MATSCIENCE

INSTITUTE OF MATHEMATICAL SCIENCES
MADRAS, INDIA.

TWELFTH ANNIVERSARY

ANNUAL REPORT 1973

The Institute of Mathematical Sciences
Madras

"The pursuit of science is at its best
when it is a part of a way of life"

Annual Report 1973

Patron:

Mr. C. Subramaniam

Union Minister for Industrial Development, Science and Technology, Government of India

Chairman of the Board of Governors:

Mr. V. R. Nedunchezhiyan

Minister for Education, Government of Tamil Nadu

Director:

Professor Alladi Ramakrishnan

Board of Governors

1.	Hon'ble Thiru V. R. Nedunchezhiyan Minister for Education Government of Tamil Nadu Madras.	Chairman
2.	Thiru K. Diraviam, I.A.S. Secretary to Government Education Department Government of Tamil Nadu Madras.	Member
3.	Thiru N. S. Siva Additional Secretary to Government of India Department of Atomic Energy Shastri Bhavan Madras.	,,
4.	Professor K. G. Ramanathan School of Mathematics Tata Institute of Fundamental Research Bombay.	,,
5.	Professor Alladi Ramakrishnan Director The Institute of Mathematical Sciences Madras.	,,
6.	Professor K. R. Unni Permanent Member The Institute of Mathematical Sciences Madras.	,,

Finance Committee

Thiru K. Diraviam, I.A.S., Secretary to Government Education Department Government of Tamil Nadu Madras.	Chairman
Thiru S. Venkitaramanan Secretary to Government Finance Department Government of Tamil Nadu Madras.	Member
Mr. S. Sundararajan Deputy Secretary to Government of India Department of Atomic Energy Shastri Bhavan Madras.	,,
Professor Alladi Ramakrishnan Director The Institute of Mathematical Sciences Madras.	,,

Advisory Committee

Thiru K. Diraviam, I A.S. Secretary to Government Education Department Government of Tamil Nadu Madras.	Chairman
Professor Alladi Ramakrishnan Director The Institute of Mathematical Sciences Madras.	Member
Dr. A. N. Mitra Department of Physics & Astrophysics Delhi University Delhi.	,,
Dr. M. S. Narasimhan School of Mathematics Tata Institute of Fundamental Research Bombay.	,,
Dr. V. C. Kulandaiswamy Dean, Postgraduate Studies College of Engineering Guindy, Madras.	

General Information

Aims and Objects

1. To create and provide an atmosphere and environment suitable for creative work and the pursuit of knowledge and advanced learning in the mathematical sciences for their own sake.

2. To promote and conduct research and original investigation of fundamental sciences in general, with particular emphasis on Mathematics, Applied Mathematics, Theoretical Physics and Astrophysics.

3. To foster a rigorous mathematical discipline, to stimulate a zest for creative work and cultivate a spirit of intellectual collaboration among academic workers in pure and applied branches of science.

4. To arrange lectures, meetings, seminars and symposia in pursuance of its academic work for the diffusion of scientific knowledge.

5. To invite scientists in India and abroad actively engaged in creative work to deliver lectures and participate in academic activity.

Academic Activities

The primary activity of the Institute is creative research in Mathematical Sciences. In pursuit of the objectives of the Instititute weekly seminars as well as series of lectures on various topics of interest, both by visiting scientists and the academic staff of the Institute are held.

To commemorate the inauguration of the Institute an anniversary Symposium is held in January for which scientists from India and abroad are invited to deliver one hour addresses summarising their original work on recent advances in various branches of Mathematical Sciences. The Institute also organises a Seminar in Analysis.

Academic Staff

The Academic Staff consists of Senior Professors, Professors, Associate Professors, Assistant Professors, Visiting Professors, Visiting Scientists, Research Fellows and Research Trainees.

Ph. D. Programme

Facilities are available for postgraduate students to work for Ph D. degree under the guidance of the academic staff of the Institute in various faculties. Senior and Junior research fellowships are awarded by the Institute.

The standing Committee of the Inter-University Board of India and Ceylon at its meeting held in February 28, 1967 adopted a resolution recognising the Institute as a suitable centre for research work. In view of the above resolution the Institute is now recognised by the various Indian Universities as a centre for, research for the doctorate degree in Theoretical Physics and Mathematics.

Publications

1. RESEARCH PAPERS (Preprints and reprints are available on request)

2. MATSCIENCE REPORTS based on the lecture courses delivered at the Institute both by visiting scientists and academic staff (Price Rs. 5/- within India or U. S. $ 1-00 outside India).

3. PROCEEDINGS OF THE SEMINAR IN ANALYSIS is based on lecture courses delivered at the Institute by visiting scientists or members of the Institute during the Annual Seminar in Analysis (Price Rs. 5/- within India or U. S. $ 1-00 outside India).

News of the Institute

International Conference on Functional Analysis and its Applications

With the cooperation and support from the international mathematical community and with financial support from the sponsors of the Institute an International Conference on Functional Analysis and its Applications was held at the Institute from 1st to 7th January 1973. More than fifty mathematicians representing over twenty countries participated in this conference. The conference was inaugurated by Hon'ble Mr. C. Subramaniam, Patron of our Institute on January 1, 1973 and Dr. Malcolm S. Adiseshiah, Former Acting Director-General of UNESCO, Director, The Madras Institute of Development Studies presided over the function. The conference was a great success from any international standard. The proceedings of the conference will be published by Springer-Verlag The editors of the proceedings are Professors K. R. Unni, J. H. Williamson and H. G. Garnir. (List of Mathematicians who participated in the conference is given separately.)

Conference on Nuclear Physics

MATSCIENCE Conference on Nuclear Physics was held at the Institution of Engineers (India), Mysore for five days from March 1, 1973. Inaugurated by Professor Alladi Ramakrishnan, the conference was attended by nearly 40 participants from various universities and research institutions, throughout India.

The Proceedings of the above conference has been brought out as MATSCIENCE REPORT 78.

Conference on Numerical Analysis and Combinatorial Methods

The Conference on Numerical Analysis and Combinatorial Methods was held for a week starting from 9th March 1973. The conference was inaugurated by the Hon'ble Sri C Subramaniam, Union Minister for Industrial Development, Science and Technology, and Patron of the Institue. Besides members of MATSCIENCE, participants from several institutions and universities presented papers on their work.

The Proceedings of the conference is in the process of being published as MATSCIENCE REPORT 79

Conference on Probability theory and Stochastic Processes

For a week in September starting from 24th, a conference on probability theory and stochastic processes was held at Institution of Engineers (India), Bangalore. The conference was inaugurated by Professor Alladi Ramakrishnan, Director of the Institute. Hon'ble Sri C. Subramaniam, Union Minister for Industrial Development, Science and Technology and Patron of the Institute addressed the participants on 26th September 1973. Besides members of MATSCIENCE nearly 40 scientists from throughout India participated in the conference.

Inservice Training Programme

Sponsored by the Directorate of Collegiate Education, the Institute conducted an Inservice Training Programme for the mathematics teachers in colleges in Tamil Nadu for a period of two weeks in May, 1973. About twenty teachers took part in this programme. Professors Alladi Ramakrishnan, K. R. Unni and K. H. Mariwalla gave a series of lectures.

Academic Staff

Professor Alladi Ramakrishnan — *Director*

Professor R. Vesudevan
Professor K. R. Unni
Dr. N. R. Ranganathan
Dr. T. S. Santhanam
Dr. V. Radhakrishnan
Dr. K. H. Mariwalla
Dr. K. Srinivasa Rao
Prof K. Sivasubramaniam (Tamil Nadu Government scholar-on deputation)

Senior Research Fellows;

Dr, R. Sridhar
Dr. (Miss) P. K. Geetha*
Mr. M. R. Subrahmanya**
Mr. G. N. Keshava Murthy
Miss Vimala Walter

Junior Research Fellows:

Mr. A. R. Tekumalla
Mrs. Kasturi Ramanath
Mr. R. Jagannathan
Mr. A. Vijayakumar

Research Trainees:

Mr. S. Mani*
Mr. G. S. N. Murthy
Mr. K. Venkatesh
Mr, S. G. Satyanarayana*
Miss Aruna*
Mr. C. V. Deshpande
Miss S. Poornima
Miss V. Indumathi
Mr. T. Satyanarayana*
Mr. Y. S. Prahlad*

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* Persons who have completed their tenure at the Institute
** On leave of absence at: Universite de Liege, Liege, Belgium

Invitations and Delegations

In response to invitations from various research institutions, Professor Alladi Ramakrishnan, Director of the Institute, gave lectures at the following research centres abroad on his recent work during 1973 :

U. S. A. : Mathematics department, IBM Centre, N. Y. ; Courant Institute of Mathematical Sciences, New York ; Yeshiva University, New York ; Pennsylvania State University, Pennsylvania ; South Illinois University, Illinois ; Wright-Patterson State University, Dayton, Onio ; University of Texas at Dallas, Texas ; University of Southern California, California ; Mathematical Research Centre, Madison, Wisconsin ; State University of New York, Buffalo ; U S. Naval Research Laboratory, Washington D.C. ; George Washington University, Washington D. C. ; University of California at Irvine, California ; Catholic University at Washington, Washington.

Canada : School of Computer Science, McGill University, Montreal ; University of Montreal, Montreal ; University of Manisota, Winnipeg.

Australia : Australian National University, Canberra ; University of Melbourne, Melbourne ; University of Sydney, Sydney ; Monash University, Melbourne ; Coulfield Institute of Technology, Melbourne ; University of Adelaide, Adelaide ; University of Western Australia, Perth.

Dr. N. R. Ranganathan was invited to present a paper entitled ' Generalised Clifford Groups and their Physical relevance ' in the Second International Colloquium on, Group Theoretical Methods in Physics, held at Katholieck University, Nijmegen, Holland from 25th to 29th June 1973. He was a principal invited lecturer in the International Symposium in Theoretical Pnysics organised by Pars College, Tehran held during 15th-30th September and gave four lectures on Generalised Clifford Algebra, Groups and Applications. During his trip abroad in Europe, he also gave seminars and had discussions at the following centres : Battele Advanced Centre, and CERN, Geneva ; University at Kaiscislanter, Institute for Theoretical Physics, Zurich ; The Free University of Brussals ; C E.N., Saclay ; Institute of Physics at Padres Centre of Theoretical Physics, Manscille ; University of Nice, Nice ; Imperial College of Science and Technology, London ; The University College of Wales Aberystweyth ; The University of Canterbury, Canterbury and The University of Southampton. Southampton He also spent a month at the International Centre of Theoretical Physics at

Trieste Italy. He also visited Tata Institute of Fundamental Research (1-15th February) to give three lectures, participated in the Conference on Many body problem organised by Physical Research Laboratory, Ahmedabad and was an invited lecturer in the Summer School on Techniques on Many body theory organised by Birla Institute of Technology, Ranchi. He also gave three lectures in the Winter School on Laser and its Applications organised by I.I.T., Madras in December 1973, He was invited to inaugurate the Physics association of Tagore Arts College, Pondicherry in November 1973.

Dr. K. Srinivasa Rao was invited by the Nuclear Physics Division of Bhabha Atomic Research Centre, to spend two months (June-Aug., 1973) as a visiting scientist. During his stay he gave a seminar on "Photonuclear reactions".

Dr. R. Sridhar participated in the Interational Conference on "Waves and Instabilities in Plasmas" held at Innsbruck. Austria during 1st to 6th April 1973 by presenting a paper on Statistical Mechanics of magneto-active plasma. He also visited the following centres of research in Theoretical Physics in Europe, delivered lectures and had discussions with the scientists there—The Institute of Theoretical Physics, University of Vienna; International Centre for Theoretical Physics, Trieste; CERN, Geneva; The Institute of Theoretical Physics, Zurich; Chimie Physique II, Universite Libre de Bruxelles; Department of Theoretical Physics, University of Liege; Universities of Kent at Canterbury, Southampton, Oxford and Cambridge; Institute of Nuclear Physics, University of Naples.

Invited Lectures

Professor Roger Dashen Institute for Advanced Studies Princeton, USA.	"Some recent developments in High Energy Physics"
Professor S. P. Pandya Physical Research Laboratory Ahmedabad.	"Shape mixing in light nuclei"
Mr. Krishnaswami Alladi Vivekananda College Madras.	1. "Number Theory" 2. "A theorem on the rational approximation of irrationals"
Professor K. Srinivasacharyulu Department of Mathematics University of Montreal Canada.	1. "Fixed point theorems, a survey" 2. "Invariant sub-space problem in Banach spaces" 3. "Non-associative Banach algebras"
Professor S. K. Sinha Department of Statistics University of Minnitoba Winnipeg, Canada.	"Life listing and reliability estimate with non-homogeneous data" (2 lectures)
Professor J. Crank School of Mathematical Studies Brunel University England.	"Moving boundary problems"
Professor B. Y. Underwood Madras Christian College Thambaram	"Nuclear structure studies in ^{19}F and ^{20}Ne".
Dr. S. Panchapakesan Southern Illinois University California, U.S.A.	"Multiple decision (Selection and ranking) procedures"
Professor George Marsaglia Director, School of Computer Science McGill University Montreal, Canada.	"Some results on characterisation of probability distributions"
Dr. A. Sundaram Paramakalyani College Alwarkurichi.	"Recent developments in High-Energy Physics"

Research Papers

Theoretical Physics

Alladi Ramakrishnan

Einstein - A Natural Completion of Newton.
(Jour. Math. Anal. Appl., 42, 377-380, 1973)

Alladi Ramakrishnan

Generalized Gell-Mann-Nishijima relations.
(Proceedings of the conference on Nuclear Physics, Matscience Report No. *78*, 1, 1973)

S. R. Ranganathan

Generalized Clifford groups (abstract).
(Proceedings of the Conference on Nuclear Physics, Matscience Report *78*, 257, 1973)

S. Santhanam

Unified descriptions of electromagnetic and weak interactions and leptonic quarks.
(Proceedings of the Conference on Nuclear Physics, Matscience Report *78*, 37, 1973)

S. Santhanam and A. R. Tekumalla

A new spin half wave equation.
(Proceedings of the conference on Nuclear Physics, Matscience Report No. 78, 48, 1973)

Radhakrishnan

A general method to determine particle density in a self-consistent fashion for a many-body system.
(Proceedings of the Conference on Nuclear Physics, Matscience Report *78*, 259, 1973)

K. H. Mariwalla

Nuclear Physics in a larger perspective.
(Proceedings of the conference on Nuclear Physics, Matscience Report No. *78*, 132, 1973)

Geometrization of creation field and its physical interpretation.
(Proceedings of the conference on Cosmology, Gravitation and Applications to Particle Theory, Matscience Report No. *76*, 83, 1973)

Conservation laws in classical and quantum mechanics and in general relativity.
(Proceedings of the conference on Cosmology, Gravitation and Applications to Particle Theory, Matscience Report No. *76*, 103, 1973)

K. Srinivasa Rao

Effect of Woods-Saxon Wave functions on Cross sections for charged-pion photoproduction from ^{16}O.
(Phys. Rev. *C7*, 1785, 1973)

Photopions from nuclei.
(Proceedings of the conference on Nuclear Physics, Matscience Report *78*, 4, 1973)

Photoproduction of negative pions from ^{12}C.
(Proceedings of the conference on Nuclear Physics, Matscience Report *78*, 67, 1973)

K. Srinivasa Rao (with R. Parthasarathy and V. Devanathan)

Influence of realistic deuteron wave functions on neutral pion photoproduction cross sections.
(Jour. de Physique, *34*, 683, 1973)

Final state interactions in charged pion photoproduction from deuterium.
(Nucl. Phys. & Solid State Phys., (India) *15B*, 49, 1973)

K. Srinivasa Rao (with V. Devanathan and G. N. S. Prasad)

Photoproduction of positive pions from ^{27}Al and ^{51}V
(Phys. Rev. *C8*, 188, 1973)

R. Sridhar

Collective effects in a magneto-active plasma.
(Paper presented at the Inter. Conf. on 'Waves and Instabilities in Plasmas,' Innsbruck, April, 1973)

Equation of motion method (abstract).
(Proceedings of the conference on Nuclear Physics, Matscience Report No. *78*, 271, 1973)

A. R. Tekumalla and T. S. Santhanam

CP and CPT non-invariant equations of the two-compound neutrino.
(Lett. Nuovo Cimento, 6, 99, 1973)

On a new spin $\frac{1}{2}$ field.
(Prog. Theor. Phys. *50*, Sept. 1973)

Trace of products of Clifford elements.
(Matrix and Tensor Quarterly *23*, 99, 1973)

ure Mathematics

. R. Unni

Some problems in mathematical analysis.
(J. Math. and Physical Sci., in press)

Parameasures and multipliers of Segal algebra.
(Inter. Conf. Functl. Anal. Appl., 1973, Madras, Springer-Verlag in press)

A note on multipliers on a Segal algebra.
(Studia Mathematica, in press)

Segal algebras of Beurling tpye.
(Proc. Inter. Conf. Functl. Anal. Appl., 1973, Madras, Springer-Verlag, in press)

N. Keshavamurthy & K. R. Unni

On a class of functions satisfying the Lipschitz conditions.
(J. Math. Anal. Appl., 40, 643-648, 1972)

Multipliers on weighted spaces.
(Proc. Inter. Conf. on Functl. Analysis & its Appl. 1973, Madras, Springer-Verlag, in press)

M. R. Subrahmanya

A note on a problem of Rivlin.
(J. Approx. Theory 6, 354-361. 1972)

Vimala Walter

Splines in Hilbert spaces.
(Proc. Inter. Conf. Functl. Anal. Appl., 1973, Madras, Springer-Verlag, in press)

Others

D. John Vincent

Some points on the use of acronym as heading for author entry.
(Herald of Library Science, 12, 238-240, 1973)

MATSCIENCE REPORTS

Report No.	*Author*	*Title*
74-A	Krishnaswami Alladi	Contributions to number theory (Revised and enlarged) 80 pp.
76	—	Proceedings of the conference on Cosmology, Gravitation and Application to Particle Theory, Bangalore 1971. 289 pp, 1973.
78	—	Proceedings of the conference on Nuclear Physics, Mysore, 1973, 285 pp, 1973.

OTHER PUBLICATIONS

1. Proceedings of the conference on Clifford Algebra, its generalization and applications, Ootacamund, 1971, 103 pp., 1972.
2. K. R. Unni — Pure Mathematics (Inservice Training Programme, 1973) 121 pp, 1973.
3. K. H. Mariwalla — Vectors, Tensors and Relativity (Inservice Training Programme, 1973), 149 pp. 1973.

Library

Books

During the year under report 684 new books including bound periodicals and lecture notes were added to the library bringing the total number of volumes to 12,343. These include many of the recent publications in pure and applied mathematics and theoretical physics.

Periodicals

Exchange contacts were established with the following institutions and we started receiving the following items from them :

1.	Bhabha Atomic Research Centre, Bombay :	" Reports "
2.	University of Tokyo, Faculty of Science Japan :	" Journal of Faculty of Sciences, -I, Mathematics "
3.	University of Michigan Library, Michigan, USA :	" Michigan Mathematical Journal "
4.	San Jose State University, California, USA :	" Fibonacci Quarterly "

Apart from these we are regularly receiving periodicals and lecture notes from 40 institutions thoughout the world in exchange.

Lecture Notes

Lectures notes of various institutions all over the world are regularly recived in exchange to MATSCIENCE REPORT and SEMINAR IN ANALYSIS.

Lists Published

1. List of Preprints received in the library (issued Fortinightly).
2. List of New additions (issued Bi-monthly).
3. List of available MATSCIENCE REPORTS and SEMINAR IN ANALYSIS (issued yearly).
4. List of Institute Publications (Reprints & Preprints) (issued yearly).
5. List of Periodicals received in the library (issued yearly).

APPENDICES

THE JEWEL OF TAMILNAD

It is indeed a visitation of God's grace that I should have the privilege of welcoming the President of India and the Governor of Tamil Nad during the year when our nation is celebrating the Silver Jubilee of its independence! On this magnificent occasion, I want to pay my homage and tribute to our great President in the manner to which I have been trained, not through formal written address but through what I am going to speak in an extemporaneous manner with all the feeling and emotion of which I am capable. This is a very special occasion not merely because it is the eleventh anniversary of our institute but because it so happens that I will be completing twentyfive years of research to-day.

I am extremely grateful to the President of India for the spontaneous manner in which he accepted our invitation to grace this Institute with his presence. On such a significant occasion, I have to present to him something equally significant. I am going to speak the truth, the whole truth and nothing but the truth. I am going to present your Excellency the jewel of Tamilnad, MATSCIENCE, and I am making this statement as a mathematician, supporting it by proof and document and not merely by assertion and emphasis. We are very fortunate in this institute to have a band of energetic young men who have made this institute what it is today a great—centre of learning, a jewel of Tamilnad. There are scientists here to justify my hope that this is going to be claimed as the jewel of the nation. It is characterised by all the qualities that typify a jewel; it is small in size but of permanent brightness, it is luminous and can be illumined, it shines in sun and shower and increases in value as time goes by. I would not have made this claim but for my colleagues who have led this institute during the eleven years of its career since its inception. I do not like to miss this opportunity to name those colleagues with a sense of grateful pride. Professor Unni is the most outstanding of our mathematicians. His great efforts have resulted in a conference which is a forward success because of the tremendous response from the world-wide scientific community. The conference will take place from the 1st to the 7th January 1973 and it is part of the celebrations which our President is to inaugurate to-day. Over fifty scientists and mathematicians will arrive next week from all over the world. That their travel is being sponsored by their parent organisations is a very great tribute to the work done at this institute and does not in any way detract from its hospitality.

Professor R. Vasudevan and Dr. N. R. Ranganathan are the oldest of my colleagues though they are young in age, for they have been with me from the time this Institute was conceived in my family home — Ekamra Nivas Drs. T. S. Santhanam, K. H. Mariwalla, V. Radhakrishnan are part of the eminent group of theoretical physicists which formed the nucleus of this

Institute. Dr. K. Srinivasa Rao is the youngest scientist who has recently joined this band and there are many others who will join it in due course. They are anxious to serve our country in a capacity much wider than that of a pure scientist and it is with such a view I approached the President of India last year who with spontaneous emotion reacted favourably and said 'I am going to take immediate action on this.' He did so but there are many things which are delayed due to human vagary and circumstance and I hope the Government of India will come forward with unstinted support to this Institute which has been so well conceived and sponsored by the Government of Tamilnad.

We have taken this opportunity to request the President to release the book 'L-matrix theory or the Grammar of Dirac matrices' the title of which expresses much more than the book itself, for we have therein attempted to write a grammar for the work of the eminent Nobel prizeman Professor Dirac, one of the makers of modern physics. It purports to give a satisfactory answer to an old, well-known problem, long abandoned as difficult of solution—the connection between the Pauli and Dirac matrices. The work has been published as a series of papers over three years.

The Tata McGraw-Hill Company was willing to compile the entire set of papers in the form of a single monograph. This effort is the first of its kind and nothing like this has been done before, not because there were no such authors but because publishers were not willing to take a leap into the future as the Tata McGraw-Hill has done today. It is a co-operative effort of our theoretical physics group and most of the papers are done in collaboration with my students, now my colleagues. I thought that such a publication which is unique in the annals of Indian science should be released by the Head of our State and it is not a hyperbolical claim to say that such a co-operative effort is the starting point of a new renaissance in Indian science.

The Governor's sympathy for mathematicians is so well-known that I take this opportunity to congratulate Tamilnad for having a Governor who is quite at home amidst the academic community of scientists and mathematicians. I am quite sure that the President of India with his generous affection for me and his well-known regard for my great father will pardon this spontaneous expression of my thoughts and views, untrammelled by the conventions and formalities of an official function.

I now request the Governor to set in motion the planned proceeding of the evening.

Professor ALLADI RAMAKRISHNAN,
Director, MATSCIENCE

Speech delivered at the Inauguration of the Eleventh Anniversary Celebration on 23rd December, 1972.

LIST OF INSTITUTIONS AT WHICH PROFESSOR ALLADI RAMAKRISHNAN, DIRECTOR, MATSCIENCE GAVE LECTURES ON HIS RESEARCH WORK

AMERICA (U.S.A.)

University of Arizona at Tempe (1970)
Bell Telephone Laboratories, New Jersey (1963, 66)
Boeing Research Laboratories, Seattle, Washington (1968, 69)
Boston University, Boston (1967)
University of California, Berkeley (1962, 65, 71)
University of California, Irvine (1966, 70, 71, 73)
University of California, Los Angeles (1962, 69)
University of California, Riverside (1971, 72)
University of Chicago, Chicago (1956)
Case Institute of Technology, Cleveland (1958)
University of Colorado, Boulder (1962)
Cornell University, Ithaca (1967)
Courant Institute of Mathematical Sciences, New York (1967, 68, 73)
University of Dayton, Dayton Ohio (1968, 70)
Douglas Aircraft Corporation, New York (1966, 69)
General Motors Research Laboratories, Detroit, Michigan (1969)
University of Hawaii, Honolulu, (1966, 67, 69)
Hughes Research Laboratories, Malibu, California (1962)
Howard University Washington, D. C. (1971)
Illinois Institute of Technology, Chicago (1958)
University of Illinois, Urbana (1970)
University of Maryland, Maryland (1958)
Institute of Advanced Study, Princeton (1957, 58)
Institute of Theoretical Physics, M. I. T., Cambridge (1968)
Iowa State Univesity, Iowa (1971)
Lockheed Aircraft Corporation, New York (1969)
St. Louis University, St. Louis (1966, 71, 72)
Massachusetts Institute of Technology, Massachusetts (1956)
U. S. Naval Research Laboratory, Washington, D.C. (1958, 66–73)
New York State University, Physics, Biology, Engineering, Statistics, Buffalo (1967, 70, 72, 72)
University of North Carolina, Chapel Hill (1971)
North Texas University, Denton (1969, 70)
Oak Ridge National Laboratory, Tennessee (1970)

Pennsylvania State University, Pennsylvania (1972, 73)
Purdue University, Lafayette (1968, 70)
Rand Corporation, California (1962, 71)
University of Rhode Island, Kingston (1971, 72)
Rutgers University, New Jersey (1971, 72)
University of Rochester, Rochester (1963, 67)
University of Southern California Los Angeles (1967, 71, 73)
University of Texas at Austin (1970)
Stanford University, Physics, Statistics and Engineering, Stanford (1962,69, 70, 71, 72)
State College, Long Beach, California, (1965, 70)
Syracuse University, Syracuse (1966, 69, 72)
University of Texas at Dallas (1970, 71, 73)
Thomas J. Watson Research Center, IBM, New York (1971, 73)
Utah State University, Logan, Utah (1971, 72)
University of Washington, Seattle (1967, 69)
University of Wisconsin at Madison (1966, 70)
University of Wisconsin at Milwaukee (1966, 67, 71)
University of Wyoming, Laramie (1972)
Wright-Patterson Air Force, Dayton, Ohio (1968, 69, 70, 73)
Wright University, Dayton (1971, 72)
Wayne State University, Detroit (1969)
Yeshiva University, New York (1967, 70, 71, 72, 73)
Mathematics Department, I. B. M., Yorktown Heights, New York (1973)
South Illinois University, Mathematics, Physics, Carbondale, Illinois (1973)
Mathematical Research Center, Madison, Wisconsin (1973)
State University of New York, Buffalo, New York (1973)
George Washington University, Washington, D. C. (1973)
The Catholic University at Washington, Washington (1973)
Yerks Astronomical Observatory, Chicago University (1958)

AUSTRALIA

Australian National University, Canberra (1954, 71, 73)
Latrobe University, Melbourne (1971)
University of Melbourne, Melbourne (1954, 71, 73)
University of Sydney, Sydney, (1954, 71, 73)
Monash University, Melbourne (1973)
Caulfield Institute of Technology, Melbourne, (1973)
University of Adelaide, Adelaide, (1973)
University of Western Australia, Perth (1973)

BELGIUM

Department of Mathematics, University of Liege, Liege (1971)
Department of Physics, University of Liege, Liege (1971)

CANADA

University of Alberta, Edmonton (1969)
Carleton University, Ottawa (1969)
Sir George Williams University, Montreal (1971, 73)
McGill University, Physics, Computer Science, Montreal (1971, 72, 73)
University of Montreal, Montreal (1968, 71, 72, 73)
National Research Council, Ottawa (1958)
Simon Fraser University, Vancouver (1968)
University of Toronto, Toronto (1968)
University of Ottawa, Ottawa, (1958)
University of Manitoba, Winnipeg (1973)

DENMARK

Bohr Institute, Copenhagen (1950, 60)

ENGLAND

University of Edinburgh, Edinburgh (1949)
Imperial College of Science and Technology, London (1960, 63, 67, 69)
University of Manchester, Manchester (1949, 56)
Oxford University, Oxford (1949, 60)
Physical Society of Great Britain, Birmingham (1949)
Atomic Energy Establishment, Harwell, England (1960)

FRANCE

Institute of Henri Poincare, Paris (1960, 66)
C. E. N., Saclay (1964, 65, 67, 68, 69)
University of Paris, Orsay (1967)

IRELAND

University of Dublin, Dublin (1949)
Dublin Institute for Advanced Studies, Dublin (1950)

ITALY

International Centre for Theoretical Physics, Trieste (1963, 65, 67, 68, 70)
University of Naples, Naples (1967)
University of Padua, Padua (1966, 69)
University of Rome, Rome (1966, 69)

IRAN

Aria-Mehr University, Teheran (1968)

JAPAN

University of Kyoto, Kyoto (1956)
Osaka University, Osaka (1956)
Tokyo University of Education, Tokyo (1966, 70)
Yukawa Hall, Kyoto (1956)

NEW ZEALAND

University of Canterbury, Christchurch (1971)

NORWAY

University of Oslo, Oslo (1950)

SINGAPORE

University of Singapore, Singapore (1971)

SWITZERLAND

University of Berne, Berne (1960, 69)
CERN, Geneva (1960, 62, 66)
E. T. H. Zurich (Federal Institute of Technology), Zurich (1950)
University of Geneva, Geneva (1967)
Swiss Physical Society, Winterthur (1960)
University of Zurich, Zurich (1950, 51, 56)

SWEDEN

Cramer's Institute, Stockholm (1950)
University of Uppsala, Uppsala (1950)

U. S. S. R.

Academy of Sciences, Moscow (1968)
Physical-Technical Institute, Academy of Sciences, Leningrad (1968)
Nuclear Research Centre, Dubna (1964)

WEST GERMANY

University of Bonn, Bonn (1971)
University of Gottingen, Gottingen (1956)
University of Heidelberg, Heidelberg (1956)
University of Marburg, Marburg (1956, 60)
University of Stuttgart, Stuttgart (1956)

LIST OF PUBLICATIONS OF Professor R. VASUDEVAN
during 1970 to 1973 (arranged according to subjects)

Stochastic differential equations :

1. Vasudevan, R., R. Bellman and T. T. Soong, On Moment Behavior of a class of Stochastic Difference Equations, *J. Math. Anal, Appl.*, Vol. 40, 1972, pp. 159–162. (Read at 41st National Meeting of Operations Research Society of America, April 1972 at New Orleans.)

2. ——— Quasilinearization and Stability of Nonlinear Stochastic Systems, *J. Math. Anal. Appl.*, Vol. 40, 1972, pp. 286–299.

I. **Manybody Physics** :

3. Vasudevan, R., R. Pratap and R. Sridhar, On the D. H. V. A, Oscillations in a Plasma, IL Nuovo Cimento, Vol. 8, Series II, 1972, p. 223.

4. Vasudevan, R., R. Kalaba and R. Huss, On a Boundary Value Problem for Integro-Differential Equations, to appear in the *Journal of Mathematical Physics*, 1974.

5. Vasudevan, R. and R. M. Wilcox, Solution of the Differential Equation $\frac{\delta^2}{\delta x\, \delta y} + ax\, \frac{\delta}{\delta x} + \text{by}\, \frac{\delta}{\delta y} + c\, x\, y + \frac{\delta}{\delta t} P(x, y, t) = 0$ and the Bogoliubov transformation," to appear in the *Journal of Math. Anal. Appl.*, Vol. 4?, 1973, p. 555.

II. **Applied Mathematics :**

6. Vasudevan, R., R. Bellman and B. G. Kashef, Splines Via Dynamic Programming, *J. Math. Anal. Appl.*, Vol. 38, No. 2, 1972, pp. 471–479.

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13. ———, A Note on the Matrix Riccati Equations - II. Transport Processes with Sources, *Utilitas Mathematica*, Vol. 3, p. 107. 1973,

14. Vasudevan, R. and R. Bellman, Upper and Lower Bounds for the Solution of Fredholm Integral Equations, Univ. of Southern California, T. R. No. 73–4, to appear in *Utilitas Math.*

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16. ———, Wave Equation with Sources, Invariant Imbedding and Bremmer Series Solutions, Univ. of Southern California, T. R. No. 73–16. (to appear in *J. Math. Anal. Appl.*).

17. Vasudevan, R., E. S. Lee and K. M. Wang, Invariant Imbedding Method of Characteristics and Parameter Estimation. Univ. of Southern California, T. R. No. H3 p. 66, RB 73–38, 9/73.

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32. ———, "Invariant Imbedding and Radiation Dosimetry-V. Finite Order Intensity of Radiation in a Target Slab," *Mathematical Biosciences*, Vol 17, 1973.

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34. ———, "Invariant Imbedding and Radiation Dosimetry-VII. Finite Order Scattering and Transmission Functions in Two Component Approxmation," (to appear in *Mathematical Biosciences*).

35. ———, "Invariant Imbedding Radiation Dosimetry-VIII. Reflections from a Double Layer Finite Order Functions," (to appear in *Mathematical Biosciences*).

36. Vasudevan, R., R. Bellman, A. Fymat and S. Ueno, "Invariant Imbedding and Radiation Dosimetry-IX. The Inverse Problem of Determining a Plane Source in a Finite Isotropically Scattering Target Slab," to appear.

37. Vasudevan, R., R. Bellman and S. Ueno, "Invariant Imbedding and Radiation Dosimetry-X. Intensity of Finite Order Scattered Gamma Radiation Emergent from a Target Slab with Internal Sources," to appear.

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INTERNATIONAL CONFERENCE

ON

FUNCTIONAL ANALYSIS AND ITS APPLICATIONS

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