

Pr. 2889

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

Wh. 12-20.

Annual Report of the work of the
Institute and its Constituent
Schools presented by the Council
to the Minister for Education in
respect of the Financial Year
1953-54.

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

Annual Report of the work of the Institute and
its Constituent Schools presented by the Council
for the Financial Year 1953-54

In accordance with the provisions of Section 29 of the Institute for Advanced Studies Act, 1940 (No. 13 of 1940), the Council of the Institute has the honour to present to the Minister for Education for submission to the Government a report of the work and activities of the Institute and its Constituent Schools for the financial year ending 31st March, 1954.

The general purpose which it is hoped to accomplish is clearly stated in the Act establishing the Institute, namely, the Institute for Advanced Studies Act, 1940 (No. 13 of 1940) and in the Establishment Orders establishing the three Constituent Schools, namely, the Institute for Advanced Studies (School of Celtic Studies) Establishment Order, 1940, the Institute for Advanced Studies (School of Theoretical Physics) Establishment Order, 1940, and the Institute for Advanced Studies (School of Cosmic Physics) Establishment Order 1947, and need not be referred to here. It is deemed desirable, however, to include in the report for the purposes of record certain particulars about the constitution of the Council of the Institute and of the membership of the Governing Boards of the three Constituent Schools on the 31st March 1954.

The report is presented under the following principal heads:-

- I - Constitution of the Council of the Institute and of the Governing Boards of the three Constituent Schools on the 31st March, 1954.
- II - Report of the Governing Board of the School of Celtic Studies.
- III - Report of the Governing Board of the School of Theoretical Physics.
- IV - Report of the Governing Board of the School of Cosmic Physics.

I - Constitution of the Council of the Institute and of the Governing Boards
of the three Constituent Schools on the 31st March 1954

1. THE COUNCIL OF THE INSTITUTE.

Chairman:

Right Reverend Monsignor Patrick Browne, M.A., D.Sc.,
President, University College, Galway.

Ex-Officio Members:

Dr. Michael Tierney, M.A., D.Litt.,
President, University College, Dublin;

Dr. Albert J. McConnell, M.A., M.Sc., Sc.D.,
Provost, Trinity College, Dublin;

Right Reverend Monsignor Patrick Boylan, D.D., M.A., D.Litt.,
President, Royal Irish Academy.

Members Appointed by the Governing Boards of the Constituent Schools:

Professor Michael A. O'Brien, M.A., Ph.D.;

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

Professor Erwin Schroedinger, M.A., Ph.D., D.Sc., F.R.S.;

Professor Ernest T. S. Walton, M.A., M.Sc., Ph.D., F.T.C.D.;

Professor Leo W. Pollak, Ph.D.

2. THE GOVERNING BOARD OF THE SCHOOL OF CELTIC STUDIES.

Chairman:

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

Senior Professors:

Michael A. O'Brien, M.A., Ph.D.;

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

Kyles Dillon, M.A., Ph.D.

Appointed Members:

Miss Áine de Paor, M.A., Ph.D.;

Reverend John Ryan, S.J., M.A., D.Litt.;

Reverend Francis Shaw, S.J., M.A.;

Éamonn Mac Giolla Iasachta, M.A., D.Litt.;

Ernest Gordon Quin, M.A., F.T.C.D.;

Reverend Donnchadh Ó Floinn, M.A.

3. THE GOVERNING BOARD OF THE SCHOOL OF THEORETICAL PHYSICS.

Chairman:

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

Senior Professors:

Erwin Schroedinger, M.A., Ph.D., D.Sc., F.R.S.;

John L. Synge, M.A., Sc.D., F.R.S.C., F.R.S.

Appointed Members:

Albert J. McConnell, M.A., M.Sc., Sc.D.;

George R. Keating, M.Sc.;

Thomas S. Wheeler, Ph.D., D.Sc., F.R.C.Sc.I.;

Reverend James R. McConnell, D.Sc.;

Máirtín Ó Tnúthail, D.Sc.;

Patrick Quinlan, B.E., M.Sc., Ph.D.

4. THE GOVERNING BOARD OF THE SCHOOL OF COSMIC PHYSICS.

Chairman:

Ernest T. S. Walton, M.A., M.Sc., Ph.D., F.T.C.D.

Senior Professors:

Leo W. Pollak, Ph.D.;

Hermann A. Brück, D.Phil., Ph.D.;

Cormac Ó Ceallaigh, M.Sc.

Appointed Members:

John J. Dowling, M.A., F.Inst.Phys.;

Eric M. Lindsay, M.A., M.Sc., Ph.D.;

Rev. Patrick J. I. McLaughlin, D.Sc.;

Thomas Edwin Nevin, D.Sc.;

Patrick J. Nolan, Ph.D., D.Sc.;

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

Mariano Doporto, D.Phys.Sc.

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

1. ACADEMIC STAFF, SCHOLARS AND EXTERN RESEARCH WORKERS.

Senior Professors:

Michael A. O'Brien, Director of the School;

Daniel A. Binchy;

Myles Dillon.

Professors:

James P. Carney;

David Greene (appointed as from 1 April 1953).

Assistant Professors:

Miss Cecile O'Rahilly;

Rev. Cuthbert McGrath, O.F.M.

Assistant:

Miss Sheila Falconer.

Scholars:

Louis Paul Nemo (Roparz Hémon);

Mrs. Nessa Doran;

Dr. Aled I. R. Wiliam (from 15 April 1953);

Séamus Breathnach (from 1 October 1953).

Extern Research Workers commissioned by the School:

Dr. R. I. Best;

Mr. Seán Mac Airt;

Mr. Liam Price;

Mrs. Mary Ellen Carney;

Rev. Shan Ó Cuív;

Professor J. Vendryes;

Dr. Tomás de Bhaldraithe;

Rev. Seán Ó Catháin, S.J.;

Rev. Lambert McKenna, S.J.;

Rev. Canice Mooney, O.F.M.;

Rev. Anselm Faulkner, O.F.M.;

Rev. Pádraig Ó Súilleabháin, O.F.M.;

Rev. Bartholomew Egan, O.F.M.;

Professor Heinrich Wagner;

R. B. Breatnach.

2. GENERAL LINES OF RESEARCH WORK.

As usual, the main work of the School during the year lay in Irish studies, both early and modern; in the latter field the collection of material for the linguistic atlas was nearly completed and it is expected that the coming session will see the work of compilation begun. Another notable achievement was the publication of Dr. de Bhaldraithe's morphology of the dialect of Cois Fairrge; the author hopes to extend his survey of this dialect to the syntax and vocabulary. Other branches of Celtic studies were not neglected; apart from work on etymology and comparative literature, works on mediaeval Breton and on modern Scottish Gaelic dialects were in preparation and are expected to be ready for the printer during the coming year. Celtica Vol.II, part 2 appeared and Vol.III was in preparation, as was a special Zeuss Memorial volume, under the editorship of Professor Myles Dillon, to which many leading Indo-European scholars have promised to contribute. Two books were published in the Mediaeval and Modern Irish Series, one was with the printers and two were in preparation, while fifteen volumes were in preparation in the Hiberno-Latin Texts Series. The first volume of the Book of Leinster, originally undertaken by Drs. Bergin and Best and now carried on by Drs. Best and O'Brien, made its appearance, while the material for the second volume is with the printers. At the end of the year under review eight volumes, edited or written by members of the staff or by extern research workers, had been published, fourteen were in the press and material for twenty-four others was in course of preparation.

During this session, the School was invited to initiate the series of Thomas Davis Lectures on Radio Éireann. Six lectures were given by the Senior Professors and Professors on the theme of Early Irish Society; these lectures have since been published by the Cultural Relations Committee of the Department of External Affairs under the editorship of Professor Myles Dillon. There follows a list of the lectures: The Irish Language, by Myles Dillon; Early Irish Literature, by David Greene; Irish Origin-Legends, by M. A. O'Brien; Secular Institutions, by D. A. Binchy; The Impact of Christianity, by James Carney; and Early Irish Society, by David Greene.

A record of work in progress by individual members of the academic staff, scholars and research workers follows.

Senior Professors:

Michael O'Brien: Edited material for Celtica III; as co-editor with Dr. Best of the Book of Leinster revised Vol.II and checked it with photostats and manuscript; continued work on Indexes of Vol.I (in the press) of Corpus Genealogiarum Hibernicarum and on the texts of Vols.II and III; work progressed on a new edition of the Old Irish Life of St. Brigid and on a new edition of the Feast of Bricriu; articles for Celtica III prepared and sent to press; edited a Middle Irish poem for Ériu, Vol.XVII, Part I; contributed a series of Grammatical and Etymological Notes to the Zeuss Memorial Volume of Celtica.

Daniel A. Binchy: Work on Early Irish Law and legal texts; the work of transcribing all the legal manuscripts with a view to publishing a Corpus Iuris Hibernici was continued; re-edited an Old Irish law-tract for Ériu, Vol.XVII, Part I (in the press); contributed an article on 'Some Celtic Law Terms' to the Zeuss Memorial Volume of Celtica.
Delivered the Lowell Lectures in Boston during March 1954.

Myles Dillon: Completed and saw through press the General Index to the British Museum Catalogue; revised and returned final proof of

letter G for the Royal Irish Academy Contributions to a Dictionary of the Irish Language; edited Serglige Con Culainn for the Mediaeval and Modern Irish Series, Vol.XIV; work proceeded on a new edition of Lebor na gCert; excerpting for the Dictionary of Classical Modern Irish was continued. LECTURED on Celtic at various Universities in Australia and India during the summer of 1953.

Professors:

James P. Carney: Studies in Irish Literature, a book of about 400 pp., is now in the press; work continued on the preparation of a Catalogue of Irish Manuscripts in the National Library.

David Greene: During the year completed and sent to press Fingal Rónáin and Other Stories for the Mediaeval and Modern Irish Series, as well as continuing work on the proofs of Duanaire Nheig Uidhir, only part of which had come back from the printer during the period under review; gave two lectures in the Thomas Davis series and attended and took part in the discussion at the International Conference on Celtic Folk-Lore organised by the British Council in Scotland in October 1953; prepared articles for Celtica III and for the Zeuss Memorial Volume; published two articles and a review in Celtica II, part 2; an article on Irish Literature appeared in the 1954 American printing of the Encyclopaedia Britannica; contributed an article to Ériu, Vol.XVII, Part I (now in the press).

Assistant Professors:

Miss Cecile O'Rahilly: Edition of Trompa na bhFlaitheas completed and is now being seen through press; work on the Dictionary of Classical Modern Irish continued.

Rev. Cuthbert McGrath, O.F.M.: Work on Flunket's Latin-Irish Dictionary continued; two volumes of Franciscan verse in the press.

Assistant:

Miss Sheila Falconer: An edition of an Early Modern Irish version of the Quest of the Holy Grail has now appeared; review of La legende Arthurienne et le Graal has been published in Celtica II, 2; edition of short text on the Life of Pope Gregory from MS. Rawl. B 477 prepared; first article on the Verbal System of the LU Táin sent in for Ériu, Vol. XVII, Part I; excerpting works for the Dictionary of Classical Modern Irish continued.

Scholars:

Roparz Hemon: Continued research work on various aspects of Middle and Modern Breton; two articles have been published in Celtica II, 2; article for Celtica III prepared; preparation of an edition of Christmas Hymns in the Vannes Dialect completed.

Mrs. Nessa Doran: Transcription of the bardic poems in the Book of Fermoy completed; commenced work on preparation of Catalogue of Irish Manuscripts in the National Library under the supervision of Professor Carney.

Dr. Aled I. R. Wiliam: Attended courses in Old Irish at both Universities; worked on a Middle Welsh law book under the direction of Professor Binchy.

Séamus Breathnach: Worked on Togail Troí and similar translation literature.

Extern Research Workers:

Dr. R. I. Best: Volume I of an edition of the Book of Leinster has appeared; Vol. II in the press, and further volumes in preparation.

Séan Mac Airt: Work progressed on a new edition of the Annals of Ulster.

Liam Price: A new volume in the series of Place-Names of Co. Wicklow has now been published.

Mrs. Mary Ellen Carney: Work continued on the Irish version of the Aphorisms of Hippocrates.

Rev. Shan Ó Cuív: Materials for a bibliography of the works of Canon Peter O'Leary, a supplement to Celtica II, 2, has now appeared.

Joseph Vendryes: Edition of Airne Fíngéin has now appeared; work on an Etymological Dictionary of Irish continued.

Tomás de Bhaldraithe: A work on the phonology and grammar of the Irish of Cois Fhairrge has now appeared.

Rev. Seán Ó Catháin, S.J.: Edition of Betha Muire in the press.

Rev. Lambert McKenna, S.J.: Edition of text on Metrical Defects in Bardic Poetry and a Commentary on the Introduction to the Irish Grammatical Tracts in preparation for Celtica.

Rev. Canice Mooney, O.F.M.: An edition of Seanmónta Chonntae Thir Eoghain in the press; an edition of Poenitentiarum Sancti Maelruain has appeared in Celtica II, 2.

Rev. Anselm Faulkner, O.F.M.: Edition of Farrthas an Anma has now appeared; editions of Beatha Dhiadha and Scáthán Spioradálta in progress.

Rev. Pádraig Ó Súilleabháin, O.F.M.: Editions of Beatha San Froinsias and Lucerna Fidelium in the press; work on editions of Buaidh na Croiche and An tAirdheach Ríogha in progress.

Rev. Bartholomew Egan, O.F.M.: An edition of O'Hussey's and O'Mulconry's grammars in the press.

Heinrich Wagner: Continued collection of material for the Irish Linguistic Atlas in various counties.

R. B. Breatnach: Worked on Déisi Irish materials left by the late Archbishop Michael Sheehan.

3. COURSES OF LECTURES.

Professor Binchy gave the Lowell Lectures in Boston during March 1954. His subject was Celtic Institutions, on which he delivered eight lectures.

Professor Binchy also delivered two lectures on Celtic and Roman Law and Celtic Kingship to the Mediaeval Academy of America at Harvard University.

Professor Dillon lectured on Irish literature and philology at various Universities in Australia and India during the summer of 1953.

4. STATUTORY PUBLIC LECTURE.

The Statutory Public Lecture under the auspices of the School was delivered by Professor D. A. Binchy in Trinity College, Dublin, on Tuesday, 1st December 1953. Professor Binchy's subject was Celtic Kingship.

5. PUBLICATIONS.

	Date of Publication
AIRNE FÍNGEIN. Edited by Joseph Vendryes. (Mediaeval and Modern Irish Series, Vol.XV) pp.xxiii + 95. Price 5s.	11/7/53
SERGLIGE CON CULAINN. Edited by Myles Dillon. (Mediaeval and Modern Irish Series, Vol.XIV) pp.xviii + 93. Price 5s.	9/10/53
PARRTHAS AN ANMA. Anselm Ó Fachtna, O.F.M. a chuir in eagar. (Scribhinní Gaeilge na mBrathar Mionur, Iml.III) pp.xxviii + 251 + 2 facs. plates. Price 15s.	9/10/53
LORGAIREACHT AN tSOIDHIGH NAOMHTHA. Edited by Sheila Falconer. pp.xcix + 394. Price 2ls.	30/11/53

THE PLACE-NAMES OF CO. WICKLOW - IV.

The Barony of Talbotstown Lower.
By Liam Price.

pp.185-280.

Price 2s.

30/12/53

GAEILGE CHOIS FHAIRRGE. An Deilbhíocht.

Tomás de Bhaldraithe a chuir le chéile.

pp.xxiv + 394.

Price 2ls.

31/12/53

CELTICA, Vol.II, Part 2. Edited by M. A. O'Brien.

With Supplement - Materials for a Bibliography
of the Very Reverend Canon Peter O'Leary.

pp.217-364 + Supplement pp.39.

Price 5s.

11/2/54

Supplement to Celtica.

Price 1s.

THE BOOK OF LEINSTER, Vol.I.

Edited by R. I. Best and M. A. O'Brien.

pp.xxvi + 260 + 3 facs. plates.

Price 30s.

31/3/54

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

1. ACADEMIC STAFF AND SCHOLARS.

Senior Professors:

Erwin Schroedinger, Director of the School;

John L. Synge.

Assistant:

Ernesto Corinaldesi (appointed January 1954).

Visiting Professors:

Cornelius Lanczos;

Francis J. Murray;

Walter Heitler.

Scholars:

F. Roesler (left June 1953);

M. J. Klein (left July 1953);

J. R. Pounder;

V. G. Hart;

H. F. Sandham;

P. N. Daykin (left August 1953);

P. J. Donohoe (left September 1953);

J. G. Roche (left December 1953);

B. Bertotti (entered October 1953);

C. B. Rayner (entered October 1953);

S. O'Brien.

Technical Assistant:

Miss Evelyn Wills.

Studentship:

Rev. James McMahon was granted a studentship, which he held at Stanford University from October 1952 to September 1953.

2. GENERAL LINES OF RESEARCH WORK.

The basic relations for antiferromagnetic substances were worked out in a simplified form, using the work of van Vleck and the original Weiss theory of ferromagnetism, supported by Heisenberg's theory of exchange energy. The critical investigation of current quantum theory was continued; its concept of measurement, in the opinion of one of us (Schroedinger), is modelled much too closely after the pattern of astronomy, which aims at predicting the future behaviour of a system, which it can only observe but not influence, from previous measurements on the same system. This pattern fits very few, if any, measuring devices actually used by physicists. The relation between the two existing versions (real and complex) of the generalized theory of gravitation was investigated with a view to the feasibility of other versions, suggested by those two, but different from them (Bertotti). The Einstein-Hofmann-Infeld equations of motion for the two-body-problem were analysed with a view to vouchsafing a direct understanding of the origin of the bewildering assembly of correction terms by which these laws of motion differ from Newton's (Bertotti). A systematic analysis of the observational findings that would present themselves in a so-called de Sitter World led to interesting results (partly adumbrated long ago by A. S. Eddington) in some of the representations of this cosmological solution of Einstein's theory of gravitation. The result, familiar from text-books, that no body or light-pulse can cross the closed spherical "mass-horizon" (where time seems to "stand still") is contrasted with the fact that nearly all bodies in free motion move from some point of the mass-horizon to some other point within a finite span of their eigentime. Intelligent observers near the centre can infer from their observations that this is so; the whereabouts of man or beast (possibly inhabiting such a body) before and after that time-span might well puzzle the central observers, even though in their own time scale the said time-span reaches from the infinite past to the infinite future.

Professor Synge has nearly completed a book on relativity to be published by the North-Holland Publishing Co.; in this work Mr. Gardner has contributed a method for solving an algebraic problem presented by the

collision of spinning particles, and Mr. Sandham proofs of certain theorems on Bessel functions needed in the theory of shock waves in a relativistic gas.

Mr. Hart wrote a paper on the equilibrium of membranes elastically supported, and has been engaged on solving boundary-value problems by numerical methods, in particular the problem of finding the steady current in a tank of viscous liquid under the action of a wind blowing across its surface, which involves the solution of the biharmonic equation.

Mr. Pounder has been investigating problems in electrostatics and in elasticity, in particular the vibrations of rods.

Mr. Rayner has worked out the gravitational field of a rotating sphere on the basis of Whitehead's theory of relativity and the effects on planetary motion due to the rotation.

The problem of constructing a potential $V(r)$ from given S phase shift and binding energies of the Klein-Gordon equation has been treated by Dr. Corinaldesi, and the analogue of the Gel'fand and Levitan integral equation has been established. Professor Heitler kindly read and criticized the manuscript of a paper on this subject, which has been accepted for publication. The possibility of extending this work to the case of the Dirac equation is being considered. Dr. Corinaldesi is also studying the question of the validity of the Born approximation as applied to relativistic equations. This work originates from the remark that so far no criterion exists for deciding in which cases the approximation is reliable. The problem is of importance in connection with recent experiments on scattering of high energy electrons by nuclei.

Dr. Heitler's research activities were connected with work being carried out in Dublin, in particular with Rev. Professor McConnell's work on the negative proton. Professor Heitler spent considerable time with Dr. Corinaldesi, making a survey of the present state of quantum electrodynamics and meson theory.

Mr. Sandham investigated properties of the elliptic and hypergeometric functions, and from these deduced results in number theory and the summation of series. He is at present completing a paper on "Products of Hypergeometric Series".

Mr. Roche worked on the mathematical theory of statistics.

Dr. Lanczos developed a formula which expresses the definite integral of an analytical function with the help of the value of the function and its first n derivatives at both end-points of the range, by approximations of increasing convergence. It was shown how the repeated application of this formula can be used for the solution of ordinary differential equations and of eigenvalue problems of the Sturm-Liouville type.

Fr. McMahon collaborated with Professor G. Szégo in examining the eigenvalues of nearly circular and nearly spherical domains, and the most significant results obtained were published by G. Szégo in a Technical Report (Nr. 34) for the Office of Naval Research, under the title "Isoperimetric Inequalities for certain Eigenvalues of a Membrane". He also worked on the lower bounds for the electrostatic capacity of a body in Euclidean n -space, and a paper on this topic is in preparation for publication. He attended lectures on Conformal and Quasi-Conformal Mapping, Partial Differential Equations, Hilbert Space, and Modern Theories of Measure and Integration.

3. SEMINAR AND LECTURES.

In the summer term Professor Schroedinger completed the series of lectures to the Seminar on Unified Field Theory, begun the previous term. Professor Synge then gave two courses of lectures, the first on the instability of the tippe-top, the second on relativistic statistical mechanics. This was followed by two further short courses, given by Professor Schroedinger, the first on some questions in Einstein's new unified field theory raised by Dr. C. P. Johnston in Physical Review (89, 320; January 1953) and the second on Onsager's statistical theory of

irreversible processes. Professor Lanczos lectured on the determination of eigenvalues of ordinary differential equations by using information available at the two end-points of the range.

During the first winter term Professor Synge spoke on some basic concepts in space-time, and Professor Schroedinger lectured on ferromagnetism and antiferromagnetism.

In the second winter term, two courses of lectures were given by Professor Heitler. The first of these courses was on the principle of detailed balance, and the second on the theory of line-breadth. He also delivered a lecture on the self-stress of the electron.

In the second winter term Professor McCusker also gave a series of talks, on recent experimental progress in cosmic radiation; and Dr. Corinaldesi gave some informal seminars on field theory.

Members of staff and students from Trinity College, Dublin, University College, Dublin, and St. Patrick's College, Maynooth, as well as members of the two physics schools of the Institute attended these courses, as usual.

4. STATUTORY PUBLIC LECTURE.

The Statutory Public Lecture was delivered under the auspices of the School in University College, Dublin, on Friday, 12 February 1954, at 8 p.m. by Professor R. E. Peierls (University of Birmingham). His subject was: Our Present Knowledge of the Atomic Nucleus.

5. VISITING PROFESSORS.

Professor C. Lanczos (now of North American Aviation, Los Angeles) left on October 3, 1953, having spent the academic year 1952-53 at the School.

Professor F. J. Murray, here on three months leave of absence from Columbia University, New York, left in April 1953.

Professor W. Heitler (University of Zürich) spent the session from January to April 1954, at the School.

6. VISITING LECTURERS.

Professor A. Proca, of the Institut Henri Poincaré, visited the School from 26 to 28 January 1954, and gave two lectures to the Seminar, on Fundamental Particle Mechanics.

Professor R. E. Peierls, of the University of Birmingham, visited the School on February 12 and 13, 1954, and gave three lectures to the Seminar on selected problems from the theory of the nucleus. The problems were: Charge Independence and Isotopic Spin; Nuclear Models; Stripping Reactions.

7. DISTINGUISHED VISITORS.

During the period under review Professor R. Fürth (in May), Dr. G. Stephenson (in April), and Dr. E. Arnaud (in February) paid short visits to the School. Professor H. S. Green (University of Adelaide), a former Visiting Professor at the School, spent some days in May here, and lectured to the Seminar on 22 May, on his recent theoretical work in cosmic radiation.

8. PROFESSORS' ACTIVITIES.

Professor Synge lectured at Queen's University, Belfast, on "Function-space: elementary ideas and applications", on February 4, 1954. At the Spring Meeting of the Physical Society (London) on High Energy Accelerators and Cosmic Rays, at University College, Dublin, he read a paper entitled "Relativistic Theory of Collisions of Particles with Angular Momentum" on 31 March 1954.

The annual European Forum at Alpbach was held from 15 August to 4 September 1953, and as usual Dr. Schroedinger attended this. He was also present at the meeting of the German and Austrian Physical Societies at Innsbruck, from September 20 to 25, 1953.

Early in March 1954 Professor Heitler delivered a lecture at the University of Liverpool, on the Theory of Line Breadth. On April 5 he lectured on the Self-Stress of the Electron, at St. Patrick's College, Maynooth.

The honorary degree of D.Sc. was conferred on Professor Heitler by the National University of Ireland on April 8 1954.

In May 1953 Dr. Lanczos lectured at the University College of the South West of England (Exeter) on the application of the Chebysheff polynomials to the solution of differential equations. In June 1953 he spoke at Birkbeck College (University of London) on integration by end-point information; and to the London Mathematical Society on: "Convergent differentiation of a Fourier series".

9. APPOINTMENT.

On 11 November 1953, the President, on the advice of the Government, under paragraph 8 (3) of the Institute for Advanced Studies Act, 1940, appointed Cornelius Lanczos, Ph.D., to a post as Senior Professor in the School of Theoretical Physics with effect as from 1 April 1954.

10. PUBLICATIONS.

- (1) Book: Nature and the Greeks. By E. Schroedinger.

University Press, Cambridge, 1954.

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

No.11 - On Relativistically Rigid Surfaces of Revolution.
By J. R. Pounder.

Price 3s. pp. 53. Published 30 January 1954.

(3) Contributions to Periodicals:

(a) Contributions recorded as in the press in previous reports:

- Rev. J. McMahon: Lower bounds for the electrostatic capacity of a cube. Proc. R.I.A. 55 A 9, 133, July, 1953.
- F. C. Roesler and C. B. A. McCusker: On the anisotropic distribution of secondaries in extreme energy cosmic ray stars. Phys. Rev., 91, 690, 1953.
- M. J. Klein: Order, organization and entropy. B.J.P.S., 4, No. 14, 158, 1953.
- H. F. Sandham: A square as the sum of seven squares. Quart. J. Math. Oxford, 4, 230, 1953.
- H. F. Sandham: A square as the sum of nine, eleven and thirteen squares. J. Lond. Math. Soc., 29, 31, 1954.
- H. F. Sandham: Two series of partitions. Amer. Math. Monthly, 61, 104, 1954.
- N. L. Balázs: Les Relations d'incertitude d'Heisenberg empêchent-elles le "Démon de Maxwell" d'opérer? Comptes Rendus des séances de l'Académie des Sciences, 236, 998, 1953.
- J. L. Synge: Fundamental Theorem of Electrical Networks (A Note): Quart. Appl. Math. 11, 215, July 1953.
- J. L. Synge: Flow of viscous liquid through pipes and channels. Proc. Fourth Symposium on Appl. Math. of the Amer. Math. Soc.; McGraw-Hill, 1953, p.141.
- J. L. Synge: On the transfer of energy between electro-magnetic dipoles. Proc. R.I.A., 56 A 1, 1 January, 1954.

(b) New Contributions:

- J. L. Synge: Review of R. Weinstock's "Calculus of variations with applications to physics and engineering". Bulletin Amer. Math. Soc., 59, 402, 1953.
- Stephen O'Brien and J. L. Synge: The instability of the tip-top explained by sliding friction. Proc. R.I.A., 56 A 3, 23, February, 1954.
- N. L. Balázs: The energy-momentum tensor of the electro-magnetic field inside matter. Phys. Rev. 91, 408, 1953.
- E. Schroedinger: The general theory of relativity and wave-mechanics. Scientific Papers (presented to Max Born), Oliver and Boyd, Edinburgh, 65, 1953.
- E. Schroedinger: Electric charge and current engendered by combined Maxwell-Einstein-fields. Proc. R.I.A. 56 A 2, 13, February, 1954.
- E. Corinaldesi: Relativistic scattering of electrons and the Born approximation. Nuovo Cim. 11, 200, 1954.

- E. Schroedinger: Measurement of length and angle in quantum mechanics. *Nature*, 173, 442, 1954.
- C. B. A. McCusker and F. C. Roesler: New evidence concerning extreme energy interactions in heavy nuclei. *Phys. Rev.* 91, 769, 1953.
- C. B. A. McCusker and F. C. Roesler: Interpretation of O+xp type stars in photographic emulsions. *Phys. Rev.* 91, 769, 1953.
- (c) The following contributions were in the press at the end of the period under review:
- M. J. Klein: A note on Wild's solution of the Boltzmann equation. *Proc. Camb. Phil. Soc.* 50, 293, 1954.
- C. B. Rayner: The application of the Whitehead theory of relativity to non-static, spherically symmetrical systems. *Proc. Roy. Soc. A*, 222, 509, 1954.
- V. G. Hart: Equilibrium of membranes elastically supported at the edges. *Quart. Appl. Math.*
- B. Bertotti: On the relation between fundamental tensor and affinity in unified field theory. *Nuovo Cim.* 11, 358, 1954.
- E. Corinaldesi: Construction of potentials from phase shift and binding energies of relativistic equations. *Nuovo Cim.*
- H. F. Sandham: The perimeter of an ellipse. Accepted for reading at the International Congress of Mathematicians at Amsterdam, September, 1954.

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

A. Astronomical Section, Dunsink Observatory

1. ACADEMIC STAFF AND SCHOLARS

Senior Professor: H. A. Brück.

Chief Assistant: H. E. Butler (resigned 31 October 1953).

Research Associate: Máire T. Brück.

Assistant (part-time): F. J. O'Connor (resigned 31 March 1954).

Scholar: G. I. Thompson.

2. EQUIPMENT.

The tube and mirror cell for the new 28-inch reflector have been delivered and mounted. The 28-inch mirror itself is being re-figured by Messrs. Cox, Hargreaves and Thomson, Ltd., who have also undertaken the work of providing the necessary convex and flat auxiliary mirrors.

The Eichner Iris Astrophotometer for the photometric measurement of star plates has been delivered and set up. A stereocomparator for the simultaneous inspection of pairs of star plates has been acquired from the Oxford University Observatory.

A mounting for the 15-inch concave mirror with fine adjustments for eclipse work has been constructed in the workshop.

3. RESEARCH WORK.

Solar Work: Dr. G. I. Thompson has been engaged in taking solar spectra in the near and far ultraviolet both in the second and third orders of the grating. These plates have been carefully standardised photometrically, and microphotometer tracings have been obtained of most of them. The definition of these spectra is excellent and, at least in the third order, superior to the Mount Wilson spectra on which the well-known Utrecht photometric solar atlas is based. The final evaluation of the

plates will have to wait for the construction, now well advanced, of an attachment to the Moll Photometer which will make it possible to record intensities directly.

Dr. Thompson has obtained also sets of plates of the Kr line 4320 Å in the first and third orders with a view to deriving exact instrumental profiles in these orders.

The instrumental profile in the second order has been studied by Dr. Maire Brück who with Professor Brück has been responsible for other photometric tests of the performance of the spectrograph the results of which have been included in a paper on the Dunsink solar installation, now in the press.

A new photoelectric photometer for the direct recording of the solar spectrum is being developed in which difficulties such as that of variations in sky transparency are overcome, and which will make it possible for instance to detect changes in line profiles such as those suspected at the time of solar flares, of as little as 3 per mille of the intensity of the continuous spectrum.

Some time has been spent on preparing apparatus for observation of the total solar eclipse of 30 June 1954. As indicated in the last Report, interferometric measurements of line widths in the flash spectrum, attempted first at the 1952 eclipse, were to be repeated with more powerful equipment. This part of the programme has been worked out in close co-operation with Dr. D. A. Jackson, F.R.S., now of the Laboratoire Bellevue of Paris.

The second part of the eclipse programme is to be concerned with an attempt to extend as far as possible into the outer parts of the corona measurements of intensity and polarisation, and the performance of suitable optics of sufficient light gathering power in combination with red and polaroid filters has been investigated for this purpose.

Stellar Work: The 12-inch refractor has been used for the regular observation of lunar occultations and, for a time, for lunar photographs,

the latter to test its suitability for regular determinations of positions of the Moon which with a special moon camera attachment, developed by the U.S. Naval Observatory of Washington, are to be undertaken by sixteen different observatories, including Dunsink.

Dr. Butler has continued testing for a number of star plates of different type his automatic method of star counting and has written up a detailed account, now in the press, of the principle involved.

Professor Brück has tested the performance of the new Iris Star Photometer by measuring the magnitudes of about a thousand stars in standard fields of the southern sky. The plates had been secured with the ADH telescope by Dr. Butler during his stay in Bloemfontein.

With the new photometer it is possible to measure with considerable accuracy on one plate stellar magnitudes over a range of 9 or even 10 magnitudes, corresponding to an intensity ratio of 10,000 to one, as compared with a range of 3 or 4 magnitudes in conventional photometers.

A start has been made with the measurement of ADH plates of open star clusters which are to lead to knowledge of their distribution in space along the spiral arms of our galaxy.

4. CONFERENCES.

Professor Brück attended in May a meeting in Leiden, called by Professor Oort, to discuss with representatives from various continental countries astronomical co-operation in South Africa and the future of the Boyden Station in Bloemfontein. Visits were paid on that occasion to the Amsterdam and Utrecht Observatories where solar problems were discussed.

In October Professor Brück attended the Bremen meeting of the Astronomische Gesellschaft and lectured there and at the Hamburg Observatory on recent solar and stellar work at Dunsink.

5. PERSONAL.

Dr. H. E. Butler left the staff of the Observatory on 31 October 1953 on his appointment as Chief Assistant (with the rank of Principal Scientific Officer) at the Royal Observatory, Edinburgh. No successor had been appointed yet at the end of the period under consideration. Mr. O'Connor resigned from his post as temporary Assistant on 31 March 1954.

6. OPEN NIGHTS AND VISITORS.

The Observatory has been open to the public as usual on the first Saturday of each month. These Open Nights have proved as popular as ever. Special arrangements have been made whenever possible for members of various societies to visit the Observatory, and the total number of visitors has been about 4000, the same as last year. Distinguished astronomers who came to Dunsink during the year, have included Professor Bok of Harvard and Professor Meurers of Bonn with both of whom problems of common interest were discussed.

7. PUBLICATIONS.

Contributions from the Dunsink Observatory:

No.8: H. E. Butler: An Indirect Method of Starcounting.
("Vistas in Astronomy", 1954. In Print).

Summary: The paper discusses the possibility of deriving the relative numbers of stars of different brightness on a photographic plate from galvanometer records which measure the intensity of a parallel beam of light which has passed through two identical copies of the original plate. The records are taken while the plates are moved from a position of complete coincidence to one in which stars on one copy correspond to sky background on the other. The method has been tested in the case of plates of various type, and satisfactory results have been obtained though certain difficulties have arisen in some cases.

No.9: H. A. Brück and Máire T. Brück: The Solar Installation of Dunsink Observatory. ("Vistas in Astronomy", 1954.
In Print).

Summary: The construction of the various parts of the solar telescope and spectroscope are described, and an account is given of some tests of the spectrograph. Such tests show for instance that the

intensity of scattered light in the blue region of the spectrum and in the second order amounts to only 0.1 to 0.3 per cent of the intensity of the spectrum. The resolving power of the instrument has been determined by means of its instrumental profile. In the second order the half-value width of the Kr line 4320 has been found to be as small as 0.029 mm which corresponds to a resolving power of 110,000 or to 70 per cent of the theoretical value. The high resolution of the spectrograph becomes evident in the quality of the solar spectra in which blends are more clearly resolved than in the Utrecht Atlas of the solar spectrum, based on Mount Wilson spectrograms.

H. A. Brück: Measurements of Line Widths in the Flash Spectrum.
(Publ. Accademia Naz. dei Lincei, 1953).

Summary: This paper discusses the question of the resolution necessary to secure reliable measures of the widths of chromospheric lines for determinations of temperature and turbulence. The resolving power of ordinary spectroscopes as normally used for observation of the flash spectrum, is too small to allow accurate measurement of narrow lines. The advantages of interferometers such as the Fabry Perot etalon are discussed, and the results of a first attempt to use such an interferometer during an eclipse are presented.

Non-technical articles have included three papers on the present position of solar physics and the state of astronomical cosmology by Professor Brück, published in "Studies", 1953 and 54.

B. Cosmic Ray Section

ACADEMIC STAFF AND SCHOLARS.

Senior Professor: C. Ó. Ceallaigh.

Professor: C. B. A. McCusker.

Research Associate: T. E. Nevin.

Scholars: B. G. Wilson (entered 1 Sept. 1952).

P. D. McCormack (entered 1 Nov. 1952).

R. H. W. Johnston (entered 1 Oct. 1953).

J. Dardis (entered without stipend 1 Dec. 1952,
now on Department of Education Research
Grant).

Following the appointment of the Senior Professor, the scope of the work of the Section has been enlarged by the inclusion of the major technique of the nuclear research photographic plate. Thus, in the work now in progress, all the leading methods are represented - photographic plates, cloud-chambers and various types of counters.

Two microscopes and associated equipment, the property of the Institute were transferred from University College, Cork and set up in Dublin and, in addition, through the courtesy of Professor J. J. McHenry, a third instrument carrying a scattering stage has been made available. This has been done on the understanding that it will be replaced by an instrument of equivalent performance. The replacement instrument is at present under construction.

The Departments of Education and Finance sanctioned the employment of not more than four scanners. The following were appointed on a temporary basis in this capacity - Miss M.M. O'Hea, M.Sc., Mrs. R.H.V. Johnston, who came to Dublin already trained, and two trainees, Miss P. Leahy and Miss M. O'Brien. The latter have made excellent progress, and all have proved very satisfactory.

In addition to the three instruments brought from Cork, 3 Zeiss Winckel Standard Microscopes for scanning purposes, and 1 Cooke Troughton Simms M. 4000 microscope, have been bought for the Section.

In common with the Physics Dept., University College, Dublin, the Institute purchased one half stack of exposed and processed stripped emulsions. Unfortunately, owing to errors in processing, these plates have proved very disappointing. Great difficulty has been found in tracing π -mesons through the stack to events from which they emerge, which is a severe limitation on the usefulness of the plates. Because of this, the attention is now being directed to the identification of the grey tracks emerging from stars of which the speed and geometry is such that they are likely to be arrested in the stack.

One event of great interest has been observed by Mrs. R.H.W. Johnston. It has been interpreted as the interaction of a hyperon arrested in photographic emulsion, and would appear to be the first unambiguous case of such a process. Recently, a similar event has been observed at the University of Padua.

It is planned to obtain a new exposure under matter at moderate altitudes in order to obtain satisfactory yields of heavy meson events. Unfortunately, this project has received a setback because of the recent grounding of commercial Comet aircraft.

In addition to the foregoing, work is in progress, which is of a more technical nature, but which may be carried out conveniently with the plates available.

1) Calibration experiments for mass estimation by the range-scattering method,

2) Development of the gap-length-residual range technique of mass-estimation with particular emphasis on the method of mean gap-length.

Reports on the latter work have been made during the year by C. O'Ceallaigh (1), at the International Conference at Bagnères de Bigorre, July 1953, and (2), at the recent Conference at Padua, April 1954. The latter communication is at present in course of publication.

During the year Mr. Daly spent a short period at the H.H. Wills Physical Laboratory where he was engaged in learning the techniques of microscope maintenance and design.

During the year further work by Dr. F.C. Roesler and Professor McCusker on the theory of the so-called 'jets' in photographic emulsions has appeared. Experimental work by Italian and Belgian physicists has confirmed this theory and it has been extended by Heitler and Terresux and more recently by Cocconi. In addition to this an explanation by Professor McCusker and Dr. F.C. Roesler of the related $O + xp$ type stars has been confirmed by the experimental work of Mei and Pickup. Further it has been possible to show that in a version of the Fermi theory of very high energy

interactions modified to overcome the difficulty caused by the limited transverse velocity in the interaction zone and the postulate of established equilibrium, the anisotropy caused by the conservation of momentum is much too small to account for that observed. A similar conclusion was later reached by Bhabha. Theoretical work on these very interesting high energy encounters is being continued.

On the experimental side the results of the experiment on meson production in hydrogen have been published. The hodoscope is now working on an investigation of the nucleon cascade in lead. This experiment (in charge of Mr. Dardis) has already yielded some very interesting results which have meant continuing it for longer than originally planned. The transition curve of penetrating extensive showers shows a very peculiar form which now however it seems possible to explain. A variation of the rate of local penetrating showers with time has been observed and is being studied and confirmed.

Mr. McCormack has successfully built and operated a liquid scintillator and the associated electronics. His results have shown a second maximum in the transition curve in lead and a larger apparatus is being built to investigate this further.

The magnet and cloud chamber on which Mr. Wilson has been working is now in operation and a considerable number of pictures has been obtained.

Some of these are of great interest. Examples of hyperons, neutral and charged heavy mesons (including one τ -meson) and some possibly new phenomena have been observed. In addition the apparatus is being used to investigate the second maximum of the Rossi transition curve and the behaviour of μ -mesons in their passage through matter.

The parallel plate spark counter is now working. Progress has been considerably delayed by the large amount of extra work which the unexpected results of the hodoscope experiment has entailed.

During the year Professor McCusker has given a number of lectures including Part 1 of a course on recent progress in the study of cosmic radiation.

The Statutory Public Lecture was delivered by Professor C. O'Ceallaigh in Trinity College, Dublin on 22 March 1954. The lecture was entitled "The Nuclear Research Photographic Plate and its application to the study of Cosmic Radiation.

PUBLICATIONS.

- Menon, M.G.K., and O'Ceallaigh, C.: A note on the range-scattering method of mass estimation.
Phil.Mag. 44, 1291, Nov. 1953.
- Menon, M.G.K. and O'Ceallaigh, C.: Observations on the decay of heavy mesons in photographic emulsions.
Proc.Roy.Soc. A 221, 292.
- Johnston, R.H.W., and O'Ceallaigh, C.: Evidence for a nuclear interaction of a charged hyperon arrested in photographic emulsion.
Phil.Mag. 45, 424, 1954.
- McCusker, C.B.A., Porter, N.A., and Wilson, B.G.: Production of mesons above 10 Bev.
Phys.Rev. 91, 384, 1953.
- McCusker, C.B.A., and Roesler, F.C.: New evidence concerning extreme energy interactions in heavy nuclei.
Phys.Rev. 91, 769, 1953.
- McCusker, C.B.A., and Roesler, F.C.: The interpretation of O + xp type stars.
Phys.Rev. 91, 769, 1953.
- McCusker, C.B.A., and Roesler, F.C.: The anisotropic distribution of secondaries in extreme energy cosmic ray stars.
Phys.Rev. 91, 690, 1953.
- McCusker, C.B.A., and Roesler, F.C.: An analysis of cosmic ray jets.
Il Nuovo Cimento 11, 93, 1954.
- McCusker, C.B.A.: Recent Advances in the study of Cosmic Radiation: Part 1. Particle physics. Stencil copy of lecture notes, March 1954.
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C. Geophysical Section

1. ACADEMIC STAFF AND SCHOLARS.

Senior Professor: Leo W. Pollak, Director of the School.

Professor: Thomas Murphy.

Research Associate: P. J. Nolan.

Scholars: J. O'Connor (to 4 December 1953)

Thomas C. O'Connor (from 7 December 1953).

Senior Technical Assistant: Thomas J. Morley.

2. INVESTIGATIONS, EXPERIMENTAL AND FIELD WORK.

(i) The new (photographic) nuclei counter which works most satisfactorily, has been used for various experiments. In order to utilise fully the advantages of photographic recording a movable stage has been built-in which enables different parts of the graticule to be exposed in the airtight cloud chamber in quick succession without the necessity of waiting until the droplets of the showers have evaporated. Simultaneous observation by eye of the processes in the cloud chamber during recording is provided. A Polaroid Land camera which gives a finished picture on paper in the camera in one minute is being adapted for recording with the nuclei counter.

With improved technique approximately 200 photograms have been made, and both counted and analysed by Pollak. The results obtained with very constant concentration of nuclei taken from a large rubber gasometer show that the frequency distribution of nucleus counts is a fair approximation to the Poisson type of distribution.

A paper on the innovations and results will be read by POLLAK at the 10th General Assembly of the International Union for Geodesy and Geophysics in Rome, September 1954.

(ii) Professors Pollak and Murphy and Scholar Thomas O'Connor have continued their investigation of photo-electric condensation

nuclei counters. They extended their examinations to five counters all made exactly according to the same specification. A galvanometer of short period has been used to study the formation of the fog in the cloud chamber of the counters. Simultaneously, the coagulation of room air nuclei in our 4000 liter rubber gasometer is measured and the characteristic constants in the decay law determined by the least squares method.

The results will be communicated at the Rome meeting of the I.U.G.G. in September 1954.

(iii) Arising from the results of the gravity and magnetic survey already completed Professor Murphy carried out a vertical magnetic force survey in the Central Lowlands of Ireland during the months of April to July inclusive. He is working up this detailed magnetic survey and is also investigating the possibility of applying mathematical analysis to his data as a guide for future geophysical surveys.

(iv) A trial was made by Murphy on March 14, 1953 to detect at Rathfarnham the effect of a distant quarry blast. Four tons of explosives were used and the vertical seismograph, recently reconstructed in our workshop, recorded the arrival of the shock waves. Equipment for precise timing of future blasts is being assembled and the experiments are undertaken with a view to measuring the velocities of elastic waves in the various surface rocks of Ireland.

(v) Most of the elements of the high sensitive magnetometer have been constructed by Murphy using the special parts kindly presented to us by the Carnegie Institution of Washington.

(vi) Professor Murphy and Rev. Dr. Ingram, S.J. are studying experimentally the applicability of Ingram-Timoney's theory of an inverted pendulum with trifilar suspension, given in Geophysical Bulletin No.9, to a small version of O'Leary's seismograph.

(vii) A photo-electric sky brightness meter has been constructed in our workshop and some observations made (See Miscellaneous ii).

(viii) Dr. P. A. Heelan, S.J. developed a theory for the indentation of a plane and spherical membrane. This problem has interesting geophysical applications and is of practical value. The formulae appear to agree with experimental data previously obtained by Pollak and will be tested under improved conditions in the near future.

3. PUBLICATIONS.

- (i) L. W. Pollak and T. Murphy: Comparison of Photo-electric Nuclei Counters.
(Geofisica Pura e Applicata, Milano; Vol.25, 1953, pp.44-60).

Summary (Extract): Identical photo-electric nuclei counters have been compared using natural and artificially produced aerosols. The main results were obtained in the laboratory under controlled conditions using nuclei stored in a rubber gasometer of 4000 litres volume. No effects detrimental to the stored gas or any other objection to its use have been found.

The results of several thousand comparisons show that no two counters will record the same concentration of nuclei in samples taken simultaneously from the same enclosure. Each counter shows small random fluctuations of short period, $\pm 3\%$ of the concentration, with superimposed unpredictable variations of longer period. The differences in readings between any two counters depend on the concentration, the type and the relative amounts of the charged and uncharged nuclei in a sample. These differences, which seldom exceed $\pm 20\%$ of the concentration, are rather constant for several hours and even days. This feature enables allowances to be made for the differences and a routine of observations is suggested which has been successfully employed in the laboratory and in the open.

The investigation is proceeding.

- (ii) P. J. Nolan and P. S. MacCormaic: The nuclei produced by disruptive discharge at a water surface.
(Geophysical Bulletin of the School of Cosmic Physics, No.7; Dublin, July 1953).

Summary: Extremely small condensation nuclei are produced by electric discharge at a water surface. The nuclei are uncharged and consequently can play no part in the drop charging process of Wilson's theory of thunderstorms. The failure of previous observers to detect the discharge nuclei is ascribed to the low effective expansion ratio of the Aitken counter.

By measuring the size and the super-saturation required for condensation on discharge nuclei it is shown that there is a vapour pressure deficit of between 10% and 15%. Similar measurements indicate that in the case of atmospheric condensation nuclei the vapour pressure deficit is about 5%.

The Wilson ion and cloud expansion ratios are determined by means of the photo-electric nucleus counter. The results show that the expansion of the counter is truly adiabatic.

- (iii) T. Murphy: The magnetic survey of Ireland for the epoch 1950.5.
(Geophysical Memoirs of the School of Cosmic Physics,
No.4; Dublin 1953).

Summary (Extract): A magnetic survey of Ireland was carried out in 1950 comprising measurements of declination, horizontal intensity and inclination at 44 stations; 37 of these stations are identical with or very close to those occupied by Walker in 1915.

Normal values for all the components have been deduced by the method of least squares and presented in the form of linear equations involving the latitude and longitude.

The declination survey is shown to be in agreement with a survey of Great Britain made in 1948 and the deduced value for the vertical intensity is in good agreement with the Vertical Magnetic Survey of 1945 made by the Irish Geological Survey.

In order to compare this survey with the previous one in 1915, the normal values for the latter were recomputed. The deduced anomalies for the components at each station for the two surveys, apart from three exceptions, show no change within the limits of the experimental errors. The method for deducing declination values since the survey of 1915 by applying a simple correction obtained from magnetic observations in England is shown to be quite accurate.

Line integrals of the horizontal force have been computed for the epochs 1915.0 and 1950.5 and it is shown that the corresponding earth-air currents have no significance.

- (iv) E. J. Öpik: Convective transfer in the problem of climate.
(Geophysical Bulletin of the School of Cosmic Physics,
No.8; Dublin, October 1953).

Summary (Extract): Equations are given for the convective transfer of heat in vertical direction in free thermal convection, allowing for lateral exchange and introducing the concept of a dimensionless coefficient of contact transfer. These formulae represent experimental data within 20 to 30 per cent, whereas the usual "mixing length" approximation overestimates the transfer by a factor of about 30.

Similar formulae are given for the forced transfer in a steady-gradient atmosphere, caused by aerodynamic turbulence. Here the "mixing length" approximation is better, giving transfer figures which are too large by a factor of only about 3.

Equations are derived for the convective transfer along the earth's surface, by analogy with the above-mentioned simpler case, but using empirically determined local coefficients of proportionality. The variation of local mean temperature depending upon insolation is determined. These equations are applied to the problem of fluctuations of mean annual and seasonal temperatures, depending upon the variations of the orbital elements of the earth. The fluctuations are found to be too small to account for the repeated advance and retreat of glaciation during the ice ages.

- (v) Rev. R. E. Ingram, S.J. and J. R. Timoney: Theory of an inverted pendulum with trifilar suspension.
(Geophysical Bulletin of the School of Cosmic Physics,
No.9; Dublin, February 1954).

Summary: The Theory of small oscillations is applied to the inverted, trifilar suspension pendulum. The potential energy in a small displacement is calculated from geometrical considerations using vectorial methods. The periods of the principal modes of oscillation are found. The theory is applied to the O'LEARY Seismograph (mass 2 tons) at Rathfarnham Castle and gives results in close agreement with the measured values.

Publications in Course of Printing

Geophysical Memoirs No.1, Parts 1 and 2 (Second Edition), Part 3 (First Edition): L. W. Pollak: Eight-Place Supplement to Harmonic Analysis and Synthesis for three to one hundred equidistant values of empiric functions.

4. METEOROLOGICAL AND GEOPHYSICAL SEMINAR

- 16th April 1953: Dr. P. J. Nolan, University College, Dublin: Nuclei produced by disruptive discharge at the surface of a water drop.
- 27th May 1953: Dr. R. Fürth, Birkbeck College, London University: On the application of Fourier transforms and a photo-electric Fourier transformer.
- 28th May 1953: Dr. R. Fürth, Birkbeck College, London University: On methods for the determination of the size of sub-microscopic particles.
- 4th June 1953: Dr. E. J. Opik, Armagh Observatory: Convective transfer in the problem of climate.
- 22nd October 1953: Dr. Johannes Georgi, Hamburg: My experiences while wintering in "Eismitte" (Greenland).
- 23rd October 1953: Dr. Johannes Georgi, Hamburg: The meteorology of "Eismitte" (Greenland).
- 12th November 1953: Rev. Professor P. J. McLaughlin, St. Patrick's College, Maynooth: Atmospheric pollution.
- 3rd December 1953: P. M. A. Bourke, Assistant Director, Irish Meteorological Service: Potato blight and the weather.
- 21st January 1954: Dr. P. J. Nolan, University College, Dublin: Coagulation of nuclei.
- 4th February 1954: P. Petherbridge, B.Sc., Department of Scientific and Industrial Research, Watford, Herts.: Meteorological aspects of the natural lighting of buildings.
In the discussion Professor Pollak described the photoelectric theodolite for sky brightness measurements recently devised in the Geophysical Section of the School and showed some preliminary results of measuring the variation of sky brightness over Dublin.
- 4th March 1954: M. V. O'Brien, Director, Geological Survey, Dublin: How the geologist uses geophysical aids in applied geology and research.
- 25th March 1954: Senior Professor L. W. Pollak, Director, School of Cosmic Physics, Dublin: Geophysical miscellanea.

Reviews of the Seminar lectures appear regularly in "Weather" published by the Royal Meteorological Society, London. The reviews give summaries of the talks and discussions written by the Dublin correspondent of "Weather", F.E.D.