



# **Proceedings of the 1st MINE VENTILATION SYMPOSIUM**

March 29-31, 1982  
The University of Alabama  
University (Tuscaloosa), Alabama

**Howard L. Hartman**  
Symposium Chairman and Proceedings Editor

Sponsored by  
**Underground Ventilation Committee of SME-AIME**  
joint committee of the Coal Division  
and Mining and Exploration Division  
**Department of Mineral Engineering**  
**University of Alabama**

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## FOREWORD

Late in March 1982, 203 registrants gathered in Tuscaloosa, Alabama, at The University of Alabama to inaugurate the first national conference on mine ventilation ever held in the United States. Ventilation engineers, government scientists, equipment manufacturers, and university faculty and students made up the audience that heard 32 state-of-the-art technical papers.

It was a first-time event in a branch of mining as old as the industry itself. Agreement was unanimous that another five centuries ought not to pass before the next symposium was held! In fact, action was taken by the Underground Ventilation Committee of SME-AIME, sponsor of the meeting, that symposia be held every two years, rotated among interested universities. The 2nd Mine Ventilation Symposium was approved by the UVC for the University of Nevada-Reno for 1985.

Subject matter covered in this the 1st Symposium varied over the all-inclusive environmental field of mine ventilation and was presented in 7 sessions over 3 days. Nine papers dealt with computer applications and modeling, 6 with auxiliary ventilation, 4 with fans and ventilation shafts, 3 with mine fires, 3 with methane and explosive gas control, 3 with mine air cooling, and 3 with general topics. The striking number of papers devoted to or encompassing the use of the computer in modeling systems and solving problems as well as monitoring and controlling ventilation circuits demonstrated how pervasive an influence it has become in the mining industry and mine ventilation field.

A fourth day of the Symposium was devoted to highly successful field trips to the surface and underground operations at the deep coal mines of Jim Walter Resources, Inc. in Brookwood, AL.

The Underground Ventilation Committee, sponsor of the Symposium and newly formed by SME-AIME, is itself a creature of the surging interest in the maintenance of a safe and comfortable underground environment. A group of ventilation practitioners--both mining and tunneling--petitioned the Society of Mining Engineers for recognition in fall 1980 and was officially granted unit (technical) committee status a year later. Led by six recently appointed officers, UVC plans to program at both the AIME Annual Meeting and SME Fall Meeting as well as sponsor the mine ventilation symposium and encourage the publication of significant papers in the field.

For further particulars on the organization and operation of UVC, see the introductory paper in this volume, "New Recognition for an Old Technical Field."

Georgius Agricola would be astonished indeed by the state of mine ventilation in the late 20th century. A scientific field dedicated to the preservation of human life and comfort, it has come a long way since the black days of medieval mining. It is to the further advancement of underground ventilation technology that this series of symposiums and the activities of UVC are dedicated.

Howard L. Hartman  
The University of Alabama

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## PROGRAM

### TECHNICAL SESSIONS

Monday, March 29

Presiding: John W. Stevenson, Jim Walter Resources, Inc., Brookwood, AL

8:00 AM Registration Continuing Education Center

9:00 Welcome  
Richard L. Sanford, Head, Department of Mineral Engineering  
Joab Thomas, President  
The University of Alabama

9:15 New Recognition for an Old Technical Field (page 3)  
Howard L. Hartman, Symposium Chairman, The University of Alabama

#### SESSION I: FANS AND VENTILATION SHAFTS

9:30 Shaft Sinking Using the V-Mole--Description of the TMCI Operation in Alabama (page 9)  
Klaus-Peter M. Hanke, Thyssen Schachtbau GmbH, Tuscaloosa, AL

10:00 Pneumatic Transport in Conjunction with Shaft Construction (page 19)  
William R. Eby and Cheri Eby, Eby Constructors, Kent, WA

10:30 COFFEE BREAK

11:00 Main Mine Fan Reverse Performance Characteristics (page 23)  
Michael F. Dunn and Francis S. Kendorski, Engineers International, Inc., Downers Grove, IL;  
Raphael D. Schilz, Joy Manufacturing Co., New Philadelphia, OH; and Edward D. Thimons, U.S.  
Bureau of Mines, Pittsburgh, PA

11:30 Silencers for Sectional Fans (page 29)  
Earl Kennedy, Consolidation Coal Co., Morgantown, WV

12:00 LUNCH

#### SESSION II: AUXILIARY VENTILATION

1:30 PM Coal Mine Face Ventilation Systems: New Concepts and Underground Results (page 33)  
Edward F. Divers, U.S. Bureau of Mines, Pittsburgh, PA

2:00 Improved Coal Face Ventilation Through Use of Dust Scrubber Systems Leads to Greater Production Efficiency (page 43)  
A.D.S. Gillies, University of Missouri, Rolla, MO

2:30 Face Ventilation Systems Performance in Low-Height Coal Seams (page 55)  
Robert A. Haney, Stephen J. Gigliotti, James L. Banfield, MSHA, Pittsburgh, PA

3:00 COFFEE BREAK

3:30 Dust Control Using Wet-Type Dust Collectors (page 63)  
Bob J. Rawicki, Underground Surface Pollution Control, Inc., Lexington, KY

4:00 How the Six Cleanest U.S. Longwalls Stay in Compliance (page 67)  
Charles D. Taylor and Robert A. Jankowski, U.S. Bureau of Mines, Pittsburgh, PA

4:30 Mine Sealants--Their Uses and Benefits (page 71)  
M. E. Herrera, American Energy Products Corp., Pico Rivera, CA

## TECHNICAL SESSIONS (Continued)

Tuesday, March 30

Presiding: Bruce R. Johnson, Magma Copper Co., Magma, AZ

## SESSION III: COMPUTER APPLICATIONS AND MODELING

- 8:30 AM Computerized Control and Warning System for Uranium Mines (page 77)  
C. T. Sheeran and J. C. Franklin, U.S. Bureau of Mines, Spokane, WA
- 9:00 Sunnyside No. 3--A Case Study in Ventilation Planning (page 83)  
Malcolm J. McPherson and Michael Hood, University of California, Berkeley, CA
- 9:30 Developing Input Data for Computer Simulation of Mine Ventilation Systems from a Pressure-Quantity Survey (page 95)  
G. W. Luxbacher, Occidental Research Corp., Madisonville, KY; and R. J. Ramani, The Pennsylvania State University, University Park, PA
- 10:00 COFFEE BREAK
- 10:30 Modeling the Ventilation Network for an Old Coal Mine (page 103)  
Robert L. Grayson, Jones & Laughlin Steel Corp., McMurray, PA; R. Mike Mishra, Emway Resources, Inc., Washington, PA; and Y. J. Wang, West Virginia University, Morgantown, WV
- 11:00 Measuring and Modeling Natural Draft in Underground Mine Ventilation Systems (page 111)  
William E. Bruce, MSHA, Denver, CO
- 11:30 Computer-Assisted Ventilation Planning at a Coal Mine (page 119)  
Duk-Won Park, The University of Alabama, University, AL
- 12:00 LUNCH
- 1:30 PM Computer Applications for Henderson Mine Ventilation Planning (page 133)  
Tribhawan N. Srivastava, Climax Molybdenum Co., Empire, CO
- 2:00 Cost Effectiveness of Increasing Airflow in Underground Coal Mines (page 143)  
Sandip K. Mukherjee, Anthony W. Laurito, and Madan M. Singh, Engineers International, Inc., Downers Grove, IL; and Jon C. Volkwein, U.S. Bureau of Mines, Pittsburgh, PA
- 2:30 Application of CPM Procedures in Mine Ventilation (page 159)  
Y. J. Wang, West Virginia University, Morgantown, WV; and Jan M. Mutmanský, The Pennsylvania State University, University Park, PA
- 3:00 COFFEE BREAK

## SESSION IV: MINE FIRES

- 3:30 Mine Shaft Fire and Smoke Protection Systems--An Update on Hardware Development and In-Mine Testing  
Guy A. Johnson, U.S. Bureau of Mines, Minneapolis, MN (page 171)
- 4:00 Instrumentation for Mine Safety: Fire and Smoke Problems and Solutions (page 179)  
Ralph B. Stevens, ESD Corporation, Santa Clara, CA
- 4:30 Ventilation Control Measures Taken and Interpretation of Chromatograph Analyses During Recent Arizona Mine Fires (page 197)  
Ralph K. Foster, MSHA, Denver, CO

TECHNICAL SESSIONS (Continued)

Wednesday, March 31

Presiding: Pierre Mousset-Jones, University of Nevada, Reno, NV

## SESSION V: METHANE AND EXPLOSIVE GAS CONTROL

- 8:30 AM Predicting Methane Emission in Real Time for Longwall Faces (page 211)  
Richard Dunmore, MRDE, National Coal Board, Burton-on-Trent, Staff, England, U.K.
- 9:00 Centrifugal Fans and Their Use in Bleeder Applications (page 219)  
Stephen P. Harrison, Consolidation Coal Co., Pittsburgh, PA; and David Kennedy, Buffalo Forge Co., Buffalo, NY
- 9:30 Commercial Coal Degasification--A Case History (page 235)  
Kenneth L. Ancell, Enhanced Energy Resources, Inc., Houston, TX
- 10:00 COFFEE BREAK

## SESSION VI: MINE AIR COOLING

- 10:30 Analyzing Ventilation and Cooling Requirements for Mines (page 243)  
J. van der Walt, E. M. de Kock, and L. K. Smith, Engineering Management Services, Ltd., Johannesburg, South Africa
- 11:00 Development of a High Performance, Low Maintenance, In-Line Water Spray Cooler for Mines (page 259)  
Kenneth S. Heller and John F. McCoy, III, Foster-Miller Associates, Inc., Waltham, MA; and Edward D. Thimons, U.S. Bureau of Mines, Pittsburgh, PA
- 11:30 Thermal Recovery System for Reducing Mine Refrigeration and Energy Needs (page 271)  
Richard J. Kline, Foster-Miller Associates, Inc., Waltham, MA; and Edward D. Thimons, U.S. Bureau of Mines, Pittsburgh, PA
- 12:00 LUNCH

## SESSION VII: GENERAL VENTILATION

- 1:15 PM Control of Radon Daughters in Underground Uranium Mines (page 279)  
Wade E. Cooper, MSHA, Denver, CO; and Peter M. Turcic, MSHA, Arlington, VA
- 1:45 Improvement of Ventilation System Efficiency Through the Analysis of Air Leakage (page 285)  
E. Topuz, Sastry Bhamidipati, and Mark Bartkowski, Department of Mining and Minerals Engineering, Virginia Polytechnic Institute & State University, Blacksburg, VA
- 2:15 The Use of the S.I. Unit System in Mine Ventilation Calculations and Practice (page 291)  
Jan Wolski, New Mexico Institute of Mining & Technology, Socorro, NM
- 2:45 Evaluation and Concluding Remarks  
Howard L. Hartman, Symposium Chairman, The University of Alabama
- 3:00 COFFEE BREAK

FIELD TRIPS

- 3:15-6:30 Surface and Underground Installations  
Jim Walter Resources, Inc., Brookwood, AL

Thursday, April 1

- 8:00-noon Surface Installations  
Jim Walter Resources, Inc., Brookwood, AL



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## **Keynote Address**

**Howard L. Hartman**

Symposium Chairman and  
Professor of Mining Engineering and Holder of Endowed Chair  
The University of Alabama  
University, Alabama



## NEW RECOGNITION FOR AN OLD TECHNICAL FIELD

Howard L. Hartman

Symposium Chairman and  
Professor of Mining Engineering and Holder of Endowed Chair

The University of Alabama  
University, Alabama 35486

For The University of Alabama and the Underground Ventilation Committee of SME-AIME, I welcome you most cordially to the 1st Mine Ventilation Symposium.

To use a time-honored phrase, this is a historic event. Thirty two papers are to be presented by 55 authors in this, the first U.S. and North American conference devoted to underground ventilation.

Mine ventilation engineers have long lamented the absence of an appropriate forum in which matters related to the underground atmosphere could be argued. True, an international congress is now being held every four years, but few of us are fortunate enough to be able to attend when it is abroad. The Mine Ventilation Society of South Africa enrolls a number of Americans as members, and its journal is a welcome depository for some of our papers, but again, that organization is based overseas.

Following the II International Mine Ventilation Congress at the University of Nevada in 1979, a number of us met to consider the formation of an American forum. An organizing committee was formed to pursue the establishment of an "Underground Ventilation Organization," preferably affiliated with the Society of Mining Engineers of AIME and open as well to non-AIME members from other North American countries and to representatives of the tunneling and underground space communities.

We succeeded in our mission partially if not wholly. I chaired the UVO committee, and we explored a variety of alternatives, both within and without AIME. A separate society is attractive but economically unrealistic at this time (perhaps feasible in the future if a sponsoring "angel" steps forward to subsidize it). Linking up with SME-AIME carries obvious advantages, but unfortunately some constraints too. Although the negotiating group for UVO held out for autonomy, none is possible under the AIME constitution (short of creating yet another society). Finally, we agreed on committee status, with the group to be jointly based in the Coal Division and Mining and Exploration Division. In November 1981, the Underground Ventilation Committee was born.

Our structure is simple (the Committee's statement of "Purpose and Organization" and a list of officers are appended to these remarks). Anyone may affiliate with the Committee and attend our meetings (e.g., we meet tomorrow during lunch), although voting and holding office are limited to

SME members from either of the two divisions. As you'll note, our purpose is "to foster engineering interest and technological progress in the ventilation of mines, tunnels, and other underground openings." Programmatically, our plans are to conduct joint Coal and M&E technical sessions at both AIME and SME meetings as well as to sponsor symposia every other year on university campuses on a rotating basis. Session papers and symposium proceedings will be published by SME.

If at some future time, the formation of an independent mine ventilation society in North America seems viable, the Underground Ventilation Committee of SME-AIME could well provide the organizational nucleus.

In addition to commemorating the establishment of the UVC and the initiation of these university symposia, we recognize another singular event at this meeting: the publication of two major text and reference books on mine ventilation in the U.S. and the planned release of a new edition of the South African work on gold mine ventilation. When can ventilation buffs recall it so good?--three new books to choose from in the space of a few months! Dr. Christopher Hall of the University of Idaho is the author of Mine Ventilation Engineering, published last fall by SME; and I and 24 others are coauthors of the new edition of Mine Ventilation and Air Conditioning, to be released by John Wiley & Sons next month. My unbiased (?) judgment of both U.S. books is that they contribute substantially to the text and reference literature in our field of mine ventilation.

As the magazine ad would remind us, "You've come a long way, baby." It seems only yesterday that Georgius Agricola, the first literary mining engineer, was lamenting the deplorable state of the mine atmosphere during the Middle Ages and the short, grim life of underground miners. That some of them survived, we suspect, is more a tribute to the stamina of the miners than to the genius of the mine ventilation engineers of those days!

Times have changed. They changed substantially with the coming of the Industrial Revolution and the arrival of the machine age. Interestingly, however, the drastic changes occurring in mine ventilation and environmental control date from the years of the Post-Industrial Era, the years of our lifetime.

In Chapter 1, the new edition of Mine Ventilation and Air Conditioning singles out four

monumental events of the past two decades which account for--among other things--the ascendancy of atmospheric environmental control in mines:

1. The invention of the high-speed, electronic digital computer, permitting solutions to ventilation-system problems heretofore unsolvable, and allowing monitoring and remote control to become realities.

2. The development of the systems approach, which optimizes complex industrial operations, permitting men, materials, and methods to be coordinated in the most efficient way.

3. The enactment of tough new federal legislation, embodying strict regulations to improve the safety of mining operations.

4. The advent of socioengineering, the applying of technology with full consideration of the social, political, economic, and environmental consequences as well as the technical benefits.

What the full impact of these developments will be on mine ventilation is still unfolding. Clearly, the environment in the next decade can occupy no less influential a role in mining engineering than it did in the last. It is one of the purposes of the 1st Mine Ventilation Symposium to begin the assessment of that role and its definition for the future.

I look forward to being in attendance at the 10th Symposium in the year 2001, wherever it is held. For a long time, I've held the conviction that underground disasters caused by contamination of the atmosphere--fires and explosions, which cruelly snuff out many lives in an instant--can be eliminated from underground mining. An accomplishment of that magnitude is equivalent to finding a cure for cancer. But it is possible, and I believe it will occur through dramatic improvements in the way we ventilate mines. It will occur because the people in this room can will it to occur.

I here go on record today as predicting that atmospheric mine disasters will be eliminated by the time our 10th Symposium convenes. Whether it is the 9th, 10th, or 11th is not the point. Fires and explosions can be eliminated from mines. It is incumbent upon this assembled body of mine ventilation experts to see that they are.

The University, the Committee, and I welcome you to a historic event, the 1st Mine Ventilation Symposium.

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#### APPENDIX A

Purpose and Organization, Underground Ventilation Committee, Joint Coal Division - Mining & Exploration Division, Society of Mining Engineers, AIME.

Name: The Underground Ventilation Committee (UVC) is a unit or technical committee of AIME-AIME that functions jointly across the Coal Division and Mining & Exploration Division.

Purpose: The purpose of the UVC is to foster engineering interest and technological progress in the ventilation of mines, tunnels, and other underground

openings. Underground ventilation is here defined as the control of the quality, quantity, and temperature-humidity of the atmosphere of a designated underground space within specified limits. The UVC accomplishes its purpose by conducting technical sessions at SME and AIME meetings, sponsoring periodic symposia in cooperation with host universities, and soliciting papers for publication in Mining Engineering and SME transactions and proceedings. It also offers an affiliation home for SME members engaged in the practice of underground ventilation. In these ways, UVC seeks to encourage research, education, publications, and technology transfer in the field of underground ventilation.

Membership: Membership in UVC is open to any member of SME-AIME whose divisional preference is Coal or Mining & Exploration.

Officers: To satisfy the bylaws of both divisions, UVC shall have six officers, whose titles and duties are as follows:

1. Chairman: Administers the committee, presides at meetings, maintains the committee rolls, represents the committee in Society affairs, conducts elections. The Chairman and Vice Chairman for Programs represent UVC on the Executive Committees of their respective divisions and are responsible for communications liaison.

2. Vice Chairman for Programs: Serves as Chairman-Elect, assists the Chairman in administrative matters, chairs technical sessions sponsored by UVC, represents the committee on division program committees, contributes information to the divisions for the Annual Review issue of Mining Engineering.

3. Vice Chairman for Program Planning: Plans and solicits papers for technical sessions and symposia, assisted by the two Program Planners.

4. Vice Chairman for Publications: Solicits, processes, and reviews papers submitted for publication, represents the committee on division publication committees.

5. Program Planner for Coal: Assists the Vice Chairman for Program Planning, representing underground coal mine ventilation.

6. Program Planner for Mining & Exploration: Assists the Vice Chairman for Program Planning, representing underground noncoal mine ventilation.

TERMS OF OFFICE: The Chairman and three Vice Chairmen shall serve one-year terms. The two Program Planners shall serve staggered two-year terms.

LINE OF SUCCESSION: Persons appointed to either the fifth or sixth offices shall normally progress through the three Vice-Chairman offices to Chairman.

DIVISIONAL INTEREST: Since UVC is a joint committee, the six officers shall be chosen in alternating years to stagger representation from the two divisions; that is, three officers shall hold first preference for the Coal Division and three for the Mining & Exploration Division.

SELECTION PROCEDURE: All SME-AIME members who have requested membership in UVC may vote for officers. Normally, only the person nominated for either the

fifth or sixth offices in UVC requires election in any given year, the other officers progressing through the various offices to Chairman. Persons nominated for office must be confirmed and appointed jointly by the two Division Chairmen, according to division procedures. The six current officers comprise a nominating committee to choose a candidate(s) for the coming year for the office of Program Planner (Coal or M&E).

Adopted February 15, 1982 by UVC.

#### APPENDIX B

Current (Founding) Officers, Underground Ventilation Committee, Joint Coal Division - Mining & Exploration Division, Society of Mining Engineers, AIME.

Chairman	Howard L. Hartman The University of Alabama	Coal 1983
Vice Chairman- Programs	Pierre Mousset-Jones University of Nevada-Reno	M&E 1984
Vice Chairman- Program Planning	John W. Stevenson Jim Walter Resources, Inc.	Coal 1985
Vice Chairman- Publications	Bruce R. Johnson Magma Copper Company	M&E 1986
Program Planner- Coal	Madan M. Singh Engineers International, Inc.	Coal 1987
Program Planner- M&E	Y. J. Wang West Virginia University	M&E 1988





# Fans and Ventilation Shafts