



Report for 1980--U.S. National Committee for Rock Mechanics: A Summary of the Work Conducted During Calendar Year 1980 (1981)

Pages
67

Size
8.5 x 10

ISBN
0309331129

Assembly of Mathematical and Physical Sciences;
National Research Council

 [Find Similar Titles](#)

 [More Information](#)

Visit the National Academies Press online and register for...

- ✓ Instant access to free PDF downloads of titles from the
 - NATIONAL ACADEMY OF SCIENCES
 - NATIONAL ACADEMY OF ENGINEERING
 - INSTITUTE OF MEDICINE
 - NATIONAL RESEARCH COUNCIL
- ✓ 10% off print titles
- ✓ Custom notification of new releases in your field of interest
- ✓ Special offers and discounts

Distribution, posting, or copying of this PDF is strictly prohibited without written permission of the National Academies Press. Unless otherwise indicated, all materials in this PDF are copyrighted by the National Academy of Sciences.

To request permission to reprint or otherwise distribute portions of this publication contact our Customer Service Department at 800-624-6242.

Copyright © National Academy of Sciences. All rights reserved.



REPORT FOR 1980—
U.S. NATIONAL COMMITTEE FOR ROCK MECHANICS

A Summary of the Work
Conducted during Calendar Year 1980

Assembly of Mathematical and Physical Sciences
National Research Council

National Academy Press
Washington, D.C. 1981

NOTICE: The project that is the subject of this report was approved by the Governing Board of the National Research Council, whose members are drawn from the Councils of the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine. The members of the Committee and Panels were chosen for their special competences and with regard for appropriate balance.

The National Research Council was established by the National Academy of Sciences in 1916 to associate the broad community of science and technology with the Academy's purposes of furthering knowledge and of advising the federal government. The Council operates in accordance with general policies determined by the Academy under the authority of its Congressional charter of 1863, which establishes the Academy as a private, nonprofit, self-governing membership corporation. The Council has become the principal operating agency of both the National Academy of Sciences and the National Academy of Engineering in the conduct of their services to the government, the public, and the scientific and engineering communities. It is administered jointly by both Academies and the Institute of Medicine. The National Academy of Engineering and the Institute of Medicine were established in 1964 and 1970, respectively, under the charter of the National Academy of Sciences.

SPONSORS: This project was sponsored in 1980 through U.S. Bureau of Mines Contract No. JO 199030 by the following agencies: U.S. Bureau of Mines, U.S. Geological Survey, U.S. Bureau of Reclamation (formerly Water and Power Resources Service), Defense Nuclear Agency, Department of the Air Force, Department of the Army, Department of the Navy, Department of Energy, National Science Foundation, Federal Highway Administration, and Urban Mass Transportation Administration. The study of the Panel on Rock-Mechanics Research Requirements, reported herein, is being supported by the U.S. Geological Survey under Grant No. 14-08-0001-G-601, the Department of Energy under Contract No. EY-76-C-02-2708-027 (Modification M012), and the National Science Foundation under Grant No. PFR-7910294.

A limited number of copies available from
U.S. National Committee for Rock Mechanics
2101 Constitution Avenue
Washington, D.C. 20418

CONTENTS

| | |
|---|----|
| INTRODUCTION | 1 |
| ACTIVITIES OF THE COMMITTEE | 2 |
| Nomination and Appointment of Members and Officers | 2 |
| Annual Meeting of the Committee | 3 |
| Changes in the Committee's Constitution, Organization, and Procedures | 4 |
| ACTIVITIES OF THE PANELS | 5 |
| Panel on Domestic and International Activities | 5 |
| Panel on Rock-Mechanics Research Requirements | 6 |
| REPRESENTATION OF THE UNITED STATES IN THE ACTIVITIES OF THE INTERNATIONAL SOCIETY FOR ROCK MECHANICS (ISRM) | 8 |
| ISRM Council Meeting | 8 |
| Secretariat Activities | 9 |
| APPENDIX A | 10 |
| Membership, 1980 U.S. National Committee for Rock Mechanics | |
| APPENDIX B | 16 |
| Record of the Annual Meeting, 1980 | |
| APPENDIX C | 28 |
| Constitution | |

INTRODUCTION

The U.S. National Committee for Rock Mechanics (USNC/RM), a part of the Assembly of Mathematical and Physical Sciences, was formed within the National Research Council in 1967 to represent U.S. interests in the science and engineering of rock mechanics. Its purposes are the following:

- To serve the national interests of the United States by recommending actions for advancing the science and engineering of rock mechanics to government, industry, and the universities.
- To provide coordination and promote cooperation among the technical and professional societies and organizations involved in rock mechanics.
- To effect appropriate participation in all activities of the International Society for Rock Mechanics (ISRM) through the National Academy of Sciences—National Academy of Engineering—National Research Council (NAS-NAE-NRC), which adhere to the ISRM on behalf of U.S. scientists, engineers, and technologists interested in rock mechanics.

The Committee conducts advisory studies; distributes reports of findings and recommendations; assists host universities in organizing annual, national rock-mechanics symposia; presents awards annually for outstanding contributions to the advancement of the science and engineering of rock mechanics; and participates in activities of the ISRM. These activities include international congresses at four- to five-year intervals, Commission studies of rock-mechanics problems of international importance, and regional symposia on timely rock-mechanics themes.

This annual report describes the work of the Committee and its Panels in calendar year 1980. The Committee is grateful to the federal agencies that sponsor its activities and to the professional societies and organizations that both furnish support and nominate representatives to serve on the Committee.

ACTIVITIES OF THE COMMITTEE

NOMINATION AND APPOINTMENT OF MEMBERS AND OFFICERS

Five members completed terms on the Parent Committee on June 30, 1980, and were succeeded by new members appointed for terms ending in 1983, as indicated below:

| <i>MEMBERSHIP SOURCE</i> | <i>RETIRING MEMBERS</i> | <i>NEW MEMBERS</i> |
|---|---|---|
| At Large | Don C. Banks Waterways Experiment Station | John D. Bredehoeft U.S. Geological Survey |
| At Large | Madan M. Singh Engineers Inter- national Inc. | Bruce R. Clark Leighton and Associates |
| Geological Society of America | Fitzhugh T. Lee U.S. Geological Survey | George A. Kiersch Consultant |
| American Society of Civil Engineers | Charles Fairhurst University of Minnesota | Fred H. Kulhawy Cornell University |
| American Society for Testing and Materials | Egons R. Podnieks U.S. Bureau of Mines | Howard J. Pincus University of Wis- consin, Milwaukee |

In addition, C. William Lovell was appointed as the representative of the Transportation Research Board, for a term expiring in 1983, to replace William F. Brumund, who resigned because of the press of other work.

Don C. Banks completed his term as Committee Chairman on June 30 and became Immediate Past Chairman and an *ex-officio* member. He was succeeded by Neville G. W. Cook for the year July 1, 1980, to June 30,

1981. Kate H. Hadley was nominated by the Committee members and appointed by the National Research Council to serve as Chairman-Elect for the same period and to succeed as Chairman on July 1, 1981.

A roster of the Committee and its Panels is included as Appendix A.

ANNUAL MEETING OF THE COMMITTEE

The Parent Committee and representatives of the Panels met in Rolla, Missouri, on May 27, just prior to the 21st Annual U.S. Symposium on Rock Mechanics. The record of the meeting is included as Appendix B.

Major decisions by the Committee were as follows:

- Chapters 1 and 2 of the draft report on rock-mechanics research requirements will be revised, with the Committee Chairman, Dr. Banks, drafting the executive summary (Chapter 1) and the Steering Group drafting the bridging chapter (Chapter 2) between the executive summary and the technical chapters (Chapters 3 through 9).
- Plans for the 22nd Symposium at the Massachusetts Institute of Technology, as presented by Herbert H. Einstein, were approved (Appendix B, Enclosure 2).
- The bid of the University of California at Berkeley to host the 23rd Symposium was accepted.
- Keynote lectures will be instituted in connection with the annual symposia, possibly starting in 1982.
- Sponsorship of symposia will be reviewed, with the possibility of adding sponsorship by professional societies represented on the Committee.
- A new procedure for eliciting nominations for the annual research awards was approved (Appendix B, Enclosure 3).
- The plan to publish a rock-mechanics periodical was dropped.
- The U.S. Delegation to the meeting of the ISRM Council will discuss reduction of U.S. dues with the General Secretary, ISRM.

Activities of the Constituent Societies

Ten professional societies and organizations are represented on the Committee. A summary report of their activities is given in Appendix B.

The Committee discussed ways to develop stronger and more effective ties between the societies and the Committee, including sponsorship of

symposia by the societies and strengthened roles for society representatives. Further consideration of the matter and appropriate action was planned during the year.

CHANGES IN THE COMMITTEE'S CONSTITUTION, ORGANIZATION, AND PROCEDURES

The Assembly of Mathematical and Physical Sciences (AMPS), at its meeting on September 26 and 27, 1980, approved changes in the constitution recommended by the Committee in August 1976 and June 1979. Although the earlier changes had not been formally approved, the Committee had been operating within the provisions of the proposed revisions since 1976. The series of amendments makes the constitution consistent with the terminology, procedures, and policies of the National Research Council. Specifically, they clarify the purposes and functions of the Committee and ensure that the provisions relating to membership, terms of service, duties of officers, and voting procedures conform to NRC policies. The Governing Board received and approved the Assembly's recommendation of the amendments on October 25, 1980. A copy of the revised constitution is included as Appendix C.

The Committee Chairman, Dr. Cook, believing that additional changes in organization and procedures would strengthen the Committee, corresponded with the Chairman of the Assembly late in 1980 concerning his thoughts. As a consequence of the exchange of correspondence, an *ad hoc* group consisting of three former Committee Chairmen and two members of the National Academy of Sciences was appointed to assist Dr. Cook in reviewing the Committee's activities and recommending appropriate changes. The group was scheduled to meet early in 1981. The results of their review, and subsequent Committee action, will appear in the annual report for 1981.

ACTIVITIES OF THE PANELS

PANEL ON DOMESTIC AND INTERNATIONAL ACTIVITIES

Sponsorship of Annual Rock-Mechanics Symposia

Each year the Panel is responsible for assisting with the planning for and conduct of the symposium. To accomplish this, three members of the Panel serve as members of the Organizing Committee established by the host institution.

The 21st U.S. Symposium on Rock Mechanics, hosted by the University of Missouri at Rolla, was held May 28-30, 1980. The theme of the symposium was "State of the Art in Rock Mechanics." Technical sessions were held on the following topics: finite-element case studies and radioactive-waste disposal; aspects of mechanical breakage of rock; effects of temperature; laboratory testing of rock; longwall mining and subsidence; rock fracture by explosives; rock mechanics; mathematical modeling; dynamic, acoustic, and seismic studies; and ground support and strata control. The proceedings include a total of 103 papers, as well as discussion of the papers presented during the sessions.

With respect to future symposia, the Panel took the following actions:

- Reviewed plans prepared by the Organizing Committee for the 22nd Symposium (to be hosted by the Massachusetts Institute of Technology, June 29-July 2, 1981) and recommended approval by the Committee.
- Reviewed bids received from potential sponsors of the 23rd Symposium and recommended acceptance of the offer tendered by the University of California at Berkeley.
- Discussed and proposed to the Committee the initiation of keynote lectures, beginning with the 23rd Symposium.
- Discussed the feasibility of sponsorship of symposia by the professional societies and reported the considerations involved to the Committee.

Awards for Outstanding Research Papers in Rock Mechanics

The Subpanel on Awards reviewed papers submitted in response to the solicitation for nominations and selected the following authors as recipients:

- Applied Research Award

Frank O. Jones and William W. Owens
for

"A Laboratory Study of Low Permeability Gas Sands"
(Preprint 7551, Society of Petroleum Engineers, Dallas, Texas)

- Basic Research Award

Barry H.G. Brady and John W. Bray
for

"The Boundary Element Method for Determining Stresses and Displacements Around Long Openings in a Triaxial Stress Field" and
"The Boundary Element Method for Elastic Analysis of Tabular Ore Body Extraction, Assuming Complete Plane Strain"
(*Int. J. Rock Mech. Min. Sci. & Geomech. Abstr.* 15, 21-28 and 29-37)

No student research award was granted because too few papers were received to enable appropriate competition. The papers nominated for the 1980 award will be held for consideration the following year.

The Subpanel, concerned about the sharp decline in the number of nominations for the awards, drafted a brief statement proposing a new procedure for nominating and evaluating papers. The "Annual Research Awards" statement (Appendix B, Enclosure 3) was approved by the Panel and then by the Committee.

PANEL ON ROCK-MECHANICS RESEARCH REQUIREMENTS

The Panel continued its study of rock-mechanics research requirements for resource recovery, construction, and earthquake-hazard reduction. The study is being funded separately from other Committee activities by the U.S. Geological Survey, the Department of Energy, and the National Science Foundation.

The study progress in 1980 included the following:

- Completion in January of initial draft reports by the seven technical subpanels.

- Conduct of a workshop in February, at which the draft chapters were reviewed and revisions recommended.

- Completion of a draft report including the seven technical chapters, an executive summary, and a technical summary and conclusions.

- Review by members of the Committee and discussion at the annual meeting.

- Completion of the final draft report.

- Review and approval by the NRC's Assembly of Mathematical and Physical Sciences.

At the end of the year the report was being edited and prepared for publication early in 1981. The Committee plans to distribute copies of the report to all federal agencies that provide funds for its activities.

REPRESENTATION OF THE UNITED STATES IN THE ACTIVITIES OF THE INTERNATIONAL SOCIETY FOR ROCK MECHANICS (ISRM)

In fulfillment of its responsibility to effect appropriate participation in all activities of the ISRM, the Committee

- Represents the United States in meetings of the ISRM Council.
- Participates in ISRM congresses and symposia and encourages participation by U.S. members of the ISRM.
- Arranges for U.S. participation in activities of the study Commissions of the ISRM.
- Provides for membership of U.S. scientists, engineers, and technologists in the ISRM.

ISRM COUNCIL MEETING

The 1980 meeting of the Council was held on June 22, in Stockholm, Sweden. Representatives of 19 member countries participated; the United States was represented by a delegation of three, headed by the Committee Chairman, Don C. Banks.

The ISRM accomplishes its substantive activities through Commissions that are established to study scientific and technical matters of concern to the Society. These Commissions meet in conjunction with the ISRM Council, to which they report the progress of their activities. Of the seven Commissions currently active, two are chaired by individuals from the United States. These are the Commission on Case Histories and the Commission on Education. A summary report of the Council and Commission meetings appears as Appendix D.

The Council meeting was held in conjunction with the international symposium "Rockstore '80," which the ISRM—together with several other organizations—sponsored. The symposium was attended by delegations from the U.S. National Committee for Rock Mechanics and the U.S. National Committee on Tunneling Technology. A summary report of the symposium is included as Appendix E.

SECRETARIAT ACTIVITIES

Membership

The Committee Secretariat provides for affiliate membership in the ISRM for individuals in the United States. This includes maintaining membership records, arranging for subscriptions to the journals, and distributing the quarterly *ISRM News* and other pertinent material.

Each year the Secretariat prepares and distributes a "Directory of U.S. Members of the ISRM." At the end of 1980, there were 293 members. They are listed in Appendix F.

Symposia and Congresses

At the 1980 meeting of the ISRM Council, it was proposed and approved that the ISRM sanction the 23rd U.S. Symposium on Rock Mechanics as an official international symposium of the Society. The Committee and Secretariat will assist the host institution, the University of California at Berkeley, in fulfilling the requirements that ISRM sponsorship imposes.

During 1980 the Secretariat continued distribution of *Advances in Rock Mechanics: Volume III, Events and Discussions*, published in 1979. This document is the final volume of the proceedings of the 3rd Congress of the ISRM, which the Committee hosted in September 1974.

MEMBERSHIP, 1980
U.S. NATIONAL COMMITTEE FOR ROCK MECHANICS

OFFICERS

Chairman and Member-at-Large

Neville G. W. Cook
Department of Material Science
and Mineral Engineering
University of California, Berkeley

Chairman-Elect and Member-at-Large

Kate H. Hadley
Gulf Coast Division
Exxon Company U.S.A.
Houston, Texas

Immediate Past Chairman

Don C. Banks
Waterways Experiment Station
Army Corps of Engineers
Vicksburg, Mississippi

MEMBERS-AT-LARGE

John D. Bredehoeft
Water Resources Division
U.S. Geological Survey
Reston, Virginia

Bruce R. Clark
Leighton and Associates
Irvine, California

James H. Coulson
Tennessee Valley Authority
Knoxville, Tennessee

Fred A. Donath
CGS, Inc.
Urbana, Illinois

Melvin Friedman
Center for Tectonophysics
Texas A&M University
College Station, Texas

William W. Hakala
Division of Ocean Drilling Programs
National Science Foundation
Washington, D.C.

SOCIETY REPRESENTATIVES

Society of Mining Engineers
L. Alan Weakley
Exxon Company U.S.A.
Aurora, Colorado

Transportation Research Board
C. William Lovell
School of Civil Engineering
Purdue University
Lafayette, Indiana

Geological Society of America
George A. Kiersch
Consultant
Tucson, Arizona

American Society of Civil Engineers
Fred H. Kulhawy
School of Civil and Environmental
Engineering
Cornell University
Ithaca, New York

Society of Petroleum Engineers

Kenneth E. Gray
Department of Petroleum Engineering
University of Texas
Austin, Texas

*American Society for Testing
and Materials*

Howard J. Pincus
Departments of Geological Sciences
and Civil Engineering
University of Wisconsin
Milwaukee, Wisconsin

American Geophysical Union

James T. Engelder
Lamont-Doherty Geological Observatory
Palisades, New York

*American Society of Mechanical
Engineers*

Arfon H. Jones
Terra Tek, Inc.
Salt Lake City, Utah

Association of Engineering Geologists

Arthur B. Arnold
Bechtel, Inc.
San Francisco, California

Society of Exploration Geophysicists

William E. Kenyon
Schlumberger
Ridgefield, Connecticut

LIAISON REPRESENTATIVES

Building Research Advisory Board
(to be appointed)

Transportation Research Board

John W. Guinnee
Transportation Research Board
National Research Council
Washington, D.C.

Federal Agencies

Eugene C. Robertson
Engineering Geology Branch
U.S. Geological Survey
Reston, Virginia

EX OFFICIO MEMBERS

ISRM Vice President for North America

Thomas C. Atchison
Department of Civil and Mineral
Engineering
University of Minnesota
Minneapolis, Minnesota

Chairman, AMPS

Herbert H. Friedman
Assembly of Mathematical and
Physical Sciences (AMPS)
National Research Council
Washington, D.C.

Foreign Secretary, NAS

Thomas F. Malone
National Academy of Sciences
Washington, D.C.

Foreign Secretary, NAE

N. Bruce Hannay
National Academy of Engineering
Washington, D.C.

SECRETARIAT STAFF

Executive Secretary

Robert L. Bangert
U.S. National Committee for Rock
Mechanics
National Research Council
Washington, D.C.

Assistant Executive Secretary

Susan V. Heisler

Administrative Assistant

Barbara S. Adams

Secretary

Jean L. Hensley

PANEL ON DOMESTIC AND INTERNATIONAL ACTIVITIES

Kate H. Hadley, *Chairman*
Gulf Coast Division
Exxon Company U.S.A.
Houston, Texas

James H. Coulson
Tennessee Valley Authority
Knoxville, Tennessee

Herbert H. Einstein
Department of Civil Engineering
Massachusetts Institute of Technology
Cambridge, Massachusetts

Arfon H. Jones
Terra Tek, Inc.
Salt Lake City, Utah

William R. Judd
School of Civil Engineering
Purdue University
Lafayette, Indiana

George A. Kiersch
Consultant
Tucson, Arizona

David A. Summers
Rock Mechanics and Explosives Research Center
University of Missouri
Rolla, Missouri

L. Alan Weakly
Exxon Company U.S.A.
Aurora, Colorado

PANEL ON ROCK-MECHANICS RESEARCH REQUIREMENTS

Steering Group

John W. Handin, *Cochairman*
Center for Tectonophysics
Texas A&M University
College Station, Texas

William R. Judd, *Cochairman*
School of Civil Engineering
Purdue University
Lafayette, Indiana

Howard J. Pincus, *Study Director*
Departments of Geological Sciences
and Civil Engineering
University of Wisconsin
Milwaukee, Wisconsin

Subpanel on Porosity, Permeability, and Fluid Flow in Situ

H. Donald Outmans, *Chairman*
Union Oil Company of California
Brea, California

Michael S. King, *Consultant*
Department of Geological Sciences
University of Saskatchewan
Saskatoon, Saskatchewan, Canada

John D. Bredehoeft
Water Resources Division
U.S. Geological Survey
Reston, Virginia

Ernest H. Koepf
Core Laboratories, Inc.
Dallas, Texas

Amos N. Nur
School of Earth Sciences
Stanford University
Stanford, California

George F. Pinder
Department of Civil Engineering
Princeton University
Princeton, New Jersey

Henry J. Ramey, Jr.
Department of Petroleum Engineering
Stanford University
Stanford, California

Subpanel on in Situ Stress Measurement at Depth

Bruce R. Clark, *Chairman*
Leighton and Associates
Irvine, California

Henri S. Swolfs, *Consultant*
Branch of Engineering Geology
U.S. Geological Survey
Denver, Colorado

James R. Aggson
U.S. Bureau of Mines
Denver, Colorado

James T. Engelder
Lamont-Doherty Geological
Observatory
Palisades, New York

Kate H. Hadley
Gulf Coast Division
Exxon Company U.S.A.
Houston, Texas

Mark D. Zoback
Office of Earthquake Studies
U.S. Geological Survey
Menlo Park, California

Subpanel on Fracture Mapping, Natural and Artificial

Charles H. Dowding, *Cochairman*
Department of Civil Engineering
Northwestern University
Evanston, Illinois

Richard E. Goodman, *Cochairman*
Department of Civil Engineering
University of California
Berkeley, California

Terence K. Young, *Consultant*
Department of Geophysics
Colorado School of Mines
Golden, Colorado

Herbert H. Einstein
Department of Civil Engineering
Massachusetts Institute of Technology
Cambridge, Massachusetts

Melvin Friedman
Center for Tectonophysics
Texas A&M University
College Station, Texas

R. Jeffrey Lytle
Geophysical Applications
Lawrence Livermore National
Laboratory
Livermore, California

Ted O. Price
Sigma Industrial Systems, Inc.
Richland, Washington

Phillip R. Romig
Department of Geophysics
Colorado School of Mines
Golden, Colorado

Subpanel on Rock Fragmentation
Methods—Drilling and Construction

Chapman Young, *Chairman*
Science Applications, Inc.
Steamboat Springs, Colorado

George B. Clark, *Consultant*
Department of Mining Engineering
Colorado School of Mines
Golden, Colorado

John B. Cheatham, Jr,
Department of Mechanical and Aerospace
Engineering and Materials Science
Rice University
Houston, Texas

Neville G. W. Cook
Department of Material Science and
Mineral Engineering
University of California
Berkeley, California

Carl R. Peterson
Department of Mechanical Engineering
Massachusetts Institute of Technology
Cambridge, Massachusetts

Darrell D. Porter
Rio Blanco Oil Shale Company
Denver, Colorado

David E. Siskind
U.S. Bureau of Mines
Twin Cities, Minnesota

Subpanel on Interpretation/Scaling
Laboratory Test Results to Field
Problems

Lloyd S. Cluff, *Cochairman*
Woodward—Clyde Consultants
San Francisco, California

Madan M. Singh, *Cochairman*
Engineers International, Inc.
Downers Grove, Illinois

Z.T. Bieniawski, *Consultant*
Department of Mineral Engineering
Pennsylvania State University
University Park, Pennsylvania

Charles E. Glass, *Consultant*
College of Mines and Geological
Engineering
University of Arizona
Tucson, Arizona

Brian T. Brady
U.S. Bureau of Mines
Denver, Colorado

Kenneth E. Gray
Department of Petroleum Engineering
University of Texas
Austin, Texas

Ronald E. Heuer
Consultant
Champaign, Illinois

Ellis L. Krinitzsky
Waterways Experiment Station
Army Corps of Engineers
Vicksburg, Mississippi

Howard R. Pratt
Science Applications, Inc.
La Jolla, California

Subpanel on Thermophysical/
Thermomechanical Properties
Determination

Eugene C. Robertson, *Chairman*
Engineering Geology Branch
U.S. Geological Survey
Reston, Virginia

Robert F. Roy, *Consultant*
Department of Geology
University of Texas
El Paso, Texas

William H. Diment
Earthquake and Tectonic Risk Branch
U.S. Geological Survey
Reston, Virginia

Bruce S. Hemingway
Experimental Geochemistry and
Mineralogy Branch
U.S. Geological Survey
Reston, Virginia

Brann Johnson
Center for Tectonophysics
Texas A&M University
College Station, Texas

Thomas J. Shankland
Geological Research Group
Los Alamos Scientific Laboratory
Los Alamos, New Mexico

James A. Stottlemyre
Water and Land Resources Department
Battelle Pacific Northwest
Laboratories
Richland, Washington

Subpanel on Numerical Modeling

Mihran S. Agbabian, *Chairman*
Agbabian Associates
El Segundo, California

Christopher St. John, *Consultant*
Department of Civil and Mineral
Engineering
University of Minnesota
Minneapolis, Minnesota

Maciej P. Bieniek
Department of Civil Engineering
and Engineering Mechanics
Columbia University
New York, New York

Francois E. Heuze
Lawrence Livermore National
Laboratory
Livermore, California

Darrell E. Munson
Shock Wave Phenomena Division
Sandia Laboratories
Albuquerque, New Mexico

David K. Parrish
Center for Tectonophysics
Texas A&M University
College Station, Texas

Staff

Robert L. Bangert, *Executive Secretary*
Susan V. Heisler, *Assistant Executive
Secretary*
Barbara S. Adams, *Administrative
Assistant*
Jean L. Hensley, *Secretary*

NATIONAL RESEARCH COUNCIL
ASSEMBLY OF MATHEMATICAL AND PHYSICAL SCIENCES

2101 Constitution Avenue Washington, D. C. 20418

U.S. NATIONAL COMMITTEE FOR ROCK MECHANICS

(202) 389-6155

1980 ANNUAL MEETING

U.S. NATIONAL COMMITTEE FOR ROCK MECHANICS

May 27, 1980
HOWARD JOHNSON'S MOTOR LODGE
ROLLA, MISSOURI

Record of the Meeting

ATTENDEES

MEMBERS:

Don C. Banks, *Chairman and Member-at-Large*
Neville G.W. Cook, *Chairman-Elect, Member-at-Large, and
Chairman, Panel on Domestic and International Activities*
Arthur B. Arnold, *AEG Representative*
James H. Coulson, *Member-at-Large*
Fred A. Donath, *Member-at-Large*
James T. Engelder, *AGU Representative*
Kenneth E. Gray, *SPE Representative*
Kate H. Hadley, *Member-at-Large*
William E. Kenyon, *SEG Representative*
Fitzhugh T. Lee, *GSA Representative*
Madan M. Singh, *Member-at-Large*
L. Alan Weakly, *SME Representative*

EX OFFICIO MEMBERS:

Thomas C. Atchison, *ISRM Vice President for North America*
Sidney V. Green, *Immediate Past Chairman*

GUESTS:

Herbert H. Einstein, *Organizing Chairman, 22nd U.S.
Symposium on Rock Mechanics and Member, Panel on Domestic
and International Activities*
William R. Judd, *Cochairman, Panel on Rock Mechanics
Research Requirements*
Howard J. Pincus, *Study Director, Panel on Rock Mechanics
Research Requirements*

GUESTS

(continued):

David A. Summers, *Organizing Chairman, 21st Symposium
on Rock Mechanics and Member, Panel on Domestic and
International Activities (Part-Time)*

STAFF:

Robert L. Bangert, *Executive Secretary*
Susan V. Heisler, *Assistant Executive Secretary*
Barbara S. Adams, *Administrative Assistant*

The agenda for the meeting is attached as Enclosure 1.

The Chairman, Don C. Banks, called the meeting to order at 9:10 a.m. He reported on several activities that had occurred since the last annual meeting:

- Coordination with other national groups: He had written to five persons in Mexico to establish coordination. Unfortunately, there was no response. The 13th Canadian Rock Mechanics Symposium is being held at the same time as the U.S. Symposium and therefore there will be no official Canadian participation. Steps have been taken to improve coordination.
- Meetings of Executive Committee: He briefly reported the results of meetings held in Washington in December 1979 and in Indianapolis in April.

ISRM Membership: Efforts to increase U.S. membership include prior mailing of ISRM information sheets with Symposium announcements, participation of Mrs. B. S. Adams at Symposium registration, and information sheets on display at registration.

- Symposia on mining research: Correspondence with George Clark concerning future conduct of symposia on mining research by five universities was reviewed. At this point, Dr. Gray noted some of the topics of the symposia:
 - Pennsylvania State University: mine safety
 - University of Minnesota: mine design
 - University of Texas at Austin: *in situ* extraction
 - University of Missouri at Rolla: mine mechanization

STATUS REPORT — ADMINISTRATION AND FINANCES

Mr. Bangert reported that the amendments to the constitution voted by the Committee in 1976 and 1979, which had not been forwarded to the Governing Board because of an NRC-wide study of constitutions of USNC's, would now be sent forward. The NRC study has been completed, and accordingly the USNC/RM changes can now be proposed first to the Assembly of Mathematical and Physical Sciences and then to the Governing Board. The Committee will operate in accordance with the proposed amendments:

The Committee's financial status was briefly reported. Sufficient funds are expected to be available through the contract period (until September 30, 1980) with a modest carryover expected. A proposal for a one-year extension of the Bureau of Mines contract will be requested.

POTENTIAL SOURCES OF BIAS

Mr. Bangert informed the members that every committee within the NAS-NAE-NRC is required to review annually the status of members with regard to potential sources of bias. He then read the letter from Dr. Handler, President of the NAS, which is printed on the reverse of each bias form, and asked the members to notify the Secretariat if there were any changes to the form at the time of appointment to membership.

REPORTS OF THE PANEL CHAIRMEN

Panel on Rock Mechanics Research Requirements

Dr. Pincus, Study Director, reported on study progress since the last annual meeting and the schedule for completion of the study. Progress included the series of subpanel meetings, drafts of the seven technical chapters, visits by the Study Director and executive secretary to federal agencies in December 1979, the workshop in Denver in February 1980, and revised drafts of the report including chapters one and two and review of the revised draft, which was sent out on May 9. Remaining work includes revision of the draft report, review and approval by the Panel and the Committee, NRC review (now scheduled for June 16), editing, and publication.

He reported that there would be a breakfast meeting on May 28 for all Panel members in Rolla. The purpose is to report on the study progress. Dr. Pincus emphasized the need to get comments from subpanels, particularly with regard to what they want to see in chapter two. The Steering Group will confer by phone on changes before the draft report is submitted for review.

Costs and level of effort have been omitted from the present draft because there are so many variables that accurate estimates are virtually impossible, and inaccurate estimates might do a disservice to the federal agencies that are or might be interested in funding research. "Piggybacking" will also affect the amount of research funds required. The Executive Committee approved the omission of detailed estimates, although some level of effort must be included. If the Committee wants to include estimated costs, an attempt could be made.

Following this report, Mr. Bangert reviewed the financial status of the study:

| | |
|---|---------------|
| Total anticipated funding: | \$172,150 |
| Expended through April 1980: | <u>99,390</u> |
| Outstanding Commitments: | <u>10,415</u> |
| Remainder available to complete the study: | \$ 62,345 |

It appears that adequate funds are available to complete the study as planned.

Following these reports there was considerable discussion. The following were the major items:

- Draft chapters 1 and 2. At the suggestion of Dr. Cook and Dr. Banks, these draft chapters are to be rewritten. Dr. Banks accepted the task of drafting chapter 1, Executive Summary, with a goal for distributing the draft on June 6. The Steering Group will draft Chapter 2, a "bridging" chapter of discussion and findings between the Executive Summary and the seven technical chapters.

- Names of persons to be recommended by the Committee to the Assembly to be considered as NRC reviewers were discussed. The final list includes: Stan Wilson, Don Deere, Evert Hoek, Barry Raleigh (USGS), Cole McClure, (Bechtell), and Paul Witherspoon.

● Level of effort was discussed. Using Mr. Green's estimated figures (as reported to ISRM in 1979), the federal government spent \$80-100 million in 1978 for rock mechanics activities, and private industry spent an estimated \$25-50 million. Only about 5% of these monies was spent on fundamental research. As an exercise, the Committee considered what additional amounts might be appropriate for research. Although it is difficult, if not impossible, to estimate with accuracy what is required, it appeared to be the consensus from this exercise that an increase of sevenfold to tenfold in the next five years in the amount spent for fundamental research would be appropriate to address the research needs described in the reports technical chapters. Even so, the anticipated accomplishments from such an increase cannot be forecast with specificity, in part because there may not be sufficient numbers of trained personnel to use the funds with greatest efficiency.

Panel on Domestic and International Activities

Plans for 21st Symposium

Dr. Summers reported that the Symposium was all set and gave details of the program. About two hundred registrants are expected. Approximately eighty-five papers will be presented

Plans for 22nd Symposium

Dr. Einstein reported the plans for the 22nd Symposium as follows:

- The Symposium will be organized as described in the attached announcement (Enclosure 2).
- Preprints (softbound) will be distributed to registrants. Hard-bound copies will be available on order.
- Registration fee will be similar to this year (with increase dictated by inflation).
- Nontechnical functions will include an ice breaker party Sunday evening, a harbortour and clambake Monday evening, the luncheon for USNC/RM activities Tuesday noon, and a Boston Pops concert on Wednesday evening. There may be a program for accompanying persons.
- Accommodations will include dormitories and hotels.
- Field trips will be offered on July 2 to various tunnel jobs and quarries in the Boston area.

The Committee approved the plans as described.

Review of Bids-23rd U.S. Symposium on Rock Mechanics

Dr. Banks reported on the result of evaluation of bids for the 23rd Symposium by the appointed *ad hoc* group. Two bids were received, one from the Virginia Polytechnic Institute and State University (VPI and SU) and the other from the University of California, Berkeley (UC/B). Both presented well-planned and described bids, but the UC/B bid was preferred for two reasons. First, it was felt that UC/B's proposed program was a better response to the needs of the U.S. rock-mechanics community. Second, the group believed that the technical interests represented by the UC/B organizing committee were broader than those represented by the VPI and SU committee.

A vote was then held on sponsorship of the 23rd Symposium. The result was nine to three in favor of UC/B. However, VPI and SU would be encouraged to resubmit when bidding was opened for the 24th Symposium.

Discussion ensued on several matters related to rock-mechanics symposia. The following points were made:

- Mr. Green suggested that symposia sponsorship be broadened to include professional societies.
- Dr. Cook suggested that the symposia be held in conjunction with professional society rock-mechanics meetings, perhaps every two or three years.
- Mr. Weakly stated that most society meetings are user oriented (i.e., composite case histories) rather than theory oriented (as are university-sponsored symposia).

As a result of the discussion, the society representatives were requested to discuss the possibility of society sponsorship of symposia and be prepared to report their societies' views later.

Keynote Lectures for Future Symposia.

Dr. Banks reported on proposal that keynote lectures be instituted, perhaps in 1982, in conjunction with annual symposia. Subject for the first lecture could be the history of rock mechanics in the U.S. over the past twenty-four years, with emphasis on symposia. An alternate could be on classic papers. The Committee decided that the first lecture should take place at Berkeley in 1982, but further decisions were reserved for later action.

Annual Research Awards.

Professor Judd discussed the sharply declining number of awards nominations and proposed a new procedure for nominations. (Enclosure 3).

The Committee approved the proposed procedure.

Rock-Mechanics Periodical.

Dr. Cook reported that the society representatives had shown no enthusiasm for a periodical and recommended that the idea be dropped. There was no objection.

Panel on Fundamental Problems in Rock Mechanics and Educational Requirements

Mrs. Heisler reported that work on the preparation and distribution of the questionnaire to be used in developing a directory of personnel in rock-mechanics education, research, and application is going forward.

International Society for Rock Mechanics

Delegation to Council Meeting, Stockholm.

Mr. Bangert reported that the U.S. delegation would consist of Dr. Banks, Mr. Atchison, and himself. Additionally, part of the expenses of Dr. Edward J. Cording, Chairman of the ISRM Commission on Education, would be defrayed by the USNC/Tunneling Technology, because he would be a delegate to Rockstore 80.

U.S. Annual Dues to the ISRM

Mr. Bangert reported that the U.S. paid an annual fee of \$1200 to the ISRM in addition to a portion of the fee for individual members, whereas all other nations pay only a \$60 fee plus a portion of members' fees. The basis for the higher fee is stated as "National Groups not open to individual membership." Consequently, the U.S. pays considerably more than other member nations with similar-sized membership. He sought the Committee's approval to discuss the matter in Stockholm with the Secretary General with a view to proposing a more equitable sharing of ISRM costs. There was no objection.

(This was discussed in Stockholm on June 22 with Dr. Silverio. As a result of the discussion, U.S. dues will be the same as those of other countries starting in 1982.)

Commission on Case Histories.

Dr. Banks reported that Dr. Wittke, President of ISRM, had approved the names of the proposed members of the Commission, and he (Dr. Banks) is in the process of contacting them.

REPORTS OF SOCIETY REPRESENTATIVES*

ASSOCIATION OF ENGINEERING GEOLOGISTS (AEG): Mr. Arnold reported that he has been trying to increase interest in USNC/RM activities by putting articles in the quarterly news. The AEG annual meeting will be held in Dallas in October

* No report was given for the *TRANSPORTATION RESEARCH BOARD (TRB)* because the representative has resigned due to pressing business activities and a new representative had not yet been nominated.

1980. He will be looking into the AEG's interest in joint sponsorship of meetings.

AMERICAN GEOPHYSICAL UNION (AGU): Dr. Engelder suggested that the USNC/RM develop a clearinghouse for information on what research projects agencies and industry are funding, what projects are being undertaken, and who is doing the research. He noted that solid-earth geophysicists need this information and that it is difficult and time consuming to obtain.

AMERICAN SOCIETY FOR CIVIL ENGINEERS (ASCE): Professor Judd (reporting for Dr. Fairhurst) informed the Committee that the spring 1981 Convention in New York will have a session on rock mechanics in large hydro projects. Also some time in the next year and a half there may be a conference on limits of application of rock mechanics. This has been proposed as an Engineering Foundation Conference, and Z.T. Bieniawski is the proposed chairman.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME): Mr. Green (reporting for Dr. Jones) stated that the rock-mechanics committee of the Petroleum Division is very active and has good attendance at its meetings. He feels that ASME would be interested in joint meetings. Mr. Green also noted that the *Journal of Energy Technology*, edited by Dr. John Cheatham, is publishing a number of rock-mechanics papers.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM): Dr. Pincus (reporting for Dr. Podnieks) reported that he will succeed Dr. Podnieks as ASTM representative on July 1, 1980. He announced that an ASTM symposium on fracture mechanics, ceramics, concrete, and rock will be held in Chicago on June 23 and 24, 1980. A symposium is planned for Detroit in June 1981, the subject of which will be acoustic emissions. Committee D-18 (rock mechanics) will be planning symposia on rock mechanics in 1982 - possibly January and June. Suggestions for topics would be welcome. Dr. Pincus also stated that USNC/RM help could be used in revising existing and developing new ASTM standards. He received an affirmative response from Committee members.

GEOLOGICAL SOCIETY OF AMERICA (GSA): Mr. Lee reported that news of USNC/RM annual meetings, symposia, and awards are published in the GSA News. He stated that "Geology Beneath Cities" would be published soon. Dr. George Kiersch will be the new GSA representative on the Committee; he will discuss the possibility of joint meetings with Dr. Kiersch later this week.

SOCIETY OF EXPLORATION GEOPHYSICISTS (SEG): Dr. Kenyon observed that there is not much subject matter in current rock-mechanics symposia to attract geophysicists. He has proposed some rock-mechanics subjects for SEG meetings and will follow up on this suggestion.

SOCIETY OF MINING ENGINEERS (SME): Mr. Weakly reported that the request for publication of information on ISRM membership in the SME journal was turned down, but it is probably a misunderstanding that he can clear up. SME does not favor a rock-mechanics periodical because it is felt that it would be too technical. He will raise the possibility of sharing a fall meeting with a rock-mechanics symposium, and also the idea of holding rock-mechanics sessions at annual meetings.

SOCIETY OF PETROLEUM ENGINEERS (SPE): Dr. Gray announced a forum on earth stresses in relationship to petroleum products to be held August 3-8, 1980. This will have a limited attendance of about one hundred. No proceedings will be published. He reviewed the SPE concern over whether affiliation with USNC/RM should continue. Dr. Gray favors continuation. The question will be discussed by the SPE Executive Committee when it meets in June. He feels that all societies may be unsure of the role they are to play in USNC/RM affairs and recommends that this question be addressed.

ANNOUNCEMENT OF ELECTION RESULTS

Mr. Bangert announced results of the election of officers and members as follows

- Kate H. Hadley to be Chairman-Elect from July 1, 1980, to June 30, 1981.
- John D. Bredehoeft, member from Government for three-year term starting July 1, 1980.
- Bruce R. Clark, member from Industry for three-year term starting July 1, 1980.

CERTIFICATES OF APPRECIATION

Dr. Banks presented certificates of appreciation to Kenneth E. Gray, Madan M. Singh, and Fitzhugh T. Lee, outgoing Committee members, Sidney J. Green at the completion of his term as Immediate Past Chairman, and Neville G.W. Cook at the completion of his term as Chairman-Elect, and Chairman of the Panel on Domestic and International Activities. In turn, Dr. Cook presented Don C. Banks a certificate of appreciation for his distinguished service as Chairman. Certificates of other outgoing members who were not present are to be mailed.

INSTALLATION OF OFFICERS, 1980-1981

Dr. Banks, on relinquishing duties as Chairman, thanked the members of the Committee for their support. He predicted that Dr. Cook will be an enthusiastic Chairman who will help the Committee probe into what can be done to further rock mechanics in the U.S. He then passed the gavel to Dr. Cook.

On accepting the gavel, Dr. Cook thanked Dr. Banks on behalf of the Committee for his distinguished service as Chairman and said he would look forward to working with Dr. Banks as Immediate Past Chairman in the coming year.

FUTURE OUTLOOK--STATUS OF ROCK MECHANICS IN THE U.S.

Dr. Cook stated that, in general, the U.S. leads the rest of the world in the field of rock mechanics but there is a body of accumulated experience elsewhere that we can use. He hopes, with help of all members of the Committee, to insure that the science of rock mechanics continues to prosper as well in the future as it has in the past.

There being no further business, the meeting was then adjourned.

U.S. NATIONAL COMMITTEE FOR ROCK MECHANICS

1980 ANNUAL MEETING
MAY 27

9:00 a.m.
2nd Floor Conference Room
Howard Johnson's Motor Lodge
Rolla, Missouri

AGENDA

| | |
|---|--------------------------------|
| Introduction | <i>Don C. Banks</i> |
| Status Report — Administration and Finances | <i>Robert L. Bangert</i> |
| Potential Sources of Bias | <i>Robert L. Bangert</i> |
| Reports of Panels | |
| Rock Mechanics Research Requirements | <i>Howard J. Pincus</i> |
| Domestic and International Activities | <i>Neville G.W. Cook</i> |
| Plans for 22nd (1981) Symposium | <i>Herbert H. Einstein</i> |
| Review of Bids — 23rd (1982) Symposium | <i>Don C. Banks</i> |
| Keynote Lectures for Future Symposia | <i>Don C. Banks</i> |
| Annual Research Awards | <i>William R. Judd</i> |
| Rock Mechanics Periodical | <i>Neville G.W. Cook</i> |
| Educational Requirements | <i>Susan V. Heisler</i> |
| International Society for Rock Mechanics | |
| Delegation to Council Meeting, Stockholm | <i>Robert L. Bangert</i> |
| Question of Amount of U.S. Annual Dues | <i>Robert L. Bangert</i> |
| Commission on Case Histories | <i>Don C. Banks</i> |
| Reports of Society Representatives | <i>Society Representatives</i> |
| Certificates of Appreciation | <i>Don C. Banks</i> |
| Election Results | <i>Robert L. Bangert</i> |
| Installation of Officers, 1980-1981 | |
| Future Outlook — Status of Rock Mechanics in the U.S. | <i>Neville G.W. Cook</i> |

**ROCK MECHANICS
FROM RESEARCH
TO APPLICATION**



**22ND U.S. SYMPOSIUM
ON ROCK MECHANICS**

to be held at M.I.T. June 29–July 2, 1981

Topics:

- 1 HEAT AND FLUID FLOW**
 - Geothermal/Geopressure Energy
 - Underground Storage
 - Radioactive Waste Isolation
 - In Situ Retorting and Gasification
- 2 FRAGMENTATION AND FRACTURE PROPAGATION**
 - Hydraulic and Explosive Fracturing
 - Excavation and Drilling
- 3 DEFORMATION OF ROCK MASSES**
 - Foundation Settlements and Subsidence
 - Deformation Around Underground Openings
 - Cause and Effects of Swelling Rock
- 4 SITE CHARACTERIZATION**
 - Exploration Strategy and Technology
 - Rock Mass Classification
 - Fracture Mapping
 - Deep In Situ Stress Measurements
- 5 TRANSFER OF RESEARCH RESULTS INTO PRACTICE**

Each of the topics 1–4 will be treated in two consecutive sessions, one devoted to research, one to application. Topic 5 will include summaries and discussions of the research transfer problems that became apparent in topics 1–4; in addition, opportunity exists for papers specifically addressing the research and technology transfer problem.

Prospective authors are invited to submit an extended abstract (1000–1500 words, plus 1 to 2 figures) for review and selection of papers, and a brief (200 word max) abstract for inclusion in the Symposium program. The abstracts should be identified by the topic and whether they are research or application oriented.

Schedule for Paper Submission
 Abstracts due: December 1, 1980
 Notification of authors by: January 31, 1981
 Papers due: March 31, 1981

For further information please contact:
 Herbert H. Einstein
 Department of Civil Engineering
 Room 1-330
 Massachusetts Institute of Technology
 Cambridge, Massachusetts 02139
 (617) 253-3598

Send abstracts to:
 Lea A. Johnson
 Director, Conference and Seminar Office
 Room 9-335
 Center for Advanced Engineering Study
 Massachusetts Institute of Technology
 Cambridge, Massachusetts 02139
 (617) 253-7411

NATIONAL RESEARCH COUNCIL
ASSEMBLY OF MATHEMATICAL AND PHYSICAL SCIENCES

2101 Constitution Avenue Washington, D. C. 20418

5. NATIONAL COMMITTEE FOR ROCK MECHANICS

(202) 389-6415

ANNUAL RESEARCH AWARDS

Because of the sharply declining number of award nominations, the Subpanel on Awards and the Executive Committee propose the awards be abandoned or the following changes made in award procedures:

1. The Subpanel on Awards shall consist of persons with a wide knowledge of applied and research activities in rock mechanics in each of their specific professions. Therefore, the Subpanel on Awards shall have six members as follows: a chairman and one person each from civil, mining, and petroleum engineering, tectonophysics or geophysics, and engineering geology.
2. Each member is responsible for evaluating current publications in his profession. From this survey each member shall nominate at least one and no more than three papers for the applied and the basic research awards.
3. Each Subpanel on Awards member is responsible for contacting those universities and colleges that have graduate programs in the member's specialty. The purpose is to urge such institutions to nominate masters' thesis for the student award and PhD thesis for the basic research award.
4. The professional society representatives on the Parent Committee are to nominate one person from their respective societies for the Subpanel on Awards membership. The chairman of the Parent Committee and the Subpanel on Awards chairman then shall select the five Subpanel on Awards members from these nominations and from any other nominations made by members of the Parent Committee.
5. In addition to the above, award nominations can be made by any other members of the rock-mechanics community.
6. The Subpanel on Awards shall be appointed no later than June 15 of each year.

May 20, 1980

CONSTITUTION
OF THE
U.S. NATIONAL COMMITTEE FOR ROCK MECHANICS

*Approved by the Governing Board
National Research Council
February 5, 1967*

*Amendments Approved
February 4, 1968
December 6, 1970
October 15, 1972
October 25, 1980*

I. PURPOSES

The purposes of the U.S. National Committee for Rock Mechanics (USNC/RM), hereinafter referred to as the Committee, shall be:

- A. To serve the national interests of the United States by recommending to government, industry, and the universities actions for advancing the science and engineering of rock mechanics.
- B. To provide coordination and promote cooperation among the technical and professional societies and organizations involved in rock mechanics.
- C. To effect appropriate participation in all activities of the International Society for Rock Mechanics (ISRM) through the National Academy of Sciences – National Academy of Engineering – National Research Council (NAS-NAE-NRC), which adheres to the ISRM on behalf of United States scientists, engineers, and technologists interested in rock mechanics.

II. COGNIZANCE

The Committee shall be responsible to the Assembly of Mathematical and Physical Sciences of the National Research Council (NRC).

III. FUNCTIONS

- A. To initiate and encourage programs and actions directed toward advancing the science and technology of rock mechanics and their effective application.
- B. To nominate a U.S. representative and alternative representative to the Council of the ISRM and to provide information and guidance for such representatives.

- C. To collect and disseminate technical information related to rock mechanics, including current research, interdisciplinary developments, and innovative programs.
- D. To promote and sponsor national and international conferences on rock mechanics.
- E. To inform rock-mechanics specialists in the United States about domestic and international activities in rock mechanics.
- F. To perform additional duties, as considered appropriate by the Committee, that may be requested by other organizations.

IV. MEMBERSHIP

- A. MEMBERS. The Committee shall consist of eighteen (18) voting members, as follows:
 - 1. Ten (10) members nominated as formal representatives of the following professional societies and organizations which, in accordance with the provisions in section IV E, are eligible for such representation on the Committee:
 - American Geophysical Union (AGU)
 - American Society for Testing and Materials (ASTM)
 - American Society of Civil Engineers (ASCE)
 - American Society of Mechanical Engineers (ASME)
 - Association of Engineering Geologists (AEG)
 - Geological Society of America (GSA)
 - Society of Exploration Geophysicists (SEG)
 - Society of Mining Engineers (SME) of AIME
 - Society of Petroleum Engineers (SPE) of AIME
 - Transportation Research Board (TRB)
 - 2. Eight (8) members-at-large nominated to maintain an approximate balance of representation from the following separate areas of activity, each of which shall be represented by at least two (2) members: federal, state, and/or local government; industry; and academic and research institutions or organizations.
- B. *EX-OFFICIO* MEMBERS. Non-voting *ex-officio* members shall include the following:
 - 1. The Chairman of the Assembly of Mathematical and Physical Sciences, National Research Council.
 - 2. The Foreign Secretary of the National Academy of Sciences.
 - 3. The Foreign Secretary of the National Academy of Engineering.
 - 4. Any U.S. resident who is an officer of the International Society for Rock Mechanics (ISRM).
 - 5. An Immediate Past Chairman of the Committee whose term as a member expires simultaneously with his term as Chairman, for a period of one (1) year following expiration of these terms.
 - 6. The Executive Secretary of the Committee.

- C. TERM OF OFFICE. Committee members shall be appointed to serve terms of not more than three (3) years and in such manner that approximately one third of the terms expire on June 30 of each year. Committee members may be reappointed, but continuous membership on the Committee shall be limited to a total of six (6) consecutive years, except for members who are appointed officers. The term of a member appointed as an officer of the Committee shall be extended, if necessary, to permit the member to serve in succession as Chairman-Elect, and Chairman, as provided for in Section VI, below. If a member's employment or his affiliation with his professional society or organization changes in a manner that effects the composition of the Committee, as specified in Section IV A, above, the member's term on the Committee may be terminated at the discretion of the Committee and a successor nominated, as provided for in Section IV D, below. These provisions do not apply to *ex-officio* members.
- D. NOMINATION OF MEMBERS. Each year, prior to the expiration date of terms of at-large members, the Chairman of the Committee shall appoint a nominating subcommittee with representation from government, industry, and academia, collectively representing the scope of the Committee's interests. The nominating subcommittee shall request suggestions for nominations from the Committee and may request suggestions for nominations from United States industrial, professional, and governmental organizations actively participating in the field of rock mechanics. The nominating subcommittee shall consider these suggestions in selecting a group of nominees required to maintain the overall composition of the Committee, as provided for in Section IV A, above. The nominating subcommittee shall then recommend nominees for appointment to fill each at-large vacancy occasioned by expiration of terms of members. The list of nominees recommended by the nominating subcommittee shall be submitted to the Committee for selection of one nominee for each vacancy.

The societies and organizations listed in Section IV A shall be requested to nominate individuals to be considered for appointment as their formal representatives on the Committee.

The list of nominees shall then, upon approval of the Chairman of the National Research Council, be submitted for appointment in accordance with the procedures of the Assembly of Mathematical and Physical Sciences.

The officers of the Committee shall nominate successors for completion of unexpired terms of members, but in the case of formal representatives, this responsibility shall rest with the concerned professional society or organization. These nominations shall be submitted for approval and appointment as provided for herein.

- E. ELIGIBLE SOCIETIES AND ORGANIZATIONS. United States professional societies and organizations may be considered eligible for formal representation on the Committee on the basis of their active involvement in the field of rock mechanics. For the purpose of determining eligibility, "active involvement" shall be construed to mean sponsorship of meetings and publication of papers pertaining to rock mechanics, and it shall be the responsibility

of the applying society or organization to provide evidence to satisfy this criterion. Approval of an application for formal representation shall be granted by two-thirds vote of the full Committee and shall become effective upon written notice of ratification of this constitution by the concerned society or organization. The continuing eligibility for representation of any society or organization is subject to periodic review by the Committee.

- F. NONMEMBER PARTICIPATION. The Committee may invite interested non-members to attend its meetings as advisors or observers and to serve as members of panels.

V. PANELS

Whenever the need arises, and within budgetary limitations and resources, the Committee may form *ad hoc* panels to assist the Committee in fulfilling its purposes and carrying out its functions. The panel members shall be appointed with the approval of the Chairman of the National Research Council and in accordance with the procedures of the Assembly of Mathematical and Physical Sciences.

VI. OFFICERS

The officers of the Committee shall be a Chairman, a Chairman-Elect, and an Immediate Past Chairman, who shall be appointed to these offices with the approval of the Chairman of the National Research Council and in accordance with the procedures of the Assembly of Mathematical and Physical Sciences from nominations made by the Committee from its membership. The terms of office of the Chairman, the Chairman-Elect, and the Immediate Past Chairman shall be one (1) year. At the end of the terms of office, the Chairman shall become Immediate Past Chairman and the position of Chairman shall be filled by the Chairman-Elect. A new Chairman-Elect shall then be nominated and appointed as provided for herein.

A. Duties of the Chairman

The Chairman of the Committee shall perform the usual duties of a committee chairman, including specifically the following:

1. Calling the meetings of the Committee.
2. Presiding over meetings of the Committee.
3. Requesting the Assembly of Mathematical and Physical Sciences to appoint members to panels of the Committee.
4. Serving as a member *ex-officio* of all panels of the Committee.
5. Acting for the Committee, in consultation with the Executive Committee, in any emergency requiring the rapid transaction of urgent business; such actions are to be referred to the full membership of the Committee for information and comment as soon as possible.

B. Duties of the Chairman-Elect

The Chairman-Elect shall act for the Chairman in his absence and assist the Chairman in discharging his duties.

C. Duties of the Immediate Past Chairman

The Immediate Past Chairman shall provide guidance to the Chairman and Chairman-Elect and shall assist them in performing their duties.

VII. EXECUTIVE COMMITTEE

- A. The Executive Committee shall consist of the Chairman, the Chairman Elect, the Immediate Past Chairman (*ex-officio*, nonvoting), panel chairmen, and one representative elected each year by Committee vote at the annual meeting.
- B. The Executive Committee shall manage the affairs of the Committee between annual meetings. However, policy matters shall be reserved for decision by the full Committee except when emergency action is required, in which case the Executive Committee may act on behalf of the Committee, provided the full Committee is notified within 30 days of the action taken. The Executive Committee shall meet on the call of the Chairman not less than once each year and more frequently if required to accomplish the purposes of the Committee.

VIII. MEETINGS

Meetings of the Committee shall be called by the Chairman of the Committee at times and places designated by him. At least one such meeting shall be held each year.

IX. VOTING PROCEDURES

A quorum for the Committee shall consist of half of the voting members of the Committee plus one. Unless otherwise specified in the constitution, actions presented to the Committee shall be resolved by simple majority of the votes cast.

X. FINANCES

All funds (e.g., contributions, registration fees, contracts, and grants) shall be solicited, received, and disbursed in accordance with prevailing policies and practices of the NAS-NRC.

It is the NAS-NRC's responsibility to assure payment of the annual dues, and the USNC shall abide by guidelines with respect to the fulfillment of dues obligations, in particular the Committee shall seek NAS-NRC agreement on increase of dues.

XI. AMENDMENTS

Subject to approval by the Governing Board of the National Research Council, this constitution may be amended by an affirmative vote of two thirds of the full voting membership of the Committee.

MEETING OF THE COUNCIL
INTERNATIONAL SOCIETY FOR ROCK MECHANICS
Stockholm, Sweden
June 22, 1980

ATTENDANCE

*U.S. Delegation
(NRC-USNC/RM)*

Don C. Banks, Representative and
Chairman, USNC/RM

Thomas C. Atchison, Alternate Repre-
sentative and ISRM Vice President
for North America

Robert L. Bangert, Secretary to U.S.
Delegation and Executive Secretary,
USNC/RM

*Number of Countries
Represented*

19 of 35 member countries

*Changes in ISRM Member
Countries*

Poland is no longer a member country
because of nonpayment of dues.

*ISRM Membership
(as of March, 1980)*

Countries
Individual Members
Supporting Members

36¹
4,633
143²

*International Organizations
Represented*

International Tunnelling Association (ITA)
International Bureau of Rock Mechanics (IBRM)
International Society for Soil Mechanics
and Foundation Engineering (ISSMFE)

Budget and Finances

The budgets approved for 1981 can be
summarized as follows:

Office of the Secretariat:
Receipts: \$41,800 (U.S.)
Expenditures: \$31,800
Credit balance
for 1982: \$10,000

¹ See remarks above concerning Poland.

² Japan has recently added 62 supporting members to this total.

Commission Reports³:

| | |
|--|----------|
| Sales carryover from 1980, and contributions | \$22,200 |
| Publication costs: | \$14,800 |
| Credit balance for 1982: | \$ 7,400 |

Summary of expenditures and receipts in 1979 was:

| | Escudos | \$(at 50 Esc.= \$1) |
|----------------------------|-----------|------------------------|
| Receipts | 3,571,024 | 71,420.48 |
| Expenditures | 1,781,609 | 35,632.18 |
| Credit balance for 1980 | 1,789,415 | 35,788.30 |

Future Meetings

1981 Board and Council meetings will be held in Tokyo, Japan, in September in conjunction with the International Symposium on Weak Rocks.

1982 Board and Council meetings are tentatively planned for Aachen, Germany, in May in connection with Symposium on Rock Mechanics Related to Caverns and Pressure Shafts.

Fifth Congress, ISRM, and Board and Council Meetings will be held in Melbourne, Australia, from April 10-15, 1983.

ISRM COMMISSION REPORTS

Commission reports were presented orally by Commission Chairmen, if present, and by the Secretary General, if not. Only the report of the newly established Commission on Case Histories (Chairman: Don C. Banks, U.S.) is presented in detail; the others are briefly summarized.

Commission on Case Histories

See attachment 1.

Commission on Computer Programs

The Commission will emphasize application of computer programs to underground openings.

Commission on Research

New Commission, just getting organized.

Commission on Falling Rocks

France will make a proposal in 1981 for re-activation of this Commission.

³ This budget represents the capacity to publish. Actual receipts and expenditures will be determined by demand for reports.

Commission on Swelling Rocks

Five areas of activity are under study:

- characteristics of swelling rock
- classification of swelling rock
- identification of problem areas
- analysis and design of engineering structures
- laboratory and field testing

A draft report will be available in Tokyo in 1981.

Commission on Teaching

A report compiled from the Commission's questionnaire is scheduled for completion by the time of the Tokyo meeting. Preliminary data were given: Teaching of rock mechanics and employment of rock mechanists are divided equally (40% each) between civil engineering and mining with the remaining 20% in engineering geology and other fields. 104 universities responded to the questionnaire; 52 have a PhD program, and 26 have an extension program. (Chairman is E.J. Cording, U.S.)

Commission on Testing Methods

A book on testing techniques will be published by Pergamon Press. (Cochairman is Z.T. Bieniawski, U.S.)

New Commissions announced were:

- Excavation of Rock
- Design of High Rock Slopes
- Dilation of Rock
- Erodibility of Rock
- Geothermal Energy
- Tunneling Failure and Remedial Measures

COOPERATION WITH OTHER
INTERNATIONAL ORGANIZATIONS

Oral reports of the international organizations listed as being represented were presented. The ITA President suggested close coordination of work of similar ITA working groups and ISRM Commissions. Certain ISSMFE activities are also parallel to those of ISRM.

ISRM SPONSORSHIP

ISRM will sponsor the following technical meetings:

International Symposium on Weak Rocks,
Tokyo, September 1981

Symposium on Rock Mechanics Related to
Caverns and Pressure Shafts, Aachen,
Germany, May 1982.

23rd U.S. Symposium on Rock Mechanics,
Berkeley, California, 1982

ISRM CONGRESS

The Fifth International Congress on Rock Mechanics will be held in Melbourne, Australia, April 10-15, 1983. Basic principles of rock mechanics, and application of rock-mechanics principles to mining projects will be emphasized.

CONCLUSIONS

As noted in the report of the Fourth International Congress held in Montreux, Switzerland, in September 1979, the International Society for Rock Mechanics is a healthy, growing organization with a broad base of support on all continents. The ISRM's effort to broaden its activities to include mining as well as civil construction should open new prospects for international cooperation of U.S. rock mechanists in the field of mining.

U.S. representation in the ISRM by the USNC/RM continues to be of value to the U.S.

Enclosure

REPORT OF COMMISSION ON CASE HISTORIES

Don C. Banks, USA
 Stockholm, Sweden
 June 22, 1980

At the last Council meeting of the International Society for Rock Mechanics (Montreux, September 1979) a proposal to establish a Commission on Case Histories was made by the National Group of the United States. The proposal was accepted by the Council. The purpose of the Commission is to assemble case histories to gain insight into justification and procedures for various site investigation, design, and construction approaches involving rock media. It is anticipated that lessons learned from case histories can clearly lead to more economical and safer rock-mechanics design practice — whether it be from an educational or information standpoint.

On December 3, 1979, the President of ISRM invited Dr. Don C. Banks to become Chairman of the Commission and, if accepted, to submit a list of potential members. After discussion with the National Group of the U.S., acceptance, and a submittal of the names of potential members was made by letter to the President, ISRM, on February 21, 1980. On April 28, 1980, the President sent letters to the eight people asking for their agreement to serve on the Commission.

| <u>Name</u> | <u>Country</u> | <u>Interest</u> | <u>Accepted</u> |
|-----------------|-------------------------|-----------------|-----------------|
| Horace Wagner | South Africa (Africa) | Mining | |
| Shunzo Okamoto | Japan (Asia) | Civil | X |
| Lance Endersbee | Australia (Australasia) | Civil | |
| Alberto Motto | Italy (Europe) | Civil | X |
| Pierre Londe | France (Europe) | Civil | |
| Don Coates | Canada (North America) | Mining* | |
| Z.T. Bieniawski | USA (North America) | Mining | X |
| Dinnis da Gama | Brazil (South America) | Mining | X |

Thus a quorum has accepted the invitation to serve on the Commission. Our next step will be to complete the Commission membership concurrent with inviting selected individuals to work with the Commission in establishing model case histories to be used as a guide for individuals who propose future case histories.

The Commission is still in the formative stages but it is hoped that at least two case histories will be prepared within the next 12 months.

*Personally declined but suggested D.G.F. Hedley, Canada (North America), Mining, who accepted.

INTERNATIONAL SYMPOSIUM

"ROCKSTORE 80"

Stockholm, Sweden

June 23-27, 1980

ATTENDANCE

| | |
|--|---|
| <i>U.S. Delegation</i> (NRC-USNC/TT) | Michael B. Barker, Representative |
| | Edward J. Cording, Representative |
| <i>(Department of Energy)</i> | John Millhone |
| <i>Other U.S. Participants</i> (NRC-USNC/RM)* | Don C. Banks, Chairman, USNC/RM |
| | Thomas A. Atchison, Vice President for North America, ISRM |
| | Robert L. Bangert, Executive Secretary, USNC/RM |
| <i>Total U.S. Participation</i> | 61 |
| <i>Total Participation</i> | More than 800 |
| <i>Number of Countries Represented</i> | 49 |
| <i>Other Organizations Represented</i> | African Development Bank |
| | Food and Agriculture Organization of the United Nations |
| | Inter-American Development Bank |
| | International Energy Agency |
| | Organization of Oil Exporting Countries |
| | United Nations Division for Energy and Natural Resources |
| | United Nations Environment Programme |

Lists of participants and official delegations are on file in the Secretariat, U.S. National Committee on Tunneling Technology.

PURPOSE, SCOPE, AND ORGANIZATION

Rockstore 80 is the second international symposium on use of subsurface space conducted in Stockholm in recent years, the first having been in 1977. Briefly, the purpose of the symposium was to bring together policy makers and technical experts from many countries and international organizations to discuss the use of subsurface space for three purposes: environmental protection, low-cost storage, and energy saving.

The organization of the symposium, under the patronage of King Carl XVI Gustaf, was a function of several agencies of the Swedish government and Swedish commercial interests. However, several international agencies sponsored the meeting. These were:

*Participants in Council Meeting of the International Society for Rock Mechanics on June 22 and then stayed for Symposium.

United Nations Centre for Natural Resources, Energy and Transport
International Tunnelling Association
International Society for Rock Mechanics
International Association of Engineering Geology

CONDUCT OF THE SYMPOSIUM*

The symposium included six separate activities:

● *Round Table Sessions* were conducted by official panels and with representatives of invited national government, international governmental agencies, and international organizations.

● *General Sessions* were conducted by panels of international experts and directed at all participants. Invited speakers presented prepared papers.

● *Special Sessions* were conducted by professionals in particular specialities and were open to speakers with and without prepared papers.

● *Exhibition*, at which planners, contractors, equipment manufacturers, and consultants (primarily European) displayed their capabilities.

● *Field Excursions* were conducted in the Stockholm area during two days of the symposium to demonstrate subsurface facilities.

● *Technical Tours* were conducted after the symposium sessions were completed during which participants were afforded the opportunity to visit subsurface installations in operation and under construction in Finland, Norway, and Sweden.

The subject content of the symposium covered a wide range of issues and considerations in subsurface applications including:

- environmental protection (general session and round table session)
- low-cost storage (general and round table session)
- energy savings (general session)
- nuclear waste disposal
- energy production, distribution, and conservation underground
- subsurface construction in less-developed regions
- subsurface in metropolitan areas

(The last four were all special sessions.)

*Programs, abstracts, and proceedings are on file in the Secretariat, USNC/TT.

U.S. PARTICIPATION

Participation from the United States included:

- co-chairmanship of sessions on low-cost storage; subsurface use in metropolitan areas; energy production, distribution, and conservation underground.
- participation in round-table session by official representatives (Department of Energy and USNC/TT).
- presentation of numerous papers at general and special sessions.
- attendance by U.S. participants at all sessions and numerous technical tours.

U.S. participants also took advantage of the opportunity for informal discussions with colleagues from other nations.

Official U.S. representation was somewhat less than that of other major nations. The only U.S. government official present was Mr. John Millhone, Director, Buildings and Community Systems, Department of Energy. Several other U.S. government agencies had been invited to send official representatives, but did not do so, primarily—we understand—because of limitations on travel.

CONCLUSIONS

Several themes were apparent in the discussions. Cases were cited, particularly by the Scandinavian participants, in which the underground facilities were more economical than the above-ground alternative. Others noted that in many other cases ground conditions are severe and the cost of tunneling is high. Increasingly, the underground is being utilized in these more difficult ground conditions because there are few other alternatives. In such projects, costs may not be balanced by conventional short-term estimates of benefits. Several speakers emphasized the need to develop a longer perspective regarding the potential benefits of major underground projects, such as subway systems. The substantial impact upon the community and the ability of underground facilities to shape the community was noted. Such influences are not easily quantified.

The U.S. should continue to work with other nations in development of appropriate uses of subsurface space. In this connection, Mr. Milhone of DOE, who departed prior to the closing session, asked Mr. Barker to say that the U.S. would be willing to join with other nations in providing financial support to carry on the activities discussed at Rockstore 80.

DIRECTORY OF U.S. MEMBERS
OF THE
INTERNATIONAL SOCIETY FOR ROCK MECHANICS (ISRM)
1980

DECEMBER 1980

ABEL, John F., Jr.
Professor
Dept. of Mining Engineering
Colorado School of Mines
Golden, CO 80401
Phone: (303) 279-4901

ADAMS, William R., Jr.
Chief, Tests and Geotechnical
Engineering Section
Allegheny County Dept. of
Engineering and Construction
942 Mirror St.
Pittsburgh, PA 15217
Phone: (412) 355-5931

AGAPITO, Jose F.T.
President
Agapito & Associates
715 Horizon Dr., Suite 340
Grand Junction, CO 81501
Phone: (303) 242-4220

AGRAWAL, Ashok K.
Instructor
Div. of Mining Engineering
Technology
Davis Hall
West Virginia Institute
of Technology
Montgomery, WV 25136
Phone: (304) 442-3160/3215

AHANONU, Owowonta Ogbonnaya
Mining Engineer
Duval Corporation
4715 East Fort Lowell Rd.
Tucson, AZ 85712
Phone: (602) 881-6200

APPL, Fredric C.
Professor
Dept. of Mechanical Engineering
Seaton Hall
Kansas State University
Manhattan, KS 66506
Phone: (913) 532-5610

ARNOLD, Arthur B.
Chief Geologist
Bechtel, Inc.
P.O. Box 3965
San Francisco, CA 94119
Phone: (415) 768-8299

ARZI, Avner A.
Senior Consultant
Woodward-Clyde Consultants
80 Krinizi St., Suite 23
Ramat-Gan, Israel
Phone: (3) 738179

ATCHISON, Thomas C.
Visiting Professor
Dept. of Civil and Mineral
Engineering
University of Minnesota
221 Church St., SE
Minneapolis, MN 55455
Phone: (612) 376-5580

ATKINSON, Richard Henry
Vice President
Atkinson-Noland &
Associates, Inc.
2619 Spruce St.
Boulder, CO 80302
Phone: (303) 444-3620

AUGHENBAUGH, Nolan B.
Chairman and Professor
Dept. of Mining, Petroleum,
and Geological Engineering
University of Missouri-Rolla
Rolla, MO 65401
Phone: (314) 341-4751

AUSTIN, Michael Gerald
Senior Physicist
Austin Emerson Astro-
physics Enterprises
1187 Granada St.
Vallejo, CA 94590
Phone: (415) 357-4610 X-426

AUSTIN, William G.
Head, Rock Mechanics Section
Water and Power Resources
Service
P.O. Box 25007, DFC
Denver, CO 80225
Phone: (303) 234-3171

AVASTHI, Jitendra M.
Research Engineer
Gulf Research & Develop. Co.
P.O. Drawer 2038
Pittsburgh, PA 15230
Phone: (412) 665-5983

AVERY, Robert T.
Staff Senior Engineer
Lawrence Berkeley Laboratory
Building 46-189
University of California-
Berkeley
Berkeley, CA 94720
Phone: (415) 486-6236

BANGERT, Robert L.
Executive Secretary
U.S. National Committee for
Rock Mechanics
National Research Council
2101 Constitution Ave., NW
Washington, DC 20418
Phone: (202) 389-6415

BANKS, Don C.
Chief, Engineering Geology and
Rock Mechanics Div.
USAE Waterways Experiment
Station
P.O. Box 631
Vicksburg, MS 39180
Phone: (601) 634-2630

BARBOUR, Timothy G.
Senior Engineer
Science Applications, Inc.
202 West Magnolia St.
Fort Collins, CO 80521
Phone: (303) 493-7306

BASSARAB, Dennis R.
Assistant Professor
Dept. of Geological Engineering
University of Missouri-Rolla
Rolla, MO 65401
Phone: (314) 341-4751

BAUER, Robert A.
Assistant Geologist
Illinois State Geological
Survey
Natural Resources Building
Urbana, IL 61801
Phone: (217) 344-1481

BECKER, Edgar
Civil Engineer
Kaiser Engineers, Inc.
300 Lakeside Dr.
P.O. Box 23210
Oakland, CA 94623
Phone: (415) 271-4216

BECKWITH, George H.
Senior Vice President
Sergent, Hauskins &
Beckwith
3940 West Clarendon Ave.
Phoenix, AZ 85190
Phone: (602) 272-6848

BECKWITH, William B., Jr.
Chief Estimator
Civil, Mining and Marine Div.
Dravo Engineers and
Constructors
One Oliver Plaza, 33rd Floor
Pittsburgh, PA 15222
Phone: (412) 566-3000

BELESKY, Robert Mark
Graduate Student
104 Mineral Sciences Building
The Pennsylvania State
University
University Park, PA 16802
Phone: (814) 863-2924

BENNETT, Robert David
Civil Engineer
USAE Waterways Experiment
Station
P.O. Box 631
Vicksburg, MS 39180
Phone: (601) 634-3974

BENNETT, Warren
Geotechnical Engineer
Materials Laboratory and
Research Bureau
New Mexico State Highway Dept.
P.O. Box 1149
Santa Fe, NM 87501
Phone: (505) 983-0550

BIENIAWSKI, Z.T.
Professor
Dept. of Mineral Engineering
104 Mineral Sciences Building
The Pennsylvania State
University
University Park, PA 16802
Phone: (814) 863-1645

BLAKE, Wilson
Consulting Mining Engineer
Route 2, P.O. Box 928
Hayden Lake, ID 83835
Phone: (208) 772-2575

BOLSTAD, Douglas D.
Research Supervisor, Ground
Control Div.
U.S. Bureau of Mines
Spokane Research Center
East 315 Montgomery Ave.
Spokane, WA 99207
Phone: (509) 484-1610

BRANTHOVER, Gerald L.
President
Branthoover & Richards, Inc.
P.O. Box 6074
Harrisburg, PA 17112
Phone: (717) 236-1540

BRATTON, Geoffrey P.
Rock Mechanics Engineer
Union/Molycorp
P.O. Box 469
Questa, NM 87556
Phone: (505) 586-0212 X-253

BRIERLEY, Gary S.
Manager
Haley & Aldrich of New York
50 Chestnut Plaza
Rochester, NY 14604
Phone: (716) 232-7386

BRUHN, Robert W.
Project Engineer
GAI Consultants, Inc.
570 Beatty Rd.
Pittsburgh, PA 15239
Phone: (412) 242-6530

BUKOVANSKY, Michal
President
GEO-HYDRO Consulting, Inc.
9485 West Colfax, #304
Denver, CO 80215
Phone: (303) 232-6324

BUR, Thomas R.
Geophysicist
U.S. Bureau of Mines
100 West Crystal Lake Rd.
Burnsville, MN 55337
Phone: (612) 725-4550

BUREAU, Gilles
Geotechnical Consultant
Civil Systems Inc.
2450 Washington Ave.
San Leandro, CA 94577
Phone: (415) 895-9610

BURTON, Donald E.
Geomechanics Code Development
Group Leader
Lawrence Livermore National
Laboratory
P.O. Box 808, L-200
Livermore, CA 94550
Phone: (415) 422-3959

BUTTERS, Scott W.
Vice President
Terra Tek, Inc.
420 Wakara Way
Salt Lake City, UT 84108
Phone: (801) 582-2220

CELESTINO, Tarcisio B.
Research Assistant
Dept. of Civil Engineering
University of California-
Berkeley
Berkeley, CA 94720
Phone: (415) 642-2401

CHAE, Yong S.
Professor
Dept. of Civil Engineering
Rutgers University
P.O. Box 909
Piscataway, NJ 08854
Phone: (201) 932-3675

CHAN, Lap-Yan
Research Assistant/Teaching
Assistant
440 Davis Hall
University of California-
Berkeley
Berkeley, CA 94720
Phone: (415) 642-4201

CHAN, Samuel S.M.
Professor
Dept. of Mining Engineering
and Metallurgy
University of Idaho
Moscow, ID 83843
Phone: (208) 885-6376

CHAN, Tin
Staff Scientist, Earth
Sciences Div.
Lawrence Berkeley Laboratory,
B90A
One Cyclotron Rd.
University of California-
Berkeley
Berkeley, CA 94710
Phone: (415) 486-4392

CHASE, George H.
Hydrologist
U.S. Geological Survey
National Center MS760
Reston, VA 22092
Phone: (703) 860-7556

CHEN, C.Y.
Mining/Geotechnical Engineer
Office of Surface Mining
U.S. Dept. of the Interior
1951 Constitution Avenue, NW
Washington, DC 20240
Phone: (202) 343-5244

CHONG, Ken P.
Professor
Dept. of Civil Engineering
University of Wyoming
Laramie, WY 80271
Phone: (307) 766-3322

CIKANEK, Edward M.
Lead Engineer
Harza Engineering Company
150 South Wacker Dr.
Chicago, IL 60606
Phone: (312) 855-7000

CLARK, Bruce R.
Director, Rock
Mechanics
Leighton and Associates, Inc.
17975 Sky Park Circle
Irvine, CA 92714
Phone: (714) 556-1421

CLEARY, Michael P.
Associate Professor
Dept. of Mechanical Engi-
neering
Massachusetts Institute of
Technology
77 Massachusetts Ave.
Cambridge, MA 02139
Phone: (617) 253-2308

CLEMENCE, Samuel P.
Associate Professor
Department of Civil
Engineering
132 Hinds Hall
Syracuse University-Syracuse
Syracuse, NY 13210
Phone: (315) 423-2311

COLLINS, James P.
Partner
James P. Collins &
Associates
642 Kreag Rd.
Pittsford, NY 14534
Phone: (716) 248-2740

COOK, Neville G.W.
Dept. of Material Science
and Mineral Engineering
University of California-
Berkeley
Berkeley, CA 94720
Phone: (415) 642-3846

COOLEY, William C.
President
Terraspace, Inc.
304 North Stonestreet Ave.
Rockville, Maryland 20850
Phone: (301) 424-0090

COULSON, James H.
Principal Civil Engineer
Tennessee Valley Authority
400 Commerce Ave., W3D228
Knoxville, TN 37902
Phone: (615) 632-3159

COURSEN, David L.
Research Fellow
Potomac River Laboratory
E.I. du Pont de Nemours
& Co., Inc.
P.O. Box 761
Martinsburg, WV 25401
Phone: (304) 267-2941

CRADDOCK, Campbell
Professor
Dept. of Geology
Weeks Hall
University of Wisconsin-
Madison
Madison, Wisconsin 53706
Phone: (608) 262-1317

D'APPOLONIA, Elio
Chairman of the Board
D'Appolonia Consulting
Engineers, Inc.
10 Duff Rd.
Pittsburgh, PA 15235
Phone: (412) 243-3200

DAEMEN, Jaak J.K.
Assistant Professor
Dept. of Mining and
Geological Engineering
University of Arizona
Tucson, AZ 85721
Phone: (602) 626-2501

DAVIS, Alvin H.
Staff Member
Group G-6, MS 665
Los Alamos Scientific
Laboratory
Los Alamos, NM 87545
Phone: (505) 667-6384

DEERE, Don U.
Consultant, Applied Rock
Mechanics
6834 SW 35th Way
Gainesville, FL 32601
Phone: (904) 378-3061

DENDROU, Basile
Research Engineer
Agbabian Associates
250 North Nash
El Segundo, CA 90245
Phone: (213) 772-0681

DESAI, C.S.
Professor
Dept. of Civil Engineering
302-E Norris Hall
Virginia Polytechnic Institute
and State University
Blacksburg, VA 24061
Phone: (703) 961-7143

DESAI, Drupad B.
Chief Engineer
Daniel, Mann, Johnson &
Mendenhall
1900 Arlington Federal
Building
201 North Charles St.
Baltimore, MD 21201
Phone: (301) 837-5127

DiBERNARDO, Mala Roenick
Engineering Geologist
Woodward-Clyde Consultants
1425 Broad St.
Clifton, NJ 07011
Phone: (201) 471-2000

DODGE, Basilios
Consultant, Engineering
Geologist
P.O. Box 216
Rahway, NJ 07065
Phone: (212) 458-2747

DOE, Thomas
Staff Scientist
Lawrence Berkeley Laboratory
Building 90, Room 1070
University of California-
Berkeley
Berkeley, CA 94720
Phone: (415) 486-6778

DOUGLASS, Peter M.
Vice President
Hart-Crowser & Associates, Inc.
Design Service Building
1910 Fairview Ave. East
Seattle, WA 98102
Phone: (206) 324-9530

DOWDING, Charles H.
Associate Professor
Dept. of Civil Engineering
Northwestern University-Evanston
Evanston, IL 60201
Phone: (312) 492-7270

DUTTA, Piyush Kanti
Research Director
Irag Gage
Etna Rd.
Labanon, NH 03766
Phone: (603) 448-4497

DZIUBEK, John A.
Manager, Geotechnical Dept.
Michael Baker, Jr., Inc.
4301 Dutch Ridge Rd.
P.O. Box 280
Beaver, PA 15009
Phone: (412) 495-7711

EHGARTNER, Brian L.
Graduate Student
Virginia Polytechnic Institute
and State University
Blacksburg, VA 24060
Phone: (703) 961-6671

EINSTEIN, Herbert H.
Associate Professor
Dept. of Civil Engineering
Massachusetts Institute of
Technology
77 Massachusetts Ave.,
Room 1-330
Cambridge, MA 02139
Phone: (607) 253-3598

ERDLE, James C.
Head, Reservoir Engineering
Dowell-Schlumberger Research
and Development Center
Zone Industrielle de Molina
la Chazotte
Boite Postale 90
42002 Saint-Etienne Cedex,
France
Phone: (33)-77-32-64-23

EVANS, Dennis A.
President
D.A. EVANS, Inc.
23011 Moulton Parkway,
Suite J-10
Laguna Hills, CA 92653
Phone: (714) 770-8528

EVANS, Hilton B.
Manager, Integrated Seismic/
Well Log Services
Seismograph Service Corp.
P.O. Box 1590
Tulsa, OK 74102
Phone: (918) 627-3330

FELLNER, Richard W.
Staff Engineer
Agbabian Associates
250 North Nash St.
El Segundo, CA 90245
Phone: (213) 640-0576

FLANAGAN, Richard F.
Chief Engineer
Goldberg-Zoino Associates
of New York
Rand Building, Suite 1000
Buffalo, NY 14203
Phone: (716) 856-8980

FOLEY, Steven C.
Director, Rock Mechanics
Laboratory
Dept. of Mining and Geological
Engineering
University of Arizona
Tucson, AZ 85721
Phone: (602) 626-4653

FOLWELL, William T.
Manager, Rock Mechanics
Mining Services and
Equipment Div.
Dresser Industries, Inc.
P.O. Box 24647
Dallas, TX 75224
Phone: (214) 333-3211

FONT, Robert G.
Associate Professor
Dept. of Geology
Baylor University
Waco, TX 76703
Phone: (817) 755-2361

FOWLER, Brian K.
Geological Engineer
Pike Industries, Inc.
U.S. Route Three
Tilton, NH 03276
Phone: (603) 286-4324

GALLET, Alain S.
Senior Geotechnical Engineer
Sargent & Lundy Engineers
55 East Monroe St.
Chicago, IL 60603
Phone: (312) 269-7156

GATES, Richard H.
Senior Consultant
Golder Associates, Inc.
10628 NE 38th Place
Kirkland, WA 98033
Phone: (206) 827-0777

GERCEK, Hasan
Graduate Student
104 Mineral Sciences Building
The Pennsylvania State
University
University Park, PA 16802
Phone: (814) 863-1634

GORTON, Quentin A., Jr.
Consulting Civil Engineer
and Geologist
2571 Moraga Dr.
Pinole, CA 94564
Phone: (415) 758-2175

GOULD, James P.
Partner
Mueser, Rutledge, Johnston
& DeSimone
415 Madison Ave.
New York, NY 10017
Phone: (212) 355-4800

GRAY, Richard E.
Vice President
GAI Consultants, Inc.
570 Beatty Rd.
Monroeville, PA 15146
Phone: (412) 242-6530

GREEN, Sidney J.
President
Terra Tek, Inc.
420 Wakara Way
Salt Lake City, UT 84108
Phone: (801) 582-2220

HAAS, Charles J.
Professor, Mining Engineering
Rock Mechanics and Explosives
Research Center
University of Missouri-Rolla
Rolla, MO 65401
Phone: (314) 341-4318

HADLEY, Kate H.
Senior Supervisory Geologist
Offshore District
EXXON, USA
P.O. Box 23704
Harahan, LA 70183
Phone: (504) 838-7773

HAIMSON, Bezalel C.
Professor, Rock Mechanics
Dept. of Metallurgical and
Mineral Engineering
University of Wisconsin-Madison
1509 University Ave.
Madison, WI 53706
Phone: (608) 262-2563

HAMEL, James V.
Consulting Engineer
Hamel Geotechnical
Consultants
1992 Butler Dr.
Monroeville, PA 15146
Phone: (412) 824-5943

HANDIN, John W.
Professor
Center for Tectonophysics
Texas A&M University
College Station, TX 77843
Phone: (713) 845-3251

HANSEN, Douglas E.
President
LACHEL HANSEN & Associates, Inc.
P.O. Box 741
Bellevue, WA 98009
Phone: (206) 883-2224

HANSMIRE, William H.
Senior Geotechnical Engineer
Parsons, Brinckerhoff, Quade
& Douglas, Inc.
One Penn Plaza
New York, NY 10001
Phone: (212) 239-7900

HARDY, H. Reginald, Jr.
Professor and Chairman
Geomechanics Section
117 MS Building
The Pennsylvania State
University
University Park, PA 16802
Phone: (814) 863-1620

HATHEWAY, Allen W.
Vice President and Chief
Geologist
Haley & Aldrich, Inc.
238 Main St.
Cambridge, MA 02142
Phone: (617) 492-6460

HAVERLAND, Michael L.
Supervisory Structural Engineer
Water and Power Resources
Service
Denver Federal Center, D-225
Denver, CO 80225
Phone: (303) 234-3599

HAYES, Michael
Geologist
c/o Pacific Gas and
Electric Co.
77 Beale St., Room 2624
San Francisco, CA 94106
Phone: (415) 781-4211 X-3649

HAYS, Timothy
Librarian
Technical Library
Army Corps of Engineers
U.S. Dept. of the Army
424 Trapelo Rd., Building 100A
Waltham, MA 02254
Phone: (617) 894-2400 X-416

HENDRON, Alfred J., Jr.
Professor
Dept. of Civil Engineering
2230 Civil Engineering
Building
University of Illinois-Urbana
Urbana, IL 61801
Phone: (217) 333-6944

HESS, John D.
President
Structural Behavior Engi-
neering Laboratories, Inc.
P.O. Box 23167
Phoenix, AZ 85063
Phone: (602) 272-0274

HOBBS, Bruce
Deputy State Geologist
Div. of Mineral Resources
Dept. of Conservation and
Economic Development
P.O. Box 3667
Charlottesville, VA 22903
Phone: (804) 293-5121

HOCKING, Grant
552 23rd Rd.
Grand Junction, CO 81503
Phone: (303) 242-3948

HOELLE, John L.
Assistant Project Engineering
Geologist
D'Appolonia Consulting
Engineers
10 Duff Rd.
Pittsburgh, PA 15235
Phone: (412) 243-3200

HOFMANN, Ronald
Scientist/Manager
Science Applications, Inc.
2450 Washington Ave., #120
San Leandro, CA 94577
Phone: (415) 351-7807

HUNT, Stephen R.
Research Geologist
EXXON Production Research Co.
P.O. Box 2189
Houston, TX 77001
Phone: (713) 965-7817

INGRAFFEA, Anthony R.
Assistant Professor and
Manager of Structural
Research
Dept. of Structural Engi-
neering
371 Hollister Hall
Cornell University
Ithaca, NY 14853
Phone: (607) 256-3336

ISRAELSEN, O. Allen
Bovay Engineers, Inc.
1747 Pennsylvania Ave., NW
Suite 702
Washington, DC 20006
Phone: (202) 223-1155

JACOBY, Henry J.
Chairman of the Board
Grow Tunneling Corporation
1775 Broadway
New York, NY 10019
Phone: (212) 586-1760

JEFFREY, Robert G.
Research Assistant
College of Mines
University of Arizona
Tucson, AZ 85713
Phone: (602) 626-4653

JOHNSTON, David H.
Senior Research Geophysicist
Long Range Research Div.
EXXON Production Research Co.
P.O. Box 2189
Houston, TX 77001
Phone: (713) 965-4677

JONES, Arfon H.
Executive Vice President
Terra Tek, Inc.
420 Wakara Way
University Research Park
Salt Lake City, UT 84108
Phone: (801) 582-2220

JORGENSEN, Duane
Senior Staff Geologist
U.S. Gypsum Co.
Rural Route #1
Saltville, VA 24370
Phone: (703) 496-7733

JUDD, William R.
Professor
School of Civil Engineering
Purdue University
West Lafayette, IN 47907
Phone: (317) 494-8692

KARMIS, Michael
Assistant Professor
Mining and Minerals
Engineering Dept.
Holden Hall 213
Virginia Polytechnic Insti-
tute and State University
Blacksburg, VA 24061
Phone: (703) 961-7057/6671

KARWOSKI, William J.
Senior Rock Mechanics
Engineer
Occidental Oil Shale, Inc.
P.O. Box 2687
Grand Junction, CO 81502
Phone: (303) 242-8463 X-216

KHAIR, A. Wahab
Research Assistant
5 Mineral Sciences Building
Pennsylvania State University
University Park, PA 16802
Phone: (814) 865-2372

KHALAF, Fouad
Assistant Professor
Mining, Petroleum, and
Metallurgy
Faculty of Engineering
Cairo University
On loan as:
Drilling Specialist
Gulf of Suez Petroleum
Company
P.O.B. 2400, Garden City
Cairo, Egypt
Phone: 31883, Telex 92248 UN

KIERSCH, George A.
Geologic Consultant
4750 North Camino Luz
Tucson, AZ 85718
Phone: (602) 299-3776
and
Emeritus Professor
Cornell University
119 Warwick Place
Ithaca, NY 14850
Phone: (607) 257-0395

KIESEWETTER, Carl H.
Instructor
Dept. of Mechanical/Civil
Technology
Middlesex County College
Edison, NJ 08817
Phone: (201) 548-6000 X-252

KIM, Chin Man
Manager, Engineering Research
and Development
BJ-Hughes, Inc.
1133 Ave. "G" East
Arlington, TX 76011
*Phone: (817) 649-1213 or
(214) 264-1528*

KIM, Kunsoo
Associate Professor
Mining Engineering Dept.
Michigan Technological
University
Houghton, MI 49931
Phone: (906) 487-2816

KINTZER, Frederick C.
Engineering Geologist
URS/John A. Blume
& Associates, Engineers
130 Jessie St.
San Francisco, CA 94105
Phone: (415) 397-2525

KOELSCH, Ted A.
Research Geologist
EXXON Production Research Co.
P.O. Box 2189
Houston, TX 77001
Phone: (713) 965-4624

KRANZ, Robert L.
Research Associate
Dept. of Geophysics
Texas A&M University
College Station, TX 77843
Phone: (713) 845-3251

KUHN, Alan K.
Project Supervisor
D'Appolonia Consulting
Engineers, Inc.
2340 Alamo SE, Suite 306
Albuquerque, NM 87106
Phone: (505) 842-0835

KULHAWY, Fred H.
Associate Professor
School of Civil and Environ-
mental Engineering
Cornell University
Ithaca, NY 14853
Phone: (607) 256-4820

LA POINTE, Paul R.
Research Associate
Wisconsin Superconductive
Energy Storage Project
1500 Johnson Dr.
Madison, WI 53706
and
Dept. of Metallurgical and
Mineral Engineering
University of Wisconsin-Madison
1509 University Ave
Madison, WI 53706
Phone: (608) 262-1478

LACHEL, Dennis J.
Vice President
LACHEL HANSEN & Associates, Inc.
P.O. Box 5266
Golden, CO 80401
Phone: (303) 279-4321

LANG, Thomas A.
President
Leeds, Hill and Jewett, Inc.
1275 Market St.
San Francisco, CA 94103
Phone: (415) 626-2070

LAWRENCE, R. Jeffery
Member of the Technical Staff
Organization 400
Sandia Laboratories
P.O. Box 5800
Albuquerque, NM 87185
Phone: (505) 844-3261

LEMCOE, M.M.
Project Manager, Rock Mechanics
ONWI
Battelle Project Management Div.
505 King Ave.
Columbus, OH 43201
Phone: (614) 424-5688

LEONARD, Roy J.
Professor
Civil Engineering Dept.
University of Kansas
Lawrence, KS 66045
Phone: (913) 864-3016

LIENHART, David A.
Director
Ohio River Div. Laboratory
U.S. Army Corps of Engineers
5851 Mariemont Ave.
Cincinnati, OH 45227
Phone: (513) 684-8694

LIFRIERI, Joseph J.
Assistant Chief
Geotechnical Engineer
Environmental Engineering
744 Mountain Blvd.
Watchung, NJ 07060
Phone: (201) 755-7087

LIN, Wunan
Geophysicist
Lawrence Livermore National
Laboratory, L-350
P.O. Box 808
Livermore, CA 94550
Phone: (415) 422-7162

LOVELL, C. William
Professor
School of Civil Engineering
Purdue University
West Lafayette, IN 47907
Phone: (317) 494-8179

LOWE, John, III
Partner
Tippetts-Abbett-McCarthy-
Stratton
655 Third Ave.
New York, NY 10017
Phone: (212) 867-1777 X-401

LUNDQUIST, Robert G.
Mining Research Consultant
35 Mohegan Rd.
Acton, MA 01720
Phone: (617) 263-1059

LYTLE, J. David
Chief, Instrumentation and
Evaluation Section
Attention: ED-FI
U.S. Army Corps of Engineers
210 Tucker Blvd., North
St. Louis, MO 63101
Phone: (314) 263-5636

MA, Mark S.
Research Assistant
Dept. of Metallurgical and
Mining Engineering
University of Wisconsin-Madison
Madison, WI 53706
Phone: (608) 233-7308

MABRY, Richard E.
Senior Project Engineer
Woodward-Clyde Consultants
5120 Butler Pike
Plymouth Meeting, PA 19462
Phone: (215) 825-3000

MacPHERSON, Hobart H.
Graduate Student
Dept. of Civil Engineering
Room 2206 CEB
University of Illinois-Urbana
Urbana, IL 61801
Phone: (217) 344-3215

MARLIAVE, Burton H.
Consulting Geologist
67 Grandview Place
Walnut Creek, CA 94595
Phone: (415) 932-3802

MARSHALL, Gleny S.
203 North Live Oak Dr.
Moncks Corner, SC 29461
Phone: (803) 899-2831

McCLAIN, William C.
Executive Vice President
RE/SPEC Inc.
P.O. Box 725
Rapid City, SD 57701
Phone: (605) 343-7868

McCLURE, Cole R.
Manager, Engineering—Geology
Bechtel, Inc.
P.O. Box 3965
San Francisco, CA 94119
Phone: (415) 768-8214

McCUSKER, Terence G.
Tunnel Consultant
120 Howard St., Suite 650
San Francisco, CA 94105
Phone: (415) 777-5670

McDONOUGH, John T.
Senior Mining Engineer
Minerals Div.
CONOCO
555 17th St.
Denver, CO 80202
Phone: (303) 575-6268

McHUGH, Stuart
Geophysicist
SRI International
333 Ravenswood Ave., A286
Menlo Park, CA 94025
Phone: (415) 326-6200 X-4614

McHURON, Clark E.
Consulting Engineering
Geologist
274 Mocking Bird Circle
Santa Rosa, CA 95405
Phone: (707) 539-0211

MERRITT, Andrew H.
Vice President
Deere & Merritt Inc.
7726 SW 36th Ave.
Gainesville, FL 32601
Phone: (904) 372-6153

MERRITT, J.L.
President/Treasurer
Merritt CASES, Inc.
710 Brookside Ave.
P.O. Box 1206
Redlands, CA 02373
Phone: (714) 793-2027

MIGNOGNA, Richard P.
Mining Engineer
ARCO Coal Company
P.O. Box 5300
Denver, CO 80217
Phone: (303) 575-7500

MILLER, Stanley M.
Geological Engineer
2569 Kennedy Ave.
Laramie, WY 82070
Phone: (307) 742-0394

MILLER, Wendell O.
Research Civil Engineer
Geotechnical Laboratory, EGRMD
Rock Mechanics Application
Group
USAE Waterways Experiment
Station
P.O. Box 631
Vicksburg, MS 39180
Phone: (601) 634-2117

MISTEREK, Dewayne L.
Head, Instrumentation Section
Water and Power Resources
Service, Code 225
P.O. Box 25007
Denver, CO 80225
Phone: (303) 234-6008

MONTENYOHL, Victor
Fragmentation Engineer
Occidental Oil Shale Inc.
P.O. Box 2687
Grand Junction, CO 81502
Phone: (303) 242-8463 X-406

MONTGOMERY, Carl T.
Research Leader
Dowell Div. of Dow Chemical
Company U.S.A.
P.O. Box 21
Tulsa, OK 74102
Phone: (918) 560-2890

MORIN, Wilbur J.
Lyon Associates
7900 Westpark Dr.
McLean, VA 22101
Phone: (703) 893-0850

MORITA, Nobuo
Research Scientist Associate V
Div. for Rock Mechanics
Balcones Research Center
University of Texas-Austin
10,100 Burnet Rd.
Austin, TX 78758
Phone: (512) 835-3086

MORLAN, Lynn E.
Associate/Senior Engineer
Foundation Sciences, Inc.
1630 SW Morrison St.
Portland, OR 97205
Phone: (503) 224-4435

MRUGALA, Marek
Graduate Assistant
Mining Dept.
104 Mineral Sciences Building
The Pennsylvania State
University
University Park, PA 16802
Phone: (814) 863-1635

NEFF, Thom L.
Professor
Portland State University
P.O. Box 751
Portland, OR 97207
Phone: (503) 229-4286

NELSON, Jeffrey William
Assistant Project Engineer
D'Appolonia Consulting
Engineers, Inc.
7400 South Alton Court
Englewood, CO 80112
Phone: (303) 771-3464

NELSON, Ronald A.
Senior Research Scientist
Research Center
Amoco Production Company
P.O. Box 591
Tulsa, OK 74102
Phone: (918) 664-3806

NESBITT, Robert H.
Consulting Engineering
Geologist (Retired)
1225 Morningside Lane
Alexandria, VA 22308
Phone: (703) 765-9046

NEWMAN, David A.
Graduate Assistant
104 Mineral Sciences Building
The Pennsylvania State
University
University Park, PA 16802
Phone: (814) 684-5710

NICHOLAS, David E.
Consultant
5225 East Pima, Suite B
Tucson, AZ 85712
Phone: (602) 327-8647

NICHOLSON, Glenn Austin
Civil Engineer
Geotechnical Laboratory
USAE Waterways Experiment
Station
P.O. Box 631
Vicksburg, MS 39180
Phone: (601) 636-3111 X-3611

NORMAN, Carl E.
Associate Professor
Dept. of Geology
University of Houston
Houston, TX 77004
Phone: (713) 749-3870

OSTERWALD, Frank W.
Geologist, Engineering Geology
Branch
U.S. Geological Survey
P.O. Box 25046, MS 903
Denver Federal Center
Denver, CO 80225
Phone: (303) 234-3818

OUTMANS, H. Donald
Research Associate
Union Science and Technology Div.
Union Oil Company of California
P.O. Box 76
Brea, CA 92621
Phone: (714) 528-7201

PANEK, Louis A.
Senior Technical Advisor,
Rock Mechanics
U.S. Bureau of Mines
Building 20, DFC
Denver, CO 80225
Phone: (303) 234-4170

PARISEAU, William G.
Professor
Mining Engineering
315 WBB
University of Utah
Salt Lake City, UT 84112
Phone: (801) 581-5164

PECK, Ralph B.
Civil Engineer,
Geotechnics
1101 Warm Sands Dr., SE
Albuquerque, NM 87123
Phone: (505) 293-2484

PENG, Syd S.
Chairman
Mining Engineering Dept.
West Virginia University
Morgantown, WV 26506
Phone: (304) 293-5695

PETERSON, Carl F.
Program Manager
Systems, Science & Software
P.O. Box 1620
La Jolla, CA 92038
Phone: (714) 453-0060

PINCUS, Howard J.
Depts. of Geological Sciences
and Civil Engineering
University of Wisconsin-
Milwaukee
P.O. Box 413
Milwaukee, WI 53201
Phone: (414) 963-4017/4561

PODNIIEKS, Egons R.
Research Supervisor,
Advanced Systems, Fire and
Equipment Safety
U.S. Bureau of Mines
Twin Cities Research Center
P.O. Box 1660
Twin Cities, MN 55111
Phone: (612) 725-4530

PRICE, Ronald H.
Member of Technical Staff
Geomechanics Research
Div. 5532
Sandia National Laboratories
Albuquerque, NM 87185
Phone: (505) 844-6829

PRITCHARD, Robert S.
Senior Research Scientist
Flow Research Company
21414 68th Ave. South
Kent, WA 98031
Phone: (206) 872-8500

PUGLIESE, Joseph M.
Environmental Specialist
(Mining)
U.S. Bureau of Mines
P.O. Box 1660
Twin Cities, MN 55111
Phone: (612) 349-3131

PYKE, Robert
Geotechnical Consultant
Civil Systems Inc.
2450 Washington Ave.
San Leandro, CA 94577
Phone: (415) 895-9610

RAFIA, Farzan
Graduate Assistant
Dept. of Mineral Engineering
104 Mineral Sciences Building
The Pennsylvania State
University
University Park, PA 16802
Phone: (814) 234-2139

RAGAN, Donald M.
Professor
Dept. of Geology
Arizona State University
Tempe, AZ 85281
Phone: (602) 965-6939

RAJARAM, V.
Mining Engineer
E.K. Lehmann & Associates, Inc.
1409 Willow St.
Minneapolis, MN 55403
Phone: (612) 871-6304

REED, John J.
Consultant, Mining Engineer
P.O. Box 126
Anacortes, WA 98221
Phone: (206) 293-4149

REN, Nae-Kan
Research Engineer,
Rock Mechanics
Dowell Div. of Dow Chemical Co.
P.O. Box 21
Tulsa, OK 74102
Phone: (918) 560-2911

REPETTO, Gary J.
Manager, Mining
Services
Dunhill of Albuquerque
2403 San Mateo NE, W-2
Albuquerque, NM 87110
Phone: (505) 884-6734

RICHARDS, Donald P.
Senior Engineer/Associate
Jenny Engineering Corp.
16027 West 5th Ave.
Golden, CO 80401
Phone: (303) 278-2735

RICHARDS, James W.
President
Branthoover & Richards, Inc.
P.O. Box 6074
Harrisburg, PA 17112
Phone: (717) 236-1540

ROBBINS, Richard J.
President
The Robbins Company
P.O. Box C8027
Kent, WA 98031
Phone: (206) 872-0500

ROBERTS, Dale L.
Assistant Chief Geologist
Bechtel, Inc.
P.O. Box 3965
San Francisco, CA 94105
Phone: (415) 768-8550

ROBERTSON, Eugene C.
Geophysicist
U.S. Geological Survey
922 National Center
Reston, VA 22092
Phone: (703) 860-7404

RUDNICKI, John W.
Assistant Professor
Dept. of Theoretical and
Applied Mechanics
216 Talbot Laboratory
University of Illinois-Urbana
Urbana, IL 61801
Phone: (217) 333-7947

RUSSELL, James E.
Professor,
Mining Engineering and
Geophysics
Dept. of Petroleum Engineering
Texas A&M University
College Station, TX 77843
Phone: (713) 845-2241

SAIDMAN, Marcel
Senior Consulting Engineer
United Engineers &
Constructors, Inc.
30 South 17th St.
Philadelphia, PA 19101
Phone: (215) 422-4935

ST. JOHN, Christopher M.
J.F.T. Agapito and Associates
715 Horizon Dr., Suite 340
Grand Junction, CO 81501
Phone: (303) 242-4220

SAKELLARIOU, Chris A.
Mining Engineer
Terra Tek, Inc.
420 Wakara Way
Salt Lake City, UT 84108
Phone: (801) 582-2220

SANGREY, Dwight A.
Professor and Head
Dept. of Civil Engineering
Carnegie-Mellon University
Schenley Park
Pittsburg, PA 15213
Phone: (412) 578-2940

SANTOS, Jose' Rolando R.
President
Engineering Geoscience, Inc.
Cattleya Condominium, Suite 203
Salcedo St., Legaspi Village
Makati, Metro Manila
Philippines 87-11-64
Phone: 8181131 to 35

SAVELY, James P.
Geological Engineer
7138 East Paseo San Andres
Tucson, AZ 85710
Phone: (602) 885-8802

SCHMIDT, Birger
Senior Professional Associate
Parsons, Brinckerhoff, Quade
& Douglas, Inc.
165 Post St.
San Francisco, CA 94108
Phone: (415) 986-2929

SCHMIDT, Richard A.
Member of Technical Staff
Organization 4732
Sandia National Laboratories
Albuquerque, NM 87185
Phone: (505) 844-0770

SCHWARTZ, Charles W.
Assistant Professor
Dept. of Civil Engineering
University of Maryland
College Park, MD 20742
Phone: (212) 454-2212

SCOTT, Gregg A.
Civil Engineer
Water and Power Resources
Service
P.O. Box 25007
Denver, CO 80225
Phone: (303) 234-3250

SCOTT, James C.
Geotechnical Engineer
Woodward-Clyde Consultants
2909 West 7th Ave.
Denver, CO 80204
Phone: (303) 573-7882

SCOTT, James J.
President
Scott Mine Technical Service
Box 36—Lecoma Star Route
Rolla, MO 65401
Phone: (314) 364-4008

SEEGMILLER, Ben L.
Principal
Seegmiller Associates
447 East 200 South
Salt Lake City, UT 84111
Phone: (801) 363-0606

SHANKLAND, Thomas J.
Staff Member, Geophysics Group
MS 977
Los Alamos Scientific
Laboratory
Los Alamos, NM 87544
Phone: (505) 667-4907

SHARMA, Rohini P.
Advanced Mining Engineer
Rock/Soil Mechanics Dept.
Duval Corp.
4715 East Fort Lowell Rd.
Tucson, AZ 85712
Phone: (602) 881-6200 X-284

SHOLLEY, Michael G.
Geologist
Bechtel, Inc. (45-31-SF07)
P.O. Box 3965
San Francisco, CA 94119
Phone: (415) 768-6086

SHOREY, Edwin F.
Engineering Geologist
CH2M Hill, Inc.
200 SW Market St., 12th Floor
Portland, OR 97201
Phone: (503) 224-9190

SILVER, Marshall L.
Professor
Dept. of Materials Engineering
University of Illinois at
Chicago Circle
Chicago, IL 60680
Phone: (312) 996-5165

SINGH, Madan M.
President
Engineers International, Inc.
5107 Chase Ave.
Downers Grove, IL 60515
Phone: (312) 963-3460

SLEBIR, Edward J.
Structural Engineer, Div. of
Research
Water and Power Resources
Service, Code 1543
P.O. Box 25007
Denver, CO 80225
Phone: (303) 234-3171

SMELSER, Thomas W.
Mechanical Engineer
U.S. Bureau of Mines
Spokane Research Center
East 315 Montgomery Ave.
Spokane, WA 99207
Phone: (509) 484-1610

SMITH, Ronald E.
Vice President
Woodward-Clyde Consultants
1300 Piccard Dr.
Rockville, MD 20850
Phone: (301) 258-9780

SOTTILE, Antonine L.
Ph.D. of Engineering
P.O. Box 28292
Washington, DC 20005

SPRUNT, Eve S.
Research Geophysicist
Mobil Research and Development
Corp.
P.O. Box 900
Dallas, TX 75221
Phone: (214) 333-6111

STOWE, Richard L.
Geologist
USAE Waterways Experiment
Station
P.O. Box 631
Vicksburg, MS 39180
Phone: (601) 636-3111

STRANSKY, Terry
Geologist
Ohio River Div. Laboratories
U.S. Army Corps of Engineers
5851 Mariemont Ave.
Mariemont, OH 45227
Phone: (513) 684-8691

STRID, Joel A.
Chief Mining Engineer
Carbon County Coal Co.
P.O. Box 733
Hanna, WY 82327
Phone: (307) 325-9471

STUDEBAKER, Irving G.
Senior Mining Engineer
Occidental Oil Shale, Inc.
2090 Sequoia Rd.
Grand Junction, CO 81503
Phone: (303) 242-8463

SWANSON, Peter L.
Graduate Research Assistant
Cooperative Institute for
Research in Environmental
Sciences (CIRES)
University of Colorado-Boulder
Boulder, CO 80309
Phone: (303) 492-8029

SWEENEY, Norman F.
Geotechnical Engineer
Pacific Gas & Electric Co.
77 Beale St., Room 1382
San Francisco, CA 94106
Phone: (415) 781-4211 X-4124

TARKOY, Peter J.
Geotechnical Consultant
102 North Main St.
Sherborn, MA 01770
Phone: (617) 653-6583

THILL, Richard E.
Geophysicist
U.S. Bureau of Mines
Twin Cities Research Center
P.O. Box 1660
Twin Cities, MN 55111
Phone: (612) 725-4580

THIRUMALAI, K.
Manager, Rock Mechanics
Rockwell International
Energy Systems Group
P.O. Box 800
Richland, WA 99352
Phone: (509) 373-4181

THOMS, Robert L.
Professor
Institute for Environmental
Studies
Louisiana State University
Baton Rouge, LA 70803
Phone: (504) 388-8521

TOCKSTEIN, Carl D.
Civil Engineer
Tennessee Valley Authority
400 Commerce Ave., W3D222
Knoxville, TN 37902
Phone: (615) 632-3620

TOUSEULL, Jack A.
Structural Engineer
1037 South Miller Way
Lakewood, CO 80226
Phone: (303) 234-3172

TULA, Alex
Engineering Geologist
CH2M Hill, Inc.
P.O. Box 2088
Redding, CA 96099
Phone: (916) 243-5831

UEBLACKER, Horst
Ueblacker & Associates
7230 West Archer Place
Lakewood, CO 80226
Phone: (303) 232-0140

UNAL, Erdal
Graduate Assistant
104 Mineral Sciences Building
The Pennsylvania State
University
University Park, PA 16802
Phone: (814) 238-1055

VAN EECKHOUT, E.M.
Assistant Professor
Montana College of Mineral
Science and Technology
Butte, MT 59701
Phone: (406) 792-8321 X-343

VARNES, David J.
Geologist
U.S. Geological Survey
Denver Federal Center, MS 903
Denver, CO 80225
Phone: (303) 234-3346

VELTROP, Jan A.
Vice President and Chief
Engineer
Harza Engineering Co.
150 South Wacker Dr.
Chicago, IL 60076
Phone: (312) 855-7127

VERSAW, Ronald E.
Specialist Engineer
Golder Associates
1658 Cole Blvd., Suite 180
Golden, CO 80401
Phone: (303) 232-8530

VISCA, Paul Joseph
Consultant, Geological Engineer
P.O. Box 36144
Tucson, AZ 85740
Phone: (602) 743-0820

WALL, Charles Frederick
Engineering Geologist
Bechtel, Inc.
15740 Shady Grove Rd.
Gaithersburg, MD 20760
Phone: (301) 258-3139

WALLACE, George B.
Princical Engineer
Bovay Engineers, Inc.
East 808 Sprague Ave.
Spokane, WA 99202
Phone: (509) 838-4111 X-38

WALLACE, James L.
Research Chemist
Dowell Div. of Dow Chemical Co.
P.O. Box 21, Building 8
Tulsa, OK 74102
Phone: (918) 560-2912

WAWERSIK, Wolfgang R.
Member of Technical Staff
Organization 5532
Sandia National Laboratory
Albuquerque, NM 87185
Phone: (505) 844-4342

WEAKLY, L. Alan
Senior Mining Research
Supervisor
EXXON Company USA
P.O. Box 14342
Aurora, CO 80014
Phone: (303) 695-2301

WEISS-MALIK, Roberto F.
Project Engineering Geologist
D'Appolonia Consulting
Engineers, Inc.
M.R. 522-B
Chesterton, IN 46304
Phone: (219) 926-1178

WILLIAMS, John R.
Senior Engineer
Dames & Moore
44 Mall Road
Burlington, MA 01803
Phone: (617) 273-3080

WILLIS, Clifford L.
Vice President and Chief
Geologist
Harza Engineering Co.
150 South Wacker Dr.
Chicago, IL 60606
Phone: (312) 855-7500

WINKLER, Kenneth W.
Research Geophysicist
Schlumberger-Doll Research
P.O. Box 307
Ridgefield, CT 06877
Phone: (203) 438-2631

WITHIAM, James L.
Project Engineer
D'Appolonia Consulting
Engineers
10 Duff Rd.
Pittsburgh, PA 15235
Phone: (412) 243-3200

WONG, I.H.
Consulting Engineer
Ebasco Services, Inc.
91st Floor
2 World Trade Center
New York, NY 10048
Phone: (212) 839-1423

YEN, Bing C.
Professor
Dept. of Civil Engineering
California State University-
Long Beach
Long Beach, CA 90840
Phone: (213) 498-5118

YEUNG, Denis
Graduate Student
Mining Engineering Dept.
The Pennsylvania State
University
University Park, PA 16802
Phone: (814) 863-2877

YOUNG, Dae Sik
Mining Engineer
Texasgulf, Inc.
High Ridge Park
Stamford, CT 06904
Phone: (203) 358-5314

YOUNG, Terence K.
Visiting Assistant Professor
Dept. of Geophysics
Colorado School of Mines
Golden, CO 80401
Phone: (303) 279-0300 X-2458

YOW, Jesse L., Jr.
Physicist
Lawrence Livermore National
Laboratory
P.O. Box 808, L-366
Livermore, CA 94550
Phone: (415) 422-3521

ZACCHEO, Philip F.
Principal Geotechnical Engineer
Tippetts-Abbett-McCarthy-Stratton
655 Third Ave.
New York, NY 10017
Phone: (212) 867-1777

ZAVODNI, Zavis M.
Project Mining Engineer
Kennecott Minerals Co.
Engineering Center
1515 Mineral Square
Salt Lake City, UT 84147
Phone: (801) 534-8442

ZEIGLER, Timothy W.
Civil Engineer
Carbondale Mining Technology
Center
U.S. Dept. of Energy
P.O. Box 2597
Carbondale, IL 62901
Phone: (618) 985-3771

ZEUCH, David H.
Organization 5532
Sandia National Laboratories
Albuquerque, NM 87185
Phone: (505) 844-5678

ZIPF, R. Karl, Jr.
Mining Engineer
Morrison-Knudsen Company, Inc.
P.O. Box 531
Boise, ID 83701
Phone: (208) 386-6267

