INSTITUTE
for ADVANCED STUDY

REPORT

FOR THE ACADEMIC YEAR

1998 – 99

PRINCETON · NEW JERSEY

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Extract from the letter addressed by the Institute's Founders, Louis Bamberger and Mrs. Felix Fuld, to the Board of Trustees, dated June 4, 1930.

Newark, New Jersey.

> *It is fundamental in 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.*

1998

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INSTITUTE FOR ADVANCED STUDY: BACKGROUND AND PURPOSE

The Institute for Advanced Study was founded in 1930 with a major gift from New Jersey businessman and philanthropist Louis Bamberger and his sister, Mrs. Felix Fuld, who wished to use their fortunes to make a significant and lasting contribution to society. They sought the advice of educator Abraham Flexner, who developed the concept of the Institute as a community of scholars whose primary purpose would be the pursuit of advanced learning and scholarly exploration. The Institute for Advanced Study has sustained its founding principle for more than sixty-eight years. This commitment has yielded an unsurpassed record of definitive scholarship.

The Institute fills a unique role in postgraduate education and scientific and scholarly research. Called (by Institute Trustee Vartan Gregorian) "the university to universities," the Institute serves all colleges and universities by providing a place where scholars can hone their skills and do their best work, thereby adding substantially to their ability to contribute as both teachers and scholars to the academic institutions where they base their careers. For young scholars just entering the academic world, an opportunity to work at the Institute can set the direction for lifelong research interests and thereby determine professional careers. The Institute provides more mature scholars with the opportunity to take a new direction in their research or to complete a major piece of work away from the many obligations and distractions of working life at a contemporary university. In our era, a time when pure research and scholarly activities are undervalued, these opportunities are exceedingly rare.

The Institute's foremost objective is the advancement of knowledge and the deepening of understanding across a broad range of the humanities, sciences, and social sciences. One of the Institute's unique strengths is its small and distinguished permanent Faculty, well-established scholars whose broad interests and extensive ties to the larger academic world are reflected in their own work and also in the guidance and direction they provide to the Institute's visiting Members. The Faculty defines the major themes and questions which become the focus of each School's seminars and other activities, and the Faculty selects and works closely with visiting Members. Small in number and organized in four Schools (Historical Studies, Mathematics, Natural Sciences, and Social Science), the Faculty and Members can interact with one another without the departmental and disciplinary barriers found in universities.

Each year the Institute awards fellowships to 160-180 visiting Members from universities and research institutions throughout the world. The Institute's nearly 5,000 former Members hold positions of intellectual and scientific leadership in the United States and abroad. More than a dozen Nobel laureates have been Institute Faculty or Members, and others are winners of the Wolf or MacArthur prizes. Twenty-seven out of thirty-six Fields Medalists, the Nobel equivalent for mathematicians, have come from the Institute.

The Institute does not receive income from tuition or fees. Resources for operations come from endowment income, grants from private foundations and government agencies, and gifts from corporations and individuals.

"It seemed to me that the time was ripe for the creation in America of an institute in the field of general scholarship and science ... not a graduate school, training men in the known and to some extent in methods of research, but an institute where everyone — faculty and members — took for granted what was known and published, and in their individual ways endeavored to advance the frontiers of knowledge."

— Abraham Flexner, Founding Director (1930-39) of the Institute, Memorandum to the Board of Trustees of the Institute for Advanced Study, September 26, 1931

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"The Institute partakes of the character both of a university and of a research institute; but it also differs in significant ways from both. It is unlike a university, for instance, in its small size... [and] in 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 a research institute in that its purposes are broader; it supports many separate fields of study; with one exception, it maintains no laboratories; and above all in that it welcomes temporary members, whose intellectual development and growth are one of its principal purposes. The Institute, in short, is devoted to learning, in the double sense of the continued education of the individual, and of the intellectual enterprise on which he is embarked."

— J. Robert Oppenheimer, Report of the Director, 1948-1953

John von Neumann (left) and J. Robert Oppenheimer, Director of the Institute for Advanced Study from 1947-66, at the dedication of the Institute for Advanced Study computer, 1952.

The traditional spring meeting this past May of the Trustees of the Institute for Advanced Study was structured as a retreat, during which the Trustees considered issues that included how excellence is sustained at the Institute, how success is measured, and how directions for change are identified. Some of the ideas discussed emerged from the Institute's own recently completed Decadel Review. Sir John Elliott, Regius Professor of Modern History at Oxford University (and a faculty member in the Institute's School of Historical Studies from 1973-1990), participated in the Decadal Review's round-table discussion on Humanities and the Social Sciences. "It is vital," he said, "that the Institute not lose confidence in itself and in its central purpose: the promotion of the integrity of scholarship, of scholarly values that are inherent in the humanist tradition. What it stands for is even more important than it was at the time of its founding in the 1930s. The Institute should remain a refuge for hard-pressed scholars from around the world, an opportunity for organic collaboration, cross-disciplinary exchange of a largely informal character, not available in other institutions. It should allow individual scholars to pursue their interests at the highest possible level of excellence, without external interference, without having to conform to criteria of utility."

During the retreat, Phillip A. Griffiths, Director, discussed the changing character of research and scholarship. He noted the marked increase in both collaborative and interdisciplinary work. He also pointed out that traditionally research has been reductionist but that it is now being complemented by more integrated work; however, the balance between basic scholarship and activities that are directly relevant must be approached cautiously. Dr. Griffiths commented on the changing character of research institutions themselves, mentioning in particular the increasing linkages, partnerships and consortia among research institutions.

Since its founding, the Institute for Advanced Study has both benefited from and contributed to collaborations with other institutions. We have had, over the years, especially productive ongoing relationships with Princeton and Rutgers Universities. In today's world, however, the nature of collaboration has expanded, and in addition to our historical linkages, the Institute today must be involved more broadly in cooperative projects than ever before.

In a project designed to help raise the level of science in developing countries, the Institute for Advanced Study and The World Bank have created the Millennium Science Initiative (MSI), made possible by some extraordinary synergies between The World Bank, the international scientific community, and private foundations, most notably the David and Lucile Packard Foundation. The primary objective of the MSI is to create and nurture excellent science, scientific talent, and scientific institutions in developing countries by establishing a network of small, efficient, innovative research Institutes whose mission is education through research. The Republic of Chile is the first nation to begin a Millennium Science Initiative; plans are well underway to have three Institutes and five to seven "nuclei" operating there by the beginning of the year 2000. The oversight of the MSI is provided by the Science Institutes Group (SIG), whose founding members are the leading research institutes in India, Korea, and Brazil. The directors of those institutes form the core of SIG's advisory board, and Phillip Griffiths serves as convener.

Closer to home, the terms of two Trustees of the Institute for Advanced Study concluded this year, and to each we express our appreciation for their years of service to the Institute, which has benefited greatly from their participation on our Board.

Jean Bethke Elshtain, the Laura Spelman Rockefeller Professor of Social and Political Ethics at the University of Chicago, served as the Academic Trustee for the School of Social Science. To this role, she brought her fine judgment and her ability to help us listen, at multiple levels, to the current discourses within and concerning the Institute. A conciliarist without compromise, she sees the potential creativity of cross-currents and works towards consensus. The breadth and intensity of her commitment has warmed us all, and we thank her for her enduring insights and generous service.

Agnes Gund, President of the Museum of Modern Art, brought to the Institute her deep conviction that the vitality of the arts and humanities and our appreciation of them are critical to the integrity of society, and are essential to human life in their transformative power. She has understood and reminded us that challenge and change are the hallmarks of that vitality and creativity, whether in a studio, school, museum, or institute. Her courage and conviction have energized our willingness to welcome challenge and change in our academic and administrative, as well as our aesthetic, pursuits. The membership generously endowed by Agnes Gund and her husband, Daniel Shapiro, will underwrite the work of visiting Members and remain a legacy of concern for and appreciation of advanced scholarship.

It is my pleasure to welcome Marina v.N. Whitman to the Institute Board. Dr. Whitman, an economist, is currently Professor of Business Administration and Public Policy at the University of Michigan, Ann Arbor, where she has been a faculty member since 1992. Dr. Whitman previously served as Vice President and Chief Economist (1985-92) and Group Vice President of Public Affairs (1979-85) for General Motors Corporation. She was a Professor of Economics at the University of Pittsburgh from 1962-79. Among her many business and professional affiliations, she has served as a member of the U.S. Price Commission and the Council of Economic Advisers, Executive Office of the President, and is a current or past director of Chase Manhattan Corporation, ALCOA, Proctor & Gamble, Browning-Ferris Industries, and UNOCAL. She holds a B.A. *summa cum laude* from Radcliffe College, and M.A. and Ph.D. degrees from Columbia University. She is the daughter of the late John von Neumann, who was a Faculty member in the Institute for Advanced Study's School of Mathematics from 1933-57.

I am also pleased to welcome Gavin Wright, the William Robertson Coe Professor in American Economic History at Stanford University, as the new Academic Trustee for the School of Social Science. He holds a B.A. degree from Swarthmore College, and received his Ph.D. in economics from Yale University in 1969. Dr. Wright taught at the University of Michigan from 1972 until 1982, when he became a Professor of Economics at Stanford University. Wright's research uses the tools of economics to interpret historical developments. One focus of his work has been the economic history of the American South. In the past decade, he has turned to the question of the historical sources of American economic performance, viewed in comparative and international context. The author of five books and numerous articles, Dr. Wright served as president of the Economic History Association during 1997-98, and currently serves on the Board of Directors of the National Bureau of Economic Research.

We are extremely pleased that our Board will continue to benefit from the participation of Anne d'Harnoncourt, who has agreed to a two-year reappointment term as the Academic Trustee for the School of Historical Studies. Ms. d'Harnoncourt is the George D. Widener Director and CEO of the Philadelphia Museum of Art.

The Institute is fortunate to have a remarkably dedicated Board of Trustees, and I would like to express my deepest gratitude and appreciation to them, to Phillip Griffiths, to the Faculty, the current and past Members, the staff, the Friends, and other supporters of the Institute. The Institute flourishes because of the commitment of those who contribute to the life of this extraordinary community, and I would like to thank each and every one.

James D. Wolfensohn
Chairman

I am pleased to announce the appointment of Avi Wigderson to the permanent Faculty of the School of Mathematics. Professor Wigderson, who was a visiting Member at the Institute in 1995-96, is an internationally recognized authority in the field of theoretical computer science. He comes to the Institute from Hebrew University, where he had taught since 1986 in the Department of Computer Science, serving as Chairman (1993-95) and Professor (1991-99) in the Computer Science Institute. Prior to his association with Hebrew University, Professor Wigderson taught at the University of California, Berkeley, during 1983-84; was a visiting scientist at IBM Research during 1984-85; and the following year was a Fellow at the Mathematical Sciences Research Institute in Berkeley, California. Professor Wigderson received his B.Sc. in computer science *summa cum laude* from Technicon-Israel Institute of Technology, and his M.S.E., M.A., and Ph.D. degrees in computer science from Princeton University.

I regret to announce the passing of André Weil, Professor in the School of Mathematics from 1958-76 and Professor Emeritus from 1976-98. André Weil was one of the 20th century's greatest mathematicians, and was especially known for his work in number theory and algebraic geometry. His research was path-breaking, and his influence through his written work has had great effect on the understanding of mathematics throughout the world. In the 1930s Professor Weil was a founder of Bourbaki, a group of French mathematicians who wrote a highly influential multi-volume series of treatises that organized and unified mathematical knowledge. The work, *Elements de Mathematique*, offered, for the first time, a survey of the leading work in practically every field of mathematics.

In 1994 Professor Weil received the Kyoto Prize in Basic Science from the Inamori Foundation of Kyoto, Japan, an award that is referred to as Japan's Nobel Prize. The citation noted that Weil, who was recognized for his lifetime achievement in mathematics, "altered the very course of 20th century thought in mathematics. His so-called Weil Conjectures have provided the guiding principles for algebraic geometry, which, in turn, have given rise to the accurate and efficient transmission of information through coding theory. Today, Dr. Weil's work continues to play extremely important roles in fields ranging from elementary particle physics to encryption and computer security." On January 8-9, 1999, the Institute hosted a conference on the work of André Weil. Further information about this conference may be found in the section reporting academic activities in the School of Mathematics.

This was the first year of the School of Historical Studies' three-year program on the history and culture of traditional China. Sinology scholars in this program benefit from the Institute's ownership of the core of the Gest Library, which is housed at Princeton University. With the Gest Library, considered the finest collection of Chinese publications outside mainland China, the Institute and Princeton University's resources for the study of traditional China have been termed by one visiting scholar "unparalleled in the U.S."

Patricia Ebrey, Professor of History and Chinese Studies at the University of Washington, was the School's Visiting Professor in 1998-99. Throughout the year Professor Ebrey led a seminar series on "Visual Dimensions of Chinese Culture," and a symposium on the

same topic was held on March 26. Both the seminar series and the symposium were organized to create a community among the China scholars at the Institute and to foster ties to the larger community of China scholars in the region.

The entire group of China Members at the Institute during the fall term planned the March symposium, which was designed to explore the idea of treating visual materials as though they were any other kind of evidence. Symposium participants examined the idea of visual culture and how it might be connected to other aspects of culture. Three of the China group at the Institute gave papers at the symposium, with the remaining papers presented by scholars from Boston, Brown, Princeton, and Yale Universities, and the Academia Sinica in Taiwan. Scheduled to coordinate with a Princeton Art Museum symposium on Chinese calligraphy, the symposium attracted about 150 people. Plans are for several of the papers presented to be published in a special issue of the journal *Asia Major*.

This was the final year of a three-year interdisciplinary program in mathematics and physics on quantum field theory, led by Professor Pierre Deligne, School of Mathematics, and Professor Edward Witten, School of Natural Sciences. The written lecture notes have just been published by the American Mathematical Society in two volumes titled *Quantum Fields and Strings: A Course for Mathematicians*. The program was funded by the National Science Foundation, the J. Seward Johnson, Sr. Charitable Trusts, the Harmon Duncombe Foundation, the Ambrose Monell Foundation, and the Friends of the Institute for Advanced Study.

George Lusztig of MIT was the Distinguished Visiting Professor in the School of Mathematics this year, and led the special program on geometric methods in representation theory. Begun in 1988 with the support of the Ambrose Monell Foundation, which continues to support the program, the Distinguished Visiting Professor program has two main objectives: to define areas of concentrated activity in mathematics and to make it possible to bring to the Institute a distinguished scholar with interests related to those areas.

In March the School of Social Science began publication of a series of Occasional Papers. Each paper in this new project will be a version of a talk given at the School's weekly Thursday seminars, where current Members in the School present their work-in-progress and then invite questions. The seminars, which are supported in part by the National Endowment for the Humanities, are open to the public and have been an important part of the School's program since the School of Social Science was founded more than twenty-five years ago.

The Program in Theoretical Biology, headed by Martin Nowak, completed its first year at the Institute for Advanced Study. Current research interests are in the areas of evolutionary theory, the dynamics of infectious diseases, immunology, and genomics. During the year, research projects included work on the origins and evolution of human language, on developing mathematical models leading to a new understanding of immunological memory, and on the evolution of cooperation. The Program also organized two new activities: a lecture series in biology that included twenty-three public lectures covering a wide range of topics from ecology to clinical biomedical research, and a symposium on "Mathematical Modeling and Biomedical Research," co-hosted by the Institute and The Rockefeller University.

We once again welcomed over 2,000 people to the nine performances (three programs, each performed three times) in the Institute Concert Series organized by Artist-in-Residence Robert Taub, and given in Wolfensohn Hall. An additional event took place at the Institute in November, when Milton Babbitt, James Levine, and Robert Taub participated in a panel discussion, moderated by Claudio Spies, on the process of bringing a new work to life in performance. The discussion took place one week prior to Taub, Levine and the Metropolitan Opera Orchestra giving the world premiere, in Carnegie Hall, of Babbitt's *Piano Concerto No. 2*, commissioned by the Geraldine R. Dodge Foundation.

The composer Martin Butler from the University of Sussex was in residence at the Institute this year, and gave several lectures and performances of his work and that of other composers. In addition, he completed *A Better Place*, a chamber opera in one act, on commission from English National Opera and scheduled to premiere in April 2000.

From June 20 through July 10, the Summer Session of the IAS/Park City Mathematics Institute (PCMI) was held in Park City, Utah. This marked the 9th year for PCMI, with over 215 participants in attendance at six separate yet overlapping programs for researchers, high school teachers, undergraduate faculty, mathematics education researchers, and undergraduate and graduate students. PCMI was again enriched by being able to host a concert, and a pre-concert lecture, by Robert Taub. This concert was sponsored by the Huntsman Foundation.

The research topic for PCMI's Graduate Summer School and Research Program was Arithmetic Algebraic Geometry. A highlight of the session was the announcement, made by Brian Conrad and invited researcher Richard Taylor (and written up in a subsequent issue of the *Notices* of the American Mathematical Society), of the proof of the celebrated Taniyama-Shimura-Weil Conjecture. Conrad and Taylor were members of the team, which also included Christophe Breuil and Fred Diamond, who accomplished this work, which provides further evidence for the "Langlands program," the far-reaching web of conjectures formulated decades earlier by School of Mathematics Professor Robert Langlands.

From May 17-27, the Institute for Advanced Study hosted PCMI's annual Mentoring Program for Women in Mathematics, organized by Chuu-Lian Terng of Northeastern University and Karen Uhlenbeck of the University of Texas at Austin. The program emphasized the content and culture of mathematics and included lectures, seminars, working problem groups, mentoring and networking sessions and the opportunity to meet and interact with leading mathematicians. The 40 participants included graduate students, undergraduates, postdoctoral scholars, and senior researchers.

Together with Harvard University and the Smithsonian Institution, the Institute sponsored "The World of St. Paul," an eleven-day exploration of sites richly associated with Judaism, Christianity, and Greco-Roman civilization. The journey on the private yacht *Clelia II* took eighty travellers to sites in Greece and Turkey that represented some of the most dramatic moments in the history of Judaism and the rise of Christianity, set in the context of the Greco-Roman culture of Paul's life and times. School of Historical Studies Professor Glen Bowersock was a featured lecturer; his topics were "The World and Travels of St. Paul," "Paul and the Pagans: From Athens to Ephesus," and "The Early Scenes of Paul's Mission: Antioch and Paphos."

Director's Visitors, distinguished visitors whose interests frequently do not fall within the normal school structure of the Institute, contribute greatly to the vitality of the Institute community. This year Director's Visitors included Paul Berg, Director, Beckman Center for Molecular and Genetic Medicine, Stanford University Medical Center; Charles Ryskamp, former Director of the Frick Collection; Maxine Singer, President, Carnegie Institution of Washington; and Sampei Usui, Department of Mathematics, Osaka University.

The Biennial Conference of the Association of Members of the Institute for Advanced Study (AMIAS) was held at the Institute in March. All four schools were represented with lectures by Institute faculty members. Professor Joan Wallach Scott spoke on "Social Science in Transition"; Professor Frank Wilczek talked about "The World of Quarks and Gluons"; Professor Jack F. Matlock, Jr. explored "Some Disputed Questions in the Field of International Relations and Modern History"; and Professor Robert D. MacPherson addressed the question, "The Future of Mathematics: Can it be Predicted?"

Lectures and receptions for AMIAS members and their guests were held this year in Cambridge, New York City, and Chicago; the guest speakers were Oleg Grabar, Professor Emeritus, School of Historical Studies; Martin Nowak, Head of the Institute's Program in Theoretical Biology; and paleontologist Paul Sereno from the University of Chicago. Trustees Michael Bloomberg and Jean Elshtain participated through their gracious hosting of the events.

In conclusion, it is important to acknowledge the commitment of all whose ongoing efforts make it possible for the Institute for Advanced Study to thrive as a unique and remarkable scholarly community. To the Faculty, Trustees, Members and former Members, the Friends of the Institute, and our dedicated staff, I would like to express my deepest gratitude.

Phillip A. Griffiths
Director

OFFICE OF THE DIRECTOR
RECORD OF EVENTS

The following is a calendar of events sponsored by the Office of the Director

Friends of the Institute
Friends' Forum: "Recollections of a British Museum Keeper"
NEIL STRATFORD, *Member, School of Historical Studies, Institute for Advanced Study*

Institute Film Series

Composer-in-Residence Program
"The Anxieties of Influence: The Use of Electronics and Popular Idioms as Compositional Material"
MARTIN BUTLER, *Composer-in-Residence, Institute for Advanced Study*

Friends of the Institute
Fireside Chat: "Nixon and Kissinger: The Odd Couple"
WILLIAM BUNDY, *former U.S. Assistant Secretary of State for East Asia*

Institute Film Series

An Evening for Members and Friends
"The Preservation of the Florida Everglades"
WILLIAM RILEY, *businessman, environmentalist and writer*

Artist-in-Residence Program
"A Conversation with Milton Babbitt, James Levine, and Robert Taub"
MILTON BABBITT, *Professor Emeritus, Princeton University*, JAMES LEVINE, *Artistic Director, Metropolitan Opera*, and ROBERT TAUB, *Artist-in-Residence, Institute for Advanced Study*

Friends of the Institute
Friends' Forum: "The Evolution of Galaxies in the Universe"
DAVID HOGG, *Member, School of Natural Sciences, Institute for Advanced Study*
and
"The Milky Way as a Cannibal"
KATHRYN JOHNSTON, *Member, School of Natural Sciences, Institute for Advanced Study*

Institute Film Series

Institute Concert Series
Pre-Concert Lecture
ROBERT TAUB, *Artist-in-Residence, Institute for Advanced Study*

Institute Concert Series
Debussy: Pour le Piano; String Quartet; Schumann: Piano Quintet
ROBERT TAUB, *Artist-in-Residence, Institute for Advanced Study* and VANBRUGH STRING QUARTET

Institute Lecture
"The Civil Society Argument"
MICHAEL WALZER, *Professor, School of Social Science, Institute for Advanced Study*

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Holiday Reception for Friends and Faculty

Composer-in-Residence Program
"Why Write an Opera? Some Cultural and Practical Considerations"
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"Investment Perspectives: Ruminations of a Curmudgeon"
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Bach: Partita No. 1 in B-Flat Major; Chromatic Fantasy & Fugue; Cello Suite No. 1 in G Major; Beethoven: Sonata for Cello & Piano in A Major, Op. 69.
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Bach: Italian Concerto; Ravel: Gaspard de la Nuit; Chopin: Sonata No. 3 Op. 58
ROBERT TAUB, *Artist-in-Residence, Institute for Advanced Study*

Institute Film Series

Institute Lecture
"The Discovery of the Expansion of the Universe"
JIM PEEBLES, *Member, School of Natural Sciences, Institute for Advanced Study*

April 6
Institute Film Series

April 7
An Evening for Members and Friends
"Lawrence of Arabia: A Film's Anthropology"
STEVEN CATON, *Member, School of Social Science, Institute for Advanced Study*

Institute Film Series

April 10
Composer-in-Residence Program: Piano Recital
Scarlatti: Sonata in D major K.492, Sonata in E major K.215, Sonata in G major K.427; Butler: Three Little Folk Games (1995); Rakowski: Three Etudes: E-Machines (1988), Nocturnal (1991), Fourth of Habit (1998); Butler: Nathaniel's Mobile (1995), Lucifer's Banjo (1997); Debussy: Reflets dans l'eau (Images Book 1, 1905); Butler: On the Rocks (1992); Debussy: L'isle Joyeuse (1904)
MARTIN BUTLER, *Composer-in-Residence, Institute for Advanced Study*

April 14
Friends of the Institute
Culture and Cuisine Series: "Old and New in the Côte d'Or"
LEONARD BARKAN, *Director, New York Institute for the Humanities at New York University*

May 10
Friends of the Institute
Annual Meeting and Picnic

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The School of Historical Studies is concerned principally with the history of Western and Near Eastern civilization. Within this wide area of study, a large range of topics has been explored at one time or another by Faculty and Members, but the emphasis has been particularly strong in the fields of Greek and Roman civilization, medieval, early modern and modern European history, Islamic culture, and the history of art, science and ideas.

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. The second appointment to the Faculty of the School of Humanistic Studies was that of the German art historian, Erwin Panofsky. Panofsky ranged through the entire gamut of European art from the Middle Ages to motion pictures, but he was most closely associated with the development of the field of iconology.

Three additional appointments strengthened the field of classical and Near Eastern studies: Elias Avery Lowe, a Latin paleographer who worked on the handwriting of pre-ninth century manuscripts; Ernst Herzfeld, a Near Eastern archaeologist and historian, whose scholarly work comprised nearly 200 titles; and Hetty Goldman, one of the pioneering American women archaeologists, whose discoveries at Tarsus in Turkey were published in six volumes. Modern history was represented at the Institute from the outset with the appointment of the military and political historian Edward M. Earle. Earle was an

original member of the School of Economics and Politics, which merged in 1949 with the School of Humanistic Studies to become the School of Historical Studies.

After World War II, classical studies were further augmented by the appointments of Homer A. Thompson in Greek archaeology, Harold F. Cherniss in Greek philosophy, and Andrew Alföldi in ancient history and numismatics. Although Alföldi published tirelessly on a wide range of subjects during his years at the Institute, he was mainly pre-occupied with the history of early Rome and that of Julius Caesar, on both of which subjects he wrote several books. Medieval history came to the Institute Faculty with Ernst Kantorowicz, whose interest stretched in time from the later phases of classical antiquity to the fifteenth and sixteenth centuries, and in space embraced both Western Europe and the Byzantine and Islamic East. The art historical tradition was carried on by Millard Meiss, who was able to complete at the Institute his great work on late medieval manuscript painting in Burgundy.

Additions to the Faculty in modern history came with the appointments of Sir Ernest Llewelyn Woodward in British diplomatic history; George F. Kennan, former Ambassador to Russia, in Russian history and international relations; Felix Gilbert, in Renaissance as well as modern history; Morton White in the history of modern philosophy; and Peter Paret in modern European history. Roman military history and papyrology were represented by James F. Gilliam; medieval history of the Latin East, Venice, and the relations between the Papacy and the Levant, by Kenneth M. Setton; medieval science, especially the classical heritage, by Marshall Clagett; Islamic art and culture by Oleg Grabar; and Greek and Roman history, especially the Hellenistic period, by Christian Habicht.

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

PROFESSOR GLEN BOWERSOCK delivered the annual Syme Lecture at University of Oxford (Wolfson College) in November 1998 on "Tacitus and Pushkin." He also presented a paper in March 1999 at a colloquium in Capri on the writings and career of the younger Seneca. At the annual meeting of the Archaeological Institute of America in Washington in December he provided commentary on papers concerned with the Roman frontier in the Near East. In May 1999, at a symposium held in Athens under the auspices of the Finnish Institute of Archaeology he delivered the concluding speech. Last November he led a cruise for the first time in twenty years in the eastern Mediterranean (Greece, Turkey, Syria, Cyprus, Israel). He lectured on the career and travels of St. Paul for a group that included Friends of the Institute, which was a co-sponsor of the cruise.

Professor Bowersock served in the past year as an advisor to the Centre National de Recherche in France. At the initiative of the Minister of Education, the chairman of the

board of the CNRS invited him for meetings in Paris together with a small international group of scholars to consider possible plans for restructuring the entire enterprise. Professor Bowersock also accepted an invitation from the University of Toronto to review a cluster of twelve departments and programs in anticipation of forthcoming budgetary plans for the beginning of the millennium. Over the past academic year he published seven scholarly articles on subjects ranging from the presence of Nabataean Arabs in Rome to the development of biography as a genre. He organized a small afternoon colloquium at the Institute on the Indian Ocean in antiquity and contributed several journalistic pieces to newspapers and reviews in Britain and America. He continued as general editor of a series at the Harvard University Press and worked as well on the final stages of a large work, edited together with Professor Oleg Grabar at the Institute and Professor Peter Brown at Princeton University, to be entitled *Late Antiquity: A Guide to the Postclassical World.*

During the academic year 1998-99, PROFESSOR GILES CONSTABLE edited (with Gert Melville and Jörg Oberste of the University of Dresden) a volume (including an article by himself) on the Cluniacs in their socio-political surroundings. He published four other articles and a booklet entitled ' "Love and Do What You Will:" The Medieval History of an Augustinian Precept.' He gave talks or lectures at the conference in honor of Hildegard of Bingen in Bingen (September), Bard College (October), a conference at Calvin College (November), the University of Sydney (November), Monash University (November), the Columbia Medieval Seminar (February), and to the Friends of the Institute for Advanced Study (February), and gave the commencement address at Longwood College (May). He commented on sessions at the Leeds Medieval Conference (July) and at the meeting of the Medieval Academy of America (April). He also attended meetings at Villanova University and Princeton University. As usual he arranged in December a meeting of the Delaware Valley Medieval Association, at which several Members of the Institute spoke.

PROFESSOR PATRICIA CRONE continued to work on Islamic political thought in the formative period (c. 600-1100), with the ultimate aim of producing a relatively short book accessible to non-Islamicists and non-academic readers. So far the project has spawned four substantial articles of a specialist nature (one published this year, two in press, and one in draft) as well as preliminary chapters. There is still a long way to go.

The publication of her book with Dr. Zimmermann (Oxford), which went to press last summer, was delayed by an unexpected turn of events. This book is an edition, translation and far-ranging discussion of an early polemical text preserved in a photocopy of a lost manuscript. The manuscript itself, which had been obtained in Oman by a Libyan, was lost when the Libyan authorities jailed its owner, confiscated his library, left him to die, and stonewalled all enquiries about his books. Shortly after Crone and Zimmermann's work, based on a photocopy left in Cambridge, had gone to press, a young Omani who had heard of their project arrived in England bearing two new manuscripts from private collections in Oman. The revision necessitated by this surprise has recently been completed. The book has now gone to press for the second time.

The book with Dr. Zimmermann is a highly technical work which uses an early sectarian epistle as a window onto intellectual developments largely forgotten by the mainstream tradition; it also tries to provide the bio-bibliographical tools for further use of the literary heritage of the sect in question, which is now being made available by the Ministry of Culture in Oman. By contrast, another collaborative work of Professor Crone's, this time with Professor S. Moreh (Jerusalem), is intended for lay readers and specialists

alike. Entitled *The Book of Strangers: Medieval Arabic Graffiti on the Theme of Nostalgia*, it offers a translation and discussion of a small collection of poetic graffiti, which makes pleasant reading and offers a lively picture of the emotional life of tenth-century Muslims. The publishers claim that it will be out before the end of the year.

In addition, Professor Crone taught a graduate seminar at the University of Pennsylvania, Philadelphia, another at Princeton University, presided over a panel at the meeting of the Middle East Studies Association in Chicago, contributed a paper to the meeting of the American Orientalist Society in Baltimore, and organized an informal seminar at the Institute.

PROFESSOR PATRICIA EBREY spent 1998-99 at the Institute as a Visiting Professor. During the year she ran a seminar for scholars of the region and a symposium open to the public, both on the subject of "Visual Dimensions of Chinese Culture." The aim of both programs was to bring together specialists in Chinese history, art, religion, and literature to analyze the relationships between the visual and the verbal in Chinese culture. She gave lectures at the University of Michigan, Swarthmore College, the University of Virginia, and the Chiang Ching-kuo Foundation on her ongoing research project, a study of Chinese culture in the early twelfth century from the perspective of the Emperor Huizong (r. 1100-1125), an avid patron of architecture, garden building, musical performances, and religious spectacles who put together huge collections of paintings, calligraphies, and antiques, took over direction of the court painting academy, and established himself as a painter and calligrapher of note. Among the books and articles that appeared this year or are still in press are "Some Elements in the Intellectual and Religious Context of Chinese Art" in *Five Thousand Years of Chinese Art* (Guggenheim Museum of Art); "The Ritual Context of Sung Imperial Portraiture" in Wen Fong, ed., *The Arts of Sung and Yuan China* (Princeton University Art Museum); "Shifting Western Interpretations of Footbinding, 1300-1890," *Late Imperial China*, a co-edited volume; *Dialogue with the Ancients: Studies in the Cultural History of 3rd to 6th Century China* (Harvard University Press); and a co-authored work, *A History of World Societies* (Houghton Mifflin). In addition, a Chinese translation of her *Cambridge Illustrated History of China* is in press in China. She serves on the editorial board of the Association for Asian Studies, *China Review International*, and the *Journal of Chinese Religions*. Following her year at the Institute she returned to the University of Washington as Professor of History, Director of the Center for East Asian Studies, and Senior Fellow of the Walter Chapin Simpson Center for the Humanities.

IRVING LAVIN continued to serve as a member of the National Committee for the History of Art, of the Porter Prize Committee of the College Art Association of America, and of the Scientific Council of Modena Capitale, a year-long commemoration of the quadricentennial of that city's elevation to capital of the D'Este dukedom. Among the projects he has helped to plan for Modena is a structural fantasy designed by the architect Frank Gehry. He has also served as advisor to Gehry for a major museum of Coca-Cola memorabilia to be built near Louisville, Kentucky; to the architect Michael Graves for the decorative program of a new Federal Court House in Washington; and to the Storm King Art Center, Mountainville, New York, for the future planning and development of that institution.

Professor Lavin gave a course of lectures at the Istituto Italiano per gli Studi Filosofici in Naples, and gave a number of lectures and papers at symposia, including: Sixteenth

Century Society, Toronto; Graduate School of Design, Harvard University; Académie de France à Rome; University of Naples; The Hebrew University of Jerusalem, Israel; University of Washington; Temple University; Clark Institute, Williamstown Masschusetts. Professor Lavin serves on the editorial boards of a number of scholarly journals, including *Quaderni d'italianistica*, *History of European Ideas*, *Art e Dossier*, *Palladio*, *rivista di storia dell' architettura e restauro*.

Publications include two books in Italian and several papers in English: *Bernini e l'immagine del principe cristiano ideale*, Modena, 1998; *Bernini e il salvatore. La "buona morte" nella Roma del seicento*, Rome, 1998; "*Ex Uno Lapide: The Renaissance Sculptor's Tour de Force*," in M. Winner, et al., eds., *Il Cortile del Belvedere. Der Statuenhof des Belvedere im Vatikan*, Mainz, 1998, 191-210; "Bernini's Bust of the Medusa: An Awful Pun," in S. De Blaauw, et al., eds., *Docere delectare movere. Affetti, devozione e retorica nel linguaggio artistico del primo barocco romano*, Rome, 1998, 155-74; Remarks in Celebration of the Centenary of the Kunsthistorisches Institut in Florenz, in *Kunsthistorisches Institut in Florenz. Einhundertjähriges Jubiläum. 1897-1997. Jahresbericht*, Florence, 1999, 8-9.

PROFESSOR JACK F. MATLOCK, Jr. delivered lectures on U.S. foreign policy, U.S.-Russian relations, and contemporary Central Asia at the National Defense University, the DACOR Bacon House Foundation in Washington, D.C., the New York University School of Law, and at Princeton University. He also delivered the Finch Lecture on World Affairs at Miami University, Oxford, Ohio. He participated in several conferences and working groups, including those at Ditchley Park, England, on the Asian Subcontinent, at King's College, Cambridge, England, on Russia on the Eve of the New Millennium, at the Carnegie Endowment for International Peace in Washington on U.S.-Russian Relations, and at the Institute for National Strategic Studies in Washington on Challenges and Opportunities in U.S.-Russian Relations.

Professor Matlock was co-chairman of an Atlantic Council study group that visited China and several countries in Central Asia and the Subcontinent. He was co-author of a detailed report of the group's findings as well as a shorter article in the *Christian Science Monitor*. He chaired several sessions at the Council on Foreign Relations in New York, and at conferences sponsored by the Harriman Institute at Columbia University. He was interviewed on numerous television and radio programs.

Articles completed during the year included an essay, "Russia, Europe, and 'Western Civilization,'" to be published in a collection of articles by the Cornell University Press; an article on the 150th anniversary of the Communist Manifesto in the March 1999 issue of *Hemispheres*; comments on an address by former Russian Prime Minister Kiriyenko in the *East European Constitutional Review*; and two reviews for *The New York Times Book Review*. An article on the war over Kosovo, "The One Place NATO Could Turn for Help," appeared in *The New York Times* in April.

Professor Matlock continued writing two books with the working titles *Reagan and Gorbachev: How the Cold War Ended*, and *Understanding Russia*.

PROFESSOR HEINRICH von STADEN gave a lecture on the Hippocratic Corpus at the Max-Planck-Institut für Wissenschaftsgeschichte in Berlin in July. At the invitation of the Society of Biblical Literature he also lectured in Cracow (Poland) in July 1998, on philosophical and epistolary landscapes in Greek literature. In September, he gave a

lecture on the Roman encyclopedist Celsus at the Université de Nantes, France. At the invitation of the Human Sciences Research Council he visited five South African universities in late October and early November, giving seven seminars and lectures on subjects ranging from ancient theories of metaphor to relations between ancient Near Eastern and Greek science. In February 1999, he delivered a Faculty Lecture at the Institute for Advanced Study ("When Physicians Err...: Responses to Medical Failures in Antiquity"). In April, he lectured at Rutgers University ("Reading the Agonal Body") and at Princeton University (on literacy and medicine in the early Roman empire). In May, he gave the annual T. Cook Smith lecture in Louisville, Kentucky, and in June he traveled to Bonn, Berlin, and Mainz at the invitation of the Deutsche Forschungsgemeinschaft and the Berlin-Brandenburgische Akademie der Wissenschaften.

In the academic year 1998-1999, Professor von Staden's publications included "The Rule and the Exception: Celsus on a Scientific Conundrum," in *Maladie et maladies dans les textes latins antiques et médiévaux*, ed. C. Deroux (Collection Latomus, vol. 242, 1998), pp. 105-128; "Andréas de Caryste et Philon de Byzance: médecine et mécanique à Alexandrie," in *Sciences exactes et sciences appliquées à Alexandrie*, ed. G. Argoud and J.-Y. Guillaumin (Centre Jean Palerne, Saint-Étienne, 1998), pp. 147-172; "Gattung und Gedächtnis: Galen über Wahrheit und Lehrdichtung," in *Gattungen der wissenschaftlichen Literatur*, ed. W. Kullmann, J. Althoff, M. Asper (Tübingen, 1998), pp. 65-94; "*Dynamis: the Hippocratics and Plato*," in *Philosophy and Medicine*, ed. K. J. Boudouris (Alimos, 1999), vol. II, pp. 262-279; and several reviews. Professor von Staden also continued to serve on the editorial boards of the journals *Configurations* and *Bulletin of the History of Medicine*, on the board of managers of the *Journal of the History of Medicine and Allied Sciences*, and as a member of a research unit associated with the Comité National de Recherche Scientifique, Paris, France.

PROFESSORS EMERITI

PROFESSOR MARSHALL CLAGETT's *Ancient Egyptian Science, a Source Book, Vol. III - Ancient Egyptian Mathematics*, was published in May 1999 by the American Philosophical Society in Philadelphia. It includes a long preliminary section summarizing and analyzing the development of Egyptian mathematical techniques, followed by extensive English translations of the pertinent papyri, and includes a collection of the hieratic texts, with their hieroglyphic transcriptions, that formed the basis for the preceding translations. Professor Clagett has commenced research for Volume IV, which will center on Egyptian medicines and biology.

PROFESSOR OLEG GRABAR presented lectures at the University of Notre Dame and the Kuwait National Museum; he was a Patten Lecturer at Indiana University and ran a seminar in the Department of Near Eastern Languages and Cultures in the same university. He was a commentator on papers given at the Middle East Studies Association and at the Qajar Symposium held at the Brooklyn Museum. He continued to serve on the visiting committee of the Institute for Art History at the Getty Foundation and the grants committee of the Max van Berchem Foundation in Geneva. He was elected corresponding member of the Academie des Inscriptions et Belles Lettres in Paris. His publications included: "Qu'est-ce que l'Art Fatimide," *Tresors Fatimides du Caire* (Paris, 1998); "Islamic Esthetics," *Dictionary of Esthetics* (Oxford, 1998); "Persian Miniatures: Illustrations or Paintings," in R.G. Hovannisian and G. Sabagh, eds. *The Persian Presence in the Islamic World* (Cambridge, 1998); and

"Space and Holiness in Medieval Jerusalem," in L. Levine ed., *Jerusalem, Its Sanctity and Centrality to Judaism, Christianity, and Islam* (New York, 1999).

PROFESSOR CHRISTIAN HABICHT retired from the School of Historical Studies on July 1, 1998. That same month, he was one of eight speakers at an international conference on "Greek Personal Names: Their Value as Evidence," sponsored by the British Academy; his topic was "Foreign Names in Athenian Nomenclature." He received the London Hellenic Society's Criticos Prize for his *Athens from Alexander to Antony*. He lectured at the Friedrich Schiller-University of Jena on "Rhamnus: Eine attische Landgemeinde und Festung im Licht neuer Inschriften." At the Kommission für Alte Geschichte und Epigraphik in Munich, he held four seminars on recently found inscriptions from Attica for about thirty junior scholars.

At his initiative, the Gladys Krieble Delmas Foundation provided a two-year grant for the production of images of inscriptions that can be viewed and studied on the Internet; work on dated decrees of the Athenian assembly is being done at Ohio State University; and work on inscriptions from Eleusis at Cornell University.

In his absence, he was elected a member of an international Advisory Committee for production of a new edition of some 18,000 Athenian inscriptions. In early June of 1999, he attended a conference on that subject sponsored by the Berlin-Brandenburgische Akademie der Wissenschaften in Berlin. He continued to serve on editorial boards, on two committees of the American Philosophical Society, and on the board of supervisors for Inscriptiones Graecae.

His Sather Lectures on *Pausanias' Guide to Ancient Greece* were republished as a paperback, with a new preface, by the University of California Press. He wrote a number of articles and a review of the new biography of Augustus by Jochen Bleicken, and published the following papers: "Messianic Elements in the Prechristian Greco-Roman World," in *Towards the Millennium* (P. Schäfer, M. Cohen, Eds.), Leiden 1998, pp. 47-55; "Zur ewig währenden Errinerung. Ein auf das Nachleben zielender Topos," *Chiron* 28, 1998, pp. 35-41; "Aus der Arbeit der Inscriptiones Graecae I-III" (with C. Crowther, L. and K. Hallof), Chiron 28, 1998, pp. 85-162; "Kleine Beiträge zur altgriechischen Personenkunde," *Revue des Études Anciennes* 100, 1998, pp. 487- 494; "Sthennis," Horos 10-12, 1992-1998, pp. 21-26.

PROFESSOR GEORGE KENNAN provided several interviews over this past year. They included one for the 75th anniversary issue of *Foreign Affairs*; an extended and televised interview, in German, for German Public Television on the attitudes of the German public on the Jewish question during World War II; and a telephone interview for National Public Radio on the history of NATO.

Professor Kennan received, and discussed current problems with, the new Russian Ambassador to the United States. He spoke, as guest of honor, at the State Department dinner commemorating the 75th anniversary of the inauguration of the American Foreign Service.

Professor Kennan continued writing on the eighteenth century New England period in the history of his own family. He read and commented critically, at the request of their authors, on several full-length books and articles, mostly in the field of the history of American diplomacy.

PROFESSOR PETER PARET continued to divide his work between two areas: the culture and political history of literature and the fine arts in 19th and 20th century Germany; and efforts to understand and manage war as an instrument of policy in Revolutionary and Napoleonic Europe. During the academic year he completed a group of essays on art, artists, society, and politics in Germany from the middle of the 19th century to 1945, which will be published by Cambridge University Press. His address in September 1998 at the international conference in Potsdam on the novelist and poet Theodor Fontane appeared in the *Frankfurter Allgemeine Zeitung*. An expanded version, "Fontane und Liebermann - Versuch eines Vergleiches," is included in *Theodor Fontane. Am Ende des Jahrhunderts*, ed. Hanna Delf von Wolzogen (de Gruyter Verlag, Berlin). In the spring he joined the advisory board of the Max Liebermann Gesellschaft.

He also published "Die Darstellung des Krieges in der Bildenden Kunst," in *Die Wiedererweckung des Krieges*, eds. Joachim Kunisch and Herfried Münkler, de Gruyter Verlag, Berlin; and "Modernism and the 'Alien Element' in German Art," in *Berlin Metropolis*, ed. Emily Bilski, University of California Press, Berkeley-Los Angeles. The chapter is being reprinted in the catalogue of an exhibition on Jewish and Gentile elements in Berlin culture, 1890-1918, which opens this November in the Jewish Museum in New York, and for which Professor Paret is acting as a historical advisor. Among his reviews and shorter pieces is an article in the ninth volume of the *American National Biography* on Felix Gilbert, who was a professor in the School of Historical Studies from 1962 to 1991.

Professor Paret continued to support efforts to preserve and make more easily available to scholars the poster collection of the Hoover Institution of Stanford University, one of the most important collections of its kind in the United States. In April, he gave a talk on the aesthetic and historical interpretation of posters at the opening of an exhibition of posters in the Hood Museum of Dartmouth College.

The volume of essays by twenty-five contributors, *Makers of Modern Strategy*, that Professor Paret edited in 1986, and to which he contributed three chapters, is being published in Greek by Constantine Tourikis Editions, Athens. The work has already appeared in Spanish, Italian, and Japanese editions. The analytic essays on Clausewitz's *On War* that he, Michael Howard, and the late Bernard Brodie published in 1976, have been published in Spanish by the Ministerio de Defensa, Madrid. In May, Professor Paret was elected an honorary member of the German Clausewitz Gesellschaft.

PROFESSOR HOMER THOMPSON has curtailed his academic activities of late, but he continues his interest in the publication program of the excavation of the Athenian Agora, and enjoys discussions of his past work with colleagues and friends.

PROFESSOR MORTON WHITE's autobiography, *A Philosopher's Story*, was published in the summer of 1999 by Penn State University Press. His article "Peirce's *Summum Bonum* and the Ethical Views of C. I. Lewis and John Dewey" will appear in the December 1999 issue of *Philosophy and Phenomenological Research*. Professor White's paper on "The Ideas of the Enlightenment and their Legacy," delivered at the Twentieth World Congress of Philosophy in Boston in July of 1998, will be published this fall in Volume 7 of the *Proceedings* of the Congress. He has accepted an invitation to deliver the John Dewey Memorial Lecture at the annual meeting of the American Educational Research Association, to be held in New Orleans in April 2000.

THE SCHOOL OF HISTORICAL STUDIES

DMITRI AFINOGENOV
Byzantine Studies
Russian Academy of Sciences, Moscow

MAROUN AOUAD
Medieval and Islamic Philosophy
Centre National de la Recherche Scientifique, Paris

ELKA BAKALOVA
Medieval History and Art
Institute of Art Studies, Sofia · *s*

GREGORY BAYER
Ancient Philosophy
Independent Scholar · *v*

ALISON BEACH
Medieval History
Institute for Advanced Study · *a*

PAOLO BERNARDINI
Early Modern European History
Scuola Normale Superiore, Pisa

CHRISTOPHER BICKFORD
American History
Connecticut Academy of Arts and Sciences · *v*

MAGGIE BICKFORD
Chinese Art and Architecture
Brown University

JAMES CAHILL
Chinese Art History
University of California, Berkeley and
Princeton University · *vf*

ALEXEY CHERNETSOV
Medieval Russian History and Archaeology
Russian Academy of Sciences, Moscow

MICHAEL J. COHEN
History of Palestine/Israel and the Modern Middle East
Bar-Ilan University · *f*

ROGER CRUM
History of Art
University of Dayton

NICOLA DI COSMO
History of Relations between China and Inner Asia
Harvard University · *s*

ELEANOR DICKEY
Greek and Latin Linguistics and Social History
University of Ottawa

MICHELE FARAGUNA
Ancient History
Università di Trieste

CAROLE FINK
Modern History
The Ohio State University · *s*

VALERIE FLINT
Medieval Ecclesiastical History
University of Hull · *vs*

JACK FREIBERG
Art History
Florida State University

BRIAN GOLDING
Medieval History
University of Southampton

EDWARD HARRIS
Ancient Greek History
Brooklyn College, City University of New York · *f*

WOLFHART HEINRICHS
Medieval Arabic Literature
Harvard University · *s*

CHRISTOPHER ANDREW JONES
Anglo-Saxon Church History
Idaho State University

KATHRYN KERBY-FULTON
Medieval Literature
University of Victoria · *vf*

VICTOR MAIR
Chinese Language and Literature
University of Pennsylvania

f First Term · *s* Second Term · *v* Visitor · *a* Research Assistant

GEORGIY MIRSKY
History and Political Science
Russian Academy of Sciences, Moscow

JAWID MOJADDEDI
Islamic History
Institute for Advanced Study · *a*

YITZHAK NAKASH
Near Eastern Studies
Brandeis University

FREDERICK PAXTON
European Medieval History
Connecticut College

MARSHALL T. POE
Russian History
Columbia University

KARLA POLLMANN
Classics and Patristics
University of St. Andrews · *s*

WALTER PREVENIER
Medieval Social History
University of Gent · *vs*

FRANÇOIS QUEYREL
Greek Archaeology
La Sorbonne · *s*

CYNTHIA ROBINSON
Art History
Institute for Advanced Study · *a*

PAUL ROREM
History of Theology
Princeton Theological Seminary · *v*

ALDO SCHIAVONE
History of Roman Law
University of Florence · *f*

ECKART SCHÜTRUMPF
Classical Philology, Greek Philosophy
University of Colorado, Boulder · *s*

ERKKI SIRONEN
Late Antique Athens
University of Helsinki · *s*

ROSEMARY STANFIELD-JOHNSON
Late Medieval and Early Modern Iran
Hofstra University · *f*

JENNY STRATFORD
Medieval History
University of London · *vs*

NEIL STRATFORD
Medieval Art and Architecture
The British Museum

CLAUDIA SWAN
Northern Renaissance and Baroque Visual Culture
Northwestern University

THOMAS SZABÓ
Medieval European History
Max-Planck-Institut für Geschichte, Göttingen · *s*

JOACHIM SZIDAT
History of the Later Roman Empire
University of Bern

HSINGYUAN TSAO
Chinese Art History
Reed College

JOHN VAN ENGEN
Medieval History
University of Notre Dame · *vf*

MICHAEL WEISS
Indo-European Linguistics
University of North Carolina, Chapel Hill · *s*

LEONID ZHMUD
Ancient Greek Science and Philosophy
Russian Academy of Sciences, St. Petersburg

f First Term · *s* Second Term · *v* Visitor · *a* Research Assistant

THE SCHOOL OF HISTORICAL STUDIES

RECORD OF EVENTS

The following is a calendar of events sponsored by the School of Historical Studies

Historical Studies Colloquium: "A New Approach to the Economy of Classical Athens: The Nature of Technical Specialization"
EDWARD HARRIS, *Brooklyn College, City University of New York*

Historical Studies Colloquium: "Arthur Kingsley Porter and Burgundy"
NEIL STRATFORD, *The British Museum*

Medieval Seminar: "Scribes, Preachers, and Exegetes: The Women of Twelfth Century Admont"
ALISON BEACH, *Institute for Advanced Study*

Weekly Informal Art History Colloquium: "Romanesque Column Capitals East and West"
NEIL STRATFORD, *The British Museum*

Visual Dimensions of Chinese Culture Seminar: "Theoretical/Compatative"
PATRICIA EBREY, *Institute for Advanced Study*
MAGGIE BICKFORD, *Brown University*
HENRY SMITH, *Columbia University*

Historical Studies Colloquium: "Ephemeral Art and Totalitarian Politics: The Transformation of Florence for Hitler's Visit of 1938"
ROGER CRUM, *University of Dayton*

Princeton Art History Colloquium: "The Problem of the Choir of Florence Cathedral: From Brunelleschi to Michael Graves"
IRVING LAVIN, *Institute for Advanced Study*

Weekly Informal Art History Colloquium: "Florentine Urbanistics in the Renaissance and During the Visit of Adolf Hitler"
ROGER CRUM, *University of Dayton*

Historical Studies Colloquium: "The Military and Strategic Significance of the Middle East During the Early Cold War Period: Contingency Planning 1945-54"
MICHAEL J. COHEN, *Bar-Ilan University*

Weekly Informal Art History Colloquium: "Science, Witches, and Dreams in Dutch Art of the Early Seventeenth Century"
CLAUDIA SWAN, *Northwestern University*

Visual Dimensions of Chinese Culture Seminar, Issues of Social and Political Order, I - Creating Hierarchies: "Visual Display of Status in Northern Song Kaifeng"
PATRICIA EBREY, *Institute for Advanced Study*
"Some Thoughts on the Use of Art for Social History"
MARTIN POWERS, *University of Michigan*

Historical Studies Colloquium: "Medieval Russian City of Staraya Ryazan: General Characteristics, Recent Excavations and Perspectives"
ALEXEY CHERNETSOV, *Russian Academy of Sciences, Moscow*

Weekly Informal Art History Colloquium: "Early Wooden Pagodas and the Problem of Entrance Ways in 10th-century China"
HSINGYUAN TSAO, *Reed College*

Historical Studies Colloquium: "New Sources for the Study of Early Medieval Liturgical Commentary"
CHRISTOPHER JONES, *Idaho State University*

Medieval Seminar: "Silencing Optimism: Alternative Eschatology and the Dangers of Franciscan Joachimism in Late Medieval England"
KATHRYN KERBY-FULTON, *University of Victoria*

Weekly Informal Art History Colloquium: "Elegant Copies; the Unending Tradition in Chinese Painting"
JAMES CAHILL, *University of California, Berkeley* and *Princeton University*

Historical Studies Colloquium: "Textiles as Texts: Rewriting the Cultural History of Sung (960-1279) China with the Material Evidence of Huang Sheng's (d. 1243) Tomb"
MAGGIE BICKFORD, *Brown University*

Weekly Informal Art History Colloquium: "Chinese Painting and Poetry: Evidence from Costume and Jewelry"
MAGGIE BICKFORD, *Brown University*

Princeton Art History Colloquium: "Rediscovering the Artist in Carolingian Manuscript Illumination: A Case Study"
LARRY NEES, *University of Delaware*

Historical Studies Colloquium: "Bramante's Tempietto and Spanish Royal Patronage in Renaissance Rome"
JACK FREIBERG, *Florida State University*

Medieval Seminar: "Cross-Cultural Implications of Conversion in Sefavid Iran"
ROSEMARY STANFIELD JOHNSON, *Hofstra University*

Visual Dimensions of Chinese Culture Seminar, Issues of Social and Political Order, II - Crossing Boundaries:
"Textiles as Texts: Rewriting Song Cultural History with the Material Evidence of Huang Sheng's Tomb"
MAGGIE BICKFORD, *Brown University*
"Calling Back the Ancestor's Shadow: Chinese Ritual and Commemorative Portraits."
EVELYN RAWSKI, *University of Pittsburgh* and JAN STUART, *Freer Gallery of Art*

Historical Studies Colloquium: "Sunni-Shi`i Polemic in the Safavid Period"
ROSEMARY STANFIELD-JOHNSON, *Hofstra University*

Medieval Seminar: "The Procession on the Day of the Restoration of Images in Constantinople on March 11, 843"
DMITRY AFINOGENOV, *Russian Academy of Sciences, Moscow*

Historical Studies Colloquium: "Making the Nomads Imperial: The Cultural Domain of the Early Khitan Empire"
HSINGYUAN TSAO, *Reed College*

Medieval Seminar: "Bayad wa Riyad: Slipped Between the Cracks"
CYNTHIA ROBINSON, *Institute for Advanced Study*

Weekly Informal Art History Colloquium: "Visual Aspects of Chinese Court Protocol"
PATRICIA EBREY, *Institute for Advanced Study*

School of Historical Studies Lecture: "The Western Presence in the Indian Ocean from the Hellenistic Period to Late Antiquity"
JEAN-FRANÇOIS SALLES, *Maison de l'Orient, Lyon*
Commentary: D. T. POTTS, *University of Sydney*

Visual Dimensions of Chinese Culture Seminar, Issues of Religious Ideas and Practices, I: "Recent Publications on Illustrated Fiction and Drama"
VICTOR MAIR, *University of Pennsylvania*
"Daoism at the Ming Court: The Evidence from Painting"
STEPHEN LITTLE, *Art Institute of Chicago*

Historical Studies Colloquium: "Problems and Perspectives of the History of Roman Legal Thought"
ALDO SCHIAVONE, *University of Florence*

Medieval Seminar: "Devout Communities and Inquisitional Orders: The Legal Defense of the New Devout"
JOHN VAN ENGEN, *University of Notre Dame*

School of Historical Studies Lecture: "Konstantin Leontiev"
KONSTANTIN ZHUKOV, *Russian Academy of Sciences*

Princeton Art History Colloquium: "Prostitutes in the Bushes?! A Problem in Public Exemplarity at Pompey the Great's Theater Garden"
ANN KUTTNER, *University of Pennsylvania*

History of Science Discussion Seminar: Discussion of Paula Findlen, *Possessing Nature: Museums, Collecting, and Scientific Culture in Early Modern Italy*

Historical Studies Colloquium: " 'A Morbid Taste for Bones': Relics and Politics in Twelfth-century Britain"
BRIAN GOLDING, *University of Southampton*

Weekly Informal Art History Colloquium: "Russian Medieval Sculpture"
ALEXEY CHERNETSOV, *Russian Academy of Sciences, Moscow*

Weekly Informal Art History Colloquium: "Science, Illustration, and Meaning in the Dutch Graphic Art in the Later Sixteenth- and Early Seventeenth-centuries"
CLAUDIA SWAN, *Northwestern University*

Historical Studies Colloquium: "Russia and Russian Nationalism"
GEORGIY MIRSKY, *Russian Academy of Sciences, Moscow*

History of Science Discussion Seminar: "Eudemus of Rhodes: The First Historian of Greek Science"
LEONID ZHMUD, *Russian Academy of Sciences, St. Petersburg*

Historical Studies Colloquium: "How to Become Emperor by Usurpation in the Later Roman Empire: Some Considerations"
JOACHIM SZIDAT, *University of Bern*

Medieval Seminar: "The Letters Between Bishop Evodius of Uzalis and Augustine of Hippo"
FREDERICK PAXTON, *Connecticut College*

Princeton Art History Colloquium: "Bells, Scales, and Pitch Standards: The Archaeology of Music in Ancient China"
ROBERT BAGLEY, *Princeton University*

Historical Studies Colloquium: "The Best State in Aristotle's Politics"
ECKART SCHÜTRUMPF, *University of Colorado, Boulder*

Weekly Informal Art History Colloquium: "History and Culture in China's Longest Silk Scroll Painting"
HSINGYUAN TSAO, *Reed College*

Visual Dimensions of Chinese Culture Seminar, Issues of Religious Ideas and Practices, II: "The Wheel of Rebirth: Discourses of Death in Chinese Buddhism"
STEPHEN TEISER, *Princeton University*
"The Changing Notion of Buddhahood in Early Chinese Buddhist Art: A Sixth-century Stele from the Shaolin Monastery."
DOROTHY WONG, *University of Virginia*

Historical Studies Colloquium: "Roman Flattery: How to Get Rich Using Latin Forms of Address"
ELEANOR DICKEY, *University of Ottawa*

Historical Studies Colloquium: "Byzantine Texts of the Second Iconoclasm in Slavic Translations"
DMITRY AFINOGENOV, *Russian Academy of Sciences, Moscow*

Medieval Seminar: "The Roads of North Italy in the Period of the Italian Communes"
THOMAS SZABO, *Max-Plank-Institut für Geschichte*

Weekly Informal Art History Colloquium: "Cult of the Spanish Kings at San Pietro in Montorio, Rome"
JACK FREIBERG, *Florida State University*

History of Science Discussion Seminar: Discussion of Londa Schiebinger, *Nature's Body: Gender in the Making of Modern Science*

Medieval Seminar: " 'Lifesize': Images, Power and Protection"
FLORA LEWIS, *Independent Scholar*

Historical Studies Colloquium: "Russian Historical Mythology: The Case of 'Moscow, the Third Rome' "
MARSHALL T. POE, *Columbia University*

History of Science Discussion Seminar: Discussion of Abraham Pais, *'Subtle is the Lord...': The Science and Life of Albert Einstein*

Historical Studies Colloquium: "The Death of Hathumoda, Abbess of Gandersheim"
FREDERICK PAXTON, *Connecticut College*

Weekly Informal Art History Colloquium: "Buddhist Poetry and Painting"
VICTOR MAIR, *University of Pennsylvania*

Visual Dimensions of Chinese Culture Seminar, Issues of Identity, I - Gender: "The Subject of Pain"
DOROTHY KO, *Rutgers University*
"The Emperor's Erotica"
JAMES CAHILL, *University of California, Berkeley* and *Princeton University*

Islamic History Seminar: "The Meaning of Scribal Signs and Symbols in Arabic Manuscripts"
MAROUN AOUAD, *Centre National de la Recherche Scientifique, Paris*

Weekly Informal Art History Colloquium: "Arabic Amulets and the Creation of Bamana Ritual Textiles in Mali, West Africa: A Visual Synthesis"
SARAH BRETT-SMITH, *Rutgers University*

Historical Studies Colloquium: "The Image of the Ideal Ruler in Medieval Bulgarian Art and Literature"
ELKA BAKALOVA, *Institute of Art Studies, Sofia*

History of Science Discussion Seminar: Discussion of Simon Schaffer's article "Natural Philosophy and Public Spectacle in the Eighteenth Century"

[illegible]

Historical Studies Colloquium: "Statius' Thebaid and the Legacy of Virgil's Aeneid"
KARLA POLLMANN, *University of St. Andrews*

[illegible]

Medieval Seminar: "A Lost Work by Amalarius of Metz?"
CHRISTOPHER JONES, *Idaho State University*

[illegible]

Weekly Informal Art History Colloquium: "Archival Research on Collections of Precious Metal Objects in English Royal Collections"
JENNY STRATFORD, *University of London*

[illegible]

School of Historical Studies Lecture: "The Winter of our Discontent: Historians and Their Fates in Post-Perestroika Moscow"
YURI BESSMERTNY, *Russian Academy of Sciences*

[illegible]

Historical Studies Colloquium: "Archives in Ancient Greece: The Case of Land Registers"
MICHELE FARAGUNA, *Università di Trieste*

[illegible]

Weekly Informal Art History Colloquium: "The Piero Project: Using Electronics to Study Renaissance Fresco Painting"
MARILYN ARONBERG LAVIN, *Princeton University*

[illegible]

Visual Dimensions of Chinese Culture Seminar, Issues of Identity, II - Ethnicity: "The Early 'Great Wall(s)' in Northern China"
NICOLA DI COSMO, *Harvard University*
"Making the Nomads Imperial"
HSINGYUAN TSAO, *Reed College*
"A Buddhist Ritual Complex at Beijing"
NANCY STEINHARDT, *University of Pennsylvania*

Historical Studies Colloquium: "Alberico Gentili's de papatu romano Antichristo (1584) and the Theological Foundations of Modern International Law"
PAOLO BERNARDINI, *Scuola Normale Superiore, Pisa*

History of Science Discussion Seminar: Discussion of the Wilson Quarterly issue on "Is Everything Relative? A Debate on the Unity of Knowledge"

[illegible]

Medieval Seminar: "The History of Religious Orders, Especially the Mendicants"
GERT MELVILLE, *University of Dresden*

[illegible]

Princeton Art History Colloquium: "Liturgy, Legitimacy, and Program: The Art Historian in the Virgin Chapel of Beauvais Cathedral"
MICHAEL COTHREN, *Swarthmore College*

[illegible]

Historical Studies Colloquium: "Traditions of Metaphorology in Classical Arabic"
WOLFHART HEINRICHS, *Harvard University*

[illegible]

Medieval Seminar: "Richard II and the English Royal Treasure"
JENNY STRATFORD, *University of London*

[illegible]

Historical Studies Colloquium: "The Rhetorical Syllogism in Arabic Commentaries on Aristotle's Rhetoric"
MAROUN AOUAD, *Centre National de la Recherche Scientifique, Paris*

History of Science Discussion Seminar: Discussion of a paper by A. Kojevnikov, "Freedom, Collectivism, and Quasiparticles: Social Metaphors in Quantum Physics"

Historical Studies Colloquium: "Change in the Epitaph Culture of Greece During Late Antiquity"
ERKKI SIRONEN, *University of Helsinki*

Medieval Seminar: "Death Rituals and Gender in Early Christian Greece"
JULIA BURMAN, *Independent Scholar*

Historical Studies Colloquium: "Turning Elephants into Porcupines: The Prickly Sprouts of Manchu Imperialism Seen Through a Soldier's Memoir"
NICOLA DI COSMO, *Harvard University*

Islamic History Seminar: "The Devil's Questions in al-Shahrastani's Kitab al-milal wa'l-nihal."
WOLFART HEINRICHS, *Harvard University*

School of Historical Studies Lecture: "Art as a Figure of Speech: Links Between Painting, Literature, and Music Around 1900"
FLORENS DEUCHLER, *University of Geneva* and *Swiss Institute, Rome*

Medieval Seminar: "Russian Historical Book Illustration in the Sixteenth Century"
ALEXEY CHERNETSOV, *Russian Academy of Sciences*

Medieval Seminar: "How Eriugena Maximized his Textual Problem with the Dionysian Celestial Hierarchy, Chapter Four"
PAUL REMEL, *Princeton Theological Seminary*

Islamic History Seminar: " 'al-Farabi's Noetic Politics' "
DIMITRI GUTAS, *Yale University*

History of Science Discussion Seminar: Discussion of Peter Galison, *Image and Logic: A Material Culture of Microphysics*

Weekly Informal Art History Colloquium: "Patrons and their Purchase: Images in the Theater of Pompey"
JANE DeROSE EVANS, *Temple University*

Medieval Seminar: "Late Echoes of Western Medieval Iconographic Formulae in Bulgarian Art"
ELKA BAKALOVA, *Institute of Art Studies, Sofia*

Weekly Informal Art History Colloquium: "The Blindness of Laocoon: Analysis of the Monumental Sculptural Group"
FRANÇOIS QUEYREL, *La Sorbonne*

History of Science Discussion Seminar: Discussion of Daniel Garber, *Descartes' Metaphysical Physics*

Islamic History Seminar: "Sufi Biographies"
JAWID MOJADDEDI, *Institute for Advanced Study*

History of Science Discussion Seminar: Discussion of Martin Heidegger, *The Question Concerning Technology*

"This has been my most productive year ever… as always at the Institute, it is good that there are lots of visitors around, both younger and older people. You never know who you'll meet, who will help you during a mathematical conversation, or who you will help."

— Member, School of Mathematics

THE SCHOOL OF MATHEMATICS

FACULTY

ENRICO BOMBIERI, *IBM von Neumann Professor*
JEAN BOURGAIN
PIERRE DELIGNE
ROBERT P. LANGLANDS, *Hermann Weyl Professor*
ROBERT D. MacPHERSON
THOMAS SPENCER

PROFESSORS EMERITI

ARMAND BOREL
ATLE SELBERG

ACADEMIC ACTIVITIES

The largest program in the School of Mathematics for 1998-99 was the special year in geometric methods in representation theory. This is an area of research that has been very active during the last two decades. Problems in representation theory, some of which have been open for a century, have been resolved using geometric methods. The program was directed by the School's Distinguished Visiting Professor, G. Lusztig of MIT. The main program consisted of two research lectures each week. Some of the lectures were single research reports, and some were organized into longer lecture series. Major series of lectures were "Character Sheaves" by G. Lusztig, an exposition of Lusztig's work giving a geometric explanation of the characters of representations of classical groups; "Quiver Varieties" by H. Nakajima, giving Nakajima's geometric construction of canonical bases of representations; "Bases in Equivariant K-Theory" by G. Lusztig, giving a new conjecture for the structure of Lie Algebra representations in equal characteristic; and "Geometric Langlands Correspondence" by D. Gaitsgory, an exposition of the theory by A. Beilinson and V. Drinfeld, functorializing and proving Langlands conjectures for function fields.

In addition, there were occasional expositional "baby seminars" in the evening organized by A. Kirillov on "classical" material, meaning results that are several years old.

One of the most important geometric techniques that has been applied to the geometric study of representation theory in recent years are the ideas of intersection homology, perverse sheaves and D-modules. There was a course on this material, together with the background material of the derived category and pure sheaves in characteristic p. It was organized by a group of Members, and it met once or twice per week. The lectures in this course were given by M. Khovanov, D. Gaitsgory, S. Arkhipov, M. Goresky, A. Kirillov, M. Nori, P. Deligne, and I. Mirkovic. We are grateful to the National Science Foundation and the Ambrose Monell Foundation for their support of this program.

The program in combinatorics and computational complexity continued this year under the direction of N. Alon (Tel Aviv University, Israel) in the fall term, and A. Wigderson (The Hebrew University of Jerusalem, Israel) in the spring. The main program consisted of a weekly seminar with both internal and external speakers. In November, there was a three-day workshop on "Randomized and Derandomized Algorithms for Discrete Structures" sponsored jointly with DIMACS and organized by N. Alon, A. Frieze (Université Pierre et Marie Curie), and B. Reed (Carnegie Mellon University).

A mini-course on computational pseudo-randomness was given by A. Wigderson exploring the relation between the efficiency of probabilistic algorithms and that of deterministic ones for the same problem.

There was a working seminar on algebraic combinatorics, organized by R. Ehrenborg, which met weekly. This seminar centered on polytopes and on combinatorics related to the problems in representation theory studied in Lusztig's special year. Grants from the Alfred P. Sloan Foundation, NEC Research Institute, the State of New Jersey, and the Arcana Foundation helped to make these activities possible.

In January, there was a one-week conference on combinatorial geometry, centering on the new proof by T. Hales (University of Michigan) of the Kepler Conjecture. This was sponsored jointly with the *Annals of Mathematics* and was organized by G. Fejes Tóth of the Mathematical Institute of the Hungarian Academy of Sciences. In conjunction with this, Hales gave a popular lecture for a general non-mathematical audience on the history of the Kepler conjecture, and the ideas involved in proving it.

During the year there was a seminar on number theory and representation which met intermittently and was organized by C. Skinner and R. Langlands. A bi-monthly seminar on mathematical physics focusing on turbulence theory was organized by T. Spencer and M. Chertkov (Princeton University), and a weekly seminar on "Determinants in Pure and Applied Math" was organized by T. Spencer and P. Deift (Courant Institute).

Together with Princeton University and Rutgers University, two weekly seminars continued as in the past: one on "Nonlinear Analysis" organized by J. Bourgain, A. Chang (Princeton University), and S. Klainerman (Princeton University); and one on "Harmonic Analysis and Number Theory" organized by E. Bombieri, P. Sarnak (Princeton University), and H. Iwaniec (Rutgers University).

There was a cluster of Members present during the year whose speciality is low-dimensional topology. The Marston Morse Memorial Lectures were given by T. Mrowka (Massachusetts Institute of Technology) on "Gauge Theory and Low-dimensional Topology: Past, Present and Future." In conjunction with these lectures, there was a Marston Morse Memorial Conference on the same area of geometry organized by P. Oszvath and Z. Szabo, both of Princeton University, and R. MacPherson.

This was the last year of the three-year program, funded by the National Science Foundation, in quantum field theory, organized jointly with the School of Natural Sciences. The main activity this year was the completion of the written lecture notes for the project. This has now been published by the American Mathematical Society as *Quantum Fields and Strings: A Course for Mathematicians*, by P. Deligne, P. Etingof

(Massachusetts Institute of Technology), D. Freed (University of Texas, Austin), L.C. Jeffrey (University of Toronto), D. Kazhdan (Harvard University), J. Morgan (Columbia University), D. Morrison (Duke University), and E. Witten.

Much of the academic activity of the School of Mathematics revolves around discussions and collaborations among the Members and with the Faculty. The School has continued to refine mechanisms to encourage these interactions. The traditional Members Seminar continued, with Members giving lectures on their current work. At the beginning of the year, there was a series of short talks by all postdoctoral Members giving an exposition of some aspect of their research interests.

R. MacPherson was elected to the American Philosophical Society in May 1999, and the same month, T. Spencer was elected to the American Academy of Arts and Sciences.

André Weil, Professor Emeritus of the School of Mathematics, died on August 6, 1998, at the age of 92. In January, the School held a two-day memorial conference on aspects of his work and its legacy, organized by A. Borel, P. Deligne, and R. MacPherson. Professor Weil's work influenced several different fields of mathematics, as is illustrated by the list of talks at the conference: "A. Weil and the Building of Adelic Geometry," P. Cartier (École Normale Supérieure, Paris); "A. Weil and Topology," A. Borel; "A. Weil and Algebraic Geometry," P. Deligne; "A. Weil and Elliptic Curves," A. Wiles (Princeton University); "A. Weil and C.L. Siegel," R. Langlands; "A. Weil and Advanced Analytic Number Theory," P. Sarnak (Princeton University).

A. Wigderson was appointed to the Faculty of the School of Mathematics as of July 1, 1999. Wigderson, a Nevanlinna Prize winner, is a leading computer scientist, specializing in complexity theory. He has wide-ranging interests, and his addition to the Faculty represents a belief that discrete mathematics and complexity theory should be naturally integrated into the Institute's program of mathematical research. Wigderson has been a frequent visitor to the School of Mathematics, and has directed its program in Discrete Mathematics on three occasions.

THE SCHOOL OF MATHEMATICS

MEMBERS, VISITORS, AND RESEARCH STAFF

DORIT AHARONOV
Quantum Computation
The Hebrew University of Jerusalem, Israel

NOGA ALON
Combinatorics and Theoretical Computer Science
Tel Aviv University, Israel · *f*

SERGEI ANISOV
Singularity Theory
Independent University of Moscow, Russia · *f*

SERGEY ARKHIPOV
Semi-infinite Cohomology of Quantum Groups at Roots of 1
Independent University of Moscow, Russia

ROMAN BEZRUKAVNIKOV
Representations of Reductive Groups, D-modules
Institute for Advanced Study

ILIA BINDER
Complex and Harmonic Analysis
California Institute of Technology

MIKLÓS BÓNA
Enumerative Combinatorics of Permutations, Posets and Graphs
University of Quebec, Montreal

JEAN-BENOÎT BOST
Arakelov Geometry and Diophantine Approximation
Institut des Hautes Études Scientifiques, France · *f*

ALEXANDER BRAVERMAN
Geometric Constructions of Representations, Geometric Langlands Correspondence
Massachusetts Institute of Technology · *s*

DIEGO CORDOBA
Fluid Mechanics
Princeton University

GOTTFRIED CURIO
Mathematical Physics
Institute for Advanced Study · *j*

PERCY DEIFT
Integrable Systems and Spectral Theory
New York University, Courant Institute of Mathematical Sciences · *f*

RICHARD EHRENBORG
Algebraic Combinatorics
Cornell University

PAUL FEEHAN
Gauge Theory, Analysis, and Applications to Low-dimensional Topology
Ohio State University

EVA MARIA FEICHTNER
Topological Combinatorics
Massachusetts Institute of Technology · *v*

MICHAEL FINKELBERG
Quantum Groups
Independent University of Moscow, Russia

EHUD FRIEDGUT
Combinatorics and Random Structures
The Hebrew University of Jerusalem, Israel

ERIC FRIEDLANDER
Algebra and Algebraic Geometry
Northwestern University · *s*

SUSAN FRIEDLANDER
Fluid Dynamics/PDE
University of Illinois, Chicago · *s*

KAZUHIRO FUJIWARA
Galois and Automorphic Representations
Nagoya University, Japan

TERRY FULLER
Geometric Topology of 4-manifolds
University of California, Irvine

DENNIS GAITSGORY
Geometric Aspects of Representation Theory
Harvard University

f First Term · *s* Second Term · *v* Visitor
j · Joint Appointment with School of Natural Sciences

WEE TECK GAN
Representation Theory of p-adic Groups and Automorphic Forms
Harvard University · *i*

MARK GORESKY
Geometric Questions Related to Automorphic Forms
Institute for Advanced Study

WILLIAM GRAHAM
Lie Theory, Algebraic Geometry
The University of Georgia · *vf*

THOMAS HALVERSON
Representation Theory of Iwahori-Hecke Algebras
Macalester College · *s*

TAMÁS HAUSEL
Geometry of Moduli Spaces, Topological Quantum Field Theories
University of Oxford

VOLKER HEIERMANN
Representation Theory over Local Fields
Humboldt Universität Berlin, Germany

NANCY HINGSTON
Periodic Orbits of Hamiltonian Systems
The College of New Jersey

WERNER HOFFMANN
Automorphic Forms, Trace Formula
Institute for Advanced Study · *f*

YUKARI ITO
Algebraic Geometry (Singularity Theory)
Tokyo Metropolitan University, Japan · *v*

MIKHAIL KHOVANOV
Quantum Groups, Low-dimensional Topology
Institute for Advanced Study

ALEXANDER KIRILLOV
Representation Theory, Combinatorics
Massachusetts Institute of Technology

JANÉ KONDEV
Statistical Physics
Institute for Advanced Study

LEONID KORALOV
Random Flows, Turbulence, Hamiltonian Systems
State University of New York, Stony Brook

EMMANUEL KOWALSKI
Automorphic Forms and L-functions
Rutgers University · *i*

DMITRY KOZLOV
Topological and Algebraic Combinatorics
Massachusetts Institute of Technology

SLAVA KRUSHKAL
Low-dimensional Topology and Geometry
Max-Planck-Institut für Mathematik Bonn, Germany

EREZ LAPID
Automorphic Forms, Trace Formula
University of California, Los Angeles

YANGUANG LI
Chaos in Partial Differential Equations
Massachusetts Institute of Technology

WEN-CHING LIEN
Hyperbolic Conservation Laws with a Moving Source
Stanford University

GEORGE LUSZTIG
Group Representation Theory
Massachusetts Institute of Technology · *dvp*

ANDREA MAFFEI
Representation and Invarient Theory
Università di Roma "La Sapienza", Italy · *v*

SHAUN MARTIN
Symplectic Geometry, Gauge Theory, K-theory
Massachusetts Institute of Technology

MARK McCONNELL
Topology and Arithmetic Groups
Oklahoma State University

IVAN MIRKOVIC
Geometry of Langlands Correspondence
University of Massachusetts, Amherst

HIRAKU NAKAJIMA
Geometry, Representation Theory
Kyoto University, Japan

MADHAV NORI
Algebraic Geometry
University of Chicago · *s*

f First Term · *s* Second Term · *v* Visitor · *dvp* Distinguished Visiting Professor
i Veblen Research Instructor

HARU PINSON
Mathematical Physics
Institute for Advanced Study · *a*

LEONID POSITSELSKI
Homological Algebra
Harvard University

GOPAL PRASAD
Arithmetic of Semi-simple Groups and Representation Theory
University of Michigan, Ann Arbor

MARGARET READDY
Algebraic Combinatorics
Cornell University · *v*

DAVID RENARD
Harmonic Analysis on Reductive Groups
University of Poitiers, France

KONSTANZE RIETSCH
Canonical Bases and Total Positivity
Massachusetts Institute of Technology

YONGWU RONG
3-manifold and Knot Theory
The George Washington University · *s*

DANIEL SAGE
Algebraic Groups, Composite Materials
University of Utah

SIGMUND SELBERG
Nonlinear Wave Equations
Princeton University

ALEXANDER SHNIRELMAN
Fluid Dynamics, Turbulence
Tel Aviv University, Israel · *f*

CHRISTOPHER SKINNER
Number Theory
Institute for Advanced Study

JOEL SPENCER
Random Structures, Probabilistic Methods
New York University, Courant Institute of Mathematical Sciences · *f*

RAMESH SREEKANTAN
Arithmetic of Algebraic Cycles
University of Chicago

SALVATORE TORQUATO
Statistical Mechanics and Homogenization Theory
Princeton University

PETER TRAPA
Representation Theory of Reductive Groups
Massachusetts Institute of Technology

JEFFREY VANDERKAM
Analytic Number Theory
Princeton University

VLADIMIR VOEVODSKY
K-theory and Arithmetical Algebraic Geometry
Northwestern University

VAN VU
Algebraic and Probabilistic Methods in Combinatorics
Yale University

AVI WIGDERSON
Theoretical Computer Science
The Hebrew University of Jerusalem, Israel

ANDREW WILES
Algebraic Number Theory
Princeton University · *s*

STEVEN ZUCKER
Hodge Theory, Shimura Varieties
Johns Hopkins University

f First Term · *s* Second Term · *v* Visitor · *a* Research Assistant

THE SCHOOL OF MATHEMATICS

RECORD OF EVENTS

The following is a calendar of events sponsored by the School of Mathematics

Combinatorics and Complexity Theory Seminar:
"A Sublinear Bipartite Tester for Bounded-degree Graphs"
DANA RON, *Massachusetts Institute of Technology*

Combinatorics and Complexity Theory Seminar:
"Constructions of Near-optimal Extractors Using Pseudo-random Generators"
LUCA TREVISAN, *Columbia University/DIMACS*

Geometric Methods in Representation Theory Seminar:
"Intersection Homology of Periodic Flag Spaces"
IVAN MIRKOVIC, *Institute for Advanced Study*
"Cohomological Support of Tilting Modules"
MICHAEL FINKELBERG, *Institute for Advanced Study*

Baby Representation Theory/Geometry Seminar:
"Springer Correspondence"
KONSTANZE RIETSCH, *Institute for Advanced Study*

Working Seminar in Algebraic Combinatorics:
"The Cd-index of Polytopes"
RICHARD EHRENBORG, *Institute for Advanced Study*

Turbulence Theory Seminar: "Weak Solutions of the Euler Equations and Their Possible Significance in the Turbulence Problem"
ALEXANDER SHNIRELMAN, *Institute for Advanced Study*

Combinatorics and Complexity Theory Seminar:
"Resolution Made Simple"
AVI WIGDERSON, *Institute for Advanced Study* and *The Hebrew University of Jerusalem, Israel*

Geometric Methods in Representation Theory Seminar:
"Intersection Homology of Periodic Flag Spaces"
IVAN MIRKOVIC, *Institute for Advanced Study*
"Hilbert Schemes and the Heisenberg Algebra"
HIRAKU NAKAJIMA, *Institute for Advanced Study*

Baby Representation Theory/Geometry Seminar:
"D-modules on Flag Varieties"
DENNIS GAITSGORY, *Institute for Advanced Study*

Number Theory Seminar: "Linear Independence of Hecke Operators"
JEFFREY VANDERKAM, *Institute for Advanced Study*

Working Seminar in Algebraic Combinatorics:
"The Cd-index, Part II: Existence and Coalgebra Techniques"
RICHARD EHRENBORG, *Institute for Advanced Study*

Princeton-IAS-Rutgers Nonlinear Analysis Seminar:
"On a Fourth Order PDE in Conformal Geometry"
ALICE CHANG, *Princeton University* and *University of California, Los Angeles* and PAUL YANG, *Princeton University* and *University of Southern California*

Combinatorics and Complexity Theory Seminar:
"Digraph Minors"
PAUL SEYMOUR, *Princeton University*

Members Seminar: "Asymptotics for Random Permutations: A Determinantal Approach"
PERCY DEIFT, *Institute for Advanced Study*

Determinants in Pure and Applied Mathematics:
"Integrable Operators, Riemann-Hilbert Problems and Determinants"
PERCY DEIFT, *Institute for Advanced Study*

Geometric Methods in Representation Theory Seminar: "Intersection Homology of Periodic Flag Spaces"
MICHAEL FINKELBERG, *Institute for Advanced Study*

Baby Representation Theory/Geometry Seminar:
"Sheaves on Affine Grassmannians, Part II"
GEORGE LUSZTIG, *Institute for Advanced Study*

Number Theory Seminar: "Multiplicities of Cuspidal Representations of SL(n)"
EREZ LAPID, *Institute for Advanced Study*

Working Seminar in Algebraic Combinatorics:
"The Cd-index, Part III: Coalgebras and Inequalities"
RICHARD EHRENBORG, *Institute for Advanced Study*

Princeton-IAS-Rutgers Harmonic Analysis/Number Theory: "Towards a Siegel-Weil Formula in Exceptional Groups"
WEE TECK GAN, *Institute for Advanced Study*

Princeton-IAS-Rutgers Nonlinear Analysis Seminar:
"The Construction of Global Surfaces of Section in Three-dimensional Dynamical Systems Via First Order Elliptic Systems"
HELMUT HOFER, *New York University, Courant Institute*
"On Fine Properties of Eigen Values of Analytic Matrix Functions"
MICHAEL GOLDSTEIN, *University of Toronto*

Minicourse on Perverse Sheaves: "Derived Categories and Functors II"
ALEXANDER KIRILLOV, *Institute for Advanced Study*

Turbulence Theory Seminar: "Statistics of Burgers Turbulence"
WEINAN E, *New York University, Courant Institute*

Combinatorics and Complexity Theory Seminar:
"On the Action of the Symmetric Group on the Selected-type Partition Lattices"
DMITRY KOZLOV, *Institute for Advanced Study*

Minicourse on Perverse Sheaves: "Introduction to D-modules, Part I"
SERGEY ARKHIPOV, *Institute for Advanced Study*

Geometric Methods in Representation Theory Seminar:
"Character Sheaves"
GEORGE LUSZTIG, *Institute for Advanced Study*
"Quiver Varieties"
HIRAKU NAKAJIMA, *Institute for Advanced Study*

Baby Representation Theory/Geometry Seminar:
"Affine Grassmanians, Part III"
IVAN MIRKOVIC, *Institute for Advanced Study*

Working Seminar in Algebraic Combinatorics:
"An Overview of the Pattern Avoidance Problem"
MIKLOS BONA, *Institute for Advanced Study*

Minicourse on Perverse Sheaves: "Introduction to D-modules, Part II"
SERGEY ARKHIPOV, *Institute for Advanced Study*

IAS/DIMACS Workshop on Randomized and Derandomized Algorithms for Discrete Structures
Organizers: NOGA ALON, ALAN FRIEZE, BRUCE REED
MIKI SIMONOVITS: "The Regularity Lemma and Its Applications"
GABOR SARKOZY: "The Regularity Lemma and the Blow-up Lemma"
RAPHY YUSTER: "Decomposing Hypergraphs with Hypertrees"
ANDRZEJ RUCINSKI: "How to Avoid the Regularity Lemma"
YOSHIHARU KOHAYAKAWA: "Embeddings of Small Graphs in Sparse Regular Graphs"
JEONG HAN KIM: "Small Complete Arcs in Projective Planes"
VIJAY VAZIRANI: "Majorizing Estimators and the Approximation of #P-complete Problems"
ANDREW THOMASON: "Colouring by Hereditary Properties"
PENNY HAXELL: "Integer and Fractional Packings in Dense Graphs"
LUBOS THOMA: "On Dependent Arcs in Acyclic Orientations"
JOEL SPENCER: "Packing Random Rectangles"
SARMAD ABBASI: "Spanning Subgraphs of Dense Graphs"
RAVI KANNAN: "Low Rank Approximations, Regularity and Clustering"
VAN VU: "On the List-chromatic Number of Locally Sparse Graphs"
MICHAEL KRIVELEVICH: "Testing Bipartiteness Efficiently"
JANOS KOMLOS: "Tiling Turan Theorems"
HANNO LEFMANN: "Independent Sets in Graphs and Hypergraphs and Applications"

ANDRZEJ CZYGRINOW: "The Algorithmic Aspects of the Hypergraph Regularity Lemma"

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Minicourse on Perverse Sheaves: "Sheaves"
MIKHAIL KHOVANOV, *Institute for Advanced Study*

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Determinants in Pure and Applied Mathematics:
"The Determinant Representations for Quantum Correlation Functions of Completely Integrable Systems"
VLADIMIR KOREPIN, *State University of New York, Stony Brook*

Geometric Methods in Representation Theory Seminar:
"Character Sheaves, Part II"
GEORGE LUSZTIG, *Institute for Advanced Study*
"Quiver Varieties, Part II"
HIRAKU NAKAJIMA, *Institute for Advanced Study*

[illegible]
Baby Representation Theory/Geometry Seminar:
"Affine Grassmanians, Part IV"
DENNIS GAITSGORY, *Institute for Advanced Study*

Number Theory Seminar: "Cycles on Families of Abelian Surfaces"
RAMESH SREEKANTAN, *Institute for Advanced Study*

Special PDE Seminar: "Chaos in PDE"
YANGUANG (CHARLES) LI, *Institute for Advanced Study*

Working Seminar in Algebraic Combinatorics:
"Cells in the Group of R-signed Permutations"
PETER TRAPA, *Institute for Advanced Study*

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Minicourse on Perverse Sheaves: "Introduction to D-modules, Part III"
SERGEY ARKHIPOV, *Institute for Advanced Study*

Princeton-IAS-Rutgers Nonlinear Analysis Seminar:
"Reflection on the History of PDE"
FELIX BROWDER, *Rutgers University*
"Functions of Bounded Higher Variation"
ROBERT JERRARD, *University of Illinois, Urbana*

[illegible]
Special Seminar: "A Global View of Dynamics"
JACOB PALIS, *Institute of Pure & Applied Mathematics, Brazil*

Turbulence Theory Seminar: "Passive Scalar Advection: New Experimental Results"
ZELLMAN WARHAFT, *Cornell University* and *Princeton University*

[illegible]
Combinatorics and Complexity Theory Seminar:
"Time-Space Tradeoffs for Boolean Branching Programs"
MICHAEL SAKS, *Rutgers University*

Members Seminar: "Hermitian Vector Bundles, Slopes and Diophantine Approximation"
JEAN-BENOIT BOST, *Institute for Advanced Study*

Minicourse on Perverse Sheaves: "Introduction to D-modules, Part IV"
SERGEY ARKHIPOV, *Institute for Advanced Study*

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Geometric Methods in Representation Theory Seminar:
"Character Sheaves, Part III"
GEORGE LUSZTIG, *Institute for Advanced Study*
"Quiver Varieties, Part III"
HIRAKU NAKAJIMA, *Institute for Advanced Study*

[illegible]
Baby Representation Theory/Geometry Seminar:
"Equivariant D-modules on a Semi-simple Lie with Support in the Nilpotent Cone"
DAVID RENARD, *Institute for Advanced Study*

Working Seminar in Algebraic Combinatorics: "Cells in the Group of R-signed Permutations, Part II"
PETER TRAPA, *Institute for Advanced Study*

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Minicourse on Perverse Sheaves: General Discussion

Princeton-IAS-Rutgers Harmonic Analysis/Number Theory: "Divisibility of Class Numbers and Sieve Techniques"
ETIENNE FOUVRY, *Université d'Orsay*

[illegible]
Math/Physics Seminar: "A Canonical Quantization of the Baker's Map"
RON RUBIN, *Massachusetts Institute of Technology*

[illegible]
Combinatorics and Complexity Theory Seminar:
"Dependent Percolation in Two Dimensions"
BELA BOLLOBAS, *Memphis State University* and *Cambridge University*

Members Seminar: "The Shannon Capacity of Graphs"
NOGA ALON, *Institute for Advanced Study*

Minicourse on Perverse Sheaves: "Borel-Moore-Verdier Duality"
MARK GORESKY, *Institute for Advanced Study*

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Determinants in Pure and Applied Mathematics:
"Determinants and Statistical Mechanics in Two Dimensions"
TOM SPENCER, *Institute for Advanced Study*

Geometric Methods in Representation Theory Seminar:
"Character Sheaves, Part IV"
GEORGE LUSZTIG, *Institute for Advanced Study*
"Quiver Varieties, Part IV"
HIRAKU NAKAJIMA, *Institute for Advanced Study*

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Baby Representation Theory/Geometry Seminar:
"Representations of Hecke Algebras Via Equivariant K-theory"
ROMAN BEZRUKAVNIKOV, *Institute for Advanced Study*
Minicourse on Perverse Sheaves: "Intersection Cohomology Sheaves"
MARK GORESKY, *Institute for Advanced Study*

Number Theory Seminar: "Arakelov Geometry and Diophantine Approximation on Abelian Varieties"
JEAN-BENOIT BOST, *Institute for Advanced Study*

Working Seminar in Algebraic Combinatorics:
"Toric Varieties for Combinatorialists"
MARK McCONNELL, *Institute for Advanced Study*

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Princeton-IAS-Rutgers Harmonic Analysis/Number Theory: "Period Functions Associated to Maass Waveforms and Spectral Theory on the Modular Surface"
JOHN LEWIS, *Framingham State College*

Princeton-IAS-Rutgers Nonlinear Analysis Seminar:
"New Global Wellposedness Results for NLS"
JEAN BOURGAIN, *Institute for Advanced Study*

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Number Theory Seminar: "Arakelov Geometry and Diophantine Approximation on Abelian Varieties (continued)"
JEAN-BENOIT BOST, *Institute for Advanced Study*

Turbulence Theory Seminar: "Turbulent Transport of Passive Scalar and Vector Fields"
IGOR ROGACHEVSKI, *Ben-Gurion University*

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Combinatorics and Complexity Theory Seminar:
"Shor's Quantum Factorization Algorithm"
DORIT AHARONOV, *Institute for Advanced Study*

Members Seminar: "The Quest for Ghosts on Shimura Varieties"
STEVE ZUCKER, *Institute for Advanced Study*

Minicourse on Perverse Sheaves: "T-structures and Perverse Sheaves"
ALEXANDER KIRILLOV, *Institute for Advanced Study*

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Determinants in Pure and Applied Mathematics:
"Random Matrix Models for Spectra"
PETER SARNAK, *Princeton University*

Geometric Methods in Representation Theory Seminar:
"Character Sheaves, Part V"
GEORGE LUSZTIG, *Institute for Advanced Study*
"Quiver Varieties, Part V"
HIRAKU NAKAJIMA, *Institute for Advanced Study*

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Working Seminar in Algebraic Combinatorics:
"Toric Varieties for Combinatorialists, Part II"
MARK McCONNELL, *Institute for Advanced Study*

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Combinatorics and Complexity Theory Seminar:
"On the Bidirected Cut Relaxation for the Metric Steiner Tree Problem"
VIJAY VAZIRANI, *Georgia Tech*

Members Seminar: "Random Packings of Spheres"
SALVATORE TORQUATO, *Institute for Advanced Study*

Minicourse on Perverse Sheaves: "Perverse Sheaves, Part II"
ALEXANDER KIRILLOV, *Institute for Advanced Study*

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Determinants in Pure and Applied Mathematics:
"On the Riemann-Hilbert approach to the asymptotic analysis of the correlation functions of the quantum nonlinear Schroedinger equation. Non-free fermionic case"
ALEXANDER ITS, *Indiana University, Purdue University, Indianapolis*

Geometric Methods in Representation Theory Seminar:
"Character Sheaves, Part VI"
GEORGE LUSZTIG, *Institute for Advanced Study*
"Quiver Varieties, Part VI"
HIRAKU NAKAJIMA, *Institute for Advanced Study*

Baby Representation Theory/Geometry Seminar: "Representations of Hecke Algebras Via Equivariant K-theory, Part II"
ROMAN BEZRUKAVNIKOV, *Institute for Advanced Study*

Minicourse on Perverse Sheaves: "Intersection Cohomology Sheaves"
MICHAEL FINKELBERG, *Institute for Advanced Study*

Working Seminar in Algebraic Combinatorics: "On Cohomology Algebras of Subspace Arrangements"
EVA MARIA FEICHTNER, *Institute for Advanced Study*

Princeton-IAS-Rutgers Harmonic Analysis/Number Theory: "An Explicit Construction of an Automorphic Descent Map from Self-dual GL (N)-modules to Modules on Classical Groups"
STEVEN RALLIS, *Ohio State University*
Princeton-IAS-Rutgers Nonlinear Analysis Seminar: "Unusual Questions About S1-valued Sobolev Spaces. Applications to Ginzburg-Landau"
HAIM BREZIS, *Rutgers University* and *Université Paris VI*

Turbulence Theory Seminar: "Instanton for the Kraichnan Passive Scalar Problem"
EUGENI BALKOVSKY, *Weizmann Institute of Science, Israel*

Combinatorics and Complexity Theory Seminar: "Combinatorial Uses of Entropy"
JEFF KAHN, *Rutgers University*

Minicourse on Perverse Sheaves: "Perverse Sheaves on a Triangulated Space (After A. Polishchuk)"
MAXIM VYBORNOV, *Yale University*

Special Math Physics Seminar: "Random Walks, Percolation, and Quantum Gravity in Two Dimensions"
BERTRAND DUPLANTIER, *Centre d'Etudes Nuclaires de Saclay, France*

Determinants in Pure and Applied Mathematics: "Random Unitary Matrices, Permutations and Painleve"
CRAIG TRACY, *University of California, Davis*

Geometric Methods in Representation Theory Seminar:
"Character Sheaves, Part VII"
GEORGE LUSZTIG, *Institute for Advanced Study*

"Quiver Varieties, Part VII"
HIRAKU NAKAJIMA, *Institute for Advanced Study*

Minicourse on Perverse Sheaves: "Perverse Sheaves"
MIKHAIL KHOVANOV, *Institute for Advanced Study*

Princeton-IAS-Rutgers Harmonic Analysis/Number Theory: "Intersecting a Curve with Algebraic Subgroups of a Multiplicative Group"
ENRICO BOMBIERI, *Institute for Advanced Study*

Special Seminar: "Using PostScript for Mathematical Illustration"
WILLIAM CASSELMAN, *University of British Columbia*

Special Analysis and Control Theory Seminar: "Singular Integral Operators and Upper Bounds for Structured Singular Value μ"
SERGEI TREIL, *Massachusetts Institute of Technology* and *Michigan State*

Special Math Biology Seminar: "Mathematical Models for the Evolution of Language"
MARTIN NOWAK, *Institute for Advanced Study*

Combinatorics and Complexity Theory Seminar: "Arithmetic Progressions in Finite Sets"
JEAN BOURGAIN, *Institute for Advanced Study*

Minicourse on Perverse Sheaves: "Perverse Sheaves and Small Resolutions"
MIKHAIL KHOVANOV, *Institute for Advanced Study*

Working Seminar in Algebraic Combinatorics: "Operator Matching, Scaling, and Sinkhorn's Iteration"
LEONID GURVITS, *NECI/Technion, Israel*

Minicourse on Perverse Sheaves: Discussion Group

Princeton-IAS-Rutgers Nonlinear Analysis Seminar: "Fine Analysis of Blowup and Applications"
YANYAN LI, *Rutgers University*
"Topology, Variational Problems, and Geometric Complexity"
STEPHEN SEMMES, *Rice University*

Turbulence Theory Seminar: "Delocalization by Disorder: Non-Fermi Liquid as Passive Scalar Fluid"
JONATHAN MILLER, *NEC Research Institute*

"Configuration Spaces and Stasheff Polyhedra"
PIERRE CARTIER, *École Normale Supérieure, Paris*

January 15
Combinatorics and Complexity Theory Seminar:
"Testing Regular Languages"
MICHAEL KRIVELEVICH, *DIMACS Center, Rutgers University*

Minicourse on Perverse Sheaves: Review and Discussion

Geometric Methods in Representation Theory Seminar:
"Semi-infinite Construction of Representations, Part I"
BORIS FEIGIN, *Landau Institute*
"Geometric Proof of the Casselman-Shalika Formula"
DENNIS GAITSGORY, *Institute for Advanced Study*

Around Quantization Seminar: "From Knizhnik-Zamolodchikov Equations to the Structure of Hecke Algebras"
PIERRE CARTIER, *École Normale Supérieure, Paris*

Workshop on Discrete Geometry and The Kepler Problem: "What Are All the Best Sphere Packings in Low Dimension?"
JOHN CONWAY, *Princeton University*

Combinatorics and Complexity Theory Seminar:
"A Combinatorial Proof of the Log-concavity of the Numbers of Permutations with k Runs"
MIKLOS BONA, *Institute for Advanced Study*

Minicourse on Perverse Sheaves: "Introduction to Etale Cohomology, Part I"
MADHAV NORI, *Institute for Advanced Study*

Geometric Methods in Representation Theory Seminar:
"Semi-infinite Construction of Representations, Part II"
BORIS FEIGIN, *Landau Institute*
"Representations of P-adic Groups and Kashiwara Crystals"
ALEXANDER BRAVERMAN, *Institute for Advanced Study*

Around Quantization Seminar: "Homotropy - Everything Algebras"
PIERRE CARTIER, *École Normale Supérieure, Paris*

Baby Representation Theory/Geometry Seminar:
"Quiver Varieties of Type A"
ANDREA MAFFEI, *Institute for Advanced Study*

January 28
Around Quantization Seminar: "On the Classification of Star Products"
PIERRE CARTIER, *École Normale Supérieure, Paris*

Princeton-IAS-Rutgers Nonlinear Analysis Seminar:
"On a New Proof of the Stability of Minkowski Space in General Relativity"
SERGIU KLAINERMAN, *Princeton University*

Minicourse on Perverse Sheaves: "Introduction to Etale Cohomology, Part II"
MADHAV NORI, *Institute for Advanced Study*

Combinatorics and Complexity Theory Seminar:
"Groups and Expanders"
YEHUDA SHALOM, *Princeton University*

Members Seminar: "The Congruence Subgroup Problem and Computation of the Metaplectic Kernel"
GOPAL PRASAD, *Institute for Advanced Study*

Minicourse on Perverse Sheaves: "Introduction to Etale Cohomology, Part III: The Six Operators"
PIERRE DELIGNE, *Institute for Advanced Study*

Geometric Methods in Representation Theory Seminar:
"Canonical Bases and Quantum SL(N) at Roots of Unity"
ERIC VASSEROT, *Cergy-Pontoise, France*
"Beilinson's Sheaf-theoretic Construction of the Center of Affine Hecke Algebra, and Nilpotent Classes Attached to Double Cells"
ROMAN BEZRUKAVNIKOV, *Institute for Advanced Study*

Number Theory Seminar: "Galois Deformations and Automorphic Representations"
KAZUHIRO FUJIWARA, *Institute for Advanced Study*

Princeton-IAS-Rutgers Harmonic Analysis/Number Theory: "New Estimates for L-functions"
H. IWANIEC, *Rutgers University*

Minicourse on Perverse Sheaves: "Introduction to Etale Cohomology, Part IV: The Six Operators and Perverse Sheaves"
PIERRE DELIGNE, *Institute for Advanced Study*

Combinatorics and Complexity Theory Seminar: "Small Complete Arcs in Projective Planes"
VAN VU, *Institute for Advanced Study*

Members Seminar: "The Existence of Motives in Characteristic Zero"
MADHAV NORI, *Institute for Advanced Study*

Minicourse on Perverse Sheaves: "Introduction to Etale Cohomology, Part V: Weights, Purity and Decomposition Theorem"
PIERRE DELIGNE, *Institute for Advanced Study*

Geometric Methods in Representation Theory: "Semi-infinite Cohomology of Quantum Groups and Coherent Sheaves on the Steinberg Variety"
SERGEY ARKHIPOV, *Institute for Advanced Study*
"Semi-infinite Construction of Representations, Part III"
BORIS FEIGIN, *Landau Institute, Chernogolovka*

Baby Representation Theory/Geometry Seminar: "Introduction to Semi-infinite Cohomology"
SERGEY ARKHIPOV, *Institute for Advanced Study*

Number Theory Seminar: "Galois Deformations and Automorphic Representations, Part II"
KAZUHIRO FUJIWARA, *Institute for Advanced Study*

Working Seminar in Algebraic Combinatorics: "Tableaux, Hyperplanes and Constructing Representations"
ARUN RAM, *Princeton University*

Princeton-IAS-Rutgers Nonlinear Analysis Seminar: "Some Progress Toward Jaffe and Taubes Conjectures"
TRISTAN RIVIERE, *Centre National de la Recherche Scientifique, Paris*
"On the Nonlinear Stability of Minkowski Space, Part II"
SERGIU KLAINERMAN, *Princeton University*

Minicourse on Perverse Sheaves: "Introduction to Etale Cohomology, Part VI: Weights, Purity and Decomposition Theorem"
PIERRE DELIGNE, *Institute for Advanced Study*

Turbulence Theory Seminar: "Accelerated Inhomogeneous Flows: Richtmyer-Meshkov and Raleigh-Taylor Vortex Dynamical Evolutions and Mixing"
NORMAN ZABUSKY, *Rutgers University*

Geometric Methods in Representation Theory Seminar:
"Bases in Equivariant K-theory, Part I"
GEORGE LUSZTIG, *Institute for Advanced Study*
"Geometric Langlands Correspondence, Part I"
DENNIS GAITSGORY, *Institute for Advanced Study*

Number Theory Seminar: "Galois Deformations and Automorphic Representations, Part III"
KAZUHIRO FUJIWARA, *Institute for Advanced Study*

Working Seminar in Algebraic Combinatorics: "Tableaux, Hyperplanes and Constructing Representations, Part II"
ARUN RAM, *Princeton University*

Princeton-IAS-Rutgers Harmonic Analysis/Number Theory: "Periods of Eisenstein Series"
EZRA LAPID, *Institute for Advanced Study*

Princeton-IAS-Rutgers Nonlinear Analysis Seminar: "Geometry of Special Sets Associated with Solutions of PDE"
FANG-HUA LIN, *New York University, Courant Institute*

Minicourse on Perverse Sheaves: "Basic Constructions for Perverse Sheaves on Affine Flag and Grassman Varieties"
ROMAN BEZRUKAVNIKOV, *Institute for Advanced Study*

Combinatorics and Complexity Theory Seminar: "Touching and Representing Convex Sets"
MEIR KATCHALSKI, *Rutgers University* and *Technion, Israel*

Members Seminar: "Conformal Geometry of Planar Domains"
ILIA BINDER, *Institute for Advanced Study*

Geometric Methods in Representation Theory Seminar:
"Bases in Equivariant K-theory, Part II"
GEORGE LUSZTIG, *Institute for Advanced Study*
"Geometric Langlands Correspondence (after Beilinson and Drinfeld), Part II"
DENNIS GAITSGORY, *Institute for Advanced Study*

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Number Theory Seminar: "Galois Deformations and Automorphic Representations, Part IV"
KAZUHIRO FUJIWARA, *Institute for Advanced Study*

Working Seminar in Algebraic Combinatorics: "Tableaux, Hyperplanes and Constructing Representations, Part III"
ARUN RAM, *Princeton University*

[illegible]

Minicourse on Perverse Sheaves: "Loop Grassmanian Construction of the Group Algebra and the Enveloping Algebra of the Dual Group"
IVAN MIRKOVICH, *Institute for Advanced Study*
Turbulence Theory Seminar: "Quantum Mechanics of Turbulent Scalar Decay"
DAN THANH SON, *Massachusetts Institute of Technology*

[illegible]

Members Seminar: "Morse Theory on the Space of Closed Curves"
NANCY HINGSTON, *Institute for Advanced Study*

Combinatorics and Complexity Theory Seminar: "Some Problems in Algebraic Complexity"
AVI WIGDERSON, *Institute for Advanced Study*

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Geometric Methods in Representation Theory Seminar:
"Bases in Equivariant K-theory, Part III"
GEORGE LUSZTIG, *Institute for Advanced Study*
Geometric Langlands Correspondence (after Beilinson and Drinfeld), Part III
DENNIS GAITSGORY, *Institute for Advanced Study*

[illegible]

Number Theory Seminar: "Galois Deformations and Automorphic Representations, Part V"
KAZUHIRO FUJIWARA, *Institute for Advanced Study*

Special Analysis Seminar: "Universal Covering Maps and Radial Variation"
PAUL MULLER LINZ, *Yale University*

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Princeton-IAS-Rutgers Harmonic Analysis/Number Theory: "Curves Associated to Certain Rings of Automorphic Forms"
KAMAL KHURI-MAKDISI, *McGill University*

[illegible]

Minicourse on Perverse Sheaves: "Nearby Cycles Construction of Central Sheaves on Affine Flag Variety and Some Applications"
ROMAN BEZRUKAVNIKOV, *Institute for Advanced Study*

[illegible]

Combinatorics and Complexity Theory Seminar: "Approximation Algorithms for the K-median Problem, and Other Clustering Problems"
EVA TARDOS, *Cornell University*

Members Seminar: "Dimensional Estimates for Vassiliev Invariants of Knots"
YONGWU RONG, *Institute for Advanced Study*

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Geometric Methods in Representation Theory Seminar:
"Bases in Equivariant K-theory, Part IV"
GEORGE LUSZTIG, *Institute for Advanced Study*
"Parabolic Sheaves on Surfaces and SLn"
MICHAEL FINKELBERG, *Institute for Advanced Study*

[illegible]

Number Theory Seminar: "Galois Deformations and Automorphic Representations, Part VI"
KAZUHIRO FUJIWARA, *Institute for Advanced Study*

[illegible]

Princeton-IAS-Rutgers Nonlinear Analysis Seminar: "Analytic Aspects of Inverse Mean Curvature Flow and Applications to General Relativity"
GERHART HUISKEN, *Princeton University*

Princeton-IAS-Rutgers Harmonic Analysis/Number Theory: "Non-vanishing of Quadratic Dirichlet L-functions at s=1/2"
SOUNDARARAJAN KANNAN, *Princeton University*

Special Geometric Methods in Representation Theory: "Bernstein's Center and the Lifting"
DAVID KAZHDAN, *Harvard University*

[illegible]

Minicourse on Perverse Sheaves: "Loop Grassmanian Construction of the Group Algebra and the Enveloping Algebra of the Dual Group, Part II"
IVAN MIRKOVICH, *Institute for Advanced Study*

Turbulence Theory Seminar: "Burgers Turbulence in d Dimensions"
STAS BOLDYREV, *Princeton University*

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Combinatorics and Complexity Theory Seminar: "Statistical Zero-Knowledge: An Introduction and a Survey of Recent Developments"
SALIL VADHAN, *Massachusetts Institute of Technology*

Geometric Methods in Representation Theory Seminar: "Bases in Equivariant K-theory, Part V"
GEORGE LUSZTIG, *Institute for Advanced Study*
"Towards Geometric Realizations of the Category of Representations of the Small Quantum Group"
ALEXANDER BRAVERMAN, *Institute for Advanced Study*

Dynamical System Workshop:
"Hydrodynamic Instability for Certain ABC Flows"
SUSAN FRIEDLANDER, *Institute for Advanced Study* and MIKHAIL VISHIK, *University of Texas, Austin*
"Transport in Chaotic Flow: Universal Dependence on Frequency and the Effects of Molecular Diffusion"
VERED ROM-KEDAR, *Weizmann Institute of Science, Israel* and CIMS
"Singularly Perturbed NLS Systems"
CHONGCHUN ZENG, *New York University, Courant Institute*
"Spatial-temporal Chaos and Effects of Stochastic Dynamics"
DAVID CAI, *New York University, Courant Institute*
"Buckling of Fibers: Nonlinear Boundary Value Problems"
PHIL HOLMES, *Princeton University*
"Stability of a Self-Similar 3-dimensional Gas Flow"
WEN-CHING LIEN, *Institute for Advanced Study*
"Homoclinic Trajectories in a Model of Second-Harmonic Generation in a Passive Optical Cavity"
GREGOR KOVACIC, *Rensselaer Polytechnic Institute*
"Random Walks Along Orbits of Dynamical Systems (Joint work with YA. G. SINAI)"
VADIM KALOSHIN, *Princeton University*
"Chaos in Partial Differential Equations"
CHARLES LI, *Institute for Advanced Study*

Minicourse on Perverse Sheaves: "The Formalism of Vanishing Cycles"
PIERRE DELIGNE, *Institute for Advanced Study*

Members Seminar: "Representations of P-adic Groups and the Plancherel Formula"
VOLKER HEIERMANN, *Institute for Advanced Study*

Combinatorics and Complexity Theory Seminar:
"Algebraic Problems Raised in Complexity Theory"
MARIO SZEGEDY, *AT&T*

Geometric Methods in Representation Theory Seminar:
"Quiver Varieties and Quantum Affine Enveloping Algebras"
HIRAKU NAKAJIMA, *Institute for Advanced Study*

"Coinvariants for Affine Lie Algebras: The Gluing Axiom"
ALEXANDER KIRILLOV, *Institute for Advanced Study*

Number Theory Seminar: "Construction of Tame Supercuspidal Representations"
J.-K. YU, *Princeton University*

Working Seminar in Algebraic Combinatorics:
"Linear Inequalities for Flag Numbers in Graded Partially Ordered Sets"
GABOR HETYEI, *University of Kansas*

Princeton-IAS-Rutgers Nonlinear Analysis Seminar:
"Local Well-posedness of Nonlinear Wave Equations of Null Form Type: A Survey of Some Recent Results"
SIGMUND SELBERG, *Institute for Advanced Study*

Geometric Methods in Representation Theory Seminar: "Quiver Varieties and Quantum Affine Enveloping Algebras, Part II"
HIRAKU NAKAJIMA, *Institute for Advanced Study*

Turbulence Theory Seminar: "Instabilities in MHD"
SUSAN FRIEDLANDER, *Institute for Advanced Study*

Combinatorics and Complexity Theory Seminar:
"Eulerian Digraph Immersion"
THOR JOHNSON, *Princeton University*

Marston Morse Memorial Lecture: "Gauge Theory and Low Dimensional Topology: Past, Present and Future, Part I"
TOMASZ MROWKA, *Massachusetts Institute of Technology*

Marston Morse Memorial Lecture: "Gauge Theory and Low Dimensional Topology: Past, Present and Future, Part II"
TOMASZ MROWKA, *Massachusetts Institute of Technology*

Geometric Methods in Representation Theory Seminar: "Double Coset Algebras for Groups Over Q_p((t)) and Cherednik's Double Affine Algebras"
MIKHAIL KAPRANOV, *Northwestern University*

Marston Morse Memorial Lecture: "Gauge Theory and Low Dimensional Topology: Past, Present and Future, Part III"
TOMASZ MROWKA, *Massachusetts Institute of Technology*

Princeton-IAS-Rutgers Harmonic Analysis/Number Theory: "Holomorphy and Boundedness of the Third Symmetric Power L-functions for GL(2)"
FREYDOON SHAHIDI, *Purdue University*

Geometric Methods in Representation Theory Seminar:
"Projective Functors and Representations of SL2"
MIKHAIL KHOVANOV, *Institute for Advanced Study*
"Two Geometric Realizations of the Derived Category of Modules Over the Big Quantum Group"
ROMAN BEZRUKAVNIKOV, *Institute for Advanced Study*

Princeton-IAS-Rutgers Harmonic Analysis/Number Theory: "Rogers-Ramanujan Identities: A Convergence of Q Series, Partitions, Algebra, Function Theory and Physics"
BARRY McCOY, *State University of New York*

Special Random Matrix Theory Seminar:
"Dual Pairs and Random Matrix Theory"
MARTIN R. ZIRNBAUER, *Princeton University*
"Random Matrices and Random Permutations"
ANDREI OKUNKOV, *University of Chicago*

Turbulence Theory Seminar: "Adaptive Mesh Refinement for Ideal Two-dimensional Magneto-hydrodynamics"
CHRISTIANE MARLIANI, *New York University, Courant Institute*

Combinatorics and Complexity Theory Seminar:
"Arithmetic Progressions in Sparse Sets"
TIMOTHY GOWERS, *University of Cambridge*

Princeton-IAS-Rutgers Nonlinear Analysis Seminar:
"The Geometry of a Contact Form and a Vector-field in its Kernel"
ABBAS BAHRI, *Rutgers University*
"Recent Results on Necessary Conditions for Curve Minimization Problems"
HECTOR SUSSMANN, *Rutgers University*

Princeton-IAS-Rutgers Harmonic Analysis/Number Theory: "On Spectral Gap for Nonarithmetic Subgroups of SL(2,Z)"
ALEX GAMBURD, *Princeton University*

Princeton-IAS-Rutgers Nonlinear Analysis Seminar:
"On 3D Ginzburg-Landau Functionals and Minimizers"
JEAN BOURGAIN, *Institute for Advanced Study*

Turbulence Theory Seminar: "Two-dimensional Turbulence in the Inverse Cascade Range"
VICTOR YAKHOT, *Boston University*

Princeton-IAS-Rutgers Harmonic Analysis/Number Theory: "On the Rank of Elliptic Curves"
JOSEPH SILVERMAN, *Brown University*

Special Seminar: "The Geometry of Classical Particles"
MICHAEL ATIYAH, *University of Edinburgh*

Turbulence Theory Seminar: "Small-scale Turbulent Dynamo"
IGOR KOLOKOLOV, *Budker Institute* and
MICHAEL CHERTKOV, *Princeton University*

"My stay at the Institute has been an exciting adventure; in addition to our very penetrating and fruitful research, my attendance at seminars and colloquia has been invaluable in bringing me into contact with a wide range of physics and mathematics."

— Member, School of Natural Sciences

From left: Institute Trustee Richard Black with John March-Russell, Mark Alford, and Christopher Kolda, former Members in the School of Natural Sciences.

THE SCHOOL OF NATURAL SCIENCES

STEPHEN L. ADLER, Particle Physics, *New Jersey Albert Einstein Professor*
JOHN N. BAHCALL, Astrophysics, *Richard Black Professor*
PIET HUT, Astrophysics
NATHAN SEIBERG, Theoretical Physics
FRANK WILCZEK, Theoretical Physics, *J. Robert Oppenheimer Professor*
EDWARD WITTEN, Mathematical Physics, *Charles Simonyi Professor*

PAWAN KUMAR, Astrophysics

FREEMAN J. DYSON, Mathematical Physics and Astrophysics

ACADEMIC ACTIVITIES

Part of PROFESSOR STEPHEN ADLER's work this year involved a continuation of his study of generalized quantum or trace dynamics, in which an action principle based on a total trace leads directly to operator equations of motion. Earlier work with Millard, Horwitz, and Kempf showed that under certain assumptions, the statistical mechanics of trace dynamics can function as a pre-quantum mechanics, with the canonical commutation relations of quantum field theory arising as an emergent property. Work this year, in collaboration with Horwitz, has focused on the goal of analyzing the quantum measurement problem in this framework. As a first step, Adler and Horwitz studied existing stochastic extensions of the Schrödinger equation, to see if there is one that could be a phenomenological approximation to an underlying pre-quantum dynamics. In a significant advance, they were able to prove that the stochastic dynamics on projective Hilbert space proposed by Hughston leads to state vector collapse to energy eigenstates, with collapse probabilities given by the quantum mechanical probabilities computed from the initial state. This is the first time that such a proof has been given for a stochastic modification of the Schrödinger equation with a generic Hamiltonian. Adler and Horwitz also showed that for a system composed of independent subsystems, Hughston's equation separates into similar independent equations for each of the subsystems, correlated only through the common Wiener process that drives the state reduction. Current work is directed at the problem of trying to find a connection between the Hughston equation and the corrections to Schrödinger evolution implied by trace dynamics.

In particle phenomenology, Adler made a detailed study of extensions of the standard model in which the three families are differentiated, before spontaneous symmetry breaking, by a discrete chiral quantum number based on the cube roots of unity, that is an exact symmetry of the low energy effective Lagrangian. This requires that the Higgs fields also come in families of three, differentiated by discrete chiral quantum numbers as well. Results of a detailed tree approximation analysis of such models with one or two triples

of Higgs doublets (i.e., with three or six Higgs doublets) were reported in two publications. The six-doublet model looks particularly interesting: it has a number of nice features and one very unpleasant feature. The nice features are that: (i) six Higgs doublets is an alternative way, if we don't find low energy supersymmetry, to get the three standard model running couplings to cross at a common point, (ii) for a wide class of Higgs potentials, the cross coupling of the two discrete chiral Higgs triplets, even if arbitrarily weak, produces spontaneous CP violation, (iii) in both the three- and six- Higgs models, the leading cyclically symmetric approximation gives a "democratic" mass matrix with all matrix elements equal to unity, and so has one heavy and two massless families, with a CKM matrix equal to unity, and (iv) when cyclic asymmetries are added as a perturbation, the degeneracy of the first two families results in their CKM mixing being zeroth order in the perturbation, while the mixings with the third family are first order in the perturbation. The unpleasant feature is that flavor changing neutral current effects are too large unless one set of Higgs states, at least, is very heavy - at least 17 TeV from fit independent bounds, and more like hundreds of TeV based on detailed fitting of the model to all of the mass and CKM matrix data. In the simplest scenario, in which the two Higgs discrete chiral triplets have similar structure but are weakly coupled, the only Higgs states in the LHC range would be pseudo-Goldstone phase oscillations between the Higgs chiral triplets. These constitute a set of three states, with charges Å1 and 0, and are distinguished from conventional Higgs states by the fact that they have as strong couplings to first and second family fermions as they do to third family fermions.

Finally, as his Dirac Prize lecture, Adler wrote a short historical review of his involvement in work dealing with aspects of chiral symmetry.

PROFESSOR JOHN BAHCALL concentrated on high energy ($> 10^{14}$ eV) and low energy (< 20 MeV) neutrinos. The high energy neutrinos can only be produced in astronomical sources. Together with Eli Waxman (Weizmann Institute of Science, Israel), Bahcall refined predictions for bursts of neutrinos from gamma ray bursts that could be observed by new experiments at the South Pole (under ice) and in the Mediterranean Ocean (under water). Bahcall and Waxman also clarified and strengthened their bound on the flux of high energy neutrinos that may come from all astronomical sources; this upper limit is based upon the observed number of high energy cosmic rays.

Together with Sarbani Basu (Institute for Advanced Study) and Marc Pinsonneault (Ohio State), Bahcall determined the accuracy with which solar measurements of pressure mode oscillation frequencies can measure the sound speed and density profiles. When models that are not very different from the standard solar model are used to invert the oscillation frequencies, then the sound speed and density profiles can be determined accurately, better than 0.1% and 1%, respectively.

Bahcall is leading a large collaboration that has obtained Hubble Space Telescope discretionary time for studying a nearby supernova if one should be discovered. The program, which requires special observations because of the large range of possible brightnesses of the yet unknown supernova, applies to supernova that might occur within 100 kpc of the sun.

PROFESSOR PIET HUT investigated the evolution of compact star clusters, using N-body simulations in which both stellar evolution and physical collisions between stars were taken into account. Observational consequences of the latter process are the

presence of blue stragglers and, in the case of run-away mergers, possibly the presence of one or more black holes. These investigations were based on large-scale simulations, using the GRAPE-4, a special-purpose computer developed by a group of astrophysicists at Tokyo University. The simulations formed part of a collaborative project with Jun Makino and Simon Portegies Zwart, from Tokyo University, and Steve McMillan, from Drexel University.

Hut organized a conference at Tokyo University, 'Astrophysics on the GRAPE Family of Special Purpose Computers,' in January 1999, together with Makino. They also published an invited review under the same title in *Science*. Currently, Hut is involved in the ongoing project to develop the GRAPE-6, which at a speed of more than 100 Tflops is expected to become once again the world's fastest computer in the year 2000, regaining the title that its predecessor, the GRAPE-4, had held in 1995 and 1996.

Together with co-author Douglas Heggie, from Edinburgh University, Hut finished the first draft of a monograph titled, 'The Gravitational Million-Body Problem.' While aimed primarily at graduate students in astrophysics, this book is also meant to convey some of the salient points of stellar dynamics to colleagues working in quite different areas, such as plasma physics and computer science.

Hut organized a summer school, titled 'Values in a World of Fact,' in August 1998, together with cognitive psychologist Roger Shepard, Stanford University; philosopher of science Bas van Fraassen, Princeton University; physicist Arthur Zajonc, Amherst College; and writer Steven Tainer, University of California, Berkeley. This was the first public offering of the Kira Institute (web site: http://www.kira.org), which they founded during the previous academic year.

Among several other interdisciplinary activities, Hut organized a session at the October 1988 State of the World Forum in San Francisco titled, 'The Role of the Subject in Science.' He also organized a conference, 'Ambiguity brought into Focus,' in March 1999, together with Hayao Kawai at the International Research Center for Japanese Studies, Kyoto. Among some of the invited talks he gave was a lecture, 'Science, Phenomenology, and World Views,' at a conference on Non-duality in Asian and Western Philosophy and Science at Columbia University, New York, in April 1999, and a lecture, 'Theory, Experiment, and Nature,' at a symposium on the philosophy of science at Leiden, Holland, in June 1999.

During the period 1998-99, VISITING PROFESSOR PAWAN KUMAR worked on the pulsation of the sun and gamma-ray bursts. His work with Sarbani Basu, an Institute Member, provided a theoretical fit to the lines in the power spectrum of the acoustic oscillation of the sun, which were observed to be not symmetric about their peaks, and provided an explanation as to why the asymmetry in velocity and intensity power spectra are opposite of each other. Kumar and Basu showed that turbulent convective eddies, which generate the acoustic oscillations in the sun, arriving at the bottom of the solar photosphere give rise to an observable intensity fluctuation, which is correlated with the oscillation they generate. This affects the shape of the lines in the acoustic mode power spectra and results in the reversal of the sense of asymmetry in the intensity spectra. Their theoretical calculations provide a good understanding and fit to the observed velocity power spectra; and this fit has been used to determine the location in the sun where the sources responsible for exciting the solar acoustic oscillations are located.

Gamma-ray bursts are extremely energetic and enigmatic phenomena involving an explosion of some object about which little is known. These bursts, where much of the energy

is radiated in the gamma-rays, typically last for a few seconds, and are detected at a frequency of roughly once a day originating in some random part of the sky. Recent observations have confirmed that these explosions are occurring at a distance of a few billion light-years from us in which the ejecta from the exploding object undergo collisions and their kinetic energy is converted to gamma-rays and other lower energy photons we detect. Kumar's work on gamma-ray bursts explored some consequences of this collision model, which was developed by Martin Rees of Cambridge University and Peter Meszaros of PennState University, among others. Kumar found that the conversion of kinetic energy of the ejecta to radiation, via internal shocks, is a rather inefficient process which has an efficiency of approximately 5%. Therefore, the total energy release in the explosion is larger than the energy in radiation by a factor of about twenty. This suggests that the energy involved in some of the most energetic gamma-ray bursts is larger than the energy in an exploding neutron star or a solar mass black hole.

During the last year PROFESSOR NATHAN SEIBERG focused on the exciting Maldacena correspondence between string theory in AdS space and the conformal field theory on the boundary of that space.

With S. Lee, S. Minwalla, and M. Rangamani he used the correspondence to calculate all three point functions of chiral operators in $N=4$ supersymmetric field theory in four dimensions in the strong coupling limit (with large number of colors). The results were compared with the weak coupling limit. Surprisingly, all three point functions were the same in the two limits. This led them to conjecture that these correlation functions are independent of the coupling constant and are given exactly by the leading order result. This conjecture was later verified by E. D'Hoker, D. Z. Freedman and W. Skiba in the first nontrivial order in the weak coupling expansion.

With A. Giveon and D. Kutasov, and in a later paper with D. Kutasov, the special case of three dimensional AdS was studied in detail. This case is special because it is amenable to an exact stringy analysis going beyond the gravity approximation. Vertex operators of physical excitations were constructed. Among them are vertex operators of various currents, the energy momentum tensor and supersymmetry in the boundary conformal field theory. The Ward identities that these operators satisfy were also derived. These vertex operators were interpreted as "almost pure gauge." They are physical because of their behavior at infinity.

This system has long string excitations. The physics of these excitations was analyzed with E. Witten. The effective theory of the long string is a (super-)Liouville theory. For certain values of the background fields, these excitations form a continuous energy spectrum above a gap, and lead to a pathology of the conformal field theory. This effect has a number of applications. It clarifies the nature of the conformal field theory of the string worldsheet when the target space has certain singularities leading to enhanced gauge symmetry. It also explains, in a way which is intrinsic to AdS space, the reason it is difficult to see the Coulomb branch of the corresponding conformal field theories.

In two papers, one with O. Aharony, M. Berkooz and D. Kutasov, and the other with S. Minwalla, the subtle theory of NS5-branes was studied. It was suggested that these theories have a holographic description in the same spirit as the AdS/CFT correspondence. This proposal leads to an identification of some of the observables in the theory in terms of vertex operators of the first quantized string theory. The chiral operators in

the theory are identified with primary fields of the current algebra on the string world-sheet, thus shedding new light on the A-D-E classification of these operators. Some correlation functions can be computed at low energies by studying the corresponding supergravity theory. They exhibit a number of interesting features. Among them is the realization that the NS5-branes have nonzero absorption probability from the asymptotic region. This probability becomes one at high energies.

PROFESSOR FRANK WILCZEK recently discovered that we can calculate the properties of certain versions of QCD at extremely high densities rigorously, using the methods of superconductivity theory. In this context, crucial but notoriously elusive aspects of QCD, notably including the confinement of quarks, can be understood in a straightforward way. The simplest and cleanest case occurs when the number of light quark flavors equals the number of quark colors, and the quarks are all degenerate. Then there is a pretty form of condensation — "color-flavor locking" — that exhibits the properties mentioned, and is clearly energetically favored. Additional behaviors arise when the splitting of quark masses is taken into account.

Professor Wilczek participated in a very detailed study of the implications of the SuperK discovery of neutrino masses, in the framework of unified gauge theories. In view of this discovery, the *SO(10)* version of these theories becomes especially attractive. If the successful unification of couplings is taken at face value, there is a severe restriction on the allowed symmetry-breaking Higgs fields. If we enforce this restriction, we can correlate masses and mixing of quarks and leptons, and form sensible expectations for proton decay. The results are quite encouraging, in that a simple model of fermion masses and mixings is both overconstrained and successful; while the expected proton decay is consistent with existing experimental limits but not hopelessly out of reach.

In 1998-9, PROFESSOR EDWARD WITTEN introduced a new point of view about D-branes (an important ingredient in present-day nonperturbative understanding of string theory), by showing how to interpret D-brane charge in terms of a mathematical theory called K-theory. This also led to some new constructions of D-branes. In addition, with coauthors N. Berkovits and C. Vafa, Witten showed how a currently much-studied example of a string background with Ramond fluxes can be formulated as a conformal field theory. In another project, Witten, with Professor Seiberg, put the relation of string theory to "noncommutative Yang-Mills theory" on a much more precise and thorough footing. In his other work in 1998-9, he clarified several interesting details about the relation of quantum gravity with negative cosmological constant to gauge theory on the boundary of spacetime.

PROFESSOR EMERITUS FREEMAN DYSON spent most of the year working on the final stages of the publication of two books. *The Sun, the Genome and the Internet* was published by Oxford University Press in April 1999. It is a popular account of some modern technologies and their social implications. The other book, *Origins of Life*, is a new edition of a work originally published in 1985. The new edition will be published by Cambridge University Press in the fall of 1999. In order to bring the book up to date, Professor Dyson has been studying discoveries that have been made by biologists in the intervening fourteen years.

During the year, Professor Dyson also taught for a semester at Gustavus Adolphus College in Minnesota. His only original research was a short paper in number theory, "The Sixth Fermat Number," submitted for publication to *Mathematics of Computation*.

THE SCHOOL OF NATURAL SCIENCES

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f First Term · *s* Second Term · *v* Visitor · *d* Director's Visitor
m Long Term Member

THE SCHOOL OF NATURAL SCIENCES

RECORD OF EVENTS

The following is a calendar of events sponsored by the School of Natural Sciences

Academic Year 1998–99

[illegible]

IAS/Princeton University High Energy Theory Lunchtime Seminar: "Four-point Functions in the CFT/AdS Correspondence and Holography"
HONG LIU, *Imperial College, London*

[illegible]

Astrophysics Talk: "Solar Neutrinos"
JOHN BAHCALL, *Institute for Advanced Study*

[illegible]

IAS/Princeton University High Energy Theory Seminar: "Near Horizon Geometry and Fermion Emission from String Black Holes"
ARUNDHATI DASGUPTA, *Institute of Mathematical Sciences, India*

[illegible]

Astrophysics Talk: "The Impact of SN1987A with Its Circumstellar Ring"
DICK McCRAY, *JILA and University of Colorado*

[illegible]

IAS/Princeton University High Energy Theory Lunchtime Seminar: "Modular Invariant Partition Function for the Fivebrane"
CHIARA NAPPI, *Institute for Advanced Study*

[illegible]

Astrophysics Talk: "State of the Cosmological Tests: A Revisionist View"
JIM PEEBLES, *Princeton University*

[illegible]

IAS/Princeton University High Energy Theory Seminar: "Non-spherical Horizons"
DAVID MORRISON, *Duke University*

[illegible]

Astrophysics Talk: "Gamma-ray Bursts and Their Afterglows"
BOHDAN PACZYNSKI, *Princeton University*

[illegible]

IAS/Princeton University High Energy Theory Lunchtime Seminar: "Grand Unification at Intermediate Mass Scales through Extra Dimensions"
KEITH DINES, *Conseil Europeen pour la Recherche Nucleaire*

October 27
Astrophysics Talk: "The Search for Solar G-modes with the GOLF and MDI Instruments on SOHO"
ROGER ULRICH, *University of California, Los Angeles*

November 2
IAS/Princeton University High Energy Theory Seminar: "Observations on AdS2/CFT1"
ANDREW STROMINGER, *Harvard University*

November 3
Astrophysics Talk: "Looking at Binary Pulsars from New Angles"
JOE TAYLOR, *Princeton University*

November 6
IAS/Princeton University High Energy Theory Seminar: "Signatures from the SUSY Flavor Problem"
JONATHAN FENG, *Institute for Advanced Study*

November 10
Astrophysics Talk: "Fast and Slow Accretion onto Black Holes"
ROGER BLANDFORD, *Institute for Advanced Study and California Institute of Technology*

November 13
IAS Special Math/Physics Seminar: "A Canonical Quantization of the Baker's Map"
RON RUBIN, *Massachusetts Institute of Technology*

November 16
IAS/Princeton University High Energy Theory Seminar: "The Phase Diagram of QCD"
MISHA STEPHANOV, *State University of New York, Stony Brook*

November 17
Astrophysics Talk: "Dynamics from Under Newton's Shadow"
DONALD LYNDEN-BELL, *University of Cambridge*

November 20
IAS/Princeton University High Energy Theory Lunchtime Seminar: "Entries in the Dictionary Relating Black Holes and Gauge Theory"
GARY HOROWITZ, *University of California, Santa Barbara*

November 24
Astrophysics Talk: "Measurements of the Anisotropy in the CMB"
LYMAN PAGE, *Princeton University*

November 30
IAS/Princeton University High Energy Theory Seminar: "M-theory, Topological Strings and a Large N Conjecture"
CUMRUN VAFA, *Harvard University*

December 1
Astrophysics Talk: "Star Formation and the Structure of Molecular Clouds"
CHRIS McKEE, *Institute for Advanced Study* and *University of California, Berkeley*

December 4
IAS/Princeton University High Energy Theory Lunchtime Seminar: "Light Cone or Not Light Cone?"
JOE POLCHINSKI, *Institute for Theoretical Physics, Santa Barbara*

December 8
Astrophysics Talk: "Probing the Dark Side of Structure Formation"
WAYNE HU, *Institute for Advanced Study*

January 15
IAS/Princeton University High Energy Theory Lunchtime Seminar: "Electric Dipole Moments in Gauge Mediated Models and a Solution to the SUSY CP Problem"
TAKEO MOROI, *Institute for Advanced Study*

January 25
IAS/Princeton University High Energy Theory Seminar: "A New Description of the Superstring on Ad3 Times S3"
NATHAN BERKOVITS, *University of Sao Paulo*

January 29
IAS/Princeton University High Energy Theory Lunchtime Seminar: "Brane Constructions and Conifolds"
KESHAV DASGUPTA, *Institute for Advanced Study*

February 5
IAS/Princeton University High Energy Theory Seminar: "Models of String Cosmology"
RAMY BRUSTEIN, *Ben Gurion University, Beersheva*

February 9
Astrophysics Talk: "Early Results from the 2-micron All Sky Survey (2MASS)"
MICHAEL SKRUTSKIE, *University of Massachusetts*

February 12
IAS/Princeton University High Energy Theory Lunchtime Seminar: "Thermal Monopoles"
BARAK KOL, *Tel Aviv University, Israel*

February 16
Astrophysics Talk: "The First Light of the Universe"
AVI LOEB, *Harvard University*

February 18
Special IAS Postdoc Meeting: "Some Aspects of String Thermodynamics in the Presence of Branes"
ELIEZER RABINOVICI, *The Hebrew University of Jerusalem, Israel*

February 22
IAS/Princeton University High Energy Theory Seminar: "Color Superconductivity and the Long-range Color Magnetic Force"
DAM THANH SON, *Massachusetts Institute of Technology*

February 26
Astrophysics Talk: "How and When Did the First Stars Form?"
MICHAEL NORMAN, *University of Illinois, Urbana*

March 1
IAS/Princeton University High Energy Theory Lunchtime Seminar: "Aspects of Mirror Symmetry in Three-dimensional Abelian Gauge Theories"
ANTON KAPUSTIN, *Institute for Advanced Study*

March 4
Astrophysics Talk: "Learning about the Virgo Cluster from the Internal Kinematics of its Spiral Galaxies"
VERA RUBIN, *Carnegie Institute of Washington, DC*

March 8
IAS/Princeton University High Energy Theory Seminar: "Toric Insights Into (0,2) Compactification"
PHIL CANDELAS, *University of Texas*

March 11
Astrophysics Talk: "What Sculpts the ISM?"
ALYSSA GOODMAN, *Harvard University*

March 15
IAS/Princeton University High Energy Theory Lunchtime Seminar: "Some Results in F-theory/Heterotic Duality in Four Dimensions"
GOVINDAN RAJESH, *Institute for Advanced Study*

March 22
IAS/Princeton University High Energy Theory Seminar: "Predicting Quark and Lepton Masses and Mixings in SO(10)"
STEPHEN M. BARR, *Bartoll Research Institute*

March 23
Astrophysics Talk: "LIGO"
BARRY BARISH, *California Institute of Technology*

March 24
IAS/Princeton University High Energy Theory Seminar: "Aspects of Models with Large Extra Dimensions"
MICHAEL PESKIN, *Stanford Linear Accelerator Center*

March 30
Astrophysics Talk: "Planets Around Solar-type Stars"
GEOFFREY MARCY, *University of California, Berkeley*

April 2
Astrophysics Talk: "Strip-mining the Lyman Alpha Forest: The Search for Metals"
ROMEEL DAVE, *Princeton University*

April 5
IAS/Princeton University High Energy Theory Seminar: "Phases of R-charged Black Holes, Spinning Branes and Strongly Coupled Gauge Theories"
MIRIAM CVETIC, *University of Pennsylvania*

April 6
Astrophysics Talk: "Implications of the NICMOS Observations of the Northern HDF"
RODGER I. THOMPSON, *Arizona State University*

April 9
Astrophysics Talk: "Stellar Atmospheres for Cosmologists"
MASATAKA FUKUGITA, *University of Tokyo*

IAS/Princeton University High Energy Theory Lunchtime Seminar: "Renormalization Group Flows in AdS/CFT"
STEVE GUBSER, *Harvard University*

April 14
Astrophysics Talk: "Star-forming Galaxies at $1 < z < 4$"
KURT ADELBERGER, *California Institute of Technology*

April 16
IAS/Princeton University High Energy Theory Seminar: "D-branes and Asymmetric Orbifolds"
JEFF HARVEY, *University of Chicago*

April 20
Astrophysics Talk: "More Ado About the Cosmic Microwave Background"
MARC KAMIONKOWSKI, *Columbia University*

April 23
IAS/Princeton University High Energy Theory Lunchtime Seminar: "Asymptotic Freedom and Confinement from Type 0 String Theory"
JOE MINAHAN, *Institute for Advanced Study*

April 27
Astrophysics Talk: "Science and Technology of a 100m Ground Based Telescope: The OWL Concept"
ROBERTO GILMOZZI, *European Southern Observatory, Garching*

May 3
IAS/Princeton University High Energy Theory Seminar: "An Instanton Physicist's 'Proof' of Maldacena's Conjecture"
MICHAEL MATTIS, *Los Alamos National Lab*

May 7
IAS/Princeton University High Energy Theory Lunchtime Seminar: "An Alternative to Compactification"
LISA RANDALL, *Princeton University*

May 13
Special Postdoc Seminar: "Strings in AdS3"
NATHAN SEIBERG, *Institute for Advanced Study*

May 17
IAS/Princeton University High Energy Theory Seminar: "Aspects of D-geometry"
MICHAEL DOUGLAS, *Rutgers University*

May 18
IAS/Princeton University High Energy Theory Special Seminar: "The Evolution of Cooperation"
MARTIN NOWAK, *Institute for Advanced Study*

"My year at the Institute has been one of the most enjoyable and productive of my scholarly life. I credit the Institute ... for providing the serene intellectual environment in which scholarship thrives. This year has had a profound impact on my personal development as a social scientist. I have been able to interact with political theorists, historians and anthropologists from whom I have learned about other methodologies and theories in the broader social sciences."

— Member, School of Social Science

CLIFFORD GEERTZ, *Harold F. Linder Professor*
JOAN WALLACH SCOTT
MICHAEL WALZER, *UPS Foundation Professor*

ALBERT O. HIRSCHMAN

Twenty scholars from the United States and abroad were invited to be part of the School's scholarly community as Members and Visitors for the 1998-99 academic year—from a pool of 158 individuals who applied for membership. Three research assistants also participated in the year's activities. The National Endowment for the Humanities partially or fully funded six fellows. Fields of inquiry of the group included anthropology, two; history, three; literature, two; philosophy, three; political science, eight; and sociology, two.

In January, Adam Ashforth joined the School as Visiting Associate Professor for a term of five years. A political scientist, Professor Ashforth has completed a study of the resurgence of witchcraft in post-apartheid South Africa.

In 1998-99, our focus was on political economy, on the interrelated processes of economic globalization and political change, as they are manifest in various parts of the world: Western and Eastern Europe, Asia, Africa, and Latin America.

PROFESSOR CLIFFORD GEERTZ gave the Charles Homer Haskins Lecture of the American Council of Learned Societies in Philadelphia in April and the keynote address at the inaugural symposium of the Department of Social and Cultural Anthropology at Stanford University, also in April. He participated in a symposium on "Sémiotique des cultures et sciences cognitives" at the Institut Ferdinand de Saussure, Geneva-Archamps, Geneva, in June, and in one on "Anthropology Now" in Syros, Greece, in July. A new collection of his essays, *Available Light: Anthropological Reflections on Philosophical Topics*, is in production at Princeton University Press. In April, he received an Honorary Doctor of Letters from Antioch College, Yellow Springs, Ohio.

PROFESSOR EMERITUS ALBERT O. HIRSCHMAN completed a new book entitled *Crossing Boundaries - Selected Writings* which was published by Zone Books, New York, at the end of 1998. It contains an article, "Melding the Public and Private Spheres: Taking Commensality Seriously," written in 1998, as well as a 1997 article written on the occasion of the Fiftieth Anniversary of the Marshall Plan. The book also contains an extended autobiographical interview originally published in 1994 in Italian by Donzelli Editore

in Rome. Professor Hirschman translated this interview into English for the Zone book edition.

Professor Hirschman was invited to participate in an exhibition held in Marseilles, France, in honor of the late Varian Fry who had worked in Marseilles in 1940-41, when Professor Hirschman was one of his principal advisors. For this occasion, Professor Hirschman wrote a special recollection entitléd "The Marseilles Atmosphere in 1940," which will be published in both French and English.

On November 13, 1998, Professor Hirschman was awarded the Thomas Jefferson Medal by the American Philosophical Society in Philadelphia, for "distinguished achievement in the arts, humanities, or social sciences."

Professor Hirschman published a book review of Sidney Pollard's *Marginal Europe: The Contribution of Marginal Lands Since the Middle Ages* (Oxford, Clarendon Press 1997) in *Economic Development and Cultural Change*, Vol. 41, No. 3, April 1999, pp. 688-691.

He traveled to Spain in March 1999 to give a talk at the University of Barcelona and took this occasion to visit various architectural monuments. In April 1999, he received a honorary degree from the University of Naples, Italy.

In 1998-1999, he took art lessons from Anna Zavrazhnov, on the advice of his daughter Lisa who died in May 1999 of the consequences of brain cancer.

During 1998-99, PROFESSOR JOAN WALLACH SCOTT published "Border Patrol" in *French Historical Studies* (summer 1998); and "Some Reflections on Gender and Politics," in *Revisioning Gender*, edited by Myra Marx Ferree, Judith Lorber, and Beth Hess. She worked on the second edition of *Western Societies: A Documentary History* (which she co-edited with Brian Tierney), and on the second edition of *Gender and the Politics of History*. She was a keynote speaker at a conference on gender and history in Fukuoka City, Japan. She also lectured at the University of Tokyo and at Doshisha University in Kyoto. Professor Scott gave lectures at Columbia University, Notre Dame, the University of Connecticut, and the Central European University in Budapest. She presented a paper, "Fantasy Echo: Historical Traditions of International Feminism," at the meetings of the American Historical Association. Professor Scott was appointed to the Board of Governors of the Humanities Research Institute of the University of California. She is chair of Committee A (Academic Freedom) of the American Association of University Professors.

During the academic year 1998-99, PROFESSOR MICHAEL WALZER gave the William H. Leary Lecture at the University of Utah Law School in the fall of 1998; he also lectured at the New School for Social Research and at the University of Wisconsin (Madison). During the spring semester he was on leave from the Institute for Advanced Study, visiting at the Shalom Hartman Institute in Jerusalem, where he continued his work on *The Jewish Political Tradition* with his Israeli collaborators. (Volume one will be published in 2000 by Yale University Press.) He visited Europe to give the Multatuli Lecture at the University of Leuven in Belgium and to speak at a conference organized by the Gramsci Institute in Turin, Italy. He also lectured at the The Hebrew University of Jerusalem, Israel; Ben Gurion University, Beersheva; Haifa and Tel Aviv Universities; Tel Hai College; and at the Teachers' College of the Kibbutz movement. His book *Just and Unjust Wars* appeared in a French translation; and *On Toleration* came out in Italian, Dutch, and Estonian editions.

THE SCHOOL OF SOCIAL SCIENCE

MEMBERS, VISITORS, AND RESEARCH STAFF

ARI ACKERMAN
Political Science
Shalom Hartman Institute · *a*

KAMRAN ALI
Anthropology
University of Rochester

RAINER BAUBÖCK
Political Science
Institute for Advanced Studies, Vienna

SUSAN BRISON
Philosophy
Dartmouth College · *v*

JAMES BROOKS
History
University of Maryland

CATHRYN CARSON
History
University of California, Berkeley

STEVEN CATON
Anthropology
Harvard University

NAHUM CHANDLER
Literature
Johns Hopkins University

THOMAS FLYNN
Philosophy
Emory University

MAURO GUILLÉN
Sociology
University of Pennsylvania

NANCY HIRSCHMANN
Political Science
Cornell University

EVELYNE HUBER
Political Science
University of North Carolina, Chapel Hill

JENNIFER MILLIGAN
History
Rutgers University · *a*

JAMES MITTELMAN
Political Science
American University

MICHAEL MOSHER
Political Science
University of Tulsa

ARVIND RAJAGOPAL
Sociology
New York University

DEGUNG SANTIKARMA
Anthropology
School for International Training, Bali · *a*

GORDON SCHOCHET
Political Science
Rutgers University

CHARLES SHEPHERDSON
Philosophy
Emory University

JOHN STEPHENS
Political Science
University of North Carolina, Chapel Hill

LOUISE TILLY
History
New School for Social Research · *vs*

ELIZABETH WEED
Literature
Brown University · *vf*

f First Term · *s* Second Term · *v* Visitor · *a* Research Assistant

THE SCHOOL OF SOCIAL SCIENCE

RECORD OF EVENTS

The following is a calendar of events sponsored by the School of Social Science

Political Economy Seminar: Organizational Meeting
MICHAEL WALZER, *Professor, School of Social Science*

Social Science Thursday Luncheon Seminar:
"The Experience of Universality"
MICHAEL WALZER; *Professor, School of Social Science*

Social Science Thursday Luncheon Seminar:
"Rights Matter"
GORDON SCHOCHET, *Rutgers University; Member, School of Social Science*

Political Economy Seminar: Discussion of Clifford Geertz, "The World in Pieces"
CLIFFORD GEERTZ, *Professor, School of Social Science*

Social Science Thursday Luncheon Seminar:
"The Welfare State in Hard Times"
EVELYNE HUBER and JOHN D. STEPHENS, *University of North Carolina; Members, School of Social Science*

Social Science Thursday Luncheon Seminar:
"Foucault and the Mapping of History: The Philosopher-Historian as Cartographer"
THOMAS FLYNN, *Emory University; Member, School of Social Science*

Political Economy Seminar: Discussion of Evelyne Huber and John D. Stephens, "Welfare State and Production Regimes in the Era of Retrenchment"
EVELYNE HUBER and JOHN D. STEPHENS, *University of North Carolina; Members, School of Social Science*

Social Science Thursday Luncheon Seminar:
"The Transformation of Public Ideals and Resistant States: With Illustrations from Japan and France"
MICHAEL MOSHER, *University of Tulsa; Member, School of Social Science*

Social Science Thursday Luncheon Seminar: "At the Mercy of Globalization"
JAMES MITTELMAN, *American University; Member, School of Social Science*

Political Economy Seminar: Discussion of Michael Mosher, "Border Patrols and Border Crossings: The Seductions of Globalization"
MICHAEL MOSHER, *University of Tulsa; Member, School of Social Science*

Social Science Thursday Luncheon Seminar:
"The 'Subject' of Liberty: Freedom and the Question of Welfare Rights"
NANCY HIRSCHMANN, *Cornell University; Member, School of Social Science*

Political Economy Seminar: Discussion of James Mittelman, "At *the Mercy of Globalization*, Introduction and Conclusion"
JAMES MITTELMAN, *American University; Member, School of Social Science*

Social Science Thursday Luncheon Seminar:
" 'Anger be now thy song': The Anthropology of an Event"
STEVEN CATON, *Harvard University; Member, School of Social Science*

Political Economy Seminar: Discussion of Arvind Rajagopal, "Thinking About the New Indian Middle Class: Gender, Advertising and Politics in an Age of Economic Reforms"
ARVIND RAJAGOPAL, *New York University; Member, School of Social Science*

Social Science Thursday Luncheon Seminar: "Physics and Philosophy in Culture: Heisenberg in West Germany"
CATHRYN CARSON, *University of California, Berkeley; Member, School of Social Science*

Political Economy Seminar: Discussion of Mauro Guillén, *Developing Difference: Organizations, Globalization, and Development in Argentina, South Korea, and Spain*, Table of Contents, Chapter 1, and Chapter 5
MAURO GUILLÉN, *University of Pennsylvania; Member, School of Social Science*

Social Science Thursday Luncheon Seminar: "Self-rule or Self-determination? Arguments For Multinational Federalism"
RAINER BAUBÖCK, *Institute for Advanced Studies, Vienna; Member, School of Social Science*

Social Science Thursday Luncheon Seminar: "Nations, Tribes, and Colours: Metaphors Toward a History For the Twenty-First Century"
JAMES BROOKS, *University of Maryland; Member, School of Social Science*

Social Science Thursday Luncheon Seminar: "The Making of a 'Hindu Public': Political Language in an Emerging Visual Regime"
ARVIND RAJAGOPAL; *New York University; Member, School of Social Science*

Political Economy Seminar: Discussion of James Brooks, "Violence, Justice, and State Power in the New Mexican Borderlands, 1780-1880"
JAMES BROOKS, *University of Maryland; Member, School of Social Science*

Social Science Thursday Luncheon Seminar: "The Epoch of the Body: Need and Demand in Kojève and Lacan"
CHARLES SHEPHERDSON, *Emory University; Member, School of Social Science*

Social Science Thursday Luncheon Seminar: "Delimitations: The Positions of W.E.B. Du Bois in the History of Thought"
NAHUM CHANDLER, *Johns Hopkins University; Member, School of Social Science*

Social Science Thursday Luncheon Seminar: "Socrates and Max Weber: Integrity, Disenchantment, and the Illusions of Politics"
DANA VILLA, *University of California, Santa Barbara; Member, School of Social Science*

Social Science Thursday Luncheon Seminar: "Developing Difference: Diversity and Renewal in the Global Economy, with Illustrations from the Wine & Liquor Industry"
MAURO GUILLÉN, *University of Pennsylvania; Member, School of Social Science*

Social Science Thursday Luncheon Seminar: "Making 'Responsible' Men: Planning the Family in Egypt"
KAMRAN ALI, *University of Rochester; Member, School of Social Science*

Social Science Thursday Luncheon Seminar: "Felt Politics and Moral Vision: Feeding the Homeless in the Welfare State"
REBECCA ALLAHYARI, *University of Maryland; Affiliate, Center for the Study of American Religion, Princeton University*

Political Economy Seminar: Discussion of Nancy Hirschmann, "A Question of Freedom, A Question of Rights: Women and Welfare"
NANCY HIRSCHMANN, *Cornell University; Member, School of Social Science*

March 25
Social Science Thursday Luncheon Seminar: "Homo Poiliticus: Caste Politics and the Politics of Caste"
NICHOLAS DIRKS, *Chair of Anthropology, Columbia University*

April 1
Social Science Thursday Luncheon Seminar: "Doing World History?"
LOUISE TILLY, *New School for Social Research; Visitor, School of Social Science*

April 7
Political Economy Seminar: Discussion of Rainer Bauböck, "Self-determination and Self-government"
RAINER BAUBÖCK, *Institute for Advanced Studies, Vienna; Member, School of Social Science*

April 21
Political Economy Seminar: Discussion of Kamran Ali, Chapters from manuscript in progress.
KAMRAN ALI, *University of Rochester; Member, School of Social Science*

May 19
Political Economy Seminar: Discussion of James Mittelman, *The Globalization Syndrome: Transformation and Resistance*, Chapters 9 and 10
JAMES MITTELMAN, *American University; Member, School of Social Science*

May 26
Political Economy Seminar: Discussion of Gordon Schochet, "Natural Rights, Native Rights, and the Sense of Justice: or, Locke and Rawls on the Navaho Reservation"
GORDON SCHOCHET, *Rutgers University; Member, School of Social Science*

"Let me say that I am not unaware of the fact that I have sketched an educational Utopia. I have deliberately hitched the Institute to a star; it would be wrong to begin with any other ambition or aspiration ... But I do not deceive myself; it will not be easy to begin on any such basis; it will be harder, as the years pass, to keep this standard. We shall find ourselves dealing with men and women, not with angels or supermen ... But we shall be helped, not harmed, by the high level at which we have pledged ourselves to act. In any case, unless we attempted something much higher than is now attained, there would be little reason to attempt anything at all."

— Abraham Flexner, Memorandum to the Board of Trustees of the Institute for Advanced Study, September 26, 1931

Albert Einstein, Anne Crawford Flexner (Mrs. Abraham Flexner), Abraham Flexner, J.R. Hardin, and Herbert H. Maass on May 22, 1939, at the laying of the cornerstone of Fuld Hall, the Institute for Advanced Study's first building.

PROGRAM IN THEORETICAL BIOLOGY
Martin A. Nowak, Head

The Institute for Advanced Study started an initiative in the biological sciences in the fall of 1998. Research within the program is carried out across a broad range of subjects of biological and biomedical interest. Currently, there are three main areas of focus: evolution, infection and genomics.

Martin Nowak, along with David Krakauer, Linda Wahl, and Dominik Wodarz, Members in the program in theoretical biology, worked on the following research projects during the 1998-99 academic year:

Infectious diseases
Mathematical models that lead to a new understanding of immunological memory were developed: while antibody mediated memory protects against re-infection, cytotoxic T-lymphocyte (CTL) mediated memory is primarily responsible for eliminating virus infections. Failure to establish an efficient CTL memory response leads to persistent infections. This could be of crucial importance for understanding HIV disease progression. Most HIV infected patients do not establish an efficient CTL memory response and therefore fail to control the virus. The CTL memory response needs CD4 cell help, but these are exactly the cells that are infected and killed by HIV.

This new theory has consequences for designing more efficient anti-HIV therapy: certain treatment schedules can help to mount a CTL memory response. Thus it seems possible that anti-HIV treatment can be used to switch patients from a state with high virus load and low CTL memory to a state with low virus load and high CTL memory. Once patients are in this latter state, therapy can be withdrawn, opening up the possibility of controlling HIV without continuous therapy.

There have been a number of collaborations between the Institute for Advanced Study and experimental groups, including Charles Bangham, Imperial College, London; Jeff Lifson, National Cancer Institute, Frederick; Andrew McMichael, University of Oxford; Alan Thomsen, Copenhagen; Bruce Walker, Harvard University; and Rolf Zinkernagel, ETH, Zurich. Nowak is also working on a book on virus dynamics with Robert May, University of Oxford.

Evolution of language
Nowak is fascinated by questions concerning the origin and evolution of human language. Working with David Krakauer, he formulated a mathematical theory that explores how human language can evolve by natural selection. Nowak and Krakauer analyze how associations between signals and objects form in a pre-linguistic society, explore the consequences of errors during communication or language acquisition, and describe a pre-linguistic error limit. They show how word-formation can overcome this error limit. Finally, they analyze the emergence of simple grammatical rules. This work constitutes a systematic, mathematical approach for thinking about language evolution.

Evolution of cooperation
Nowak worked with Karl Sigmund on the evolution of cooperation based on indirect reciprocity. The idea is that altruistic acts increase an individual's reputation and also the

chance of receiving altruistic acts from others. In contrast to direct reciprocity there is no need for repeated encounters between the same two individuals.

Linda Wahl and Nowak developed a mathematical framework for the continuous prisoner's dilemma, where cooperation or defection is not an all or nothing decision, but players can opt to be more or less cooperative on a continuous scale.

Mathematical Modeling and Biomedical Research
On April 29, the Institute hosted a symposium on "Mathematical Modeling and Biomedical Research" with The Rockefeller University. The presentations (a complete list is included in the list of lectures) followed a common theme of exploring the interface between theoretical biology (mathematical modeling) and clinical research in both drug development and drug trials.

Nowak received the Albert Wander Prize of the University of Bern and the Akira Okubo Prize of the International Society for Mathematical Biology. He gave the Porter Lectures at Rice University and the Erwin Schroedinger Lecture at the University of Vienna.

The Program in Theoretical Biology Lecture Series

October 7	"Ecosystems and the Biosphere as Complex Adaptive Systems" Simon Levin, *Princeton University*
October 21	"Viral and Lymphocyte Dynamics in HIV Infection" David D. Ho, M.D., *The Rockefeller University* and *Aaron Diamond AIDS Research Center*
November 4	"Ecological Sinks for Atmospheric Carbon" Stephen Pacala, *Princeton University*
November 18	"Words and Rules" Steven Pinker, *Massachusetts Institute of Technology*
	"How the Mind Works" Steven Pinker, *Massachusetts Institute of Technology*
December 1	"Feedbacks from Theory Concerning Immune System Performance" Lee Segel, *Weizmann Institute of Science, Israel*
February 17	"Computing with DNA and RNA: The Origin of Biological Information Processing" Laura Landweber, *Princeton University*
February 22	"Towards a Quantitative Understanding of Persistent Virus Infections" Charles R. M. Bangham, *Imperial College, London*
March 3	"Abstract Chemistry" Walter Fontana, *Santa Fe Institute*

"Chance and Necessity in Evolution: Insights from RNA"
Walter Fontana, *Santa Fe Institute*

March 25 "Adapting the Aspiration Level for Repeated Games"
Karl Sigmund, *University of Vienna*

March 31 "Mathematical Tools for Phylogenetic Analysis"
Andreas Dress, *City University New York, City College*

"The Tree of Life: Is it Really a Tree?"
Andreas Dress, *City University New York, City College*

April 7 "Immune Control of HIV Infection"
Bruce D. Walker, MD, *Harvard Medical School*

April 14 "On the Interpretation of Human Genomic Variation"
Marc Feldman, *Stanford University*

April 28 "The Scientific Wealth of Nations"
Sir Robert May, *University of Oxford*

April 29 Symposium: Mathematical Modeling and Biomedical Research

"Modeling Virus Infections"
Martin A. Nowak, *Institute for Advanced Study*

"The Use of DNA Arrays to Follow the Pattern of Transcription in Normal and Tumor Cells"
Arnold J. Levine, *The Rockefeller University*

"Biological System Analysis: Small is Beautiful"
Stanislas Leibler, *Princeton University*

"Protein Structure Modeling in Genomics"
Andrej Sali, *The Rockefeller University*

"Using Patterns of Evolution for Genome Interpretation"
Teresa Gaasterland, *The Rockefeller University*

"The Population Biology and Evolution of Antibiotic Resistance"
Bruce R. Levin, *Emory University*

May 5 "Molecular Evolution as Biased Diffusion in Sequence Space"
Manfred Eigen, *Max-Planck-Institut, Göettingen*

The Historical Studies-Social Science Library [Marcia Tucker, Librarian] contains some 100,000 volumes and has subscriptions to about 1,000 journals. The library is strongest in classical studies, ancient history, and archaeology, but it contains basic document collections, reference works, and important secondary works of scholarship in most fields of history and the social sciences. The journal collection is extensive, and fairly complete back runs exist to the founding of the Institute. The library has occupied its present building since 1964.

The Institute's rare book collection, the gift of Lessing J. Rosenwald, consists of about 2,000 volumes on the history of science and was compiled by Herbert M. Evans in the 1930s. The collection, which is housed in a special room, includes numerous first editions of important scientific works in mathematics, astronomy, physics, and the life sciences.

The library has an extensive collection of offprints including those received by Professors Andrew E. Z. Alföldi, Kurt Gödel, Ernst H. Kantorowicz, Elias Avery Lowe, Millard Meiss, Erwin Panofsky, and former Members Robert Huygens and Walther Kirchner.

The microfilm collections of the library include a large selection from *Manuscripta*, a collection of several thousand fifteenth- to nineteenth-century printed books from the Vatican Library. The Bavarian Academy has given the Institute a microfilm copy of slips presented for the *Thesaurus Linguae Latinae*. The library has microfilm copies of the papers of Albert Einstein, Kurt Gödel, and Simone Weil.

The Historical Studies-Social Science Library houses the Institute archives. The papers in the collection date from the 1930s and include official correspondence of the Director's Office, minutes of meetings of the Faculty and the Board of Trustees, miscellaneous correspondence concerning past Faculty members, records of the Electronic Computer Project, and other documents. The archives also include the Institute's extensive photograph collection.

The Mathematics-Natural Sciences Library [Momota Ganguli, Librarian] is located on the second floor of Fuld Hall and contains some 30,000 volumes (bound periodicals and monographs) plus subscriptions to nearly 200 journals. Its collection of older periodicals is housed in compact shelving on the lower level of the Historical Studies-Social Science Library. The subject areas covered by the library are pure and applied mathematics, astrophysics, and theoretical, particle, and mathematical physics.

Both of the Institute's libraries participate in the shared cataloging system of the Research Libraries Group, which gives Institute scholars computerized access to a database that contains more than twenty-two million records. Searches of this database retrieve bibliographic information and identify the location of materials in all participating libraries. Access to electronically cataloged titles is available via Horizon, the Institute's web-accessible online catalog. The Institute's libraries are participants in the JSTOR project, which makes available archival electronic versions of many core journals.

The Historical Studies-Social Science Library maintains a computer center with access to a variety of word processing packages for both PCs and Macintoshes, access to databases in the fields of Classical Studies, the history of science, Islamic and French studies, and Internet access for additional information resources. The Mathematics-Natural Sciences Library has access to the Math-Sci Online database and the entire CD-ROM set of the Digitized Sky Survey.

All scholars affiliated with the Institute enjoy the same privileges as Princeton University faculty in the Harvey S. Firestone Memorial Library and the nineteen special-subject libraries in the Princeton University Library system and also in the Robert E. Speer Library of the Princeton Theological Seminary.

The librarians and the faculties of all four schools at the Institute warmly appreciate gifts of books and articles from former and current Members of the Institute.

"I have lived in the proximity of the Institute Woods for over half a century. They are a friend, a source of inspiration and restoration."

— George F. Kennan, Professor Emeritus, School of Historical Studies

INSTITUTE FOR ADVANCED STUDY/PARK CITY MATHEMATICS INSTITUTE

The IAS/Park City Mathematics Institute (PCMI) is an integrated mathematics program that has been sponsored by the Institute for Advanced Study since 1993-94. PCMI is designed to strengthen mathematics education at all levels, in turn benefiting the mathematics community as a whole. By fostering interaction between education and research, PCMI charts new territory in mathematics education reform and mathematics research.

The Summer Session of 1999 had over 215 participants in attendance at the Inn at Prospector Square in Park City, Utah, from June 20-July 10. Six separate yet overlapping programs for researchers, high school teachers, undergraduate faculty, mathematics education researchers, and undergraduate and graduate students were held during this time.

The research topic for the Graduate Summer School and Research Program was Arithmetic Algebraic Geometry, organized by Karl Rubin of Stanford University and Brian Conrad of Harvard University. The Undergraduate Program, designed to enhance students' interest in mathematics in general and their understanding of arithmetic algebraic geometry in particular, was organized by Robert Bryant of Duke University. The high school teachers worked with researchers and educators to deepen their knowledge of mathematics and explore new methods of teaching. Teachers-in-residence, selected from alumni sites, and current site directors from the High School Teacher Program also participated. In addition to the lectures and courses developed specifically for each group, there were Cross Program Activities, presentations and small-group discussions on the National Council of Teachers of Mathematics (NCTM) Standards 2000, and lively debates on the role of technology in mathematics education.

The interaction which is so integral to PCMI continues during the academic year in selected regional, university-based sites where participating high school teachers work in collaboration with the site directors and other faculty. The Summer Session of 1999 marked the beginning of a new two-year cycle with new teachers drawn from the following sites: California State University, San Bernardino, Rider University, Rhode Island College, the University of Cincinnati, and the University of Michigan at Dearborn. At these sites, the high school teacher participants work closely with university faculty in order to bring about curricular and pedagogical reform, first in their home districts, and then in the larger community.

High School Teacher Program

The long-time director of the High School Teacher Program, Naomi Fisher of the University of Illinois at Chicago, stepped down from the PCMI Steering Committee in 1999. Her successor is Susan Addington of California State University, San Bernardino.

The High School Teacher Program courses at the 1999 Summer Session were: "Building Mathematics in the Classroom," Cynthia Hays, McCallum High School, Austin, Texas; "Teaching Mathematics with Technology," James King, University of Washington; and "Advanced Mathematics: Constructible Numbers," Susan Addington, California State University, San Bernardino. Specific topics covered included: constructing angles and regular polygons; the Golden Ratio; tetrahedral kites and an origami regular pentagon; writing in the mathematics classroom; spherical geometry using the Lenart Sphere; the

Golden Mean and paper folding; impossible constructions; arcs on the sphere; theory of origami; the Archimedean solids with polydrons; rectifying areas; reflections and other plane symmetries; tesselations; pop-up polyhedra.

Guest speakers and presentations to the High School Teacher Program included a discussion with Gail Burrill, Mathematical Sciences Education Board and past-president of the National Council of Teachers of Mathematics; "Pick's Theorem," Phyllis Chinn, Humboldt State University; "Miras;" "Advanced Technology Techniques;" "Introduction to Java Sketchpad and Other Sketchpad Topics," all by Annie Fetter of the Geometry Forum at Swarthmore College; "Solving Cubic and Quartic Polynomial Equations," John Polking, Rice University; "Introduction to Arithmetic Algebraic Geometry," Karl Rubin, Stanford University; and "Teaching Using The History of Mathematics," Robert Stein, California State University, San Bernadino. In addition, there was a special session with the participants of the Mathematics Education Research Program.

The courses of the High School Teacher Program are designed this year to provide a cohesive curriculum for the participants. Thus, the topic of the Advanced Mathematics course, "Constructible Numbers," provided the framework for activities used in "Building Mathematics in the Classroom" and "Teaching Mathematics with Technology." Also included in the curriculum was a daily problem session for the teachers.

As part of the year-round High School Teacher Program the University of Cincinnati site teachers organized and taught a six-month course for high-school geometry teachers. The course, which was held at the University, was completely subscribed with thirty participants, all of whom received graduate level credits. The University of Louisville site sponsored a visit from Dr. William Schmidt of Michigan State University. Dr. Schmidt is the U.S. National Director of the Third International Mathematics and Science Study (TIMSS).

All of the PCMI teachers continue to be active in their sites, either with group activities or with individual presentations on in-service days or at regional, state, and local chapters of the NCTM. Three PCMI teachers made a presentation to their colleagues at the Annual Convention of the NCTM in April, and two of these teachers have been invited to make a presentation in Portugal in the fall of 1999.

Mathematics Education Research Program

Organized by Timothy Kelly of Hamilton College, with assistance from Joan Ferrini-Mundy of Michigan State University, the Mathematics Education Research Program had ten participants, including three lead researchers. The topic was "Mathematical Reasoning and Proof."

Seminar titles included "Sociomathematical Norms in Calculus and Differential Equations," Karen King, San Diego State University; "Dynamic Software in Pre-service Teacher Preparation," Helen Gerretson, University of Northern Colorado; "Student Proof Schemes," Guershon Harel, Purdue University; "The Ethnography of Argumentation," Erna Yackel, Purdue University Calumet; "Social and Socio-mathematical Norms in a Differential Equation Classroom," E. Yackel; "Realistic Mathematics Education (Freudenthal)," E. Yackel; "Discussion of Dreyfuss: Why Johnny Can't Read," E. Yackel; "Discussion on White Paper on Reasoning and Proof for Standards 2000 (Hanna and Yackel)," E. Yackel.

Undergraduate Faculty Program
There were eleven participants in the Undergraduate Faculty Program. This year's focus was "The Role of Proof," and a variety of activities took place under the guidance of Guershon Harel, Purdue University. Seminars included "Transition Course," "Application of the Necessity Principle," and "Proof." Undergraduate Faculty Program participants also attended the Undergraduate Program and the Graduate Summer School, and there was heavy interaction with the Mathematics Education Research Program.

Undergraduate Program
The courses and lecturers for the Undergraduate Program were "Introduction to Elliptic Curves," taught by David Pollack of Ohio State University, and "Introduction to Zeta-functions and *L*-functions," taught by Keith Conrad of Ohio State University. In addition to the regular courses, the twenty-four undergraduate participants met once each day for problem sessions. They also were encouraged to attend the introductory-level courses of the Graduate Summer School, and many did so.

Graduate Summer School and Research Program
The Graduate Summer School met for three formal lectures and one problem session each day. This year's lecturers and courses were: "Introduction to Elliptic Curves and Modular Forms," Joe P. Buhler, Reed College; "Isawa Theory for Elliptic Curves," Ralph Greenberg, University of Washington; "Deformation of Galois Representations," Fernando Gouvêa, Colby College; "Serre's Conjecture," Kenneth Ribet, University of California, Berkeley; "Open Questions," Alice Silverberg, Ohio State University. Two lectures by John Tate of the University of Texas, Austin were inserted into the regular schedule of the Graduate Summer School.

A highlight of PCMI this year was the announcement of the proof of the Taniyama-Shimura-Weil Conjecture. This exciting development stunned the audience at Kenneth Ribet's lectures and caused organizer Brian Conrad of Harvard University to give two supplemental lectures at the graduate level on the results of the new proof: "Shimura's Construction of Weight 2 Modular Representations" and "Elaboration on Last Fifteen Minutes of Shimura's Proof." The announcement, made from the PCMI Summer Session by organizer Brian Conrad and invited researcher Richard Taylor, was written up in a subsequent issue of the *Notices of the American Mathematical Society*.

The Research Program included one or two organized seminars each day. Researchers also attended Graduate Summer School lectures and Undergraduate Program advanced lectures, joined in informal activities with other participants, and participated in the small group discussions on the NCTM Standards 2000. Titles for 1999 research seminars were:

"P-adic Semi-stable Galois Representations I," Jean-Marc Fontaine, University of Paris XI; "The Local Langlands Conjecture," Richard Taylor, University of California, Berkeley; "P-adic Semi-stable Galois Representations II," Jean-Marc Fontaine, University of Paris XI; "Wild Ramification and Deformation Rings," Brian Conrad, Harvard University; "*L*-functions in P-adic Etale Cohomology," Matthew Emerton, University of Michigan; "Slopes of P-adic Modular Forms," Lawren Smithline, University of California, Berkeley; "The Local Langlands Conjecture II," Richard Taylor, University of California, Berkeley; "Heights of Elliptic Curves and Black Hole Entropies," Stephen Miller, Yale University; "Wild Ramification and Deformation Rings II," Brian Conrad, Harvard University;

"*L*-functions, Curves, and Roots of Unity," Christian Popescu, University of Texas, Austin; "Some Abelian Varieties with Visible Tate-Shafarevich Groups," William Stein, University of California, Berkeley; "Automorphic *L*-functions Over Function Fields," Winnie Li, Pennsylvania State University; "Relation Between *L*-value and Period Integral for Quotients of J0(N)," Amod Agashe, University of California, Berkeley; "Modularity of Q-curves and a Generalized Fermat Equation," Jordan Ellenberg, Princeton University; "The Hidden Structure of de Rham Cohomology," Robert Coleman, University of California, Berkeley; "Deforming Galois Representations," Ravi Ramakrishna, Cornell University; "Geometrically Simple Abelian Varieties Over Finite Fields," Hui (June) Zhu, Mathematical Sciences Research Institute; "The Rank of Abelian Varieties in Infinite Galois Extensions," Siman Yat-Fai Wong, Brown University; "Finding Similarities of Tate-Shafarevich Elements," Catherine O'Neil, Harvard University; "Lowering Levels of Reducible Galois Representations," Shuzo Takahashi, Harvard University; "Modules of Iwasawa Algebras Coming from Galois Cohomology," Susan Howson, Massachusetts Institute of Technology.

Cross Program Activities
Held four times each week, the formal Cross Program activities were focused on mathematical topics, on the NCTM Standards 2000, and on the use of technology in mathematics education. Cross Program Activities were as follows:

"An Introduction to Arithmetic Algebraic Geometry," Karl Rubin, Stanford University; "Geometer's Sketchpad - Teaching Geometry with Dynamic Software," James King, University of Washington; "Cryptography and Mathematics," János Csirik, University of California, Berkeley; "The Use of Technology in the Mathematics Classroom: A Panel Discussion," John Polking, Rice University, William McCallum, University of Arizona, Franco Salialo, York University, William Stein, University of California, Berkeley, Jeff Farmer, University of Northern Colorado, Helen Gerretson, University of Northern Colorado, and Art Mabbott, Odle Middle School; "Pre-concert Lecture," Robert Taub, Institute for Advanced Study; "Juggling Permutations," Joe Buhler, Reed College and Phyllis Chinn, Humboldt University; "Principals and Standards for School Mathematics (Standards 2000)," Gail Burrill, MSEB and past-president of NCTM; breakout discussions among mathematics researchers, students, and educators about the NCTM standards, organized by Alan McRae, Washington and Lee University; plenary session reports from the breakout discussions on NCTM Standards 2000, moderated by John Polking, Rice University; "Technology Troika: Three Examples of Technology in Mathematics Education," organized by Alan McRae, Washington and Lee University, moderated by James King, University of Washington, illustrations presented by William McCallum, University of Arizona, Ken Collins, Charlotte Latin School, and John Polking, Rice University; "My Students Are Greek To Me," Guershon Harel, Purdue University; informal discussion on ethno-mathematics, moderated by Herb Clemens, panelists were Laverne Bitsie-Baldwin, Kansas State University and Susan Addington, California State University, San Bernardino; "Theory and Examples of Congruences of Modular Forms," Matthew Emerton, Yale University.

The High School Teacher Program sponsored a "Polyhedra Building Party" which all participants were invited to attend and to take part in construction activities. An enthusiastic crowd filled the room throughout the evening, including participants from all programs.

The computer lab, under the direction of James King, University of Washington, was equipped with a variety of computer hardware and software, providing Windows, Macintosh, and Linux platforms for participants' use. Software and equipment donated by manufacturers included Microsoft Office 2000, Mathematica by Wolfram Research, Cabri Geometry by Texas Instruments, Geometer's Sketchpad by Key Curriculum Press, Maple by Waterloo Maple, Y&Y TeX, TeXtures by Blue Sky Research, and TI-92 calculators by Texas Instruments. The lab was a valuable resource for educational and computational work as well as Internet access.

On June 28, through the generous sponsorship of the Huntsman Foundation, PCMI hosted a concert by pianist Robert Taub, Artist-in-Residence at the Institute for Advanced Study. Robert Taub gave a pre-concert lecture to the PCMI participants during the Cross Program Activity on the day of the concert.

All PCMI resources and activities encourage casual interaction and promote a sense of community among the participants. The professional relationships and friendships formed in this way, extending across the mathematics community, are among PCMI's most important outcomes.

Publication Series

Rapid progress was made in 1998-99 on the publication of the lecture notes from each year's Graduate Summer School. This past year saw the publication of Volumes 5, 6, and 7. It is expected that Volume 8 (from 1998) will be published in late 1999 or early 2000. The PCMI lecture series, which is published by the American Mathematical Society (AMS) now includes the following titles: *Geometry and Quantum Field Theory*, Volume 1; *Nonlinear Partial Differential Equations in Differential Geometry*, Volume 2; *Complex Algebraic Geometry*, Volume 3; *Gauge Theory and Four Manifolds*, Volume 4; *Hyperbolic Equations and Frequency Interactions*, Volume 5; *Probability Theory and Applications*, Volume 6; *Symplectic Geometry and Topology*, Volume 7. All titles are available from the AMS. There are plans to publish material from the Undergraduate Programs in an AMS series in the future.

Funding

PCMI in 1998-99 was made possible by the generosity of the following individuals and foundations:

The National Science Foundation
W. K. Kellogg Foundation
Michael Bloomberg
Frank and Peggy Taplin
Ladislaus von Hoffmann
Elaine and James D. Wolfensohn
Albert and Ellen Schwartz Philanthropic Fund

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Brian Conrad, Professor, Harvard University
2000 Organizers:
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Graduate Summer School:
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High School Teachers Program:
Susan Addington, Professor, California State University, San Bernardino
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Chuu Lian Terng, Professor, Northeastern University
Undergraduate Faculty Program:
Daniel Goroff, Harvard University
Undergraduate Program:
Robert L. Bryant, Professor, Duke University

MENTORING PROGRAM FOR WOMEN IN MATHEMATICS

Many of the women undergraduate and graduate students participating in the IAS/Park City Mathematics Institute Summer Session attended a preliminary workshop at the Institute for Advanced Study from May 17-27. The program, organized by Chuu-Lian Terng of Northeastern University and Karen Uhlenbeck of the University of Texas, Austin, emphasized the content and culture of mathematics and included lectures, seminars, working problem groups, mentoring and networking sessions, as well as the opportunity to meet and interact with leading mathematicians. The forty participants included graduate students, undergraduates, postdoctoral scholars, and senior researchers. In addition to the registered participants, the lectures and seminars were extremely popular with students and mathematicians from the surrounding area. All lectures were open to the public.

Karen Uhlenbeck led a "Women in Science" seminar, a daily informal discussion group geared for the undergraduates and new graduate students, and well attended by all participants. Two highlights of these seminars were an interview with Joan Feigenbaum, a research scientist at AT&T, and panel discussions on working in industry and in academe.

The Women's Program has enabled the IAS/Park City Mathematics Institute to increase significantly the number of female participants in its Summer Session. It has also provided female students with an opportunity to form professional friendships and collaborations that develop still further during the PCMI Summer Session and beyond. In this way, the Women's Program provides strong encouragement and real support for women to remain in the field of mathematics. The Women's Program was funded by the National Science Foundation.

Lectures and Seminars:
The undergraduate lecture series, "Codes and Curves," was given by Judy Walker, University of Nebraska, Lincoln. The graduate lecture series, "The Arithmetic of Elliptic Curves, Modular Forms, and Calabi-Yau Varieties" was given by Wen Ching Winnie Li, Pennsylvania State University, Noriko Yui, Queens University (Ontario, Canada), and Alice Silverberg, Ohio State University. Expository lectures on the research topic were given by two members of the local mathematics community: "Why Zeta Functions," by Peter Sarnak, Princeton University; and "An Introduction to Galois Representations," by Chris Skinner, Institute for Advanced Study.

The research seminar was organized by Lisa Fastenberg, University of Massachusetts, Amherst. Seminar titles were: "Uniform Bounds for Rational and Integral Points on Curves," Lisa Fastenberg; "The Intermediate Jacobian of Some Rigid Calabi-Yau Threefolds," Helena Verrill, Max Planck Institut fur Mathematik; "The Difficulty of Pattern Classification," Christine Heitsch, University of California, Berkeley; "Plane Curve Singularities, Hilbert Schemes, and Jet-Bundles," Heather Russell, Harvard University; "Supersingular Abelian Varieties Over Finite Fields," Hui (June) Zhu, Mathematical Sciences Research Institute; "Formal Patching of Wildly Ramified Covers," Rachel Pries, University of Pennsylvania; "Stark's Conjecture in the Octohedral Case," Karrolyn Fogel, California Lutheran University.

A participant seminar included the following titles: "Sophie Germain and Fermat's Last Theorem," Karrolyn Fogel, California Lutheran University; "Algebraic Number Fields and Their *L*-functions," Alina Cojocaru, Queen's University (Canada); "Knots and Varieties," Heather Dye, University of Texas, Austin; "Canonical Heights and Polynomial Dynamics," Susan Goldstine, McMaster University; "Braids," Mari Campbell, University of California, San Diego.

Planning Committee

The Women's Program Committee assists the organizers in planning and promoting the program and recruiting lecturers and participants. Members include: Alice Chang, Professor, Princeton University; Ingrid Daubechies, Professor, Princeton University; Joan Feigenbaum, AT&T Research; Antonella Grassi, Professor, University of Pennsylvania; Nancy Hingston, Professor, The College of New Jersey; Rhonda Hughes, Professor, Bryn Mawr College; Robert MacPherson, Professor, Institute for Advanced Study; and Lisa Traynor, Professor, Bryn Mawr College.

"For me, the very special nature of life here is creatively stimulating and nurturing, and the artistic freedom engendered by this environment I find invaluable. It is very good for me as an artist and as a person to be here, and I feel fortunate. The time and freedom I have here to work, to write a book, to record, to simply be involved totally is allowing me to make a greater contribution to my field. For this I am grateful."

— Robert Taub, Artist-in-Residence

The 1998-99 Institute Concert Series included a collaboration between Robert Taub and guest artist Matt Haimovitz, cellist.

INDEPENDENT AUDITORS' REPORT

The Board of Trustees,
Institute for Advanced Study -
Louis Bamberger andMrs. Felix Fuld Foundation

We have audited the accompanying balance sheet of Institute for Advanced Study - Louis Bamberger and Mrs. Felix Fuld Foundation (the "Institute") as of June 30, 1999 and the related statements of activities and cash flows for the year then ended. These financial statements are the responsibility of the Institute's management. Our responsibility is to express an opinion on these financial statements based on our audit. The prior year summarized comparative information has been derived from the Institute's June 30, 1998 financial statements, and in our report dated September 30, 1998, we expressed an unqualified opinion on those financial statements.

We conducted our audit in accordance with generally accepted auditing standards. Those standards require that we plan and perform the audit to obtain reasonable assurance about whether the financial statements are free of material misstatement. An audit includes examining, on a test basis, evidence supporting the amounts and disclosures in the financial statements. An audit also includes assessing the accounting principles used and significant estimates made by management, as well as evaluating the overall financial statement presentation. We believe that our audit provides a reasonable basis for our opinion.

In our opinion, such financial statements present fairly, in all material respects, the financial position of the Institute at June 30, 1999 and the changes in its net assets and its cash flows for the year then ended in conformity with generally accepted accounting principles.

Deloitte & Touche LLP

September 17, 1999

BALANCE SHEET
JUNE 30, 1999 (WITH COMPARATIVE TOTALS FOR 1998)

ASSETS	1999	1998
CASH	$ 2,678,020	$ 23,979
ACCOUNTS RECEIVABLE	236,944	97,290
GOVERNMENT GRANTS AND CONTRACTS RECEIVABLE	1,334,918	2,013,779
ACCRUED INCOME ON INVESTMENTS	1,528,916	1,850,178
PREPAID AND OTHER ASSETS	484,768	290,134
CONTRIBUTIONS RECEIVABLE - NET (Note M)	1,433,660	2,288,517
SHORT-TERM INVESTMENTS (Note B)	14,310,456	25,998,238
UNAMORTIZED DEBT ISSUANCE EXPENSE	729,237	779,139
INVESTMENTS (Note B)	345,027,767	339,978,980
LAND, BUILDINGS AND IMPROVEMENTS, EQUIPMENT AND RARE BOOK COLLECTION - NET (Note C)	36,606,666	23,663,420
TOTAL ASSETS	$404,371,352	$396,983,654

See notes to financial statements.

LIABILITIES AND FUND BALANCES	1999	1998
ACCOUNTS PAYABLE AND ACCRUED EXPENSES	$ 8,636,939	$ 7,178,041
ACCRUED INVESTMENT MANAGEMENT FEES	3,041,528	1,204,773
REFUNDABLE ADVANCES (Note F)	4,419,414	2,649,193
TRUST FUND OBLIGATIONS	1,998,718	1,591,714
LONG-TERM DEBT (Note D)	42,389,367	42,356,135
NOTE PAYABLE (Note C)	1,140,907	1,193,094
Total liabilities	61,626,873	56,172,950
NET ASSETS:		
Unrestricted	233,210,268	233,561,262
Temporarily restricted	23,756,682	24,016,293
Permanently restricted	85,777,529	83,233,149
Total net assets	342,744,479	340,810,704
TOTAL LIABILITIES AND NET ASSETS	$ 404,371,352	$ 396,983,654

STATEMENT OF ACTIVITIES (WITH COMPARATIVE TOTALS FOR 1998)
YEAR ENDED JUNE 30, 1999

	UNRESTRICTED	TEMPORARILY RESTRICTED
REVENUES, GAINS AND OTHER SUPPORT:		
Private contributions and grants	$ 448,018	$ 2,864,299
Government grants	-	4,504,217
Income on long-term investments	7,846,991	3,553,870
Net realized and unrealized gains on long-term investments (includes ($2,287,244) and $9,598,973 in unrealized (losses) and gains in 1999 and 1998, respectively)	3,736,147	981,830
Gain on sale of capital assets	847,019	-
Net assets released from restrictions - Satisfaction of program restrictions	12,163,827	(12,163,827)
Total revenues, gains and other support	25,042,002	(259,611)
EXPENSES AND LOSSES:		
School of Mathematics	4,984,500	-
School of Natural Sciences	5,046,766	-
School of Historical Studies	3,488,977	-
School of Social Science	2,087,799	-
Libraries and other academic expenses	4,239,203	-
Administration and general	5,189,554	-
Auxiliary activity - tenants' housing expenses, net of unrestricted revenue	356,197	-
Total expenses and losses	25,392,996	-
CHANGES IN NET ASSETS	(350,994)	(259,611)
NET ASSETS, BEGINNING OF YEAR	233,561,262	24,016,293
NET ASSETS, END OF YEAR	$233,210,268	$23,756,682

See notes to financial statements.

1999		
PERMANENTLY RESTRICTED	TOTAL 1999	TOTAL 1998
$ 1,199,916	$ 4,512,233	$ 8,506,388
-	4,504,217	4,403,453
-	11,400,861	10,593,690
1,344,464	6,062,441	23,088,246
-	847,019	999,171
-	-	-
2,544,380	27,326,772	47,590,948
-	4,984,500	4,762,545
-	5,046,766	4,736,059
-	3,488,977	3,600,218
-	2,087,799	1,696,062
-	4,239,203	3,725,423
-	5,189,554	4,473,824
-	356,197	408,328
-	25,392,996	23,402,459
2,544,380	1,933,775	24,188,489
83,233,149	340,810,704	316,622,215
$85,777,529	$342,744,479	$340,810,704

STATEMENT OF CASH FLOWS
YEAR ENDED JUNE 30, 1999

	1999	1998
CASH FLOWS FROM OPERATING ACTIVITIES:		
Change in net assets	$ 1,933,775	$24,188,489
Adjustments to reconcile change in net assets to net cash provided by operating activities:		
Depreciation	2,055,693	1,937,516
Decrease (increase) in accrued income	321,262	(400,646)
Decrease (increase) in accounts and grants receivable	539,207	(344,932)
Decrease in contributions receivable	854,857	426,179
Increase in accounts payable	1,458,898	1,109,268
(Increase) decrease in prepaid and other assets	(194,634)	2,205
Increase in refundable advances	1,770,221	663,756
Increase (decrease) in accrued management fees	1,836,755	(13,973)
Net realized and unrealized gains on long-term investments	(6,062,441)	(23,088,246)
Gain on sale of capital assets	(847,019)	(999,171)
Net cash provided by operating activities	3,666,574	3,480,445
CASH FLOWS FROM INVESTING ACTIVITIES:		
Proceeds from sale of capital assets	2,729,304	2,387,716
Purchase of capital assets	(16,881,223)	(4,521,810)
Proceeds from sale of investments	208,526,124	520,455,018
Purchase of investments	(208,182,147)	(526,581,165)
Net cash used in investing activities	(13,807,942)	(8,260,241)
CASH FLOWS FROM FINANCING ACTIVITIES:		
Increase in trust fund obligations	407,004	3,280
Decrease (increase) in unamortized debt service expense	49,902	(690,029)
Increase in long-term debt	33,232	26,715,875
Decrease in notes payable	(52,187)	(25,706)
Decrease (increase) in investment receivable-bond issue	12,357,458	(21,757,596)
Net cash provided by financing activities	12,795,409	4,245,824
NET INCREASE (DECREASE) IN CASH	2,654,041	(533,972)
CASH, BEGINNING OF YEAR	23,979	557,951
CASH, END OF YEAR	$ 2,678,020	$ 23,979
SUPPLEMENTAL DATA:		
Interest paid	$ 2,362,599	$ 1,560,625

See notes to financial statements.

NOTES TO FINANCIAL STATEMENTS
YEAR ENDED JUNE 30, 1999

A. SUMMARY OF SIGNIFICANT ACCOUNTING POLICIES

The Institute for Advanced Study (the "Institute"), 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."

Basis of Presentation - The accompanying financial statements are prepared on the accrual basis and are presented in accordance with recommendations contained in Not-for-Profit Organizations issued by the American Institute of Certified Public Accountants. Certain prior year amounts presented for comparative purposes have been reclassified to conform to the current year presentation.

Use of Estimates - The preparation of financial statements in conformity with generally accepted accounting principles requires management to make estimates and assumptions that affect the reported amounts of assets and liabilities and disclosure of contingent assets and liabilities at the date of the financial statements. Estimates also affect the reported amounts of revenues and expenses during the reporting period. Actual results could differ from those estimates.

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 net asset classifications.

Fund balances restricted by outside sources are so indicated and are distinguished from unrestricted funds allocated or designated to specific purposes by action of the governing board. Externally restricted funds may only be utilized in accordance with the purpose established by the grantor of such funds. In contrast, the governing board retains full control over unrestricted funds to be used in achieving any of the Institute's objectives.

True endowment funds are subject to the restrictions of the gift instruments which require that the principal be invested in perpetuity; only income earned on such funds may 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. Unrestricted quasi-endowment funds have no external restrictions. However, certain of these funds have been internally designated to support specific needs of the Institute.

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 earned on investments and receivables is generally accounted for in the fund owning such assets. However, unrestricted income earned on investments of endowment and similar funds is accounted for as revenue in unrestricted operating funds, and restricted income is accounted for as deferred restricted revenue until used in accordance with the terms of the restriction or transferred to endowment and similar funds.

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 funds, 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). Interest expense, net of related interest income, is capitalized on construction in progress of qualifying assets.

B. INVESTMENTS

Effective July 1, 1996, the Institute adopted the provisions of Statement of Financial Accounting Standards No. 124, "Accounting for Certain Investments Held by Not-for-Profit Organizations" ("SFAS No. 124"). SFAS No. 124 requires that investments in equity securities with readily determinable fair values and all investments in debt securities be reported at fair value with gains and losses included in the statement of activities. Previously, investments purchased by the Institute were recorded at cost; investments received by gift were recorded at the fair market value at the date of donation.

Endowment and similar funds investments at June 30, 1999 are comprised of the following:

	CARRYING VALUE	MARKET VALUE
Pooled investments:		
Equity securities	$161,466,121	$198,813,891
Debt securities	181,823,883	183,271,443
Mortgages from faculty and staff	2,534,701	2,534,701
Investment accounts receivable	321,132	321,132
Investment accounts payable	(1,193,125)	(1,206,500)
Total pooled investments	344,952,712	383,734,667
Funds invested separately:		
Equity securities	75,055	107,268
Total	$345,027,767	$383,841,935

Marketable debt and equity securities are carried at market value. Realized gains and losses are computed based on the average cost of the investment. Market values are determined utilizing quoted market prices.

Equity securities include the Institute's interests in certain limited partnerships with a carrying value of approximately $96,076,500 and a market value of approximately $105,334,700 at June 30, 1999. The Institute accounts for these investments under the equity method and, accordingly, recognizes its proportionate share of ordinary income and net realized gains attributable to the investments of the partnerships. The Institute's proportionate share of ordinary gain and net realized gain was $2,637,646 and $4,604,865, respectively, for the year ended June 30, 1999.

In addition, equity securities include the Institute's interests in four open-ended investment funds (the "Funds") incorporated in the Cayman Islands with carrying values of $65,389,589 and market values of $93,479,214 at June 30, 1999. The Institute accounts for these investments at the lower of cost or market value. Market value is determined as the number of shares held by the Institute multiplied by the net asset value for such shares. Net asset value, as determined by the Funds, reflects the underlying assets held by the Funds and any investment gain or loss. Realized gains and losses are computed based on the actual cost of the investment.

The Institute's interests in limited partnerships and Funds represent 27.9% and 19.0%, respectively, and 46.9% collectively of total investments held by the Institute at June 30, 1999. These instruments may contain elements of both credit and market risk. Such risks include, but are not limited to, limited liquidity, absence of regulatory oversight, dependence upon key individuals, emphasis on speculative investments (both derivatives and nonmarketable investments) and nondisclosure of portfolio composition.

Substantially all of the 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 table summarizes the investment return and its classification in the statement of activities for the year ended June 30, 1999:

	UNRESTRICTED	TEMPORARILY RESTRICTED	PERMANENTLY RESTRICTED	TOTAL
Dividends and interest	$ 7,846,991	$ 3,553,870	$ -	$ 11,400,861
Realized loss on investments reported at fair value	$(2,397,353)	$ (253,639)	$(875,011)	$ (3,526,003)
Realized gain on investments reported at other than fair value	7,693,713	1,394,414	2,787,562	11,875,689
Total realized gain	5,296,360	1,140,775	1,912,551	8,349,686
Total unrealized loss	(1,560,213)	(158,945)	(568,087)	(2,287,245)
Total realized and unrealized gain	$ 3,736,147	$ 981,830	$1,344,464	$ 6,062,441
Investments, beginning of year				$ 339,978,980
Investment purchases				207,512,470
Investment sales				(208,526,124)
Investment returns:				
Realized gains			$ 8,349,686	
Unrealized losses			(2,287,245)	
Total return on investments				6,062,441
Investments, end of year				$345,027,767
Investments, beginning of year				$339,978,980
Gifts available for investment:				
Gifts creating a permanent endowment				1,383,437
Gifts creating trust funds				576,257
Investment returns:				
Dividends and interest			$11,400,861	
Realized gains			8,349,686	
Unrealized losses			(2,287,245)	
Total return on investments				17,463,302
Amounts appropriated for current operations				(14,143,343)
Annuity trust income payment				(230,866)
Investments, end of year				$345,027,767

The participation in the pool and ownership of the other investments at June 30, 1999 is shown in the table below:

Permanently restricted net assets	$ 85,695,199
Temporarily restricted net assets	23,976,420
Unrestricted net assets	235,356,148
	$345,027,767

Short-term investments represent the balance of the proceeds from the 1997 NJEFA bonds that have not yet been expended for construction purposes. These funds are being held in trust by The Bank of New York. Such funds are invested in U.S. Government obligations with maturities of less than one year. At June 30, 1999, the market value of such securities approximates their carrying value.

C. PHYSICAL PLANT

Physical plant and equipment are stated at cost at date of acquisition, less accumulated depreciation. Library books, other than rare books, are not capitalized.

A summary of plant assets at June 30, 1999 follows:

Land and improvements	$ 1,038,088
Buildings and improvements	49,507,258
Equipment	14,066,875
Rare book collection	203,508
Joint ownership property	1,141,050
Total	65,956,779
Less accumulated depreciation	(29,350,113)
Net book value	$36,606,666

During 1997, the Institute entered into a Deed of Pathway and Conservation Easement (the "Easement") whereby the Institute has received $11,794,600 in cash and $1,274,196 in contributions receivable at June 30, 1997, in consideration for the sale of land development rights for certain Institute properties. The Easement requires that those properties, set forth therein, be preserved to the greatest extent possible in their existing natural, scenic, open, wooded and agricultural state and be protected from uses inconsistent therewith.

Of the $11,794,600 in cash received by the Institute, $5,625,000 represents monies received from the New Jersey Green Acres Fund to be repaid by the parties to the Easement. The Institute's pro rata share of $1,140,907 has been recorded as a note payable in the accompanying statement of financial position at June 30, 1999. The note payable bears interest at a rate of two percent and requires semi-annual payments through January 8, 2017.

The note is payable as follows at June 30, 1999:

2000	$53,236
2001	54,306
2002	55,397
2003	56,511
2004	57,647
Through 2017	863,810
Total	$1,140,907

D. LONG-TERM DEBT

A summary of long-term debt at June 30, 1999 follows:

Series F & G 1997 - NJEFA	$42,875,000
Less unamortized bond discount	(485,633)
Total long-term debt	$42,389,367

Interest expense on long-term debt for the year ended June 30, 1999 was approximately $2,108,130.

In November 1997 the Institute received proceeds of the New Jersey Educational Facilities Authority offering of $16,310,000 Revenue Bonds, 1997 Series F and $26,565,000 Revenue Bonds, 1997 Series G of the Institute for Advanced Study Issue. A portion of the proceeds ($16,969,355) was used to retire the existing Revenue Bonds, 1991 Series. The remainder of the proceeds is to be used for renovation of members housing, construction of a new academic building and additional capital projects.

The bonds bear interest at rates ranging from 4% to 5%, payable semi-annually, are subject to redemption at various prices and require principal payments and sinking fund installments through July 1, 2028. 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.

The bonds are repayable as follows at June 30, 1999:

2000	$ 955,000
2001	1,140,000
2002	1,195,000
2003	1,250,000
2004	1,310,000
Through 2028	37,025,000
Total	$42,875,000

E. PENSION PLANS AND OTHER POST RETIREMENT BENEFITS

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 to the Teachers Insurance and Annuity Association and/or the College Retirement Equities Fund. Contributions are based on the individual participants' compensation in accordance with the formula set forth in the plan documents on a nondiscriminatory basis. Contributions for the year ended June 30, 1999 totaled approximately $1,050,880.

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 these benefits if they meet minimum age and service requirements. The Institute accrues these benefits over a period in which active employees become eligible under existing benefit plans.

The components of the periodic expense for these postretirement benefits for 1999 are as follows:

Postretirement Benefit Costs:	
Service Cost - benefits attributable to service during the year	$ 127,351
Interest Cost on Accumulated Postretirement Benefit Obligation	282,573
Total	$ 409,924

The actuarial and recorded liabilities for these benefits, none of which have been funded, are as follows at June 30, 1996 (a recomputation of the accumulated postretirement benefit obligation as of June 30, 1999 was not performed due to the immaterial change from the prior measurement date):

Accumulated Postretirement Benefit Obligation	
Retirees	$1,810,053
Fully Eligible Active Plan Participants	604,638
Other Active Plan Participants	948,829
Total	$3,363,520

For measurement purposes, a 13.0% Pre-62 trend rate was used for 1997 health care costs, with the rate decreasing ratably until the year 2006, then remaining constant at 5.50% thereafter. In addition, a 10.0% Post-62 trend rate was used for 1997, declining ratably to 5.50% in 2006 and remaining constant thereafter. The health care cost trend rate assumption has a significant effect on the amounts reported. For example, a 1% increase in the health care trend rate would increase the accumulated postretirement benefit obligation by $672,501 at June 30, 1997 and the net periodic cost by $115,444 for the year. The weighted average discount rate used in determining the accumulated postretirement benefit obligation was 7.5%.

F. CHANGES IN DEFERRED RESTRICTED REVENUE (REFUNDABLE ADVANCES)

Restricted receipts, which are recorded initially as deferred restricted revenue, are reported as revenues when expended in accordance with the terms of the restriction or transferred to quasi-endowment funds. Changes in deferred restricted revenue amounts are as follows:

	Total Deferred Restricted Revenue
Balance at June 30, 1998	$2,649,193
Additions:	
Contributions, grants, etc.	9,371,347
Restricted endowment income	3,620,822
Quasi-endowment funds utilized	1,288,843
Total additions	14,281,012
Deductions:	
Funds expended from contributions, grants, etc.	7,601,126
Funds expended from restricted endowment	4,909,665
Total deductions	12,510,791
Balance at June 30, 1999	$4,419,414

G. FUNDS HELD IN TRUST BY OTHERS

The Institute is the residuary beneficiary of a trust and, upon the death of the life tenant, will be entitled to receive the corpus thereof. The approximate market value of the trust's assets, as reported by the administrator of the trust, aggregated $3,875,860 as of June 30, 1999, and is not included in the accompanying financial statements.

H. FUNCTIONAL ALLOCATION OF EXPENSES

The costs of providing the various programs and other activities have been summarized on a functional basis in the statement of activities and cash flows. Accordingly, certain costs have been allocated among the programs and supporting services benefited. The net costs incurred by the Institute in operating both the Dining Hall ($530,711 net of $397,612 in revenues) and members' housing ($622,855, net of $868,518 in revenues) have been allocated among the programs and supporting services benefited. An overhead charge is allocated to certain schools generally based upon their ability to recover such costs under the terms of various grants and contracts. Overhead allocated from administration and general expenses to various programs totaled $3,199,527 for the year ended June 30, 1999.

Interest expense on plant fund debt, net of interest income on short-term investments, is allocated to schools based upon their occupancy of academic buildings funded with such debt. Allocated interest expense totaled $830,800 and allocated interest income totaled $-0- for the year ended June 30, 1999.

I. TAX STATUS

The Institute is exempt from Federal income taxes pursuant to Section 501(c)(3) of the Internal Revenue Code and is listed in the Internal Revenue Service Publication 78.

J. TEMPORARILY AND PERMANENTLY RESTRICTED ASSETS

The Institute reports gifts of cash and other assets as restricted support if they are received with donor stipulations that limit the use of the donated assets. When a donor restriction expires, that is, when a stipulated time restriction ends or purpose restriction is accomplished, temporarily restricted net assets are reclassified to unrestricted net assets and reported in the statement of activities as net assets released from restrictions.

The Institute reports gifts of buildings and equipment as unrestricted support unless explicit donor stipulations specify how the donated assets must be used. Gifts of long-lived assets with explicit restrictions that specify how the assets are to be used and gifts of cash or other assets that must be used to acquire long-lived assets are reported as restricted support. Absent explicit donor stipulations about how long those long-lived assets must be maintained, the Institute reports expirations of donor restrictions when the donated or acquired long-lived assets are placed in service.

Temporarily restricted net assets are available for the following purposes:

	1999
Academic Services:	
Educational Programs	$23,756,682
Permanently restricted net assets are restricted to:	
Investments to be held in perpetuity, the income from which is expendable to support academic services	$85,777,529

Net assets were released from donor restrictions by incurring expenses satisfying the restricted purposes or by occurrence of other events specified by donors.

Purpose restrictions accomplished:	1999
Program expenses:	
School of Mathematics	$3,448,035
School of Natural Sciences	2,476,349
School of Historical Studies	1,316,343
School of Social Science	1,884,359
Academic support costs:	
Libraries and other academic	2,384,552
Computing	63,800
Administration and general:	
Fund raising	12,120
Tenants' housing	164,026
Equipment acquired and placed in service	183,115
Trust fund disbursements	231,128
Total restrictions released	$12,163,827

K. FUNCTIONAL EXPENSES

The Institute provides academic services to a community of scholars, including permanent faculty and visiting members. Expenses related to providing these services are as follows:

	1999
Expenses incurred were for:	
Salaries, wages, and benefits	$11,752,194
Stipends	5,101,344
Honoraria	158,614
Grants to other organizations	696,072
Supplies and travel	2,041,053
Services and professional fees	2,470,188
Depreciation	2,055,693
Interest	1,117,838
Total expenses	$25,392,996

L. DISCLOSURES ABOUT FAIR VALUE OF FINANCIAL INSTRUMENTS

The Institute is required by SFAS No. 107, "Disclosure About Fair Value of Financial Instruments," to disclose the estimated fair value of financial instruments, both assets and liabilities recognized and not recognized in the statement of financial position, for which it is practicable to estimate fair value. The estimated fair value amounts in the following disclosure have been determined by the Institute using available market information and appropriate valuation methodologies. The estimates are not necessarily indicative of the amounts the Institute could realize in a current market exchange, and the use of different market assumptions or methodologies could have a material effect on the estimated fair value amounts.

June 30, 1999	Carrying Amount	Estimated Fair Value
Assets:		
Cash	$ 2,678,020	$ 2,678,020
Investments	359,338,223	398,152,391
Grant/Contributions Receivable	2,768,578	2,768,578
Liabilities:		
Long-term debt	42,389,367	42,389,367
Note payable	1,140,907	1,140,907

The fair value of investments is based on quoted market prices. The fair market valuation of grant/contributions receivable was estimated based on past cash collection experience. For long-term debt, the fair values are estimated using the interest rates currently offered for debt with similar terms and remaining maturities. The estimated fair value of mortgages for faculty and staff is based upon similar terms at which similar institutions would provide as part of an overall compensation package to such individuals. The estimated fair value of the note payable is based on the discounted value of the future cash flows expected to be received from the note.

The fair value estimates presented are based on information available to the Institute as of June 30, 1999, and have not been revalued since that date. While the Institute is not aware of any significant factors that would affect the estimates since that date, current estimates of fair value could differ significantly from the amounts disclosed.

M. DISCLOSURES OF PROMISES TO GIVE (CONTRIBUTIONS RECEIVABLE)

	June 30, 1999
Unconditional promises to give:	
Less than one year	$ 575,449
One to five years	983,954
More than five years	6,000
	1,565,403
Discount on promises to give	(131,743)
	$1,433,660

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