309-327.

Erwin Schroedinger (1887-1961), Austro-Irish Nobel Laureate. Lect. to the Irish-Austrian Society, 14.4.88. RDS 1988, Occas. Papers Ir. Sci. Tech. no. 5, 13 pp.

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

Dissipative quantum tunneling: Quantum Langevin equation approach. Phys. Lett. 128A (1988), 29-34.

Quantum oscillator in a blackbody radiation field II. Direct calculation of the energy using the fluctuation-dissipation theorem. Ann. Phys. 185 (1988), 270-283.

Independent oscillator model of a heat bath: exact diagonalization of the Hamiltonian. J. statist. Phys. 53 (1988), 439-455.

J. T. Lewis:

* The large deviation principle in statistical mechanics and its application to the boson gas. 4 lects., M. Kac Sem. Amsterdam 1987. CWI 1988, 62 pp.

J. T. Lewis & G. A. Raggio:

* The equilibrium thermodynamics of a spin-boson model. J. statist. Phys. 50 (1988), 1201-1220.

W. Cegła, J.T. Lewis, & G. Raggio:

* The free energy of quantum spin systems and large deviations. Commun. math. Phys. 118 (1988), 337-354.

M. van den Berg, J. T. Lewis, & J. V. Pulè:

The large deviation principle and some models of an interacting boson gas. Commun. math. Phys. 118 (1988), 61-85.

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

The large deviation principle for the Kac distribution. Helv. phys. Acta 61 (1988), 1063-1078.

M. Fannes, J. T. Lewis, & M. Verbeure:

Symmetric states of composite systems. LMP 15 (1988), 255-260.

G. A. Raggio:

* A remark on Bell's inequality and decomposable normal states. LMP 15 (1988), 27-29.

The free energy of a spin-boson model. J. statist. Phys. 53 (1988), 565-581.

N. G. Duffield & J. V. Pulè:

A new method for the thermodynamics of the BCS model. Commun. math. Phys. 118 (1988), 475-494.

E. E. Mueller:

* Bose-Einstein condensation in dependence of the mean energy density. Ann. Phys. 184 (1988), 219-230.

T. C. Dorlas:

*Renormalization of a hierarchical ϕ^4_3 model. J. Phys. A: Math. Gen. 21 (1988), 1753-1758.

A. C. van Enter:

* One-dimensional spin-glasses, uniqueness and cluster properties. J. Phys. A: Math. Gen. 21 (1988), 1781-1786.

L. O'Raifeartaigh:

Gravitation and the unification of the fundamental forces. Ir. Astron. J. 18 (1988), 196-198.

L. O'Raifeartaigh & A. Wipf:

* WKB properties of the time-dependent Schroedinger system. Found. Phys. 18 (1988), 307-329.

P. A. Horváthy, L. O'Raifeartaigh, & J. H. Rawnsley:

* Monopole-charge instability. Inter. J. mod. Phys. A 3 (1988), 665-702.

Y. Fujimoto, A. Wipf, & H. Yoneyama:

Symmetry restoration of scalar models at finite temperature. Phys. Rev. 38D (1988), 2625-2634.

N. Gorman & T. D. Spearman:

* Equivalence of stabilizing conditions for inverse problems. Europhys. Lett. 5 (1988), 191-194.

* Resonance pole determination in a quantum-mechanical model. Nuovo Cim. 99A (1988), 741-752.

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

* Spin-connection generalized Yang-Mills fields on double-dual generalized Einstein-Cartan backgrounds. J. math. Phys. 29 (1988), 1212-1219.

Z.-Q. Ma & D. H. Tchrakian:

Dimensional reduction of higher-order topological invariants. The case CP^n. Phys. Rev. 38D (1988), 3827-3830.

A. Wiedemann, H.J.W. Mueller-Kirsten, & D.H. Tchrakian:

Investigation of a theory with soliton-like configurations. Inter. J. mod. Phys. A 3 (1988), 2349-2369.

R. Kerner & D.H. Tchrakian:

Spontaneous compactification on S^{2n} as solution to the generalized Einstein-Yang-Mills-Higgs system. Phys. Lett. 215B (1988), 87-92.

B. P. Dolan & D. H. Tchrakian:

* New Lagrangians for bosonic *m*-branes with vanishing cosmological constant. Phys. Lett. 202B (1988), 211-216.

B. P. Dolan:

A group-theoretical approach to black-hole radiation. Nuovo Cim. 102B (1988), 649-659.

J. Burzlaff:

* The soliton number of optical soliton bound states for two special families of input pulses. J. Phys. A: Math. Gen. 21 (1988), 561-566.

T. Garavaglia:

Finite temperature field theory and quantum noise in an inductively coupled oscillator. Phys. Lett. 131A (1988), 151-155.

Finite temperature field theory and quantum noise in an electrical network. Phys. Rev. 38A (1988), 4365-4368.

M. Vandyck:

* On the problem of space-time symmetries in the theory of supergravity. GRG 20 (1988), 261-277.

On the problem of space-time symmetries in the theory of supergravity II. N=2 supergravity and spinorial Lie derivatives. GRG 20 (1988), 905-925.

J. D. McCrea, E. W. Mielke, & F. W. Hehl:

* A remark on the axisymmetric Chen et al. solution of the Poincaré gauge theory. Phys. Lett. 127A (1988), 65-69.

J. O'Gorman, P. Phelan, J. McInerney, & D. Heffernan:

* Nonlinear dynamics of self-pulsing external cavity semiconductor injection lasers. J. opt. Soc. Am. B 5 (1988), 1105-1112.

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

The mechanism for generation of triplet superconductivity. J. Phys. C: Solid State Phys. 21 (1988), L751-L755.

J. M. Golden & G. A. C. Graham:

* The generalized partial correspondence principle in linear viscoelasticity. Q. appl. Math. 46 (1988), 527-538.

G.A.C. Graham & J.M. Golden:

The three-dimensional steady-state viscoelastic indentation problem. Inter. J. Engg. Sci. 26 (1988), 121-126.

J. L. Synge:

* An unperiodic concentrated sonic impulse. Q. appl. Math. 46 (1988), 65-75.

For the 100th birthday of the American Mathematical Society. A Century of Mathematics in North America. AMS 1988, pt.1, 19-20.

J. G. Kingston & J. L. Synge:

The sequence of pedal triangles. Amer. math. Mon. 95 (1988), 609-620.

In the press:

J.T. Lewis:

Large deviations and statistical mechanics. Leuven Notes in Math. & Theor. Phys. A.

T. Dorlas, J.T. Lewis, & J.V. Pulè:

The Yang-Yang thermodynamic formalism and large deviations. Commun. math. Phys.

D. Petz, G.A. Raggio, & A. Verbeure:

Asymptotics of Varadhan-type and the Gibbs variational principle. Commun. math. Phys.

G.A. Raggio & R.F. Werner:

Quantum statistical mechanics of general mean field systems. Helv. phys. Acta.

R.F. Werner:

Inequalities expressing the Pauli principle for generalized observables. Leuven Notes in Math. & Theor. Phys. A.

An application of Bell's inequalities to a quantum state extension problem. LMP.

T. Dorlas & A.C.D. van Enter:

Non-Gibbsian limit for large-block majority-spin transformations. J. statist. Phys.

T. Dorlas:

The statistical mechanics of a Bethe-Ansatz-soluble model. Proc. 9th IAMP Congr. on Math. Phys, Swansea 17-28 July 1988.

W. Cegła & M. Klimek:

Criterion for the large deviation principle. Proc. RIA, A.

E. Buffet & J.V. Pulè:

Gelation: the diagonal case revisited. Nonlin.

N.G. Duffield & J.V. Pulè:

Thermodynamics and phase transitions in the Overhauser model. J. statist. Phys.

P. McGill:

Some eigenvalue identities for Brownian motion. Math. Proc. Camb. Phil. Soc.

N. Gorman, L. O'Raifeartaigh, D. Williams, & W. McGlinn:

A unified approach to the computation of central terms in Kac-Moody and Virasoro algebras. Inter. J. mod. Phys. A.

J. Balog & L. O'Raifeartaigh:

Covariant light-cone algebra. Nuclear Phys. B

J. Balog, P. Forgács, L. O'Raifeartaigh, & A. Wipf:

String propagation on non-compact group manifolds: An SU(1,1) based counterexample. Nuclear Phys. B

J. Balog & M.P. Tuite:

The failure of Atkin-Lehner symmetry for lattice compactified strings. Nuclear Phys. B

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

Spherically symmetric SO(4) instanton of a non-Abelian Higgs model in 4 dimensions. Mod. Phys Lett. A.

M. A. Vandyck:

On the problem of space-time symmetries in the theory of supergravity III: Superspace formalism. GRG.

J. Devitt & P.S. Florides:

A modified Tolman mass-energy formula. GRG.

D.M. Heffernan, J. O'Gorman, B. Hawdon, & J. Hegarty:

Frequency locking and quasiperiodicity in an modulated external cavity injection laser. J. appl. Phys.

Feedback induced instabilities in external cavity injection lasers. Electron. Lett.

J. M. Golden & G.A.C. Graham:

A fixed length crack in a sinusoidally loaded general viscoelastic medium. Continuum Mechanics & Its Applications, eds. G.A.C. Graham & S.K. Malik, Hemisphere (Wash. DC).

B. Goldsmith:

Mixed modules in L. Rocky Mount. J. Math.

11. LIBRARY

Approximately 100 new titles were added to the library stock during the year; approximately 200 current periodicals were taken, of which almost half were received by gift or under exchange arrangements. The RIA 'permanent loan' collection was maintained - and a few new titles added to it; other forms of cooperation with research libraries at home and abroad were continued.

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

In addition to the regular exchanges and gifts, gifts of books, journals, and other material were received from the estate of the late Mr Ronald Anderson, Professor J. McConnell, Professor Synge, Dr Cegla, Dr Dorlas, Dr Golden and Professor Graham, Professor Sredniawa, Amsterdam Centrum Wisk. Inform., ICTP (Trieste), KEK (Japan), Kyoto Univ., Tokyo Univ., and Univ. of Warsaw.

Dr E. de Valera presented his father's and grandfather's collection of scientific books on permanent loan to the School Library, subject to certain conditions. The books (approx. 1200) include some rare works and some very interesting annotations.

IV - Annual Report of the Governing Board of the School of Cosmic Physics for the Year ending 31 December 1988, adopted at its meeting on 1 June 1989.

1 STAFF, SCHOLARS, ETC.,

Academic Staff

Senior Porfessors:

Astronomy Section:	P.A. Wayman, Director of School
Cosmic Ray Section:	L. O'C. Drury
Geophysics Section:	T. Murphy (to 17 October)

Professors:

A.W.B. Jacob (Officer-in-charge, Geophysics Section, from 18 October), T. Kiang, A. Thompson

Assistant Professors:

D. O'Sullivan, T.P. Ray

Research Assistants:

I. Elliott, P.W. Readman, (1 vacancy)

Experimental Officers:

T.A. Blake, J. Daly, B.D. Jordan

Visiting Scientist:

F.H. Cheng (from 15 December)

Technical and Clerical Staff

Astronomy Section:	A.M. Callanan, W.M. Dumpleton, M. Smyth
Cosmic Ray Section:	G. Broderick, E. Clifton, E. Flood
	A. Grace-Casey, S. Ledwidge, H. Sullivan
Geophysics Section:	K. Bolster, A. Byrne, C. Horan, G. Wallace, V. Ward (to 29 January).

Scholars:

C.J. Bean, R. Biernicowicz, S. Bleszynski (to 31 July), M.N. Devaney (from 1 August), P. Duffy, C.P. Lowe (to 29 February), B. O'Reilly.

Professors Emeriti:

H.A. Brück, C. O'Ceallaigh

Research Associates:

P.B. Byrne, M. Hoey, N.P. Murphy, W.E.A. Phillips, R.M. Redfern, P.M. Shannon

Vacation Students:

K. Graham, D. Maxwell, L. O'Súilleabháin,

C. Domingo (Scholar, Cosmic Ray Section, 1985-87) was awarded the Ph.D. degree at Universidad Autonoma de Barcelona in September with thesis entitled "Study of the Response of Solid State Nuclear Track Detectors to Ultra Heavy Ions in order to determine the Composition of Cosmic Ray Primaries".

A.W.B. Jacob was appointed to the IASPEI Commission on Controlled Source Seismology.

Minor Planet No. 3751 was named 3751 KIANG by the International Astronomical Union in Minor Planet Circular 12976 or 2 April, on the nomination of E. Bowell of Lowell Observatory, Arizona, in honour of T. Kiang for his contribution to the study of minor planets and their orbital characteristics.

C.P. Lowe (Scholar, Geophysics Section) was awarded the Ph.D. degree by Dublin University in February for her thesis entitled "A Crustal Study along a North-South Seismic Refraction Profile in Ireland".

P.A. Wayman was appointed Chairman of the National Committee for the History and Philosophy of Science of the Royal Irish Academy.

A visit by the Lord Mayor of Dublin, Alderman Carmencita Hederman, to Dunsink Observatory on 17 June marked the completion of the renovation the 12-inch James South Telescope as a contribution to 'Dublin Millennium Year 1988' (see 8.4 below).

2. RESEARCH WORK (Astronomy and Cosmic Rays)

2.1. Instrument Science

2.1.1. Solar Low-Energy Detector

B.D. Jordan, A. Thompson, D. O'Sullivan, and S. Bleszynski, with S. McKenna-Lawlor, SPCM.

Assembly and testing of a third flight model as 'flight spare' was completed. All three SLED models were finally delivered for integration into ESTER modules at KFKI, Budapest, in March and were forwarded to the USSR for integration with the Phobos spacecraft. The launch of the two spacecraft Phobos-1 and Phobos-2 from Baikonur took place on 7 and 12 July respectively; the payload of each included a SLED instrument. These instruments were switched on respectively on 19 and 25 July and were found to be operating satisfactorily. Both space craft operated successfully until 2 September when contact with Phobos-1 was lost. At the end of the year SLED on Phobos-2 was expected to function normally up to the time of close approach to Mars, due to take place in February and March 1989.

The SLED Engineering Model and the check-out equipment that had been used at IKI, Moscow, for test purposes were returned to Dublin in January. The microprocessor board has been donated to Dublin Corporation for inclusion in the 'Dublin Millennium Time Capsule'. The flight spare and associated check-out equipment remain at IKI.

2.1.2. 'Transputer' equipment for Image-Enhancement.

R.M. Redfern, UCG M.N. Devaney, I. Elliott, B.D. Jordan)

A Transputer graphics board was installed in a Tandon PC-AT along with the existing Transputer Development System. The linking together of the two boards provides a marked improvement in the

speed of the graphics manipulation and the system incorporates a 'frame grabber' for recording TV formats from the plate-viewing machine. In principle this feature can be used to receive the TV images of the telescope field of view for record purposes during observing. The original CAMAC-Nova equipment of the measuring machine has now been replaced by the Tandon/Transputer equipment.

A new version of the Imaging Photon Detector Transputer interface is under construction for use at the GHRIL on the William Herschel Telescope on La Palma. It incorporates a T414 Transputer, a high-speed FIFO memory chip, and transceivers to connect the Transputer links at the GHRIL to the main control Transputer in The Tandon PC installed in the telescope control room, an interconnecting distance of about 100m.

Software being written for the Transputer system includes image-analysis and image-sharpening routines and programs to perform on-line analysis of 'seeing' and focussing.

2.1.3 Image-sharpening data reduction

R.M. Redfern, UCG, M.N. Devaney, with IAC, Tenerife, Spain.

A method of using a modified Wiener filter on time-tagged single photon data has been developed, which can pre-process the data for use by a wide range of image-sharpening algorithms, making optimum use of the available information. Application of the method, with the simplest possible centroiding algorithm, using a bright unresolved reference object within the image field, to data from the 50 cm Swedish solar telescope on La Palma (used at night) has been shown to result in near-diffraction-limited images of the bright triple-star system ADS 6650, with high dynamic range, at extremely low counting rates. The method has been shown to be applicable, with the Kapteyn telescope, to fields containing reference stars as faint as 16.75 mag. The use of the Wiener filter with single photon events was shown to be of advantage compared with methods that use data binned into TV frames, even under excellent seeing conditions.

2.1.4. Nuclear Track Detector Response Studies

D. O'Sullivan, A. Thompson, J. Daly, with C. Domingo,
University of Barcelona.

Studies of the response of solid state nuclear track detectors (SSNTDs) to high energy ultra heavy nuclei continued, in particular work directed towards latent track variation with time under conditions of long-term exposure (order of years) in earth orbit. The main activity involved (1) processing and analysis of experimental material obtained by exposure of detector stacks to near-relativistic beams of Uranium at the Berkeley Bevalac in 1987, and (2) preparing results from the previous two years' work for publication, with the results reported for the year 1987 and given in detail at the 14th International Conference on SSNTDs in Lahore in April.

2.1.5 Stellar Coronograph

P.A. Wayman

An outline design for a stellar coronograph with provision for image-enhancement has been drawn up, incorporating a CCD detector for recording a circumstellar image in which the definition is enhanced by reception of the stellar image on an imaging photon detector (IPD). The design is intended to utilise real-time image analysis and actuating of a tilting plate image shifting device under computer control. The design was submitted to the La Palma Users' Committee for instrumental development as suitable for the Kapteyn telescope and has been passed to the High-Resolution Studies committee for further consideration.

2.1.6 Image Compression

I. Elliott

Consideration has been given to the application of fractal geometry for data compression of images using the Iterated Function System (IFS) method developed by M. Barnsley and others. A number of fractal and IFS images were generated using the transputer-based image-processing system and programs were written to demonstrate the relationship between Julia sets and the Mandelbrot set. It is intended to investigate the use of IFS methods for compressing certain complex astronomical images such as the solar photosphere granulation.

2.2 Solar System and Heliosphere

2.2.1 Giotto Mission to Comet Halley

Energetic Particle Analyser Experiment

A. Thompson, D. O'Sullivan, with S. McKenna-Lawlor, SPCM, and MPAe and ESTEC

Analysis of the data obtained by the EPA instrument on Giotto has continued. A study of the relativistic electron fluxes recorded after the outbound crossing of the bowshock indicated that they had been strongly beamed by the magnetic field. Among the possible acceleration mechanisms considered were magnetic field line reconnection and a quasi-perpendicular shock formed downstream at the bowshock. The energy spectra and anisotropies of cometary ions observed by the EPA instrument were employed in a study of acceleration processes in the vicinity of Comet Halley. Evidence was found for both first and second order Fermi acceleration.

Attempts to observe an ion foreshock region at Comet Halley, analogous to the electron foreshock reported by Fuselier et al., were abandoned due to poor statistics.

2.2.2 Neutral Particles in the Heliosphere

S. Bleszynski

Discusion of possible experimental techniques for detecting neutral particles in the heliosphere was incorporated in the Ph.D. thesis of S. Bleszynski. Estimates of the sensitivity attainable show that a new technique using impact ionisation on a gas jet should be very suitable for studying hot heliopause hydrogen.

2.2.3 Asteroid Dynamics

T. Kiang

Research on the Kirkwood Gaps in the distribution of asteroid orbits was continued. The problem investigated concerns the accuracy attainable after a long numerical integration of the differential equations of the simplest gravitational model.

It was found that, for 400-year periodicity in orbital variation, 250,000 integration steps were optimal, giving minimum loss of 4 significant figures. Study of the stability equations showed further that the time-constant derived was meaningful only if it was less than 10^{-6} years. For the 2:1 resonance gap only one, with one marginal case, out of six periodic orbits tested, was significantly unstable; hence the 2:1 gap is not vindicated on this simplest gravitational model. In this work a new method of integrating the variational equations using just two suitably chosen displacements within the hypersurface of the given Jacobi constant and perpendicular to the orbital motion halved the required computing time.

2.2.4 X-Ray Imager

L. O'C. Drury, A. Thompson

The proposal for a solar X-ray Imager Experiment (XI) in which the Institute had participated was one of two selected by the European Space Agency as candidate for a full disk imaging experiment for the SOHO-Cluster mission. The other candidate was the Extreme-UV Imaging Telescope (EIT) proposal. The two experiments were judged to be approximately equal in scientific merit and in technical quality, but, with better financial support, EIT was eventually chosen for the mission.

2.3. Stellar Astronomy and Clusters

2.3.1 Jets from Young Stars

T.P. Ray with MPIA

Work in conjunction with R. Mundt and T. Bührke of the Max Planck Institut für Astronomie, Heidelberg, on jets associated with young stellar objects (YSO's) and Herbig-Haro (HH) objects has continued. Ray and Bührke have shown that 5 out of 6 known young stars in the HL Tau association have jets or outflows. This remarkable degree of activity can only be explained if the outflow timescale for this group is longer than that expected for an 'isolated' star. Mutual gravitational disturbances may be the cause; the common direction for the HL Tau jets does not appear to be that of the local magnetic field.

Deconvolved images of jets obtained at Calar Alto have been resolved in the direction perpendicular to the flow. It has been possible to follow variation in opening angle with distance from the source for the first time. It was found that these jets are not free for a significant portion of their length. There may be pressure from the hot interstellar medium or from a toroidal field. While it has been clear for some time that stellar jets have very narrow opening angles, this work shows that collimation is achieved over relatively large scale lengths up to 600 AU.

2.3.2 Photometry of Binary Stars

P.A. Wayman, with IOA, Cambridge.

In the programme of binary star measurement for the astrometric satellite project HIPPARCOS, results for a total of 1706 binary stars have been completed down to 9th magnitude and with separations down to 0.5 arcseconds. Where the magnitude differences are less than 1 m. the relative positions are derived to an accuracy of the order of 5 milliarcseconds and the magnitude differences to 0.01 m.

2.3.3 Line Profiles in Beta Lyrae

R. Biernicowicz

The interpretation of H and He profiles in the 350 - 500 nm spectral region of Beta Lyrae have been studied on the basis of its being a massive Algol-type system with a B 8 II giant component enveloped by an optically thick disk. The profiles were presented in the form of 3-dimensional diagrams of intensity against wavelength (radial velocity) and time for, e.g., He 4472A and Mg II 4481A. The optical lines are disturbed by strong absorption components shifting periodically with amplitude corresponding to about 180 k/s, due to the atmosphere of the giant star. Absorption lines from the main sequence companion have not been discovered. The process of subtracting the absorption effects at $H\alpha$ and $H\beta$, using two different model atmospheres(Kurucz and Vidal et al.) has been applied.

R. Biernicowicz also contributed to the joint observing programme of the 'La Palma 5% International Time Programme' for 1988 on Cataclysmic Variables organised by P.A. Charles (R. Greenwich Observatory). He used the Isaac Newton Telescope for eight nights to record 2 A resolution spectra of SU UMa, YZ Cnc, TY Psc and U Gem at different phases.

2.4 Insterstellar Material

2.4.1 Supernova Remnants

L. O'C. Drury, with MPIK).

The collaboration with H.J. Volk and W. Markiewicz in Heidelberg was continued. This aims to achieve a better understanding of cosmic ray production in supernova remnants by constructing simplified models at a leval of complexity intermediate between analytic solutions and full numerical solutions. A consistent set of approximations leading to system of eleven coupled differential equations has been found; this can be integrated in less than a minute on most computers so that it is easy to study the dependence of the solutions on various parameters. Perhaps the most important conclusion is that, with reasonable parameters, solutions can be found which generate enough cosmic rays to supply the Galaxy without reaction effects leading to a contradiction with other observations. This strongly supports the viability of diffusive shock acceleration as the main production mechanism for the galactic cosmic rays at energies below 10^{15} eV. In particular, earlier fears that strong modification of shock structure might lead to insufficient generation of hot gas for consistency with X-ray observations of young remnants seem unfounded.

2.4.2 Fermi Acceleration Theory

P. Duffy.

The second order Fermi acceleration of cometary ions by Alfvén waves was studied. The model used describes molecules originating from the comet nucleus being ionised by solar radiation. Subsequently these ions undergo a pick-up process whereby they are accelerated in the local interplanetary fields to a certain momentum in the frame of the solar wind. Moving on helical trajectories along the ambient magnetic field, the pick-up ions then interact with Alfvén waves of the appropriate resonant wavenumber and are thereby accelerated. Exact solutions for the momentum distribution function's evolution with time were found using this model. Work was also done in Arizona on particle acceleration in a system of periodic shocks.

2.4.3 ISOPHOT experiment on ISO

L.O'C. Drury, T.P. Ray, with MPIA

A Micro Vax II computer system was installed to facilitate work on the photometer for the Infrared Space Observatory. The system has been performing well and the Munich Image Data Analysis System (MIDAS) has been tested. The role of the Institute in the Isophot collaboration has been clarified in discussion with other partners; it will concentrate on defining the scientific requirements for analysis of the polarimetric and spectropolarimetric data from Isophot.

2.5 Galaxies and Cosmology

2.5.1 Cerenkov Line-emission Mechanism

T. Kiang; F.H. Cheng, Hefei

Additional data on Balmer line intensities in quasars and Seyfert galaxies have been analysed. Predicted line-intensities of the Balmer lines contain just two combinations of physical parameters, probably varying from object to object and also in time for one object. Each object has 3, 4 or sometimes 5 observed lines and therefore it was possible to investigate the relationship between the proposed Cerenkov line-emission process and the observed Balmer decrement. A chi-squared test in comparing theoretical intensity ratios with the observations show that quasars' Balmer decrements, but not those of Seyfert galaxies, can be interpreted by the theory of Cerenkov line-emission. This suggests that there is an abundance of relativistic electrons in dense gas clouds representing the broad emission line regions of quasars (BLR's).

Cerenkov line-emission theory has been applied to the two-peak structure of the Lyman alpha emission line of Mk106. The temperature of the H1 zone of the optically thick clouds in the BLR was estimated to be around 10^4 K, corresponding to peak position of black-body radiation near to 300 mm.

2.5.2 Blue Elliptical Galaxies

P.L. Grimley, SPC Maynooth

Observations with the CCD camera of the Kapteyn Telescope on La Palma in June produced some good data on galaxies classified as elliptical but having blue continuum colours or uv excess. The images obtained confirmed the elliptical classifications and are providing evidence for interaction and to identify discrete regions of star formation. One object was clearly a spiral galaxy and Mkn 491 showed strong evidence for merging.

2.5.3 LDEF Mission

The Ultra-Heavy Cosmic Ray Experiment.

D. O'Sullivan, A. Thompson, and J. Daly, with C. Domingo, Barcelona, and ESTEC

The UHCRE project deployed from the Space Shuttle 'Challenger' in April 1984 is now scheduled to be retrieved from Earth orbit on 15 November 1989. The experiment is expected to provide the largest sample (>1200) of cosmic ray nuclei with $Z > 65$ ever collected in a single study, including the first significant sample of cosmic ray actinide nuclei. The most recent calculations by NASA of the decay of the LDEF orbit indicate instability below 170 nmi. being reached in February 1990 and re-entry in March 1990, placing more stringent limits on the planned recovery date than existed heretofore.

3 RESEARCH WORK (Geophysics)

3.1 Gravity and Geodesy

3.1.1 Geodesy

T. Murphy

In collaboration with J. Dixon, DIT Bolton Street, coordinates for Dunsink Observatory, No. 5 Merrion Square, and Skreen Church Tower were obtained using the Global Positioning System (GPS)

3.1.2 Onshore Gravity

T. Murphy, K. Bolster

Fieldwork was continued in Counties Kerry and Limerick in order to complete the area covered by Sheets 17 & 18 of the 1:126,720 scale maps. The gravity contouring of Sheet 23 was carried out and the results printed. The gravity contouring of Sheets 12 & 15 has been carried out and made ready for drafting and printing.

3.1.3 Marine Gravity

P.W. Readman with University of Hamburg.

Analysis of data collected during the Hibernian Offshore Gravity Survey (HOGS) has continued in collaboration with the Hamburg Geophysics Institute. The large volume of data has been carefully filtered and corrected, in order to allow, interalia, for the Eotvos correction due to the ship's motion for which the navigational data of the cruise had to be carefully analysed. The data have been merged with that obtained from the COOLE project and with the DIAS land data set to produce a preliminary gravity map.

3.2 Meteorology

K. Bolster

Meteorological work is no longer a research interest of the Geophysics Section. The end of the previous year saw the completion of 40 years of daily observations (1948-1987). Publication of data has now ceased and more limited measurements are carried out at Leinster Lawn and on the roof of 5 Merrion Square (a.m. only) on weekdays, with readings for other days being taken from the hydrograph, thermograph and rain-recorder. Readings are given once a week to the Meteorological Service by telephone and monthly returns of temperatures and rainfall are made on standard forms. Archival and current records remain available to interested enquirers, students, etc.

3.3 Seismic Work

3.3.1 The Seismic Network

A.W.B. Jacob, K. Bolster

An increase in seismic activity took place in 1988. Between January and August 20 events were recorded in the Irish Sea. These were mainly on a NE-SW trend which we have noted before and some were very close to the Irish coast. All were quite small,

the largest being ML 1.7. On 31 December an event was recorded onshore about halfway between Wexford and Enniscorthy.

The most damaging earthquake overseas occurred in Soviet Armenia on 7 December. This was only of magnitude 7, but it happened in a vulnerable area with a large population. It came close to overloading our network, which operates at high amplification in order to monitor smaller events near to Ireland. With valuable technical assistance from the Seismology Unit of the British Geological Survey in Edinburgh and additional support from the Electricity Supply Board, the network, which has been in use for ten years, was thoroughly overhauled early in the year.

3.3.2 Celtic Onshore-Offshore Lithospheric Experiment - COOLE Experiment - COOLE

B. O'Reilly, A.W.B. Jacob, P.M. Shannon

With work on the onshore line (in Press) and the Porcupine Seabight (published 1988) substantially complete, the main effort has been devoted to the profiles in and across the North Celtic Sea Basin. A model for crustal and lithospheric deformation has been developed and this, rather unexpectedly, ties in with earthquake patterns to the south. There is coherence with work on the lower lithosphere (3.3.3 below).

It is likely that mid-crustal detachments played an important part in the structural development of the North Celtic Sea Basin during the Mesozoic. Modelling was carried out using an approach based on the lithospheric stretching model of McKenzie. The situation in the Basin is not simple and there is a marked change across the median basement flexure detected in the seismic structure. The lower lithosphere appears to have been thinned equally on both sides of this flexure but above the mid-crustal detachment surface the pattern is different. This modelling has implications for the development of many basins around Ireland and further to the south and east.

3.3.3 Lower Lithospheric Studies

C. Bean, A.W.B. Jacob

This work developed rapidly during the year and very significant progress has been made. We now have a more detailed picture of crystalline alignment in the lower lithosphere than any available elsewhere on the Earth. The degree of alignment and its direction has been measured and a shear heating mechanism postulated.

In contrast to less well defined results based on S waves which have passed through the Earth's core (the SKS phase) our results indicate that the upper mantle may not be a strain marker for the last major orogenic episode in a region since it can undergo deformation which decouples from the brittle upper crust. Signs of this deformation may thus not be transmitted to the Earth's surface. Evidence of this decoupling was also found in the work in the North Celtic Sea Basin (3.3.2 above).

3.3.4 Seismic Project in Kenya - KRISP

A.W.B. Jacob, G. Wallace

The Kenyan authorities unexpectedly withdrew the Research Permit for this project in August, even though preliminary work was already well advanced. As there were signs that the decision was not necessarily final, the group, including the DIAS Geophysics Section, decided to continue with planned preparations. This included DIAS participation in a US Geological Survey experiment in New England in September. Four DIAS instruments were operated in conjunction with USGS equipment in Vermont. It was decided to delay commitment to similar work in Kenya until the situation there became clearer. Fieldwork was provisionally planned for January 1990 and EC contracts were signed in late autumn of 1988.

3.3.5 GEOTWIN

A.W.B. Jacob, C.J. Bean, T.A. Blake, with University of Karlsruhe.

This EC contract has provided a valuable framework for many of the other projects carried out by the Section in co-operation with other groups. The incentive and opportunity to develop and improve the handling and interpretation of large bodies of seismic data has been most important. In recent years the Section has recorded a great deal of seismic data and has access to much more. This programme continues to April 1990.

3.3.6 EGT - Eupopean Geotraverse

A.W.B. Jacob, T.A. Blake, K. Bolster, with European groups.

More work was needed to supply the University in Zurich with a partially processed data set from the southern part of the Geotraverse. This required extensive measurements of start-times and sampling rates on re-sampled records. During the year some

segments of the data were merged and record sections produced. The profile crosses crust which varies widely in thickness from less than 30 km beneath the Po plain and the Swabian Jura to more than 50 km below the Alps. The nature of the crust also changes. A preliminary paper is in Press.

3.3.7 ILIHA - Project in Iberia, 1989

A.W.B. Jacob

Planning of this complex and very extensive experiment continued during 1988. Following meetings at San Fernando (Cadiz) in October and Estoril (Portugal) a timetable and plan for seismic work in September/October 1989 was drawn up. As a direct result of DIAS research in the lower lithosphere, the ILIHA plans were substantially altered. The project derives from and is part of the EGT programme (3.3.6 above).

3.3.8 RAPIDS - Seismic Profile West from Ireland

A.W.B. Jacob, C.J. Bean, T.A. Blake, K. Bolster, B. O'Reilly, P.W. Readman, with University of Hamburg.

This project was inaugurated in Cork on 6 September by Dr. S. McCarthy, Minister of State for Science and Technology, and the German Ambassador. The survey vessel, F.S. Valdivia, returned on 10 October after carrying out over 700 km of seismic refraction profiling in the ocean to the west of Ireland. There were some problems with equipment early in the cruise and the weather in the second half was unusually bad. Even though work was suspended at one stage, a large data set was gathered using small explosive sources near the surface and seismic stations on the sea bottom. Maximum water depth was about 3 km.

By the end of 1988 digitizing of the data was in progress and first indications were that the quality was very good. The sea-bottom stations give good records even though surface conditions are bad.

3.4 Palaeomagnetism

P.W. Readman with N. Abrahamsen, Aarhus.

Some further work has been done on post-glacial lake sediments from Denmark, in particular from Soro So, a lake about 120 km from Skanderborg So, from which a record was already obtained of the secular variations in geomagnetic declination and inclination since 8500 BP. The new results from Soro so have been found to largely confirm those from the previous study. However, some fine structure observed in part of the Skanderborg record, similar to that found in historical and archaeomagnetic records, was not found in the equivalent part of the record from Soro So. This may have resulted from differences in sediment

deposition rates or from differences in their physical properties of the sediment relevant to the process by which the sediment acquires its remanence. The collaboration with Aarhus is continuing.

5 COMPUTER INSTALLATIONS

5.1. At 5 Merrion Square

T.A. Blake

After the SI 470 MByte disk was moved to the new MicroVAXII the Data General S130 system was phased out and the maintenance contract discontinued. The MicroVAXII was installed in February and the disk storage is fully used. Later in the year a Vaxstation 2000 was added and the DEC machines configured as a local area Vaxcluster. Ethernet was installed in part of the building. To allow data transfer between the MicroVaxII and the MV2000 equipment, media and documentation for the MV2000 Kermit Protocol were acquired. Other equipment acquired during the year included a portable Amstrad PPC computer, one Atari 1040ST and one Atari MegaST with 2 MB of memory.

5.2 Dunsink Observatory

I. Elliott

Two Tandon PC-AT systems with EGA graphics, 20 MB hard disk drives and Epson LQ-500 printers were purchased for general computing and word processing requirements. Software purchased and implemented included ChiWriter, MathCAD, PC-Imega and Kermit.

The data link to the VAX 11/780 at UCD Computer Centre worked reliably during the year. Re-allocation of storage space on the 470 MB (Astronomy) disk for Starlink programs became necessary and the Starlink software collection was up-dated.

6. HISTORICAL AND EDUCATIONAL ASTRONOMY

6.1 Megalithic Astronomy, Newgrange

T.P. Ray, with L. O'Suilleabháin

A study of the astronomical orientation of the Newgrange Megalithic Tomb was concluded. The results show that the statistical case for Newgrange having an astronomical function is very strong, certainly as good as, if not better than, that for

Stonehenge built some 1000 years later. It was shown that 5100 years ago sunlight would have penetrated into the main chamber immediately at sunrise on the shortest day of the year although at present it is 4.5 minutes later. The direction of sunrise at the winter solstice 5100 years ago corresponds to the minimum azimuth seen from the chamber through the roof-box. Hence 'first light' would have been an extremely narrow beam. This line was found to be along the major axis of the chamber and sunlight would have disappeared from the chamber just along the line of maximum azimuth though the roof-box. That is, the geometry - roof-box, passage, chamber - is symmetrical with respect to the Winter Solstice of 3100 BC.

6.2 Grubbs of Dublin

P.A. Wayman

The contribution of T. Grubb (1800-78) and H. Grubb (1844-1932) to the development of telescope design over nine decades is only partially described in historical accounts. Material relevant to successive stages in this development is being collected in conjunction with I. Glass (Cape Town) and C.J. Butler (Armagh) and others.

6.3 Astronomy Education

I. Elliott, P.A. Wayman

A proposal was submitted jointly with UCD Audio Visual Centre and Armagh Planetarium to the DELTA project of the EC in respect of evaluating Interactive Video Techniques for the teaching of scientific concepts. A study was made during a visit to the United States of the STAR (Science Teaching through its Astronomical Roots) programme and an account presented at an educational meeting in Dublin.

7 LA PALMA OBSERVATORY

7.1 General

The Governing Board continued its responsibility for Irish participation in the Spanish International Astrophysical Observatory of the Canary Islands at the Observatorio del Roque de los Muchachos on the island of La Palma. It received the advice of an Advisory Committee, as in previous years. The membership of the Advisory Committee was B. O'Donnell (EOLAS), M. de Groot (R.I.A. nominee), P.A. Wayman, P.K. Carroll and T.P. Ray.

The Committee met twice and was represented at meetings of the UK the UK Panel for Allocation of Telescope Time held in January and July. Information Sheets Nos. 17 & 18 were distributed in March and September respectively.

The La Palma Users' Committee meeting 1-2 November was attended by R.M. Redfern and the Herstmonceux Conference on 'Results from the Roque' was attended by N. Devaney, P.A. Wayman and T.P. Ray.

7.2 La Palma visits, 1988

Visits for observing and instrumental work on La Palma were made as follows:

N. Smith (UCD), JKT, 23 - 25 January

P.O'Kane (UCG), GHRIL on WHT, 29 March - 5 April

P.L. Grimley (SPCM), JKT, 7 - 12 June

B.D. Jordan, QUBES on JKT, 22 - 29 July

R.M. Redfern, WHT, 3 - 10 August

T.P. Ray, WHT, 8 - 11 September; INT 10 - 12 December

R. Biernicowicz, INT, 21 - 29 December

7.3 Image Sharpening

R. M. Redfern, N. Devaney

R. M. Redfern finished the academic year 1987-'88 as Visiting Professor in the Instrumentation Section of the Instituto de Astrofisica de Canaries (Tenerife), working particularly on image-sharpening methods at the GHRIL (Ground-based High-Resolution Imaging Laboratory) on the 4.2-m William Herschel Telescope. Successful tests were made at the Swedish 50-cm Solar Telescope (used at night) and at the GHRIL, the recorded IPD counts being analysed subsequently. Real-time analysis has not yet been done. Attempts by R.M. Redfern, in conjunction with T. Shanks (Durham) and others, to detect blue giant stars in a Virgo Cluster galaxy by image-sharpening were not successful but preliminary results were encouraging.

8 SEMINARS, COLLOQUIA, LECTURES

8.1 Statutory Public Lecture

The Statutory Public Lecture of the School was given on November 10 in Trinity College, Dublin by Professor T. Murphy on 'Why measure gravity?'

8.2 Seminars in the School

The following seminars were presented on Institute premises during the year:

6 January	J.W. Menzies (Cape Town): "The LMC Supernova 1987A"
25 February	Y.Y. Zhou (Hefei): "Clustering of Radio Sources and Quasars"
6 June	I. Elliott: "Transtech Devices for Computer Graphics"

8.3 External Lectures

P.A. Wayman and L. Drury contributed to Maths Course 444 for Senior and Junior Sophister students at Trinity College, Dublin, during the Michelmas Term on 'Topics in Stellar Physics' and 'The Interstellar Medium' respectively.

D. O'Sullivan gave a series of eight lectures on 'Cosmic Rays' to Sophister students in physics at Trinity College, Dublin.

I. Elliott gave a course of sixteen lectures on 'Introductory Astrophysics' to Junior Sophister students in honours physics in Trinity College, Dublin, in the Michelmas Term.

Contributions to meetings of the Astronomical Science Group of Ireland were as follows:

31 March, University College, Cork:

T.P. Ray, 'Cluster of Jets in the HL Tau region'

P.A. Wayman, 'Gas Shells of RS Puppis'

T. Kiang, 'Periodic Orbits for Asteroids in the 2:1 Kirkwood Gap'

5 October, Royal Irish Academy, Dublin:

L.O'C. Drury, 'Infrared Space Observatory'

I. Elliott, 'The Universe as a Teaching Aid'

P.A. Wayman, 'The STAR Programme of the US National Science Foundation'

P.A. Wayman addressed the Royal Aeronautical Society (Irish Branch) on 'Navigation Principles' on 25 January.

L. O'C. Drury spoke on 'Fermi Acceleration' at the Ringberg Workshop in Germany on Hotspots in Radio Galaxies, 8 - 12 February.

A.W.B. Jacob and C.P. Lowe gave a seminar on 'Seismic Refraction Methods' in the Department of Geology, Trinity College, on 8 February.

C.J. Bean gave a paper 'A Refraction Seismic Study of the Upper Mantle between Ireland and Northern Britain' at the Annual Irish Research Meeting of the Irish Geological Association in Trinity College, Dublin, on 27 February.

P.W. Readman gave a talk entitled 'Palaeolmagnetism of Holocene Lake Sediments from Soro So, Denmark' at a meeting of the European Geophysical Society at Bologna, Italy, 21 - 25 March.

D. O'Sullivan gave an invited talk and two contributed papers on Solid State Nuclear Track Detectors at Lahore, Pakistan, in April. In the same month he gave a seminar at the Space Physics Department and spoke at a Colloquium at the Department of Astronomy and Astrophysics of the Tata Institute, Bombay.

C.J. Bean presented a joint paper with A.W.B. Jacob entitled 'P-wave Anisotropy below the Moho' at the Third International Workshop on Seismic Anisotropy, Berkeley, California, on 1 June.

P.A. Wayman spoke on'The Pursuit of Good Seeing on La Palma' at the Physics Department, University of California at Santa Cruz, on 22 July and at Lowell Observatory, Flagstaff, Arizona, on 27 July.

T. Kiang described his work on numerical investigation of stability in the Kirkwood Gap orbits of asteroids at Gaithersberg, Florida, 25-29 July, at a meeting of the American Astronomical Society on Dynamical Astronomy and at Colloquium No. 109 of the International Astronomical Union on 'Applications of of Computer Technology to Dynamical Astronomy'.

T. Kiang contributed a paper 'A Chronological Chart of Chinese Astronomical Records' at Commission 41 (History of Astronomy) at the XXth General Assembly of the International Astronomical Union in Baltimore, Maryland, on 3 August.

L. O'C. Drury spoke on 'Particle Acceleration and Shock Wave Structure' and on 'Cosmic Rays - a Short Survey of Open Problems' at the Varenna International Summer School and Workshop on Plasma Astrophysics, 24 August - 3 September.

A.W.B. Jacob spoke on 'Anisotropy in the Lower Lithosphere' at the ILIHA Workshop Meeting in Estoril, Portugal, 10 - 12 November.

At the 30th Herstmonceux Conference on 'Results from the Roque' at the Royal Greenwich Observatory, Sussex, on 14 November, T.P. Ray spoke on 'Jets and Herbig-Haro Objects from High-Luminosity Young Stellar Objects' and N. Devaney spoke on 'Real-Time Image Sharpening'.

L. O'C. Drury gave an invited discourse, 'Die Kosmische Strahlung: Neue Aspekte eines alten Problems' at the Max Planck Institut für Astronomie Jubilaumskolloquium, 24 November.

8.4 Popular Astronomy

Talks were given to the Irish Astronomical Society by N. Devaney, I. Elliott, D. O'Sullivan, T.P. Ray and P.A. Wayman, to the Society of Electronic and Radio Technicians by I. Elliott, and to the Limerick Astronomy Club and the Cork Astronomy Club by P.A. Wayman. In March and again in October, W. Dumpleton and P.A. Wayman contributed the programme material for week-end courses on introductory astronomy at the West of Ireland Agricultural College, Ballinafad, Co. Mayo. Open Nights at Dunsink Observatory were held on fourteen nights, as usual, and a week-long

series of open evenings, 17-25 June, was arranged as marking Dublin Millennium Year, 1988. The Youth Conference of the Royal Dublin Society on Science and Arts was received at Dunsink Observatory on 7 July and other group visits were made by the Irish Society for Archives, the Guinness Choir, the Irish Astronomical Society, the Finglas Environment Heritage Project, and the Royal Aeronautical Society.

9 EXTERNAL WORK

The following working visits to other institutions and conferences were undertaken during the year (see also 7.2 and 8.3 above):

C.J. Bean:

A visit to the Geophysics Institute, Karlsruhe, and the Cambridge reflection seismics group (BIRPS) to discuss the lower lithospheric results.

6 - 8 April. 12th UK Geophysical Assembly, Leeds.

T.A. Blake:

1 March. Seminar on Open Networking, EOLAS, Dublin.

21-25 March. Vax/Vms Systems Management course, Dublin.

1-2 September. DECUS (Ireland) annual meeting, Dublin.

L. O'C. Drury:

25 Jan. - 7 Feb. M.P. Inst. Heidelberg

8 - 10 March. Isophot Review, Heidelberg

28 - 31 March. SLED Meeting, KFKI Budapest

15 April. EIT/XI meeting, ESA Paris.

10 - 11 May. Isophot meeting, DSRI Copenhagen

12 Sept. Steering Committee, 22 Cosmic Ray Conference, London

7 - 9 Nov. ESIS/SPAN meeting, Frascati

10 - 11 Nov. Isophot status review, Heidelberg

24 - 27 Nov. MPAe Lindau, 50th Anniversary Meeting

I. Elliott:

27 - 29 March. Occam Users' Group Meeting, Sheffield

30 - 31 March. R. Astronomical Society, Spring Meeting, Preston.

C. Horan:

9 Nov. - 9 Dec. University of Hamburg on RAPIDS digitization.

A.W.B. Jacob:

Visits on a number of occasions to University of Hamburg in connection with RAPIDS project (etc.)

Visits to University of Karlsruhe were made in connection with GEOTWIN co-operative project.

10 February. EC meeting on earthquake monitoring

6 - 8 April. 12th UK Geophysical Assembly, Leeds

27 April (with C.J. Bean). William Smith Meeting on the Continental Lithosphere, Geological Society, London

31 May - 4 June (with C.J. Bean). Third International Workshop on Seismic Anisotropy, Berkeley, California.

July. Marine Geophysics group, University of Cambridge.

B.D. Jordan:

Several visits to Armagh Observatory and Queen's University, Belfast in connection with the Echelle Spectrograph project.

T. Murphy:

6 - 8 April. 12th UK Geophysical Assembly, Leeds

D. O'Sullivan:

24 - 27 May. Giotto Plasma Workshop, MSSL London

5 - 14 July. Phobos Mission activities, IKI Moscow (launch of Phobos-1 and Phobos-2)

23 - 29 July. 27th Plenary meeting, COSPAR Helsinki

12 September. Steering Committee for the 22nd International Cosmic Ray Conference, London.

P.W. Readman:

Two visits to the Geophysics Institute, Hamburg, to work on the HOGS project.

A visit to Geophysical Laboratory, University of Aarhus, Denmark in connection with lake sediment palaeomagnetic work.

A. Thompson:

18 - 23 March. Heavy Nucleus Collector Science Steering Committee and LDEF Status Review; NRL collaboration. Washington D.C.

14 - 17 April. SOHO/EIT-XIO Meeting, ESA, Paris

21 - 27 July. 27th Plenary Meeting COSPAR, Helsinki

12 - 16 September. ESTER Collaboration meeting, Budapest.

28 Sept. - 1 Oct. Ph.D. examination, Barcelona.

P.A. Wayman:

13 May. R. Astronomical Society meeting, London

1 - 11 August. XXth General Assembly, International Astronomical Union, Baltimore, Maryland. (Irish National Representative.)

11 November. R. Astronomical Society meeting, London

14 - 15 November. 30th Herstmonceux Conference, R. Greenwich Observatory.

10 PUBLICATIONS

10.1 Journals

L. O'C. Drury, with A.F. Heavens:

"Relativistic Shocks and Particle Acceleration", Mon.Not. R. Astr. Soc., 235 997, 1988.

A.W.B. Jacob, T. Murphy, with J. Makris, R. Egloff, P. Mohr and P. Ryan:

"Continental Crust under the Southern Porcupine Seabights West of Ireland", Earth and Planetary Science Letters, 89: 387-397, 1988.

T. Kiang, with S.P. Xiang and J.L. Zhang:

"Apparent Velocities of Sources Moving in the Gravitational Field of a Kerr Black Hole", Astrophysical Journ., 330 168 - 177, 1988.

T. Murphy:

"Notes on the Six-inch and One-inch Sheet Maps of Ireland and Methods for Deducing Rectangular and Geographical Coordinates for Points Thereon ", Geophysical Bulletin, Series D, (DIAS), No. 39.

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

"Energetic Particles in Space: The Giotto Mission to Halley's Comet". Irish Astronomical Journal, 18: 176-178, 1988.

T.P. Ray, with T. Bührke and R. Mundt:

"A Detailed Study of HH34 and its Associated Jet", Astron. Astrophys., 200 99, 1988.

T.P. Ray, with R. Mundt and T. Bührke:

"A Close Association of Five Jet and Outflow Sources in the HL Tauri Region", Astrophys. Journ. Lett., 333 L69, 1988.

P.W. Readman, with N. Abrahamsen:

"Quaternary Magnetostratigraphy in Denmark", Boreas, 16 375-380, 1987.

P.W. Readman, with N. Abrahamsen:

"Palaeomagnetism of Post Glacial Lake Sediments from Skandferborg So, Jutland, Denmark", Physics of the Earth and Planetary Interiors, 52, 177-192, 1988.

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

"The Lightweight Energetic Particle Detector EPONA and its Performance on Giotto", Journ. Phys. E: Sci. Instr., 20: 732-740, 1987.

A Thompson, D. O'Sullivan, with E. Kirsch, S. McKenna-Lawlor and F.M. Neubauer:

"Detection of Energetic Electron (E > 300 keV) and Ion Fluxes (E > 97 keV) from Comet P/Halley by the Giotto Experiment EPA on 1986 March 13/14", Astron. Astrophys., 193: 303-308, 1988.

C.J. Bean and A.W.B. Jacob:

"A Seismic Study of the Subcrustal Lithosphere between Ireland and Northern Britain", (Abstract), Geophys. Journ. R. Astr. Soc., 92: 555, 1988.

C. Domingo, D. O'Sullivan, A. Thompson, with C. Baixeras, F. Fernandez and A. Vidal-Quadras:

"A Study of Charge Discrimination for the UH Cosmic Ray Component with Polycarbonate Detectors", The 11th European Cosmic Ray Symposium, Balatonfured, Hungary, 21-27 August 1988.

C. Domingo, D. O'Sullivan, A. Thompson, with C. Baixeras, F. Fernandez and A. Vidal-Quadras:

"Latent Track Intensification due to Ageing in Solid State Nuclear Track Detectors", Proceedings of the 14th International Conference on Solid State Nuclear Track Detectors, Lahore, 2-6 April 1988.

L. O'C. Drury:

"Particle Acceleration and Shock Wave Structure", Proceedings of the Varenna International Summer School and Workshop on Plasma Astrophysics, ESA SP285, 1, 131.

L. O'C. Drury:

"Cosmic Rays - a Short Survey of Open Problems", Proceedings of the Varenna International Summer School and Workshop on Plasma Astrophysics, ESA SP285, 1, 205.

D. O'Sullivan, A. Thompson, C. Domingo, with V. Domingo and K-P. Wenzel:

"The Outlook for Ultra Heavy Cosmic Ray Studies with Plastic Track Detectors", Proceedings of the 14th International Conference on Solid State Nuclear Track Detectors, Lahore, 2-6 April 1988.

D. O'Sullivan, A. Thompson, with V. Afonin, K. I. Gringauz, E. Keppler, E. Kirsch, A.K. Richter, S.M.P. McKenna-Lawlor, A.J. Somogyi, L. Szabo, K. Szego, and I. Szucs:

"The Low Energy Charged Particle Detector SLED", The 11th European Cosmic Ray Symposium, Balatonfured, Hungary, 21-27 August 1988.

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

"In-situ Energetic Particle Observations at Halley's Comet 12-15 March 1986, recorded by the EPONA Experiment abroad Spacecraft Giotto", Proceedings of the 13th General Assembly of the European Geophysical Society, Bologna, 21-25 March 1988.

D. O'Sullivan, A. Thompson, with E. Kirsch, S. McKenna-Lawlor, P. Daly, K-P. Wenzel and F.M. Neubauer:

"Pitch Angle Distribution of Ions (>60 keV) and Electrons (> 300ke V) measured by the EPA Instrument during the Giotto Halley Encounter", Proceedings of the 13th General Assembly of the European Geophysical Society, Bologna, 21-25 March 1988.

T.P. Ray with R. Mundt:

In "Mass Outflows from Stars and Galactic Nuclei", eds. L. Bianchi and R. Gilmozzi, Kluwer 1988, p. 293.

T.P. Ray with T. Bührke and R. Mundt:

In "Formation and Evolution of Low Mass Stars", eds. A. K. Dupree and M.T.V.T. Lago, Kluwer, 1988, p. 281.

P.W. Readman, with N. Abrahamsen:

"Palaeomagnetism of Holocene Lake Sediments from Soro So, Denmark". (Abstract), Ann. Geophysicae, Special Issue, p. 21, 1988.

P.W. Readman, with S. Papamarinopoulos and K.M. Creer:

"Geomagnetic Intensity Studies from Baked Earth Objects and Limnic Sediments from Greece for the last 4000y B.P." (Abstract), Proceedings of the NATO Advanced Study Meeting on Palaeomagnetism, Newcastle-upon-Tyne, 1988.

8.3 Irish Astronomical Journal

The Irish Astronomical Journal produced one issue during 1988, Vol. 18 No. 3. The March 1988 issue included the following contributions,

INSTITIUID ARD-LEINN BHAILE ATHA CLIATH

(Dublin Institute for Advanced Studies)

FINANCIAL STATEMENTS FOR YEAR ENDED 31 DECEMBER 1988

CONTENTS

INSTITIUID ARD-LEINN BHAILE ATHA CLIATH

(Dublin Institute for Advanced Studies)

1988

GENERAL

The Institute was established under the Institute for Advanced Studies Act, 1940.

Its functions include the provision of facilities for the furtherance of advanced studies and the conduct of research in specialised branches of knowledge.

It comprises three Schools - Celtic Studies, Theoretical Physics and Cosmic Physics.

ACCOUNTING POLICIES

1. Accounting basis:

   The Accounts have been prepared under the historical cost convention.

2. Oireachtas and Lottery Grants

   Income shown in the Accounts under these headings is the actual cash received in the period of the Account and includes £102,000 for increases in remuneration.

3. Fixed Assets:

   Fixed Assets comprise the furniture and equipment of the Institute and are shown at cost less accumulated depreciation.

   The rate of depreciation is 10% per annum.

   Premises occupied by the Institute are leased from the Office of Public Works.

4. Capital Reserve:

   The capital reserve comprises income allocated for the purchase of fixed assets. It is written down in line with the depreciation of the related assets.

5. Library:

   Expenditure on library books and materials is charged to the Income and Expenditure Account. The current value of such books and materials is estimated at £470,000.

6. Publications:

Expenditure on publications is written off in the year in which it is incurred. The estimated value of such publications on hand at 31 December 1988 was £674,500.

7. Superannuation:

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

INSTITIUID ARD-LEINN BHAILE ATHA CLIATH

(Dublin Institute for Advanced Studies)

Income and Expenditure Account

for the year ended 31 December 1988

1987 £		1988 £
	INCOME	
1,892,000	Oireachtas Grants	1,317,000
---	Lottery Grant	605,000
47,180	Sales of Publications	37,847
6,301	Celtic Studies Summer School Fees	---
32,332	School of Cosmic Physics (Note 4)	191,253
49,021	Miscellaneous (Note 9)	41,381
2,026,834		2,192,481
55,386	Less allocated for capital purposes (Note 6)	160,124
1,971,448		2,032,357
	EXPENDITURE	
436,105	School of Celtic Studies	503,272
262,777	School of Theoretical Physics	264,786
683,944	School of Cosmic Physics	836,148
449,256	Administration	459,642
1,832,082		2,063,848
139,366	SURPLUS (DEFICIT) for year	(31,491)
306,200	Balance at 1 January	445,566
445,566	Balance at 31 December	414,075

The Accounting Policies, Notes 1 to 9 and Statement 1 form part of these accounts.

M. Kwaitake

CHAIRMAN - COUNCIL OF THE INSTITUTE

INSTITIUID ARD-LEINN BHAILE ATHA CLIATH

(Dublin Institute for Advanced Studies)

Balance Sheet at 31 December 1988

1987				1988
£	£		£	£
293,469		Fixed Assets (Note 5)		384,968
		Current Assets:		
	439,785	Cash on hands and at Bank	350,884	
506,917	67,132	Debtors and prepayments	168,839	519,723
800,386		Total Assets		904,691
		Current Liabilities:		
	(40,354)	Creditors and Accruals (Note 2)	(83,508)	
(61,351)	(20,997)	Funds (Note 1)	(22,140)	(105,648)
739,035		Net Assets		799,043
		Financed by:		
445,566		Surplus-Income and Expenditure Account		414,075
293,469		Capital Reserve (Note 6)		384,968
739,035				799,043

The Accounting Policies, Notes 1 to 9 and Statement 1 form part of these accounts.

CHAIRMAN - COUNCIL OF THE INSTITUTE

INSTITIUID ARD-LEINN BHAILE ATHA CLIATH

(Dublin Institute for Advanced Studies)

Statement of Source and Application of Funds

for the year ended 31 December 1988

	£
Source of Funds:	
Deficit for the year	(31,491)
Capital Income	160,124
	128,633
Application of Funds:	
Purchase of Fixed Assets	160,124
	(31,491)
Increase/(Decrease) in Working Capital:	
Increase in Debtors	101,707
Increase in Current Liabilities	(44,297)
Decrease in Cash Balances	(88,901)
	(31,491)

INSTITIUID ARD-LEINN BHAILE ATHA CLIATH

(Dublin Institute for Advanced Studies)

Statement I

Detailed Analysis of Income and Expenditure for the year ended 31 December 1988

	School of Celtic Studies	School of Theoretical Physics	School of Cosmic Physics	Administration	Total	1987 Total
INCOME	£	£	£	£	£	£
Oireachtas Grants	1,000	258,000	736,400	321,600	1,317,000	1,892,000
Lottery Grant	455,000	-	-	150,000	605,000	-
Sales of Publications	37,185	27	635	-	37,847	47,180
Celtic Studies Summer School Fees	-	-	-	-	-	6,301
School of Cosmic Physics (Note 4)	-	-	191,253	-	191,253	32,332
Miscellaneous (Note 9)	1,313	-	6,092	33,976	41,381	49,021
	494,498	258,027	934,380	505,576	2,192,481	2,026,834
Less allocated for capital purposes (Note 6)	14,351	1,600	123,785	20,388	160,124	55,386
	480,147	256,427	810,595	485,188	2,032,357	1,971,448
EXPENDITURE						
Salaries, Wages and Superannuation (Note 8)	403,913	177,840	591,730	226,010	1,399,493	1,234,118
Scholarships	30,030	36,309	25,468	-	91,807	80,729
Honoraria	602	50	250	591	1,493	1,008
Library	11,775	27,035	21,866	-	60,676	54,971
Microfilms	247	-	-	-	247	3,440
Publications	27,488	1,848	4,109	-	33,445	58,944
General Administration (Note 3)	-	-	-	208,995	208,995	200,968
Travel & Survey Expenses	7,229	8,543	35,766	828	52,366	57,644
Symposia & Seminar Expenses	84	974	-	-	1,058	17,201
Equipment: Consumable & Maintenance	-	-	36,874	-	36,874	38,034
Special Commitments and Projects	-	-	97,407	-	97,407	13,282
General Expenses	21,904	12,187	22,678	23,218	79,987	71,743
	503,272	264,786	836,148	459,642	2,063,848	1,832,082
SURPLUS (DEFICIT) FOR YEAR	(23,125)	(8,359)	(25,553)	25,546	(31,491)	139,366
Balance at 1 January 1988	180,612	37,327	102,465	125,162	445,566	306,200
Balance at 31 December 1988	157,487	28,968	76,912	150,708	414,075	445,566

INSTITIUID ARD-LEINN BHAILE ATHA CLIATH

(Dublin Institute for Advanced Studies)

NOTES TO THE ACCOUNTS

1. Funds:

These comprise:		£
	Vernam Hull Bequest	20,939
	Carmody Fund	1,201

The funds are held on deposit.

2. Creditors and Accruals:

Included in this heading is £11,027 contract research monies unexpended at 31 December, 1988, which is credited to revenue in line with expenditure on projects.

3. General Administration Expenses:

	£
Rent, Rates & Insurance	79,484
Premises Maintenance	56,776
Postage & Telephones	39,622
Fuel, Light & Power	27,950
Sundry Supplies	5,163
	208,995

4. School of Cosmic Physics - Research Programmes & Fees:

Project	Contributor	Opening Balance	Income	Applied	Unexpended
		£	£	£	£
Seismic Survey at Carnsore	**ESB**	-	300	300	-
Geotwin	**EEC**	8,260	10,376	18,636	-
EGT (Geotraverse)	**EEC**	-	473	473	-
HOGS	Dept.Energy/ Oil Industry	3,110	1,000	1,786	2,324
BGS	Br.Geol.Surv.	-	4,186	4,186	-
KRISP	**EEC**	22	10,734	10,756	-
ISOPHOT	**ESA**	-	65,927	65,927	-
ILIHA	**EEC**	-	9,074	1,629	7,445
RAPIDS	Dept.Ind. & Commerce	-	83,797	83,039	758
Cosmic Ray Conf. (1991)	Bord Fáilte	-	500	-	500
Other Fees and Contributors	Various	-	4,521	4,521	-
		11,392	190,888	191,253	11,027

INSTITIUID ARD-LEINN BHAILE ATHA CLIATH

(Dublin Institute for Advanced Studies)

NOTES TO THE ACCOUNTS (Contd.)

5. Fixed Assets (Furniture & Equipment):

	£	£
Cost at 1 January 1988		667,109
Additions	160,124	
Less Disposals	2,909	157,215
Cost at 31 December, 1988		824,324
Accumulated Depreciation at 1 January, 1988		373,640
Depreciation in year	68,323	
Less Depreciation on Disposals	2,607	65,716
Accumulated Depreciation at 31 December, 1988		439,356
Net book value at 31 December, 1988		384,968
Net book value at 31 December, 1987		293,469

6. Capital Reserve:

Balance at 1 January 1988		293,469
Income capitalised in year	160,124	
Less Disposals	2,909	157,215
		450,684
Depreciation	68,323	
Less Depreciation on Disposals	2,607	65,716
Balance at 31 December, 1988		384,968

7. Leasing:

(a) Operating Leases:

The premises occupied by the Institute are leased from the Office of Public Works. The commitment on foot of such leases in respect of 1988 is £39,800. All except £260 of this commitment is on foot of leases of property from year-to-year.

(b) Finance Leases:

There were no appreciable finance leases in existence at 31 December, 1988.

8. Superannuation:

The total superannuation payments in the year amounted to £313,574. The salaries and superannuation charge in the accounts is net of contributions totalling £11,086.

9. Miscellaneous:

Included in Miscellaneous is Bank Interest earned of £33,531 (1987 - £45,648) for the year.

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

Report of the Comptroller and Auditor General

I have examined in accordance with approved auditing standards the Accounts set out on Pages 1 to 8 which are in the form approved under the provisions of Acht um Institiuid Ard-Leinn, 1940. I have obtained all the information and explanations which I considered necessary for the purpose of my audit.

In my opinion proper books of account have been kept by an Institiuid and the Accounts, which are in agreement with them, give a true and fair view of the state of its affairs at 31 December 1988, and of its transactions and source and application of funds for the year then ended.

P. L. McDONNELL
Comptroller and Auditor General
30 November 1989.