

The Einstein Centennial
Symposium



The Institute for Advanced Study

Princeton, New Jersey

March 4-9, 1979

The profile on the front cover is taken from the gold medal given on the occasion of the Einstein Award. The medal was designed by Gilroy Roberts, chief engraver at the United States Mint, from a bas-relief provided by Albert Einstein himself. The Einstein Award was first presented by the Lewis and Rosa Strauss Foundation in 1951 to Professors Kurt Gödel and Julian Schwinger. The most recent recipient was Professor Stephen W. Hawking, in 1978.

TO CELEBRATE the achievements of Albert Einstein by observing, in his American home, the Centennial of his birth, March 14, 1879, is a responsibility most willingly assumed by the Institute for Advanced Study. Here he lived and worked from 1933 to 1955, the first and foremost member of the Faculty. In his spirit, like Chaucer's clerk, we continue to "gladly . . . learn and gladly teach," so that in celebrating Einstein's accomplishments we also celebrate our shared values: the continuing quest for fundamental knowledge, the search for peace and justice, and the rejection of those very conceits and distempers which such pursuits sometimes engender.

In taking up his name for our own purposes, let us be mindful of Albert Einstein's distaste for commemorative celebrations. "Everything connected with the cult of the person has always been embarrassing to me," he wrote to Max von Laue on February 3, 1955, declining an invitation from scientific societies in West Berlin and East Germany to a joint celebration of the fiftieth anniversary of his first papers on relativity and quantum theory. "If I have learned one thing in pondering throughout a long life, it is this, that we are much further from a deeper insight into the elementary processes than most of our contemporaries believe (but you are not included), so that noisy celebrations are definitely not appropriate to the actual state of affairs."

As quietly as our gratitude will permit, as appropriately as the actual state of affairs will allow, let us pay homage to Albert Einstein in his Centennial Year.

HARRY WOOLF
Director

The Einstein Centennial Symposium

March 4-9, 1979

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The artist Max Liebermann (1847–1935) created this portrait of Albert Einstein in Berlin about 1925. It was presented to the Institute for Advanced Study in 1977 in memory of Bruno Italiener, Rabbi, Historian, by his daughter, Ruth Ivor.

Schedule of Events

Sunday, March 4

Morning

10:00 - 12:30 P.M.

Registration

*Henry Chauncey Conference Center
Educational Testing Service (ETS)*

Afternoon

12:30 - 2:00 P.M.

Lunch *ETS Dining Room*

2:00 - 5:00 P.M.

Registration *ETS Main Lobby*

Evening

6:00 - 7:30 P.M.

Reception *ETS Main Lounge*

7:30 - 9:00 P.M.

Dinner *ETS Dining Room*

9:00 P.M.

Welcome by Howard C. Petersen

Opening Remarks by Harry Woolf

Dedication of the Einstein Memorial Sculpture

Remarks by Dr. Jürgen Schmude,
*Federal Minister of Education and Science
Federal Republic of Germany*

Presentation of the Einstein Medal

ETS Dining Room

Monday, March 5

Morning

7:00 - 8:00 A.M.

Breakfast *ETS Conference Center*

Developments in Relativity

Institute Dining Hall

Session Chairman: C. N. Yang

9:00 - 10:30 A.M.

Roads to the Relativistic *Weltbild*

Paper: Gerald Holton

Comment: Arthur I. Miller

General discussion

10:30 - 10:45 A.M.

Coffee break

10:45 - 12:15 P.M.

Special Relativity Theory in Engineering

Paper: W. K. H. Panofsky

Comment: E. M. Purcell

General discussion

Afternoon

12:30 - 1:30 P.M.

Lunch *Institute Dining Areas*

Quantum Theory

Institute Dining Hall

Session Chairman: Julian Schwinger

Monday, March 5

2:00 – 3:30 P.M.

Einstein and Quantum Physics: The Early Years

Paper: Martin J. Klein

Comment: Thomas S. Kuhn

General discussion

3:30 – 3:45 P.M.

Coffee break

3:45 – 5:15 P.M.

Einstein on Particles, Fields and the Quantum Theory

Paper: A. Pais

Comment: R. Jost

General discussion

Evening

6:45 – 7:15 P.M.

Cocktails *Institute Common Room*

7:15 – 8:30 P.M.

Dinner *Institute Dining Areas*

8:30 – 10:00 P.M.

Chamber Music Concert: The Juilliard String Quartet

Institute Dining Hall

Tuesday, March 6

Morning

7:00 - 8:00 A.M.

Breakfast *ETS Conference Center*

Developments in Relativity

Institute Dining Hall

Session Chairman: V. L. Ginzburg

9:00 - 10:30 A.M.

Experimental Challenges Posed by
Einstein's General Theory of Relativity

Paper: Irwin I. Shapiro

Comment: David T. Wilkinson

General discussion

10:30 - 10:45 A.M.

Coffee break

10:45 - 12:15 P.M.

Theoretical Advances in General Relativity

Paper: Stephen W. Hawking

Comment: W. G. Unruh

General discussion

Tuesday, March 6

Afternoon

12:30 – 1:30 P.M.

Lunch *Institute Dining Areas*

Relativity and Its Ramifications

Session Chairman: E. Amaldi

2:00 – 3:30 P.M.

General Relativity and Differential Geometry

Paper: S. S. Chern

Comment: Tullio Regge

General discussion

3:30 – 3:45 P.M.

Coffee break

3:45 – 5:15 P.M.

Relativity and 20th-Century Intellectual Life

Paper: Ernest Nagel

General discussion

Evening

6:45 – 7:15 P.M.

Cocktails *Institute Common Room*

7:15 – 8:30 P.M.

Dinner *Institute Dining Areas*

8:30 – 9:30 P.M.

Einstein's Europe: *Felix Gilbert*

Institute Dining Hall

Wednesday, March 7

Morning

7:00 - 8:00 A.M.

Breakfast *ETS Conference Center*

The Universe

Institute Dining Hall

Session Chairman: Dennis Sciama

9:00 - 10:30 A.M.

The Size and Shape of the Universe

Paper: Martin J. Rees

Comment: P. J. E. Peebles

General discussion

10:30 - 10:45 A.M.

Coffee break

10:45 - 12:15 P.M.

Galaxies and Intergalactic Matter

Paper: George B. Field

Comment: W. L. W. Sargent

General discussion

Wednesday, March 7

Afternoon

12:30 - 1:30 P.M.

Lunch *Institute Dining Areas*

The Universe (*continued*)

Institute Dining Hall

Session Chairman: P. A. M. Dirac

2:00 - 3:30 P.M.

Beyond the Black Hole

Paper: John Archibald Wheeler

Comment: Freeman J. Dyson

General discussion

3:30 - 3:45 P.M.

Coffee break

3:45 - 5:15 P.M.

Issues in Cosmology

Paper: Dennis Sciama

Comment: Charles W. Misner

General discussion

Evening

6:45 - 7:15 P.M.

Cocktails *Institute Common Room*

7:15 - 8:30 P.M.

Dinner *Institute Dining Areas*

8:30 - 10:00 P.M.

Chamber Music Concert: The Emerson Quartet

Institute Dining Hall

Thursday, March 8

Morning

7:00 – 8:00 A.M.

Breakfast *ETS Conference Center*

Quantum Gravity

Institute Dining Hall

Session Chairman: Victor F. Weisskopf

9:00 – 10:30 A.M.

Quantum Gravity and Supergravity

Paper: Yuval Ne'eman

Comment: Peter van Nieuwenhuizen

General discussion

10:30 – 10:45 A.M.

Coffee break

10:45 – 12:15 P.M.

Einstein and the Unity of Theoretical Physics

Paper: Eugene P. Wigner

General discussion

Afternoon

12:30 – 1:30 P.M.

Lunch *Institute Dining Areas*

Einstein—The Man and His Contributions

Institute Dining Hall

Session Chairman: Hans A. Bethe

Thursday, March 8

2:00 - 3:30 P.M.

Working with Einstein

Banesh Hoffmann, Moderator

Valentine Bargmann

Peter G. Bergmann

Ernst G. Straus

George E. Uhlenbeck

3:30 - 3:45 P.M.

Coffee break

3:45 - 5:00 P.M.

Einstein and the Physics of the Future

Marvin L. Goldberger, Moderator

Stephen L. Adler

Freeman J. Dyson

Steven Weinberg

C. N. Yang

5:00 - 5:30 P.M.

Closing Comments: Harry Woolf

Evening

6:30 - 7:30 P.M.

Cocktails *Institute Common Room*

7:30 - 9:00 P.M.

Dinner *Institute Dining Areas*

9:00 - 10:00 P.M.

Special Address (speaker to be announced)

Institute Dining Hall

Friday, March 9

Morning

7:00 - 8:30 A.M.

Breakfast *ETS Conference Center*

9:00 - 10:30 A.M.

Viewing of selected Einstein papers
Institute Library / John Stachel

10:30 - 10:45 A.M.

Coffee break

11:00 - 12:00 NOON

Firestone Library, Princeton University: "1905"

Afternoon

12:30 - 2:00 P.M.

Lunch *ETS Dining Room*

Departure

Einstein Centennial Symposium Participants*

- Stephen L. Adler
Institute for Advanced Study
- Charles R. Alcock
Institute for Advanced Study
- E. Amaldi
Università degli Studi, Rome
- Philip W. Anderson
Princeton University
- Michael F. Atiyah
University of Oxford
- John N. Bahcall
Institute for Advanced Study
- James Bardeen
University of Washington, Seattle
- John Bardeen
University of Illinois, Urbana
- Valentine Bargmann
Princeton University
- Peter G. Bergmann
Syracuse University
- Hans A. Bethe
Cornell University
- Arne Beurling
Institute for Advanced Study
- Julian Bigelow
Institute for Advanced Study
- Enrico Bombieri
Institute for Advanced Study
- Armand Borel
Institute for Advanced Study
- S. Chandrasekhar
University of Chicago
- S. S. Chern
University of California, Berkeley
- Leon N. Cooper
Brown University

* as of January 15, 1979

Roger F. Dashen
Institute for Advanced Study

Gerard H. de Vaucouleurs
University of Texas, Austin

Robert H. Dicke
Princeton University

P. A. M. Dirac
The Florida State University

Sidney D. Drell
Stanford Linear Accelerator Center

Freeman J. Dyson
Institute for Advanced Study

Jurgen L. Ehlers
Max Planck Institute

Leo Esaki
Thomas J. Watson Research Center, IBM

Herman Feshbach
Massachusetts Institute of Technology

George B. Field
Harvard University

Val Fitch
Princeton University

Daniel Z. Freedman
State University of New York, Stony Brook

Felix Gilbert
Institute for Advanced Study

V. L. Ginzburg
U.S.S.R. Academy of Sciences

Donald A. Glaser
University of California, Berkeley

Marvin L. Goldberger
California Institute of Technology

Maurice Goldhaber
Brookhaven National Laboratory

Herman H. Goldstine
Institute for Advanced Study

Melvin Gottlieb
Princeton University

Adolph Grünbaum
University of Pittsburgh

Feza Gürsey
Yale University

Harish-Chandra
Institute for Advanced Study

Stephen W. Hawking
University of Cambridge

Ernest Henley
University of Washington

Armin Hermann
University of Stuttgart

Banesh Hoffmann
Queens College

Gerald Holton
Harvard University

R. Jost
E. T. H., Zurich

Robert Kargon
Johns Hopkins University

Bruria Kaufman
Weizmann Institute

John R. Klauder
Bell Laboratories

Martin J. Klein
Yale University

Thomas S. Kuhn
Institute for Advanced Study

Willis E. Lamb
University of Arizona

Robert Langlands
Institute for Advanced Study

T. D. Lee
Columbia University

Leon Mandansky
Johns Hopkins University

Arthur I. Miller
Harvard University and University of Lowell

John Milnor
Institute for Advanced Study

Charles W. Misner
University of Maryland

Deane Montgomery
Institute for Advanced Study

Philip Morrison
Massachusetts Institute of Technology

Ernest Nagel
Columbia University

Yuval Ne'eman
Tel-Aviv University

Otto Neugebauer
Institute for Advanced Study

Heinz Pagels
The Rockefeller University

A. Pais
The Rockefeller University

W. K. H. Panofsky
Stanford Linear Accelerator Center

P. J. E. Peebles
Princeton University

Sir Rudolph Peierls
University of Oxford

Arno A. Penzias
Bell Laboratories

E. M. Purcell
Harvard University

I. I. Rabi
Columbia University

Martin J. Rees
University of Cambridge

Tullio Regge
Institute for Advanced Study

Burton Richter
Stanford Linear Accelerator Center

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California Institute of Technology

J. Robert Schrieffer
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John Archibald Wheeler
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Milton G. White
Princeton University

Hassler Whitney
Institute for Advanced Study

Arthur Wightman
Princeton University

Eugene P. Wigner
Princeton University

David T. Wilkinson
Princeton University

Robert W. Wilson
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C. N. Yang
State University of New York, Stony Brook

S. Yoshikawa
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Hideka Yukawa
Kyoto University

Richard A. Zdanis
Johns Hopkins University

Ya B. Zel'dovich
U.S.S.R. Academy of Sciences

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Arne Beurling*
André Weil*
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Bernard Lewis

* *Professors Emeriti*

The Einstein Centennial Celebration

Participants in the Symposium may be interested in other aspects of the Institute's *National Einstein Centennial Celebration*, honoring the one-hundredth anniversary of Albert Einstein's birth.

The Einstein Centennial Symposium has been designed for a scholarly and scientific audience; other components of the Celebration will augment and enhance public participation in the Einstein Centennial Year and hence contribute to a broader understanding of basic science and of cultural history; still others will have as their principal purpose the establishment of the Albert Einstein Memorial at the Institute.

Projects directed primarily toward more general public involvement in the *National Einstein Centennial Celebration* include the following Institute initiatives:

An Einstein Centennial Stamp, to be issued at the Institute in March, 1979.

The Holy Geometry, a ninety-minute film on Einstein's life and work, to be produced by Malone/Gill Productions, Inc., in collaboration with the Institute and Station KCET Los Angeles for presentation on the Public Broadcasting System.

Adrian Malone, executive producer of *The Holy Geometry*, is best known for his award-winning *The Ascent of Man*.

Albert Einstein: A Partial Portrait, a new biographical volume on Einstein which will stress the problems and solutions which characterized his lifework and emphasize the unique way in which his science was the center of his concerns.

This Centennial biography will feature a text by Martin J. Klein, physicist and historian of science at Yale University, with an extended graphics section on Einstein's world by Jo Gladstone, who worked

with the late Jacob Bronowski on both the film and book versions of *The Ascent of Man*.

The Einstein Centennial Traveling Exhibit, prepared for the Institute by the American Institute of Physics and consisting of sixteen panels which will place Einstein in the context of the scientific tradition which he revolutionized, the various movements he espoused, and the communities of intellectuals and scholars with which he was associated.

Individual copies of the exhibit will be made available to each State Humanities Council which will organize Centennial programs utilizing the exhibit in conjunction with the Einstein Centennial Lecture Bureau.

The Einstein Centennial Lecture Bureau and the Traveling Exhibit have been organized by the Institute with the support of the National Endowment for the Humanities. To expand the Centennial Celebration beyond the confines of the scientific community, the Lecture Bureau will make available speakers to various community and educational organizations throughout the country.

Albert Einstein: 1879-1979, a Centennial exhibit co-sponsored by the Institute for Advanced Study and the Smithsonian Institution, from March 1979 to March 1980, in the National Museum of History and Technology in Washington, D.C., will be the most extensive and comprehensive exhibit ever to be devoted to the life, work, and world significance of Einstein.

Organized by Paul Forman and Paul Hanle, the exhibit will feature sections on original portraits of Einstein, on Einstein's biography and personality, his scientific work, his influence on human affairs, and

on the experimental testing and confirmation of his theories.

The Albert Einstein Permanent Exhibit, to be organized for the Einstein Centennial Year in San Francisco's *Exploratorium* by Exploratorium Director Frank Oppenheimer, will be an interpretive exhibit designed to indicate to the viewing public the way in which human understanding of nature progresses. The fourteen exhibits of which the overall exhibit will be composed will be primarily concerned with an explication of the historical processes involved in the history of physics.

Specially organized for the Einstein Centennial with the support of IBM, the exhibit will become a part of the Exploratorium's permanent display.

The Albert Einstein Memorial at the Institute. Efforts are also under way to establish at the Institute a cluster of endowed professorships and fellowships, which will constitute an academic memorial to the great scientist who was the first member of the Institute's faculty.

Acknowledgments

The Einstein Centennial Celebration has been made possible through the support and generous gifts of the following corporations, Federal agencies, foundations, institutions and individuals:

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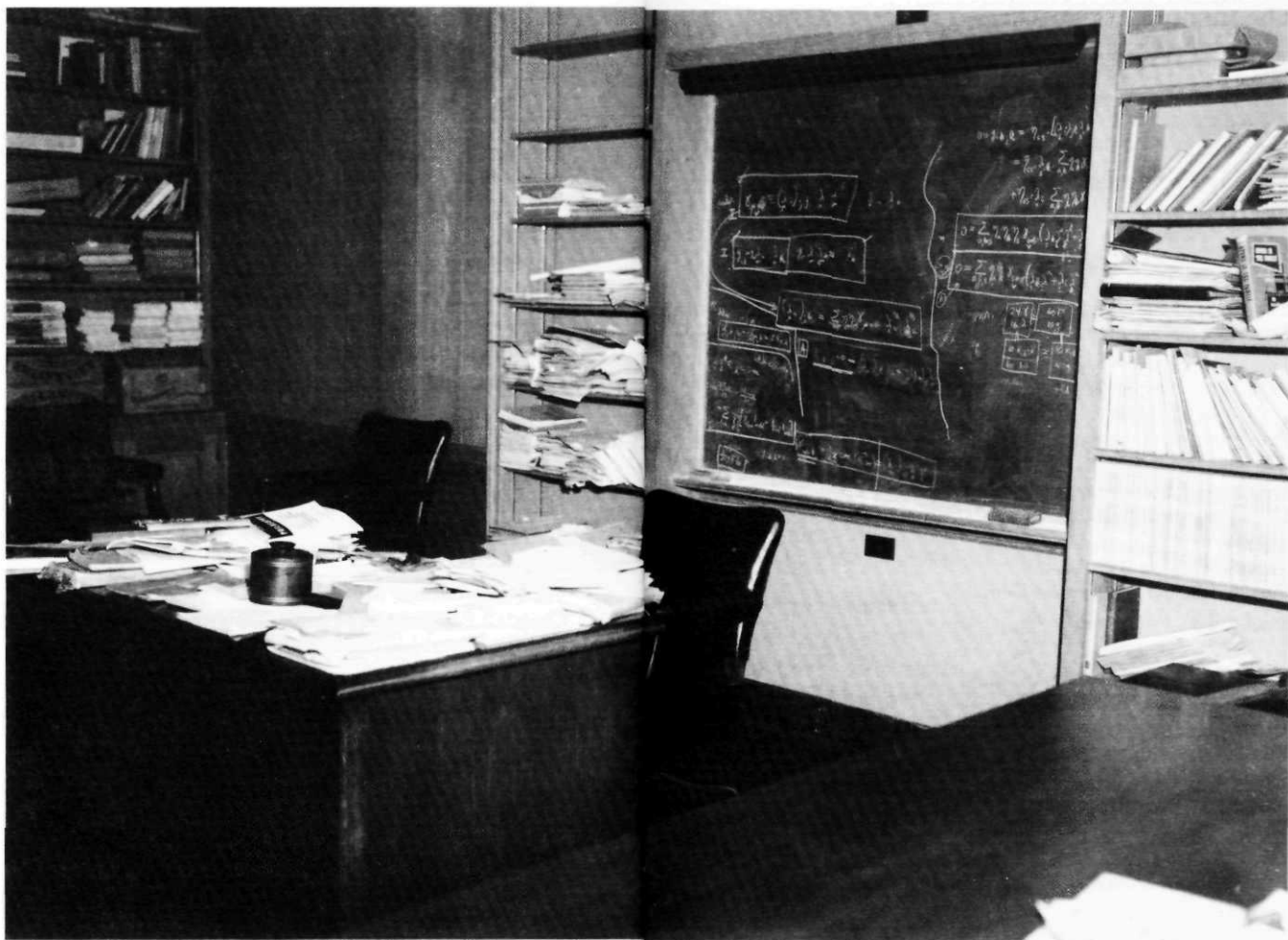
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Albert Einstein to Felix Klein, April 4, 1917:

"But I have no doubt that the day will come when this outlook will have to give way to another, differing in principle, for reasons that today we still cannot foresee. I believe that this process of deepening of theory has no limits. . . ."

"Aber ich zweifle nicht, dass einmal der Tag kommen wird, an dem auch diese Auffassungsweise einer prinzipiell anderen weichen müssen, aus Gründen, die wir heute noch nicht ahnen. Ich glaube, dass dieser Prozess der Vertiefung der Theorie keine Grenze hat. . . ."

The Institute for Advanced Study

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The Institute for Advanced Study

The Institute for Advanced Study, an independent, private institution devoted to the encouragement, support, and patronage of learning, was founded in 1930 as a community of scholars where intellectual inquiry could be carried out in the most favorable circumstances.

These goals have been implemented by a faculty of exceptional merit which over the years has included such celebrated figures as Albert Einstein, Kurt Gödel, E. A. Lowe, Millard Meiss, Marston Morse, John von Neumann, J. Robert Oppenheimer, Erwin Panofsky, Oswald Veblen, and Hermann Weyl; by a continually renewed group of carefully selected visiting members who are in residence at the Institute each year; and by the development of facilities and a mode of operation designed specifically to support and assist in every way possible the intellectual purposes of the Institute.

For close to five decades the Institute for Advanced Study has made a substantial contribution to the world of higher learning by providing support—intellectual and material—to visiting members whose development and growth constitute one of its principal purposes. Its record of distinction in the achievements both of its permanent faculty and of its visiting members is undisputed.

Central to the Institute's view of learning is the conviction that most important work is the product of the disciplined and creative individual mind, and that the individual scholar must be responsible for how he or she uses the precious resources of time and energy. The community of peers in the designated area of intellectual work is the ultimate judge of the results. The choice and conduct of research and study

and the nature and extent of working relations with visiting members are accordingly matters which are decided entirely by each individual member of the faculty.

The Institute today occupies about a square mile of land in Princeton township; most of this is farm and woodland. Its buildings house offices for faculty and members, seminar and lecture rooms, common rooms, and libraries. Although the Institute has no administrative or organic connection with Princeton University, there has always been very close collaboration between the two institutions on matters of common interest.

The Institute's annual budget of approximately six million dollars is supported in large part by income from endowment as well as by contributions from private foundations, corporations, Federal agencies, and individuals. Additional endowment is now being sought along with program and unrestricted funds in order to accommodate planned growth while sustaining in an era of sharply rising costs the Institute's established levels of achievement.

The official Institute seal, shown on the back cover, was created by M. Pierre Turin in 1932, and was the winning entry in a competition conducted by the Institute. The original die, from which medals and bookplates have also been made, is kept on deposit for the Institute by l'Administration des Monnaies et Medailles in Paris.



The Institute for Advanced Study

Princeton, New Jersey 08540

Addenda to
Einstein Centennial
Symposium Participants

- Marcel Bardon
National Science Foundation
- Kenneth Brecher
Massachusetts Institute of Technology
- Jing-run Chen
Academia Sinica, Peking
- Elizabeth Roboz Einstein
University of California, Berkeley
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University of Illinois, Chicago
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- Joseph H. Taylor, Jr.
University of Massachusetts
- Wen-chun Wu
Academia Sinica, Peking

Addenda to
Acknowledgments

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Tibor and Dorothy Fabian
Sibyl and William T. Golden Foundation
Brunson S. McCutchen
Supermarkets General Corporation