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**Conference in
Modern Analysis
and Probability**

AMERICAN MATHEMATICAL SOCIETY

VOLUME 26

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**Conference in
Modern Analysis
and Probability**

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CONTEMPORARY MATHEMATICS

Volume 26

Conference in Modern Analysis and Probability

**Richard Beals, Anatole Beck,
Alexandra Bellow and Arshag Hajian,
Editors**

AMERICAN MATHEMATICAL SOCIETY

Providence • Rhode Island



This volume is dedicated to
PROFESSOR SHIZUO KAKUTANI
with the affection, admiration and
respect of his students and colleagues.

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INTRODUCTION

The Conference in Modern Analysis and Probability in honor of Professor Shizuo Kakutani was held on June 8-11, 1982, at Yale University on the occasion of his retirement. In these Proceedings we present the papers that were submitted for this Conference. Some of the invited authors were unable to attend, and due to time constraints not all the papers submitted were included in the program of the Conference.

The three major areas of mathematics on which the Conference focused were functional analysis, probability theory, and ergodic theory. Most of the articles presented were works by the respective authors on problems that were pioneered by Professor Kakutani in the past. Questions in Brownian motion, induced transformations, representation of M-spaces, and fixed point theorems were discussed.

Members of the organizing committee were Richard Beals, Anatole Beck, Alexandra Bellow, and Arshag Hajian. Due to geographical restrictions, however, the weight of the preparatory work fell on Richard Beals. The assistance given to the Committee by Phyllis Stevens of the Mathematics Department at Yale was invaluable; her experience and competence insured the smoothness of the Conference. The painstaking work of retyping the manuscripts for the Proceedings was done by the secretarial staff of the Mathematics Department at Yale under the careful guidance of Regina Hoffman; we owe much to her in the preparation of these Proceedings.

We are indebted to the National Science Foundation¹ for the initial funding of this Conference, without which it would have been difficult for this Conference to have taken place.

¹NSF Grant - MCS-8118339

FOREWORD

As indicated by this conference honoring Shizuo Kakutani on his formal retirement from his Professorship at Yale, his talents and achievements in his chosen field are well known and appreciated throughout the world of mathematics.

I would like to take this opportunity to make a few remarks about his achievements as a humanitarian, - a person devoted to promoting the welfare of humanity, in this case, particularly those who showed an interest in mathematics, though this was not a necessary condition.

I first met Shizuo in the spring of 1941 at the Institute for Advanced Study. I would not remember this if it were not for the fact that he wrote me a letter dated May 8, 1941, in which he expressed his pleasure at having met me and sent a solution to a problem concerning the transitivity properties of a dynamical system which I had posed to him. As always, he was careful about accreditations and said that John Oxtoby had suggested the method for constructing the desired example.

I came to Yale in 1948. The presiding chairman of the department was W. R. Longley, who was scheduled to retire in 1949, and though it was generally assumed that I would inherit the august post, the administration did not make it official until well along in the spring of 1949. Early in 1949, Jake informed me that our mutual friend, Shizuo Kakutani, who was then visiting the Institute for Advanced Study, was seeking a position in the United States. We informed Longley and persuaded him to go forward with the necessary steps leading to an appointment for Shizuo. I think there was some concern as to how the undergraduates would react to being taught by a Japanese whose interests might be mainly concentrated in mathematical research. But the appointment went through and, to our good fortune, Shizuo joined us.

As it turned out, there was no need of any concern. Shizuo took great interest in the undergraduate teaching and in the students themselves, an action which is often conducive to more effort on the part of the students. His courses were never routine and he must have put much time, effort and ingenuity into preparing his lectures. He never paraded his superior knowledge or unusual talents in mathematics. He set high standards of achievements but was always compassionate for those who could only reach lesser heights. The excellence of his teaching did not go unrecognized and in 1968 he was presented with the William Clyde DeVane Award at a meeting of the undergraduate membership of Phi Beta Kappa.

Let me turn to Shizuo, the library builder. When I came to Yale, the Department of Mathematics had its own library. It was housed in a fairly large

room on the top floor of Leet Oliver and was by no means insignificant. There were many volumes and even journals such as *Acta Mathematica*, which, like many of the books, was duplicated in the Main Library. There was no librarian, - it was run on the honor system, - and it was very useful. One of the members of the department was in charge of the library and there was little in the way of duties connected with the position.

A few years after I came, Ed Begle, who had been in charge of the library, had more important things to do, and I asked Shizuo to take on the task, assuming that he would give about as much time to it as the others had.

Quite unintentionally, I think I made some of his early days on the job the unhappiest of his life. There were some fine old volumes, beautifully bound, in the departmental library, but these were duplicated in the Main Library, and I didn't think that we needed two copies of the same book. Since there was little support for our library, I decided to sell the duplicates. One of the New York book dealers came to New Haven, offered what seemed like a reasonable sum and took them away. I have never seen anyone looking more woe-begone than Shizuo was, as the books were carried off. He looked as if he were losing some of his best friends. I didn't realize until long afterward that those books were among his best friends.

But he recovered and soon made it clear that he wasn't going to take just a casual interest in the departmental library, - he aimed at making it rank with the best mathematical libraries in the country. And that is just what he did, with the backing of Charles Rickart, particularly, during whose chairmanship our library finally acquired a librarian.

I hardly need to say anything about the remarkable effectiveness of Shizuo's teaching at the graduate level. Many of his doctoral students were at this conference and each has his own tale of the profound influence that Shizuo has had on his life. His concern for the welfare of his students didn't end with their attainment of the doctoral degree. I think he always knew where all his students were, what they were doing and, when needed, he gave them support. When he didn't have enough to worry about as far as his own students were concerned, he used to worry about mine.

But Shizuo's teaching has reached far beyond the confines of Yale University and its students. In a sense he has been the effective teacher of a host of us, a stimulating and gracious giver, sharing his knowledge, ideas, ingenuity and the precious gift of time, with one and all. For this, we extend our thanks to our good friend Shizuo and hope that we can continue to learn from him for a long time to come.

Program of the
Conference on Modern Analysis and Probability
Tuesday, June 8, 1982

- 9:30-10:20 J. Lindenstrauss: "Some recent results on Banach lattices"
- 11:00-11:50 K. Itô: "Stochastic differential equations in infinite dimensions"
- 2:00-2:40 F. Browder: "Degree theories, old and new"
- 2:50-3:30 E. Hewitt: "Conjugate Fourier series on the character group of the rationals"
- 4:00-4:40 W. Johnson: "Extensions of Lipschitz mappings"
- 5:00-5:40 L. Karlovitz: "Chebyshev and related extremal polynomials"

Wednesday, June 9, 1982

- 9:30-10:20 D. Sullivan: "Riemann surfaces and dynamics"
- 11:00-11:50 A. Dvoretzky: "The Fatou inequality and cluster points of random variables"
- 2:00-2:40 P. Loeb: "A Daniell integral and extensions of nonstandard measure theory"
- 2:50-3:30 R. Anderson: "Some applications of nonstandard analysis in probability theory"
- 4:00-4:40 R. Kaufman: "Bernoulli convolutions and differentiable functions"
- 4:50-5:30 M. Sharpe: "Processes evolving from the indefinite past"

Thursday, June 10, 1982

- 9:00-9:45 K. Jacobs: "Ergodic theory and combinatorics, a survey"
- 10:00-10:45 H. Furstenberg: "IP sets and ergodic theory"
- 11:15-12:00 M. Ratner: "Rigidities of horocycle flow"
- 2:00-2:40 W. Parry: "Invariants of finitary isomorphisms with finite expected code-lengths"
- 2:50-3:30 D. Maharam Stone: "Some problems related to measure algebras"
- 4:00-4:40 M. Keane: "The unicity of infinite clusters and the continuity of the percolation probability"
- 4:50-5:30 B. Weiss: "Equivalence of transformations and flows"

Friday, June 11, 1982

- 9:00-9:45 A. Katok: "Special representations for group actions and Kakutani equivalence"
- 10:00-11:15 J. Feldman and D. Ornstein: "Kakutani equivalence"
- 11:30-12:15 R. Zimmer: "Actions of arithmetic groups"
- 2:00-2:40 J. Choksi: "Some recent developments arising out of Kakutani's work on completion regularity of measures"
- 2:50-3:30 J. Oxtoby: "Probability limit identification functions"
- 4:00-4:40 K. Petersen: "Efficient encoding and metrically sofic systems"

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