



# DIAS

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Pr. 3406

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

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Annual Report of the work of the  
Institute and its Constituent  
Schools presented by the Council  
to the Minister for Education in  
respect of the Financial Year  
1954-55.

Pr. 3406

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

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Annual Report of the work of the Institute and  
its Constituent Schools presented by the Council  
for the Financial Year 1954-55

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In accordance with the provisions of Section 29 of the Institute for Advanced Studies Act, 1940 (No. 13 of 1940), the Council of the Institute has the honour to present to the Minister for Education for submission to the Government a report of the work and activities of the Institute and its Constituent Schools for the financial year ending 31st March, 1955.

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 1955.

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, 1955.
- 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 1955.

1. THE COUNCIL OF THE INSTITUTE.

Chairmen:

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;

Dr. James M. O'Connor, B.A., M.D.,  
President, Royal Irish Academy.

Members Appointed by the Governing Boards of the Constituent Schools:

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

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.;

Myles 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.;

Cornelius Lanczos, Ph.D.

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 Coallaigh, M.Sc.

Appointed Members:

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

Eric N. 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.

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II - Report of the Governing Board of the School of Celtic Studies adopted at its meeting on 11 May 1955.

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.

Assistant Professors:

Miss Cecile O'Rahilly;  
Rev. Cuthbert McGrath, O.F.M.

Assistant:

Miss Sheila Falconer (resigned as from 31st July, 1954).

Assistant (Part-time):

Mrs. Nessa Doran.

Scholars:

Louis Paul Némo (Ropars Hémon);  
Dr. Aled I. R. Wiliam (to 30 September 1954);  
Séamus Breathnach (to 30 September 1954);  
Mrs. Margaret Pepperdene (1 August 1954 to 31 January 1955);  
Gearóid Mac Niccaill (from 1 October 1954).

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;  
Mr. Brian 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;  
Dr. R. B. Breatnach;  
Mr. Seán de Búrca.

## 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 completed and the work of compilation was begun. Seán de Búrca completed his description of Tourmakeady Irish and prepared it for press. Other branches of Celtic studies were not neglected; apart from work on etymology and comparative literature, works on mediaeval Welsh and Breton and on modern Scottish Gaelic dialects were prepared and sent to press. *Celtica* Vol.III was sent to press, as was also a special Zeuss Memorial volume, under the editorship of Professor Hyles Dillon, to which many leading Indo-European scholars have contributed. One work in the Mediaeval and Modern Irish Series (*Desiderius*) was reprinted, one was with the printers and eight were in preparation, while two volumes in the Hiberno-Latin Texts Series were in press and thirteen were in preparation. The second and third volumes of the *Book of Leinster*, edited by Drs. Best and O'Brien, were at the press while Vols.IV and V were in an advanced state of preparation. At the end of the year under review one volume was published, two were reprinted, twenty-two volumes edited or written by members of the staff or by extern research workers were in the press and material for thirty-eight others was in course of preparation. In addition two dictionaries (Classical Modern Irish and An Etymological Dictionary of Irish) were in preparation.

a syllabus for the newly established Lectureship in Irish. Returned final proofs of Fingal Ronáin and Other Stories for the Mediaeval and Modern Irish Series, as well as continuing work on the proofs of Duanaire Mhéis Uidhir; prepared articles for Celtica III and for the Zeuss Memorial Volume.

Assistant Professors:

Miss Cecile O'Rahilly: Final seeing through the press of Trompa na bhFlaitheas; work on the Dictionary of Classical Modern Irish continued; a Welsh text (Llyfr Marchwriseth) edited for Celtica.

Rev. Cuthbert McGrath, O.F.M.: Work on Flunket's Latin-Irish Dictionary continued; two volumes of Franciscan verse (Dán na mBráthar Micnúr) revised and Dánta Briain meic Giolla Phédraic prepared for Celtica.

Assistant:

Miss Sheila Falconer: Edition of short text on the Life of Pope Gregory from MS. Rawl. B 477 prepared for Celtica III; first article on the Verbal System of the LU Táin now in press for Ériu XVII; excerpting works for the Dictionary of Classical Modern Irish continued.

Assistant (Part-time):

Mrs. Nessa Doran: Completed Nos.15-45 of a descriptive Catalogue of Irish Manuscripts in the National Library under the supervision of Professor Carney.

Scholars:

Roparz Hemon: Continued work on A Historical Grammar of Breton and on Contributions to a Historical Dictionary of Breton; article for Celtica III prepared; an edition of Christmas Hymns in the Vannes Dialect completed and sent to press.



Dr. Aled I. R. William: 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.

Mrs. Margaret Pepperdons: Worked on Early Irish literary and historical problems.

Gearóid Mac Niccaill: Worked on an edition of the Duanaire Meic Shuibhne and prepared several articles for Celtica III and Éigse.

Extern Research Workers:

Dr. R. I. Best: Continued work on an edition of the Book of Leinster. Vols. II and III are in the press and Vols. IV and V were in preparation. A paper on the MS. Laud 610 contributed to the Zeuss Memorial Volume of Celtica.

Seán Mac Airt: Work progressed on the indexes and translation of a new edition of the Annals of Ulster the text of which was in the press.

Liam Price: Work continued on the Place-Names of Co. Wicklow.

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

Brian Ó Cuív: Prepared a series of articles for Celtica III.

Joseph Vendryes: Work continued on an Etymological Dictionary of Irish.

Tomás de Bhaldraithe: Several articles prepared for Celtica III.

Rev. Seán Ó Catháin, S.J.: Edition of Betha Muire revised.

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 revised for press.

Rev. Canice Mooney, O.F.M.: Corrected second proofs of an edition of Searmónta Chúise Uladh now in the press.

Rev. Anselm Faulkner, O.F.M.: Text of An Bheatha Dhiadha sent to press; work on glossary etc. proceeded; An Scáthán Spioradálta in an advanced stage of preparation and work started on a critical edition of An Bheatha Chrábhaidh.

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. First proofs corrected and returned to printer; work continued on preface and notes.

Heinrich Wagner: Continued collection of material in various counties for the Irish Linguistic Atlas; Gaeilge Theilinn revised for press.

R. B. Breatnach: Preparation of Déisi Irish materials left by the late Archbishop Michael Sheehan for the press.

### 3. LECTURES AND CONFERENCES.

Professor Dillon lectured as Visiting Professor at the University of Vienna during the Winter Semester 1954-55. He also gave three lectures on Early Irish History at Cambridge in March 1955 and read a paper on Vestiges of an extinct Irish Dialect to the Royal Irish Academy.

Professor Carney represented the School at the Arthurian Congress held at Rennes in August 1954 and lectured on the Irish Affinities of Tristan and Isolde. He also lectured on the Irish Elements in Beowulf at the Universities of Leeds and London.

4. STATUTORY PUBLIC LECTURE.

The Statutory Public Lecture under the auspices of the School was delivered by Professor James Carney in University College, Dublin on Tuesday, 8th March 1955. Professor Carney's subject was The Old Irish Poems on the Blessed Virgin.

5. SUMMER SCHOOL.

A Summer School was held from the 26th August to the 17th September 1954. Twenty-four enrolled and attended the course. This number included students and members of university staffs from Ireland, England, Scotland, Wales, Germany, Holland, France and the United States of America. Twelve Scholarships, nine of which were kindly provided by the Department of External Affairs, were awarded to foreign students whose financial resources would not otherwise have permitted them to attend. Courses of lectures were delivered as follows:-

Professor O'Brien: 10 lectures on Advanced Old Irish, 7 lectures on Bardic Poetry.

Professor Binchy: 10 lectures on Celtic Kingship.

Professor Dillon: 17 lectures on The Comparative Philology of the Celtic Languages and 17 lectures on Old Irish.

Professor Carney: 7 lectures on Old Irish Literature.

Professor Greene: 17 lectures on Early Welsh.

Mr. Brian Ó Cuív: 17 lectures on Phonetics of Modern Irish.

A Course in Practical Phonetics was held concurrently with the Summer School and lectures were delivered by Mr. Brian Ó Cuív at 5, Merrion Square. The attendance of eight included lecturers from Irish Universities.

6. PUBLICATIONS.

- | a. | <u>New Work</u>  | Date of<br>Publication |
|----|--|------------------------|
|    | TRCHPA NA bhFLAITHEAS. Edited by Cecile O'Rahilly.<br>pp.xxxi + 427. Price 30s.                                      | 31/3/55                |
| b. | <u>Reprints</u>  |                        |
|    | LECTURES ON EARLY WELSH POETRY.<br>Edited by Ifor Williams.<br>pp.76. Price 2s.                                      | 11/11/54               |
|    | DESIDERIUS. Edited by T. F. O'Rahilly.<br>(Mediaeval and Modern Irish Series, Vol.XII).<br>pp.li + 363. Price 7s.6d. | 10/2/55                |

III - Report of the Governing Board of the School of Theoretical Physics adopted at its meeting on 20 April 1955.

1. ACADEMIC STAFF AND SCHOLARS.

Senior Professors:

Erwin Schroedinger, Director of the School;

John L. Synge;

Cornelius Lanczos.

Assistant:

Ernesto Corinaldesi.

Research Associates:

Stephen O'Brien;

Mrs. Sheila Tinney.

Scholars:

Y. G. Hart (left September 1954);

H. F. Sandham;

B. Bertotti (left July 1954, re-entered January 1955);

C. B. Rayner (left November 1954);

J. R. Pounder;

F. A. E. Pirani (entered September 1954);

L. Bass (entered October 1954);

B. K. P. Scaife (entered October 1954);

E. Bellomo (entered October 1954);

P. C. Rath (entered December 1954, left February 1955).

2. GENERAL LINES OF RESEARCH.

The Einstein-Straus-Schroedinger generalized theory of gravitation has reached a dead-lock. A very pertinent criticism by C. P. Johnson Jr. (Phys. Rev. 89, 320, 1955), though Schroedinger's version is exempt from

it and Einstein (ibid. p.321) does not consider it necessarily fatal to his, throws into relief the disconcerting situation that ten years' endeavour of competent theorists has not yielded even a plausible glimpse of - Coulomb's law. Work on special problems in other variants of the theory of gravitation (continuous creation; Whitehead's), not aiming at the goal of "unification", has been carried out and is reported below.

The possible existence of longitudinal light-waves or, in modern technical terms, of the light-quant having a small but finite rest-mass, had been discussed in highly competent circles (e.g. by L. de Broglie) with an apparent oversight of the impending gross discordance with well-established experimental evidence. We (L. Bass and E. Schroedinger) believe to have shown, that the discordance need not arise, nay is unlikely, since the longitudinal waves would have a very feeble interaction with all matter. Proca's field equations, which were used in this investigation, have been further investigated by one of us (E.S.) in their matrix-form. By pointing to a very simple and direct transition from the tensor-form to the matrix-form, a better insight into the latter has been obtained and the understanding of its unusual normalization has been improved. One believes to discern in this particular case a general law, the total field-energy of the Proca-field having at the outset nothing whatever to do with the constituent frequencies, but being brought into close connection with them, viz. as their mean value, when the total charge is normalized to one unit. Two fundamental ignorances, concerning the quantization of charge and the energy-character of frequency, appear to be intimately linked, and one dares to predict that they will be removed at one go.

Professor Synge completed a book on Relativity: The Special Theory, which will be published shortly by the North-Holland Publishing Company, and also, with the assistance of Mr. Hart, a book entitled The Hypercircle in Mathematical Physics, which will be published by the Cambridge University Press. This latter book deals with the approximate numerical solution of certain boundary value problems of mathematical physics. He has also worked on the approximate solution of the biharmonic equation by the hypercircle

method, on the relativistic theory of the propagation of light in moving dispersive media, and on the theory of molecular encounters in a relativistic gas.

In addition to his work on the book mentioned above, Mr. Hart continued his work on viscous flow and wrote a paper on the flow of a viscous liquid in an open channel under wind action, which has been submitted for publication.

Dr. Rayner completed his work on planetary orbits about a rotating central body, according to Whitehead's theory of elasticity, and has submitted for publication a paper on this subject. He investigated the two-body problem, but his work was anticipated by the appearance of a paper by another author. He completed a paper on Whitehead's law of gravitation in a space-time of constant curvature; this has been submitted for publication.

Dr. Pirani, supported by a Rutherford Memorial Fellowship of the Royal Society of Canada, has published a paper on the theory of an expanding universe involving the continual creation of matter and is continuing work in this subject. A short note on a contradiction with observation in D. E. Littlewood's metrical theory of gravitation has been accepted for publication. In collaboration with Dr. Bass, he has corrected and generalized a well-known result of Thirring for the gravitational field of a rotating shell in an approximately flat space-time, and is investigating the theory of the Foucault pendulum in general relativity.

Dr. Bass also investigated, with Dr. Corinaldesi, the treatment of high energy collisions by means of integral equations.

Mr. Pounder investigated the vibrations of an elastic sphere and, in collaboration with Professor Synge, has developed a new method in connection with the wave equation in  $N$  dimensions.

Mr. O'Brien has obtained statistical results for the head-on collisions of relativistic particles with intrinsic angular momentum.

Mr. Sandhu worked on hypergeometric and elliptic functions. From identities in elliptic functions results in number theory were deduced.

Series involving hypergeometric functions and a function defined by generalising the coefficients in the equation of the second order defining the hypergeometric function were also studied.

Dr. Bertotti studied the motion of charged particles according to general relativity, obtaining in a simple way Dirac's equation.

Dr. Scalfè studied the theory of dielectric polarisation, and a paper on this subject has been accepted for publication. A paper is in preparation which will give the results of an extended discussion, by correspondence, with Professor Fröhlich of Liverpool, concerning a recent paper by the latter. Dr. Scalfè has also investigated the problem of the effect of an electric field on the viscosity of non-conducting liquids, and a critical review of the theory of dielectrics is in preparation.

Dr. Bellomo worked on the classical theory of the electron, with the aim of showing that any rigid model leads to the so-called run-away solutions. He has not yet completed this investigation.

Dr. Corinaldesi has been engaged in writing a book on the theory of colliders for Pergamon Press, Ltd. and in his work on the high energy limit in scattering theory. He has also suggested, and evolved in discussions with Dr. Pirani, a mechanism for Hoyle's idea of continuous creation of matter in the universe, based on Dirac's hole theory, and considered the problem of the self-stress of a spin 1/2 particle in interaction with a field of particles of non-vanishing rest-mass. These last two investigations are not yet completed. Finally, he has tried to derive the equations of Hoffman, Einstein and Infeld for the two-body problem in general relativity by a quantum mechanical method. So far the Newton term and the velocity dependent term have been obtained.

Professor Lanczos investigated the conservation laws of general relativity and their relation to the dynamical problem. One can show that in the case of the symmetry of the  $t^{ik}$  the conservation laws lead to a unique motion law of a particle. Einstein's  $t_1^k$  are not symmetric and do not allow the establishment of a motion law. One can show, however, that in



any field theory which is generally covariant and which possesses a variational principle, the symmetric  $t^{ik}$  exist. This establishes a general relation between field equations and dynamical law. The symmetry of the  $\xi_{ik}$  is not demanded. Hence even the generalized field equations of Einstein are amenable to this treatment and can be investigated concerning their dynamical behaviour.

Another investigation deals with the Green's function of an arbitrary linear differential operator. The binomial expansion of the Green's function into eigenfunctions exists only if the eigenfunctions form a complete function system. Frequently this is not the case and the eigenfunctions may not even exist. By a certain modification of the eigenvalue problem every Green's function becomes associated with two complete orthogonal function systems. The binomial expansion theorem can now be quite generally established.

### 3. SEMINAR AND LECTURES.

In the summer term Professor Schroedinger gave a series of lectures on the de Sitter universe. During the months of June and July lectures were delivered at the Seminar meetings, as follows - J. R. Pounder, Vibrations of elastic rods and spheres under variable forces; C. B. Rayner, Whitehead's theory of relativity; V. G. Hart, The hypercircle method applied to a hydrodynamical problem; Professor Lanczos, Rayleigh-Ritz estimates for non-self-adjoint differential operators; Professor Synge, Elementary geometry of function-space; E. Corinaldesi, Construction of potentials from phase-shift and binding energies.

During the first winter term Dr. Corinaldesi spoke on collision problems, and Professor Synge lectured on geometrical optics of moving dispersive media. Professor Lanczos began a course of lectures on the use of the Green's function in the solution of boundary value problems, which he completed in the beginning of the second winter term.

In the second winter term also, Professor Schroedinger gave a series of

talks on the wave equation for spin 1 in Hamiltonian form, and Professor Synge spoke on relativistic encounters.

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.

A Statutory Public Lecture was delivered under the auspices of the School in Trinity College, Dublin, on Tuesday, 8 March 1955, at 8 p.m. by Professor Lanczos. His subject was: Experiments in Gravity.

5. VISITING LECTURERS.

Professor L. Schwartz, of the Institut Henri Poincaré, visited the School on April 12 and 13, 1954, and gave two lectures to the Seminar on Theory of Distribution.

Professor Colin Cherry, of the Imperial College of Science and Technology, London, visited the School from 24 to 26 March 1955, and gave two lectures to the Seminar, the first on Historical and Social Background to Communication Theory, and the second on Mathematical Theory of Information.

6. PROFESSORS' ACTIVITIES.

The annual European Forum at Alpbach was held from 17 August to 6 September, and as usual Professor Schroedinger attended this.

Professor Synge attended, as delegate of the Royal Irish Academy, the Centenary Celebrations of Henri Poincaré in Paris, 15-17 May, 1954. He read a paper on "A technique for the approximate solution of the biharmonic equation" at an International Mathematical Convention in Trieste (25-28 August). He represented the Institute at the International Congress for Mathematicians in Amsterdam (2-9 September), where he read a paper on "Maxwellian fields in vacuo without singularities and with finite total energy." The following scholars were also present at this Congress:

H. F. Sandham, who read a paper on "The perimeter of an ellipse", J. R. Ponder, V. G. Hart and C. B. Rayner. Professor Synge also attended the Colloque Henri Poincaré in Paris (18-27 October) and gave two lectures on "La Géométrie élémentaire de l'espace fonctionnel avec des applications à la physique classique".

7. PUBLICATIONS.

(1) Books:

(i) Books recently published:

Geometrical Mechanics and de Broglie Waves. By J. L. Synge. University Press, Cambridge, 1954.

Sentido y Contraintido de la Ciencia. By J. L. Synge. (Trans. J. G. Diaz). Editorial Alhambra, Madrid, 1954.

(ii) Books in the press:

✓ Relativity: The Special Theory. By J. L. Synge. North-Holland Publishing Company. 1956

The Hypercircle in Mathematical Physics: a Method for the Approximate Solution of Boundary Value Problems. By J. L. Synge. Cambridge University Press.

Still in press

Still in press

Applied Analysis. By C. Lanczos. Prentice-Hall, New York.

(2) Contributions to Periodicals:

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

J. L. Synge: Relativistically rigid surfaces. Studies in Mathematics and Mechanics, presented to Richard von Mises. Academic Press Inc., New York, 1954. p.217

B. Bertotti: On the relation between fundamental tensor and affinity in unified field theory. *Il Nuovo Cimento*, 11, 358, April 1954.

E. Corinaldesi: Construction of potentials from phase shift and binding energies of relativistic equations. *Il Nuovo Cimento*, 11, 468, May 1954.

H. F. Sandham: Some infinite series. *Proc. Amer. Math. Soc.*, V, 430, June 1954.

H. F. Sandham: The perimeter of an ellipse. *Proc. International Congress, Amsterdam*, Sept. 1954. *Abstract*

M. J. Klein: A note on Wild's solution of the Boltzmann equation. *Proc. Camb. Phil. Soc.*, 50, 293, 1954.

- V. G. Hart: Equilibrium of membranes elastically supported at the edges. Quarterly of Applied Maths., XII, 408, 1954.
- C. B. Rayner: The application of the Whitehead theory of relativity to non-static, spherically symmetric systems. Proc. Roy. Soc. A, 222, 509, 1954.

(b) New Contributions:

- B. Bertotti: On the two-body problem in general relativity. Il Nuovo Cimento, 12, 226, August 1954.
- E. Corinaldesi: High-energy expansions of phase shifts. Il Nuovo Cimento, 12, 438, September 1954.
- E. Corinaldesi: Remark on an unusual cosmic ray event. Il Nuovo Cimento, 12, 571, 1954.
- J. L. Synge: Maxwellian fields in vacuum without singularities and with finite total energy. Proc. International Mathematical Congress, Amsterdam, September 1954. *Abstract*
- J. L. Synge: Note on the Whitehead-Rayner expanding universe. Proc. Roy. Soc. A, 226, 336, 1954.
- E. Schroedinger: A thermodynamic relation between frequency shift and broadening. Il Nuovo Cimento, 1, 63, January 1955.
- E. Schroedinger: The philosophy of experiment. Il Nuovo Cimento, 1, 5, January 1955.
- F. A. E. Pirani: On the energy-momentum tensor and the creation of matter in relativistic cosmology. Proc. Roy. Soc. A, 228, 455, March 1955.

(c) The following contributions were in the press at the end of the period under review:

- ✓ E. Schroedinger: The wave equation for spin 1 in Hamiltonian form. Proc. Roy. Soc. A.
- ✓ L. Bass & E. Schroedinger: Must the photon mass be zero? Proc. Roy. Soc. A.
- ✓ C. B. Rayner: The effects of rotation of the central body on its planetary orbits, after the Whitehead theory of gravitation. Proc. Roy. Soc. A.
- ✓ B. K. P. Scaife: The high temperature susceptibility of a permanent dipolar lattice. Phil. Mag.
- ✓ J. L. Synge: Motion of a viscous fluid conducting heat. Quarterly of Applied Maths.
- ✓ F. A. E. Pirani: On the perihelion motion according to Littlewood's equations. Proc. Camb. Phil. Soc.
- H. F. Sandham: A product of hypergeometric functions. Quarterly Jour. of Maths. *with diagram*
- File in journal  
concerning  
Reber.* C. Lanczos: Iterative solution of large scale linear systems. Jour. Wash. Acad. Sci.

IV - Report of the Governing Board of the School of Cosmic Physics adopted at its meeting on 28 November 1955.

A. Astronomical Section, Dunsink Observatory

1. ACADEMIC STAFF AND SCHOLARS.

Senior Professor: H. A. Brück.

Chief Assistant: M. J. Szyth (from 1 September 1954).

Assistant: G. I. Thompson (from 1 April 1954).

Research Associate: Máire T. Brück.

Scholar: Vacant.

2. EQUIPMENT.

The mirrors for the new 26-inch Cassegrain reflector were delivered by Messrs. Cox, Hargreaves and Thompson, Ltd. Cells for the convex and flat mirrors, a focusing attachment and other parts for the new instrument were constructed by Mr. Murphy in the workshop of the observatory.

The quartz mirrors for the solar installation arrived also, and the necessity of remounting the vertical solar telescope was availed of to reconstruct the mountings of both the primary and secondary mirrors of the coelostat.

A new clock installation, consisting of a Shortt Free Pendulum and Slave Clock, was mounted in the basement of the observatory, the Free Pendulum in a recess of a telescope pier and in a chamber which is temperature controlled.

3. RESEARCH WORK.

Solar Work: Dr. Thompson continued his photometric work on the ultra-violet spectrum of the Sun. Poor weather conditions during the year hampered actual solar observations and made it impossible so far to secure a sufficient number of suitable spectrograms beyond 3400 Å.

Measurements of the region of spectrum between 3400 and 3500 Å were

completed. These have been based on intensity records obtained with a Moll recording photometer and a special photoelectric device constructed by Dr. Thompson along the lines of the similar Utrecht instrument in such a way that intensities in the solar spectrum can be recorded directly from the spectrograms and the plate characteristics.

Apart from recent Mount Wilson spectrograms, the Dunsink spectra represent for the moment the best observational data on the intensity distribution in the ultra-violet solar spectrum. For a comparison of the Mount Wilson and Dunsink observations, intensity records and a preliminary discussion of the Dunsink results were sent to Professor Minnaert of Utrecht who is engaged in extending with the help of the Mount Wilson spectra the well-known Utrecht Solar Atlas into the ultra-violet region. The Mount Wilson and Dunsink measurements of intensity appear to exhibit small, but systematic differences whose origin is being investigated further at the two observatories.

For a further study of the performance of the solar spectrograph a very accurate set of instrumental profiles was secured by Dr. Thompson in the 1st, 2nd and 3rd orders of the grating, using the Kr 4319 line and giving all-night exposures for the faint line wings. These results are being prepared for publication.

Solar Eclipse of June 30: Three months were taken up entirely with preparations at Dunsink and on the Swedish island of Öland for observation of the total solar eclipse of June 30. The Irish party, one of 19 from different observatories and countries, consisted of Professor Brück and Dr. Maire Brück who were joined on the island by Dr. D.A. Jackson, F.R.S., now of Paris, who had come directly from France bringing some of his own instruments such as a 5-layer Fabry-Perot etalon and a 2-prism spectrograph. The heavy equipment, namely a 16-inch coelostat, a 15-inch mirror telescope, a corona camera and a number of other apparatus arrived on Öland from Dunsink a month before the eclipse.

The eclipse camp was set up at Persnäs in the immediate neighbourhood

of that of the Stockholm Observatory. The Swedish astronomers did everything to assist the Irish and other parties during their stay on the island. All instruments, mounted on fairly massive concrete foundations, were brought into perfect adjustment a week before the eclipse was due, and at least the experiment on the interferometric measurement of line widths in the spectrum of the chromosphere would have yielded results of considerable interest, if heavy cloud had not spoiled our efforts at the critical time.

Stellar Work: The Eichner Astrophotometer was used by Professor Brück for further measurements of plates of open star clusters. In the course of the reduction of these plates the lack of sufficiently accurate photometric scales of stellar magnitudes has become apparent. Further plates of open clusters in three regions of wavelength and with more adequate provision of such scales are to be secured by Dr. Thompson who left Dunsink in the middle of March for the Boyden Station in South Africa.

Dr. Smyth was engaged in designing a photoelectric photometer for stellar photometry of the pulse-counting type which is to be used in conjunction with the new 28-inch reflector.

#### 4. CONFERENCE ON THE BOYDEN STATION.

Professor Brück attended a conference in Hamburg, called by the Director of the Harvard Observatory, at which the future of the Boyden Station after the withdrawal of Harvard Corporation from its operation was discussed. The participants were the Directors of the Brussels, Dunsink, Hamburg, Harvard and Stockholm Observatories. The Director of the Armagh Observatory was invited but could not attend on account of his absence in South Africa.

The conference was of considerable importance to the two Irish Observatories, since the threatened closing of the Station on July 1, 1955 would have seriously affected the working of the ADH telescope, mounted at the Station. In Hamburg an agreement was arrived at according to

which the Boyden Station with all its instruments is to continue in existence and is to be operated jointly by the six observatories mentioned earlier. The operating costs of the Station as a whole are to be borne by the three "newcomers" in lieu of the capital invested in the Boyden Station by Harvard and, to some extent, by the two Irish observatories. All six participants are to have equal observing rights at the Station and, with the exception of Harvard, will be responsible for sending suitable observers. As far as Dunsink is concerned, the agreement appears to be very satisfactory in the given circumstances.

5. ASSEMBLY OF INTERNATIONAL ASTRONOMICAL UNION.

With the beginning of the new year preparations were started in earnest for the organisation of the Dublin Meeting in August/September 1955 of the International Astronomical Union. The organisation was in the hands of Professor and Mrs. Brück who worked in close cooperation with Professor T.B. Nevin.

6. PERSONAL.

Professor Brück was nominated a Member of the Pontifical Academy of Sciences.

Professor Brück was elected also a Corresponding Member of the Akademie der Wissenschaften und Literatur, Mainz, and was re-elected for a further period of three years a Foreign Correspondent of the Institut d'Astrophysique, Paris.

7. OPEN NIGHTS AND VISITORS.

The Observatory was open to the public as usual on the First Saturday of each month. Whenever possible, arrangements were made for special visits by societies and others, and the total number of visitors, well over 4000, exceeded that of last year.

Distinguished astronomers who came to Dunsink during the year, included



Professor O. Struve of Berkeley, California, the President of the International Astronomical Union, and Professor P. Th. Oosterhoff of Leiden, Holland, the Union's General Secretary, who were here for discussions on the Dublin Meeting of the Union.

Mr. G.G. Yates of the Cambridge Observatories spent a week at Dunsink working with the Eichner Astrophotometer.

8. PUBLICATIONS.

The printing of Contributions No. 8 (by H.E. Butler) and No.9 (by H.A. Brück and Máire T. Brück) was delayed, but they are to appear shortly.

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B. Cosmic Ray Section

1. ACADEMIC STAFF AND SCHOLARS.

Senior Professor: C.Ó. Ceallaigh.

Professor: C.B.A. McCusker.

Research Associate: T.E. Nevin. (to 31st October 1954).

Scholars: B.G. Wilson (to 30th September 1954).

P. D. McCormack (to 31st December 1954).

R. H. W. Johnson.

J. G. Dardis (Institute Scholarship from 1st January 1955).

L. J. Crans (entered 1st October 1954).

2. RESEARCH WORK.

The research activities of the Section using the photographic plate and counter techniques have continued, and satisfactory progress may be reported.

The scanning of the Sardinia Stack S.30 was concluded. Although, for technical reasons discussed in the previous annual report, the plates

proved troublesome to scan, this was more than compensated for by the important nature of the events found.

#### Negative Hyperons

Two examples were found of the nuclear interaction at rest of a negative hyperon. Of these, one must be regarded as being the first unambiguous demonstration of the existence of negative hyperons and of the nature of their interaction with nuclei.

#### Electron Decay Mode of K-Meson

The first evidence for the existence of the electron as a possible secondary product of K-meson decay was put forward by the Bristol workers Friedlander, Keefe, Menon and van Rossum at the International Conference on Heavy Unstable Particles at Padua in April 1954, and subsequently described in the October issue of the Phil. Mag. In July of the same year the existence of this new mode of decay was confirmed in our Laboratory, and very shortly afterwards, a third example was found by Dahanayake et al. in Bristol. This work was reported on our behalf by Dr. M. G. K. Menon at the 5th Annual Rochester Conference, at Rochester, N.Y. in January of this year. Since this date, a few further examples have been found in America, in this and in several other European laboratories, and it has been shown that the mode of decay is comparatively rare ( $\sim 10\%$ ).

#### Interaction of Negative K-Meson

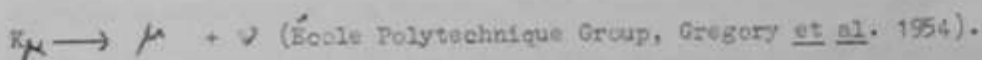
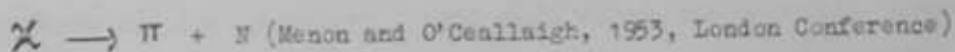
An interesting example of the uncommon negative K-meson was found and is noteworthy for the small amount of the visible energy release in the interaction. These observations have been described in four publications, details of which are listed below.

The International Conference on Heavy Unstable Particles and on High-Energy Events in Cosmic Radiation, was held at Padua from the 12th-15th April and was attended by the Senior Professor. In addition to acting as Chairman of one of the Sections, he delivered two reports, one on the Interaction at Rest of a Negative Hyperon and the other, on the Effect of

Processing on the Estimation of Ionization by Blob-Counting. Both of these are published in the Proceedings of the Conference.

In the autumn of 1954 a team drawn from the Universities of Bristol, Milan and Padua succeeded in launching and recovering a stack of plates of unprecedented dimensions, which has since been called the G-stack. The groups at the School of Cosmic Physics and at University College, Dublin, together with those at Genoa and Copenhagen were invited by the promoters of the enterprise to take part in the work of examination of the plates. This enterprise was started at the end of January 1955 and was in progress during the remainder of the period of this report.

The 250 pellicles of which the stack were composed were each 25 cms x 20 cms x 600  $\mu$ , and the original allocation to the Dublin groups was 20 plates. This allocation was later doubled. Among other reasons, dimensions were chosen so that the energetic secondary particles secondary to the decay-modes



could be brought to rest. Thus, the nature of the charged secondary particle could be established by observation of their subsequent decay products, and the range in the emulsion could be accurately measured. Again, because of the large size of the stack, it would be commonly possible to trace back the decaying particles to their stars of origin. Because of this, useful information could be obtained concerning the associated production of hyperons with K-mesons - a requirement of the theory of Gell-Mann and Pais which seeks to reconcile the copious production with the comparatively long lifetimes of the above particles. By the end of the period of this report, some 25 examples of K-mesons had been found, and measurements were in progress on those of suitable geometry.

An apparatus to study the variations in the rates of local and extensive penetrating showers with both solar and sidereal time has been running under a single thickness of lead since Dec. 7, 1954. It is satisfactory to be

able to say that the rates of both local and extensive showers averaged over three weekly periods is both constant and in agreement with the rates determined early in 1953. It is intended to run this experiment until December 7, 1955 when an analysis of the variations with both solar and sidereal time will be carried out. In addition, a second penetrating shower set has been built. Its operation has been held up by the failure of the manufacturers to deliver the necessary Geiger counters which have now been on order for over a year.

A third apparatus has now been built to work in conjunction with these two and to study extensive air showers of very high electron density. This apparatus has been running successfully since March 7, 1955.

It is also worth noting that the six small units of the new apparatus act as rather efficient core selectors and they are being used to study the distribution of various types of particles in the showers.

In another direction, it has been found impossible to confirm the work of Bothe and his co-workers. The small effect discovered by Harding under suitable circumstances has, however, been found and his explanation in terms of  $\mu \rightarrow e$  decays and the maximum of the  $\mu$ -meson energy spectrum confirmed.

### 3. INSTRUMENTS AND WORKSHOP.

During the year 1954-55 3 Zeiss Winckel scanning and 2 Cooke M.4000 scattering and measuring microscopes have been purchased. The Zeiss instruments have been fitted with protractor eyepieces by Mr. Daly and a special Bannister kinematic stage and micrometer has been fitted to the Zeiss-Winckel stand 149, 932, the performance of which is most satisfactory and the execution of which is an impressive example of the instrument-maker's craft, and reflects great credit on Mr. Daly. It is intended to construct more of these special stages as they have proved very suitable for following light tracks through the emulsions of the stacks. The new lathe ordered for the workshop has not yet arrived, but delivery is expected soon.

4. PERSONAL.

Mr. L. J. Crane was appointed (1st October 1954) to the Scholarship left vacant by the expiry, after extension, of that awarded to Mr. Wilson. During the remainder of the period, Mr. Wilson held an appointment in the University of Dublin but continued to work part-time with Professor McCusker. Mr. P. D. McCormack, whose Scholarship was extended to 30th December 1954 severed his connection with the Institute on being appointed to a temporary position under the Department of Posts and Telegraphs. Mr. J. G. Dardis was then awarded a Scholarship.

Professor McCusker lectured, by invitation, at the Atomic Research Establishment, Harwell, and at Imperial College, London.

Mr. B. G. Wilson has been awarded a Canadian National Research Council Fellowship.

5. PUBLICATIONS.

Dardis, J. G. and McCusker, C. B. A.: A possible variation in the rate of local penetrating showers.  
Proc.Phys.Soc. A 67, 1026, 1954.

McCusker, C. B. A.: The determination of meson multiplicity at about 20 Bev.  
Zeit. f. Naturforschung. 10a, 238, 1955.

McCusker, C. B. A., Dardis, J. G. and Wilson, B. G.: The rates of penetrating showers at sea level.  
Proc.Phys.Soc. A 68, 585, 1955.

Johnston, R. H. W. and Ó Ceallaigh, C.: Evidence for the nuclear interaction of a charged hyperon arrested in photographic emulsion.  
Phil.Mag. 45, 424, 1954.

Ó Ceallaigh, C.: The effect of processing on the estimation of ionization by blob counting.  
Suppl.al Nuovo Cim. 12, 412, 1954.

Friedlander, H. W., Keefe, D., Menon, M. G. K., Johnston, R. H. W., Ó Ceallaigh, C., and Kernan, A.: Observations on negative K-mesons.  
Phil.Mag. 46, 144, 1955.

Ó Ceallaigh, C.: Measurement of ionization in photographic emulsion by the technique of mean gap-length.  
CERN Standardization Publication, B.S. 11, 1954.

Johnston, R. H. W. and Ó Ceallaigh, C.: Further evidence for nuclear interaction of a charged hyperon arrested in photographic emulsion.  
Nuovo Cim. 1, 468, 1955.

Johnston, R. H. W., and Ó Ceallaigh, C.: Further evidence for the electron decay of K-mesons. Phil.Mag. 46, 393, 1955.

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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 (to 31st October 1954).

Senior Technical Assistant: Thomas J. Morley.

Scholar: Thomas C. O'Connor.

2. INVESTIGATIONS, EXPERIMENTAL AND FIELD WORK.

(i) Professor Pollak and Thomas C. O'Connor (Scholar) continued their investigation on the agreement of photo-electric condensation nucleus counters. As a result of improvements in the illuminator and the introduction of heated conducting glasses sealing the fog chamber, individual readings of identical counters with and without condensers in series now agree within less than 10% and excessive discrepancies are rare. There still remain some points not yet understood which in their opinion are connected with the formation of the fog in the cloud chambers and which prevent better agreement between identical counters.

The present agreement, however, is sufficient for the use of the counters on special field work. It is also intended to apply to turbulence problems, measurements of condensation nuclei concentration at two levels.

(ii) Professor Pollak and T. J. Morley (Senior Technical Assistant) have been working on a climatology of Dublin City for some time. An examination of the homogeneity of the monthly averages and totals obtained

from the meteorological station in Trinity College, Dublin over a period of 50 years, has been begun and it is intended also to include a modern statistical analysis of the meteorological observations in Phoenix Park which go back for more than one hundred years.

(iii) Professors Pollak and Murphy have used on the platform of 5, Merrion Square and near Dublin Airport the photo-electric theodolite for sky-brightness in various spectral ranges, constructed in our workshop. The aperture can be varied from  $1^{\circ}$  to  $10^{\circ}$ . Based on experience during these experiments an attachment for measuring the polarisation (intensity and direction) of the blue sky has been built using Zeiss Bernotar filters. The photocurrent is read on a meter or recorded on a direct writing oscillograph. A scanning of the sky in steps of 10 degrees and in eight azimuths can be carried out in about 15 minutes; in the case of a clear sky the brightness and polarisation can be measured in 20 minutes. The whole equipment is portable.

A report will be submitted to the International Commission for Illumination (Section Natural Daylight) at its meeting in Zürich, to be held in June 1955.

(iv) Professor Pollak and T. C. O'Connor (Scholar) studied the decay of aerosols in small and very small vessels. Professor Pollak's aim was to devise a method for measuring the size, density and mass of condensation nuclei in the quickly changing atmospheric aerosol, particularly during aeroplane flights. Preliminary tests of a new 'static' method are encouraging. Utilising standard equipment and measuring the decreasing concentration of condensation nuclei when enclosed in a small cylindrical container, it is possible to determine from two measurements of concentration the size of the nuclei and from three such measurements their size, density and mass.

A report will be presented at the Symposium on atmospheric condensation nuclei to be held in Dublin after Easter 1955.

(v) Professor Murphy: (a) Magnetic. The computation of the vertical magnetic survey was completed and the results prepared for publication as Geophysical Bulletin No.11. Several discussions with members of the Geological Survey took place concerning the findings of the survey and regarding the uncertainties in the geological mapping. Dr. J. C. Harper of the University of Liverpool visited the School to discuss matters connected with this Survey.

(b) Gravity. The Worden gravity meter which arrived on September 2nd has been tested and found to be satisfactory.

Several of the stations of the previous gravity surveys made with the small Graf gravimeter lent by the Department of Geodesy and Geophysics, Cambridge University in 1949 and 1950 have been re-visited to join the previous survey with the present one.

A network of base stations for the complete gravity survey of the country according to recently accepted international standards is now being set up.

The analysis of the gravity work carried out in the autumn indicates that the Worden gravimeter is settling down very well giving results of high accuracy but it is thought that the "scale value" is not in agreement with earlier gravity work. In parts of the latter the accuracy was not high and hence comparisons are difficult to make.

(c) Seismic. A recording drum belonging to Rathfarnham Castle Observatory was reconstructed in the workshop for fast recording of microseisms. This enables us to take microseisms into account in gravity work, the absence of which constituted a deficiency which was strongly felt when the pendulum observations were made in Ireland. The equipment has been installed and connected to the short period vertical seismograph and is giving good records. Discussions have taken place between Father Ingram and members of the Dublin Port and Docks Board and the Irish Lights to investigate the possibilities of installing wave recording mechanisms



which have been offered by Dr. G. E. R. Deacon of the National Institute of Oceanography of Great Britain.

(d) Other geophysical work. Discussions with the Geological Survey and Mianrai Teo, regarding the interpretation of spontaneous polarisation phenomena in the Avoca area have taken place. New types of porous pots constructed in our workshops are now in use by the Geological Survey. They are satisfactory and much more convenient to use than previous types.

(e) Geographical coordinates. For the purposes of the Gravity Survey the geographical coordinates are required to about one second of arc. So far, various methods were employed but this accuracy could be obtained only by laborious processes which were so susceptible to mistakes that they required constant re-checking. To eliminate these difficulties the latitudes of the corners of the six inch sheets were calculated. This involved an investigation into the original data of the Ordnance Survey. Unfortunately very little of this is available as the records have always been kept in Southampton where they were destroyed in the last war. Copies of some of the data were obtainable and from these the work was carried out. The figures so obtained are sufficient for the gravity survey but their ultimate accuracy is not known at all.

The Ordnance Survey gave every assistance and lent whatever records were required. They also expressed their willingness to cooperate in the gravity survey supplying hundreds of large scale maps some of which had to be specially printed by new techniques. The value of the maps represents several hundreds of pounds.

(vi) T. C. O'Connor (Scholar) has completed an investigation on the measurement of global radiation by means of black and white atmometers. A note on his results has been accepted for publication by the Editor of 'Geofisica Pura e Applicata', Milan.

He is studying now some characteristics of charged and uncharged condensation nuclei stored in a rubber gasometer of 4000 litres content.

3. PUBLICATIONS.

- (i) L. W. Pollak: Eight-Place Supplement to Harmonic Analysis and Synthesis Schedules for three to one hundred equidistant values of empiric functions. Geophysical Memoir of the School of Cosmic Physics No.1 - Part 1: Register I (Second Edition) xxi, App. i to iii, 16 pages tables; Part 2: Index (Second Edition) 35 pages tables; Part 3: Register II (First Edition) 16 pages tables. Dublin 1954.

From the Preface to the Second Edition: Since the first edition of the "Eight-Place Supplement" published in 1949 has been exhausted, a new issue was prepared. This opportunity was used to carry the accuracy of the angles given in degrees, minutes, seconds and fractions of a second in the columns headed  $\lambda$  and  $\lambda'$  to ten decimals of a second. These angles were now obtained by rounding off to ten decimals the values of  $\lambda$  directly computed in degrees, minutes, seconds and fractions of a second to 24 decimals.

- (ii) L. W. Pollak: Improvements to the Condensation Nucleus Counter with Photographic Recording and the Frequency Distribution of Nuclei Counts. (Paper presented at the Xth Assembly of the International Union of Geodesy and Geophysics on September 18, 1954).

Summary: The condensation nucleus counter with photographic recording previously described by the author has been developed further. The most important improvement consists of a movable rectangular graticule which enables exposing unused parts of it in quick succession without the necessity for waiting until the droplets of the showers have evaporated.

First showers of nuclei obtained in experiments with a small range of concentrations between 10300 and 13400 nuclei per  $\text{cm}^3$  and recorded photographically have been used to examine whether the frequency distribution of counts can be adequately described by Poisson's exponential function. The application of the chi-square test for goodness of fit to these observations and also to Scrase's observed frequencies shows that there is no reason for abandoning the hypothesis that the counts of nuclei follow the Poisson distribution. The departures obtained between the observed frequencies and the Poisson distribution can be considered as merely chance variations.

- (iii) L. W. Pollak, T. Murphy and T. C. O'Connor: The Uncertainties in Measurements of Concentration of Condensation nuclei with Photo-electric Counters and the Decay of Nuclei in large vessels. (Paper presented at the Xth Assembly of the International Union of Geodesy and Geophysics on September 18, 1954).

Summary: It has been confirmed that identically constructed photo-electric nucleus counters operated under identical conditions do not indicate the same concentration of nuclei, differing up to 30%. Differences between counters change with time with both short and long periods and are dependent on concentration, size and charge of the nuclei. For many climatological investigations the accuracy of the present model is sufficient. For special outdoor measurements and particularly for laboratory measurements the uncertainties of measurement may make conclusions highly speculative.

The coagulation, sedimentation and size of nuclei stored in a 4,000 litre vessel have been studied with four counters operated simultaneously in parallel.

- (iv) T. Murphy: A Vertical Force Magnetic Survey of the Counties of Roscommon, Longford, Westmeath and Meath with parts of the adjacent Counties of Galway, Cavan, Louth and Dublin. (Geophysical Bulletin No.11 of the School of Cosmic Physics; Dublin, January 1955).

Summary: A vertical force magnetic survey covering a rectangular area of central Ireland 108 miles from west to east and 36 miles from north to south at a density of one station per five square miles has been carried out in 1952-3. The accuracy was found to be  $\pm 10\%$ .

An anomaly of large extent over most of the area surveyed is interpreted as produced by the pre-Cambrian basement. In the east the Ordovician Volcanic Series is well marked and its extension can be traced under cover of Carboniferous rocks. In the west of the area a remarkable positive anomaly has been outlined in fair detail. This anomaly probably marks a major structural line.

- (v) P. Petherbridge, Building Research Station, Department of Scientific and Industrial Research, Garston, Watford: Meteorological Aspects of the Daylighting of Buildings. (Geophysical Bulletin No.10 of the School of Cosmic Physics; October 1954).

Summary: The way in which data on such meteorological factors as outdoor illumination and sky luminance distribution have been used in order to obtain a better understanding of the daylighting of building interiors are described.

Measurements of total solar radiation have been converted into equivalent illumination levels in order that some knowledge might be gained of the outdoor illumination obtainable in those parts of the world for which actual illumination measurements are not available but for which solar radiation data already exist.

- (vi) T. C. O'Connor, School of Cosmic Physics: On the Measurement of Global Radiation using black and white atmometers. (Accepted by the Editor, Prof. Dr. M. Bossolasco, for publication in the International Review "Geofisica Pura e Applicata", Milano on 8 January 1955).

Summary: The difference in the evaporation from black and white Livingston atmometers was compared with the global radiation as measured by a Bellani spherical pyranometer. Results show that one unit ( $\text{cm}^3$ ) of difference in the evaporation corresponds to  $20 \pm 3$  cal/cm<sup>2</sup> of global radiation. The total of 95 daily values of radiation measured by pairs of atmometers differed from the corresponding Bellani figure by 2.3%. The operation of the atmometers and the accuracy of the results are discussed. The method is considered sufficiently accurate for general climatological purposes.

#### 4. OBSERVATORY.

A recording contact anemometer has been installed on the roof of 5, Merrion Square for checking and supplementing the records of the Dines pressure tube anemometer. The transmitter of this electrical anemometer consists of a set of three cups (R. Fuess, Berlin), the total run of wind is recorded by a Casella (London) recorder. Regular records started on 26th October, 1954.

5. GEOPHYSICAL EQUIPMENT.

The Worden gravity meter arrived on September 2nd, 1954. Extensive tests carried out by Professor Murphy show that the repetition accuracy of 0.01 milligal claimed is correct and maintained during field work. The closing error of a circuit Dublin-Galway-Limerick-Dublin involving 14 links and spread over ten days was 0.10 milligal.

6. STATUTORY PUBLIC LECTURE.

Dr. G. E. R. Deacon, F.R.S., Director of the British National Institute of Oceanography, delivered the Statutory Public Lecture "Recent Studies of the Physics of the Oceans" in the Physics Theatre, University College, Dublin, on 27th October 1954.

7. METEOROLOGICAL AND GEOPHYSICAL SEMINAR.

- 29th April 1954: Brig. Gen. K. M. Papworth, Ordnance Survey Division, Belfast: The 50 inch Survey of Belfast.
- 14th May 1954: Professor Sydney Chapman, F.R.S., Queen's College, Oxford: The Aurora Polaris and the Entry of a Magnetic Dipole into a neutral ionised gas (two Seminar lectures).
- 3rd June 1954: V. H. Guarrini, Meteorological Office, Shannon Airport: Recent Advances in Apparatus for Agricultural-Meteorological Research.
- 9th June 1954: Dr. Chr. Junge, Cambridge Research Centre of the Air Force, Boston, Mass.: Latest Investigations in Atmospheric Nuclei Research.
- 28th October 1954: Dr. G. E. R. Deacon, F.R.S., Director of the British National Institute of Oceanography: Ocean Waves.
- 4th November 1954: Professor P. J. Nolan, University College, Dublin: The Portsmouth (U.S.A.) Conference in Atmospheric Electricity and visit to U.S. geophysical institutes.
- 2nd December 1954: Senior Professor I. W. Pollak, School of Cosmic Physics: Report on the Xth Assembly of the International Union of Geodesy and Geophysics in Rome, September 1954; General, Exhibition of geophysical instruments, Meteorology.  
One reel of the technical motion picture "The History of Weather Movements 1899-1939" produced by the Research Methods Company, New York was also shown.
- 16th December 1954: Professor C. B. A. McCusker, School of Cosmic Physics: The Influence of the Upper Atmosphere on High Energy Cosmic Ray Nucleons at Sea Level.

- 11th January 1955: Professor K. E. Bullen, Department of Applied Mathematics, University of Sydney, Australia: Seismology and the Physics of the Earth's Deep Interior.
- 20th January 1955: Mr. F. E. Dixon, Irish Meteorological Service: Extremes of Precipitation in Periods of Consecutive Months.
- 3rd February 1955: Professor T. E. Nevin, University College, Dublin: The Spectrum of the Aurora.
- 3rd March 1955: Dr. E. J. Öpik, The Observatory, Armagh: Meteors and the Upper Atmosphere.

8. MEETING OF THE INTERNATIONAL COMMISSION FOR RADIATION at Rome from 8th to 11th September 1954.

Professor Pollak attended this meeting of 18 delegates and reported on the Dublin experience with the Bellani integrating actinometer.

9. Xth GENERAL ASSEMBLY OF THE INTERNATIONAL UNION FOR GEODESY AND GEOPHYSICS in Rome from 14th to 25th September 1954.

Professors Pollak and Murphy attended as Irish delegates. Professor Pollak read on the 18th September the two papers listed in Section "Publications", items(ii) and (iii), which gave an account of recent work carried out in the Meteorological and Geophysical Section.

10. SYMPOSIUM ON CONDENSATION NUCLEI.

Professor Pollak was asked by the delegates of Sweden, Switzerland and Germany at the Xth General Assembly of the International Union for Geodesy and Geophysics in Rome, September 1954, to organise a symposium on condensation nuclei, particularly in respect of unification of instruments and their calibration, in Dublin since instruments introduced and developed in Dublin are now used in U.S.A., Sweden, Switzerland and Germany, and the methods reported by Professor Pollak in Rome were of interest to a wider circle.

A preliminary note on the Symposium which is scheduled for the end of April 1955 was sent out in November 1954. The response to this circular has been very good. Experts from U.S.A., Great Britain, France, West-Germany, Sweden, Italy, Switzerland and Ireland have promised to attend and to read papers at the meeting.

11. MISCELLANEOUS.

(i) Dr. Chr. Junge of the Cambridge Research Centre of the Air Force, Boston, Mass. visited the Geophysical Section on 8th and 9th June, 1954, for discussion of condensation nuclei problems and equipment. He delivered a lecture at a special meeting of our Meteorological and Geophysical Seminar on the most recent research on this subject in the U.S.A. on the 9th June, 1954.

(ii) On the invitation of the Physics Society, Birkbeck College, London University Professor Pollak delivered a lecture entitled "Geophysical Work of the Dublin Institute for Advanced Studies" on 10 November 1954.

(iii) The Ordnance Survey have once more signified their intention to assist in the gravity survey by supplying all the maps required. This represents very considerable financial assistance as hundreds of large-scale maps are required, since according to an agreement the Ordnance Survey store a complete set of duplicate maps on which the magnetic and gravity surveys are recorded.

(iv) The Research Methods Company, New York has kindly lent a reel of the 16 mm film "The History of Weather Movements 1899 -1939". The film was shown in the Meteorological and Geophysical Seminar on 2nd December 1954.

(v) During the Rome meeting Professor Pollak approached Dr. Worden of Houston Technical Laboratories with the request to lend us the Quartz element, the essential part of his gravity meter for demonstration at one of our Seminars. Dr. Worden offered to present to the School this model for instructional purposes and according to a communication of November 17, 1954 we were informed that the model was being produced for us and would be shipped on November 23, 1954. It was received and demonstrated in the Seminar on 2nd December 1954.

(vi) An extension to the laboratory of the Geophysical Section was granted and building work began in March 1955. The laboratory so far available consisted of two small rooms occupied by a workshop and a larger

room; total area 400 sq. ft. It is in this room that all our laboratory research work, the adjusting, testing and calibration of our instruments took place. It served also as a dark room for developing records and for assembly of apparatus too large for the tiny workshop, at times as a carpenter's shop, often for drying of freshly painted articles and as store for our delicate instruments and gear which are too heavy to be carried to the upper rooms of the main building. The latter equipment was by no means properly stored, usually on or underneath benches, since there was not sufficient room to install cupboards.

Furthermore for the adjustment of survey instruments, magnetic and gravity, we had no space where we could leave them open overnight, and no pillars on which we could adjust them. Up to the present the adjustment of the £8000 gravimeter had to be carried out in the bicycle shed subject to all the disturbances of people walking in the street close by and heavy traffic. Incidentally this shed had to be also used for charging our batteries and as a wood store for the workshop.

The extension of the geophysical laboratory increases its floor space by about 400 sq. ft., the additional space (one small room with pillar, one fair sized room) being equivalent to one large room but will help considerably to relieve congestion and contribute to better working conditions. A pillar is provided and better and cleaner heating system so that our expensive and delicate instruments may be used and stored under proper conditions.

(vii) The Director of the Department of Terrestrial Magnetism of the Carnegie Institution of Washington expressed in his letter of November 24, 1954 his willingness to lend an automatic multifrequency ionospheric equipment, the value of which is estimated to be £25000, for a period of approximately two years. The instrument is capable of making high-speed recordings of rapidly changing conditions in the ionosphere. It would be, however, necessary for someone to go to Washington for about a month to receive some training in the adjustment and operation of this instrument.

The final decision in this matter has been postponed until Autumn 1955, although due to lack of funds there is very little hope for us of accepting this generous offer of Dr. Tuve.

(viii) The Meteorological Research Flight, H.M. Royal Aircraft Establishment, Farnborough, Hants. asked in a letter of December 15, 1954 (MRF/15) for details of the most up-to-date model of our photo-electric nucleus counter. The Research Flight is planning a series of airborne investigations of condensation and freezing nuclei concentrations and proposes to construct a copy of our photo-electric condensation nucleus counter.

The Royal Aircraft Establishment has constructed a copy and up to the end of March carried out a number of very successful flights over England, Ireland and several hundred miles to the west of Ireland over the Atlantic.

Mr. Geoffrey J. Day promised to present a preliminary report on his results at the Symposium to be held in Dublin at the end of April 1955.

(ix) In order to complete the equipment of the meteorological station in the grounds of Trinity College, Dublin which has been operated by the Geophysical Section since July 1950, a Dines Rainfall Recorder was purchased (24th January 1955) and regular observation started on 20th March 1955.

(x) Valuable material has been presented to the Meteorological and Geophysical Section: Messrs. R. Fuess, Berlin supplied free of charge a reserve vacuum mercury switch for their contact anemometer; the Instrument and Nuclear Radiation Department of the General Electric Co., Schenectady, New York presented miniature photocells and various accessories not commercially available.

(xi) Meeting of the Technical Committee on Natural Daylight of the "Commission Internationale de l'Eclairage" in Zürich in June 1955. At the meeting of this Commission in Paris and Roysumnt in May 1953 the delegates had decided to ask Professor Pollak to undertake an investigation into the distribution of sky brightness at different cloudiness in Ireland and to



(vi) Professor Pollak attended a Conference on Cloud Physics (jointly arranged by the Physical Society and the Royal Meteorological Society, London) held in the Department of Meteorology, Imperial College, London from 4th to 5th January 1956 and a course on electronic calculating machines and equipment arranged by the British Tabulating Machine Company at Cookham (near London) from 20th to 24th February 1956.

PÁDRAIG de BRÚN

CATHAOIRLEACH

14th February, 1957.