The Institute for Advanced Study

Annual Report 1984/85

The Institute for Advanced Study

Annual Report for the Fiscal Year
July 1, 1984–June 30, 1985

It is fundamental to our purpose, and our express desire, that in the appointments to the staff and faculty, as well as in the admission of workers and students, no account shall be taken, directly or indirectly, of race, religion or sex. We feel strongly that the spirit characteristic of America at its noblest, above all, the pursuit of higher learning, cannot admit of any conditions as to personnel other than those designed to promote the objects for which this institution is established, and particularly with no regard whatever to accidents of race, creed or sex.

Extract from the letter addressed by the Founders to the Institute's Trustees, dated June 6, 1930, Newark, New Jersey.

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The Institute for Advanced Study: Background and Purpose

The Institute takes the following premises on the nature of learning as fundamental: most important work is the product of the disciplined and creative individual mind; accordingly, the individual scholar must be responsible for how he uses the precious resources of his own time and energy; the community of peers in his area of intellectual work is the ultimate judge of the results. (From Proce-dures for Academic Governance of the Institute.)

The Institute for Advanced Study, an independent, private institution devoted to the encouragement, support and patronage of learning, was founded in 1930 as a community of scholars where intellectual inquiry could be carried out in the most favorable circumstances. Focused on mathematics and classical studies at the outset, the Institute today consists of the School of Historical Studies, the School of Mathematics, the School of Natural Sciences and the School of Social Science. Each School has a small permanent Faculty, and some 160 fellowships are awarded annually to Visiting Members from other research institutions and universities throughout the world.

The objectives of the Institute were described as follows in the Founders' original letter to the first Trustees: "The primary purpose is the pursuit of advanced learning and exploration in the fields of pure science and high scholarship to the utmost degree that the facilities of the institution and the ability of the faculty and students will permit." During the past half-century, these goals have been implemented by a Faculty of exceptional merit; by an annually renewed group of Visiting Members chosen from among the many who apply; and by the development of facilities and a mode of operation designed specif-ically to support and assist the Institute's intellectual purposes in every way possible.

Although the Institute is small when measured in terms of the size of its immediate academic community or of its operating budget, its intellectual weight is great and its influence on science and scholarship extraordinary. From its earliest years, it has been internationally recognized as one of the world's leading centers of research. Indeed, its successful example has created numerous imitators both in the United States and abroad.

From the beginning, the Institute has been an international organization, although American in location and organizational form. It has operated throughout its existence on the premise that science and learning transcend national boundaries and that scholars and scientists are members of one commonwealth of the mind. Of the present Faculty, many have begun their scientific and scholarly careers outside the United States. One-third of the Visiting Members come from abroad, mostly from the great centers of learning of western Europe and Asia, and, to a lesser extent, from other regions of the world.

With its devotion to the continuing examination of new and centrally important questions as they arise at the frontiers of knowledge, the Institute partakes of the character of both a university and a research institute, while differing in significant ways from both. It is unlike a university, for instance, in its small size—its academic membership annually numbers somewhat under 200—and in the fact that it has no formal curriculum, no scheduled courses of instruction, no commitment that all branches of learning be represented in its Faculty and Members. It is unlike the usual research institute in that it supports many separate fields of study, maintains no

laboratories and determines its programs in terms of individual intellectual imperatives rather than the collective aims of research teams or the particular interests of potential donors.

For more than five decades the Institute for Advanced Study has made a substantial contribution to the world of higher learning by providing support—intellectual and material—to Visiting Members whose development and growth constitute one of its principal purposes. More than one third of these Visiting Members are young men and women 35 years of age or less whose work at the Institute involves the Faculty in a substantial amount of postdoctoral training. Though none of the Visiting Members is a student in the narrow sense of being a degree candidate, the communal atmosphere and many opportunities for discussion with Faculty members and peers, both within and outside seminar meetings, are propitious to scholarly growth.

The Institute devotes special attention to young people of accomplishment and promise, offering them membership at a stage in their careers when independent work is of the highest importance to their intellectual development. These younger Members then return to or join the faculties of universities all over the world and share what they have learned as a result of their stay at the Institute. This might be termed the invisible work of the Institute; its visible work is contained in the publications of the Faculty and Visiting Members. Both serve to reinforce in highly significant ways the quality of scholarship and research throughout the world.

The varied work of the Institute is, of course, specialized; no advanced study or deep scholarship can be otherwise. Formal attempts to organize scholarly work at the Institute are minimized, although lectures and seminars are a regular feature of its internal life. Schools may, for limited periods of time, select certain themes or programmatic arrays under which Members are encouraged to apply, but no concentration guarantees entry

and no focus excludes those outside it. The choice and conduct of research are matters which are decided entirely by each individual member of the Institute.

The Institute is nonetheless an intellectual community and not a mere collection of scholars. Community is possible because Faculty and Members have some substantial knowledge outside their own fields of specialization. The fact that the Visiting Members live together in Institute housing, eat in the same dining hall, share the same common room and libraries, and carry out their work in an institutional setting where human scale has been carefully maintained is conducive to common interest, mutual understanding and friendship.

The Faculty and Members of the Institute are also a part of the larger community of Princeton, with its University and its many institutions of research and learning. Although the Institute has no administrative or organic connection with Princeton University, there has always been close collaboration between the two institutions on matters of common interest. Many Institute seminars are open to interested members of the University's faculty and graduate school, and University seminars and conferences are frequently attended by Institute Faculty and Members. Without the University, Princeton itself would be both physically and intellectually inadequate as the site of the Institute; and the Institute has brought a degree of international excellence to the general academic climate of Princeton, contributing to the development of what has become one of the world's great educational communities.

The Institute today occupies a square mile of land in Princeton, New Jersey. Most of this is farm and woodland. Its buildings house libraries, offices for Faculty and Members, seminar and lecture rooms, and common rooms. Subsidized, conveniently located housing is maintained for all Visiting Members, and transportation is regularly provided to the center of town.

Report of the Chairman

Since its formal inception in the autumn of 1933, the Institute for Advanced Study has welcomed approximately four thousand Visiting Members. Some have attended for a term, most for the full academic year, while a not inconsiderable number have returned, usually after an interval of years, for a second or even occasionally a third time. The immediately preceding brief introduction ("Background and Purpose") to which I invite your attention describes something of these Visiting Members' varied ages, career status and university connections around the globe.

In talking with the Faculty one is repeatedly impressed with the vital importance they attach to the presence of and their interest in the Visiting Members. It is an essential part of their activities, intellectual life and productivity. In fact, future historians may well conclude subsequently that the combination of a small permanent Faculty with Visiting Members has increasingly been and is the principal element sustaining this significant institution.

This year, at the April Board meeting, a panel of Visiting Members reported on their various projects. James Lockhart from the School of Historical Studies talked about the history of Mexican Indians as seen through Indian language documents; Andrew Strominger from the School of Natural Sciences discussed progress in quantum gravity; James Lepowsky from the School of Mathematics described "The Monster: a remarkable symmetry group"; and Frank Stewart from the School of Social Science talked about customary law of the Bedouin in the Sinai peninsula.

During the past few years, the escalation in the costs of real estate in the Princeton area has caused concern to the Board as well as to the Administration of the Institute. The need to provide housing for both new Faculty members and those retiring Faculty who no longer wish to remain in houses too large for their present needs has led to various discussions at Board meetings and to the establishment of a Trustee-Faculty Committee on Housing. The Chairman of this Committee is Charles L. Brown and its other members are Albert O. Hirschman, Atle Selberg and Frank E. Taplin.

The Wolfensohn Planning and Review Committee has made good progress. Meetings were held between the full Committee and each School in the late fall, and then individual meetings between members of the Committee and Faculty, including emeriti, took place. Each School prepared a report for the Committee, discussing its past achievements, current status and objectives for the future. A questionnaire, identical to the one used by the Segal Committee in 1976, went out to all former Visiting Members since 1975, and letters were sent, as they had been a decade earlier, to distinguished scholars in the disciplines represented by the Schools, asking them to comment on the Institute's role in the larger universe of learning. A report from the Committee will be made to the Board at the April meeting in 1986 and will be summarized in next year's Annual Report.

The resignations of three Trustees were regretfully received. John Opel and Howard Kauffmann retired from the Board, and the following resolutions were accepted by the Board concerning them:

"John Opel joined the Institute's Board of Trustees in 1976, continuing the significant relationship of IBM with the Institute which dates back to the first donation from IBM in 1961 towards an IBM von Neumann Chair for a professor in the School of Mathematics. This relationship was furthered by the welcome presence of Thomas J. Watson, Jr.

on the Board from 1968 to 1975. John Opel was Tom Watson's successor and has served on the Nominating and Budget Committees. He was instrumental in the establishment, at the time of the Fiftieth Anniversary Fund, of an IBM endowment fund for a Visiting Member, and he encouraged the use of the Institute's accrued IBM funds for the establishment of a second IBM chair honoring Hermann Weyl in the School of Mathematics. He has benefited the Institute not only by his personal generosity but through his interest in strengthening the computing power of the Institute and his willingness to explore how this might best be accomplished. We are pleased that the corporate connection will be maintained by his successor, and we are deeply grateful to John for these past years of fruitful association."

"Howard C. Kauffmann joined the Board of Trustees in 1978. Since that time he has served on the Budget Committee and brought to its deliberations, as to the counsels of the Board itself, his wise perception and experienced judgment. Through his intervention, the Institute has formed a good and continuing relationship with the Exxon Education Foundation and the Exxon Research and Engineering Corporation and will, in the next few academic years, be able to enjoy Exxon Fellowships in the Schools of Natural Sciences and Social Science. The Board hereby expresses its deep appreciation for Howard's years of service to the Institute and his generous personal and corporate support of its purposes and wishes him every good fortune in his forthcoming retirement."

George Field, who had been only recently elected to the Board and was a valued member of the Wolfensohn Committee, became unable, for reasons of health, to continue his service on the Board. The following resolution was passed:

"George B. Field was elected to the Board of Trustees in 1983 and served faithfully as a Trustee for two years, bringing both his scientific acumen as an eminent astrophysicist and his humane perception to all the Board's deliberations. He was an active and effective member of the Wolfensohn Planning and Review Committee until illness forced his resignation last winter both from that Committee and the Board of Trustees. The Board wishes to record here its warm thanks for his contribution and to wish him good health and prosperity in all his works and ways."

Two new Trustees were elected to the Board and attended their first meetings in the fall of 1984: John F. Akers and Michel Vaillaud.

John F. Akers, President and Chief Executive Officer of IBM, joined IBM in 1960 after receiving a B.S. degree from Yale University and serving active duty as a Navy aircraft carrier pilot. Following various assignments with IBM, he was elected senior vice president in 1982, and in February, 1983, President and a director. In March, 1983, he was named a member of the Corporate Management Board and IBM's Policy Committee. He is also a director on the Board of the Council for Financial Aid to Education and a member of the Advisory Board of the Yale School of Organization and Management.

Michel Vaillaud is President, Chief Operating Officer and Director of Schlumberger, Ltd. He was born in France and educated at the Ecole Polytechnique in Paris. He joined the French Civil Service in 1955 where he spent eighteen years in various positions. He also served four years as Director of the National Center for Oceanic Exploration, and two years as Chairman of the French National Office for Aerospace Study and Research before joining Schlumberger, Ltd. in 1973.

J. Richardson Dilworth
Chairman

Report of the Director

The remarkable energies exerted in and released by research as it is practiced here at the Institute are unpredictable in their course and issue. Among our concerns, the protection of that free play of mind and its continuing enhancement is central and fundamental. We respond to that task by maintaining an appropriate social atmosphere, the necessary facilities and sufficient means to ensure that the creative processes can go forward in their natural varieties and forms. There must be sufficient allowance for what may be fertile silence, the quiet and unobservable gathering of energies before the next measurable and demonstrated advance in a particular subject. These reflective, gestating intervals are as necessary as they are difficult to explain to a public avid for patent (and even patentable) progress. At the same time, we are united in our concern that interests of the past do not become those of the future out of unexamined habit or intellectual creature comfort. Simple replication in the life of the mind invariably produces a decay curve, obviously to be avoided. Previously unexplored fields or new facets of knowledge should receive their due as their importance becomes manifest. There is no better way to encourage such exploration and evolution than through the appointment of new Faculty, and the Institute has recently been singularly fortunate in such changes.

New Faculty

During the last two academic years, each of the four Schools of the Institute has recommended a new appointment to its Faculty which, in every case, was accepted by the rest of the Faculty according to our regulations and approved by the Board of Trustees. It gives me great pleasure here to introduce Pierre Deligne who joined the Faculty of the School of Mathematics in the autumn of 1984, and Giles Constable, Piet Hut, and Joan Wallach Scott, whose appointments were confirmed during this past year and who will, in the fall of 1985, take up their positions in the Schools of Historical Studies, Natural Sciences and Social Science respectively.

Pierre Deligne was born in Belgium and received his M.A. and his Ph.D. from the Université Libre de Bruxelles and his Doctorat d'Etat from the Université de Paris-Sud, Centre d'Orsay. Before joining the Faculty at the Institute, Professor Deligne was a permanent member of the Institut des Hautes Etudes Scientifiques in Bures-sur-Yvette, France. He was a Visiting Member at the Institute for Advanced Study in 1972-73 and 1977 and a Visitor in 1981-82. He received the François Deruyts Prize from the Belgian Royal Academy in 1974, the Henri Poincaré Medal from the Académie des Sciences in Paris in 1974, the Quinquennial prize ("Dr. A. Deleeuw-Damry-Bourlart" for 1971-75) from the Belgian National Science Foundation in 1975 and the Fields Medal from the International Mathematical Union in 1978. He is a foreign member of the Académie des Sciences and foreign honorary member of the American Academy of Arts and Sciences. He is the author of over fifty publications in the fields of algebraic geometry and number theory.

Giles Constable was born in London, England. He received his B.A. and his Ph.D. from Harvard University in 1950 and 1957 respectively, and an honorary doctorate from the University of Paris I in 1980. From 1966-77 he was the H. C. Lea Professor of Medieval History at Harvard University and from 1977-84 Director of the Dumbarton Oaks Research Library and Collection in Washington, D.C. He has also taught at the University of Iowa, the

Centre d'études supérieures de civilisation médiévale in Poitiers, St. John's University, Catholic University of America, and Georgetown University. He has published numerous books and articles on medieval history, in particular on monasticism and the religious life of the twelfth century. His two-volume edition of *The Letters of Peter the Venerable* (1967) won the Faculty Prize of the Harvard University Press in 1968 and the Haskins Medal of the Medieval Academy of America in 1969. He is a member of the Advisory Board, Institute of Medieval Canon Law, and the Board of Editors of *Medievalia et Humanistica*. He gave the Trevelyan Lectures at the University of Cambridge, England, in the spring of 1985.

Piet Hut, born in 1952 in Utrecht, The Netherlands, received his M.Sc. degree from the University of Utrecht in 1977 and his Ph.D. degree from the University of Amsterdam in 1981. Since that time, he has been a Longterm Member of the Institute for Advanced Study. He has worked on the gravitational interactions between multiple stars, on cosmology in the early universe, and on the evolution of binary stars. In collaboration with Marc Davis and Rich Muller of the University of California at Berkeley, he proposed the existence of a hypothetical solar companion star to explain the cyclic occurrence of mass extinctions of species on earth. During part of 1984, Hut was on leave from the Institute while he carried out this research at Berkeley as Adjunct Assistant Professor in their Astronomy Department.

Before coming to the Institute, Joan Wallach Scott was Nancy Duke Lewis University Professor and Professor of History at Brown University and Director of the Pembroke Center for Teaching and Research on Women. She received her B.A. from Brandeis University in 1962, her M.A. from the University of Wisconsin in 1964, and her Ph.D. from the University of Wisconsin in 1969. She has taught at the University of Illinois at Chicago Circle, Northwestern University, and the University of North Carolina at Chapel Hill. Her special fields of interest in which she has published widely are labor history, especially that of nineteenth-century France, and the history and sociology of women, especially of working women. Her first book, *The Glassworkers of Carmaux: French Craftsmen and Political Action in a Nineteenth-Century City* (1974) received the Herbert Baxter Adams Prize of the American Historical Association. She is on the Advisory Board of the Smith College Project on Women and Social Change, is a consulting editor at the University of Illinois Press for its Series on European Labor History and was recently appointed a "directeur d'études associé" of the Ecole des Hautes Etudes en Science Sociales in Paris. She was a Visiting Member in the School of Social Science at the Institute for Advanced Study in 1978-79.

Visiting Committee

The third of the Visiting Committees to the different Schools at the Institute came this past winter to the School of Social Science, the School of Natural Sciences having been visited in 1981-82 and the School of Historical Studies in 1982-83. Chaired by Daniel Bell, Henry Ford II Professor of Social Sciences at Harvard University and a member of the Institute's Board of Trustees, the Committee was made up of Alessandro Pizzorno, a sociologist from Harvard University, Amartya Sen, economist and philosopher from All Souls College, University of Oxford, Stanley Tambiah, anthropologist from Harvard, and Charles Taylor, political scientist from McGill University in Montreal. As with past Visiting Committees, this one met for a day and a half of intensive discussions with the School's Faculty and Visiting Members and the Director and then, some months later, issued a report from which I have excerpted the following main points.

"To state our conclusion first: The School of Social Science, as presently constituted, is an extraordinary success. Each of the [permanent] members is a luminary in his discipline, respected widely by his peers. Each has done distinguished work of marked originality. Beyond this, which one might expect of scholars at the Institute, the members have created a rare and remarka-

ble collegiality and, in their cooperative effort and intellectual communication with each other, they exemplify the community of scholarship that one always hopes to see but that one seldom finds. . . .

"[This] Faculty of Social Science has . . . an intellectual commitment which the Faculty itself calls 'interpretive' social science. As stated by the School: 'three basic (and related) intellectual attitudes have shaped the development of the School of Social Science. The first affirms the importance of intellectual history in the examination of social change. The second emphasizes the connections among the social sciences as well as those between them and history and the humanities. A third reflects the belief that no satisfactory account of social change is possible without careful consideration of changes in the framework of meanings that inform social action.' . . .

"Having said all this in understanding and praise, we raise a number of questions—questions of which the Faculty itself is very much aware. To the extent that the School is united in a common orientation, that mutual commitment provides intellectual bonds and reinforcement especially when each person is confronted by criticism from other scholars who follow the mainstream, positivist or natural-science approaches. Yet by now the legitimacy of the approach has been established and the next stage, necessarily, has to be exemplary work which sets forth the fruits of the interpretative approach. But as such work goes forth, the very different content and issues and problems in the different disciplines raise the question of what ties the individuals together, as the different directions unfold. Here the small size, once an asset, may become a limitation as the individual work proceeds. . . .

"A second issue is that, given its distinct orientation, the School may find itself ignored by many of the major university departments in the social-science field whose definition of relevant issues derives from a different view of the direction of the disciplines. In any immediate sense, this is not a difficulty, given the great repute of the present Faculty. It may become a question when the problem of continuity and renewal arises. . . .

"The question, obviously, is how open the School of Social Science is to these difficulties, and to intellectual change. What emerged from many long discussions with the Faculty is that its members are as aware of these problems as we are. . . . The creation of a Visiting Committee, and the questions it can raise, is one way of maintaining a watch and we would suggest the convocation of such a Visiting Committee at four- or five-year intervals. . . .

"One of the very positive facts which strengthen the work of the School of Social Science is the increasingly close ties with the School of Historical Studies, and as newer and younger members come to that School those relationships are bound to be strengthened. But that very tie may also diminish the intellectual tension with the other, more 'mainstream' currents of social science, and to that end we offer a number of suggestions for consideration. One idea . . . would be to invite social scientists of different persuasions to come for a short period of time, at the end of the academic year and in conjunction with the work of a core seminar, to comment on the work that has been presented and to present contrasting ideas. . . .

"More important, perhaps, would be the expansion of the longer term, three- to five-year fellowship for individuals interested in some of the core themes, yet working from different perspectives. . . . Our recommendation [is] . . . to invite senior and distinguished individuals who are close to their retirement, or even retired, to spend three to five years at the Institute. . . . If the School would each year have four or five senior scholars in residence, this would broaden the perspectives and enhance the work of the School, particularly in the relation to the younger visiting members. . . .

"[Returning] to our conclusion: we think that the School is an ornament to the Institute, that its members are doing first-rate

work, that, within its compass, it is providing a vibrant intellectual leadership in the world of social science. It has been a personal and intellectual pleasure for us to have had the opportunity to make this visit and submit our report."

Members' Program

Visiting Members to the four Schools are chosen on the basis of open competition and selected by the Faculty of each School. The total number of Members this year was 128. Of these, 39% were under the age of 35, and 6% were women. Members in 1984-85 came from eighty-nine institutions located in seventeen countries. The names, academic backgrounds and fields of interest of this year's Members and Visitors are described in the pages which follow.

Among the many individuals of note who have been part of our community this year, special mention should be made of the Director's Visitor, Lawrence A. Cremin, retiring President of Teachers College, Columbia University, whose earlier works on American education have won Bancroft and Pulitzer Prizes. While here, Dr. Cremin worked on the third volume of his history of American education.

Committee on Computers and Communications

Because of the increased use of and interest in computers throughout the Institute, a Committee on Computers and Communications has been formed in order to look at our current situation and our needs, to examine problems, costs and directions. It is made up of a representative from each School and Karen Jobes, Manager of Scientific Computing, who is acting as the non-voting chairman.

Supercomputer

The Consortium for Scientific Computing, composed of the University of Arizona, Brown University, the University of Colorado, Harvard University, the Institute for Advanced Study, Massachusetts Institute of Technology, New York University, the University of Pennsylvania, Pennsylvania State University, Princeton University, the University of Rochester and Rutgers University, was successful in obtaining a grant from the National Science Foundation which will be awarded over the next five years, and to which the State of New Jersey will also contribute a significant amount. Two trustees representing each of these institutions, along with two non-voting members from the State of New Jersey, constitute the Board of Directors of the Consortium, which is incorporated in the State of New Jersey as a not-for-profit corporation. The John von Neumann Center, as it is now being called, will be temporarily located in offices at the Institute for Advanced Study until its permanent site in Princeton's Forrestal Center is ready for occupancy. As a member of the Consortium, the Institute will be provided with a high bandwidth communication link to the John von Neumann Center. The supercomputer should have the computing power of a quarter of a million PCs and will be able to perform 10 billion arithmetic operations every second.

Shelomo Dov Goitein, 1900-1985

It is with profound regret that I report the death of one of our most distinguished scholars, Shelomo Dov Goitein, on February 6, 1985. Dr. Goitein was an eminent Hebraic and Arabic scholar and had been a part of our community since 1971, first as a Visiting Member to the School of Historical Studies, and then as a Long-term Visitor. His publications ran to over 600 books, articles and reviews, and he had, before his death, completed five volumes of his great work entitled *A Mediterranean Society: The Jewish Communities of the Arab World as Portrayed in the Documents of the Cairo Geniza*. Four of these volumes are in print and the fifth will appear shortly. In 1983, Dr. Goitein was awarded the prestigious laureate prize by the John D. and Catherine T. MacArthur Foundation, a lifetime award made to individuals of "exceptional tal-

ent." In so many ways, Dr. Goitein typified the purpose and function of the Institute, that of enabling the scholar to pursue his work in the most supportive ambience possible. This particular scholar's gentle nature, exquisite courtesy and vast erudition left a deep impression on all of us who knew him here, and his extraordinary grace of life and learning were commemorated in talks given at a gathering at the Institute of his friends and family a month after his death. His presence will be deeply missed.

Other Events

During the past academic year, the librarian for the Historical Studies Library, Lily Agar, retired after fifteen years at the Institute and a few months later, the librarian of the Social Science Library, Pat Sherr, also retired after thirty-five years at the Institute. Dr. Elliott Shore was appointed to both these library positions, combining in fact what had for many years been joint and cooperative services. Dr. Shore came to the Institute from Temple University and has his doctoral degree in American History from Bryn Mawr College.

An Institute for Advanced Study Archives has been established with the help of Dr. Paul Schuchman. A grant from the National Historical Publications Records Commission permitted the Institute to avail itself of the advice of an archival consultant and an archival policy is currently being prepared. Meanwhile, materials such as Board and Faculty minutes and administrative correspondence are being processed.

In the early spring, the first Richard Llewelyn-Davies lecture was given by Asa Briggs, on "The Victorian City: Images and Realities." Lord Briggs is provost of Worcester College, University of Oxford, and the author of many books on nineteenth- and twentieth-century England. Richard Llewelyn-Davies had been a Director's Visitor at the Institute in the year before he died, and this lectureship in "Environment and Society" was established by his friends to honor the memory of an architect distinguished in the fields of contemporary architectural, urban and environmental planning. The lectureship will alternate between the Institute and the University of London.

On May 18, 1985, an evening of "Jazz and Jubilation" was held at the Institute to benefit its Visiting Member program. Music was provided by Fred Starr and the Louisiana Repertory Jazz Ensemble. (When he is not playing the clarinet, Dr. Starr is President of Oberlin College and a specialist on the Soviet Union.) The Institute is grateful to all those who worked to make this Ball a memorable and highly successful event.

Funding

To meet its own budget, the Institute leans heavily on the generosity of Foundations, both government and private, on gifts from corporations, Trustees, friends and alumni. The larger donors are listed at the end of the Annual Report, but I wish to take this opportunity to thank all those who have helped to support us, with whom we share a common commitment to the pursuit of knowledge and the value of free and independent research.

Harry Woolf
Director

Reports of the Schools

The School of Historical Studies

Faculty

Glen W. Bowersock
Marshall Clagett
John H. Elliott
James F. Gilliam

Christian Habicht
Irving Lavin
Morton White

Professors Emeriti

Harold F. Cherniss
Felix Gilbert
George F. Kennan

Benjamin D. Meritt
Kenneth M. Setton
Homer A. Thompson

Members with Long-term Appointments

Herman H. Goldstine

Bernard Lewis

Otto E. Neugebauer

The School of Historical Studies

The School of Historical Studies is concerned with all learning for which the use of the historical method is a principal instrument. Over the years it has mirrored the varied interests of its individual Faculty and Visiting Members, but certain traditions have been more or less continuous. These have stressed Greek and Roman civilization, medieval history, the history of art, modern European history, the history of modern philosophy, American intellectual history, and the history of mathematics and the sciences.

The particular emphases of the School are a product of its own history. Two years after the opening of the School of Mathematics in 1933, a School of Economics and Politics and a School of Humanistic Studies were established. In Humanistic Studies, the first professor was Benjamin Dean Meritt, a specialist in Greek history and epigraphy, who was closely associated with excavations in the Athenian Agora. He in turn brought a number of distinguished ancient historians to the Institute as Visiting Members, and he collaborated with two of them in publishing *The Athenian Tribute Lists* (1939-1953).

The second appointment to the Faculty of the School of Humanistic Studies was that of the renowned German art historian, Erwin Panofsky. The titles of some of the books written by Panofsky during his years at the Institute suggest his fields of interest: *Studies in Iconology: Humanistic Themes in the Art of the Renaissance* (1939); *Albrecht Dürer* (1943); *Abbot Suger on the Abbey Church of St.-Denis and its Art Treasures* (1946); *Renaissance and Renascences in Western Art* (1960); and *Saturn and Melancholy: Studies in the History of Natural Philosophy, Religion and Art* (1964).

Two additional appointments strengthened the field of classical studies: Elias Avery Lowe, a Latin paleographer who was embarked on the prodigious task of assembling, transcribing, documenting, photographing, and publishing all the extant Latin literary manuscripts copied before the ninth century, and Ernst Herzfeld, a Near Eastern archaeologist and historian, whose scholarly work, by the time of his death, comprised nearly 200 titles. To this group was added Hetty Goldman, one of the pioneering American women involved in archaeology whose discoveries at Tarsus in Turkey were published in six volumes.

Several other appointments, most notably that of Homer A. Thompson in 1947, and Harold F. Cherniss in 1948, and the acquisition of the Gest Library, a remarkable collection of rare Chinese books and scrolls (now housed in the Princeton University Library), complete the formal early history of the School which, in 1949, merged with the School of Economics and Politics to become the School of Historical Studies.

A few years later, in 1951, medieval studies became represented in the School by the appointment of Ernst Kantorowicz. Professor Kantorowicz's work and interests ranged from the later phases of classical antiquity to the fifteenth and sixteenth centuries; in space they embraced both western Europe and the Byzantine and Islamic East. He is best known for his monumental work, *Frederick II*, and his study of the origins and development of constitutional theory, *The King's Two Bodies*.

Meanwhile, the classical discipline was fortified by the appointment of Andrew Alföldi as professor in 1955, a distinguished historian and numismatist, and the art historical tradition was carried on by Millard Meiss (appointed professor in 1958) who was able to bring to completion during his years at the In-

stitute a number of works, among them the multi-volume study, *French Painting in the Time of Jean de Berry*.

Modern history began in the School of Historical Studies with the work of Edward M. Earle, an original member of the School of Economics and Politics at the Institute. Particularly concerned with military history, Professor Earle edited *Makers of Modern Strategy: Military Thought from Machiavelli to Hitler* (1943), a work which resulted from meetings and seminars at the Institute and which is still in print.

Sir Ernest Llewelyn Woodward, also a modern historian, joined the School in 1951, George F. Kennan in 1956, and Felix Gilbert in 1962, all strengthening the fields of modern and diplomatic history, with Professor Gilbert also sharing a commitment to Renaissance studies.

While these traditions have remained strong at the School of Historical Studies, they have not excluded scholars working in other fields who have come here as Visiting Members, the total number of which is now more than a thousand. The articles and books resulting from their research at the Institute are witness to the quality and productivity of their scholarly activity here.

Academic Activities, 1984-85

The School was host to thirty-six long-term, term and annual Members in 1984-85, and four Visitors. During the summer of 1984, it also provided research facilities for eight summer Visitors. Twenty-two Members came from foreign countries, including Australia, Canada, England, France, Israel, Italy, Japan, Jordan, Scotland, and West Germany.

All Members and Visitors at the Institute are independent scholars and concentrate on their own subjects. The topics of their individual projects are listed in the next section. But contacts and exchanges with one another, whether organized or informal, are often fruitful and stimulating. Among the formal colloquia—lectures followed by discussions— were those in art history on a monthly basis in which Princeton University's department

took part. Some of the Members also gave papers at meetings of the Institute's School of Social Science. All these are listed in the Record of Events.

Faculty

Professor Glen Bowersock delivered lectures in Dublin, Wabash, and Bryn Mawr, participated in a colloquium on Edward Gibbon's *Decline and Fall of the Roman Empire* at Indiana University, and taught in a National Endowment for the Humanities Institute on Judaic Studies at Brown University. He published a number of articles in various journals, and, together with E. L. Bowie, he published a chapter on Greek literature of the Roman imperial period in the *Cambridge History of Classical Literature*, Volume I. He also wrote a study of the social and economic history of Roman Syria for a multi-volume history of Syria that is being prepared under the auspices of the Department of Antiquities in Damascus.

The concluding volume (Volume V) of Professor Marshall Clagett's *Archimedes in the Middle Ages* (Philadelphia, 1984) appeared in the autumn of 1984 and was hailed by *The Archive for History of Exact Sciences* (Volume 29, number 4) with these words: "This Archive salutes Marshall Clagett on the completion of his great work." Professor Clagett continued work on his *Source Book in Egyptian Science*.

Professor John Elliott completed writing the political biography of the seventeenth-century statesman, *The Count-Duke of Olivares*. Among his publications were two chapters on the Spanish conquest and settlement of America in Volume I of *The Cambridge History of Latin America* (Cambridge, 1984). He delivered a lecture to the Friends of the Princeton University Library inaugurating an exhibition in the Library entitled "Princeton and the Iberian World."

Professor James F. Gilliam continued his work on the Roman army. He began the gathering and selecting of his Roman army articles for a book to be titled *Roman Army Papers* which will appear in 1986. His review of M. I. Finley's *Economy and Society in Ancient Greece*

appeared in the September 1985 issue of *The Journal of Economic History*.

Professor Christian Habicht read galley and page proofs and prepared the indices for his forthcoming book, *Pausanias' Guide to Ancient Greece* (Sather Classical Lectures, Volume 50) and for the German edition *Pausanias und seine Beschreibung Griechenlands*. He also published a paper in the Proceedings of the American Philosophical Society 129 (1985) on "An ancient Baedeker and his critics: Pausanias' Guide to Greece." He prepared a number of other papers for publication and gave lectures at the fall meeting of the American Philosophical Society in Philadelphia and the Universities of Munich, Vienna, Kiel and Berlin.

Professor Irving Lavin delivered the Slade Lectures at the University of Oxford in the spring of 1985, on the subject "The Art of Commemoration in the Renaissance." He continued as Chairman of the committee planning the 26th International Congress of the History of Art, to be held at Washington, D.C. in August, 1986. He published several articles, including one on a newly discovered portrait bust by Gianlorenzo Bernini in the Kunsthalle at Hamburg, West Germany.

Professor Morton White held a summer appointment as Visiting Scholar in Philosophy at Harvard University where he continued his research on the philosophical foundations of *The Federalist*. In the winter of 1984-85, *Journeys to the Japanese, 1952-1979*, a book written by him and his wife, Lucia White, was accepted for publication. In May, 1985, Professor White delivered the Neesima Lectures at Doshisha University in Kyoto, Japan; the title of the lectures was "Pragmatism and the Politics of Epistemology." In June, 1985, he completed the manuscript of a book tentatively called *Philosophy*, The Federalist, *and the Constitution*, which has been accepted for publication.

Professors Emeriti

Professor Harold F. Cherniss pursued his studies of ancient Greek philosophy and especially of Aristotle's criticism of Plato and the Academy.

Professor Felix Gilbert published the third revised edition of *The End of the European Era* and a new paperback edition of *Machiavelli and Guicciardini*, as well as several reviews. He gave three seminars on "The Development of Nineteenth-Century Historiography" at Stanford University and delivered the Josephine Waters Bennett Lecture at the Annual Convention of the Renaissance Society of America, entitled "The Origin of Burckhardt's *Civilization of the Renaissance in Italy*." He also lectured at Vassar College and continued his research on Venetian history in the sixteenth century and nineteenth-century historiography. He was elected a foreign member of the "Istituto Veneto di Scienze, Lettere ed Arti."

Professor George F. Kennan's second volume of his series on the Franco-Russian Alliance of 1894 (*The Fateful Alliance*) appeared in October, 1984; he began, in 1985, the research for a third volume. He also completed a monograph on a Russian scientist of the nineteenth century whose non-academic activity involved Franco-Russian relations in the 1880s and 1890s, as well as several articles on current problems of Soviet-American relations. He received an honorary degree from New York University and the James Madison Award from the Whig-Cliosophic Society of Princeton University.

Professor Kenneth M. Setton published the third and fourth volumes of his work on *The Papacy and the Levant, 1204-1571*, as well as the fifth volume of the *History of the Crusades*.

Professor Homer Thompson continued to prepare for publication the results of the excavation of the Athenian Agora. In Athens he reviewed the evidence for the restoration of several of the principal civic buildings in the Agora, and in London took part in a symposium organized by the Society of Antiquaries on the impact of Rome on Greek architecture of the Hellenistic and Roman periods.

Long-Term Members and Visitors

Professor Bernard Lewis delivered the third Director's Lecture at the Institute for Advanced Study on "Opposition to Government in Islam," the Helmsley Lecture at Brandeis

University on "The Jews of Islam," the Charles Francis Adams Lecture at the Fletcher School of Law and Diplomacy, Tufts University, on "Islamic Fundamentalism and International Relations," as well as lectures at The Graduate School and University Center of the City University of New York, Cornell University, the University of Chicago and Boston University. He participated in a conference on the Shia at Tel Aviv University and chaired a meeting of the Harvard University Visiting Committee to the Department of Near East Languages and Civilizations. He also served as a member of the External Review Committee of Hebrew and Judaic Studies, New York University and of the Graduate School of International Studies, University of Miami.

Professor Otto E. Neugebauer published, together with A. Sachs, "Mathematical and Metrological Texts" in *Cuneiform Studies*, Volume 36, and an Appendix on the astronomical chapters of *The "Book of Enoch"* by M. Black. He was awarded together with Noel Swerdlow the Pfizer Award of the History of Science Society and elected an honorary member of the Société Asiatique in Paris. He continued his work on the Ethiopic version of the "Chronography" of Abu Shaker.

The School of Historical Studies

**Members with Long-term Appointments,
Members, Visitors and Assistants 1984-85**

In the section which follows, the information was obtained from material provided by the Members, Visitors and Assistants.

Members with Long-term Appointments

Herman H. Goldstine, *History of computers and computation; theory of computing machines.*
Born 1913, Chicago, Illinois. University of Chicago, BS 1933, MS 1934, PhD 1936; honorary doctorate University of Lund 1974, Amherst College 1978, Adelphi University 1978.
University of Chicago, research associate and instructor 1936-39; University of Michigan, instructor and associate professor 1939-42; US Army, in charge of development of ENIAC and of EDVAC 1942-46; IBM Corporation, research planning staff 1958, director of mathematical sciences 1958-65, consultant to director of research 1967-69, IBM Fellow 1969- ; Institute for Advanced Study, Electronic Computer Project, associate director 1946-57, School of Mathematics, permanent member 1951-58, School of Natural Sciences, member with long-term appointment 1972- , School of Historical Studies, member with long-term appointment 1977- ; Executive officer of the American Philosophical Association 1984- .

Bernard Lewis, *Islamic history.*
Born 1916, London, England. University of London, BA 1936; University of Paris, Diplôme des Etudes Sémitiques 1937; University of London, PhD 1939; honorary doctorate Hebrew University 1974, Tel Aviv University 1979.
University of London, School of Oriental and African Studies, assistant lecturer in Islamic history 1938, lecturer 1940, senior lecturer 1946, reader 1947, professor of the history of the Near and Middle East 1949-74; University of California at Los Angeles, visiting professor 1955-56; Columbia University, visiting professor 1960; Indiana University, visiting professor 1963; Princeton University, visiting professor 1964, Cleveland E. Dodge Professor of Near Eastern

Studies 1974- ; Institute for Advanced Study, member 1969, member with long-term appointment 1974- .

Otto E. Neugebauer, *History of exact sciences in antiquity.*
Born 1899, Innsbruck, Austria. University of Göttingen, PhD 1926; University of St. Andrews, LLD 1938; honorary doctorate Brown University, Princeton University.
University of Göttingen, assistant professor 1927-33; founder and joint editor of *Quellen und Studien zur Geschichte der Mathematik, Astronomie, und Physik* 1930-38; University of Copenhagen, research professor 1933-39; University of Cambridge, W. Rouse Ball Lecturer 1939; Cornell University, Messenger Lecturer 1949; Brown University, professor of the history of mathematics and professor emeritus 1939-69; Institute for Advanced Study, School of Historical Studies, member 1950-55, 1959-60, member with long-term appointment 1960- , School of Natural Sciences, member 1950, 1952, 1954, 1956, 1958, member with long-term appointment, 1960- .

Members

James Barr, *Variable spellings in the Hebrew Bible text.*
Born 1924, Glasgow, Scotland. Edinburgh University, MA 1948, BD 1951; University of Oxford, DD 1981.
Presbyterian College, Montreal, Canada, professor 1953-55; Edinburgh University, professor 1955-61; Princeton Theological Seminary, professor 1961-65; Manchester University, professor 1965-76; University of Oxford, professor 1978- .

Xavier Barral I Altet, *L'iconographie des plafonds au Moyen Age.*
Born 1947, Barcelona, Spain. Ecole Pratique des Hautes Etudes, Diplôme de Hautes Etudes 1973; University of Paris IV (Sorbonne), Doctorat d'Etat 1978.

Sorbonne, University of Paris IV, assistant 1974-81; Université de Haute Bretagne-Rennes, II, professor 1981-   ; Ecole des Hautes Etudes en Sciences Sociales, chargé de conférences 1984-   .

Vittore Branca, *Philology and history of art.*
Born 1913, Savona, Italy. University of Pisa, Dottore in Lettere 1935; University of Florence, Libera Docenza 1943; University of Catania, Professore Titolare Universitario 1950.
Academia della Crusca, Florence, professore ricercatore 1938-49; University of Catania, professore titolare 1950-51; UNESCO, Paris, head, Arts and Letters 1951-53; University of Paris IV (Sorbonne), professeur hôte 1952-53; University of Padua, professore titolare 1953-   ; Fondazione Giorgio Cini, Venice, segretario generale 1953-   .

Charles S. F. Burnett, *The mathematical works of Adelard of Bath.*
Born 1951, Oxford, England. University of Cambridge, BA 1972, PhD 1976.
St. John's College, Cambridge, junior research fellow 1976-79; Warburg Institute, London University, senior research fellow 1979-82; University of Sheffield, Leverhulme research fellow 1982-84.

Graeme W. Clarke, *The letters and fragments of Dionysius of Alexandria.*
Born 1934, Nelson, New Zealand. Auckland University College, MA 1957; Balliol College, University of Oxford BA 1959; University of Melbourne, MA and D Litt 1976.
Australian National University, lecturer 1957, 1961-63, deputy director, Humanities Research Centre 1982-   ; University of Western Australia, senior lecturer 1964-66; Monash University, associate professor 1967-68; University of Melbourne, professor 1969-81; Institute for Advanced Study, member 1979.

George R. Collins, *Neo-medieval in twentieth-century architecture and planning.*
Born 1917, Springfield, Massachusetts. Princeton University, BA 1939, MFA 1942.
Columbia University, instructor 1946-49, assistant professor 1949-54, associate professor 1954-62, professor 1962-   .

Ségolène Demougin, *Histoire sociale et institutionnelle de la Rome antique.*
Born 1943, Metz, France. University of Strasbourg, license d'histoire 1962-65; University of Paris I, Thèse de 3ᵉ cycle 1972.

Centre National de la Recherche Scientifique, attaché de recherche 1973-78, chargé de recherche, 1978-84.

Anthony R. Disney, *The Count of Linhares and Portuguese rule in seventeenth-century Goa.*
Born 1938, Kuala Lumpur, Malaysia. University of Oxford, BA 1961; Harvard University, PhD 1970.
Melbourne University, Australia, acting lecturer 1964; La Trobe University, Australia, lecturer 1970-76, senior lecturer 1976-   .

William R. Elton, *Shakespeare and renaissance intellectual contexts.*
Born 1921, New York, New York. Brooklyn College, BA 1941; University of Cincinnati, MA 1942; Ohio State University, PhD 1957.
Brown University, instructor 1946-50; University of Connecticut, visiting assistant professor 1951-52; Ohio State University, assistant 1952-55; University of California at Riverside, assistant professor to professor 1955-69; Columbia University, visiting professor summer 1969; Graduate School, City University of New York, professor 1969-   .

Robert M. Errington, *Macedonia under the monarchy.*
Born 1939, Howdon-on-Tyne, England. University of Durham, BA 1961, PhD 1966.
Queen's University, Belfast, assistant lecturer 1963-66, lecturer 1966-73; Philipps-Universität, Marburg, West Germany, professor 1973-   .

Giorgio Fedalto, *Lists of Oriental Bishops in Antioch and Constantinople Patriarchates* and *Religious orders in Cyprus (XIII-XVI centuries).*
Born 1930, Venezia-Mestre, Italy. Università Cattolica, Milan, Doctor of Civil Law 1953; Università Gregoriana, Rome, Doctor of Theology 1960; Università Lateranense, Rome, Doctor of Canon law 1962.
University of Padua, assistant professor 1968-70, libero docente 1970, professor incaricato 1970-75, professor 1975-   ; Institute for Advanced Study, member 1977-78.

Albert J. Furtwangler, *Rhetoric of the founding fathers.*
Born 1942, Seattle, Washington. Amherst College, BA 1964; Cornell University, MA 1967, PhD 1968.
University of Chicago, assistant professor 1968-71; Mt. Allison University, Canada, assistant

professor 1971-76, associate professor 1976-83, professor 1983-   ; Linfield College, visiting professor 1980-81.

John R. Hale, *War and culture in the Renaissance: art and literature.*
Born 1923, Ashford, Kent, England. University of Oxford, BA 1948, MA 1951.
Jesus College, University of Oxford, fellows tutor 1949-64; University of Warwick, professor 1964-69; University College, London, professor 1970-   .

Bert Hansen, *Nicole Oresme's natural science in its medieval and renaissance contexts.*
Born 1944, Chicago, Illinois. Columbia College, BA 1965; Princeton University, MA 1968, PhD 1974.
Institute for Advanced Study, assistant to Professor Clagett 1969-70; Bensalem College, Fordham University, assistant professor 1970-71; Liberal Arts College, Fordham University, adjunct assistant professor 1972-74; State University of New York, Binghamton, assistant professor 1974-79; Harvard University, Mellon faculty fellow 1978-79; University of Toronto, assistant professor 1979-84.

Peter Herde, *Edition of early lives of Celestine V (Peter of Morrone) for the Monumenta Germaniae Historia biography of Boniface VIII.*
Born 1933, Ratibor, Germany. University of Munich, PhD 1958, Habilitation 1965.
Bavarian Academy of Sciences and German Historical Institute, Rome, research assistant 1956-61; Deutsche Forschungsgemeinschaft, research assistant 1961-64; University of Munich, universitätsdozent; University of California at Berkeley, visiting associate professor 1966-67; University of Frankfurt, professor 1968-76; University of Washington, visiting professor 1971; Institute for Advanced Study, member 1971-72; University of Chicago, visiting professor 1973; Harvard University, Center for Byzantine Studies, Dumbarton Oaks 1979; University of Würzburg, professor 1976-   .

Friedrich E. Hiller, *History of the development of spatial problems in Greek sculpture.*
Born 1926, Munich, Germany. University of Munich, DrPhil 1955; Philipps-Universität, Marburg, Habilitation 1964; Universität Saarbrücken, professor 1967.
Deutsches Archäologisches Institut, Athens, assistent 1956; Deutsches Archäologisches

Institut, Rome, assistent 1957-59; Philipps-Universität, Marburg, assistent 1959-64, privat-dozent 1965-67; Universität Saarbrücken, professor 1967-   .

Ryosuke B. Inagaki, *Theories of knowledge in the later scholastic philosophy.*
Born 1928, Saga, Japan. Tokyo University, BA 1951; The Catholic University of America, MA 1954, PhD 1955; Tokyo University, DLitt 1982.
Nanzan University, instructor 1955-58, assistant professor 1958-68, professor 1968-70, dean of the faculty of literature 1970-72; Kyushu University, professor 1972-   , dean of the faculty of literature 1982-84.

Walter Emil Kaegi, Jr., *Byzantium and the early Islamic conquests: a military study.*
Born 1937, New Albany, Indiana. Haverford College, BA 1959; Harvard University, MA 1960, PhD 1965.
University of Chicago, assistant professor 1965-69, associate professor 1969-74, professor 1974-   ; Institute for Advanced Study, member 1970-71.

Ranon Katzoff, *A corpus of edicts of the Roman governors of Egypt.*
Born 1938, Philadelphia, Pennsylvania. Northwestern University, BA 1960, MA 1962; Hebrew Theological College, ordination BHL 1964; Columbia University, PhD 1968.
City College, City University of New York, assistant professor 1968-71; Bar Ilan University, senior lecturer to associate professor 1971-   .

Martin J. Kemp, *The use of scientific themes in art and theory c. 1400-1880.*
Born 1942, Windsor, England. University of Cambridge, BA 1963, MA 1965; University of London, post-graduate diploma 1967.
Dalhousie University, Canada, lecturer 1967; Glasgow University, lecturer 1968-81; St. Andrews University, professor 1981-   , associate dean 1983-   .

Detlef H. Liebs, *Roman legal science in Italy 260-600 A.D.*
Born 1936, Berlin, Germany. Oberlandsgericht Celle, Referendar 1960; University of Göttingen, DrJur 1962, Habilitation 1970.
University of Göttingen, wiss. assistent 1963-70, universitätsdozent 1970; University of Freiburg, ordentl. professor 1970-   .

James Lockhart, *A social and cultural history of central Mexican Indians, 1519-1800.*

Born 1933, Huntington, West Virginia. West Virginia University, BA 1956; University of Wisconsin, MA 1962, PhD 1967.

Colgate University, assistant professor 1966-67; University of California at Los Angeles, assistant to associate professor 1967-70, professor 1972-   ; University of Texas, associate professor 1970-72.

Anthony T. Luttrell, *Biography of Juan Fernández de Heredia (1377-1396).*

Born 1932, London, England. Oriel College, University of Oxford, BA 1954, MA, DPhil 1959.

Swarthmore College, instructor 1960-62; University of Edinburgh, lecturer 1962-67; British School at Rome, assistant director and librarian 1967-73; Royal University of Malta, lecturer 1973-76, visiting lecturer 1979-80; Institute for Advanced Study, member 1977-78; UNESCO Consultant and Rapporteur concerning the Restoration of the Citadel at Gozo, Malta 1981.

Jon D. Mikalson, *Religion in literature and life in fifth-century Athens.*

Born 1943, Milwaukee, Wisconsin. University of Wisconsin, BA 1965; Harvard University, PhD 1970.

University of Virginia, assistant to associate professor 1970-84, chairman of department 1978-84.

Awadh Kishore Narain, *History and coinage of the Sakas of South Asia.*

Born 1925, Gaya, Bimar, India. Banaras Hindu University, BA 1945, MA 1947; University of London, PhD 1954.

Banaras Hindu University, lecturer 1947-53, reader 1953-60, professor 1960-71; School of Oriental and African Studies, University of London, research associate 1959-60; University of Wisconsin at Madison, visiting professor 1966-67, professor 1971-   ; Macalester College, visiting professor spring 1971; Visuabharati, Santniketan, India, visiting professor 1977.

Linda Nochlin, *Woman, art and power in the later nineteenth century.*

Born 1931, New York, New York. Vassar College, BA 1951, Columbia University, MA 1952; New York University, PhD 1963.

Vassar College, instructor to professor 1952-80; City University of New York, Graduate Center, professor 1981-   .

Mark Phillips, *An observer in Medici Florence: Marco parenti and his memoir.*

Born 1946, Durban, South Africa. Harvard College, BA 1967; University of California at Berkeley, MA 1968; University of Toronto, PhD 1974.

Carlton University, associate professor 1971-   .

Richard Pommer, *The Weissenhof exhibition housing colony of 1927.*

Born 1930, New York, New York. Columbia University, BS 1953; New York University, MA 1957, PhD 1961.

Williams College, instructor 1960-62; New York University, assistant professor 1962-66; Vassar College, professor 1966-   .

Joyce Maire Reynolds, *Inscriptions of Aphrodisias in Caria.*

Born 1918, London, England. University of Oxford, MA 1944; Newcastle upon Tyne Polytechnic, honorary DLitt 1984.

King's College, Newcastle upon Tyne, lecturer 1948-51; Newnham College, University of Cambridge, lecturer 1951-84; University of Cambridge, assistant lecturer 1952-57, lecturer 1957-83, reader 1983-84.

Aaron Sheon, *Reconsidering Van Gogh's illness.*

Born 1937, Toledo, Ohio. University of Michigan, BA 1959, MA 1960; Princeton University, PhD 1966.

University of Michigan, teaching assistant 1960; UNESCO, Paris, staff officer 1963-66; University of Rouen, director of study abroad 1974-75; University of Pittsburgh, assistant to professor 1966-   ; Carnegie-Mellon University, visiting professor 1981.

Susan Mosher Stuard, *Dowry and choice of marriage partners in Mediterranean city states, XIII to XV centuries.*

Born 1935, Rochester, New York. Smith College, BA 1957; University of Rochester, MA 1961; Yale University, PhD 1970.

State University of New York at Brockport, assistant to associate professor 1970-83; Haverford College, visiting associate professor 1983-84.

Daniel Williman, *Records from Papal Avignon;* and *Survival of fourteenth-century libraries.*

Born 1940, Summit, New Jersey. St. Mary's Seminary, Baltimore, BA 1962; Catholic University of America, MA 1964; Pontifical Institute,

Toronto, LMS 1969; University of Toronto, PhD 1973.

York University, Toronto, instructor 1967-73; State University of New York at Binghamton, archivist-paleographer 1974-77, associate director of the Center for Medieval Studies 1977-79, assistant to associate professor 1981, research grant 1981-82; Vatican Film Library, St. Louis, postdoctoral fellowship 1977.

Fawzi Zayadine, *Nabataean archaeology at Petra, Jordan.*

Born 1938, Smakieh, Kerak District, Jordan. University of Paris IV (Sorbonne), licence semitic languages 1965, doctorate 1971.

Department of Antiquities of Jordan, inspector of antiquities 1968-76, Samaria Sebaste excavations 1965-67, assistant director in charge 1976- .

Visitors

Thomas J. Figueira, *Homosexuality in its socio-political setting in archaic and classical Greece.*

Born 1948, New York, New York. Fordham University, BA 1970; University of Pennsylvania, PhD 1977.

Stanford University, assistant professor 1977-78; Dickinson College, assistant professor 1978-79; Rutgers University, assistant professor 1979- .

Shelomo D. Goitein, *Medieval Islamic and Jewish history.*

Born 1900, Burgkunstadt, Bavaria, Germany. University of Frankfurt, PhD 1923.

Hebrew University, lecturer to professor 1928-57; University of Pennsylvania, professor 1957-70, affiliated professor 1970-71; Institute for Advanced Study, visitor 1971-84.

Nicholas F. Jones, *Public and private associations of ancient Athens.*

Born 1946, Lynwood, California. University of Southern California, BA 1968; University of California at Berkeley, MA 1972, PhD 1975.

University of Pittsburgh, instructor 1975-76, assistant professor 1976-82, associate professor 1982- .

Robert R. Palmer, *Historiography of the French revolution.*

Born 1909, Chicago, Illinois. University of Chicago, BA 1931; Cornell University, PhD 1934.

Princeton University, faculty member 1936-63, Dodge professor of history 1946-63, dean of the faculty of arts and sciences 1952-63, professor of history 1966-69; Washington University at St. Louis, professor of history 1963-66; Yale University, professor of history 1969-77, emeritus 1977- ; University of Michigan, adjunct professor 1977- ; University of Chicago, visiting professor summer 1947, 1969, 1975; University of Colorado, visiting professor summer 1951; University of California at Berkeley, visiting professor summer 1962.

Assistants

Hugh H. Benson, *Plato's epistemology* and *Aspects in the history of American political thought.*

Born 1956, Canton, Ohio. Oberlin College, BA 1978; University of Michigan, MA 1982, PhD 1984.

Institute for Advanced Study, assistant to professor Morton White 1984-85.

Mark L. Darby, *Political thought of Aegidius Romanus.*

Born 1954, Aberdeen, Maryland. Vassar College, BA 1976; Cornell University, MA 1978.

Institute for Advanced Study, assistant to Professor Marshall Clagett 1980-85; Colorado College, visiting instructor 1983.

Xavier Gil Pujol, *Politics and parliaments in the kingdom of Aragon (Spain), 1592-1646.*

Born 1956, Puigcerda, Girona, Spain. University of Barcelona, licenciado en historia 1979.

Institute for Advanced Study, assistant to Professor John Elliott 1981-82, 1984-85; University of Barcelona, assistant 1982-84.

Claudia Marchitiello, *Fourteenth-century Metz books of hours.*

Born 1951, Montreal, Canada. McGill University, BA 1972; Princeton University, MFA 1975.

Institute for Advanced Study, assistant to Professor Irving Lavin 1982-85.

Benjamin l. Nadel, *The Caesareum in the Bosporan kingdom and the local cults (II century A.D.).*

Born 1918, Petrograd, Russia. Byelorussian State University, diploma with distinction 1941; USSR Academy, Leningrad, PhD 1947.

University of Paris, chargé de cours 1969; University of Chicago, 1969-70; Northern Illinois University, visiting professor 1970-71; Franconia College, professor 1972-78; Bund Archives, New

York, director 1978-84; Institute for Advanced Study, member 1980-81, assistant to Professor James F. Gilliam 1984-85.

Everett L. Wheeler, *Strategem: the history of a classical concept.*
    Born 1950, New Albany, Indiana. Indiana University, BA 1972; Duke University, PhD 1977.

Duke University, visiting lecturer 1977, visiting assistant professor 1979; University of Missouri at Columbia, visiting assistant professor 1979-80; Kommission für Alte Geschichte, Munich, von Humboldt fellow 1981-83; University of Louisville, visiting lecturer 1983; Institute for Advanced Study, assistant to Professor Glen W. Bowersock 1983-85.

The School of Mathematics

The School of Mathematics

Perhaps more than any other subject, pure mathematics is a cumulative science, for theories once proven remain part of its living body. They may change in the light of new insights and give rise to unexpected patterns of reasoning, but they do not vanish. Obviously, the historical context of the mathematics tradition, reaching back into ancient epochs and multiple cultures as well as developing through time into an ever wider set of specialized forms and designs, has produced the same specializations and difficulties of communication common to the history of other great disciplines. However, from time to time, their fragmentation finds its counterforce in unifying theories that bring hitherto unrelated divisions together and, under such unexpected and usually parsimonious insights, renders accessible to a wider community enormous fields of knowledge with intellectual efficiency and aesthetic rewards.

For this rhythm of extension and accretion to succeed, communication and exchange that maximize matching, and resonance, and even confrontation are absolutely essential. Over time, various centers have created the locus for such possibilities. The international focus of mathematical discussion in the first part of this century took place at the University of Göttingen. When it was extinguished, the Institute for Advanced Study rekindled the flame, bringing within its fold Europeans such as Kurt Gödel, Carl Ludwig Siegel, John von Neumann and Hermann Weyl, and adding to their presence such American luminaries as James Alexander, Marston Morse and Oswald Veblen. The proximity of a strong mathematics group at Princeton University also played a part in relocating and centering the new School in a benign and sympathetic environment.

As in the other Schools, formal organization is minimal. Although problems are not selected for team research, seminars, discussion groups, formal lectures and informal gatherings abound in a mélange that reflects thematic concentration and individual predilections. In response to the interests of the Faculty over time, the School has been primarily concerned with five areas broadly understood: topology; analysis and global analysis; Lie groups, algebraic groups, automorphic functions and number theory; algebraic geometry; and logic.

One feature of the School of Mathematics is its commitment to a publishing endeavor. The School participates formally in the editing of the *Annals of Mathematics*, the leading mathematical journal in the United States. Among other contributions, the aperiodic Hermann Weyl Lectures given at the Institute are published in the *Annals of Mathematics Studies*. Essentially educational and informative, the series consists of a broad survey of recent work by experts in a given area for the benefit of those in other fields or specialties. In fact, this serves as a device whereby the Faculty itself encourages communication among the various subdivisions of mathematics and, equally, seeks to stimulate research in areas beyond the Faculty's own range.

Academic Activities, 1984-85

Professor Deligne joined the Faculty in the academic year 1984-85 with his experience, knowledge and original work in algebraic geometry. His appointment represents a substantial broadening of the School's Faculty, in an active field of primary importance to many areas of mathematics.

The main activity of the School was represented by the work and initiative of individual Members, as is usual in most years here. Besides the traditional Members' Seminar held on Monday afternoons, regular periodical

seminars were organized on various subjects.

Professor Borel conducted several seminars on Fridays, on algebraic theory of D-modules on algebraic varieties and regular holonomic systems, a topic of great interest also to Professor Deligne. Another seminar, L^2-Cohomology and Intersection Cohomology, at present a very active new field to which Deligne has also contributed, was conducted by Professor Borel. This included several lectures by W-c. Hsiang of Princeton University, recent work of Cheeger and Saper, and lectures by W. Casselman on Eisenstein series and the Zucker conjecture in the rank two case. Professor Deligne started an investigation on the action of the Galois group of Q on the l-adic completion of the fundamental group of the punctured complex projective line and on Hodge theory analogues.

In collaboration with the School of Natural Sciences, Professor Milnor conducted a seminar on cellular automata and other dynamical systems. This included lectures by D. Fried, M. Boyle, J. Yorke and L. Blum. In addition, Milnor's work this year has been in the area of dynamical systems, including a study of the proper definition for the concept of "attractor," and a detailed study of complex quadratic mappings and their associated fractal geometry.

Other seminars were conducted by Visiting Members and in particular a topology seminar conducted by A. Papadopoulos and J. West, a cyclic homology seminar conducted by C. Kassel, a K-Theory seminar conducted by L. Vaserstein, and a workshop in geometric aspects of integrable Hamiltonian systems conducted by J. Harnad.

The academic year 1984-85 also saw a much larger use of computer equipment in the School of Mathematics than ever before. The workstations which were made available during the year proved to be most useful and in fact essential for the work of several Members, especially in dynamical systems, number theory and mathematical physics. In this connection, a large part of the work of D. Hejhal, a numerical investigation of Epstein zeta functions, was done with the Cray 1 at the University of Minnesota in Minneapolis.

There was in addition in a small program devoted to renormalization group methods in mathematical physics. Visiting Members in this program were J. Fröhlich from the ETH-Zürich, G. Gallavotti of the Università degli Studi in Rome, and T. Spencer from the Courant Institute in New York. There was a seminar with speakers from both the School of Mathematics and the School of Natural Sciences, and from outside the Institute. In particular, M. Aizenman spoke on his work on the absence of intermediate phases in the Ising model, and J. Imbrie on random field Ising models at temperature zero. There were also many short term Visitors, who came to work with the principal participants in the program, F. Martinelli, and E. Scoppola, for example, coming from the University of Rome to complete their joint work with Fröhlich and Spencer on localization in the Anderson tight binding model.

Professor Bombieri continued his earlier research in diophantine approximation and on the number of solutions of Thue equations and collaborated with H. Iwaniec and J. Friedlander to obtain new contributions in the theory of distribution of prime numbers, with the solution of Titchmarsh divisor problem, and on the order of the Riemann zeta function and mean value theorems for exponential sums.

In the field of number theory and automorphic forms, Professor Selberg continued his research and participated actively in the work of several Visiting Members.

Professor Emeritus André Weil gave a series of lectures on the history of mathematics, on topics in algebra, from Euclid to Bombelli.

In addition to the activities mentioned above, there are the possibly more important ones which cannot be so easily summarized. A brief informal remark sometimes has more impact than a course of lectures. Moreover, the School's success lies as much in the atmosphere, created early and sustained over a long period, of joint responsibility for the fostering of mathematics as an intellectual discipline rooted in the past and pertinent to the present, as in the individual achievements of its Faculty and Members. For this mutual effort, it is important to recognize the less visible contributions of the mathematical community here and to appreciate the great variety of ways in which ideas are transmitted.

The School of Mathematics

Members, Visitors and Assistants, 1984-85

In the section which follows, the information was obtained from material provided by the Members, Visitors and Assistants.

Members

Hans Åberg, *Homology of abstract groups.*
Born 1956, Gothenburg, Sweden. University of Stockholm, PhD 1983.

Malcolm R. Adams, *Analysis.*
Born 1956, Tolland, Connecticut. University of Oregon, BA 1978; Massachusetts Institute of Technology, PhD 1982.
University of California at Berkeley, lecturer 1982-84.

Frederick J. Almgren, Jr., *Geometric measure theory and minimal surfaces.*
Born 1933, Birmingham, Alabama. Princeton University, BS; Brown University, PhD 1962.
Princeton University, instructor 1962-63, assistant to associate professor 1965-72, professor 1972- ; Institute for Advanced Study, member 1963-65, 1969, 1974-75, 1978, 1981-82.

Henning Haahr Andersen, *Representations of algebraic groups in prime characteristics.*
Born 1950, Saedding, Skjern, Denmark. Aarhus University, CandScient 1974; Massachusetts Institute of Technology, PhD 1977.
Massachusetts Institute of Technology, research associate 1977-78; Institute for Advanced Study, member 1978-79; Aarhus University, associate professor 1979- .

David D. W. Bao, *Supergravity; relativistic fluids; relativistic field theories.*
Born 1953, Macao, Portugal. University of Notre Dame, BSc 1976; University of California at Berkeley, PhD 1983.
University of Houston at University Park, assistant professor 1983- ; Institute for Advanced Study, member 1983-84.

Donald L. Brittain, *Positive Ricci curvature on Riemannian manifolds.*
Born 1959, Salisbury, Maryland.
Massachusetts Institute of Technology, BS 1980; University of Pennsylvania, PhD 1984.

Roger A. R. Butler, *Ergodic theory and dynamical systems theory.*
Born 1955, Oakley, Hampshire, England. Southampton University, BSc 1977; Warwick University, MSc 1978, PhD 1982.
Logica Limited, London, England, computer consultant 1982-83; University of Virginia at Charlottesville, visiting assistant professor 1983-84.

Luis G. Casian, *Representations of Lie groups.*
Born 1957, Tuxpan, Veracruz, Mexico. Universidad Metropolitana, Mexico, Licenciado en Matemáticas 1978; Centro de Investigación del Politécnico, Mexico, Maestro en Ciencias 1980; Massachusetts Institute of Technology, PhD 1983.
Massachusetts Institute of Technology, visiting scholar 1983-84.

Ching-Li Chai, *Algebraic geometry.*
Born 1956, Taipei, Taiwan, China. National Taiwan University, BS 1978; Harvard University, PhD 1984.

Sagun Chanillo, *Harmonic analysis.*
Born 1955, Kanpur, India. Indian Institute of Technology, BSc 1973, MSc 1975; Purdue University, PhD 1980.
Rutgers University, visiting assistant professor 1980-82; Indiana University, visiting assistant professor 1982-84; Ohio State University, assistant professor 1984- .

Aparna Dar, L^2 *cohomology of negatively curved Kahler manifolds.*
Born 1958, Calcutta, West Bengal, India. Indian Institute of Technology, MA 1980; State University of New York at Stony Brook, PhD 1984.

Jean-Marc Deshouillers, *Number theory (analytic number theory and modular forms).*
Born 1946, Paris, France. Ecole Polytechnique, Ingénieur 1967; University of Paris VI, Docteur ès Sciences 1972.
Centre National de la Recherche Scientifique,

attaché de recherche 1968-73; University of Bordeaux I, professeur 2ème classe 1973-82, professeur 1ère classe 1983-   .

Tevian Dray, *Classical relativity and quantum gravity.*
Born 1956, Washington, D.C. Massachusetts Institute of Technology, BS 1976; University of California at Berkeley, MA 1977, PhD 1981.
Freie Universität, Berlin, West Germany, tutor 1981-83; Instituut voor Theuretische Fysica, Utrecht, The Netherlands, wetenschapelijke medewerker 1984.

Robert D. Friedman, *Algebraic geometry.*
Born 1955, Boston, Massachusetts. Harvard University, BA 1976, MA 1976, PhD 1981.
Columbia University, assistant professor 1982-84.

Jürg M. Fröhlich, *Mathematical physics (QFT and statistical physics).*
Born 1946, Switzerland. Gymnasium Schaffhausen, Switzerland, Maturität (Abitur); Eidgenössische Technische Hochschule, Zürich, Diploma in Physics 1969, PhD 1972.
University of Geneva, assistant 1972-73; Harvard University, research fellow 1973-74; Princeton University, assistant professor 1974-77; Institut des Hautes Etudes Scientifiques, permanent member 1978-82; Eidgenössische Technische Hochschule, professor 1982-   .

Giovanni Gallavotti, *Constructive field theory; classical mechanics.*
Born 1941, Naples, Italy. University of Rome, Laurea 1963; University of Florence, Diploma di Perfezionamento 1965.
Institut des Hautes Etudes Scientifiques, research associate 1966-68; Rockefeller University, research associate 1968-70; University of Rome I, associate professor 1970-72, professor 1975-83; University of Naples, professor 1973-75; Princeton University, Lefshetz professor 1982; University of Rome II, professor 1983-   ; Rutgers University, professor 1983-   .

Robert H. Gilman, *Combinatorial and computational group theory.*
Born 1942, Utica, New York. Princeton University, BA 1964; Columbia University, MA 1965, PhD 1969.
Stevens Institute of Technology, assistant to associate professor 1969-82, professor 1982-   ;

Courant Institute, visiting member 1971-72; Rutgers University, visiting professor 1982-83.

Anton Good, *Analytic number theory.*
Born 1947, Mels, Switzerland. Eidgenössische Technische Hochschule, Zürich, Dipl Math 1971, Dr Sc Math 1974.
Eidgenössische Technische Hochschule, Zürich, research assistant 1971-76, privatdozent 1979-83; Institute for Advanced Study, member 1976-78, 1983-84.

John Harnad, *Mathematical physics.*
Born 1946, Budapest, Hungary. McGill University, BSc 1967; University of Illinois, MS 1968; University of Oxford, DPhil 1972.
McGill University, research associate 1977-78, 1980-84; Centre de Recherche de Mathématiques Appliquées, University of Montreal, attaché de recherche 1979-84; Institut de Physique Théorique, Université Catholique de Louvain, Louvain-la-Neuve, Belgium, visiting professor September 1980, May 1981; University of Texas at Arlington, associate professor 1984-   .

Dennis A. Hejhal, *Dirichlet series, harmonic analysis, supercomputers.*
Born 1948, Chicago, Illinois. University of Chicago, BS 1970; Stanford University, PhD 1972.
Harvard University, assistant professor 1972-74; Columbia University, associate professor 1974-78; University of Minnesota, professor 1978-   ; Institute for Advanced Study, fall 1983.

Kenkichi Iwasawa, *Algebraic number theory.*
Born 1917, Kiryu, Japan. University of Tokyo, DrSci 1945.
University of Tokyo, assistant professor 1949-52; Massachusetts Institute of Technology, assistant to associate professor, professor 1952-67; Princeton University, professor 1967-   ; Institute for Advanced Study, member 1950-51, 1951-52, 1957-58, 1966-67, spring 1971, spring 1979.

Dmitry Kanevsky, *Rational points on cubic varieties.*
Born 1952, Moscow, U.S.S.R. Moscow State University, PhD 1978.
Department of Commerce, Moscow and Soviet Academy of Pedagogical Sciences, Moscow, research associate 1977-78; Tel Aviv University, researcher 1979-81; The Weizmann Institute of Science, postdoctoral fellow 1981-83; Max Planck Institut für Mathematik, research fellow 1983-84.

Christian Kassel, *Algebraic K-theory of topological spaces.*

Born 1951, Saverne, France. Ecole Normale Supérieure, Paris, agrégation 1974; University of Strasbourg I, doctorat d'état 1981.

Centre National de la Recherche Scientifique, attaché de recherche 1975-81, chargé de recherche 1981- ; Princeton University, visiting research mathematician April 1984.

Shin-ichi Kato, *Representation theory of algebraic groups.*

Born 1953, Urawa, Saitama, Japan. University of Tokyo, BA 1976, MA 1978, PhD 1983.

University of Tokyo, research assistant 1978.

Daniel S. Kubert, *Elliptic functions and Gauss sums.*

Born 1947, Philadelphia, Pennsylvania. Brown University, BA, MA 1969; Harvard University, PhD 1973.

Yale University, instructor 1973-75; Cornell University, assistant professor 1975-79; Institute for Advanced Study, member 1979-80; University of Kentucky, associate professor 1979-81; University of Pennsylvania, visiting associate professor 1981-82; Johns Hopkins University, visiting associate professor 1982-83.

James I. Lepowsky, *Vertex operators; affine Lie algebras; finite groups.*

Born 1944, New York, New York. Harvard University, BA 1965; Massachusetts Institute of Technology, PhD 1970.

Brandeis University, lecturer and research associate 1970-72; Yale University, assistant professor 1972-77, director of undergraduate studies 1974-75, junior faculty fellow 1975-76; Institute for Advanced Study, member 1975-76, fall 1980; University of Paris VI, maître de conférence associé, spring 1978; Rutgers University, associate professor 1977-80, professor 1980- .

Chang-Shou Lin, *Local isometric embedding.*

Born 1951, Taipei, Taiwan, China. National Taiwan University, BS 1975, MS 1977; New York University PhD 1983.

University of California at San Diego, visiting assistant professor fall 1983.

Qi-keng Lu, *Complex geometry and mathematical physics.*

Born 1927, Fushang, Guangdong, People's Republic of China. Zongshan University, Canton, BSc 1950.

Zhongshan University, Canton, assistant 1950-51; Institute of Mathematics, Academia Sinica, Beijing, assistant 1951-54, assistant to associate professor 1954-78, professor 1978- acting director 1980- .

Helmut Maier, *Small differences between prime numbers.*

Born 1953, Geislingen, West Germany. University of Ulm, diploma 1976; University of Minnesota, PhD 1981.

University of Michigan, assistant professor 1981-84; University of Georgia, assistant professor 1984- .

Mario M. Milman, *Analysis.*

Born 1950, Buenos Aires, Argentina. University of Buenos Aires, Lic Math 1972; Australian National University, PhD 1978.

University of Brasilia, visiting professor 1979-81; University of Illinois at Chicago, visiting assistant professor 1981-82; Southern Illinois University, associate professor 1982- .

Walter D. Neumann, *Topology of low dimensional manifolds and complex analytic singularities.*

Born 1946, Cardiff, Wales. Adelaide University, BA 1965, MA 1968; University of Bonn, PhD 1969.

University of Bonn, assistent 1969-75; Institute for Advanced Study, member 1971-73; University of Maryland, assistant to associate professor 1975-81, professor 1981- ; University of Michigan, visiting associate professor 1977-78.

Yevsey A. Nisnevich, *Arithmetic of Shimura varieties; cohomology of arithmetic groups.*

Born 1947, Minsk, U.S.S.R. Byelorussian State University, Minsk, U.S.S.R., BS 1969; Harvard University, MA 1981, PhD 1982.

Byelorussian Polytechnical Institute, Minsk, instructor 1969-72; Research Institute of Heat and Mass Transform, Minsk, scientific worker 1973-74; Research Institute of Medical Radiology, Minsk, scientific worker 1974-77; Research Institute of Electrolytic Metallurgy, Minsk, senior scientific worker 1977-79; University of Bonn, Sonderforschungsbereich, visiting researcher January-August 1980; Harvard University, teaching fellow 1980-82; State University of New York at Stony Brook, assistant professor 1982-84.

Athanase Papadopoulos, *Differential topology, low dimensional topology.*

Born 1957, Lattakia, Syria. Ecole Centrale de Paris, ingénieur 1981; University of Paris XI, Doct 3e Cycle 1983.

University of Paris XI, assistant professor 1983-84; Centre National de la Recherche Scientifique, University of Strasbourg, attaché de recherche 1984-   .

Richard C. Penny, *Representation theory, P.D.E. and several complex variables.*

Born 1945, Chicago, Illinois. Massachusetts Institute of Technology, PhD 1971.

Purdue University, assistant to associate professor 1971-83, professor 1983-   ; University of California at Berkeley, visiting scholar fall 1977.

Emma Previato, *Theory of algebraic curves and their Jacobians: applications to partial differential equations.*

Born 1952, Badia Polesine, Italy. University of Padua, Laurea in Matematica 1974; Harvard University, MA 1979, PhD 1983.

University of Padua, instructor 1974-76, assistant professor 1976-78; Boston University, assistant professor 1983-   .

Malempati M. Rao, *Probability of functional analysis.*

Born 1929, Nimmagadda, A.P., India. Andhra University, India, BA 1949; Madras University, India, MA 1952, MSc 1955; University of Minnesota, PhD 1959.

Carnegie-Mellon University, researcher 1959-60, assistant to associate professor 1960-66, professor 1966-72; University of California at Riverside, professor 1972-   ; University of Strasbourg, visiting professor 1978-79.

Jürgens Rohlfs, *Cohomology of arithmetic groups and automorphic forms.*

Born 1942, Haderslev, Denmark. University of Hamburg, Diplom Examination 1968, Dissertation 1970; University of Bonn, Habilitation 1976.

University of Bonn, assistant professor 1970-79, associate professor 1979-80; Katholische Universität Eidstätt, professor 1980-   , dean 1981-83.

Makoto Sakai, *Quadrature domains and potential theory.*

Born 1943, Tokyo, Japan. Yokohama National University, BS 1966; Tokyo Institute of Technology, MA 1968, PhD 1976.

Tokyo Institute of Technology, assistant 1969-74; Hiroshima University, assistant to associate professor 1974-81, Tokyo Metropolitan University, associate professor 1981-   .

Clayton C. Sherman, *Algebraic K-theory.*

Born 1946, Washington, D.C. Rice University, BA 1968, Brandeis University, MA 1969; Rice University, PhD 1976.

New Mexico State University, assistant professor 1976-81, associate professor 1981-   ; Texas Technical University, visiting associate professor 1980-82; Texas A&M University, visiting associate professor fall 1984.

Michael F. Singer, *Differential algebra.*

Born 1950, New York, New York. New York University, BA 1970; University of California at Berkeley, MA 1972, PhD 1974.

State University of New York at Stony Brook, instructor 1974-76; North Carolina State University, assistant professor 1976-82, associate professor 1982-   ; Institute for Advanced Study, member 1978-79; Princeton University, visiting assistant professor 1979-80.

Thomas C. Spencer, *Mathematical physics (statistical physics, dynamical systems).*

Born 1946, New York, New York. University of California at Berkeley, BA 1968; Courant Institute, New York City, PhD 1972.

Courant Institute, postdoctoral fellow 1972-74, professor 1980-   ; Harvard University, postdoctoral fellow 1974-75; Rockefeller University, associate professor 1975-78; Rutgers University, professor 1978-80.

Elias M. Stein, *Harmonic analysis (oscillatory integrals and Fourier analysis).*

Born 1931, Antwerp, Belgium. University of Chicago, BA 1951, MS 1953, PhD 1956.

University of Chicago, assistant to associate professor 1959-62; Institute for Advanced Study, member 1962-63; Princeton University, professor 1963-   .

Mark A. Stern, *L²-index theorems on non-compact manifolds.*

Born 1959, Seattle, Washington. Texas A&M University, BS 1980; Princeton University, PhD 1984.

Glenn H. Stevens, *Eisenstein cohomology and Dedekind symbols over imaginary quadratic fields.*

Born 1953, Tacoma, Washington. University of California at Santa Barbara, BA 1974; Georg August Universität, Göttingen, West Germany, 1974-75; Harvard University, PhD 1981.

Brandeis University, visiting assistant professor 1980-81; Rutgers University, assistant professor 1981-84; Boston University, assistant professor September–December 1984.

Jean E. Taylor, *Geometric measure theory.*

Born 1944, San Mateo, California. Mount Holyoke College, BA 1966; University of California at Berkeley, MSc 1968; University of Warwick, MSc 1971; Princeton University, PhD 1973.

Massachusetts Institute of Technology, instructor 1972-73; Rutgers University, assistant to associate professor 1973-81, professor 1982- ; Institute for Advanced Study, member 1974-75, 1977-78; Princeton University, visitor 1980-81.

William P. Thurston, *Topology, geometry.*

Born 1946, Washington, D.C. New College, Sarasota, Florida, BA 1967; University of California at Berkeley, PhD 1972.

Institute for Advanced Study, assistant 1972-73, member 1976; Massachusetts Institute of Technology, assistant professor fall 1973, Sloan-MIT fellow spring 1974; Princeton University, professor 1974- .

J. François Treves, *Overdetermined systems of linear PDE.*

Born 1930, Brussels, Belgium. Sorbonne, University of Paris IV, doctorat ès sciences 1958.

University of California at Berkeley, assistant professor 1958-60; Yeshiva University, New York City, associate professor 1960-64; Purdue University, professor 1964-70; Rutgers University, professor 1970- .

Leonid N. Vaserstein, *Classical groups over rings.*

Born 1944, Kuibyshev, U.S.S.R. Moscow State University, MSci 1966, PhD 1969.

University of Bielefeld, visiting professor December 1978; Institut des Hautes Etudes Scientifiques, visiting professor January-April 1979; University of Chicago, visiting professor May-August 1979; Cornell University, visiting professor 1979-80; Pennsylvania State University, professor 1979- .

Rainer Weissauer, *Siegel modular forms.*

Born 1954, Ludwigshafen, West Germany.

University of Heidelberg, BA 1977, PhD 1980.

University of Heidelberg, assistent 1978-80, 1981-84; King's College, University of London, research assistant 1980-81.

James E. West, *Equivariant h-cobordisms in the topological category.*

Born 1944, Grinnell, Iowa. Louisiana State University, BS 1964, PhD 1967.

Institute for Advanced Study, member 1967-68, 1977-78; University of Kentucky, assistant professor 1968-71; Cornell University, assistant to associate professor 1969-76, professor 1976- .

Lo Yang, *Complex analysis: value distribution theory.*

Born 1939, Nantong, Jiangsu, People's Republic of China. Peking University, BA 1962; Academia Sinica, PhD 1966.

Institute of Mathematics, Academia Sinica, associate professor 1977-79, professor 1979-81, deputy director 1982- ; Academia Sinica, member of the academy 1981; Chinese Mathematical Society, secretary general 1984- .

Wei-Shih Yang, *Correlation inequalities in quantum field theory.*

Born 1954, Hualien, Taiwan, China. Cornell University, PhD 1984.

Virginia R. Young, *Equivariant bordism; algebraic topology.*

Born 1960, Honolulu, Hawaii. Cumberland College, BA 1981; University of Virginia, PhD 1984.

University of Virginia, graduate teaching assistant 1982-84.

Visitors

Sueli I. R. Costa, *Non-singularity of higher order-global geometry of manifolds.*

Born 1949, Rio Clara, S.P., Brazil.

Universidade de São Paulo, Brazil, Mestrado 1974; Universidade de Campinas, Brazil, PhD 1982.

Universidade de Campinas, instructor 1972-74, professor 1974- .

Jane Piore Gilman, *Riemann surfaces and Teichmüller theory.*

Born 1945, Washington, D.C. University of Chicago, BS 1965; Columbia University, PhD 1971.

State University of New York at Stony Brook, instructor 1971-72; Rutgers University at Newark,

assistant to associate professor, 1972-   ; Institute for Advanced Study, member 1979-80.

Mei-Chin Ku, *Transformation groups.*

Born 1937, Taiwan, China. National Normal University, BS 1961; Syracuse University, MS 1964; Tulane University, PhD 1967.

Smith College, lecturer 1968-70; University of Massachusetts at Amherst, assistant to associate professor 1970-82, professor 1982-   ; Institute for Advanced Study, member fall 1977.

Assistants

Hsu-Tung Ku, *Differential geometry and transformation groups.*

Born 1933, Chayi, Taiwan, China. Taiwan Normal University, BSc 1961; Tulane University, MSc 1964, PhD 1967.

Institute for Advanced Study, member 1967-68, visitor fall 1977, assistant to Professor Deane

Montgomery 1984-85; University of Massachusetts, assistant to associate professor 1968-79, professor 1979-   .

Elena Prestini, *Harmonic analysis.*

Born 1949, Castelli Calepio, Italy. University of Milan, Laurea 1972; University of Maryland, PhD 1976.

Princeton University, instructor 1976-77; University of Milan, professore incaricato 1978-83, professore associato 1983-   ; Institute for Advanced Study, assistant to Professor Enrico Bombieri 1984-85.

Kai-man Tsang, *Analytic number theory.*

Born 1955, Hong Kong. University of Hong Kong, BA 1978, MPhil 1980; Princeton University, MA 1982, PhD 1984.

Institute for Advanced Study, assistant to Professor Atle Selberg 1984-85.

The School of Natural Sciences

Faculty

Stephen L. Adler
  (New Jersey Albert Einstein Professor)
John N. Bahcall

Roger Dashen
Freeman J. Dyson

Permanent Member

Julian H. Bigelow

Members with Long-term Appointments

Tim de Zeeuw
Michael Dine
Herman H. Goldstine
Piet Hut
Otto E. Neugebauer

E. Sterl Phinney
Tsvi Piran
Nathan Seiberg
Andrew E. Strominger
Stephen Wolfram

The School of Natural Sciences

Over time, the School of Natural Sciences has come to concentrate on two fundamental areas: the physics of the very small (meaning elementary particle physics, high energy physics and field theory) and the physics of the very large (astrophysics and general relativity).

Within the category embraced by the physics of the very small is a family of fascinating problems and processes. The problem of resolving the increasingly finer problems of the structure of matter has called for smaller and smaller probing fingers or wavelengths. In turn, this has demanded larger and larger probing energies so that high energy physics, the physics of the big machines, has become synonymous with the physics of elementary particles. From a theoretical point of view this requires the simultaneous reconciliation of quantum mechanics with Einstein's special relativity, that is, of defining a reality in which the transformation of matter into energy holds, according to the famous formula $E = mc^2$, even though according to quantum mechanics there is an uncertainty in determining the energy of a system because an arbitrarily large number of particles is involved, which leads to systems with infinite degrees of freedom. Quantum electrodynamics, which is the system describing the interaction between electrons and photons (or in field language, the interaction of the electron with the electromagnetic field), was one response to this situation. Unfortunately, it did not prove adequate to the task of dealing with the four basic types of particle interactions: the electromagnetic, the strong forces which hold the nucleus together, the weak forces responsible for β-decay in radioactivity, and gravitation. Quantum electrodynamics has now been subsumed into a more general framework, the electroweak theory, which unifies two of these forces. A separate generalization of electrodynamics, called quantum chromodynamics, is by now believed to be the correct theory of the strong force. The latter involves what is perhaps the most complex (but subtle) set of equations ever contemplated by scientists. Considerable work at the Institute is directed towards extracting the consequences of this theory. It is hoped that someday quantum chromodynamics can be combined with the electroweak theory to produce a so-called grand unified theory and that someday gravity can also be incorporated. A number of Institute Members work in this area. The history and discussion of modern particle theory at the Institute are thus attempts to find ways of developing a satisfactory theoretical understanding of particles and their interactions.

In dealing with the physics of the very large, which is the second major area of interest within the School of Natural Sciences, the astronomer faces problems whose conditions are separate and distinct from the general practice of science. Unlike the physicist who deals with the very small, the astronomer has no access to controlled laboratory experiments. His knowledge is derived from distant objects, which up to the Second World War were exclusively optical in character. The new technologies which were spawned during the war bloomed rapidly in the years that followed, broadening the spectrum of observable phenomena to include the radio spectrum, the infrared, the ultraviolet, X-ray and gamma-ray astronomy, and even the possibility of neutrino and gravitational radiation.

Changing observational methods have also led to the discovery or prediction of new astronomical objects such as neutron stars, black holes, pulsars (later identified as neutron stars), quasi-stellar objects such as quasars as well as the continuing study of old fa-

miliars such as novae, supernovae and white dwarfs. Of equal interest has been the study of the interstellar medium, important because of its influence on the transmission of radiation signals, and the cosmic black body radiation which once filled the universe in an earlier, hotter stage of its expansion. For astrophysicists, general relativity theory thus assumes great importance as they come to grips with the gravitational effects of very large masses. Small well-known deviations from Newtonian predictions within the solar system have been delineated by general relativity theory, but its greatest importance lies in the physics of neutron stars, black holes and theories of cosmic evolution. These revolutionary developments in astronomy have rekindled the interest in general relativity, so that Einstein's work remains at the edge of contemporary science as a vigorous research frontier.

Under these rather sweeping rubrics, the work of the School of Natural Sciences concentrates on particular areas: neutrino astronomy, galactic evolution, star counts, stellar dynamics, supernovae, compact X-ray sources, neutron stars and black holes. Additionally, quasars as the most distant objects, and the recently discovered rings of Uranus as some of the nearest, have occupied the research attention of the astrophysics group. The group also specializes in predicting what the Space Telescope (to be launched in 1986) will see at the very faint levels of light and in the new parts of the spectrum that will be accessible from this first permanent international observatory in space.

Academic Activities, 1984-85

A. Particle Physics

Particle physics at present is characterized by the existence of a good theoretical framework (the so-called "standard model") for describing the low-energy strong, weak and electromagnetic interactions, together with the active pursuit of ideas for unifying these interactions with each other and with gravity at higher energies.

An important theme during the past decade has been the use of numerical "Monte-Carlo" methods to simulate quantum field theories on a computer using a statistical sampling technique. Using these methods, Mackenzie last year completed a study of hadronic decay amplitudes in lattice gauge theory. This included the first lattice calculation of the pion-nucleon coupling constant and of the hadronic decay coupling constants for decuplet baryons and nonet mesons. Methods were developed which make the calculation of these three-point functions no more difficult than the analysis of two-point functions. In exploratory work on the Monte-Carlo method, Ren and Hamber studied the possibility of using the Langevin equation to evaluate statistical averages with a complex action, a method which may be useful in chiral fermion systems and quantum gravitation. Ren and Caracciolo also studied the change of variables in stochastic quantization, deriving the general formulation of variable transformation and discussing possible applications in numerical simulations. Hamber and Williams carried out an extensive investigation of the possibility of using Monte-Carlo methods to study quantum gravity. In particular, a formulation of higher derivative gravity on a simplicial lattice was developed. This work extended a lattice formulation of gravity, known to the mathematicians as geometry of piecewise linear spaces and discussed in an old paper by Tullio Regge, to include higher derivative terms. Both analytical and numerical work were carried out, and Hamber also wrote a review on simplicial quantum gravity.

Anomalies, a phenomenon in which classical symmetries are broken by quantum effects, continued to receive intensive study. Nair continued his investigation of supersymmetry anomalies. He derived the expression for the supersymmetry anomaly for $N = 1$ four-dimensional theories, and showed that the gauge anomaly is the only source of supersymmetry anomaly in certain classes of theories. Niemi, collaborating with Semenoff, studied the mathematical connections between chiral anomalies, Levinson's theorem and symmetry breaking, and established a

connection between spectral flow and fermion production. He reviewed the physics of fermion number fractionization, developed a general theory using topological techniques, and established a new open infinite space index theorem for Dirac operators which solves the mathematical problem of fermion number fractionization. In further anomaly-related work, Pruisken studied the effect of instantons in the field-theoretic description of the integral quantum Hall effect. Seiberg proposed a new definition of the topological charge density for four-dimensional lattice gauge theory, which made possible a systematic analytic study of properties of θ vacua. A phase transition at $\theta = \pi$ was observed and its nature was clarified.

Work on models for unifying the low-energy forces revolved around supersymmetry, which relates the integer-spin (boson) and the half-integer spin (fermion) content of a theory. Seiberg and Dine continued the study of dynamical supersymmetry breaking. New technologies for analyzing the behavior of supersymmetric gauge theories were developed, and by using them, many models were completely understood. These ideas and techniques were used in the context of the newly proposed superstring theory, where it was shown, with collaborators from Princeton University, that supersymmetry is dynamically broken, with zero cosmological constant in the leading approximation. Dine and Seiberg also participated in the analysis of the low energy phenomenology of the superstring theory. A detailed study of all possible low energy gauge groups with variable number of generations indicated a number of difficulties which constrain the possible compactifications. Strominger also worked primarily on superstring theories, investigating the compactification and ground state properties (with several outside collaborators), and finding results which are in striking agreement with experimental observation. Mueller studied anomalies in the reparametrization invariance of Type 1 superstrings, and in further work on string theory; Dine and Seiberg showed that superstring models are necessarily strongly coupled. In other super-

symmetry-related work, Adler showed that quaternionic Gaussian integrals simplify dramatically when the number of fermion and boson integrations are equal, and used this to construct a multi-mode quaternionic field theory.

Michael Dine (as chair of Compositeness Group, 1985 Snowmass Workshop) performed various calculations related to the superconducting supercollider. Simple models were used to discuss detection of composite structure of quarks and leptons by searching for direct photon resonances, and other phenomena.

In gravitation and relativity, Mueller set up a covariant functional Schrödinger formalism for quantum field theory in curved spacetime, with application to the Hawking effect for uniformly accelerated observers. Manogue continued her studies of the vacuum expectation value of the stress-energy tensor inside a rotating box. Strominger and Piran found the first non-trivial exact solution of the Regge equations (on the squashed three-sphere), and Strominger also proved a positive energy theorem for the gravitational theory described by the action $R + R^2$. Pope continued work on Kaluza-Klein supergravity, by showing that the four-dimensional Einstein-Yang-Mills equations with gauge group SU(2), can be embedded as an exact solution of $d = 11$ supergravity. Pope and Page constructed new Einstein spaces, by obtaining explicit examples of certain S^2 bundles over Kähler-Einstein base manifolds, and by using numerical techniques to establish the existence of Einstein metrics on certain S^4 bundles over quaternionic Kähler base manifolds. Page (in collaboration with Hawking of Cambridge) completed a paper on operator ordering and the flatness of the universe. They proposed that the Wheeler-DeWitt equation of quantum gravity be written as a Klein-Gordon equation in superspace. With this choice of factor ordering and the measure given by the natural metric in superspace, a minisuperspace model was shown to predict a density parameter $\Omega = 1$ at any fixed value of the energy density. Hull proved that supersymmetric non-linear sigma models in two space-time di-

mensions, defined on Ricci-flat internal manifolds, are ultra-violet finite to all orders of perturbation theory.

B. Astrophysics

As in previous years, Members and Visitors collaborated in a variety of different fields within astrophysics, including stellar dynamics, cosmology, interstellar matter, active galactic nuclei, gravitational lenses, and dark matter. Visitors this year included James Binney (Oxford University), Roger Blandford (California Institute of Technology), Bruce Draine (Princeton University), Brian Flannery (Exxon Research & Engineering Co.), Peter Goldreich (California Institute of Technology), Christopher McKee (University of California, Berkeley), Jan Oort (Sterrewacht Leiden) and Martin Rees (Institute of Astronomy, Cambridge).

J. N. Bahcall showed how a liquid argon detector for proton decay can be used to study both the total flux of electron neutrinos (via electron-neutrino scattering) and the flux of electron neutrinos (via the charge-changing current). At the higher energy end of the spectrum of electrons produced by neutrino interactions, only neutrino-electron scattering is important (energies above 8.5 MeV). These scattered neutrinos have an angular distribution that is confined to the forward 20° about the direction to the Sun and also have a characteristic energy spectrum. The charge-changing reaction proceeds almost entirely through the 4 MeV excited analogue state of ^{40}K, a fact which can be verified by observing the characteristic γ-decay of the analogue state in coincidence with lower energy recoil electrons (e.g., energies between 4 and 8.5 MeV). With practical amounts of liquid argon, this experiment could help to "solve" the solar neutrino problem. Bahcall also worked with a number of the Visiting Members on projects that are described elsewhere in this report.

Piet Hut applied his previous results on the numerical and analytical measurements of three-body scattering cross sections to the dynamics of globular clusters. Analytical applications were carried out in collaboration with S. Inagaki (Kyoto), and numerical simulations of globular cluster evolution are in progress in collaboration with H. Cohn (Bloomington). Especially the evolution past the stage of core collapse has been clarified by these calculations, including the nature of instabilities leading to core oscillations. Piet Hut and Scott Tremaine (MIT) made a detailed study of the disruption rate of cometary orbits under the perturbing influences of interstellar gas clouds passing near the sun. Besides improving the mathematical treatment of these perturbations, they defined a framework in which the many correction factors arising from various complications could be uniquely discussed, thereby clarifying the discussions which have been going on in the literature for several years. Piet Hut continued his investigation of the "Nemesis" hypothesis which he had coauthored the previous academic year, in which the sun is suggested to have a companion star in a wide orbit which could perturb cometary orbits sufficiently to trigger a periodicity in the occurrence of mass extinctions on Earth. He concluded that the theory passes many crucial tests and is therefore viable; the weakest point being not the theory itself but the significance of the periodicity reported in mass extinctions and crater ages. Stefano Casertano and Piet Hut undertook a systematic investigation of different operational definitions which can be used to analyze the data obtained from N-body calculations, quantifying the bias inherent in some previous methods, and suggesting more accurate alternative procedures.

Joshua Barnes worked on the following projects: (1) Dynamical instabilities of spherical stellar systems (with Jeremy Goodman and Piet Hut): a numerical survey and analytic discussion of the three kinds of instability found in Hénon's generalized polytropes was completed. Further work to classify orbits in the triaxial ellipsoidal systems resulting from the "Antonov" instability is in progress. This instability may be relevant to the structure of elliptical galaxies. (2) Angular momentum from tidal torques (with G. Efstathiou): a detailed N-body study of the origin

of angular momentum in hierarchical clustering models of galaxy formation is now being finished. In the simulations, the amount of angular momentum acquired by a proto-galaxy is insensitive to the initial fluctuation spectrum. In contrast to recent analytic claims, it is found that higher peaks in Cold Dark Matter models do not acquire less angular momentum, and that the more rapidly rotating objects are more strongly clustered with each other. (3) Halo response to galaxy formation: N-body models are used to follow the evolution of a dark galactic halo in response to growth of a disk at the center. These calculations address the prevalence of "flat" galactic rotation curves and test existing analytic models. Flat rotation curves are found to require initial dark halos with large core radii, but analytic models tend to overestimate the response within this core. (4) Merging of disk galaxies: encounters between giant disk + halo galaxies and smaller satellite systems are studied with detailed N-body models. In these collisions, the disk of the target galaxy is partly disrupted, and roughly half of the total angular momentum of the luminous material is transferred to the dark matter. (5) Hierarchical acceleration calculation N-body code (with Piet Hut): a self-refining scheme to represent the mass distribution in large N-body simulations is being developed. Preliminary versions of the algorithms have been tested on a small scale.

David Gilden worked on the following: (1) Gravitational instability in colliding clumps of molecular gas. General criteria for instability as a function of Mach number and initial Jeans length were defined. (2) Thermal instability in molecular gas. A new isobaric mode in cooling gas was identified and related to the observed microturbulence in molecular clouds. (3) Gravitational Radiation from collisions between neutron stars (with S. Shapiro). Hydrodynamic simulations of head-on collisions were simulated and total radiation emitted and waveforms were calculated. Prospects for detection were discussed. (4) Sampling Errors in Determination of Oort Limit (with John Bahcall). Simulated catalogues of stars were created using a realistic model of the galaxy in order to determine the propagation of sampling error in the Oort limit. (5) Transient disturbances in stars in the Solar Neighborhood (with John Bahcall). Density waves and molecular clouds were allowed to disrupt equilibrium distributions of tracer stars in order to determine the possibility of systematic errors in the Oort limit. (6) Reconnection in Accretion Disks (with T. Tajima). Reconnection in differentially rotating accretion disks was studied as a source of oscillations in cataclysmic binary systems.

Stefano Casertano worked on dynamical friction, on the distribution of dark mass in spiral galaxies and on the density of the galactic spheroid in the vicinity of the Sun. Stefano Casertano, Sterl Phinney and Jens Villumsen studied the motion of a satellite orbiting around a massive spherical galaxy in the presence of dynamical friction. The main result, obtained by analytical methods and confirmed by numerical calculations, is that the orbit of the satellite does not circularize significantly as the satellite itself falls onto the galaxy. Casertano and Bahcall have found that the distribution of dark matter in a number of spiral galaxies for which good mass models are available exhibits significant regularities. In particular, the ratio of dark to luminous matter within the optical radius of each system is always close to unity, for galaxies with a wide range of masses and Hubble types. Regarding the galactic spheroid, Bahcall and Casertano have reanalyzed catalogs of proper-motion stars, finding a density of $(9.5 \pm 1) \cdot 10^{-5} \text{stars pc}^{-3}$ for spheroid stars between 4 and 11 mag, in agreement with the results of star counts. They discuss the problem of the contamination of the spheroid sample by disk stars, and show that even a small fractional contamination can lead to order-of-magnitude errors in the estimated density. This effect is responsible for the large disagreement between previous estimates of the spheroid density.

Tim de Zeeuw's research concentrated mainly on the structure and dynamics of elliptical galaxies. He continued the work started during the two previous years at Leiden Observatory, The Netherlands, and in-

vestigated the special class of mass models for which the gravitational potential is of the so-called Stackel form so that the equations of motion separate in ellipsoidal coordinates. For these models most relevant calculations can be done analytically; their dynamics resemble closely that in real elliptical galaxies. He explicitly integrated Poisson's equation for the whole class of mass models with a Stackel potential. This led to a powerful new technique for the construction of such models. Together with M. Franx and R. Peletier (Leiden Observatory) some of the general properties of these models were derived, and their projections were studied. In collaboration with T. Statler (Princeton University) a number of self-consistent dynamical equilibrium models were constructed, based on the perfect ellipsoid—the prototypical Stackel model. Due to the separability of the equations of motion the individual orbital densities are known in analytic form. This speeds up the construction process considerably, so that, for the first time, a whole class of models has been built and investigated. De Zeeuw, M. Schwarzschild (Princeton University) and C. Hunter (Florida State University) established by means of rigorous mathematical methods that elliptic disks with Stackel potentials generally have a very large number of consistent phase-space distribution functions. Similar results are expected to hold for three-dimensional models.

E. Sterl Phinney completed a review article on the theory of compact radio sources. Among other things, he demonstrated that the popular toy model of relativistic beaming is inconsistent with the observed statistical properties of radio quasars. Phinney organized and gave several lectures in a seminar series on Stellar Oscillations at the Institute. In collaboration with B. F. Schutz (Cardiff), Phinney examined the properties of the instabilities in some differentially rotating cylindrical "stars," for which complete mode structures can be found analytically. Phinney completed an analysis of the properties of cosmological "snowballs" of solid H_2. Previous estimates of their rate of evaporation were shown to be in error by factors exceeding 10^{10}. Phinney also discussed the thermal and opti-

cal properties of solid H_2, and pointed out several constraints on the formation of "snowballs." The conclusion is that H_2 snowballs are unlikely to be a major constituent of our universe, but the possibility cannot be ruled out for the reasons claimed by previous authors on the subject. In collaboration with Casertano and Villumsen, Phinney completed an analytical and numerical study of dynamical friction in spherical systems with anisotropic velocity dispersions. This may have significant implications for our understanding of rich clusters and D galaxies. Phinney continued work on self-consistent models of relativistic electron-positron atmospheres created by nonthermal particles. These promise to explain many of the features of the continuous emission from active galactic nuclei. Phinney completed a review article on "Unified Theories of Active Galactic Nuclei," emphasizing the success of the black hole model in explaining the significant features of the continuum spectra. Drawing on his previous work on the hydromagnetic extraction of energy from rotating black holes, he proposed evolutionary scenarios unifying the various types of active galaxy. The exciting prospects of testing these by looking for effects of AGN on their host galaxies were pointed out.

Kavan Ratnatunga continued analysis of observations of an in-situ sample of K-giants in the outer galactic halo. He developed a procedure to integrate the metal abundance information contained in the weak lines in these low resolution spectra to derive a good abundance estimate. With this abundance calibration the line of sight velocity dispersion towards the SGP was seen to increase from about 60 km/s at 5 kpc to about 90 km/s at 10 kpc and decrease again at larger distances. The stars in an intermediate latitude field towards galactic anti-rotation showed that the more metal abundant halo K-giants formed a rapidly rotating population while the more metal weak stars were at most slowly rotating. Ratnatunga (with J. N. Bahcall and B. Jones) analyzed a sample of field stars, Andromeda, to select a sample of candidates for wide binaries. Ratnatunga (with J. N. Bahcall) derived estimates for the expected and color apparent magnitude distribution of field stars

towards high latitude globular clusters and local group galaxies using the Bahcall and Soneira galaxy model to aid planning of observation programs on the Space telescope. Ratnatunga (with J. N. Bahcall) analyzed the Veron and Veron catalog of Quasars to select a sample of quasars close to Abell clusters of galaxies for absorption line observations on the Space Telescope.

Roger Blandford worked on a novel description of gravitational lensing of distant quasars by intervening galaxies and clusters. This description is based on Fermat's principle and it allowed him and his collaborators (R. Narayan and R. Nityananda) to prove several new results about the properties of the observed images. He also developed the theory of the transmission of Alfven waves by a strong collisionless shock. This is an integral part of the theory of cosmic ray acceleration, (the work has been performed in collaboration with A. Achterberg). Finally, he had beneficial conversations about ongoing research projects on quasar emission lines, interstellar scintillation and electron-positron plasmas with several resident Members, notably E. S. Phinney.

C. Hunter worked with T. de Zeeuw and M. Schwarzschild (Princeton University) on their attempt to prove rigorously that the distribution function for a perfect elliptic disk galaxy is not unique because a certain distribution of tube orbits can be replaced by an equivalent distribution of box orbits. In particular, he showed that the Volterra integral equation for the determination of this equivalent distribution has a unique solution, though the precise behavior of this solution along the minor axis of this disk is still uncertain.

Nikolaos D. Kylafis finished two projects. 1) He developed a method, with John Bahcall, for determining the dust distribution in edge-on spiral galaxies from their surface photometry. The method was applied successfully to NGC 891. 2) He examined, with Colin Norman, the possibility that masers are pumped in regions where the electron temperature is much higher than that of the neutral particles; such conditions exist in MHD shocks. He derived an analytic condition for masing which depends on the collisional rate coefficients and the ionization fraction only. He applied his work successfully to H_2O masers.

Jan Oort's visit was not long enough for initiating and completing particular investigations. However, it did give inspiration for the completion of two large review articles: one on the Galactic Center, and one on Superclusters. The latter concerned the problem of determining what are the largest structures in the universe, and of studying their shapes and motions, and, in particular, of finding their origin: Were they inherent in the universe from the earliest time, or were they formed at a much later stage, after the birth of galaxies, through their gravitational interactions? The strongly elongated shapes of some superclusters, their very large dimensions, and the fact that galaxy clusters tend to be oriented in the same direction as the superclusters of which they are members, indicate that at least some superclusters reflect intrinsic properties of the universe. However, the controversy is by no means settled. A particularly important problem with the superclusters is concerned with the 3K background radiation emitted at the time of decoupling of matter and radiation, when the universe had about 1/1000th of its present age. In order that galaxies and clusters of galaxies be formed well before the present epoch, this background should show considerably larger inhomogeneities than have been observed. The only acceptable way out of this difficulty is that the required density fluctuations would consist largely of non-baryonic matter, like neutrinos for instance, which do not contribute to the background radiation. The universe should then consist for about 90% of its mass of such noninteracting, dark matter.

J. Sellwood worked on the global stability of stellar discs with particular emphasis on the importance of random motion. A study of realistic galaxy models was proposed. Subsequent work at the University of Groningen showed that the Standard Model of the Galaxy was in fact stable. Its stability is the result of the combined influence of the central mass component, the dark halo and a reasonable degree of random motion, since instability results when any one factor is removed. A pa-

per resulting from this work has now been accepted to appear in Monthly Notices.

H. C. van de Hulst reserved half of his visiting time to listen to accounts on work in progress both at the Institute and at the University (Astronomy Department, Geodynamics Lab). Van de Hulst also continued discussions with de Zeeuw and Schwarzschild on the strategy for finding self-consistent dynamical galaxy models with three axes. Van de Hulst explored new methods for solving radiative transfer equations in spherical geometry. This led, in the months following the visit, to a remarkable theorem by which problems for a homogeneous sphere can be mapped on a slab and thus solved exactly in terms of known functions.

Ewine van Dishoeck constructed, with J. Black (Steward Observatory, Tucson) models of diffuse interstellar clouds. The models were designed to reproduce the observations on the rotational excitation of the H_2 and C_2 molecules for various lines-of-sight. The temperatures and strengths of the interstellar radiation field are well constrained by the observations, but the densities in the clouds are uncertain by factors of about two. E. van Dishoeck also performed ab initio quantum chemical calculations on photodissociation processes in the CH molecule. Several new photodissociation channels were identified which will be important in interstellar clouds.

C. Complex Systems

In addition to its primary activities of particle physics and astrophysics, the School of Natural Sciences has also been supporting work on complex systems. Hasslacher developed techniques for representing chaotic systems as path integrals, and extracting from them information on complex scaling behavior. Wolfram worked on relations between the theory of computation and fundamental problems in physics. He showed how formally undecidable and computationally intractable problems can arise in theoretical physics. He developed a theory for the occurrence of random or chaotic behavior in physical systems, and has been applying it to provide an understanding of the mathematical mechanism of fluid turbulence. In addition, he has worked with cellular automata to develop general principles governing the generation of complexity in natural systems. Steinhardt studied the mathematical and physical properties of quasi-crystals, a new class of ordered atomic structures he recently proposed (with D. Levine). With his collaborators, Steinhardt found the extension of ordinary elasticity theory to describe quasi-crystals, and found the generalization of point and dislocation defects in such structures. He also studied the electronic density of states and many mathematical properties (symmetries, unit cell structure, classification) of quasi-crystals.

D. Miscellaneous

Dyson put together a series of lectures on the history of ideas concerning the origin of life, including his own work on this subject. The lectures were given at Cambridge, England, in January, 1985, with the title "Origins of Life." They will be published by the Cambridge University Press early in 1986.

The School of Natural Sciences

Permanent Member, Members with Long-term Appointments, Members and Visitors, 1984-85

In the section which follows, the information was obtained from material provided by the Members and Visitors.

Permanent Member

Julian H. Bigelow, *Applied mathematics; electronic computers; experimental physics.*
Born 1913, Nutley, New Jersey. Massachusetts Institute of Technology, BS 1934, MS 1935.
Sperry Rand Corporation, research engineer 1936-39; IBM Corporation, research engineer 1939-41; Massachusetts Institute of Technology, research associate 1941-42, instructor 1942-43, neurosciences research program, visiting scientist 1969-70; Columbia University, OSRD, statistical research group, associate director 1943-46; Institute for Advanced Study, Electronic Computer Project, head of experimental group of 1946-51, School of Mathematics, permanent member 1951-70, School of Natural Sciences, permanent member 1970- ; University of California at Los Angeles, visiting professor 1966-67; Massachusetts Institute of Technology, Neurosciences Research Program, visiting scientist 1969-70.

Members with Long-term Appointments

Tim de Zeeuw, *Astrophysics.*
Born 1956, Sleen, The Netherlands. Leiden University, BSc Mathematics 1976, BSc Astronomy 1977, MSc 1980, PhD 1984.
Leiden University, teaching assistant 1977-80, research assistant 1980-84; Institute for Advanced Study, long-term member 1984- .

Michael Dine, *Particle physics.*
Born 1953, Cincinnati, Ohio. The Johns Hopkins University, BS 1974; Yale University, PhD 1978.
Stanford Linear Accelerator Center, research associate 1978-80; Institute for Advanced Study, long-term member 1981- .

Herman H. Goldstine, See page 27 for biographical entry.

Piet Hut, *Stellar dynamics and cosmology.*
Born 1952, Utrecht, The Netherlands. University of Utrecht, MS 1977; University of Amsterdam, PhD 1981.
Institute for Theoretical Physics, Utrecht, research assistant 1977-78; Astronomical Institute, Amsterdam, research assistant 1979-81; Institute for Advanced Study, member 1981-82, long-term member 1982- .

Otto E. Neugebauer, See page 27 for biographical entry.

E. Sterl Phinney, *High energy astrophysics relativity.*
Born 1960, Berkeley, California. California Institute of Technology, BS 1980; University of Cambridge, PhD 1983.
Institute for Advanced Study, long-term member 1983- .

Tsvi Piran, *General relativity, relativistic astrophysics and numerical physics.*
Born 1949, Tel Aviv, Israel. Tel Aviv University, BS 1970, MS 1972; Hebrew University, PhD 1976.
Hebrew University, teaching assistant 1975-76, senior lecturer, 1981- ; University of Oxford, research associate, 1976-77; University of Texas, research associate 1977-79, assistant professor 1979; Institute for Advanced Study, member 1980-81, long-term member 1981- .

Nathan Seiberg, *Field theory and particle physics.*
Born 1956, Tel Aviv, Israel. Tel Aviv University, BS 1977; Weizmann Institute of Science, PhD 1982.
Institute for Advanced Study, member 1982-84, long-term member 1984- .

Andrew E. Strominger, *Quantum gravity.*
Born 1955, Cambridge, England. Harvard University, BA 1977; University of California at Berkeley, MA 1979; Massachusetts Institute of Technology, PhD 1981.
Massachusetts Institute of Technology, research assistant 1979-81; Institute for Advanced Study, member 1981-84, long-term member 1984-   .

Stephen Wolfram, *Complex systems theory.*
Born 1959, London, England. California Institute of Technology, PhD 1979.
California Institute of Technology, senior research associate 1980-82; Institute for Advanced Study, long-term member 1982-   .

Members

Michael Aizenman, *Rigorous studies of critical behavior in statistical mechanics and field theory.*
Born 1945, N. Tagil, U.S.S.R. The Hebrew University, Jerusalem, BSc 1969; Yeshiva University, MA 1973, PhD 1975.
Courant Institute of Mathematical Sciences, New York University, visiting member 1974-75; Princeton University, research associate 1975-77, assistant professor 1977-82; Rutgers University, associate professor 1982-84, professor 1984-   .

Joshua Barnes, *Dynamics and evolution of star clusters, galaxies, and galaxy clusters.*
Born 1956, London, England. Harvard University, BA 1979; University of California at Berkeley, PhD 1984.

Sergio Caracciolo, *Statistical mechanics and quantum field theory.*
Born 1952, Lecce, Italy. University of Pisa, Laurea 1977.
Scuola Normale Superiore, Pisa, perfezionamento 1978-80, ricercatore 1982-84; Ecole Normale Supérieure, Paris, researcher 1980-81; Institut des Hautes Etudes Scientifiques, Bures-sur-Yvette, researcher 1981-82.

Stefano Casertano, *Dynamics of galaxies and stellar systems.*
Born 1958, Naples, Italy. University of Pisa, Laurea 1979; Scuola Normale Superiore, Pisa, Diploma di Perfezionamento 1983.
Institute for Advanced Study, member 1983-   .

Glennys Farrar, *Particle physics.*
Born 1946, Washington, D.C. University of California at Berkeley, BS 1967; Princeton University, PhD 1970.
Institute for Advanced Study, member 1971-73, visitor April 1977, 1979-80, spring 1984; California Institute of Technology, assistant professor 1973-74; Rutgers University, associate professor 1979-   .

Mitchell J. Feigenbaum, *Chaos and nonlinear dynamics.*
Born 1944, Philadelphia, Pennsylvania. City College of New York, BEE 1964; Massachusetts Institute of Technology, PhD 1970.
Cornell University, research associate and instructor 1970-72, professor of physics 1981-   ; Virginia Polytechnic Institute, research associate 1972-74; Los Alamos National Laboratory, staff member 1974-81, fellow of the theoretical division 1981-   ; Institute for Advanced Study, member Spring 1978.

David Gilden, *Astrophysics.*
Born 1954, St. Louis, Missouri. University of Wisconsin at Madison, BA 1974; University of Texas at Austin, MA 1979, PhD 1982.
Institute for Advanced Study, member 1982-   .

Herbert Hamber, *Elementary particle theory, field theory, quantum gravity, statistical mechanics.*
Born 1953, Milan, Italy. University of Milan, Laurea 1977; University of California at Santa Barbara, PhD 1980.
University of California at Santa Barbara, research associate 1980; Brookhaven National Laboratory, research associate 1980-82; Institute for Advanced Study, member 1982-   .

Brosl Hasslacher, *Complex systems group.*
Born 1941, New York, New York. State University of New York at Stony Brook, PhD 1971.
Institute for Advanced Study, member 1973-75, 1980-81; California Institute of Technology, senior research fellow 1975-78; Ecole Normale Supérieure, research associate 1978-79; Centre Européen de la Recherche Nucléaire, visiting scientist 1979; Los Alamos National Laboratory, visiting scientist 1981-82, staff member 1982-   .

Christopher M. Hull, *Superstrings and supersymmetric non-linear sigma-models.*

Born 1957, London, England. University of Cambridge, BA 1979, MA 1982, PhD 1983.

Massachusetts Institute of Technology, postdoctoral research 1983-   ; Institute of Theoretical Physics, University of California at Santa Barbara, visitor 1984.

Paul B. Mackenzie, *Renormalization of lattice gauge theory.*

Born 1950, Oak Park, Illinois. University of Illinois at Urbana, BS 1975; Cornell University, MS 1977, PhD 1981.

Fermi National Accelerator Laboratory, research associate 1981-84.

Corinne Manogue, *Vacuum stability in rotating spacetimes.*

Born 1955, Cincinnati, Ohio. Mount Holyoke College, BA 1977; University of Texas at Austin, PhD 1984.

Mark T. Mueller, *Quantum field theory and gravitation.*

Born 1956, Milwaukee, Wisconsin. Massachusetts Institute of Technology, BS 1978; Stanford University, PhD 1984.

V. Parameswaran Nair, *Elementary particle physics and quantum field theory.*

Born 1955, Trivandrum, India. University College, Trivandrum, India, BSC 1976, MSc 1978; Syracuse University, PhD 1983.

Institute for Advanced Study, member 1983-   .

Antti J. Niemi, *Topological and nonperturbative methods in quantum field theories.*

Born 1956, Helsinki, Finland. Helsinki University of Technology, BSC 1979, MSc 1980; Massachusetts Institute of Technology, PhD 1983.

Institute for Advanced Study, member 1983-84.

Norman Packard, *Complex systems theory.*

Born 1954, Billings, Montana. Reed College, BA 1976; University of California at Santa Cruz, PhD 1982.

Institut des Hautes Etudes Scientifiques, member 1982-83; Institute for Advanced Study, 1983-   .

Don Nelson Page, *Quantum gravity and Kaluza-Klein theory.*

Born 1948, Bethel, Alaska. William Jewell College, BA 1971; California Institute of Technology, MS 1972, PhD 1976; University of Cambridge, MA 1978.

University of Cambridge, research assistant 1976-79; Pennsylvania State University, assistant professor 1979-83, associate professor 1983-   .

Christopher N. Pope, *Quantum gravity, and Kaluza-Klein supergravity.*

Born 1953, Croslee-by-Johnstone, Scotland. University of Cambridge, BA 1975, PhD 1980.

St. John's College, University of Cambridge, research fellow 1979-82; Imperial College of Science and Technology, University of London, research assistant 1981-83, advanced research fellow 1983-   .

Adrianus M. Pruisken, *Quantum Hall effect.*

Born 1952, Delft, The Netherlands. Technische Hogeschool Delft, BS 1974, MSc 1976; Brown University, PhD 1979.

University of Chicago, postdoctoral research 1979; University of Heidelberg, postdoctoral research 1979-80; Brown University, postdoctoral research 1980-82; Schlumberger-Doll Research, visiting scientist 1982-84.

Kavan U. Ratnatunga, *Study of K-giants in the outer galactic halo.*

Born 1952, Colombo, Sri Lanka. University of Ceylon, Colombo, Sri Lanka, BSc 1976; University of Pittsburgh, MS 1979; Australian National University, Canberra, Australia, PhD 1983.

University of Sri Lanka, Colombo, lecturer 1976-78; Institute for Advanced Study, member 1983-   .

Hai-cang Ren, *Stochastic quantization, supersymmetry, string theory.*

Born 1956, Peking, People's Republic of China. Columbia University, MA 1981, MPh 1983, PhD 1984.

Robert S. Shaw, Jr., *Dynamical systems.*

Born 1946, Boston, Massachusetts. Harvard College, BA 1972; University of California at Santa Cruz, PhD 1980.

University of Texas at Austin, consultant 1980-81; University of California at Santa Cruz, assistant professor 1982-83.

Paul J. Steinhardt, *Quasi-crystals, inflationary cosmology.*

Born 1952, Washington, D.C. California Institute of Technology, BA 1974; Harvard University, MA 1975, PhD 1978.

Harvard University, postdoctoral junior fellow 1978-81; University of Pennsylvania, assistant professor 1981-83, associate professor 1983-   .

Jens V. Villumsen, *Formation and dynamical evolution of galaxies.*

Born 1954, Svendborg, Denmark. Aarhus University, Denmark, MSc 1980; Yale University, PhD 1982.

Institute for Advanced Study, member 1982-   .

Visitors

James Binney, *Stellar dynamics.*

Born 1950, London, England. University of Cambridge, MA 1974; University of Oxford, DPhil 1976.

Princeton University, assistant professor 1979-81; University of Oxford, lecturer 1981-   .

Roger Blandford, *Theoretical astrophysics (gravitational lenses, scintillation, quasars).*

Born 1949, Grantham, England. University of Cambridge, BA 1970, MA 1974, PhD 1976.

St. John's College, University of Cambridge, research fellow 1973-76; Institute for Advanced Study, member 1974-75; California Institute of Technology, assistant professor 1976-79, professor 1979-   .

Kenneth M. Case, *Non-linear evolution equations.*

Born 1923, New York, New York. Harvard University, BS 1945, MS 1946, PhD 1948.

Los Alamos Scientific Laboratory, physics staff 1944-45, consultant 1948-   ; University of Michigan, assistant professor 1950-52, professor 1953-67, Rockefeller University, professor 1967-   ; Institute for Advanced Study, member 1948-49, 1949-50, 1956-57, visitor 1969-70, 1975-77, 1978-   .

Bruce T. Draine, *Interstellar medium.*

Born 1947, Calcutta, India. Swarthmore College, BA 1969; Cornell University, MA 1975, PhD 1978.

Harvard University, Center for Astrophysics, research fellow 1977-79; Institute for Advanced Study, member 1979-82, visitor 1983-   ; Princeton

University, assistant to associate professor 1982-   .

Brian P. Flannery, *Numerical methods, climate and CO_2, tomography.*

Born 1948, Utica, New York. Princeton University, BA 1970; University of California at Santa Cruz, PhD 1974.

Institute for Advanced Study, member 1974-76, visitor 1981-83; Harvard University, assistant to associate professor 1976-80; Exxon Research and Engineering Company, Corporate Research, research associate 1980-   .

Peter Goldreich, *Release of free energy from deferentially rotating fluids with astrophysical interest.*

Born 1939, New York, New York. Cornell University, BS 1960, PhD 1963.

University of Cambridge, postdoctoral fellow 1963-64; University of California at Los Angeles, assistant to associate professor 1964-66; California Institute of Technology, associate professor 1966-69, professor 1969-   .

Jeremy Goodman, *Interstellar scintillation; stability of stellar disks.*

Born 1956, Washington, D.C. Harvard University, BA 1979, MA 1979; Princeton University, PhD 1983.

California Institute of Technology, postdoctoral research 1983-85.

Nikolaos Kylafis, *Radiative transfer in astrophysics.*

Born 1949, Nea Avorani, Trihonidos, Greece. University of Patras, Greece, Ptyhio 1971; University of Illinois, MS 1973, PhD 1978.

University of Illinois, research associate 1979; California Institute of Technology, research fellow 1979-81; Institute for Advanced Study, member 1981-84; Columbia University, assistant professor 1984-85; University of Crete, Greece, assistant professor 1985-   .

George Lake, *Theoretical astrophysics—galaxy formation/dynamics.*

Born 1953, Washington, D.C. Haverford College, BA 1975; Princeton University, MA 1976, PhD 1980.

University of California at Berkeley, research astronomer 1979-81; Institute of Astronomy, University of Cambridge, fellow, Churchill College 1980-81; Bell Laboratories, member of technical staff 1981-   .

Christopher F. McKee, *Astrophysical blast waves.*
Born 1942, Washington, D.C. Harvard University, BA 1963; University of California at Berkeley, PhD 1970.
Harvard University, assistant professor 1971-74; University of California at Berkeley, assistant to professor 1974-   .

Jan H. Oort, *Evolution of structure in the universe.*
Born 1900, Franeker, The Netherlands. University of Groningen, The Netherlands, PhD 1926.
University of Groningen, research assistant 1921-22; Yale Observatory, research assistant 1922-24; Leiden Observatory, conservator 1924-30, assistant director 1935-45, director 1945-   ; University of Leiden, lecturer to associate professor 1924-45, professor 1945-   ; California Institute of Technology, Princeton University, visiting professor 1952, 1958; University of Oxford, reader 1958; Institute for Advanced Study, visitor 1981-83.

Bohdan Paczynski, *Astrophysics.*
Born 1940, Wilno, Poland. Warsaw University, Poland, MA 1962, PhD 1964, Docent 1967.
Warsaw University Observatory, assistant 1959-62; Licks Observatory, University of California, assistant 1962-63; Polish Academy of Science, research assistant 1964-67, assistant to associate professor 1968-78, professor 1978-82; Institute for Advanced Study, visitor 1974-   ; Princeton University, professor 1982-   .

Martin J. Rees, *Astrophysics.*
Born 1942, York, United Kingdom. Trinity College, University of Cambridge, BA 1963, PhD 1967.

California Institute of Technology, research fellow 1968, visiting associate professor 1971; Jesus College, University of Cambridge, fellow 1967-69; Institute of Theoretical Astronomy, University of Cambridge, staff member 1967-72, professor 1973-   , director 1977-82; Institute for Advanced Study, member 1969-70; King's College, University of Cambridge, senior research fellow 1969-72, professorial fellow 1973-   ; Harvard University, visiting professor 1972; Sussex University, professor 1972-73.

Herbert J. Rood, *Structure of systems of galaxies.*
Born 1937, New Brunswick, New Jersey. Massachusetts Institute of Technology, BS 1959; University of Michigan, MS 1961, PhD 1965.
Wesleyan University, assistant professor 1965-72; Institute for Advanced Study, member 1972-73, visitor 1980-   ; Michigan State University, associate professor 1973-76, associate adjunct professor 1980-82.

Gordon Semenoff, *Quantum field theory.*
Born 1953, Pincher Creek, Alberta, Canada. University of Alberta, BS 1976, PhD 1981.
University of Alberta, postdoctoral fellow and lecturer 1981-82; Massachusetts Institute of Technology, postdoctoral fellow 1982-83; University of British Columbia, research fellow 1983-   .

Ewine van Dishoeck, *Molecular astrophysics.*
Born 1955, Leiden, The Netherlands. University of Leiden, BS (chemistry) 1976, (mathematics) 1977, MA (chemistry) 1980, PhD (astrophysics) 1984.
Harvard University, research assistant 1980, junior fellow 1984-87; Leiden Observatory, research assistant 1980-84.

The School of Social Science

Faculty

Clifford Geertz
(Harold F. Linder Professor of Social Science)

Albert O. Hirschman
(1907 Foundation Professor)

Michael Walzer

Member with Long-term Appointment

Bernard Lewis

The School of Social Science

In terms of its formal existence, the School of Social Science is the youngest of the Institute's four divisions. Although its roots go back to 1935 to what was then the School of Economics and Politics at the Institute, its creation as an enduring program came with a permanent academic appointment in 1970-71 and its formulation as a School in 1973. This process of moving from program to School, from experimental venture to institutionalization, is an essential characteristic of growth at the Institute.

The School of Social Science pursues an operational pattern parallel to that of other Institute Schools, combining a rather small number of permanent Faculty with a larger group of visiting annual members drawn from an ever wider pool of candidates.

The School of Social Science does not normally attempt to take on large-scale statistical or quantitative studies. Such work has been done at the Institute, but it is not central to its purpose. Furthermore, the School does not select certain social problems and, seeking their solutions, come up with prescriptions for this or that social malaise. This does not mean that such uses may not be made of work accomplished at the Institute. Indeed, an interest in policy questions has characterized the work of some members of the School and will surely do so in the future. However, the main focus of the School is interpretive in nature, investigating the meanings of social behavior and delineating the determinants of social change. As such it is resolutely multidisciplinary, cross-cultural and internationally comparative, drawing its data from historical as well as contemporary problems, exploiting ethnographic as well as quantitative sources.

In a sense, the empirical findings of the social sciences are employed to criticize and to refine both methodology and theory in the contemporary human sciences. Thus the School, while giving credit to the long dominant quantitative approach in American social science, nevertheless shares in the growing numbers of reservations expressed about it, that is, that its methods are narrow and overspecialized, that its procedures lead to a warping present-mindedness and that both combine to create an unjustified scientism, incapable of producing a legitimate, durable set of solutions to the pressing social and economic problems of our time.

This intellectual posture demonstrates one of the roles of the Institute for Advanced Study as part of the seamless fabric of higher education and research—to use, when warranted, its private security and intellectual freedom for an independent position in, and critical assessment of, the academic accomplishment embraced by its areas of expertise.

Academic Activities, 1984-85

During 1984-85, the School of Social Science had fifteen Members, two Visitors and three Assistants. Joan W. Scott was appointed to join the permanent Faculty of the School as of July 1, 1985.

The traditional Thursday Luncheon Seminars were very well attended, not only by the Members of the School but by colleagues from Historical Studies and members of the Princeton academic community. The list of topics can be seen in the Record of Events. Three of the seminars were given by Members of the School of Historical Studies and two by guests from other universities; the other twenty were given by Members and Visitors of the School of Social Science. The range of issues discussed was as wide as usual.

The core group among the Members con-

sisted of sociologists using life histories to investigate such problems as social mobility, individual careers, youth and aging. Four Members formed the group and several others had related interests. A seminar on biography was organized and met regularly every two weeks throughout the year. Several historians from the Institute and outside, working on specific biographies, took an active part in the seminar.

As a result of convergent interests, Michael Walzer and Michael Rustin, one of the Visiting Members, jointly organized a seminar on the scope of the public sector. This seminar met throughout the year, also on a bi-weekly basis, attracted a group of social scientists and historians, and explored a variety of topics, primarily the changing conceptions of the public sector in such areas as health and schooling, and the recent arguments for privatization. A conference on these topics was held after the end of the academic year, in May 1985, with the help of a small grant from the Garfield Foundation.

An informal seminar met on several occasions during the first semester to discuss North African and Middle Eastern societies. Several members of this seminar were from out of town.

Planning Activities

The permanent members of the Faculty (Professors Geertz, Hirschman, and Walzer) met regularly to make membership application decisions for the 1985-86 year. The selection of a German fellow of junior university rank, sponsored by the Volkswagen Foundation, involved Dr. Wolf Lepenies as an advisory consultant. In all, two hundred applications were read. Outside referees were consulted for help in ranking the most promising applicants. The theme for the 1985-86 year is "Equality and Hierarchy"; six Members of the School will form the center of the study group. This will be the second year of a three-year program on "Interpretive Social Science." The first year focused on life histories as a tool of sociological research and the third

year will deal with hermeneutic and epistemological problems in the social sciences.

Funding

During the 1984-85 academic year two Members of the core program in interpretive social science were supported by a grant from The Henry Luce Foundation. Six other Members were supported, wholly or in part, by the National Endowment for the Humanities.

In addition, two conferences, one sponsored by the Social Science Research Council and one by the Garfield Foundation, were held in the spring of 1985.

Faculty

Professor Clifford Geertz was the guest participant in the University of Washington Honors Seminar in Seattle and the Henry Luce Seminars at the Whitney Humanities Center, Yale University. He participated in Moroccan-American Foundation/Aspen Institute conferences in Marrakech, Morocco, and Washington, D.C., on "Morocco: Past, Present and Future," and in a conference on "Philosophical Problems of the Social Study of Law" at Erasmus University, Rotterdam. His Huxley Memorial Lecture, "Culture and Social Change: The Indonesian Case," was published in *Man* 19:511-21. He published a general article on the state of anthropology in a special issue of the *Times Literary Supplement* and has written book reviews and contributed to collections of works on Islam and on Southeast Asia. He has written the Margaret Mead *Memoir* for the National Academy of Sciences and continued the writing of *Works and Lives: The Anthropologist as Author.* He was appointed a member of the Editorial Board of the *Journal of American Folklore* and received the Who's Who Achievement Award presented at the Pierpont Morgan Library.

Professor Albert O. Hirschman published *Getting Ahead Collectively: Grassroots Experiences in Latin America* (Pergamon Press, 1984) and "Against Parsimony: Three Easy Ways of Complicating Some Categories of Economic

Discourse," in the *Journal of Economics and Philosophy*, Vol. 1, No. 1 (1985). His book, *Shifting Involvements* (1982), was published in a German translation and his *Essays in Trespassing* (1981) in a Spanish translation. He attended a conference in San Diego, California, on the political economy of development in Latin America and East Asia (December 1984) and one in New Delhi on the comparative history of India and Indonesia (January 1985). This latter conference and the related research of a group of Indian, Indonesian, British and Dutch scholars are an outgrowth of the focus which the School of Social Science had organized on the comparative legacy of colonialism during 1980-81. Professor Hirschman gave invited lectures at Harvard, Princeton, and Tulane Universities and was active as a member of the Committee on State and Social Structures of the Social Science Research Council. He also became a member of the Executive Panel of the Ford Foundation's project on the "Future of the Welfare State" and of the Advisory Board of the newly established World Institute of Development Economics Research (WIDER), to be located in Helsinki, Finland. He was elected a Distinguished Fellow of the American Economics Association and a Corresponding Fellow of the British Academy. Having reached the age of 70, he retired from the active Faculty, but does not expect to become wholly passive.

Professor Michael Walzer delivered the Brick Lectures at the University of Missouri in the fall of 1984. He also lectured at the University of Toronto, the New School for Social Research, the University of Southern California, the University of Oxford, at Temple, Drew and Columbia Universities, and at the New York Academy of Medicine. His book *Just and Unjust Wars* came out in a Hebrew translation. Basic Books published his *Exodus and Revolution* in February, 1985. He continued to write and publish in the general area of political theory and the history of theory. His article "Liberalism and the Art of Separation" appeared in the Fall, 1984, issue of the journal *Political Theory*, and another, "La Politique de Michel Foucault," in *Lettre Internationale*. For a fourth year, he served on the committee of scholars working to rebuild the graduate faculty of the New School for Social Research.

The School of Social Science

**Members with Long-term Appointments,
Members, Visitors and Assistants, 1984-85**

In the section which follows, the information was obtained from material provided by the Members, Visitors and Assistants.

Member with Long-term Appointment

Bernard Lewis, See page 27 for biographical entry.

Members

Said A. Arjomand, *Sociology of Islam: institutions and movements.*
    Born 1946, Tehran, Iran. University of Sussex, BA 1968; University of Reading, Grad Dipl 1972; University of Chicago, MA 1976, PhD 1980.
    State University of New York at Stony Brook, assistant professor 1978-   ; St. Antony's College, University of Oxford, visiting fellow 1981-82.

Daniel Bertaux, *Sociology of social mobility; the sociological uses of life histories.*
    Born 1939, Paris, France. Ecole Polytechnique, Paris, BA 1957; University of California at Berkeley, MS 1963; Sorbonne, University of Paris 1V, Licence de Sociologie 1966.
    Centre d'Etudes et de Recherches en Automatismes, Paris, France, research engineer 1963-64, 1966-67; Fondation Singer-Polignac, Paris, travel scholarship 1965; Centre National de la Recherche Scientifique, chercheur en sociologie 1968-   ; Centre de Sociologie Européenne, researcher 1968-69; Groupe d'Etude des Méthodes de l'Analyse, researcher 1970-73; Centre d'Etudes des Mouvements Sociaux 1974-   .

Henry S. Bienen, *The impact of economic change on political stability.*

Born 1939, New York, New York. Cornell University, BA 1960; University of Chicago, MA 1962, PhD 1966.
    University of Chicago, assistant professor 1965-66; Princeton University, assistant to associate professor 1966-72, professor 1972-   .

Abdellah Hammoudi, *Ritual and vision of Christianity.*
    Born 1945, El Kelaa des Sraghna, Morocco. Institute of Sociology, Rabat, Graduate in Sociology 1968; Faculty of Letters and Arts, Rabat, graduate philosophy 1968; Sorbonne, University of Paris IV, Maîtrise 1970, PhD 1977.
    Ecole des Langues et Civilisations Orientales, Paris, assistant professor 1970-72; Institut Hassan II, Rabat, assistant to associate professor 1972-84; New York University, visiting associate professor 1979-80.

Ronald A. Heiner, *Uncertainty as the source of predictable behavior.*
    Born 1950, Salt Lake City, Utah. University of Washington 1972; University of California in Los Angeles, PhD 1975.
    Brigham Young University, assistant to associate professor 1975-83, professor 1984-   ; University of California at Los Angeles, visiting professor 1982-83.

Ann Hibner Koblitz, *The first generation of Russian women in science (1856-1890)—a group biography.*
    Born 1952, Jersey City, New Jersey. Princeton University, BA 1974; Boston University, PhD 1983.
    University of Washington, lecturer 1983-84.

Martin Kohli, *The life-course of a social institution.*
    Born 1942, Solothurn, Switzerland.

University of Bern, Lic Rer Pol 1968, Dr Rer Pol 1972; University of Constance, Habilitation 1977.

Ministry of Education, Zürich, Switzerland, statistician 1968-71; University of Constance, assistant professor 1971-77; Free University of Berlin, professor 1977-   .

Jeffrey Prager, *American values and racial inclusion: the challenge to a democratic order.*

Born 1948, Hartford, Connecticut. Occidental College, BA 1969; University of California at Berkeley, MA 1971, PhD 1978.

University of California at Los Angeles, assistant to associate professor 1977-   .

Michael J. Rustin, *Shakespeare's plays: an approach based on the 'English School' of psychoanalysis.*

Born 1938, London, England. University of Oxford, BA 1962.

North East London Polytechnic, lecturer, senior lecturer, principal lecturer 1964-74, head of department of sociology 1974-   .

Fritz H. E. Schütze, *The autobiographical narrative interview and sociological biography analysis.*

Born 1944, Augsburg, West Germany. University of Münster, Dr Phil 1972; University of Bielefeld, Habilitation 1980.

University of Bielefeld, scientific assistant 1970-80; University of California at San Francisco, visiting fellow 1978-79; University of Kassel, professor 1980-   .

Vivienne Shue, *Peasantry and polity in contemporary China.*

Born 1944, Mescalero, New Mexico. Vassar College, BA 1967; University of Oxford, B Litt 1969; Harvard University, PhD 1975.

Yale University, assistant to associate professor 1976-82; Cornell University, associate professor 1982-   .

Paul E. Starr, *The public/private boundary* and *The social organization of information.*

Born 1949, New York, New York. Columbia University, BA 1970; Harvard University, PhD 1978.

Harvard University, junior fellow 1975-78, assistant to associate professor 1978-   .

Frank H. Stewart, *Customary law of the Sinai Bedouin.*

Born 1942, Limpsfield, England. University of Cambridge, BA 1965; University of Manchester, MA 1969; University of Oxford, D Phil 1973;

Trinity College, University of Oxford, research fellow 1973-82; Wilson Center, Smithsonian Institute, fellow 1982-83; Harvard Law School, fellow in law and anthropology 1983-84.

Susan Cotts Watkins, *Convergence in the demographic characteristics of Western European countries, 1870-1960.*

Born 1938, New Orleans, Louisiana. Swarthmore College, BA 1960; Princeton University, PhD 1980.

Yale University, assistant professor 1979-82; University of Pennsylvania, assistant professor 1982-   .

Alan P. Wertheimer, *A theory of coercion.*

Born 1942, New York, New York. New York University, BA 1964; Case Western Reserve University, PhD 1968.

University of Vermont, assistant to associate professor 1968-73, professor 1977-   .

Visitors

Thomas H. Nipperdey, *The educated classes in Germany 1870-1918.*

Born 1927, Cologne, Germany. University of Cologne, Dr Phil 1953; University of Göttingen, Privatdozent 1961.

Max Planck Institut für Geschichte, Göttingen, assistent 1957-63; University of Karlsruhe, professor 1963-67; Free University of Berlin, professor 1967-71; University of Munich, professor 1971-   ; St. Antony's College, University of Oxford, fellow 1974-75; Institute for Advanced Study, member 1970-71, 1978-79.

Debora L. Silverman, *Nature, mobility and neurology: the origins of French Art Nouveau, 1889-1900.*

Born 1954, Tacoma, Washington. Princeton University, BA 1975, MA 1979, PhD 1983.

University of California at Los Angeles, assistant professor 1981-   .

Assistants

George F. Loewenstein, *An economic theory of expectations and desires.*

Born 1955, Boston, Massachusetts. Brandeis University, BA 1977; Yale University, M Phil 1982.

Institute for Advanced Study, assistant to Professor Albert O. Hirschman 1984-85.

Marie-Hélène Perey, *Moroccan ethno-epistemology.*
Born 1957, Liège, Belgium. University of Liège, Belgium, Licence en Philosophie 1979, Première Candidature en Psychologie 1977, Candidature en langues et littératures Orientales 1979.

McGill University, teaching assistant 1981-82, 1982-83, lecturer, 1982; Institute for Advanced Study, assistant to Professor Clifford Geertz 1984-85.

Joseph M. Schwartz, *Transcending politics: radical political theory's attitude towards political life.*
Born 1954, New York, New York. Cornell University, BA 1975; University of Oxford, BA 1977, MA 1981; Harvard University, MA 1979.

Harvard University, teaching fellow 1979, 1981-1984; Institute for Advanced Study, assistant to Professor Michael Walzer 1984-85.

Record of Events, 1984-1985

The following events of interest to the Institute community took place between July 1, 1984, and June 30, 1985. Not all meetings, such as some of the more informal seminars are recorded, but what follows indicates the variety and quality of Institute activities.

September 23
Concert and Reception

Little Orchestra of Princeton

September 24
School of Natural Sciences

Monday Lunchtime Seminars: "Regge calculus on a random lattice"
Hai-cang Ren, Columbia University; Visiting Member, School of Natural Sciences, IAS

September 25
School of Mathematics
School of Natural Sciences

Seminar on Cellular Automata and Other Dynamical Systems: "Non-linear block maps"
Guest Lecturer: Frank Rhodes, University of Southampton

September 26
School of Mathematics

L^2-Cohomology and Intersection Cohomology: "Introductory survey"
Armand Borel, Professor, School of Mathematics, IAS

October 1
School of Natural Sciences

Theoretical Physics Seminar: "Quantum gravity in $2 + 1$ dimensions"
Guest Lecturer: E. Martinec, Princeton University

October 2
School of Mathematics
School of Natural Sciences

Seminar on Cellular Automata and Other Dynamical Systems: "Entropies of cellular automaton-maps"
John W. Milnor, Professor, School of Mathematics, IAS

October 3
School of Natural Sciences

Informal Quantum Gravity Discussion Session: "Black holes and information loss"
Guest Lecturer: Malcolm Perry, Princeton University

October 4
School of Historical Studies

Art History Colloquium: "Mies van der Rohe and the politics of the modern movement"
Richard Pommer, Vassar College; Visiting Member, School of Historical Studies, IAS

School of Mathematics

Topology: "Earthquakes and other cataclysms on surfaces"
William P. Thurston, Princeton University; Visiting Member, School of Mathematics, IAS

October 5
School of Mathematics

L^2-Cohomology and Intersection Cohomology: "Cheeger's work, I"
Guest Lecturer: W-c. Hsiang, Princeton University

October 8
School of Natural Sciences

Monday Lunchtime Seminar: "Functional integrals on compact spin manifolds"
Guest Lecturer: Adrian Patrascioiu, University of Arizona at Tucson

October 9
School of Mathematics
School of Natural Sciences

Seminar on Cellular Automata and Other Dynamical Systems: "Boolean delay equations"
Guest Lecturer: A. Mullhaupt, Courant Institute of Mathematical Sciences, New York University

October 10
School of Mathematics

L^2-Cohomology and Intersection Cohomology; "Cheeger's work, II"
Guest Lecturer: W-c. Hsiang, Princeton University

Mathematical Physics: "Dynamics of area preserving maps"
Guest Lecturer: J. Mather, Princeton University

October 11
School of Mathematics

Cyclic Cohomology: "Introduction and homology of Lie algebras"
Guest Lecturer: D. Husemöller, Haverford College

School of Social Science

Social Science Luncheon Seminar: "How to study structural processes of life courses: a way of analyzing autobiographical narrative interviews"
Fritz H. E. Schütze, University of Kassel; Visiting Member, School of Social Science, IAS

October 12
School of Natural Sciences

Theoretical Physics Seminar: "Decoupling of anomalies in chiral gauge theories"
Guest Lecturer: E. D'Hoker, Columbia University

October 15
School of Mathematics

Members' Seminar: "Spectral and lattice point problems on SL_2"
Anton Good, Eidgenössische Technische Hochschule; Visiting Member, School of Mathematics, IAS

School of Natural Sciences	Theoretical Physics Seminar: "Skyrmion update, I" Guest Lecturer: Chiara Nappi, Princeton University
	Monday Lunchtime Seminar: "t-expansion analysis of SU(2) lattice gauge theories" Guest Lecturer: Marik Karliner, Stanford Linear Accelerator Center

October 16

School of Mathematics School of Natural Sciences	Seminar on Cellular Automata and Other Dynamical Systems: "Formal language characterization of cellular automaton limit sets" Guest Lecturer: Lyman Hurd, Princeton University

October 17

School of Mathematics	L^2-Cohomology and Intersection Cohomology: "L^2-Cohomology of algebraic surfaces" Guest Lecturer: W-c. Hsiang, Princeton University
	Mathematical Physics: "Renormalization and resummation techniques in φ_4^4" Giovanni Gallavotti, Rutgers University and University of Rome II; Visiting Member, School of Mathematics, IAS

October 17-18

School of Social Science	Biography Group: "A small conference with Anselm Strauss"

October 18

School of Mathematics	Cyclic Cohomology: "Definition of cyclic and Hochschild homologies" Guest Lecturer: D. Husemöller, Haverford College
School of Social Science	Social Science Luncheon Seminar: "Biography, body image, and medical work" Guest Lecturer: Anselm Strauss, San Francisco Medical Center, University of California

October 19

Concert	Endellion String Quartet
School of Natural Sciences	Theoretical Physics Seminar: "Light composite super multiplets" Guest Lecturer: A. Masiero, Centre Européen de la Recherche Nucléaire (CERN)

October 22

School of Mathematics	Members' Seminar: "Piecewise linear fibrations" Thomas A. Chapman, University of Kentucky; Visiting Member, School of Mathematics, IAS
School of Natural Sciences	Theoretical Physics Seminar: "Anomalies, strings, and fermion zero modes" Guest Lecturer: J. Harvey, Princeton University

October 23
School of Mathematics
School of Natural Sciences

Seminar on Cellular Automata and Other Dynamical Systems:
"Automata—theoretic aspects of distributions mod one"
Jean-Marc Deshouillers, University of Bordeaux I; Visiting
Member, School of Mathematics, IAS

October 24
School of Mathematics

L^2-Cohomology and Intersection Cohomology: "L^2-Cohomology
of algebraic surfaces, II"
Guest Lecturer: W-c. Hsiang, Princeton University

Mathematical Physics: "Distribution-valued curvature, with
examples from relativity"
Tevian Dray, Free University of Berlin; Visiting Member, School
of Mathematics, IAS

October 25
School of Historical Studies

Art History Colloquium: "The myth of the 'mad' genius: Van
Gogh and Monticelli"
Aaron Sheon, University of Pittsburgh; Visiting Member, School
of Historical Studies, IAS

School of Mathematics

K-Theory Seminar: "K-theory of spheres"
Guest Lecturer: C. Weibel, Rutgers University

Cyclic Cohomology: "Differential forms and cyclic homology"
Christian Kassel, University of Strasbourg l; Visiting Member,
School of Mathematics, IAS

School of Social Science

Social Science Luncheon Seminar: "The origin of predictable
behavior"
Ronald A. Heiner, Brigham Young University; Visiting Member,
School of Social Science, IAS

October 26
School of Mathematics

Algebraic Theory of D-Modules: "Introductory survey"
Armand Borel, Professor, School of Mathematics, IAS

October 29
School of Mathematics

Members' Seminar: "Localization theory and other problems in
mathematical physics"
Jürg M. Fröhlich, Eidgenössische Technische Hochschule;
Visiting Member, School of Mathematics, IAS

School of Natural Sciences

Monday Lunchtime Seminar: "On the non-perturbative
anomalies in gauge theories"
V. Parameswaran Nair; Visiting Member, School of Natural
Sciences, IAS

October 31
School of Mathematics

L^2-Cohomology and Intersection Cohomology: "Examples of
threefolds"
Guest Lecturer: V. Pati, Princeton University

Mathematical Physics: "Critical wetting"
Guest Lecturer: D. Fisher, Bell Labs

November 1
School of Mathematics

Cyclic Cohomology: "Cyclic sets and Connes's category $\wedge$"
Guest Lecturer: D. Husemöller, Haverford College

K-Theory Seminar: "Knots"
Guest Lecturer: J. Hoste, Rutgers University

School of Mathematics
School of Natural Sciences

Seminar on Cellular Automata and Other Dynamical Systems:
"The zeta functions of Selberg and Ruelle"
Guest Lecturer: David Fried, Boston University

School of Social Science

Social Science Luncheon Seminar: "The historical construction of
homosexuality"
Bert Hansen, University of Toronto; Visiting Member, School of
Historical Studies, IAS

November 2
Director's Lecture

"The Historical Roots of the Islamic Revolution"
Bernard Lewis, Professor of Near Eastern Studies, Princeton
University; and Long-term Member, School of Historical
Studies and School of Social Science, IAS

School of Mathematics

Algebraic Theory of D-Modules: "The Weyl algebra"
Armand Borel, Professor, School of Mathematics, IAS

School of Natural Sciences

Theoretical Physics Seminar: "Phase transition in the 3-D Ising
spin glass model"
Guest Lecturer: Andrew Ogielski, Bell Laboratories

November 5
School of Mathematics

Members' Seminar: "Classical limits for a particle in a Yang-Mills
field"
Malcolm R. Adams, University of California; Visiting Member,
School of Mathematics, IAS

School of Natural Sciences

Theoretical Physics Seminar: "Skyrmion update, II"
Guest Lecturer: Chiara Nappi, Princeton University

Astrophysics Seminar: "Stability of Galactic Disks"
Guest Lecturer: Jerry Sellwood, University of Groningen

November 6
School of Mathematics

Topology: "Measured foliations on surfaces"
Athanase Papadopoulos, University of Paris-Sud; Visiting
Member, School of Mathematics, IAS

School of Mathematics
School of Natural Sciences

Seminar on Cellular Automata and Other Dynamical Systems:
"Constraints on the degree of a Sofic homomorphism"
Guest Lecturer: Mike Boyle, IBM Watson Research Center

November 7
School of Mathematics

L^2-Cohomology and Intersection Cohomology: "L. Saper's work, I"
Guest Lecturer: W-c. Hsiang, Princeton University

Mathematical Physics: "The random field Ising model in three dimensions"
Guest Lecturer: J. Imbrie, Harvard University

School of Natural Sciences

Informal Quantum Gravity Discussion Session: "Gravitational magnetic monopoles"
Mark T. Mueller, Stanford University; Visiting Member, School of Natural Sciences, IAS

November 8
School of Historical Studies

Art History Colloquium: "Boccaccio visualized"
Vittore Branca, University of Padua; Visiting Member, School of Historical Studies, IAS

School of Mathematics

K-Theory Seminar: "Kasparov's KK-theory, I"
Guest Lecturer: R. Thomason, The Johns Hopkins University

Cyclic Cohomology: "Cyclic homology and derivations (after T. Goodwillie)"
Christian Kassel, University of Strasbourg I; Visiting Member, School of Mathematics, IAS

School of Social Science

Social Science Luncheon Seminar: "Stabilization programs, subsidy cuts, and political stability"
Henry S. Bienen, Princeton University; Visiting Member, School of Social Science, IAS

November 9
School of Mathematics

Algebraic Theory of D-Modules: "Operators on affine varieties"
Armand Borel, Professor, School of Mathematics, IAS

November 12
School of Mathematics

Marston Morse Memorial Lecture: "Index theorems and superstrings"
Guest Lecturer: E. Witten, Princeton University

School of Natural Sciences

Monday Lunchtime Seminar: "Non-trivial continuum limit for the negative coupling ϕ_4 theory in four dimensions"
Guest Lecturer: A. Kupiainen, Harvard University

November 13
School of Mathematics

Topology: "The equivariant topological s-cobordism theorem for locally linear actions of finite groups"
James E. West, Cornell University; Visiting Member, School of Mathematics, IAS

School of Mathematics
School of Natural Sciences

Seminar on Cellular Automata and Other Dynamical Systems: "Entropies for cellular automata"
Guest Lecturer: Doug Lind, IBM Watson Research Center

November 14
School of Mathematics

L²-Cohomology and Intersection Cohomology: "L. Saper's work, II"
Guest Lecturer: W-c. Hsiang, Princeton University

Mathematical Physics: "Convergence of improved perturbation expansion for the Gross-Neveu model"
Guest Lecturer: A. Kupiainen, Harvard University

November 15
School of Mathematics

K-Theory Seminar: "Kasparov's KK-theory, II"
Guest Lecturer: R. Thomason, The Johns Hopkins University

Cyclic Cohomology: "SO(2)-equivariant homology of free loopspaces"
Christian Kassel, University of Strasbourg I; Visiting Member, School of Mathematics, IAS

School of Social Science

Social Science Luncheon Seminar: "Inversion and ambiguity: The interpretation of a Moroccan masquerade"
Abdellah Hammoudi, Institut Agronomique et Vétérinaire Hassan II; Visiting Member, School of Social Science, IAS

November 16
School of Natural Sciences

Theoretical Physics Seminar: "Computations with dynamical fermions: phase diagram at finite temperature"
Guest Lecturer: F. Fucito, California Institute of Technology

November 17
Concert

Fredericka von Staade, benefit concert for the Princeton Child Development Institute

November 19
School of Mathematics

Members' Seminar: "Generalized spherical harmonics, with examples from relativity and monopole physics"
Tevian Dray, Free University of Berlin; Visiting Member, School of Mathematics, IAS

School of Natural Sciences

Theoretical Physics Seminar: "A numerical algorithm for Hamiltonian gauge theories at large N"
Guest Lecturer: Frank Brown, Princeton University

November 20
School of Mathematics

Topology: "Group actions and minimal submanifolds"
Hsu-Tung Ku, University of Massachusetts; Assistant, School of Mathematics, IAS

School of Mathematics
School of Natural Sciences

Seminar on Cellular Automata and Other Dynamical Systems: "Fractal basin boundaries"
Guest Lecturer: Jim Yorke, Institute of Physical Science and Technology, University of Maryland

November 21
School of Mathematics

L^2-Cohomology and Intersection Cohomology: "L. Saper's work, III"
Guest Lecturer: W-c. Hsiang, Princeton University

Mathematical Physics: "Absence of an intermediate phase for a class of ferromagnetic systems"
Guest Lecturer: M. Aizenman, Rutgers University

School of Natural Sciences

Astrophysics Seminar: "Cores of elliptical galaxies"
Guest Lecturer: Tod Lauer, Lick Observatory, University of California at Santa Cruz

November 26
School of Mathematics

Special Lecture: "On two arithmetic groups and two possibly nonarithmetic groups"
Guest Lecturer: J. Tits, Collège de France and Yale University

Special Lecture: "Attractors in dynamical systems"
John W. Milnor, Professor, School of Mathematics, IAS

School of Natural Sciences

Monday Lunchtime Seminar: "Electric charge of the magnetic monopole"
Gordon Semenoff, University of British Columbia; Visitor, School of Natural Sciences, IAS

November 27
School of Mathematics

Topology: "Word processing on groups"
William P. Thurston, Princeton University; Visiting Member, School of Mathematics, IAS

School of Mathematics
School of Natural Sciences

Seminar on Cellular Automata and Other Dynamical Systems: "Entropies for cellular automata"
Guest Lecturer: Doug Lind, IBM Watson Research Center

School of Natural Sciences

Informal Quantum Gravity Discussion Session: "Quantum field theory in rotating boxes"
Corrine Manogue, University of Texas at Austin; Visiting Member, School of Natural Sciences, IAS

November 28
School of Mathematics

L^2-Cohomology and Intersection Cohomology: "Locally hermitian symmetric spaces"
Armand Borel, Professor, School of Mathematics, IAS

Mathematical Physics: "Representation theory and physical models"
Guest Lecturer: Igor Frenkel, Rutgers University

School of Natural Sciences

Astrophysics Seminar: "Release of free energy in differentially rotating systems"
Guest Lecturer: Peter Goldreich, California Institute of Technology

November 29
School of Mathematics

K-Theory Seminar: "Algebraic K-theory and cyclic homology, 1"
Guest Lecturer: T. Goodwillie, Harvard University

Cyclic Cohomology: "Algebraic K-theory and cyclic homology, II"
Guest Lecturer: T. Goodwillie, Harvard University

Special Lecture: "Clifford algebras and the Cauchy integral on Lipschitz surfaces in R^{n+1}"
Guest Lecturer: A. McIntosh, Australian National University

School of Social Science

Social Science Luncheon Seminar: "The interests—from euphemism to tautology"
Albert O. Hirschman, Professor, School of Social Science, IAS

November 30
School of Mathematics

Algebraic Theory of D-Modules: "D-modules and algebraic varieties"
Armand Borel, Professor, School of Mathematics, IAS

School of Natural Sciences

Theoretical Physics Seminar: "A mechanism for reducing the value of the cosmological constant"
Guest Lecturer: Larry Abbott, Brandeis University

November 30-December 2
Conference

International Research and Exchanges Board

December 3
School of Mathematics

Members' Seminar: "Backlund transformation, Riccati systems and Grassmann manifolds"
John Harnad, University of Montreal; Visiting Member, School of Mathematics, IAS

December 4
School of Mathematics

Topology: "Word processing on groups, II"
William P. Thurston, Princeton University; Visiting Member, School of Mathematics, IAS

School of Mathematics
School of Natural Sciences

Seminar on Cellular Automata and Other Dynamical Systems: "Randomness and the computational complexity of real functions"
Guest Lecturer: Lenore Blum, City College of New York

School of Natural Sciences

Informal Quantum Gravity Discussion Session: "Vacuum states in de Sitter space"
Guest Lecturer: Bruce Allen, University of California at Santa Barbara

December 5
School of Mathematics

L^2-Cohomology and Intersection Cohomology: "Locally hermitian symmetric spaces" (continued)
Armand Borel, Professor, School of Mathematics, IAS

Mathematical Physics: "Anomalies and some new index theorems"

Antti Niemi, Princeton, N.J.; Visiting Member, School of Natural Sciences, IAS

School of Natural Sciences

Astrophysics Seminar: "Refractive scintillation in the interstellar medium"

Guest Lecturer: Roger Blandford, California Institute of Technology

December 6
School of Historical Studies

Art History Colloquium: "Programmes, commanditaires et ateliers: l'iconographie des pavements du Moyen Âge en France et en Italie"

Xavier Barral I Altet, University of Haute Bretagne-Rennes II; Visiting Member, School of Historical Studies, IAS

School of Mathematics

K-Theory Seminar: "Kasparov's KK-theory, III"
Guest Lecturer: R. Thomason, The Johns Hopkins University

Cyclic Cohomology: "Cyclic homology and pseudo-isotopy"
Guest Lecturer: W-c. Hsiang, Princeton University

School of Social Science

Social Science Luncheon Seminar: "The institutionalization of the life-course"

Martin Kohli, Freie Universität Berlin; Visiting Member, School of Social Science, IAS

December 7
School of Mathematics

Algebraic Theory of D-Modules: "Inverse and direct images"
Armand Borel, Professor, School of Mathematics, IAS

School of Natural Sciences

Theoretical Physics Seminar: "Unusual events at the CERN collider"
Guest Lecturer: Lawrence Hall, Harvard University

December 10
School of Mathematics

Members' Seminar: "Some applications of representation theory to the inversion of the Laplacian on unbounded homogeneous domains in C^n"

Richard C. Penney, Purdue University; Visiting Member, School of Mathematics, IAS

School of Natural Sciences

Monday Lunchtime Seminar: "Field theory in accelerated coordinate systems"

Mark T. Mueller, Stanford University; Visiting Member, School of Natural Sciences, IAS

December 11
School of Mathematics
School of Natural Sciences

Seminar on Cellular Automata and Other Dynamical Systems: "Average case complete problems in computational complexity theory"

Guest Lecturer: Leonid Levin, Boston University

School of Natural Sciences

Informal Quantum Gravity Discussion Session: "Black holes in supergravity"
Guest Lecturer: Pierre van Baal, State University of New York at Stony Brook

December 12
School of Mathematics

L^2-Cohomology and Intersection Cohomology: "Locally hermitian symmetric spaces" (continued)
Armand Borel, Professor, School of Mathematics, IAS

Mathematical Physics: "Renormalons—a dynamical systems approach"
Guest Lecturer: K. Gawedzki, Harvard University

School of Mathematics
School of Natural Sciences

Seminar on Cellular Automata and Other Dynamical Systems: "Scaling on trees"
Mitchell Feigenbaum, Cornell University; Visiting Member, School of Natural Sciences, IAS

December 13
School of Mathematics

K-Theory Seminar: "Mennicke symbols"
Leonid N. Vaserstein, Pennsylvania State University; Visiting Member, School of Mathematics, IAS

Cyclic Cohomology: "Mixed complexes and cotensor product"
Christian Kassel, University of Strasbourg I; Visiting Member, School of Mathematics, IAS

School of Natural Sciences

Astrophysics Seminar: "Torquing neutron stars with MHD winds"
Guest Lecturer: Christopher McKee, University of California at Berkeley

School of Social Science

Social Science Luncheon Seminar: "Sinai Bedouin law"
Frank Stewart, Harvard University Law School; Visiting Member, School of Social Science, IAS

December 14
School of Mathematics

Algebraic Theory of D-Modules: "Inverse and direct images" (continued)
Armand Borel, Professor, School of Mathematics, IAS

School of Natural Sciences

Theoretical Physics Seminar: "Superstring phenomenology"
Guest Lecturer: Ed Witten, Princeton University

December 17
School of Mathematics

Members' Seminar: "On the zeros of Epstein zeta functions"
Dennis A. Hejhal, University of Minnesota; Visiting Member, School of Mathematics, IAS

December 19
School of Mathematics

L^2-Cohomology and Intersection Cohomology: "Locally hermitian symmetric spaces" (continued)
Armand Borel, Professor, School of Mathematics, IAS

School of Natural Sciences

Astrophysics Seminar: "Very faint radio galaxies"
Guest Lecturer: Jan Oort, University of Leiden

December 20
School of Natural Sciences

Theoretical Physics Talks: "Thermodynamic instability of de
  Sitter space"
Guest Lecturer: Emil Mottola, Institute for Theoretical Physics,
  University of California at Santa Barbara

School of Social Science

Social Science Luncheon Seminar: "On relativism"
Michael Walzer, Professor, School of Social Science, IAS

December 21
School of Natural Sciences

Theoretical Physics Talks: "Some aspects of superstrings"
Guest Lecturer: John Schwarz, California Institute of Technology

January 7
School of Mathematics

Members' Seminar: "The non-vanishing of the Rankin-Selberg
  zeta function at special points"
Guest Lecturer: Henryk Iwaniec, Polish Academy of Sciences

January 7-February 10
Exhibition

Models of the Inventions of Leonardo da Vinci, an exhibition on
  loan from IBM

January 9
School of Mathematics

L^2-Cohomology and Intersection Cohomology: "Eisenstein series
  and the Zucker conjecture in the rank two case"
Guest Lecturer: W. Casselman, University of British Columbia

January 15
School of Mathematics

Topology: "Stability of concordances"
Thomas A. Chapman, University of Kentucky; Visiting Member,
  School of Mathematics, IAS

January 16
School of Mathematics

L^2-Cohomology and Intersection Cohomology: "Eisenstein series
  and the Zucker conjecture in the rank two case" (continued)
Guest Lecturer: W. Casselman, University of British Columbia

January 17
School of Mathematics
School of Natural Sciences

Special Seminar: "Superstrings I"
Guest Lecturer: Dan Friedan, University of Chicago

School of Social Science

Social Science Luncheon Seminar: "Spinsters: Why were there so
  many in Europe and so few in China?"
Susan Cotts Watkins, University of Pennsylvania; Visiting
  Member, School of Social Science, IAS

January 18
School of Mathematics

Mathematics Historical Lecture Series: "Topics in algebra: Euclid
  to Bombelli"
André Weil, Professor Emeritus, School of Mathematics, IAS

School of Mathematics	Special Seminar: "Superstrings II"
School of Natural Sciences	Guest Lecturer: Steve Shenker, University of Chicago

January 21
School of Mathematics

Members' Seminar: "Local shapes of surfaces with anisotropic surface energy"
Jean E. Taylor, Rutgers University; Visiting Member, School of Mathematics, IAS

School of Natural Sciences

Theoretical Physics Seminar: "Uniqueness of superstring actions"
Guest Lecturer: Lars Brink, University of Gothenburg, Sweden

January 21-24
School of Natural Sciences

Conference: Guaranteed Time Observers of the Space Telescope

January 23
School of Mathematics

L²-Cohomology and Intersection Cohomology: "Locally hermitian symmetric spaces" (continued)
Armand Borel, Professor, School of Mathematics, IAS

January 24
School of Mathematics

K-Theory Seminar: "Conjectured values of L-functions (after Beilinson), I"
Pierre Deligne, Professor, School of Mathematics, IAS

Cyclic Cohomology: "Homotopy theory for cyclic sets"
Guest Lecturer: M. Hopkins, Princeton University

Workshop in Geometric Aspects of Integrable Hamiltonian Systems: "Short report on Santa Barbara Conference (January 11-16) on solitons"
Emma Previato, Boston University; Visiting Member, School of Mathematics, IAS

Workshop in Geometric Aspects of Integrable Hamiltonian Systems: "Overview of forthcoming topics"
John Harnad, University of Montreal; Visiting Member, School of Mathematics, IAS

School of Social Science

Social Science Luncheon Seminar: "Social classification in liberal societies"
Paul E. Starr, Harvard University; Visiting Member, School of Social Science, IAS

January 25
School of Mathematics

Algebraic Theory of D-Modules: "Holonomicity"
Armand Borel, Professor, School of Mathematics, IAS

Mathematics Historical Lecture Series; "Topics in algebra: Euclid to Bombelli"
André Weil, Professor Emeritus, School of Mathematics, IAS

School of Natural Sciences

Theoretical Physics Seminar: "Sigma-model anomalies"
Guest Lecturer: Paul Ginsparg, Harvard University

January 28
School of Mathematics

Topology: "A linearity theorem for the action of a diffeomorphism on π_1 of a surface"
Guest Lecturer: C. Series, University of Pennsylvania

Members' Seminar: "Approximation in Cauchy-Riemann manifolds—uniqueness in nonlinear PDE"
J. François Treves, Rutgers University; Visiting Member, School of Mathematics, IAS

January 30
School of Mathematics

L^2-Cohomology and Intersection Cohomology: "Locally hermitian symmetric spaces" (continued)
Armand Borel, Professor, School of Mathematics, IAS

January 31
School of Mathematics

K-Theory Seminar: "Conjectured values of L-functions (after Beilinson)" (continued)
Pierre Deligne, Professor, School of Mathematics, IAS

Cyclic Cohomology: "Closed model category and cyclic objects"
Guest Lecturer: D. Husemöller, Haverford College

Integrable Systems: "Lie-Poisson structures, factorization and Adler-Kostant-Symes theorem"
Malcolm R. Adams, University of California at Berkeley; Visiting Member, School of Mathematics, IAS

Integrable Systems: "Zakharov-Shabat systems and the Riemann-Hilbert factorization problem"
John Harnad, University of Montreal; Visiting Member, School of Mathematics, IAS

School of Social Science

Social Science Luncheon Seminar: "Coercion and the law: contracts under duress, shotgun marriages, and plea bargaining"
Alan P. Wertheimer, University of Vermont; Visiting Member, School of Social Science, IAS

February 1
School of Mathematics

Algebraic Theory of D-Modules: "Holonomicity" (continued)
Armand Borel, Professor, School of Mathematics, IAS

Mathematics Historical Lecture Series: "Topics in algebra: Euclid to Bombelli" (continued)
André Weil, Professor Emeritus, School of Mathematics, IAS

February 4
School of Mathematics

Members' Seminar: "Some recent results about averages of functions in $\mathbf{R}^n$"
Elias M. Stein, Princeton University; Visiting Member, School of Mathematics, IAS

School of Natural Sciences	Astrophysics Seminar: "A multigrid method for computing steady disk flow in a galaxy" Guest Lecturer: Wim Mulder, University of Leiden

February 6
School of Mathematics

L^2-Cohomology and Intersection Cohomology: "Locally hermitian symmetric spaces" (continued)
Armand Borel, Professor, School of Mathematics, IAS

School of Natural Sciences

Astrophysics Seminar: "The SOLAR G-mode?"
Guest Lecturer: Wojciech Dziembowski, University of Warsaw

February 7
School of Historical Studies

Art History Colloquium: "Twentieth-century medieval: the spread of Guastavino vaulting"
George R. Collins, Columbia University; Visiting Member, School of Historical Studies, IAS

School of Mathematics

K-Theory Seminar: "Conjectured values of L-functions (after Beilinson)" (continued)
Pierre Deligne, Professor, School of Mathematics, IAS

Cyclic Cohomology: "Cyclic modules"
Guest Lecturer: W. G. Dwyer, University of Notre Dame

Integrable Systems: "Algebro-geometric methods: I. Linearization in complex torii; II. Application to NLS and Sine-Gordon equations"
Emma Previato, Boston University; Visiting Member, School of Mathematics, IAS

School of Social Science

Social Science Luncheon Seminar: "The Islamic revolution in comparative perspective"
Said A. Arjomand, State University of New York at Stony Brook; Visiting Member, School of Social Science, IAS

February 8
School of Mathematics

Algebraic Theory of D-Modules: "Regular holonomic systems"
Armand Borel, Professor, School of Mathematics, IAS

Mathematics Historical Lecture Series: "Topics in algebra: Euclid to Bombelli" (continued)
André Weil, Professor Emeritus, School of Mathematics, IAS

February 11
School of Mathematics

Members' Seminar: "SL(2,R) and stability or mixing for the geodesic flow on the Lobatchevski plane"
Giovanni Gallavotti, Rutgers Univeristy and University of Rome II; Visiting Member, School of Mathematics, IAS

School of Natural Sciences

Monday Lunchtime Seminar: "Applications of some new index theorems"
Antti Niemi; Visiting Member, School of Natural Sciences, IAS

February 12
School of Mathematics

Vertex Operators: "Introduction"
James I. Lepowsky, Rutgers University; Visiting Member, School of Mathematics, IAS

Topology: "The hyperbolic Gauss map and quasi-conformal reflections"
Guest Lecturer: C. Epstein, Princeton University

February 14
School of Mathematics

K-Theory Seminar: "K-theory of discrete valuation rings"
Clayton C. Sherman, New Mexico State University; Visiting Member, School of Mathematics, IAS

Cyclic Cohomology: "Stable K-theory and Hochschild homology"
Christian Kassel, University of Strasbourg I; Visiting Member, School of Mathematics, IAS

Integrable Systems: "Algebraically complete integrability of Hamiltonian systems"
Guest Lecturer: P. van Moerbeke, Université Catholique de Louvain and Brandeis University

School of Social Science

Social Science Luncheon Seminar: "Thinking in *Romeo and Juliet*"
Michael J. Rustin, North East London Polytechnic; Visiting Member, School of Social Science, IAS

February 15
School of Mathematics

Algebraic Theory of D-Modules: "Regular holonomic systems" (continued)
Armand Borel, Professor, School of Mathematics, IAS

Mathematics Historical Lecture Series: "Topics in algebra: Euclid to Bombelli" (continued)
André Weil, Professor Emeritus, School of Mathematics, IAS

School of Natural Sciences

Theoretical Physics Seminar: "Random geometry"
Herbert Hamber; Visiting Member, School of Natural Sciences, IAS

February 18
School of Mathematics

Topology: "Diffeomorphisms of surfaces with zero entropy"
Guest Lecturer: M. Handel, Columbia University

Members' Seminar: "Vertex operators and the monster"
James I. Lepowsky, Rutgers University; Visiting Member, School of Mathematics, IAS

School of Natural Sciences

Theoretical Physics Seminar: "New $N = 1$ supergravity theories"
Guest Lecturer: Burt Ovrut, University of Pennsylvania

February 19
School of Mathematics

Vertex Operators: "Introduction to $sl\,(2)^{\wedge}$"
James I. Lepowsky, Rutgers University; Visiting Member, School of Mathematics, IAS

February 20
School of Natural Sciences

Informal Quantum Gravity Discussion Session: "Hawking's approach to quantum cosmology"
Don N. Page, Pennsylvania State University; Visiting Member, School of Natural Sciences, IAS

February 21
School of Mathematics

K-Theory Seminar: "K-theory of discrete valuation rings" (continued)
Clayton C. Sherman, New Mexico State University; Visiting Member, School of Mathematics, IAS

Cyclic Cohomology: "Stable K-theory and Hochschild homology" (continued)
Christian Kassel, University of Strasbourg I; Visiting Member, School of Mathematics, IAS

Integrable Systems: "The reduction problem and solitons"
John Harnad, University of Montreal; Visiting Member, School of Mathematics, IAS

School of Social Science

Social Science Luncheon Seminar: "The 'women of the sixties': Russian women and science 1856-1890"
Ann Hibner Koblitz, University of Washington; Visiting Member, School of Social Science, IAS

February 22
School of Mathematics

Mathematics Historical Lecture Series: "Topics in algebra: Euclid to Bombelli" (continued)
André Weil, Professor Emeritus, School of Mathematics, IAS

School of Natural Sciences

Theoretical Physics Seminar: "An exploratory numerical study of discrete quantum gravity"
Guest Lecturer: B. Berg, DESY, Hamburg, West Germany

February 25
School of Mathematics

Members' Seminar: "Harmonizable solutions of the equation $\wedge X = Y$"
Malempati M. Rao, University of California at Riverside; Visiting Member, School of Mathematics, IAS

School of Natural Sciences

Monday Lunchtime Seminar: "Supersymmetric sigma models: geometry and finiteness"
Christopher M. Hull, Massachusetts Institute of Technology; Visiting Member, School of Natural Sciences, IAS

February 26
School of Mathematics

Vertex Operators: "Introduction to $sl\,(2)^{\wedge}$"
James I. Lepowsky, Rutgers University; Visiting Member, School of Mathematics, IAS

Topology: "Invariants of hyperbolic 3-manifolds"
Walter D. Neumann, University of Maryland; Visiting Member,
   School of Mathematics, IAS

February 28
Concert

The Princeton Ensemble

School of Mathematics

K-Theory Seminar: "Cancellation of projective modules"
Guest Lecturer: A. Roy, Rutgers University and Tata Institute

Integrable Systems: "Toda lattice and representation theory"
Guest Lecturer: R. Goodman, Rutgers University

School of Social Science

Social Science Luncheon Seminar: "The 'May 1968 generation' in
   France: A collective life history"
Daniel Bertaux, University of Montreal and Centre National de la
   Recherche Scientifique; Visiting Member, School of Social
   Science, IAS

March 1
School of Historical Studies

Special Lecture: " 'Apolidon's castle' and French Renaissance
   architecture"
Guest Lecturer: André Chastel, Collège de France

School of Mathematics

Mathematics Historical Lecture Series: "Topics in algebra: Euclid
   to Bombelli" (continued)
André Weil, Professor Emeritus, School of Mathematics, IAS

School of Natural Sciences

Theoretical Physics Seminar: "Composite Higgs bosons"
Guest Lecturer: Howard Georgi, Harvard University

March 3
Memorial Lecture

Richard Llewelyn-Davis Memorial Lecture: "The Victorian city:
   images and realities"
Guest Lecturer: Asa Briggs, Worcester College, University of
   Oxford

March 4
School of Mathematics

Topology: "Volumes of hyperbolic 3-manifolds"
Guest Lecturer: C. Hodgson, Princeton University

Members' Seminar: "Optimal isoperimetric inequalities"
Frederick J. Almgren, Jr., Princeton University; Visiting Member,
   School of Mathematics, IAS

School of Natural Sciences

Theoretical Physics Seminar: "Nuclear matter in the Skyrme
   model"
Guest Lecturer: Igor Klebanov, Princeton University

March 5
School of Mathematics

Vertex Operators: "Introduction to $sl\,(2)^{\wedge}$" (continued)
James I. Lepowsky, Rutgers University; Visiting Member, School
   of Mathematics, IAS

March 6
School of Mathematics

Mathematical Physics: "Jump discontinuities in semilinear wave equations"
Guest Lecturer: M. C. Reed, Duke University

March 7
School of Mathematics

K-Theory Seminar: "Unramified class field theory of surfaces over a finite field"
Guest Lecturer: W. Raskind, Duke University

Integrable Systems: "Quantized Toda lattices"
Guest Lecturer: R. Goodman, Rutgers University

School of Social Science

Social Science Luncheon Seminar: "Max Weber's essay on Protestantism: the German background"
Thomas Nipperdey, University of Munich; Visitor, School of Social Science, IAS

March 8
School of Mathematics

Algebraic Theory of D-Modules: "Regular holonomic systems" (continued)
Armand Borel, Professor, School of Mathematics, IAS

Special Lecture: "Sophie Germain, the theory of plates and differential geometry before Gauss"
Guest Lecturer: C. Truesdell, The Johns Hopkins University

March 11
School of Natural Sciences

Monday Lunchtime Seminar: "Quantum tunnelling in real time (non-perturbative methods)"
Guest Lecturer: Fred Cooper, Los Alamos

March 12
School of Mathematics

Vertex Operators: "Introduction to $sl\,(2)^{\wedge}$" (continued)
James I. Lepowsky, Rutgers University; Visiting Member, School of Mathematics, IAS

March 14
School of Historical Studies

Art History Colloquium: "Women, art and power: imagery and ideology in the later nineteenth and early twentieth centuries"
Linda Nochlin, City University of New York Graduate Center; Visiting Member, School of Historical Studies, IAS

School of Mathematics

K-Theory Seminar, I: "K-theory and Serre's conjecture on vanishing of intersection multiplicities"
Guest Lecturer: H. Gillet, University of Illinois

K-Theory Seminar, II: "Connections and regulators"
Guest Lecturer: C. Soulé, Paris

Cyclic Cohomology: "On higher dimensional Arakelov theory"
Guest Lecturer: C. Soulé, Paris

	Integrable Systems: "Rosochatius system, quadrics and Grassmannians" Guest Lecturer: J. Hurtubise, University of Quebec
School of Social Science	Social Science Luncheon Seminar: "Monolith, honeycomb, and web: Patterns for the polity of contemporary China" Vivienne Shue, Cornell University; Visiting Member, School of Social Science, IAS

March 15

School of Mathematics	Algebraic Theory of D-Modules: "Regular holonomic systems" (continued) Armand Borel, Professor, School of Mathematics, IAS
	Mathematics Historical Lecture Series: "Topics in algebra: Euclid to Bombelli" (continued) André Weil, Professor Emeritus, School of Mathematics, IAS
School of Natural Sciences	Theoretical Physics Seminar: "Q balls" Guest Lecturer: Sidney Coleman, Harvard University

March 18

School of Mathematics	Members' Seminar: "Optimal isoperimetric inequalities" Frederick J. Almgren, Jr., Princeton University; Visiting Member, School of Mathematics, IAS
School of Natural Sciences	Theoretical Physics Seminar: "16 + 16 supergravity coupled to matter" Guest Lecturer: Burt Ovrut, University of Pennsylvania

March 19

School of Mathematics	Vertex Operators: "Introduction to $sl\,(2)^{\wedge}$" (continued) James I. Lepowsky, Rutgers University; Visiting Member, School of Mathematics, IAS
	Topology: "Towards the classification of maps of surfaces" Guest Lecturer: W. Kazez, University of Pennsylvania

March 20

School of Mathematics	Special Lecture: "On Ramanujan and Sato-Tate conjectures and related questions" Guest Lecturer: P. Sarnak, Stanford University

March 21

School of Social Science	Social Science Luncheon Seminar: "American political culture and shifting meaning of race" Jeffrey Prager, University of California at Los Angeles; Visiting Member, School of Social Science, IAS

March 22

School of Mathematics	Algebraic Theory of D-Modules: "Regular holonomic systems" (concluded) Armand Borel, Professor, School of Mathematics, IAS

Mathematics Historical Lecture Series: "Topics in algebra: Euclid to Bombelli" (continued)
André Weil, Professor Emeritus, School of Mathematics, IAS

School of Natural Sciences

Theoretical Physics Seminar: "Field theoretic approach to the integral quantum Hall effect"
Guest Lecturer: H. Levine, Schlumberger-Doll Research Center, Ridgefield, Connecticut

March 25
School of Natural Sciences

Monday Lunchtime Seminar: "Recent developments in Kaluza-Klein theories"
Christopher N. Pope, Imperial College; Visiting Member, School of Natural Sciences, IAS

Concert

Piano Recital by Novin Afrouz

March 26
School of Mathematics

Vertex Operators: "Introduction to $sl(2)^\wedge$" (continued)
James I. Lepowsky, Rutgers University; Visiting Member, School of Mathematics, IAS

Topology: "Convex surfaces in hyperbolic 3-space"
Guest Lecturer: I. Rivin, Princeton University

School of Natural Sciences

Astrophysics Seminar: "Dynamics of traxial galaxies with a central black hole"
Guest Lecturer: Ortwin Gerhard, University of Oxford

March 27
School of Historical Studies

Lecture: "Weeping in Byzantium"
Guest Lecturer: Evelyne Patlagean, University of Paris (Nanterre)

March 28
School of Mathematics

K-Theory Seminar: "Arithmetic of diagonal cubic hypersurfaces"
Dmitry Kanevsky, Max-Planck-Institute; Visiting Member, School of Mathematics, IAS

Cyclic Cohomology: "Global class field theory of arithmetic schemes over **Z**"
Guest Lecturer: S. Saito, Harvard and Tokyo Universities

School of Social Science

Social Science Luncheon Seminar: "Minds, machines, and Searle"
Guest Lecturer: Steven Harnad, editor of *The Behavioral and Brain Sciences*

March 29
School of Mathematics

Special Lecture: "L^2 index theorems on locally symmetric spaces"
Mark A. Stern, Princeton University; Visiting Member, School of Mathematics, IAS

April 1
School of Historical Studies

Lecture: "Aristotle's 'corrective justice' and the Greek law of contract"
Guest Lecturer: Peter Kussmaul, Dalhousie University

School of Mathematics

Topology: "Critically finite rational maps of degree two"
Guest Lecturer: S. Levy, Princeton University

April 2
School of Mathematics

Vertex Operators: "Introduction to $sl\,(2)^{\wedge}$" (concluded)
James I. Lepowsky, Rutgers University; Visiting Member, School of Mathematics, IAS

Topology: "Zippers"
William P. Thurston, Princeton University; Visiting Member, School of Mathematics, IAS

School of Natural Sciences

Theoretical Physics Seminar: "The effective action for long-range QCD"
Guest Lecturer: Fred Zachariasen, California Institute of Technology

Concert

Eighteenth-Century Chamber Music, performed by Visiting Members of the Institute

April 4
School of Historical Studies

Art History Colloquium: "Perspectivists and geometers: case studies from the Renaissance to the seventeenth century"
Martin Kemp, St. Andrews University; Visiting Member, School of Historical Studies, IAS

School of Mathematics

K-Theory Seminar: "SL_2 over Laurent polynomials"
Guest Lecturer: A. Roy, Rutgers University and Tata Institute

Cyclic Cohomology: "Cyclic homology and algebraic K-theory"
Guest Lecturer: C. Weibel, Rutgers University

School of Social Science

Social Science Luncheon Seminar: "The role of associations in the Athenian democracy"
Nicholas F. Jones, University of Pittsburgh; Visiting Member, School of Historical Studies, IAS

April 5
School of Natural Sciences

Theoretical Physics Seminar: "Some two-dimensional finite field theories"
Guest Lecturer: L. Alvarez-Gaumé, Harvard University

April 8
School of Natural Sciences

Monday Lunchtime Seminar: "Consistency and the cohomology of gauge theories"
Guest Lecturer: Bernard Grossman, Rockefeller University

April 11
School of Social Science

Social Science Luncheon Seminar: "The dotal regime, 1140-1500: "Dictating choices in marriage in Mediterranean cities"
Susan Mosher Stuard, State University of New York at Brockport; Visiting Member, School of Historical Studies, IAS

April 12
School of Natural Sciences

Theoretical Physics Seminar: "Family unification in four dimensions"
Guest Lecturer: Jon Bagger, Harvard University

April 18
School of Social Science

Social Science Luncheon Seminar: "*Art Nouveau* and the Brothers de Goncourt: nobility, neurology, and French interior design, 1869-1896"
Debora Silverman, University of California at Los Angeles; Visitor, School of Social Science, IAS

April 22
School of Natural Sciences

Monday Lunchtime Seminar: "Inflation and flatness in Hawking's state of the universe"
Don N. Page, Pennsylvania State University; Visiting Member, School of Natural Sciences, IAS

School of Social Science

Special Seminar: "Surplus Oppression: the overdetermination of servility in large law firms"
Guest Lecturer: J. Walter Freiberg, lawyer, Boston, Massachusetts

April 24
School of Natural Sciences

Informal Quantum Gravity Discussion Session: "Stability? of de Sitter space"
Guest Lecturer: Jennie Traschen, University of Chicago

April 25
School of Social Science

Social Science Luncheon Seminar: "Marx's disdain for politics: A problem for radical democratic theory"
Joseph Schwartz, Harvard University; assistant to Professor Michael Walzer, School of Social Science, IAS

April 26
School of Natural Sciences

Theoretical Physics Seminar: "The role of supersymmetry transformations in $D = 10$ and $D = 11$"
Guest Lecturer: Philip Candelas, University of Texas at Austin

April 30
Concert

Bach Chamber Soloists

May 1
School of Natural Sciences

Astrophysics Seminar: "Diffuse reflection of starlight by a spherical dustcloud"
Guest Lecturer: H. C. van de Hulst, University of Leiden

May 20
School of Natural Sciences

Monday Lunchtime Seminar: "The geometry of superstring compactifications"
Andrew E. Strominger; Long-term Member, School of Natural Sciences, IAS

May 23
School of Natural Sciences

Astrophysics Seminar: "Pumping astronomical masers"
Nikolaos Kylafis, Columbia University; Visitor, School of Natural Sciences, IAS

May 30-31
School of Social Science

Conference: "The public sector and its problems"

May 31
School of Natural Sciences

Theoretical Physics Seminar: "Is the Calabi-Yau vacuum stable?"
Nathan Seiberg; Long-term Member, School of Natural Sciences, IAS

June 14
School of Natural Sciences

Astrophysics Seminar: "Weakly interacting particles in the sun and in the halo"
David Gilden, Visiting Member, School of Natural Sciences, IAS

In addition, the following lectures at the Institute were arranged by the Princeton Society of the Archaeological Institute of America.

October 17

Lecture: "The Etruscan View of Greek Art"
Guest Lecturer: Jocelyn Penny Small, Rutgers University

November 14

Lecture: "The First European Bureaucrats: Scribes at Work in Mycenaean Palaces"
Guest Lecturer: Thomas Palaima, Fordham University

December 12

Lecture: "The Greek View of Greek Art"
Guest Lecturer: R. Ross Holloway, Brown University

February 13

Lecture: "From Molehill to Monument: Restoring a Roman Gymnasium"
Guest Lecturer: Nancy Ramage, Ithaca College

March 14

Lecture: "Palaeolithic Art; Characteristics, Limits and Potentialities of Intepretation"
Guest Lecturer: Catherine Perlès, University of Paris, Musée de l'Homme

April 24

Lecture: "The Colossal Royal Statues from Commagene"
Guest Lecturer: R. R. R. Smith, Princeton University

Report of the Treasurer

Institute for Advanced Study
Louis Bamberger and Mrs. Felix Fuld Foundation

The market value of the Institute's endowment totaled $136,964,906 on June 30, 1985.

During the fiscal year, total operating expenditures were $10,980,139. After applying $2,191,702 in operating fund gifts and grants against these expenditures, the Institute was required to provide $8,788,437 from endowment resources. This represents approximately 7.0 percent of the average of the endowment market values at June 30, 1985, and June 30, 1984, as compared to 6.9 percent of the comparable endowment totals for fiscal year 1984.

The performance of the Institute's portfolio is measured annually by Hamilton, Johnston & Co., Inc. Over the ten-year period ending June 30, 1985, dividend and interest income and net realized and unrealized gains combined for a total average annual compound rate of return on Institute investments of 16.9 percent. Over the past five years, the average annual compound rate of return was 16 percent. For fiscal 1985, the annual rate of return was 26.9 percent.

The financial statements of the Institute for Advanced Study are audited by Deloitte Haskins & Sells. The auditors' opinion letter and statements for the fiscal year ended June 30, 1985, follow this report.

Ralph E. Hansmann
Treasurer

Contents

Deloitte
Haskins+Sells

The Board of Trustees,
  Institute for Advanced Study-
  Louis Bamberger and
  Mrs. Felix Fuld Foundation
Princeton, New Jersey

We have examined the financial statements of the Institute for Advanced Study-
Louis Bamberger and Mrs. Felix Fuld Foundation as of June 30, 1985 and for
the year then ended, listed in the foregoing table of contents. Our examina-
tion was made in accordance with generally accepted auditing standards and,
accordingly, included such tests of the accounting records and such other
auditing procedures as we considered necessary in the circumstances.

In our opinion, such financial statements present fairly the financial posi-
tion of the Institute at June 30, 1985 and the results of its operations and
the changes in its financial position for the year then ended, in conformity
with generally accepted accounting principles applied on a basis consistent
with that of the preceding year.

Deloitte Haskins & Sells

September 30, 1985

Institute for Advanced Study
Exhibit A
Louis Bamberger and Mrs. Felix Fuld Foundation
Balance Sheet—June 30, 1985
(With Comparative Totals for 1984)

ASSETS

Operating Funds:	1985	1984
Cash and temporary investments	$ 480,288	$ 236,651
Accounts and notes receivable	111,736	125,174
Government receivable	388,883	238,035
Specific purpose funds receivable	36,625	81,552
Accrued income on investments	1,185,579	1,149,802
Deferred charges	126,955	143,708
Due from plant funds	293,241	99,977
Total operating funds	$ 2,623,307	$ 2,074,899

Plant Funds:		
Cash	$ 22,595	$ 19,136
Debt service fund deposits	432,611	430,842
Accrued income on investments	14,202	1,858
Marketable securities, at cost approximating market (Note D)	272,123	360,053
Unamortized debt expense	80,786	83,893
Land, buildings and improvements, equipment and library books (including rare book collection) at cost, less accumulated depreciation of $10,217,109 (Notes C and D)	15,285,006	15,373,655
Total plant funds	$ 16,107,323	$ 16,269,437

Endowment and Similar Funds: (Note B)		
Cash		$ 116,293
Accounts Receivable		15,663
Marketable securities, at cost (Note D)	$123,405,014	110,967,504
Mortgages and notes receivable from faculty/staff	1,375,473	1,530,920
Total endowment and similar funds	$124,780,487	$112,630,380

LIABILITIES AND FUND BALANCES

Operating Funds:		
Accounts payable, accrued expenses, etc.	$ 312,622	$ 377,176
Deferred restricted revenue (Note G)	540,627	473,960
Fund balance (Exhibit B)—unrestricted	1,770,058	1,223,763
Total operating funds	$ 2,623,307	$ 2,074,899

Plant Funds:		
Interest payable (Note D)	$ 317,611	$ 320,842
Long-Term Debt (Note D)	8,762,766	8,902,987
Due to Operating Funds	293,241	99,977
Plant funds balance (Exhibit B)	6,733,705	6,945,631
Total plant funds	$ 16,107,323	$ 16,269,437

Endowment and Similar Funds:		
Due to Brokers, net	$ 2,587,880	
Fund balances (Exhibit B):		
Endowment funds	38,923,560	$ 34,552,495
Quasi-endowment funds	83,269,047	78,077,885
Total endowment and similar funds	$124,780,487	$112,630,380

See summary of significant accounting policies and notes to financial statements.

Institute for Advanced Study
Louis Bamberger and Mrs. Felix Fuld Foundation

Exhibit B

Statement of Support and Revenue, Expenses, Capital Additions, and Changes in Fund Balances for the Year Ended June 30, 1985 (With Comparative Totals for 1984)

	Unrestricted	Operating Funds Restricted	Total	Plant Funds	Endowment and Similar Funds	TOTAL ALL FUNDS 1985	TOTAL ALL FUNDS 1984
Support and Revenue:							
Endowment income (net of management fees)	$6,398,988	$2,504,026	$ 8,903,014			$ 8,903,014	$ 8,138,594
Contributions	196,605	1,362,205	1,558,810			1,558,810	2,051,593
Government contracts	191,616	441,276	632,892			632,892	525,816
Total support and revenue	6,787,209	4,307,507	11,094,716			11,094,716	10,716,003
Expenses:							
School of Mathematics	1,130,076	955,825	2,085,901	$ 120,545		2,206,446	2,272,100
School of Natural Sciences	1,258,128	803,701	2,061,829	234,139		2,295,968	2,117,605
School of Historical Studies	1,699,912	217,490	1,917,402	222,712		2,140,114	2,185,422
School of Social Science		1,023,764	1,023,764	74,642		1,098,406	1,137,170
Libraries	908,754	2,450	911,204	77,705		988,909	981,016
Director's Special Purpose Fund	26,106	50,663	76,769	1,124		77,893	48,945
Administration and General	1,665,796	58,190	1,723,986	148,568		1,872,554	1,825,345
Auxiliary Activity — tenants' housing expenses net of $113,399 of revenue for 1985	160,166	74,466	234,632	65,217		299,849	242,280
Total expenses	6,848,938	3,186,549	10,035,487	944,652		10,980,139	10,809,883
Excess (deficiency) of support and revenue over expenses before capital additions	(61,729)	1,120,958	1,059,229	(944,652)		114,577	(93,880)

Capital Additions:						
Gifts			142,810	$ 538,574	681,384	601,079
Realized net gains on investments			59,788	9,011,279	9,071,067	6,536,193
Investment income			29,568		29,568	242,138
Total capital additions			232,166	9,549,853	9,782,019	7,379,410
Excess (deficiency) of support and revenue over expenses after capital additions	(61,729)	1,120,958	(712,486)	9,549,853	9,896,596	7,285,530
Fund Balances at Beginning of Year	1,223,763	-0-	6,945,631	112,630,380	120,799,774	113,514,244
Transfers:						
Proceeds from disposal of plant facilities	59,788		(59,788)			
Plant acquisitions and principal debt service payments	(560,348)		560,348			
Portion of quasi-endowment funds appropriated	1,108,584			(1,108,584)		
Transfers to endowment and similar funds		(1,120,958)		1,120,958		
Fund Balances at End of Year	$1,770,058	$ -0-	$6,733,705	$122,192,607	$130,696,370	$120,799,774

See summary of significant accounting policies and notes to financial statements.

Institute for Advanced Study
Louis Bamberger and Mrs. Felix Fuld Foundation

Exhibit C

Statement of Changes in Financial Position
for the Year Ended June 30, 1985 (With Comparative Totals for 1984)

	Operating Funds	Plant Funds	Endowment & Similar Funds	TOTAL ALL FUNDS 1985	TOTAL ALL FUNDS 1984
Resources Provided:					
Excess (deficiency) of support and revenue over expenses before capital additions	$1,059,229	$ (944,652)		$ 114,577	$ (93,880)
Capital additions:					
Gifts		142,810	$ 538,574	681,384	601,079
Realized net gains on investments		59,788	9,011,279	9,071,067	6,536,193
Investment income		29,568		29,568	242,138
Excess (deficiency) of support and revenue over expenses after capital additions	1,059,229	(712,486)	9,549,853	9,896,596	7,285,530
Items not using (providing) resources:					
Provision for depreciation		944,652		944,652	866,998
Decrease in unamortized debt service expense		3,107		3,107	3,107
Loss (Gain) on disposition of investments—net			(9,011,279)	(9,011,279)	(6,536,193)
Proceeds from sale of investments			142,552,524	142,552,524	255,932,729
Decrease in accounts receivable			15,663	15,663	
Decrease in marketable securities		87,930		87,930	1,692,117
Decrease in accrued income					44,123
Decrease in deferred charges	16,753			16,753	46,750
Increase in payables		190,033	2,587,880	2,777,913	96,893
Increase in deferred restricted revenue	66,667			66,667	244,887
Total resources provided	1,142,649	513,236	145,694,641	147,350,526	259,676,941

Resources Used:					
Purchases of investments			145,823,308	145,823,308	256,120,526
Purchases of plant facilities and equipment	285,747	856,003		856,003	1,951,547
Increase in receivables				285,747	201,317
Increase in debt service fund deposits		1,769		1,769	1,916
Increase in accrued income on investments ...	35,777	12,344		48,121	664,647
Decrease in payables..........	64,554			64,554	447,112
Reduction of long-term debt..........		140,221		140,221	180,769
Total resources used	386,078	1,010,337	145,823,308	147,219,723	259,567,834
Transfers:					
Proceeds from disposal of plant facilities	59,788	(59,788)			
Plant acquisitions and principal debt service payments	(560,348)	560,348			
Portion of quasi-endowment funds appropriated	1,108,584		(1,108,584)		
Transfers to endowment and similar funds	(1,120,958)		1,120,958		
Total transfers	(512,934)	500,560	12,374		
Increase (decrease) in cash and temporary investments	$ 243,637	$ 3,459	$ (116,293)	$ 130,803	$ 109,107

See summary of significant accounting policies and notes to financial statements.

Summary of Significant Accounting Policies
June 30, 1985

The Institute for Advanced Study, an independent, private institution devoted to the encouragement, support, and patronage of learning, was founded in 1930 as a community of scholars where intellectual inquiry could be carried out in the most favorable circumstances.

Focused on mathematics and classical studies at the outset, the Institute today consists of the School of Historical Studies, the School of Mathematics, the School of Natural Sciences, and the School of Social Science. Each School has a small permanent Faculty, and some 160 fellowships are awarded annually to Visiting Members from other research institutions and universities throughout the world.

The objectives of the Institute were described as follows in the Founders' original letter to the first Trustees: "The primary purpose is the pursuit of advanced learning and exploration in fields of pure science and high scholarship to the utmost degree that the facilities of the institution and the ability of the faculty and students will permit."

Though none of the Visiting Members are students in the narrow sense of being degree candidates, educational growth is still before them. The Institute devotes special attention to identifying young people of accomplishment and promise, and offers them membership at a stage in their careers when independent work is of the highest importance to their intellectual development.

Accrual Basis

The financial statements of the Institute have been prepared on the accrual basis. The significant accounting policies followed are described below to enhance the usefulness of the financial statements to the reader.

Plant Assets and Depreciation

Uses of operating funds for plant acquisitions and principal debt service payments are accounted for as transfers to plant funds. Proceeds from the sale of plant assets, if unrestricted, are transferred to operating fund balances, or, if restricted, to deferred amounts restricted for plant acquisitions. Depreciation is provided over the estimated useful lives of the respective assets on a straight-line basis (buildings and capital improvements 20-40 years, equipment 3-6 years).

Fund Accounting

The accounts of the Institute are maintained in accordance with the principles of "fund accounting." This is the procedure by which resources for various purposes are classified for accounting and reporting purposes into funds that are in accordance with activities or objectives specified. Separate accounts are maintained for each fund; however, in the accompanying financial statements, funds that have similar characteristics have been combined into fund groups.

Fund balances restricted by outside sources are so indicated and are distinguished from unrestricted funds allocated to specific purposes by action of the governing board. Externally restricted funds may only be utilized in accordance with the purpose established by the source of such funds and are in contrast with unrestricted funds over which the governing board retains full control to use in achieving any of its institutional purposes.

Endowment funds are subject to the restrictions of gift instruments requiring in perpetuity that the principal be invested and the income only be utilized. Quasi-endowment funds have been established by the governing board to function as endowment funds and any portion of these funds may be expended.

All gains and losses arising from the sale, collection, or other disposition of investments and other non-cash assets are accounted for in the fund which owned such assets. Ordinary income derived from investments, receivables, and the like, is accounted for in the fund owning such assets, except for income derived from investments of endowment and similar funds, which income, if unrestricted, is accounted for as revenue in unrestricted operating funds, or if restricted, as deferred restricted revenue until used in accordance with the terms of the restriction or transferred to endowment and similar funds.

Other Significant Accounting Policies

Other significant accounting policies are set forth in the financial statements and notes thereto.

Certain minor reclassifications of previously reported 1984 amounts have been made to conform to 1985 account classifications.

Notes to Financial Statements
June 30, 1985

A.

The accompanying financial statements are presented in accordance with certain recommendations contained in "Audits of Certain Nonprofit Organizations" by the American Institute of Certified Public Accountants.

B.

Investments purchased by the Institute are recorded at cost; investments received by gift are carried at fair market value at the date of donation. Realized gains and losses are computed based on the average cost of the investment.

Assets of endowment and similar funds are pooled with each individual fund subscribing to or disposing of units on the basis of the market value per unit, determined on a quarterly basis.

The following tabulation summarizes changes in relationships between carrying and market values of the pooled investments:

| | Pooled Assets | | Net | Market |
	Market Value	Carrying Value	Increase (Decrease)	Value Per Unit
July 1, 1984	$114,887,776	$112,630,380	$ 2,257,396	$4,495
June 30, 1985	136,964,906	122,192,607	14,772,299	5,339
Unrealized appreciation (depreciation) for the year ended June 30, 1985			12,514,903	
Realized net gain for the year ended June 30, 1985			9,011,279	
Net change for the year ended June 30, 1985			$21,526,182	

Earnings per unit, for the year ended June 30, 1985, exclusive of realized gains and losses, amounted to $347, after deducting management fees.

The pooled investments at June 30, 1985 are comprised of the following:

	Carrying Value	Market Value
Cash equivalents	$ 16,492,331	$ 16,492,331
Equity securities	59,290,580	70,415,714
Debt securities	47,622,103	51,269,268
Mortgages and notes receivable	1,375,473	1,375,473
Investment accounts receivable	2,715,378	2,715,378
Investment accounts payable	(5,303,258)	(5,303,258)
	$122,192,607	$136,964,906

C.

Physical plant and equipment are stated at cost at date of acquisition, less accumulated depreciation. The cost of library books, other than rare books purchased subsequent to June 30, 1947, has not been capitalized. It is not practicable to determine the value of such books.

A summary of plant assets follows:

Land	$ 1,834,557
Buildings and improvements	19,562,603
Equipment	3,905,447
Library books	199,508
Total	25,502,115
Less accumulated depreciation	(10,217,109)
Net book value	$15,285,006

D.

A summary of long-term debt follows:

2.75%, 1956—Apartment Bonds	$ 496,000
7.804%, 1980—NJEFA	8,365,000
Total	8,861,000
Less unamortized debt discount	98,234
Total long-term debt	$8,762,766

On July 24, 1980, the Institute for Advanced Study received proceeds of the New Jersey Education Facilities Authority (NJEFA) offer of $8,775,000 Revenue Bonds, 1980 Series A, the Institute for Advanced Study Issue. Of the net proceeds, $4,100,000 was used to reimburse the Institute for the construction of its West Building, Dining Hall, and Social Science Library, and $1,976,559 was used to reimburse certain capital improvements. The balance is being used for major repairs and remodeling to the apartment housing facility for visiting members and other construction and major remodeling projects of Institute facilities. As of June 30, 1985, all these funds have been used to support the activities described above.

The bonds are dated July 1, 1980, bear interest at the net average annual rate of 7.804%, are subject to redemption at various prices, and require principal payments and sinking fund installments through July 1, 2011. Bond principal in the amount of $115,000 matured on July 1, 1985 and bond principal in the amount of $120,000 (1986), $130,000 (1987), $135,000 (1988), and $145,000 (1989) will mature on July 1 of the designated years. The obligation to pay the Authority on a periodic basis, in the amounts sufficient to cover principal and interest due on the bonds, is a general obligation of the Institute and is collateralized by United States Treasury Notes, 13.00% due November 15, 1990, with an aggregate face amount of $8,700,000.

The Institute for Advanced Study Apartment Bonds of 1956 are collateralized by (1) a first mortgage on the Members' housing project with a cost of $2,193,299, (2) a first lien and pledge of gross revenues from the project and (3) United States Treasury Notes, 12.625% due November 15, 1987, with an aggregate face amount of $125,000.

The bonds, which mature serially on December 1 of each year, bear interest at the rate of 2.75% and are payable $35,000 in 1985, increasing each December 1 with final payment due December 1, 1996, and are subject to redemption at various prices.

The interest expense for the year ended June 30, 1985 was $672,000.

E.

Separate voluntary defined contribution retirement plans are in effect for Faculty members and eligible staff personnel, both of which provide for annuities which are funded with the Teachers Insurance and Annuity Association and/or the College Retirement Equities Fund. Payments for the year ended June 30, 1985 amounted to $437,000.

In addition to the formal plans, the Board of Trustees or the Director has at various times authorized the payment of pensions to certain members, employees, and the widow of a deceased member. Total pension payments which aggregated $65,000 for the year ended June 30, 1985 have been charged to expense and no reserves have been provided for pensions payable in subsequent years.

In addition to providing pension benefits, the Institute provides certain health care and life insurance benefits for retired employees and Faculty. Substantially all of the Institute's employees may become eligible for those benefits if they reach normal retirement age while working for the Institute. The cost of retiree health care and life insurance benefits is recognized as expense as premiums are paid. For fiscal year 1985, those costs totaled $33,000.

F.

The Institute is the residuary beneficiary of a trust under the Will of George Placzek, deceased, and upon the death of the life tenant will be entitled to receive the corpus thereof. The approximate market value of the assets under the Will, as reported by the administrator of the Estate, aggregated $1,341,000 as of June 30, 1985 and is not included in the accompanying financial statements.

G.

Restricted receipts, which are recorded initially as deferred restricted revenue, are reported as revenues when expended in accordance with the terms of the restriction. Changes in deferred restricted revenue amounts are as follows:

	TOTAL DEFERRED RESTRICTED REVENUE
Balance at July 1, 1984	$ 473,960
Additions:	
Contributions, grants, etc.	1,870,148
Net restricted endowment income	2,504,026
Total additions	4,374,174
Deductions:	
Funds expended from contributions, grants, etc.	1,803,481
Funds expended from restricted endowment	1,383,068
Transfer to endowment and similar funds	1,120,958
Total deductions	4,307,507
Balance at June 30, 1985	$ 540,627

H.

The costs of providing the various programs and other activities have been summarized on a functional basis in the statement of support and revenue, expenses, capital additions, and changes in fund balances. Accordingly, certain costs have been allocated among the programs and supporting services benefited. The costs incurred by the Institute in operating both the Dining Hall ($270,386 net of $254,278 in revenues) and Members' Housing ($605,343 net of $700,487 in revenues) have been allocated among the programs and supporting services benefited.

Donors

The Institute for Advanced Study gratefully acknowledges contributions of gifts and grants in the amount of $2,873,086 received between July 1, 1984, and June 30, 1985. Space limitations prohibit listing all those who supported the Institute during this period. Following are the names of individuals and organizations who made contributions of $1,000 or more. To all of the contributors, the Institute expresses its deepest appreciation.

Individuals

Anonymous donors
Mr. and Mrs. Julian Aresty
Howard T. and Helen Behrman
Mariana T. Berry
Leonard Block
James E. and Diane Burke
Mr. and Mrs. Nathaniel Burt
F. Douglas Bushnell and Betty Wold Johnson
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