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Poster Sessions: An alternative to formal oral presentations

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Poster sessions are rapidly becoming an integral part of the meetings of many professional organizations. They can be very effective in communicating certain types of information. Poster-session organizers should consider the subject matter that is best presented as a poster and the conditions that make poster sessions successful. Authors should carefully plan poster design and construction so as to obtain the most efficient and effective presentation.

INTRODUCTION

Each year an increasing number of professional societies are incorporating poster sessions into their meeting programs, although this concept is relatively new in the United States. Among the first to use them (1974) were the American Society of Biological Chemists and the Biophysical Society in a joint meeting and the Geological Society of America. As more societies discovered the potential of poster sessions, they rapidly became an integral part of many meetings. The percentage of papers presented as poster sessions is highly variable among societies but is increasing—the Geological Society of America reported a growth from 12% in 1974 to 20% in 1977.

We present some observations that may be informative to persons who are either organizing the physical setup of a poster session or who anticipate individual participation in one. These observations were gathered mainly through our own involvement in planning and presenting several poster sessions, as well as through conversations with other participants in poster sessions.

SOME ADVANTAGES OF POSTERS

Initially, some societies considered the poster session merely as a means of relieving pressure on the generally

crowded schedule of oral presentations. Now, however, most have come to realize that certain types of information can be presented more effectively and efficiently by using this alternative means of communication. In fact some societies, such as the American Association of Petroleum Geologists, suggest topics that may be included in their poster sessions.

For authors, the opportunity for individual contact and extended dialogue is rewarding. Many authors and discussants feel more comfortable in a leisurely discussion than in a condensed formal oral presentation.

Posters allow considerable variety in graphic displays such as maps, charts, photographs, and computer output and may also include carefully worded statements, claims, conclusions, and principles. Viewers may evaluate this information at their own pace; thus they have time to contemplate, discuss, and return to review posters of interest.

PHYSICAL SETTING

The selection of a display area for posters will depend on available space, number of posters, number of attendees, and other circumstances. The location should be easily accessible, have good lighting, and have an uncrowded setting. Hallways, meeting rooms, foyers, or exhibit areas are reasonable choices for displays.

Poster Sessions . . .

At recent Geological Society of America meetings the posters were arranged around the perimeter of the exhibit area. This coordination between posters and exhibits was very effective because it attracted participants to a central viewing area. The American Society of Agronomy provided a separate meeting room for posters at their 1977 meeting in Los Angeles. This arrangement was also satisfactory, because the meeting room was in an easily accessible location near where many of the oral presentations were being held.

Some thought must be given to the physical display of posters. Tack-board (4 × 4 or 4 × 8 ft) is a convenient material on which to attach and display posters. Movable dividers, available at many convention halls, provide adequate support for most posters and also separate adjacent posters. Adequate lighting of the displays may be a problem in some locations. Refreshments in or adjacent to the poster area may be useful in attracting viewers and in creating a casual atmosphere. Finally, maps of numbered display areas and printed sheets with titles and locations of the posters are helpful to both the author and the audience.

COORDINATION

Posters are most often viewed informally at the convenience of the attendees. However, posters are generally displayed concurrently with the program of oral presentations. One key to successful poster sessions is sufficient display time. Ideally, each poster should be displayed for the duration of the conference; one full day is certainly the minimum.

Authors should be present for at least two consecutive hours. Staggered time schedules for authors limit the number present at any one time, thus reducing congestion in the display area. The author's working address, phone number, and convention address should be included on the poster. Author accessibility permits interested viewers to discuss specific points either in the poster area during the scheduled time or at other times and locations that are mutually convenient.

POSTER ORGANIZATION AND CONSTRUCTION

Thoughtfully organized posters should provide an ordered, logical path along which the viewer is led. This can be easily accomplished by the use of arrows and colors and by the general organization of the poster. The main points of the poster should be clear, and the flow of the discussion should be readily apparent to the viewer. In general, the convention of Western culture suggests that the line of thought should proceed from upper left to lower right. As in any presentation, it is best to choose a representative example of the principles being considered and follow it through from beginning to end, so that the viewer may readily understand how the data support the conclusions.

In order to attract attention, the title, purpose, and conclusions should be emphasized by color, print size, loca-

tion on the poster, or by combinations of these factors. A poster, like an oral presentation, should avoid excessive detail; therefore, discussion, graphs, and tables should be simple. The more important material should be emphasized by size or highlighted with color, while minor details should be subordinated or omitted. A handout can be made available to present more detail if desirable.

Durability, cost of production, assembly, and ease of transport of poster material must be considered by authors in the planning stages. Posters can be assembled at the meeting by attaching page-size material to the boards provided. Posters can also be assembled in advance on panels of convenient size. Such preassembled posters can be transported on air lines either as carry-on luggage or as cargo. It would be prudent to check with the air line prior to poster construction to determine the dimensions of large rigid items that can be accommodated in the cabin.

Efficient art production and poster durability can be enhanced by working first with small, paste-up art work. Large photos or other prints of the small-scale assembled material can easily be attached to light-weight panels of foam-core board. Color can then be added as needed. In case of disastrous loss, this method provides the author with some means of recovery through the use of the original art work. This type of poster construction is often done by a professional graphics designer. However, a poster that is not professionally prepared can be just as effective. In fact, author-prepared posters are more common than professionally prepared posters. The use of large-type typewriters, lettering tools, typeset printing, and even careful hand-lettering have all been successful. In any case, lettering should be sufficiently large for most of the messages to be legible at a distance of 4 to 6 ft.

OTHER CONSIDERATIONS

Second-class status should not be ascribed to a poster session either by the organization or by the participants. Poster presentations should receive equal billing with oral presentations. Our experience indicates that as much planning and work are needed for a poster presentation as for an oral presentation. Poster abstracts, locations, and viewing times should be published in the general program along with information on invited or volunteered oral presentations.

Those who have organized poster sessions can benefit from the participants' and the viewers' comments. Evaluation sheets and, perhaps, a suggestion box in the poster area make it convenient for viewers to comment.

Poster sessions provide a unique opportunity at meetings for participants who wish to have close contact with both a general cross section of attendees and with specialists in their particular field. Poster sessions are beneficial to others as well as to the organization. They are well worth the substantial effort required.

ACKNOWLEDGMENTS

Reviewed by Hansford T. Shacklette and Harry A. Tourtelot.

COUNCIL ACTIONS, FALL 1978

1. Adopted the *Annual Report for 1977* as the report of the Council.

2. Approved the 1979 operating budget.

3. Approved certain financial resolutions.

4. Ratified the 1978 award winners selected by the Engineering Geology Division, Hydrogeology Division, and Quaternary Geology & Geomorphology Division; selected a nominee for the 1979 Texas Instruments Foundation Award.

5. Adopted a resolution of thanks to outgoing officers, councilors, committee people, and all those responsible for the successful Toronto Annual Meeting.

6. Selected members for the 1979 committees and to be Society designees/representatives to non-GSA groups.

7. Ratified the slate for the 1979 Committee on Committees.

8. Appointed the 1979 GSA Auditing Committee.

9. Assigned national officers to attend the 1979 section annual meetings.

10. Discussed ways and means of establishing a GSA fund-raising program.

11. Accepted, on behalf of the Society, the gift of Ashland Oil, Inc., shares from Harold T. Stearns to be added to the Stearns Scholarship Fund.

12. Instructed that the \$6,000 from the Richard E. Fuller estate be assigned to the Centennial Fund.

13. Advanced 18 Members to Fellowship and ratified the election

of 180 candidates to Membership in the Society.

14. Voted that "paid-for-life" exempt members who are receiving *Bulletin, Part I*, shall also receive without charge copies of *Bulletin, Part II* in microfiche.

15. Discussed the new two-part *Bulletin* format and the incoming 1979 subscriptions.

16. Received a progress report from the *ad hoc* Committee on Centennial Planning; discussed ways of participating in the 1979 USGS Centennial.

17. Ratified the actions of the Investments Committee taken during its September 21-22, 1978, meeting in New York City.

18. Instructed the Treasurer, in consultation with the Auditing Committee, to explore the future auditing needs of the Society.

19. Named Warren D. Huff as general chairman of the 1981 GSA Annual Meeting in Cincinnati; Jules Braunstein as the general chairman of the 1982 GSA Annual Meeting in New Orleans; accepted the invitation to hold the 1983 GSA Annual Meeting in Indianapolis on October 31 through November 3.

20. Received an interim report concerning the Eckel GSA History Volume.

21. Received the report of the *ad hoc* Committee on Honors and Awards; voted to include a flyer annually with the dues statements asking the membership for nominations for the Society's honors and awards; increased the size of the Day

Subcommittee and the Honorary Fellows Subcommittee from 4 to 6 members each.

22. Discussed the rules and operation of Penrose Conferences; approved one Penrose Conference proposal; increased the size of the Penrose Conference Committee from 3 to 4 members.

23. Asked the Committee on Geology & Public Policy to make an initial review of problems of access to public and private lands for scientific and educational purposes.

24. Instructed the chairman of the Geology & Public Policy Committee to present a report to the AGI Governing Board concerning the Congressional Fellowship program.

25. Agreed to support the *Treatise on Invertebrate Paleontology* for 1979 by a contribution of \$20,000.

26. Named Peter T. Flawn as GSA's Member on the AGI Governing Board for 1979.

27. Set dates for the Executive Committee, Investments Committee, and Associated Society Presidents/Executive Committee meetings in Boulder in February 1979.

28. Selected the dates of May 8-9, 1979, for the spring meeting of the Council to be held in Boulder, CO.

29. Initiated a staff service recognition program.

30. Accepted reports from standing committees, sections, divisions, and designees/representatives to non-GSA groups.

31. Took other minor actions, records of which are on file at headquarters.

CHANGE OF ADDRESS,*

The Geological Society of America, 3300 Penrose Place, Boulder, CO 80301

NAME _____

(Please print)

New Address _____

City State/Province Zip Code

Country _____

Member Number _____

Former Address—Attach Mailing Label

Effective Date of Change _____

*North American subscribers should report address changes 6 weeks in advance; all others, 3 months in advance.

GSA UPDATE . . .

HAROLD T. STEARNS FELLOWSHIP FUND

The Harold T. Stearns Fellowship fund for the support of research in the Circum-Pacific region was established in 1974 by a generous gift from Dr. Stearns for that purpose. Since its establishment, there have been made four awards in support of graduate student research. At the October 1978 meeting of the GSA Council in Toronto, Canada, they accepted with thanks an additional gift from Dr. Stearns of 213 shares of Ashland Oil, Inc. The awards are made each year in the spring at the same time as the Penrose research grants are awarded.

AESE ANNUAL CONFERENCE

The Association of Earth Science Editors has announced that its 13th Annual Conference will convene October 14, 1979, at the Mayo Hotel in Tulsa, Oklahoma. Formal sessions will begin October 15 and will run through October 17.

Conference Headquarters will be in the Mayo Hotel located on the newly completed downtown Tulsa Mall, only a short walk from the Williams Center. In the Williams Center is the multi-theater Performing Arts Center, Williams Plaza Hotel, and the Forum shopping center and ice rink, a la the Galeria in Houston. The Williams Center also has a two-acre "green," an open area where various entertainment events are presented during the noon hour.

Delegates will have an opportunity to visit such Tulsa landmarks as the University of Tulsa, Petroleum Publishing Company, Oral Roberts University, and Philbrook and Gilcrease Art Museums.

A field trip is planned which will explore the effects of geology on urban development.

NATIONAL RESEARCH COUNCIL RESEARCH ASSOCIATESHIPS, 1979

The National Research Council is pleased to announce the NRC Re-

search Associateship Programs for 1979. These programs provide opportunities for research in many fields of atmospheric and Earth sciences, chemistry, engineering, environmental sciences, life sciences, mathematics, physics, and space sciences.

Approximately 250 new awards will be made on a competitive basis to recent recipients of the doctorate and, in some programs, to senior investigators as well. Certain programs are open to non-U.S. nationals as well as to U.S. citizens. Stipends (subject to income tax) will be individually determined and will begin at \$18,000 a year. Grants will be provided for family relocation and for limited professional travel during tenure.

Postmark deadline for applications is January 15, 1979. Awards will be announced in April.

The NRC administers the Research Associateship Programs in cooperation with selected Federal research organizations which have laboratories at about 65 geographic locations in the United States.

Prospective applicants may request information and application forms from the Associateship Office, JH 606-P, National Research Council, 2101 Constitution Avenue, N.W., Washington, D.C. 20418, telephone (202) 389-6554.

NAGT 1979 SUMMER FIELD COURSE SCHOLARSHIP APPLICATIONS AVAILABLE

With the generous help of industrial sponsors, the National Association of Geology Teachers will again operate a Summer Geology Field Course Scholarship program in 1979.

Students with superior academic records are eligible for \$100 and \$200 scholarships to help defray the cost of a summer field course in geology. The application deadline is March 1, 1979. Award announcement date is April 1, 1979. To be eligible for a NAGT scholarship, a student must attend a summer field course in geology that is at least four weeks in duration and that engages the student

primarily in field work rather than classroom work.

Letters of inquiry should be sent to Marvin E. Kauffman, Department of Geology, Franklin & Marshall College, Lancaster, PA 17604.

FULBRIGHT-HAYS AWARDS IN GEOLOGY

For more than thirty years the Fulbright-Hays program has provided opportunities for university lecturing and advanced research abroad. In recent years about 500 U.S. government awards per year have been made to American scholars and other professionals—from 5 to 10 of them to specialists in geology and closely related fields. The program, directed by the International Communication Agency, also includes awards to scholars from abroad for lecturing and advanced research at U.S. institutions.

Announcement of opportunities available to American scholars for 1980-1981 will be published in March 1979. The general composition of the program involving about 100 countries is expected to be similar to that of recent years. Registration for personal copies of the announcement is now open to U.S. citizens with university or college teaching experience. Forms are available from the Council for International Exchange of Scholars, Suite 300, Eleven Dupont Circle, Washington, D.C. 20036.

Among the 1978-1979 grants, 4 awards in geology were made to American scholars for work in Afghanistan, Australia, Iceland, and India; 14 scholars from abroad will be in the U.S.—half of them from Australia and New Zealand, and representatives also from Austria, Chile, Israel, Sri Lanka, Sudan, and the U.S.S.R. Grantee lists will be sent upon request. Nominations for 1979-1980 awards are now being forwarded to the countries which programmed grants for announcement in the spring of 1978; most scholars receiving awards will be notified by February or March 1979.

PROFESSIONAL REGISTRATION OF GEOLOGISTS IN THE COMMONWEALTH OF MASSACHUSETTS

Under the auspices of the New England Section of the Association of Engineering Geologists (AEG), two GSA members are among the four geologists that have been selected to sponsor a bill to be introduced before the Commonwealth House of Representatives in Massachusetts. The AEG Legislative Committee wishes to make the content of the bill known to interested geologists in Massachusetts and other states and will provide copies upon contact. The bill will be submitted to the Legislature in December 1978 and should be considered by the House Committee on Governmental Regulations.

The sponsors have declared that the bill is intended to protect the public in terms of health, safety, welfare, and general fiscal integrity, by providing a means by which geologic consultants can be qualified by training and experience as being capable of providing accurate and reasonable geologic data for use in engineered construction, groundwater production, waste disposal, hazards mitigation, and natural resource recovery. The bill does not prescribe that geologic consultation must be performed by those so licensed, but that individuals advertising services as consulting geologists must be so licensed. The bill is intended to provide protection to the public in terms of recognition of professional qualifications. It remains a matter of choice to the client individual, agency or corporation to choose to select the services of a registered geologist. Teachers of geology are not restricted in their academic pursuits in any form.

Copies of the draft or printed bill (depending on time of request) will be sent to those contacting one of the following GSA members: Peter J. Tarkoy, Chairman; Perini Corporation; 73 Mount Wayte Avenue; Framingham, Massachusetts 01701; or Allen W. Hatheway, One Tyler Road, Belmont, Massachusetts 02178.

NECROLOGY

Notice has been received of the following deaths: Carl C. Addison, Houston, Texas; Perry Byerly, Oakland, California; William S. Cooper, Boulder, Colorado; Earl E. Fry, Houston, Texas; Julius B. Garrett, Jr., Houston, Texas; Conrad D. Gebelein, Santa Barbara, California; Leopold A. Heindl, Arlington, Virginia; John W. James, North Tarrytown, New York; John M. Kelly, Roswell, New Mexico; Montis R. Klepper, Reston, Virginia.

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Prepared from contributions from the staff and membership by John C. Frye, Executive Director; Jo Fogelberg, Publications Manager; and June Thomas, Judy Hall, and Renée Gitchell, Production Assistants.

Attend the AGU Spring Meeting May 28-June 1, 1979 in Washington, D. C.

Special sessions of interest to geologists include:

Geomagnetism and Paleomagnetism

Electromagnetic Studies of the Aesthenosphere
Magnetic Stratigraphy: Its Origin and Reliability

Hydrology

The Unsaturated Zone as a Barrier in Waste Disposal
Methods of Soil Moisture Determination
Role of Groundwater in Drought of Mid-1970's
International Symposium on Urban Hydrology

Oceanography

Actinide Elements in the Environment

Seismology

Slow Deformation Evidence From Seismology and Geodesy (cosponsored by Tectonophysics and Geodesy)

Tectonophysics

Laboratory, Seismological, and Theoretical Determination of Attenuation of Elastic Waves Including Frequency Dependence of Q and Elastic Moduli (cosponsored by Seismology)
High Temperature Diamond Cell Workshop

Union

Lunar Research After 10 Years

If you would like information on submitting a paper, registration, the program, or hotel reservations, write to:

Meetings

American Geophysical Union
1909 K Street, N.W.
Washington, D. C. 20006

LETTERS

THE METHOD OF MULTIPLE WORKING HYPOTHESES IN SCIENCE?

Peter T. Flawn, President
Geological Society of America

It was remarkable to find, in the September 1978 issue of *Geology*, your letter which sings hosannas to T. C. Chamberlin's method of "Multiple Working Hypotheses." Very few scientists use the method and I would venture a personal opinion that no big discovery or breakthrough in science was ever the product of that method.

I was aroused to have my say not so much by the mention of Chamberlin's "method," but by the contrasting of it with a ruling theory method "in which the data are forced to the theory" (italics mine). I don't much care for straw men in science, but maybe they do have a use, when employing the method of multiple working hypotheses. But the door has been opened, as Perry Mason would say, so here goes.

Only a year ago I was lecturing to a class of juniors majoring in geology and the subject of Chamberlin's "method" came up (not by accident either). One of my very best students was willing to state his faith in the "method" as a way of doing science. My own way of contrasting the "method" is by quoting a few lines written by Darwin:

About thirty years ago there was much talk that geologists ought only to observe and not theorize; and I well remember someone saying that at this rate a man might as well go into a gravel-pit and count the pebbles and describe the colours. How odd it is that anyone should not see that all observation must be for or against some view if it is to be of any service?

(quoted in the now famous-infamous paper of Eldredge and Gould, 1972, p. 85).

I asked the student if he had read Chamberlin's paper recently and he said, No, it had been a few years back. I suggested to him that what he supposed was in Chamberlin's paper was really what the title of the paper made him think of, and, being the fair-minded democratic American that he was, the connotations were all good.

The next day, this student visited me in my office, saying that he had now reread Chamberlin's paper (remember, I said he was one of my very best students). He said that he was "shaken" to realize how different the "method" as stated by Chamberlin was from what he had thought. If readers of this letter have come this far and also are believers in Chamberlin's method, I invite them too to reread it. If no one then comes forward with a convincing defense of the method of multiple working hypotheses, maybe it could at last be put to rest.

In place of the "method" as described by Chamberlin I recommend the earlier viewpoint of G. K. Gilbert (1886) concerning hypothesis and hypotheses. The eleventh and twelfth paragraphs of Gilbert's article provide a clear, concise, realistic, and still-modern statement that Chamberlin, unfortunately, never cited. Gil-

bert's article will be on the shelves of many geologists in P. E. Cloud's valuable collection *Adventures in Earth History* (1970, paragraphs 8 and 9).

J. G. Johnson, *Department of Geology, Oregon State University, Corvallis, Oregon 97331*

Editor, *News & Information*
Geological Society of America

Dear Sir:

I have read J. G. Johnson's letter responding to my President's Message in *GSA News & Information* for September 1978 entitled "Multiple working hypotheses and policy analysis—T. C. Chamberlin revisited."

Johnson says that he does not believe that scientists use the method of multiple working hypotheses and that nothing of much scientific merit has ever come out of it. I conclude that either he or I do not understand what Chamberlin said. I believe the whole of geological literature presents a chronicle of multiple working hypotheses. A scientist attempting to explain data by asking "how?" and "why?" either consciously or unconsciously uses multiple working hypotheses unless he is working inside a theory he does not question or unless a complete, consistent theory comes through revelation.

I would be pleased indeed if our colleagues accept Johnson's invitation to reread Chamberlin's essay. Gilbert's article (1886) admired and cited by Johnson is also a classic; his commentary (p. 286) on the difference between an investigator and a theorist seems to me to be particularly pertinent to the issue that "aroused" Johnson. In any case, both essays speak for themselves.

Peter T. Flawn, *Department of Geological Sciences, P.O. Box 7909, The University of Texas at Austin, Austin, Texas 78712*

WHOLE ROCK OR ROCK ANALYSIS?

Dear Sirs:

Your GSA journals and other publications, like many others, continue to use the term "whole-rock analysis" (for example, see line 3 in article by F. Chayes and F. Mutschler in September 1978, *GSA News and Information*). What exactly is a half-rock analysis? Why has geochronologists' jargon been allowed to displace "rock analysis" which is perfectly clear, has been used for nearly 200 years, and is shorter? Moreover, as geochronologists now realize that different ages can sometimes be obtained from the use of very large samples compared with using small samples of the same rock, the very term that might have been useful to indicate an exceptionally large (>50 kg) sample is already in common use for any ordinary rock sample. It may be too late to stop the geochronological abuse of the term, but it certainly is not too late for normal geochemical use.

Bernard E. Leake, *Department of Geology, University of Glasgow, Glasgow, Scotland*

Reply to Dr. Leake

Dr. Leake's general point is well taken and we agree. In context (line 3, col. 1 of the first page of our announcement), the term "analyses" requires no adjectival modifiers and should have had none. But this does not meet his broader criticism.

Certain very common petrographic calculations require values for all the constituents conventionally referred to as "essential oxides," and it would be useful to have a word characterizing rock analyses satisfying this requirement. Traditionally, such analyses are called "complete," though everyone knows they are not. In our experience, however, quotation marks about "complete" tend to be removed in editing if they are present in the manuscript (and inserted by editors or critics if they are not). What *shall* we do?

As Dr. Leake evidently takes no other major exception to our announcement, we look forward to his cooperation with the nascent U.K. group of Project 163. If he would join the team, he would have a chance to coach the players *before* they make gaffs of this kind in public.

Felix Chayes, *Carnegie Institution of Washington, Geophysical Laboratory, 2801 Upton Street, N.W., Washington, D.C. 20008*
Felix Mutschler, *Department of Geology, Eastern Washington University, Cheney, Washington 99004*

SYMPOSIUM SPONSORED BY COMMITTEE ON GEOLOGY AND PUBLIC POLICY

At the recent GSA meeting in Toronto, the Committee on Geology and Public Policy sponsored a symposium on "Geological Information—Problems in Transfer from Scientist to Policy Maker." This well-attended symposium focused on the problems, methods, and reasons for getting the geological message to policy makers. The seven papers presented clearly demonstrated the requirement for geological information in policy formulation in a broad range of contemporary issues.

E. G. Wermund (Bureau of Economic Geology, University of Texas) reviewed the progress to date of the Environmental Geologic Atlas series for parts of Texas. In addition, he explained mechanisms, varying from conferences to legislative testimony, in transferring this information to policy makers. This experience in Texas was contrasted by J. D. Mollard's (J. D. Mollard and Associates) unique problem in explaining the selection of pipeline routes to oil company executives, regulatory agencies, and Indian bands in Canada. One way of elucidating the procedure to these decision makers was to explain the interrelationship of different terrain aspects by progressively shrinking the scale of maps and aerial photographs. G. A. Robbins (Office of Standards Development of the U.S. Nuclear Regulatory Commission) focused on the problems and frustrations that often result when evaluating faulting or seismic hazard in advance of regulatory approval by U.S. government departments.

The different regulations developed by federal agencies reflect a varied understanding of how risks should be defined, differences in the state-of-the-art at the time the regulations were prepared, historical uses of the criteria, and the lack of knowledge of processes associated with natural phenomena.

The next two speakers related their experiences and opinions of governmental scientific advisory groups. W. O. Kupsch (University of Saskatchewan) observed that with the increasing growth of bureaucracy in Canada the direct contact between the Geological Survey of Canada geologist and the policy maker has diminished. A plethora of other bodies including scientific advisory groups now intervene between geologist and policy maker, commonly losing and distorting information during the transfer which may result in decisions detrimental to the public as a whole. Using nuclear waste disposal as an example, F. A. Donath (University of Illinois) discussed the importance of scientific advisory groups involved in this critical question. The sensitive nature of the subject, the complex science and technology involved, and the vested interests both in and out of government necessitate forming specialized scientific advisory groups. Their goal is to provide an independent and constructively critical review of work proposed or completed and to identify relevant issues or areas that may have been neglected.

In both the United States and Canada, national priorities are being set that involve a diversity of geological information such as in environmental protection and energy sources. A. F. Agnew (U.S. Library of Congress) reviewed the very large number of areas considered by Congress in the past year alone that dealt with geology. Surprisingly, very few members of Congress or researchers on their staffs have formal geological training. Therefore, there is a need for greater input to the legislative process by geologists. This participation can be achieved simply by writing your Congressman or, with somewhat more difficulty, running for Congress yourself. H. R. Wynn-Edwards (Canada Ministry of State) stressed that, in Canada, identification of national goals for research and development is a growing preoccupation of governments. Many of these goals involve geology. Increasingly, decisions are being taken in the context of both capability and desirability—the technological feasibility and the socio-economic or environmental consequences. Geologists are especially important in this process because they are involved in both dimensions, and are trained to synthesize and think in terms of whole systems and time.

It is abundantly clear that policy makers at all levels of government, from Indian bands to Cabinet members, need and want accurate geological information to aid in making decisions. It is our job to make sure that they get this information.

Nathaniel W. Rutter, *Committee on Geology and Public Policy, Department of Geology, University of Alberta, Edmonton, Canada T6G 2E3*

SOUTHEASTERN SECTION, GSA, APRIL 26-27, 1979

The 28th Annual Meeting of the Southeastern Section of the Geological Society of America will be held at the Donaldson Brown Center for Continuing Education at Blacksburg, Virginia, April 26 and 27, 1979. The meeting is hosted by the Department of Geological Sciences, Virginia Polytechnic Institute and State University.

REGISTRATION

Registration is required for all those attending the meeting, field trips, spouses' program, or short course. **Preregistration forms must be received in Blacksburg by April 11, 1979.** Registration will be held in the Donaldson Brown Center for Con-

tinuing Education on April 25 from 1700 to 2130 hours and during the meeting.

Refunds on canceled preregistrations will be made in full until April 11, 1979. After that date, no refunds will be made except for canceled field trips.

WELCOMING PARTY

A welcoming party for all those attending the meeting will be held from 2000 to 2200 hours on Wednesday evening, April 25, at the Donaldson Brown Center for Continuing Education.

SYMPOSIA

(1) *Fault Systems and Faulting Mechanisms in the Piedmont*; Stephen C. Clement

(2) *Geology of the Continental Margin of the Southeastern United States*; William Dillon and Mahlon Ball

(3) *Symposium in Commemoration of the 100th Anniversary of the United States Geological Survey: Current USGS Research in the Southeastern United States*; Ellis Yochelson

(4) *Carolina Slate Belt: Origin and Evolution of an Ancient Volcanic Arc*; Stephan A. Kish and William Black

FIELD TRIPS

Field trip registrants MUST ALSO preregister for the meeting.

Field trip registration is on a first-come, first-served basis. If a trip is oversubscribed, the full trip registration fee will be refunded to late registrants. **Field trip preregistration must be received in Blacksburg by April 11, 1979, accompanied by payment in full.** Trips may be canceled owing to low numbers of registrants or for reasons beyond our control. Full refunds will be made under such circumstances. No other trip refunds will be made after April 11.

1. Virginia Piedmont Geology along the James River from Richmond to the Blue Ridge (April 27—leave 1600 hours, 28, and 29). Leaders: A. R. Bobyarchick, W. C. Bourland, W. R. Brown, L. Glover, B. K. Goodwin, D. C. Mose, and F. B. Poland.

The trip will emphasize stratigraphy, igneous activity, tectonics, and ages of geologic events. Limit 43; cost \$65.

2. Lithofacies and Biostratigraphy of Cambrian and Ordovician Shelf and Basin Facies Carbonates and Clastics, Southwestern Virginia (April 28, 29). Leaders: J. R. Markello, J. F. Read and C. G. Tillman.

On the first day, participants will examine Cambrian peritidal cyclic carbonates, stromatolitic bioherms, deeper water shales and limestone conglomerates, and review trilobite biostratigraphy. This will be followed on the second day by an examination of Middle Ordovician carbonate ramp to basin facies, which include shelf and downslope skeletal buildups, deeper water limestone, basinal shales, basin margin turbidities, polymictic conglomerates, and a discussion of the use of conodonts in providing a biostratigraphic framework for these complex facies. Limit 43; cost \$45.

3. Tectonic Features of the Overthrust Belt near Blacksburg, Virginia (April 28). Leaders: David Gray, W. D. Lowry, and Art Schultz.

Drag folds, cleavage, wedge faults, and bounding in Middle Ordovician strata in the Greendale syncline and the high-angle Saltville fault will be examined before proceeding southeast into the overthrust belt. Normal and thrust faults in overridden Mississippian strata in the most northwesterly window of the great Pulaski overthrust sheet will be viewed along with a variety of cataclastic rocks, ranging in age from Cambrian to Mississippian, which were trapped in the fault zone. An outstanding exposure of the distinctive Max Meadows-Pulaski tectonic breccias of Cambrian Elbrook carbonates will be seen, and the nappe-like Christiansburg anti-

HOUSING FORM

Southeastern Section, Geological Society of America

April 26, 27, 1979

Headquarters: Donaldson Brown Center, V.P.I. Campus

Under "Reservation Choices" insert a 1, 2, or 3 in the boxes to indicate your first, second, and third choice of lodging. Those without car are advised to elect Donaldson Brown or the Sheraton Red Lion. A genuine London double-decker bus will transport persons between the Red Lion and Donaldson Brown.

Limousine service between the Roanoke Airport and any Blacksburg motel (\$7.00 one way, \$13.50 round trip) can be reserved by calling Blacksburg Limousine Service (c/o Marriott Hotel 703/552-7001).

Reservation choices (prices as of 11/30/78)

No. of Occupants	Miles from Headquarters				
	0 Donaldson Brown	1 Sheraton Red Lion	2.5 Imperial Motel	2.5 Lake Terrace	3.5 Holiday Inn
1	<input type="checkbox"/> 14.56	<input type="checkbox"/> 24.00	<input type="checkbox"/> 13.40	<input type="checkbox"/> 12.43	<input type="checkbox"/> 23.50
2	<input type="checkbox"/> 18.72	<input type="checkbox"/> 33.00	<input type="checkbox"/> 17.90	<input type="checkbox"/> 16.59	<input type="checkbox"/> 32.50
3*			<input type="checkbox"/> 20.90	<input type="checkbox"/> 19.71	
4*			<input type="checkbox"/> 23.90	<input type="checkbox"/> 22.83	

* In room with two full-sized beds.

Arrival Date: _____ Departure Date: _____

Will arrive by: Car Public Transportation

Name: _____

Address: _____

City, State, Zip: _____

Phone: _____ Sharing room with: _____

RETURN TO: **LODGING: SEGSA**
Donaldson Brown Center
Virginia Polytechnic Institute and State University
Blacksburg, VA 24061

ALL RESERVATION REQUESTS MUST BE RECEIVED BY APRIL 11, 1979

PREREGISTRATION DEADLINE, APRIL 11, 1979

cline in the root zone will be studied. Limit 43; cost \$20.

4. Depositional Environments of Late Paleozoic Coal-Bearing Strata, Southern Appalachians (April 27—leave 1600 hours, 28, and 29). Leaders: John Ferm and John Horne.

Large laterally extensive road-cuts in eastern Kentucky provide a unique opportunity for detailed field observation of many deltaic depositional environments. Included in the field observation will be prodelta, distributary mouth bar, interdistributary bay, crevasse splay, delta plain, channel fill, point bar, levee, and flood plain depositional environments. Lectures along with field observations will provide insight into pattern and distribution of deltaic facies. Limit 43; cost \$70.

SHORT COURSE

Paleogeographic Reconstruction: The State of the Art (April 28). Coconveners: R. K. Bambach and C. Scotese.

The course will survey techniques of compiling paleogeographic reconstructions ranging from local facies complexes to whole-world reconstructions. Comparison and evaluation of independent data sources will be emphasized. The use of both stratigraphic analysis of facies patterns and paleoecologic analysis using community distributions will be illustrated for local and regional reconstructions. Large scale (world-wide) reconstructions will be discussed in terms of paleomagnetism, major patterns of sedimentation, distribution of climatically sensitive sediments, biogeographic patterns, structural and tectonic relationships, and geometric constraints of plate motion. New reconstructions of the world in the Paleozoic will be presented with a discussion of the various lines of evidence (paleomagnetic, paleoclimatic, paleobiogeographic, and tectonic) that are used in combination to refine them. Methods of data compilation for computer use, computer plotting using various projections, and a computer simulated motion picture of continental movement through the last 600 million years will be presented. Limit 35; cost \$15.

SPOUSES' PROGRAM

The program for spouses will include both the old and new. Thursday morning

FOR ADDITIONAL INFORMATION CONTACT:

David A. Hewitt, Department of Geological Sciences, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061, (703) 961-6356

after coffee the group will hear a talk on getting to know antiques and using them in the home. Lunch will be served in a continental restaurant, and in the afternoon there will be a tour of Smithfield Plantation, a Virginia Historic Landmark. Friday morning there will be a coffee and fashion seminar on what's new and what's coming in fashion and adapting these to your wardrobe.

HOUSING

The Donaldson Brown Center for Continuing Education will serve as head-

quarters hotel for the meeting. Return the housing form directly to the Donaldson Brown Center.

AIR TRANSPORTATION INFORMATION

Piedmont and Allegheny Airlines serve Woodrum Field in Roanoke, Virginia, approximately 40 miles from Blacksburg. Scheduled limousine service is available between the Donaldson Brown Center and the airport (see housing form). Rental cars are available at the airport and at the Marriott Inn in Blacksburg.

PREREGISTRATION FORM			
Southeastern Section, Geological Society of America			
28th Annual Meeting			
Blacksburg, Virginia, April 26-27, 1979			
NAME (last, first, middle) _____			
Registered as	<input type="checkbox"/> Professional	<input type="checkbox"/> Student	<input type="checkbox"/> Spouse
ADDRESS (street) _____			
CITY, STATE, ZIP _____			
PHONE (business) (_____) _____ (home) (_____) _____			
INSTITUTION (abbreviate for badge) _____			
REGISTRATION FEE		Received by Apr. 11	After Apr. 11
Professional		\$23.00	\$28.00 \$ _____
Student (ID required)		10.00	15.00 _____
Spouse		12.50	15.00 _____
FIELD TRIPS			
1. Virginia Piedmont Geology along the James River from Richmond to the Blue Ridge		65.00	_____
2. Cambrian and Ordovician Shelf and Basin Facies Carbonates and Clastics		45.00	_____
3. Tectonic Features of the Overthrust Belt near Blacksburg, Virginia		20.00	_____
4. Depositional Environments of Late Paleozoic Coal-bearing Strata		70.00	_____
ANNUAL BANQUET	No. _____	12.00 ea.	_____
SHORT COURSE		15.00	_____
			TOTAL \$ _____
Make all checks payable to Southeastern Section GSA and mail to:			
David A. Hewitt			
Department of Geological Sciences			
Virginia Polytechnic Institute and State University			
Blacksburg, VA 24061			
REFUNDS: No refunds after April 11, 1979, except for canceled field trips.			

NORTH-CENTRAL SECTION, GSA, MAY 10-11, 1979 . . .

The Department of Geology of the University of Minnesota, Duluth, will host the 13th Annual Meeting of the North-Central Section of the Geological Society of America concurrently with the 25th Meeting of the Institute of Lake Superior Geology, the 6th Annual Meeting of the North-Central Section of the Paleontological Society, and the 1st Annual Meeting of the Society of Vertebrate Paleontologists, North-Central Section, on May 10 and 11 (Thursday and Friday), 1979. For further information, write or call Local Committee Chairman Richard W. Ojakangas, Department of Geology, University of Minnesota, Duluth, MN 55812, phone: (218) 726-7237; or Program Committee Chairman Paul C. Tychsen, Department of Geology, University of Wisconsin-Superior, Superior, WI 54880, phone: (715) 392-8101, ext. 261.

Only those wearing official name badges will be admitted to convention activities. Valid student identification will be required of those registering as students.

TECHNICAL PROGRAM

Technical sessions and symposia will be held at the Normandy Inn. Depending upon abstracts received, there will be sessions on mineralogy and geochemistry, petrology, structural geology, geophysics, sedimentology, paleontology, stratigraphy, economic geology, geomorphology, environmental and engineering geology, hydrogeology, Quaternary geology, and general geology.

In addition, there will be symposia on:

1. *Sampling of Current Research by the United States Geological Survey in the North-Central United States* (Ellis L. Yochelson, convener)

2. *Midcontinent Gravity High* (John C. Green, convener)

3. *Archean Sedimentation* (Richard W. Ojakangas, convener)

4. *Middle Ordovician of the Upper Mississippi Valley* (Robert Sloan, convener)

ANNUAL BUSINESS MEETINGS

The business meeting of the North-Central Section of GSA will be held following the annual banquet on Thursday evening at the Normandy Inn.

The business meeting of the North-Central Section of the Paleontological Society will follow a noon luncheon on Thursday at the Normandy Inn.

WELCOMING PARTY

A cash-bar social event will be held in conjunction with the Lake Superior Institute at poolside at the Radisson Hotel from 1800 to 2200 hours on Wednesday evening, May 9. The Radisson is located three short blocks from the Normandy Inn.

REGISTRATION

Preregistration: To qualify for preregistration fees, your registration form must be received **no later than Tuesday, April 10, 1979**. Please complete the accompanying registration form and return it with check or money order made payable to University of Minnesota. Mail same to:

George Rapp
College of Letters and Science
University of Minnesota, Duluth
Duluth, MN 55812

On-Site Registration: Name badges, banquet and luncheon tickets, and other materials should be called for on arrival. The registration desk will be located at the welcoming party (Radisson Hotel) on Wednesday evening and on the ground floor, just inside the main entrance, of the Normandy Inn at 0730 hours on Thursday and Friday.

MEALS

Special meals are planned by the sponsoring organizations as indicated above. Tickets for these meals should be ordered in advance on the accompanying registration form. Otherwise, meals are readily obtainable at the Inn and at numerous eating facilities in the downtown area.

REMITTANCE OF FEES AND REFUND POLICY

All fees are due in advance in U.S. funds by check or money order payable to the University of Minnesota and should accompany the registration form. Refunds for all but field trip fees will be made if notification of cancellation is received by April 24, 1979. Send cancellation to:

George Rapp
College of Letters and Science
University of Minnesota, Duluth
Duluth, MN 55812

Field trip fees will be refunded only if space can be resold.

SPOUSE AND GUEST ACTIVITIES

Although no organized tours will be planned, the following may be of interest to those seeking cultural and entertaining features in the Duluth metropolitan area:

"Three Sisters" (a Chekhov drama), featured at the Duluth Playhouse; opens May 11.

"Opera Workshop Scenes," featured at UMD Experimental Theater; opens May 11.

UMD Art Gallery.

Lake Superior Museum of Transportation and Industry.

Marine Museum and aerial lift-bridge at Canal Park.

Numerous other activities will also be available.

SPECIAL EVENTS

Joint annual banquet, North-Central Section of GSA and Institute of Lake Superior Geology, Vincent McKelvey, USGS, speaker, "Scientists and Society," Main Banquet Room, Normandy Inn, Thursday, 1900 hours. Cash-bar social hour, 1730 to 1900 hours, before banquet. Paleontological Society luncheon, followed by business meeting, Thursday, 1200 hours, Normandy Inn.

STUDENT AWARDS

The Geological Society of America will award \$50 to each of the two best papers prepared and delivered by GSA Student Associates. The Paleontological Society will award a certificate for the best paleontological paper by a student.

FIELD TRIPS

All field trip registrants must also pre-register for the meeting. Preregistration deadline is April 10, 1979. Further particulars on each trip follow.

1. **Middle Precambrian, Volcanic, and Plutonic Rocks of Northern Wisconsin.** Tuesday and Wednesday, May 8-9. Limit:

PREREGISTRATION DEADLINE, APRIL 10, 1979

42. Leaders: Gene LaBerge and Michael Mudrey, Jr. Cost: \$50 per person, includes transportation, guidebook, lodging Tuesday night, Tuesday dinner, two box lunches. Trip leaves at 0800 hours, Tuesday, May 8, in front of Radisson Hotel. *Participants will receive further information by mail.*

2. Stratigraphy, Structure, and Mineral Resources of East Central Minnesota. Wednesday, May 9. Limit: 44. Leaders: G. B. Morey, D. M. Davidson. Cost: \$18 per person, includes transportation, guidebook, box lunch. Trip leaves at 0800 hours, May 9, in front of Radisson Hotel.

3. Quaternary Geology of the Duluth Area. Saturday, May 12. Limit: 39. Leader: C. L. Matsch. Cost: \$17 per person, includes transportation, guidebook, box lunch. The trip will survey the history of glaciation and post-glacial events of the head of Lake Superior and consider their impact on urban development. Trip leaves at 0800 hours, Saturday, May 12, in front of the Normandy Inn.

4. Geology of the Mesabi Iron Range. Saturday, May 12. Limit: 44. Leaders: R. W. Marsden, Wayne Plummer. Cost: \$15 per person, includes transportation, box lunch. This trip includes a visit to a taconite pit and plant. Trip leaves at 0800 hours, May 12, in front of the Normandy Inn.

5. Geologic History and Engineering

Geology of the Western Lake Superior Region. Saturday, May 12. Limit: 44. Leaders: J. T. Mengel, D. F. Parr, P. C. Tychsen. Cost: \$10 per person, includes transportation, guidebook, box lunch. The trip will survey Precambrian to Pleistocene history of the head of the lakes including engineering problems connected with the red clays. Trip leaves at 0830 hours, Saturday, May 12, in front of the Normandy Inn.

6. Cambrian and Ordovician Stratigraphy and Paleontology of Southeastern Minnesota. Wednesday, May 9. Limit: 37. Leaders: David G. Darby, Gerald F. Webers. Cost: \$30 per person, includes transportation, guidebook, box lunch. The trip will begin in the Minneapolis-St. Paul area at 0800 hours and end in Duluth. Pick-up stops will be at the Minneapolis Airport where parking is available and at a downtown site. Participants may continue with the bus to Duluth or be returned to pick-up point. *Participants will receive specific information by mail.* The trip begins at the shoreline contact with Precambrian basalts and continues southward to the offshore shelf deposits.

7. Keweenaw (Upper Precambrian) North Shore Volcanic Group. Saturday, May 12. Limit: 37. Leader: John C. Green. Cost: \$20 per person, includes transportation, box lunch. Trip leaves at

0800 hours, Saturday, May 12, in front of the Normandy Inn.

8. Archean Volcanism and Sedimentation of the Western Vermilion District. Saturday, May 12. Limit: 39. Leaders: Richard Ojakangas, David Southwick. Cost: \$20 per person, includes transportation, guidebook, box lunch. Trip leaves at 0800 hours, Saturday, May 12, in front of the Normandy Inn.

PARKING AND TRANSPORTATION

Free parking is available for house guests at the Normandy Inn, Radisson Hotel, Hotel Duluth, and the Holiday Inn. Public parking ramps are available on nearby streets. Students staying on the University of Wisconsin Campus in Superior will need to provide their own transportation to Duluth (4 miles).

TRAVEL

Duluth may be reached by auto via I-35 from the south and west and by highways 53 and 2 from the east and southeast. Air transportation is available (North Central Airlines) to Duluth International Airport, located four miles from the Normandy Inn. Limousine and taxi services are available to and from the airport. Duluth is also served by Greyhound Bus Lines and Amtrak rail service to Minneapolis and St. Paul.

HOUSING INFORMATION

Please make your own housing reservations as soon as possible!

A complete listing of hotels and motels in Duluth is available from:

Duluth Convention and Visitors' Bureau
Pioneer Hall, 325 Harbor Drive
Duluth, MN 55802
Phone (218) 722-5503

Normandy Inn: Will serve as convention center. *When making reservations here, please indicate your GSA affiliation and do so preferably by April 23.* Single: \$30.50, double: \$34.50. Address: 209 West Superior Street, Duluth, MN 55802. Phone: (218) 722-1202.

University Dormitory (for students only): University of Wisconsin, Superior, located 4 miles over Interstate High Bridge from convention center. Seventy beds available in 35 rooms (4th floor) for men and 25 beds available (3rd floor) for women. Cost: \$4 per bed if student provides own sleeping bag and towel; otherwise, \$5 per bed with linen provided. Ross Hall, University Campus. All reservations should be made with the University by April 23. Address requests to:

Paul C. Tychsen
Department of Geosciences
University of Wisconsin-Superior
Superior, WI 54880
Phone: (715) 392-8101, ext. 261

(preregistration form on following page)

PREREGISTRATION FORM

**13th Annual Meeting of the North-Central Section
of the Geological Society of America
meeting concurrently with
The Institute of Lake Superior Geology
May 10-11, 1979, Duluth, Minnesota**

(for office use only)

ck/m.o. no. _____ \$ _____	
Personal Check <input type="checkbox"/>	Other Check <input type="checkbox"/>
Issued by _____	

Name: (last, first, middle) _____

Registered as: Professional Student Spouse/Guest

Spouse/Guest name for badge _____

Affiliation: (abbreviate for badge) _____

Professional Address: _____

City, State, Zip _____

Phone (business) () _____ (home) () _____

GSA Member: Yes No Speaker: Yes No

GSA Student Associate: Yes No PS Member: Yes No

Enclosed is a check or money order (U.S. funds) payable to: The University of Minnesota in the amount of \$ _____ for:

- _____ Preregistration (before April 10) at \$20 per person
- _____ Registration (after April 10) at \$22 per person
- _____ Student preregistration* (before April 10) at \$9 per person
- _____ Student registration* (after April 10) at \$11 per person
- _____ Guest/Spouse registration at \$5 per person
- _____ Joint GSA/LSI banquet (Normandy Inn), May 10, at \$9 per person
- _____ Paleontological Society luncheon (Normandy Inn), May 10, at \$6 per person

ALL FIELD TRIP REGISTRANTS MUST ALSO PREREGISTER FOR THE GENERAL MEETING

- _____ Field Trip 1, Middle Precambrian, Volcanic, and Plutonic Rocks of Northern Wisconsin at \$50 per person.
- _____ Field Trip 2, Stratigraphy, Structure, and Mineral Resources of East Central Minnesota at \$18 per person.
- _____ Field Trip 3, Quaternary Geology of the Duluth Area at \$17 per person.
- _____ Field Trip 4, Geology of the Mesabi Iron Range at \$15 per person.
- _____ Field Trip 5, Geologic History and Engineering Geology of the Western Lake Superior Region at \$10 per person.
- _____ Field Trip 6, Cambrian and Ordovician Stratigraphy and Paleontology of Southeastern Minnesota at \$30 per person.
- _____ Field Trip 7, Keweenaw (Upper Precambrian) North Shore Volcanic Group at \$20 per person.
- _____ Field Trip 8, Archean Volcanism and Sedimentation of the Western Vermilion District at \$20 per person.

***Valid ID will be required at on-site registration**

MAIL FOR DELIVERY BY TUESDAY, APRIL 10, 1979, to:

**George Rapp
College of Letters and Science
University of Minnesota, Duluth
Duluth, MN, 55812**

To register more than one person, please duplicate or request additional forms.

BEFORE MAILING THIS FORM, PLEASE COPY THE REVERSE SIDE. IT CONTAINS IMPORTANT INFORMATION.

PUBLICATIONS

Articles in *Bulletin, Part II* February 1979

Articles in *Bulletin, Part II* are listed below. (Summaries only of these articles are in *Bulletin, Part I*.) Neither summaries in *Part I* nor articles in *Part II* are on the separate subscription.

Paper copies of *Part II* in its entirety will be made at cost (\$6/month) as a special service to those users (members and nonmember subscribers) who request them. Any such order should be accompanied by advance payment, and no discount can be offered for multiple orders or orders for a sequence of months.

1. Drainage evolution and fish dispersal in the central Appalachians, by Charles H. Hocutt. Doc. no. M90201 (On microfiche: 38 p., 8 figs.)
2. Deep-sea tephra from the Azores during the past 300,000 years: Eruptive cloud height and ash volume estimates, by T. C. Huang, N. D. Watkins, and L. Wilson. Doc. no. M90202 (On microfiche: 54 p., 15 figs., 3 tables.)
3. Makgadikgadi Pans Complex of central Botswana, by Thomas A. Baillieul. Doc. no. M90203 (On microfiche: 24 p., 9 figs., 2 tables.)
4. Ophiolite complexes on Small Nggela Island, Solomon Islands, by G. Neef and I. R. Plimer. Doc. no. M90204 (On microfiche: 36 p., 6 figs., 4 tables.)
5. Igneous origin of the orbicular rocks of the Sandia Mountains, New Mexico, by Robert D. Enz, Albert M. Kudo, and Douglas G. Brookins. Doc. no. M90205 (On microfiche: 32 p., 14 figs., 1 table.)
6. Lower Permian of the central Cordilleran Miogeosyncline, by Calvin H. Stevens. Doc. no. M90206 (On microfiche: 75 p., 25 figs.)
7. Cenozoic volcanism of the Candelaria region, Nevada, by R. C. Speed and Allen H. Cogbill. Doc. no. M90207 (On microfiche: 38 p., 3 figs., 2 tables.)
8. Deep fault trough of Oligocene age, Candelaria Hills, Nevada, by R. C. Speed and Allen H. Cogbill. Doc. no. M90208 (On microfiche: 34 p., 7 figs., 1 table.)

In February *Geology*

(separates not available)

Late Cenozoic tectonic evolution of the western United States, by R. F. Livaccari

Extent and disposition of Grenville tectonism in the Precambrian continental crust adjacent to the North Atlantic, by M. D. Max

Recent thrust faulting in southeastern Connecticut, by J. W. Block, R. C. Clement, L. R. Lew, and J. de Boer

Lower Cretaceous peritidal limestones at 2,700-m depth, Blake nose, Atlantic Ocean, by P. Enos and T. Freeman

Use of semiquantitative microfossil data for paleoceanography, by C. Sancetta

Global magmatic episodes: New evidence and implications for the steady-state mid-oceanic ridge, by P. R. Vogt

Albert Heim's general theory of natural rock deformation (1878), by A. G. Milnes

Migration of Assateague Island, Maryland, by inlet and overwash processes, by S. P. Leatherman

Use of water quality file WATSTORE in geothermal exploration: An example from the Imperial Valley, California, by C. A. Swanberg and S. Alexander

Penrose Conference Report: Modern and fossil dinoflagellates, by W. R. Evitt, K. A. Steidinger, and L. E. Stover

Watch for . . .

Treatise on Invertebrate Paleontology, Part T: *Echinodermata 2* (Crinoidea), in 3 volumes.

Memoir 152, *Cenozoic Tectonics and Regional Geophysics of the Western Cordillera*, edited by Robert B. Smith and Gordon P. Eaton.

MAP AND CHART SERIES

MC-23. *Paleoenvironmental Maps of Pennsylvanian Rocks, Illinois Basin and Northern Midcontinent Region*, by H. L. Wanless and C. R. Wright.

MC-24. *A Reconnaissance Geologic Map of the West-Central Part of the State of Nayarit, Mexico*, by Gordon Gastil and Daniel Krummenacher.

MC-25. *Geophysical Atlas of East and Southeast Asian Seas*, compiled under the direction of Dennis E. Hayes.

MC-26. *Bathymetry of the Southeast Pacific*, by J. Mamerickx and S. M. Smith.

MC-27. *Gravity Field of the Northwest Pacific Ocean Basin and Its Margin: Kuril Island Arc-Trench System*, compiled by Anthony B. Watts, M. G. Kogan, and J. H. Bodine.

Contributions from Plate Margins Working Group, U.S. Geodynamics Committee, John C. Maxwell, Coordinator:

MC-28A. *Cross Section, Alaska Peninsula-Kodiak Island-Aleutian Trench*, by R. von Huene, J. C. Moore, and G. W. Moore.

MC-28B. *Cross Section of Southern Park of Northern Coast Ranges and Sacramento Valley, California*, by John Suppe.

FEBRUARY BULLETIN SEPARATES

Titles and abstracts of conventional articles in the February 1979 GSA Bulletin, Part I are provided on the following pages to aid members who have purchased the separates option to select Bulletin, Part I separates of their choice. See instructions for ordering on page 31.

- 90209—Candelaria and other left-oblique slip faults of the Candelaria region, Nevada.

R. C. Speed, Allen H. Cogbill, Department of Geological Sciences, Northwestern University, Evanston, Illinois 60201. (15 p., 6 figs.)

The region comprising the Candelaria Hills and Excelsior Mountains, Nevada, is structurally anomalous with respect to surrounding tracts of the Basin and Range province. Its major faults strike east, and some, if not all of them, have undergone significant left slip. Ratios of lateral to vertical displacement components on strands of such faults vary from 2 to 6.5. The region of left-oblique slip faulting seems to constitute the intermediate leg of a gigantic Z pattern of Basin and Range faults.

One of these faults, the Candelaria fault system, has been studied closely in pursuit of kinematic details that might characterize the regional faulting. The Candelaria system consists of three en echelon faults of 5 to 10 km trace length joined by connector zones that possess compressional features. The amount of lateral slip transferred from one en echelon fault to another is uncertain; analysis of a complex of faults in one connector zone indicates at least some degree of integrated motion. The same connector zone is the site of a bulge that has an uplift estimated to have been 275 m since 2.8 m.y. B.P. On the basis of fault-plane striae, the extension direction is $\sim N82^\circ W$. We propose that the Candelaria fault system and a major asymmetric trough in its northern wall were created in Oligocene time by a regional left-lateral shear system oriented in the extension direction. The connector zones may be kinematic impediments which, at shallow levels at least, have prevented the system from maturing into a single plane fault. The existence of the bulge and the estimated rate of slip on part of the Candelaria fault system suggest that the system is still active.

- 90210—Topology of ridge patterns: Randomness and constraints.

David M. Mark, Department of Geography, Simon Fraser University, Burnaby, British Columbia, Canada V5A 1S6 (present address: Department of Geography, University of British Columbia, Vancouver, British Columbia, Canada V6T 1W5). (9 p., 8 figs., 1 tbl.)

A simple model, in which ridge networks are simulated by forming minimum spanning trees of sets of N points (representing peaks), distributed randomly within an ellipse, provides good predictions for ridge topological class frequencies involving six peaks. When goodness-of-fit (measured by chi-square) is plotted against the elongation ratio of the ellipse, the shape of the plot indicates the degree of ridge anisotropy present within the topography. In areas of hetero-

geneous geology but without overt structural control, the curve shows approximately equal fit for all elongations between a circle and a 2:1 ellipse; beyond this point the fit rapidly becomes very poor. In contrast, areas of flat-lying, homogeneous geology show curves that decline noticeably as one goes from the circle to an optimum fit at an elongation of about 0.5. This indicates a significant within-network ridge anisotropy in these landscapes, which is attributed to local topographic control imposed by the major tributaries of master streams. The model also fits areas with overt structural control (ridge-and-valley topography), but with an optimum elongation ratio of about 0.1. The ridge model fits networks having from four to seven peaks, but the shapes of the goodness-of-fit plots indicate that degree of anisotropy varies with magnitude in some landscapes; this is a scale effect. It is difficult to relate the ridge topology research presented in this study to previous stream topology work; reasons for this difficulty are discussed.

- 90211—Fossil ice-wedge polygons in the Colorado Front Range: Origin and significance.

J. B. Benedict, Department of Anthropology, Colorado State University, Fort Collins, Colorado 80521. (8 p., 8 figs.)

Polygonal patterned ground in a tundra valley near Sawtooth Peak, Boulder County, Colorado, is unique in the Front Range because of its large size and its resemblance to fossil ice-wedge polygons. The polygons occur in a terminal moraine of latest Pinedale age (about 15,000 to 10,000 B.P.), at an altitude of 3,390 m. They range from 10 to 25 m in diameter and are outlined by shallow, vegetated troughs that show no surface indication of sorting. The polygonal ground pattern is attributed to thermal contraction cracking and ice-wedge formation during a late Pinedale or early Holocene cold interval in which permafrost existed at least 350 m below its present lower altitudinal limit. Frost-sorted rubble accumulated in troughs above the melting ice wedges; evidence of sorting, however, is concealed by humus-rich loessal or slope-wash sediments that bury the stones and fill interstices between them to form wedges of silty material as deep as 1.0 m. Organic matter in the humus-rich silt is believed to have eroded from an Altithermal A1 horizon during early Neoglaciation; radiocarbon dates of 5750 ± 110 and 5765 ± 110 B.P. apply to formation of the Altithermal soil and are maximum ages for its erosion and redeposition, but they have no bearing on the time of patterned ground formation. Stones in the polygon borders have experienced no important frost sorting since the close of the Triple Lakes stage of Neoglaciation, which ended prior to 2855 ± 90 B.P. in the Sawtooth valley.

- 90212—Mid-Cenozoic volcano-tectonic troughs in central Nevada.

Dennis B. Burke, Edwin H. McKee, U.S. Geological Survey, Menlo Park, California 94025. (4 p., 2 figs.)

Two large east-west-elongate, fault-bounded troughs were sites of intense rhyolitic to andesitic volcanism and coeval

faulting in the central part of the Great Basin during Oligocene and early Miocene time. The orientation and age of these volcano-tectonic features fit within a regional pattern of south-southwest migration of calc-alkalic volcanism that lasted from 42 to 18 m.y. ago. The troughs and many smaller calderas predate crustal extension from Basin and Range faulting, which began subsequent to the migration of calc-alkalic activity in middle Miocene time.

- 90213—Magnetic and chemical variations of Mesozoic diabase dikes from eastern North America: Evidence for a hotspot in the Carolinas?

Jelle de Boer, Frederic G. Snider, Department of Earth & Environmental Sciences, Wesleyan University, Middletown, Connecticut 06457. (14 p., 10 figs., 2 tbls.)

Tholeiitic diabase dikes of Late Triassic and Early Jurassic age occur in swarms throughout the Appalachians. The intrusions exhibit regional variations in magnetic and chemical parameters. Aeromagnetic and ground-magnetic anomalies are highest over dikes in the Carolinas. High amplitude is due primarily to a stronger magnetization (the induced component dominates and is nearly constant within individual intrusions). Effects of host-rock magnetization, thermoremanence, and dike width, attitude, and orientation are insignificant. Chemically the Carolinas dikes are characterized by higher mean values for total iron and relatively low TiO_2 content. The magnetic and chemical patterns are reminiscent of those found for tholeiitic complexes over oceanic hotspots (Galapagos, Iceland), and suggest that the Carolinas may have been the site of such a feature in Late Triassic–Early Jurassic time. Crustal arching, rifting, and volcanism probably originated in the Carolinas. Tectonic-volcanic activity gradually migrated northeast (and possibly southwest) along the Appalachian axis with enlargement of the crustal bulge. In Jurassic time, spreading began farther east; the crustal stress configuration changed, and the tectonic pattern was dominated by the formation of new sets of tensional fractures and sinistral strike slip along pre-existing faults.

- 90214—Gravity interpretation of the Egersund anorthosite complex, Norway: Its petrological and geothermal significance

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The Egersund anorthosite complex consists of several bodies of anorthosite and a large syncline of layered norite and anorthosite with granitic rocks in the core. This igneous complex is emplaced in granulite-facies gneisses. These gneisses have a mean density of 2.70 g/cm^3 , indicative of granitic rocks. A Bouguer gravity anomaly map shows no distinctive gravity anomaly over anorthosite, but a sharp 25-mgal positive anomaly is present over the norite syncline. Gravity models indicate that the norite syncline is about 4 km thick and that relatively minor amounts of granitic gneiss are present in the core of the syncline. Anorthosite masses cannot be modeled directly but can be inferred to have a thickness of at least 4 km. Relative amounts of the rock types in the anorthosite complex are anorthosite, 70%; norite, 25%; and granitic rocks, 5%. No evidence is found for a dense mafic residuum that would be formed if the anorthosite differentiated from a basaltic magma in place. If the rocks of the complex are cogenetic, the parent magma would be noritic anorthosite, and the volume of granitic rocks is so small that it would not change the presumed composition of the parent magma appreciably. Heat flow through the anorthosite is so low (0.45 HFU) that mantle heat flow in this area can hardly be greater than 0.2 to 0.3 HFU. Granulitic gneisses or other rocks produced at low heat must compose the entire crust beneath the anorthosite complex.

- 90215—Evolution of a barrier island, Shackleford Banks, Carteret County, North Carolina.

Kenneth R. Susman, S. Duncan Heron, Jr., Department of Geology, Duke University, Durham, North Carolina 27708 (present address, Susman: 209 Pollack St., Beaufort, North Carolina 28516). (11 p., 4 figs., 3 tbls.)

Split-spoon core samples from 14 bore holes on Shackleford Banks, Carteret County, North Carolina, revealed three lithologically distinct units above an erosional surface on upper Tertiary fine-grained sands. Two Pleistocene units are recognized. The lower unit, consisting of silty, highly fossiliferous sand, was deposited in a nearshore open marine environment during a late Sangamon transgression of the sea that advanced at least 32 km inland from the present coastline. This unit was informally named the Core Creek sand by Mixon and Pilkey. Overlying the Core Creek sand is a silty, sandy gray clay herein named the Diamond City Clay. It contains a fauna indicative of a back-barrier environment.

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Shells and salt-marsh peat from the Diamond City Clay were radiometrically dated between 24,000 and 30,000 B.P., indicating that the unit was deposited during a mid-Wisconsin high stand of sea level. It is speculated that a barrier at that time stood just offshore of the present-day Shackleford Banks. The Pleistocene surface was subsequently sub-aerially exposed, and a freshwater peat was deposited in one local depression.

The Outer Banks sand of Holocene age is the uppermost unit of the island. In this sand body ten sedimentary environments, of which barrier inlets were dominant, were recognized. At least one inlet was formed in the recent past on the eastern end of the island and then migrated to the present location of Beaufort Inlet—all while Shackleford Banks remained in its same relative position. The migrating inlet eroded all previous Holocene sediments and truncated the underlying Diamond City Clay.

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- 90216—Differentiation of surficial glacial drift in southeastern Michigan from 7-Å/10-Å X-ray diffraction ratios of clays.

Richard L. Rieck, Department of Geography and Department of Geology, Western Illinois University, Macomb, Illinois 61455; Harold A. Winters, Department of Geography, Michigan State University, East Lansing, Michigan 48824; Delbert L. Mokma, Max M. Mortland, Department of Crop and Soil Sciences, Michigan State University, East Lansing, Michigan 48824. (5 p., 5 figs.)

Woodfordian till deposited by the juxtaposed Saginaw and Huron-Erie glacial lobes in southeastern Michigan appears similar in many respects but may be differentiated on the basis of certain mineralogical characteristics of clay-sized particles. This is apparent from X-ray diffractograms of basally oriented, magnesium-saturated, and glycerol-solvated specimens. Thirty-five till samples from the converging Kalamazoo (Saginaw lobe) and Mississinewa (Huron-Erie lobe) moraines and their interlobate tract have 7-Å/10-Å peak height ratios that differ significantly according to provenance. Every sample from locations within and proximal to the Kalamazoo moraine has a ratio of 0.91 or more. All but one of the samples from the Mississinewa moraine and areas to the east have ratios less than 0.91. Data from several other sources indicate that the same relationships also exist on a larger scale in southeastern Michigan. The findings are consistent with previous interpretations of the area's geology and may provide a reliable basis for the placement of the surficial boundary between drifts deposited in a complex interlobate area.

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- 90217—Holocene faulting in the western Grand Canyon, Arizona: Discussion and reply. (4 p.)

Discussion: *R. Ernest Anderson, U.S. Geological Survey, Federal Center, Denver, Colorado 80225.*

Reply: *Peter W. Huntoon, Department of Geology, University of Wyoming, Laramie, Wyoming 82071.*



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