
CMS News

A Publication of The Clay Minerals Society

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Fall 1996

Gatlinburg: mountains, bears, and clay

One thing I have come to appreciate about the Clay Minerals Society meetings is that they are always surprisingly enjoyable because, like good real estate, they have location, location, location! This year's meeting in Gatlinburg, Tennessee, attended by over 300 people, was outstanding for a multitude of reasons, not the least of which was having the opportunity to chat with a real bear outside during a coffee break! Also, for those of us from desert climes, problems with the functioning of the air conditioning in the meeting rooms enabled unexpected enjoyment of high humidity. Lack of air conditioning added an extra element of relaxation to the meeting's atmos-

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Dave Pevear

Student travel grants for Ottawa

Thanks to a gift from an anonymous donor, \$1000 in travel grant money will be available for students submitting abstracts to the 11th International Clay Conference, a joint meeting between CMS and AIPEA. To apply for one of these \$200 grants, please contact the CMS Office.

CMS and MSA members have reciprocal privileges

The CMS and MSA have entered into an agreement whereby members of each society can buy books from the other society at member prices. In the past, the CMS has not distinguished between members and non-

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Attention faculty advisors

If you have had a student in mineralogy (clay mineralogy or some other subdiscipline) at the post graduate level who is now involved in primary or secondary school education, please send his/her name and current address to either Jo Eberl or Steve Guggenheim. CMS would like to develop teaching materials in mineralogy for primary and secondary school teachers, and we would like to ask for advice and help in preparing these materials. See the President's letter in this issue for additional information.

Student Research Grant

Deadline is April 1, 1997, one month earlier than last year. Applications are available from the CMS Office.

Volume 8 arrives

The long-awaited Volume 8 of the CMS Workshop Lectures, *Organic Pollutants in the Environment*, has been published. Edited by Brij L. Sawhney, it contains the following chapters: "Sorptions of Organic Compounds on Clay Minerals: A Surface Functional Group Approach," by C. T. Johnston; "Sorptions and Desorp-

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The Clay Minerals Society



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The newsletter is distributed to all CMS members. Membership rates (1996) are as follows: full membership, including a subscription to *Clays and Clay Minerals*, \$60.00/year; student membership, \$15.00/year; nonsubscribing membership, \$30.00/year. Institutional subscriptions to *Clays and Clay Minerals*: \$185.00/yr (\$200.00 overseas) for the year 1997. Please contact the Society Office for information regarding new membership, and Allen Press (913-843-1221) for questions concerning current membership.

CMS News welcomes advertising. Inquire about rates to the Society Office. Articles and other contributions submitted to *CMS News* are subject to editing and are published on a space available basis. All opinions expressed herein are the opinions of individual contributors, and not of The Clay Minerals Society.

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Letters

Important Notice to the Members of CMS

The 34th Annual Meeting of the Clay Minerals Society for 1997 will join the 11th International Clay Conference which will be held on the campus of Carleton University in Ottawa, Canada, from June 15 to 21, 1997. At the Conference, except for the annual assembly for the Clay Minerals Society, there will be no separate technical sessions for the Society. The Society, however, will contribute to the International Conference with such events as the Brindley Lecture, the Pioneer in Clay Science Lecture, the Jackson Lecture, the Distinguished Member Award, and a pre-conference workshop. Please note these modifications in the 34th Annual Meeting from ordinary annual meetings.

Ottawa is not new to the Society. Some members may remember that in 1962, thirty-four years ago, Ottawa hosted the 11th National Conference on Clays and Clay Minerals which was a predecessor of the present CMS meetings.

Detailed descriptions regarding the 1997 International Clay Conference are given in the second circular that has been distributed to all CMS members. All CMS members are warmly invited to attend the International Clay Conference in Ottawa as well as the 1997 annual assembly of the CMS. We, the Local Organizing Committee, are looking forward to seeing all of you in Ottawa.

The 11th International Clay Conference Organizing Committee

Senior clay mineralogist position available

My client is a subsidiary of a midwestern-based, profitable, publicly held corporation. A doctorate degree is essential for the position. We are somewhat flexible with regard to the specific discipline, and will consider igneous geology, petrology, or geochemistry, but prefer clay mineralogy/geology. Our ideal candidate will possess a keen scientific understanding of clays and other common industrial minerals; familiarity with bentonite geology is desirable, but not an absolute necessity. Well-developed applied skills (both field and lab) will be demonstrated by our candidate's ability to conduct/execute appropriate chemical and mineralogical characterization of a bentonite for company usage, and field-scale mapping and characterization to delineate deposits. Our choice will also possess interpersonal and communication skills which will engender trusting, productive relationships throughout the myriad personal interactions that will occur.

For more information, please contact John Imber at Corporate Centre, Suite 129, 3601 Algonquin Rd., Rolling Meadows, IL 60008-3104 USA, or 847-506-1700 (phone) or rebmi@aol.com (e-mail).

John Imber

This newsletter printed on recycled paper.

Thanks...

To the following people who contributed to this issue:

Scott Argast
Adrian Beserra
Dave Bish
Alex Blum
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Dennis Eberl
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Walter Keller
Echo Kodama
Robert Marquez
Howard May
Bill Moll
Kathy Nagy
Jeanne Percival
Dave Pevar
Rich Pollastro
Don Scafe

Letter from the President

It is Fall now in the Midwest, which means that one day feels like summer and the next day feels like winter. It's the latter right now, so I am indoors with still many outdoor things to do around the house before winter *really* comes. With a little time on hand, I decided to review some of the ongoing projects in the Society and to outline directions that I believe we should be taking in the future. Our Society continues to operate smoothly under our able manager, Jo Eberl. Furthermore, there appears to be no imminent crisis looming over the budget or journal, so we should be concerned now over the longer term.

The Executive Committee has completed the criteria for awarding the Marilyn and Sturges Bailey Award, which now must be voted on by Council. As you probably know, Bull Bailey was prepared to endow an award to the Society at the time he died, with the award modeled along similar lines to the Roebling Medal of the Mineralogical Society of America. Thus, the award was to be for excellence in research in clay mineralogy, and it is not limited to members of the Society. Fortunately, Bailey's family has agreed to the endowment. We will start making the award at the 1998 annual meeting in Cleveland. We will need to make some By-law changes, since the Distinguished Member Award, which is part of the By-laws, will become the Bailey Award.

Speaking of the By-laws, we try to keep the By-laws up-to-date with the way that we do business. Last year, Council recognized that the President appoints *ad-hoc* committees each year, although these committees are hardly *ad-hoc* in the sense that they are short term. For example, the Nomenclature Committee has been an *ad-hoc* committee for nearly 35 years! The Executive Committee is finalizing by-law changes to make

standing committees for Continuing Education, Research Grants, Nomenclature, and Source Clays. These changes will be voted on by Council.

One of the most endearing qualities of the Society is the small annual meetings where we can meet each other as friends, and where we all know and care about each other. I wouldn't want to change the nature of these meetings. However, by meeting at a select hotel each year without interacting with other societies, we run the risk of isolation. Occasionally, we do meet jointly with other societies, as with AIPEA in Ottawa this June or perhaps with the Denver X-ray Conference in the year 2000. However, we must be careful not to miss opportunities to avoid isolation. We have already started to interact more effectively with our sister organizations, for example, by joining the American Geological Institute (an organization of about 25 U. S. societies meeting to discuss common goals, both political and otherwise), by becoming a more effective participant in AIPEA by joining AIPEA as a Society rather than as individuals, and by starting a program where we invite a program director from a funding agency to talk with our U. S. membership at the annual meeting. I believe there are several ways that we can outreach, beyond what we have been doing.

I would like to see the CMS sponsor symposia on clay mineralogy at other meetings. We recently sponsored an environmental mineralogy symposium with the Mineralogical Society at the GSA Annual Meeting in Denver in October. Although we have done this before with the MSA, we have not tried similar symposia with, for example, the Materials Research Society or the American Chemical Society.

The Policy and Administration Committee is currently working on a mission statement for a Kindergarten

to 12th grade (K-12) program. Once this program is in place, we should seek the help of K-12 teachers to aid in the development of teaching materials in clay mineralogy, mineralogy, soils, crystallography, and so on, appropriate for these grades and science curricula. There are many former students who worked on clay mineralogy projects as undergraduates and as theses for Masters and Ph.D. who are now teaching in primary and secondary schools. I suspect that these former students (even former Society members) would be interested in becoming members of CMS, if the Society broadens its scope to include K-12 teaching, perhaps even establishing K-12 education as a "special interest" group. Not only would we tap a new source of Society membership, but also we can enhance K-12 teaching by providing useful laboratory and teaching aids. In addition, there are others already in our Society interested in science education (at any level). I hope that CMS members interested in developing a K-12 program will get involved. If you know of former students teaching at the K-12 level who you think may be interested in working with us, please send their names and addresses to me. I will write a personal letter to each of them to see if we can attract their interest.

I recently attended an American Geological Institute (AGI) Council meeting, where I learned that AGI has started an Environmental Awareness Publication Series. This series of booklets is intended for the non-scientist, and publications will be distributed to municipalities and elsewhere through AGI and its member societies. I have asked the Continuing Education Committee and Blair Jones, our liaison to AGI, to develop a proposal for AGI to include a "Clays and the Environment" primer. Such a primer would be useful to in-

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Interviews with the clay scientists

William F. Moll, Jr.

Bill Moll is a Vice President-R&D at Oil-Dri Corporation of America and a past President and Secretary of The Clay Minerals Society. He was also instrumental in the founding of the Source Clays Repository. The interview took place in March, 1995, at a USGS Lab in Boulder, Colorado, and was conducted by Dennis Eberl, Howard May, Alex Blum, and Jo Eberl.

CMS: I wanted to ask you about your work in industry, about being a Brindley student, about the foundations of your science, and, most important, about cat litter.

MOLL: Although I grew up in Florida, we lived for a time in Atlanta because the Depression was a little less severe there. I was fascinated with all the rocks I saw. I particularly liked to play in the red clay, much to mother's dismay. So, perhaps from the very beginning, I liked clay. I got a degree in chemistry from the University of Florida back in the '50's, and I realized that I was really more interested in being outside than being inside a laboratory. I thought if I had a degree in geology, I would spend the rest of my life outside. I got a degree in geology, and I've spent my entire life inside a laboratory.

CMS: The way things go, for every week in the field, you spend a year in the lab these days.

MOLL: That's right. After I came from the Army, I went to Indiana University, and met with Haydn Murray. I knew nothing about clay minerals at first, but one thing that I found interesting was the way clay minerals could interact with organic compounds. You could even have a crystal that was part absolutely organic and part absolutely inorganic. In the end, I did a thesis with Carl Beck on pinholing the glaze. We found the reason the glaze periodically pinholed was that the formulator got drunk and put in too much flux. Anyway, I got a Masters degree and went to Washington University with Bill Johns. We



Jo Eberl

worked on organo-clay reactions, and I got a degree from Johns. Jobs were tight, so he suggested I do a post doc. I asked who I should write, and he said I should write everybody that's famous.

CMS: Hey, I didn't get a letter.

MOLL: Well, you were young then; this was back in '63. So I wrote Brindley. His reputation was so imposing that I walked around the block twice before I had the courage to put the letter in the box. He was interested in the kind of work I was doing, so off I went to Penn State, and I spent two years there. It was a fascinating time in my life, and I learned a couple of things. I learned that Brindley was a very nice person despite

his austere appearance, and I learned a lot about how you think in science. Brindley had taught English in secondary school in England, so he was very, very good at scientific writing. He pounded that into everybody. I think one of the reasons why so many Brindley students have realized some degree of success is they know how to communicate their ideas. This is often not taught today, but Brindley was adamant about it. He would take a paper that was very good scientifically, and it would come back, all marked up with, "This is not a topic sentence of a paragraph," and so on. He had an interesting group of people there. He was a taskmaster; he expected you to work six days a week because he worked six days a week.

Brindley liked to do interesting things. My most memorable trip with him was on a wonderful railroad across the mountains in Mexico before the International Clay Conference in Mexico City in 1975. We took the train across the desert to Chihuahua and spent the night in a hotel there. The next day we went across the mountains and went by Copper Canyon. The railroad was finished in the early '60's. The area is so remote that the builders encountered Indian tribes who had never seen white men. The next day we had a horrible bus trip. The bus was very

Moll, *continued*

nice, but the air conditioning wasn't working. Apparently the driver was too proud to admit it, so he made us ride with the windows closed in the desert all the way to a city called Culikan, which had direct air service to Mexico City. Brindley did not like hot weather at all, poor guy. We almost had to be taken out on stretchers.

CMS: I just happened to meet him at the anthropology museum in Mexico City during that meeting, and went around it with him. He had such a lively interest in everything. He was reading all of the tags and commenting on everything; it was really nice to go around with him because of that.

MOLL: He had a lively interest, and his interest was deep rather than superficial. He really liked to understand things. He knew a little Japanese, and when we got to Los Mochis, there was quite a large Japanese colony there. The Japanese had come there in the early part of the century. In the hotel, the clerk was of Japanese origin, so Brindley arranged our rooms by speaking Japanese to her.

CMS: He was invited as a Grim Lecturer in Illinois when I was there, and he stayed at this sort of phony German place...

MOLL: Jumar's?

CMS: Yes. So he went up to the desk clerk and started speaking German to her, and she said, "What?" and he said it again and again, and finally I said "He's asking you where all the girls are." (He wasn't really.)

MOLL: Very interesting man indeed, and he could drive you nuts sometimes. I knew people who would just be in tears, and they would use all kinds of words to describe Brindley. But I've got to tell you, when we found out that Brindley had died, all of us shed tears because we realized, maybe later in our careers, how important he had been to all of us as a scientist. He really was a teacher; he was a teacher first and a researcher second. But there are other people, too, I think who developed schools. John Hower certainly developed a school, Haydn Murray at Indiana, Keller...

CMS: Yes, it's interesting the people who didn't—good teachers, but not a cohesive philosophical school.

CMS: Grim had a school.

CMS: There's a little Jackson school.

MOLL: Oh, sure, well, there's a big Jackson school.

CMS: So you worked with three Distinguished Members of the Clay Minerals Society: Haydn Murray, Bill Johns, and Brindley.

MOLL: I've been very lucky in my life to be associated with, from an academic point of view, Bill Johns and George Brindley, excellent scientists. From the applied clay minerals point of view, I worked with Haydn Murray and John W. Jordan. Haydn Murray is an excellent clay mineralogist who has an intuitive talent for applying a fundamental understanding of clays to solve industrial problems. Jordan shares this talent. Jordan was so far ahead of his time in the 1940's that he is unsung today. He virtually invented the field of organo-clays and developed some of the most sophisticated and successful clay-based materials, the "bentones." National Lead Company sponsored his ten-year effort at the Mellon Institute. It stands to this day as an excellent example of academic-industrial cooperation.

CMS: What are the organo-clays used for?

MOLL: Well, the organo-clays have been used in a whole host of applications, for example, controlling the viscosity of organic systems such as paints, greases, and

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oil well drilling fluids. They've found some use in foundries, and today they're getting increasing attention for removing organic materials like oils from water streams.

CMS: So essentially you're turning a hydrophillic substance like montmorillonite into a hydrophobic substance by adding organic cations.

MOLL: That's right. The organic ions are ionically held and not easily lost. They form a micelle that actually is mostly clay by weight but is surrounded by organic cations. The system thinks of it as another organic mass.

CMS: And it has the property of holding the rest of the organic mass together?

MOLL: Yes. It's a fascinating field to be in, because you

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Moll, *continued*

have a crystal that by volume is 50% organic and 50% inorganic, but you can do a crystal structure.

CMS: Where did you go after you got out of school?

MOLL: After working with Brindley, I was interested in an academic career. This was back in the mid-60's when universities were under increased pressure to develop research grants. I liked to talk, so I thought I'd like to teach. But many of the universities where I interviewed wanted me to do largely research. So I decided to work for industry where I would be hired to do research. Unlike Brindley, I didn't think I would be able to give a group of students the necessary attention and do the needed amount of research. That is how I came to work for Jordan at Baroid in Houston. I learned a great deal there. We didn't particularly like living in Houston, however, so we decided to move back up North. That's when I joined Georgia Kaolin. I worked there for 12 years.

CMS: And you spent some time in Illinois in Champaign-Urbana.

MOLL: Yes. After the owner of Georgia Kaolin died, I realized the company would start moving out of the specialty clays and ultimately be sold. I decided that I would move on, and I had become burned out on clays. I accepted a position with Cabot Corporation, a company that made fumed silica, carbon black, and other things. They had a fumed silica plant in Tuscola, Illinois. So I went out and became involved in the laboratory with fumed silica. The Cabot Corporation had some very fine theoretical rheologists. I didn't know very much about rheology, but I learned a great deal. The mineral industry does get into your blood, and after about four years working in the fumed silica area, I got a call one day from Dick Jaffee saying they were interested in setting up a research lab on attapulgite. I realized I hadn't been in a mine in years, so I took the job at Oil-Dri.

CMS: That was in Chicago?

MOLL: Yes, on the outskirts. We had a laboratory that was in a pole barn in the middle of a cornfield. A lot can be done in a laboratory in a pole barn in the middle of a cornfield.

CMS: They say Pierre Curie's lab was underneath a staircase.

CMS: Actually there are probably advantages to having a

laboratory in a pole barn in the middle of a corn field because there are a lot of people who won't come there and interrupt your train of thought.

MOLL: That's right. Very few of the salespeople would come out during the summer when the laboratory was pretty warm. But we had a lot of togetherness, as you had to have. We got a lot done, and we began to fill up a research lab. We had a small pilot plant, too. We could make 50 grams of something in a beaker in the lab and make a ton of it in the pilot plant. We could see if we really could make it on an industrial level. Slowly we grew, and we were successful enough that the company built us a new laboratory. So we moved out of the pole barn.

CMS: You showed how research can benefit a company.

MOLL: That's right. We very rapidly identified some places where the product line needed to be fixed. One problem was that we didn't know what we were mining, so we worked with Necip Güven on an analysis of the unusual minerals that we were mining down in south Georgia. We found we have a mixture of attapulgite and smectite.

One of the things we found was that our smectite-attapulgite could clarify vegetable oil. Nobody had ever been able to succeed in using attapulgite as a clarifier for vegetable oil. But we didn't know any better.

CMS: You just knew they worked for what you wanted to do with them?

MOLL: Yes. We developed a good rapport with the sales department, and we began to develop new products. I had learned earlier that you don't want to turn the salesmen off because they are the people who go out and see unusual things. One of the things we found was that our smectite-attapulgite could clarify vegetable oil. Nobody had ever been able to succeed in using attapulgite as a clarifier for vegetable oil. But we didn't know any better, so we developed a product, and we've since been trying to find out why it works.

CMS: So what do you do—have the vegetable oil flow through the attapulgite?

MOLL: Well, the traditional material is an acid-leached calcium montmorillonite, manufactured since the first World War. Vegetable oils often have a lot of chloro-

Moll, continued

phyll in them, and chlorophyll tends to help degrade the quality of the oil. Oils have various other impurities. Putting a small amount of acid-leached clay in the oil, while heating it up to about the boiling point of water and then filtering it out, will remove the chlorophyll and all the other impurities as if by magic. We didn't have calcium montmorillonite deposits, but we had a lot of the attapulgite-smectite, and we found a way of making it work. It's an interesting area because it's back to the old organo-clays; it's back to the absorption of organic molecules of clays.

CMS: You mentioned that Joe Fripiat is doing some work for you. What is he doing?

MOLL: We use people such as Fripiat because of the pressures in a research laboratory in a medium-sized company. We are often too disrupted by emergencies in the field. So we have set up a group of people who will do longer-range work with us or for us. We've actually supported three Ph.D. dissertations and several Masters theses at various universities. We work with Amos Banin at Hebrew University, for example. Banin is well-known for understanding surface of minerals; his work on the soils of Mars is an example. And he's interested in how the surface of these materials affects organic reactions and many other things. One of his former students, Dov Shaked, now is at our laboratory. Joe Fripiat is only 80 miles north of us. We know that the surface characterization is important to product development, and Fripiat has interesting ideas and has worked in these general areas. Unlike a lot of catalytic-type people, he understands what the clay minerals are and their heterogeneity and their unusual surfaces. So he has been helping us characterize the surface. Of course, we have Haydn Murray, who knows a lot about the geological aspects of clay deposits.

CMS: There seems to be a change with the government wanting to support basic research, at least with the USGS. I wonder how important you think basic research is, and who should carry it on. Should it be as the Contract for



Bill Moll during the interview in the Boulder USGS labs.

Howard May

America says—let industry do it if they think it's worthwhile?

MOLL: I lived in New Jersey, and know the organized crime meaning of putting out a contract on somebody. I hope Mr. Gingrich's meaning is a little different and not putting out a contract on the USGS! What we do in our laboratory now, thirty years ago would have been the cutting edge of the understanding of clays. So if somebody hadn't done the work earlier, we wouldn't be where we are today. Often industrial firms just don't have the time to sit back and think long range, as people and universities and other institutions can. Industrial people certainly can propose interesting problems that need solutions. Many of the things that I've seen here today are directly applicable to current industrial problems. You were mentioning measuring the thickness of

clay platelets, which is very important. Now, of course, if you work for a company and you put in a whole new drying and grinding system, you're not going to let your competitor come in and use it. If you pay a lot of money to develop research, you're not going to give it away to a competitor. That is why industrial scientists are so reluctant to publish. Many companies, like Oil-Dri, do support

What we do in our laboratory now, thirty years ago would have been the cutting edge of the understanding of clays. So if somebody hadn't done the work earlier, we wouldn't be where we are today.

university theses and dissertations, which are in the public domain. Nevertheless, certain industries have specific problems that they need to solve.

CMS: So several companies would maybe feed money into a research center that would work on this problem much more cheaply than any of the companies could individually?

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Moll, *continued*

MOLL: Yes, and you would operate in an entirely different environment. Jordan was so successful in developing the organo-clays because he was at the Mellon Institute. It was essentially a think tank, and he worked largely as a theoretical scientist for a number of years. Now people just can't afford putting ten years and five people on the problem, or at least not in the industrial minerals area. So I think of places like the USGS.

CMS: Maybe we should adopt aspects of a CNRS-type program, where there would be a closer relation between government and industry, both basic and applied.

MOLL: Or have some ways that you can brainstorm with various industrial groups. This really doesn't compromise the quality of the intellectual effort at the university or at a research center, because often people working in industry see unusual properties that others might not recognize as significant. You talk to paper-coating people about enormous sheer rates in paper-coating machines. Or you talk to kaolin people about having to have new ways of removing troublesome amounts of impurities, where they truly need to understand more than they understand today. These are interesting theoretical questions, and they would like to have them solved. And as in the past, the petroleum industry has been very interested in illite diagenesis because it controls so much of the porosity of these reser-

As we have said, today industrial research had better understand and use fundamental research. For example, when we were first in the barn in the middle of the cornfield, we had no reason to measure the surface acidity of clays. Now it's extremely important for us to know.

voirs, and perhaps even the origin of petroleum. The industrial minerals field is not controlled by large firms willing to spend large amounts of money on research. They're usually relatively small companies or relatively small divisions of large companies. So the kinds of moneys that are available are often restricted. But the question is a very interesting one.

CMS: Another thing that the industrial companies have a very hard time justifying is working on extremely basic things like crystal structures of modulated minerals, like Bailey's and Guggenheim's work, or the thermodynamic

properties of clay minerals, which contribute a fundamental background of information to the science, but don't have any direct use.

MOLL: As we have said, today industrial research had better understand and use fundamental research. For example, when we were first in the barn in the middle of the cornfield, we had no reason to measure the surface acidity of clays. Now it's extremely important for us to know, because our product line is getting more sophisticated. One thing that I think is very interesting is that clay minerals are the most complex of all minerals—they mostly are colloidal in size, often in metastable equilibrium with their environment, and they have a very complex internal structure that reflects where they've been and where they might go. In some ways they are analogous to biological systems: small, complex, where the surface is extremely important. One of the reasons that clay minerals have found uses in industry is that they have such unique properties compared with anything else. You can go out there with a backhoe to dig up some clay, then dry and crush it, put it in a bag, and make some money. If you've already got such complex structures and you know what they are, then some relatively simple changes can make other wonderful things. I mean these are really wonderful, wonderful things, and that's one of the reasons clays are so attractive. That's why we need basic research—to understand what the clays truly are.

CMS: I was reading a book about George Washington Carver, who based a lot of inventions on the sweet potato and the peanut. He pointed to the clays up in the hills and said they have infinite possibilities.

MOLL: There are lots of possibilities.

CMS: They're doing a lot of nanoengineering work at Penn State with Sridhar Komarneni, Rustum Roy, and so on. Is your company involved with any of that?

MOLL: No. I just heard the term this morning.

CMS: We need to start an Institute of Nanoengineering.

MOLL: Sometimes it's the name, isn't it, that's important? People often change the names of their societies. Years ago, when geology was not in as good a reputation as now, a lot of Geology Departments changed their names to the Department of Earth Sciences, whatever that means. I think it means Geology. But sure, if you don't have basic research, you're not going to be able to move very rapidly. In the United States, where we have such a short-term vision of things, a company that thinks even a year ahead is rare.

Moll, *continued*

CMS: One target that we have here is to make more or less absolute measurements of the thermodynamic heat of wetting of clays, which is virtually unknown. I have some ideas about how to do it, but I think that while a given heat number for a particular smectite would probably not translate directly into a lot of product, the idea and the principle and the thermodynamic scaling behind it may have a lot of applications.

MOLL: You know, the hydration of the surface of clay and those cations are where many of its properties lie—the rapidity of swelling of smectite, or the absence of swelling—and you learn a lot about these surfaces from understanding heats of hydration. We often don't know enough about an industrial process. If we had a way of characterizing these hydration energies, then we would know what to do to change them to make the process more attractive. I sometimes am just amazed at the information that is not available. As you say, let's get the heat of hydration into databases. Right now nobody knows. And certainly the constitution of exchange cations on clays is important, and as we were saying this morning, the edges of the clays are so poorly understood. It's easy to throw something on the diffractometer and watch it swell. The edges, however,

In some ways [clays] are analogous to biological systems: small, complex, where the surface is extremely important.

are a lot more difficult to study, and that's where many things happen.

CMS: The only things we seem to know about edges are a little bit from practical inferences we've made in direct and indirect observations; the thing that sticks in our minds most is the stick model with the broken bond. We really don't know much more than that small set of facts and assumptions.

MOLL: That's right, and often our models are wrong, and we overlook important things.

CMS: We came up with the idea of why a field smells so nice on a wet rainy day—because the water competes better for the edge sites on clay than the organics do.



Bill Moll (right) talks to David Laird and Herman Roberson in Saskatoon, 1994.

High Iron Photos

CMS: And drives off light, volatile organics.

MOLL: Isn't that interesting!

CMS: And it is a commonsense observation we've all made, but we don't know why.

MOLL: Yes. Yes. The field in the rain. You open the windows up, and you smell. Sure. That's very interesting. See, we know practically nothing about clays.

CMS: Maybe you don't, but we're experts! That's why industry needs us.

MOLL: Well, that's true because you do give thought to things that we often don't do. Let me tell you something about cat litter. You asked about cat litter. Cat litter has made cats the predominant companion animal in the United States. Without cat litter, you could not keep a cat in the house.

CMS: My mother just used to take a shoe box and go out to the garden and fill it with dirt, and the amazing thing, even as a kitten, he knew what to do. What's the advantage of cat litter over dirt?

MOLL: Good question. Cats are interesting animals. They evolved in the desert, and many people believe they keep themselves very clean to hide their presence from predators or prey. Because they are small and not very strong, they have to use their wiles. They also tend to be solitary predators, so they developed strong personalities, which is appealing to a human being. They don't drink a lot of water because they are like camels and conserve water. You can leave the cat alone all day, and it is fine. A

continued on next page

Moll, continued

cat keeps itself clean and washes itself, and is very careful with what it does with its metabolic wastes, again apparently to hide its presence. It likes to dig in things that feel like dirt or sand. Now, its wastes are very high in urea. The fermentation of urea into ammonia mediated by an enzyme called urease is what causes the very strong odors. It's the ammonia you really don't like to smell. If you can hinder the fermentation of urea into ammonia, you're ahead. What happens in a cat box, if you consider it a biochemical system, is that bacteria that generate urease begin to develop. They want to get at the carbon in the urea, and they split it up. There are so many of them in there that ammonia comes off. The clay minerals deactivate urease by absorbing it, and the urease just can't get to the urea. And the clay minerals do other things—these absorbing clays are very porous—so they can pick up water. It's about the right density that cats like for digging. You want to get rid of the water, so the water evaporates. There is a whole host of other things, too.

CMS: I thought it worked by taking up the ammonia.

Cat litter has made cats the predominant companion animal in the United States.

MOLL: No, many people think that. When ammonia forms, the cat litter has failed. Cat litter precludes the fermentation of urea to ammonia. Once the ammonia is forming, there's nothing you can do about it. Clays will, yes, take ammonia ions out of water in a catfish pond, but not out of the air. The clay in cat litter stops the fermentation of urea to ammonia. Ultimately you get so much urea in there that it ferments in a week or even longer. With sand or normal dirt, the fermentation occurs in less than a day. Most people who have been successful in selling cat litter realize it is a biochemical system, and the clays have all kinds of ways to effect it.

There's a new introduction in about the last five years called clumping cat litter. This is how you can identify the place where the urea is and remove it. There are a whole variety of ways this clumping was achieved. You also add fragrance to the litter, as a means to contain the odor. Cats are carnivores, so their wastes have a lot of protein degradation compounds that are usually ill-smelling. Clays, however, tend to be low-level catalysts and decompose many fragrances. You have to be very careful



Bill Moll (right) and his Ph.D. advisor, Bill Johns, Baltimore, 1995.

Dave Pevear

which chemicals are in the fragrances so that they will remain in the cat litter for months if necessary. But you also have to be very careful that you can eat everything that you put into a cat litter, because this is a household product. The fragrances and colorants and so forth are food grade or "GRAS," meaning "generally regarded as safe." So if someone goes to the grocery store and takes home a bag of litter, thinking, "There's no science in this," they're wrong. There's a lot of science in this. There's the absorption of enzymes. There's the pore-sized distribution that allows the water to enter into the pores and then evaporate out. There's this whole idea of how to cause a clump. There is the problem of providing a fragrance that does not decompose because of the catalytic surface of clays.

CMS: What is a fuller's earth?

MOLL: Fuller's earth is whatever the Patent Office wants to call it. In United States usage, it often is attapulgite. In Great Britain, it is calcium montmorillonite. A fuller's earth is a material that will absorb oil. The Bible has references to the use of fuller's earth. After flint, fuller's earth is the oldest traded mineral. It tends to be a material from the ground that has a lot of porosity and is relatively light in weight because of the porosity. When you dry a fuller's earth-like material, it doesn't shrink. The pores don't collapse but remain intact. If you go to a fuller's earth mine and see a thirty-foot seam of clay, you realize that it's 15 feet of water and 15 feet of clay. You see heavy machinery sitting on this seam that is half water by volume. The crystallites of the clay interlock, and unlike a lot of clays, when it's dry, they stay interlocked.

CMS: What is the mineralogy of this material, or is there a range?

Moll, *continued*

MOLL: Usually they're attapulgites, attapulgite-smectites, or smectites. And we are all beginning to believe that the presence of opals is very important in giving the open porosity. Usually if you find clays with opal in them, you'll find them very absorbent. A whole range of things, such as either water or oil, can go into the pores. In other words, the water is driven out in the processing, and the water or oil can go back into the pores. It's an interesting area that we're only now beginning to understand. We always work in a wonderful density unit called pounds per cubic foot. Density is very important for things like cat litter. If it's too heavy, it's difficult to get the bag out of the car into the house. You want about three inches of cat litter in a cat litter tray. If the material is too light, the cat will kick it out, and if the material is too heavy, you can't get three inches in there unless you break your back. The people who mine the clay are very careful. If you mine something at 25 pounds per cubic foot, and your bag is sized for something at 35 pounds per cubic foot, you're not going to get the product in the bag. These are things you suddenly start worrying about. The fellows who are doing the mining in the field must be conscious of the plant's requirements.

There are all kinds of tricks we use, but it's just the power of these clays! What a unique material this cat litter is!

CMS: We had a little bit of pit experience out in eastern California on the California-Nevada border. There's a company named IMV that has a plant there; they were in the cat litter market. Probably one of your competitors.

MOLL: IMV has a very unusual suite of minerals. They have hectorite, sepiolite, calcium carbonate.

CMS: We went through some of their pits and saw that they had different grades of things stockpiled and were pulling out of these stockpiles to achieve their product.

MOLL: One of the interesting aspects about evaluating clay properties is that clays normally are sold at relatively low cost. You often have to carry this stuff by rail and have to have a rail siding. There are wonderful deposits in the West, but they are 100 miles from the nearest power line, and where would you find workers? People would have to drive miles and miles. There are all sorts of constraints on clays and clay deposit exploitation. Good clays are hard to find. Fortunately, we have two fine geologists, Fred Heivilin and Marc Herpfer.



Bill Moll with Haydn Murray and Carolyn Olson in Minneapolis, 1992. Jo Eberl

A good clay deposit is like a good invention. We have to keep quiet because our trade secrets are part of the survival of the company. Most of these firms have a lot of reluctance to publish, as I mentioned earlier. It's just a way of life. We're hired to do things to make the company survive. Ultimately discoveries do get into publication. A very interesting and often overlooked area of scientific publication is the patent literature. Often that is the only place some people publish. For a patent, you don't have to be right in your interpretation of what is happening; you just have to be right in what happens. I've found it's interesting to read some of these experiments and try to imagine what has actually happened.

That's how the Special Clays came to be. They came from someone handing us a two-pound bag of cookite, saying, "Do you want it?"

CMS: I'd like to change the subject and ask how the Source Clays Project started.

MOLL: The Source Clays Project ultimately started, I think, with the API project 49. Paul Kerr and his group went around the country collecting a lot of clays. They characterized them and reported their findings in a really fine monograph. Wards then sold the samples to other people investigating clays. The problem was that this chunk may be different from that chunk. In the late '60's, R. T. Rex became interested in setting up a clay bank at The Clay Minerals Society. Shortly after he and Brindley proposed it, Rex went on to other commitments. Brindley, knowing that I'm an inveterate collector, came to me

continued on next page

Moll, *continued*

and asked if I would be interested. Of course, I said yes. We decided to set up about a metric ton of typical clays, and to dry them and grind them, so everybody who worked on them would have something approximately the same. Incidentally, people interested in the texture of clays, particularly Walt Keller, didn't like the homogenization. We found that the clay companies were very interested in the project. They sent out geologists to collect material that would produce a metric ton and shipped it down to Baroid in Houston. They had a small, very effective, pilot plant that was staffed by people who knew what they were doing with clays. They had small equipment with which they could dry and grind these things and keep them pure.

Then what were we going to do with this material? While we were collecting them, Brindley and I went down to the National Bureau of Standards, as it was called at the time. Because of the way the NBS was set up, we couldn't distribute the clays as we thought they needed to be distributed, so we decided we'd try to set it up through the Society.

Bill Johns was interested. The University of Missouri was an attractive place because the clay industry is so important to the economy of much of Missouri that we thought they would always be somewhat interested in clays there. So Johns got the University to donate several things. They donated a place to put them, and just as important, donated the accounting procedures so all of the clays are invoiced through the university accounting system, which provides an oversight on accounting. So we got the clays and started selling them in the early '70's. In the first year, we were able to repay some of the initial investment of \$4000 that the Society had put up. Now we have actually been successful enough to sell a metric ton of Wyoming bentonite and of the so-called well-crystallized Georgia kaolin, and we have had to replace them. One thing that we have not done as well as we should have is to collect all of the data published and try to see if we could find any sort of trends. This is probably now the best characterized suite of clays in the world. I know that Pat Costanzo and Jessica Elzea have a program now of gathering up all the information and trying to understand what we've found. I found a lot of fun and joy working on it.

Now, about the designations. F. J. Flanagan at the USGS in Reston called and said, "Look, I'm going to publish this thing on materials available for the geosciences in *Geochimica Acta*. I want to include the Source Clays, but you have got to have some code numbers." I sat in my office in Elizabeth, New Jersey, and dreamed up some code numbers and called him back. The first number was the

kind of mineral, like P for palygorskite or S for smectite, and the next was the source. For instance, K was kaolin and Ga was Georgia and dash 1 was the first sample from Georgia, and dash 2 was the second sample from Georgia. And it worked out pretty well, so when we used KGa-1, we knew what it was. Later on, when I started work at Cabot Corporation and was moving out of the geology field, Jim Post at Sacramento State University took it over. Post is a collector like I am, so he collected more and continues to do so.

Very soon after we prepared the large homogenized samples, we realized that there was a whole host of interesting layer silicates that were not amenable to processing. I had been down in a quarry in Arkansas around 1967, where you could go in and collect a hundred pounds of rectorite in about 30 minutes. You just pulled it off the walls.

We decided we wanted to add rectorite, but by that time, the quarry had closed. The Geological Commission in Arkansas took us to a vein deposit from which we were able, with some effort, to get several hundred pounds of rectorite and quartz. When we were back in Little Rock, someone at the Geological Commission said, "I have a bag of cookite I've collected; would you be interested in having it?" It was a big bag of cookite! He handed it to me, and we said, "Sure." Then Bill Johns said, "Maybe we need a special group of clays." That's where the rectorite came from and the cookite. About that time we got

He did it as much for the aesthetics as he did for the science. I guess we all in clay minerals are like that...

some high-iron smectite from the basalts from Washington State. That's how the Special Clays came to be. They came from someone handing us a two-pound bag of cookite, saying, "Do you want it?"

CMS: Were you around at the founding of The Clay Minerals Society?

MOLL: No. I became really involved in The Clay Minerals Society, I guess, when I went to work at Baroid in the mid '60's, and I really became involved with this Source Clays Minerals thing; and then later on I was Secretary of the Society.

CMS: And President.

MOLL: Yes, and President.

CMS: Do you think the Society has been successful in

Moll, continued

making the balance between industry, government, and academia?

MOLL: Overall, in the number of years it's been in existence, I think so. Sometimes it appears too far one way, but it always has had the ability to readdress the general needs. It's been very flexible and has been successful over a period of years in being able to address everyone's needs.

CMS: What's your favorite clay?

MOLL: My favorite clay. Is there a politically correct answer?

CMS: In Boulder you have to expect there's a politically correct answer.

MOLL: Montmorillonite.

CMS: So you prefer octahedral to tetrahedral in your smectites?

MOLL: Montmorillonite is just a very unusual material. You can look at it in many, many ways. I don't think there is anything else in nature like montmorillonite. Something that can change its crystal lattice parameters, according to whether it's raining outside or not. It can have so many substitutions. I mean, all of the other clays are fine. I *like* the other clays.

CMS: We know you're not discriminating. Some of my best friends are kaolinites.

MOLL: And also attapulgite, or its "real name," palygorskite. Palygorskite puts bread on the table. I have now worked in companies that majored, as it were, in kaolin, in montmorillonite, and now in palygorskite. So I have essentially covered the whole world of the clays that are used in industry.

CMS: I wanted to ask something about your good wife. People seldom mention their wives in these interviews.

MOLL: My wife and I are both from the deep South. I met Pat at Washington University. She was a graduate student, getting her Masters, in the Chemistry Department, and her specialty was carbohydrate chemistry. I found that being married to a scientist was wonderful. I could talk to her about organic chemistry. She understood the



Bill Miles and Bill Moll on the Saskatoon field trip, 1994.

Dave Pevear

pressures that you have when you are a scientist, that you're coming home late because you can't cut a reaction off. I remember she would be in the lab for hours and hours because some reaction was going too slowly. She was a very good quantitative organic analyst, a field where you almost have to be born to do it. It would take them a week to find how much of a steroid was in something. She has always been very supportive of my career, and she understands what I am doing. She had a very interesting career and worked until our daughter, Nina, was born. She usually worked in medical research because carbohydrate chemistry is very important there. When my daughter was born, there was very little support for working mothers anywhere. We've been married 34 years. And being from the South, she understands my background. Like a lot of people from the South, we are far less reactionary than the stereotypes. I consider myself a Lincoln populist. I have very, very strong suspicions of people who are in positions of power with little talent, and you see that both in industry and academia, the government and...

CMS: Religion...

MOLL: And religion, yes. I think religion should play a more important part in our lives. In industry, academia, and government, you need to be in the marketplace of ideas and play out the battles there without being given artificial handicaps.

CMS: Tell us about your garden railroad.

MOLL: The garden railroad is a model railroad about half-inch scale, and you build it in the garden, and you

continued on next page

Moll, *continued*

leave it there all year. It assuages your need to own a railroad, and you contend with nature. You build it, and the rain rains on it, and you pull the weeds out of it. It's something that my wife and I both enjoy because she likes planting flowers. People involved in railroad gardens are very nice. They're interested in the outdoors and horticulture, and they like railroads. You can go to a meeting, and people are talking about a new diode for controlling the locomotive sound, and a great place to get sweet alyssum. I've been working on it for about five years now and have about 200-300 feet of track. Incidentally, we had a terrible wreck last year. A squirrel had carried a walnut into the tunnel, and our premier passenger train hit it at full speed, causing a big derailment.

CMS Student Research Grants

Purpose: The research program is designed to provide partial financial support of masters and doctoral research for graduate students of clay science and technology.

Selection: Applications will be judged on a competitive basis. The qualifications of the applicant, the financial need of the research project, and the design of the research project shall be considered. Applicants selected will be nominated by a five-member CMS committee and approved by the CMS Council. Members and nonmembers of the CMS are eligible. Students from all countries are eligible to apply.

Application: Each applicant must complete an APPLICATION FOR RESEARCH GRANT form available from the CMS Office and must obtain confidential evaluations from two faculty members at his or her university. Use the APPLICANT APPRAISAL form provided with the application.

Use of Funds: Individual grants will not exceed \$2,500. Grant money may only be used for the costs of travel by the grantee to conduct research, room and board associated with research-related field work, or for the costs of equipment, supplies, and analyses required to complete the research, with the exception of up to \$500 for expenses incurred while presenting a paper at the CMS conference on thesis research. Recipients can apply for grants on subsequent years. Application forms and appraisals (7 copies) must be postmarked by April 1, 1997 and sent to the Society Office.

CMS: Does Don (Scafe) have one, too?

MOLL: No, he doesn't. Don has full-size ones at the trolley museum where he volunteers. Getting back to clays, I think we enjoy the field not only for its intellectual challenge but also for its beauty. I was at a meeting one time, and someone was handing out volkanskolite, and it's beautiful; it's a beautiful green color. That reminds me of another Brindley story which shows what really drives scientists. I think some of his finest work was the understanding of the nickel silicates. He told me once he worked on them because they were green, and he's always been fascinated by things that were green. He did it as much for the aesthetics as he did for the science. I guess we all in clay minerals are like that; there's some aesthetic pleasure in dealing with these materials.

Thanks to our big-hearted donors

The CMS extends thanks to the following people who have made recent donations to support Eastern European clay science: **Dennis Eberl, Franitisek Eichler, Arthur Greene, Ryunosuke Hamada, Randy Hughes, Srimathie Indraratne, Bill Johns, Dewey Moore, Dave Pevear, Frank Serafin, Yasushi Shinohara, Michael Velbel, Joe White;** and to the following who have made contributions to the Student Undergraduate Fund: **Paul Bertsch, Eduardo Dominguez, Ted Eyde, Arthur Greene, Steve Guggenheim, Lindsay Keller, Jay Matthews, Ritsuro Miyawaki, Dewey Moore, Dave Pevear, Elen Roaldset, Herman Roberson, P. Smart, Michael Velbel.**

Neacsu, Ocelli edit new books

Two CMS members, George Neacsu and Mario Ocelli, are co-editors of new books.

George Neacsu and Ion Parcalabescu have edited *Prospecting and Exploring Advanced Methods of Mineral Ore Deposits in Si-Al Zone of Earth Crust*. It is available for \$20 from Grupul Editorial ALL, 20, Carol Knappe St., 78221, Bucharest, Romania. Please contact Nicolae Dumitrescu at (fax) 440-(0)1-312-7795 before ordering. 160 pages.

Mario Ocelli and Henri Kessler have edited *Synthesis of Porous Materials; Zeolites, Clays, and Nanostructures*. It is available for \$196 from Marcel Dekker, Inc., Promotion Dept., 270 Madison Ave., New York, NY 10016 USA. 744 pages, illustrated.

We hope to have room to include more information about the publications in the next newsletter.

Award Criteria

The CMS ballots will be mailed soon. In the past few years, these have included a space for members to make suggestions to the Awards Committee for recipients of the Distinguished Member Award, the Jackson Lecture, and the Brindley Lecture. In order to help members make more informed suggestions, the intent of each award and a list of previous recipients (through 1997) are given below. The Pioneer in Clay Science Award is not included on the ballot because it is chosen by the organizing committee of each meeting; however, it is included below for your information. **Please note that only those members whose dues have been paid by February 1, 1997 will be sent a ballot.**

Distinguished Member

Intent: According to the By-laws, "Distinguished Members shall be persons recognized for distinguished attainment in the field of clay mineral science."

Previous recipients: Ralph E. Grim, Clarence S. Ross, Paul F. Kerr, Walter D. Keller, George W. Brindley, William F. Bradley, Sturges W. Bailey, José J. Fripiat, Marion L. Jackson, Toshio Sudo, Haydn H. Murray, C. Edmund Marshall, Charles E. Weaver, Max M. Mortland, Robert C. Reynolds, Jr., Joe L. White, Joe B. Dixon, Thomas J. Pinnavaia, W. D. Johns, Victor A. Drits, Udo Schwertmann

George W. Brindley Lecture

Intent: To recognize a clay scientist who will infuse the Society with new ideas, someone who is both a dynamic

speaker and who is involved in innovative research. Dr. Brindley himself approved the concept of the lecture: the speaker should deliver a lecture that Brindley himself would applaud.

Previous recipients: Walter Keller, J. J. Fripiat, Ralph E. Grim, Sturges W. Bailey, M. L. Jackson, W. D. Johns, Thomas J. Pinnavaia, Philip Low, Dennis D. Eberl, Robert C. Reynolds, Jr., Gerhard Lagaly, Samuel M. Savin, Paul H. Nadeau

Marlon L. and Chrystie M. Jackson Mid-Career Clay Scientist Award

Intent: To recognize mid-career scientists for excellence in the contribution of new knowledge to clay minerals science through original and scholarly research. The awardee is to be within the ages of 39 and 60.

Previous recipients: Joseph W. Stucki, Jan Srodon, Stephen Guggenheim, David L. Bish, Darrell G. Schulze, Jerry M. Bigham

Pioneer in Clay Science Award

Intent: To recognize research contributions that have led to important new directions in clay minerals science and technology, by selecting a person who will strengthen the technical program of the annual meeting.

Previous recipients: Marion L. Jackson, R. M. Barrer, H. van Olphen, John W. Jordan, Charles E. Weaver, Udo Schwertmann, Linus Pauling, Joe L. White, Rustom Roy, Max M. Mortland, Koji Wada

Best Student Paper Awards announced

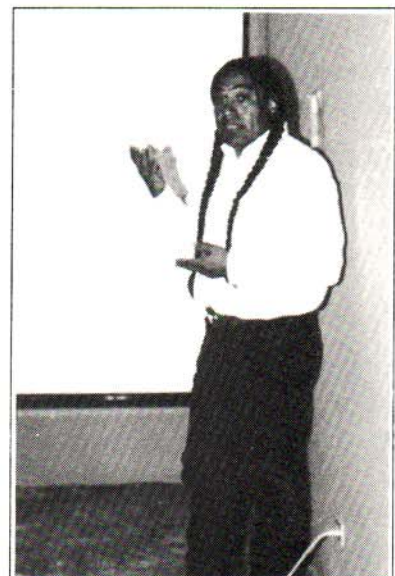
Best Student Paper: **Bob Ylagan** (U. of Illinois-Champaign), for "Mineralogy and Geothermometry of a Hydrothermally Altered Rhyolitic Hyaloclastite from Ponza Island, Italy;" Best Student Paper Runner-up: **Roxane Fagan** (U. of Western Ontario), for "The Effects of Laboratory Pretreatments on the Hydrogen- and Oxygen-Isotope Compositions of Clay Minerals;" Best Student Poster: **Robert O. Marquez** (New Mexico State U.), for "Removal of Air Pollutants

with Clays, a Brick-maker's View;" and Best Student Poster Runner-up: **Xinhua Deng** (U. of Missouri-Columbia), "Clay Mineralogy and Illite/Smectite Diagenesis at Abnormally Low Temperature at the Barbados Accretionary Prism."



Roxane Fagan with her adviser, Fred Longstaffe, in the Smoky Mountains.

Courtesy R. Fagan



Robert Marquez giving a talk in Juarez Chihuahua, Mexico.

Courtesy R. O. Marquez

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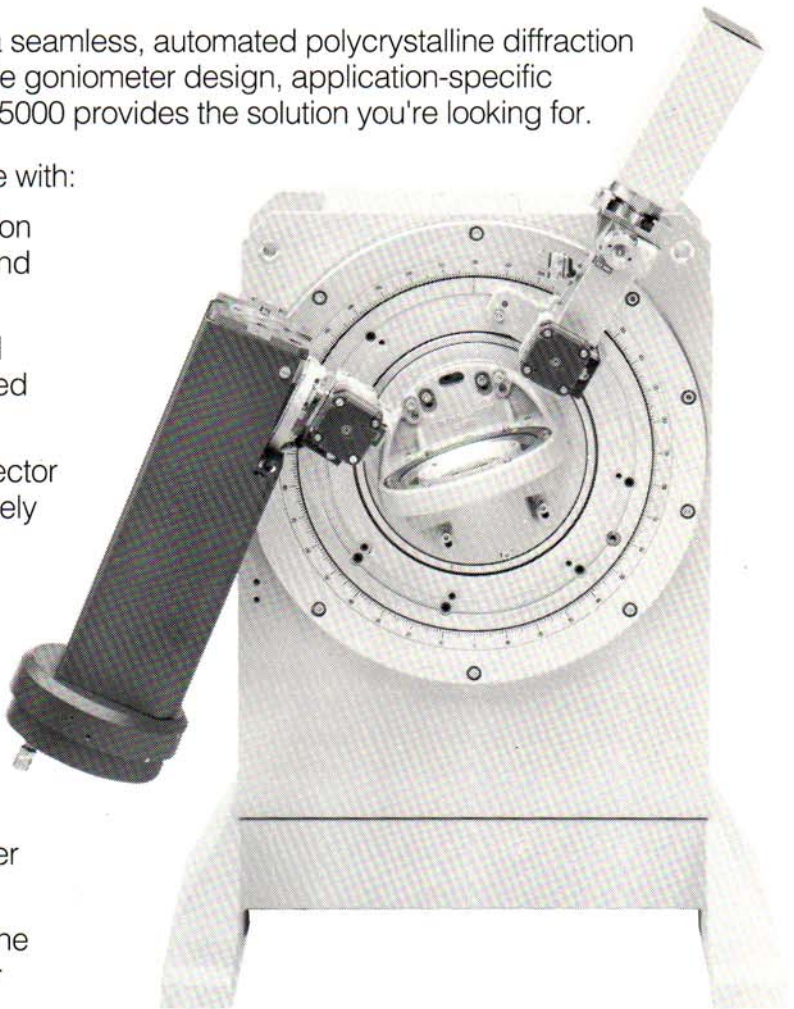
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Letter from the President,*continued from page 3*

roduce the importance of clay minerals to the general public as well. By the way, the Environmental Awareness Publication Series may be useful as a source set of publications for an undergraduate class in environmental science in the future. Five booklets have been approved: "Soils and Society," "Petroleum: Meeting Global Energy Needs," "Mining and the Environment," "Geology and Cities," and "Minerals in the Biosphere (Geochemistry of Health)." Ten additional primers have been proposed and are under review: "Caves and the Environment," "Climate Change," "Coal and the Nation's Energy Supply," "Ecosystem Analysis and the Environment," "Ecosystems Dynamics and Recovery," "Environmental Restoration," "Microbiology and Geology," "Mineral and Thermal Waters and the Environment," "Mining Remediation and Technology," and "Water Resources and Supply."

These are just some of the ideas we are examining. If you are interested in participating, either by acting as a liaison to help establish a symposium or by becoming involved in a K-12 program, please contact me. In addition, if you have any suggestions about possible programs or areas in which the Society should become involved, please contact me also. I can be reached by phone at 312-996-3263 or by e-mail at XTAL@UIC.EDU.

Stephen Guggenheim, President

P.S. Don't forget to renew your membership!

I feel so strongly about the wrongness of reading a lecture that my language may seem immoderate... The spoken word and the written word are quite different arts... I feel that to collect an audience and then read one's material is like inviting a friend to go for a walk and asking him not to mind if you go alongside him in your car.

Lawrence Bragg

MSA-CMS publication*agreement, continued from page 1*

members in the sale of its books, but starting in 1997, the prices of CMS volumes will be raised \$5.00 per volume for non-members. For a list of books available from the MSA, please contact Mineralogical Society of America, 1130 17th St. NW, Suite 330, Washington, DC 20036; phone: 202-775-4344.

To join the CMS listserv, send an e-mail message to: listserv@vm.cc.purdue.edu, and write a message as follows: SUB CLYMIN-L John Doe (replace name with your own).

To see the CMS home page, open a browser such as Netscape, and use the following address or location:

<http://shadow.agry.purdue.edu/clay/claymin/claymins.htm>

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tion of Organic Contaminants by Clays and Soils," by B. L. Sawhney; Use of Organozeolites for the Removal of Organic Contaminants from Water," by F. Cadena and E. Cazares; "Organic Contaminant Transport Through Clay Liners and Slurry Walls," by R.W. Gullick, W. J. Weber, and D. H. Gray; "Substrate Limitations in Bioremediation Removal Rates and Extents," by J.W. Blackburn; and "Spectroscopic Methods for Characterizing Surface-Sorbed Organic Contaminants: Applications of Optical, Electronic Measurements," by S.J. Traina and S. Chattopadhyay.

The book is available from the CMS Office, P.O. Box 4416, Boulder, CO 80306, USA, for a price of \$18 (including postage) to members of the CMS and MSA, and \$23 to non-members.

Archives contributions

Many thanks for contributions to the Archives by D. Berry, D. Finkelstein, H. May, W. Keller, F. Madsen, J. Matthews, and D. Pevear.

A NEW NEWMOD

The computer program NEWMOD is now available for MS WINDOWS™. It is easy to use and has features not present in the older version. It incorporates an improved plotting package that, among other things, allows the stacking of multiple calculated diffractograms on a single screen, each adjustable with respect to vertical scale. The improved MIXER program for simulation of mineral mixtures is now part of the plotting package. Contact me if you are interested in more information on the program, and in how to get it.

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Directory Corrections

The following changes or corrections to the 1996 CMS Membership Directory have been received in the Society Office. In the interests of space, only that part of the entry which is changed is listed. Please let the Office know if other corrections are necessary. The best way to do this is by sending an e-mail message to peberl@clays.org Thank you.

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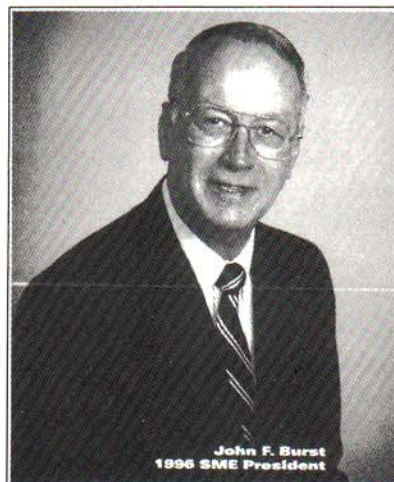
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Feats of Clay

Jim Ferris was awarded the Oparin Medal of the International Society for the Study of the Origin of Life (ISSOL), given only six times in the society's 26-year history. The medal honors a scientist deemed to have had the best sustained research program in the origin of life field. Jim has just completed a three-year term as President of ISSOL and is editor of the journal *Origins of Life and Evolution of the Biosphere*. Oparin himself was the first recipient of the medal.

Jean Hemzacek is the first recipient of the Association for Women Geoscientists' Chrysalis Scholarship. The award is given to exemplary women graduate students in the geosciences who have experienced an interruption at some time in their formal education and are in the final stages of writing their theses. Jean is teaching at Northern Illinois University this year while she finishes her doctoral work.



Jack Burst is serving this year as President of the Society for Mining, Metallurgy, and Exploration, an organization of 17,000 members in 91 countries.

Ken Towe has recently gotten married, retired, and moved to Georgia. Congratulations, Ken!

Walter Keller has been elected to the School of Mines and Metallurgy Academy at the University of Missouri-Rolla. Members are honored not only for their contribution to industry but for their many years of loyal support and service to the University of Missouri-Rolla.

George Kacandes has disappeared to Greece, where he has married the beautiful **Nicolette Sophia Trahoulia**. Congratulations, George!



Jean Hemzacek (right), recipient of the AWG Chrysalis Scholarship, with Jessica Elzea and Juanita Murray in Gallinburg. Jo Eberl

Gene Whitney has been promoted to Chief Scientist for the Energy Resource Team of the Central Region of the Geologic Division of the USGS in Denver, a position that previously was filled by three branch chiefs, and by all accounts is doing the job admirably.

The following students were awarded 1996 CMS Student Research Grants: **Andrew C. Kurtz** (Cornell University, advisor **Louis Derry**) for "A Mass Balance for Ge/Si Fractionation in Weathering Processes;" **Hongting Zhao** (University of Wyoming, advisor **George Vance**) for "Intercalation of Carboxymethyl-Beta-Cyclodextrin by Layered Double Hydroxides;" **Sandip Chattopadhyay** (Ohio State University, advisor **Sam Traina**) for "A Mechanistic Study of Sorption of Ionic Organic Compounds on Clay Minerals;" **Mark Hanan** (University of New Orleans, advisor **Matthew Totten**) for "Physical Separation of Clay Minerals in Estuarine Sediments for Determination of Adsorption Sites of Naturally Occurring Radioactive Materials (NORMS);" **Lorin Amidon** (University of Montana, advisors **Gray Thompson** and **Marc Hendrix**) for "Climate Studies of the Fossil Eocene Woods from the Sepulcher Formation, NW Yellowstone National Park and SW Gallatin National Forest, Montana; and **Mark Krekeler** (University of Cincinnati, advisors **Warren Huff** and **J. B. Maynard**) for "Mechanism of K-Bentonite Formation of Middle Ordovician K-Bentonites from the Precordillera of Argentina."

The Clay Minerals Society notes with regret the death of George Brown.

Ask the Clay Doctor

(Not a real doctor)

Dear Clay Doctor: Is there a universal language for clay science?

Le Lapin, Versailles

Dear Mr. Lapin: Currently, the most popular language for scientific communication is English. But the common language has changed in the past, and will change in the future. At different times, Greek, Latin, and German have each been in vogue. I predict that French will become popular, if some small changes are made to the language to make it easier to learn. First of all, the gender of every noun must be made either masculine or feminine. It's either *un* and *le*, or *une* and *la*, but not both. Secondly, the word *ordinateur* has to go. And while we are at it, we need to eliminate the *cédille* accent, because it is just too silly. I am sure that the Académie Française will be delighted to make these minor changes for the sake of ease of usage.

Dear Clay Doctor: The clay materials I am studying have an abundance of what appears to be organic matter (O.M.) in them. Can you suggest the best way to remove it?

Aghast in Ann Arbor

Dear Awash: What you so delicately refer to as organic matter is in fact nothing but filth, smut, or more precisely, the unclean residue of the most noxious behavior of otherwise rather reputable plants and animals. It is to be abhorred, rejected, chastised, eschewed, disdained, made fun of, and eliminated by any and all means possible. I am sorry to get carried away like this, but nothing raises my hackles like the mere mention of.....O.M. As to remedies, I have found that the direct impact by several side-winder missiles fired in rapid succession at close range is remarkably effective. This is best done out-of-doors. You might also try treating it with liquid sodium. I recommend using rather large quantities so that the resulting flames will develop their most magnificent colors. Neighboring institutions will appreciate this method as well, since the treatment will be visible for miles around, regardless of whether it is done during the day or at night. Hope this helps.

Dear Clay Doctor: How can I remove unwanted iron oxide from the clay samples I am trying to analyze?

Nonferrous in Nantucket

Dear Nonferrous: That's easy. You deal with it in exactly the same way you deal with the problem of squirrels on your bird feeder during the winter. If you learn to love the squirrels, then you no longer have a problem. Do you think iron oxide enjoys being unwanted? Indeed not! For shame! Have a heart and show a little interest in its welfare. Smear some on your face and take it to lunch. And at a nice restaurant, mind you, not some cheap spot. Later on, you can invite your friends along, and who knows, maybe they will join in the fun.

Dear Clay Doctor: How can you distinguish between marine and freshwater clays?

Awash in Atlanta

Dear Awash: Easy. Marine clays smell of putrid seaweed and have barnacles clinging to them. The barnacles have to be scraped off before submitting the clays for XRD analysis. We recommend using a number 2 medium-soft lead pencil so as not to injure the little fellows. Also, marine clays are always marked by chevron stripes and little eagle insignias, but I am sure you know that already. Freshwater clays, on the other hand, have distinctive internal structures that betray their origin. For example, they frequently display imbricate cross-stratification on the sub-micron scale. Careful study of undisturbed samples will reveal exquisitely preserved floodplain patterns with teeny little oxbow cut-offs, natural levees, and incised meanders. Alluvial fans 2-4 m μ wide in kaolinite were reported by British scientists at the World Microclay Congress last year. Not to be outdone, South African investigators described multiple graded beds in a single crystal of lacustrine sepiolite. The melee that quickly ensued and brought the Congress to a premature end was graphically described by the news media, so I won't repeat it here.

Dear Clay Doctor: In the newsletter feature, "Interviews with the Clay Scientists," scientists have been asked to name their favorite clay, and answers have ranged from illite to palygorskite. Tell me, what is your favorite clay?

Pushing for Palygorskite, Polonius

Dear Pushing: My favorite clay? Well, of course palygorskite is very nice, as is illite. And then there is allietite, with its beautiful alterations of talc and saponite. And kaolinite, white as driven snow! And there is corrensite, which can be regularly interstratified chlorite/smectite or chlorite/vermiculite; but of course smectite and vermiculite may form a continuous series based on charge, and where does one draw the line?...but I digress. Favorite clay? Favorite clay? Perpend...

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The 11th International Clay Conference The Clay Minerals Society 34th Annual Meeting

June 15-21, 1997

Ottawa, Ontario, Canada

Workshops

Mössbauer Spectroscopy (Saturday, June 14, and Sunday, June 15)

organized by Denis G. Rancourt, University of Ottawa

Synchrotron X-ray Methods in Clay Science (Saturday, June 14)

organized by Darrell G. Schulze, Purdue University, and Joseph Stucki, University of Illinois

Symposia

Mössbauer Spectroscopy in Clay Science

Convenor: Denis G. Rancourt, University of Ottawa

The Isotope Geochemistry of Clay Minerals: Progress, Potential, and Pitfalls

Convenor: Fred J. Longstaffe, University of Western Ontario

Multinuclear Magnetic Resonance of Clays

Convenors: Christian Detellier, University of Ottawa, and John A. Ripmeester, National Research Council of Canada

Microbial Geochemistry of Clay Minerals

Convenor: Grant Ferris, University of Toronto

Clay Barriers and Waste Management

Convenor: Dennis Oscarson, Atomic Energy of Canada Limited

Hydrothermal Clays in Modern and Ancient Seafloor Deposits

Convenor: Doreen E. Ames, Geological Survey of Canada

The Merits of TEM and XRD as Applied to Layer Silicates

Convenors: Hojatollah Vali and Robert F. Martin, McGill University

Clays in Industry

Convenor: Hugh J. Abercrombie, Geological Survey of Canada

Teaching Clay Mineralogy

Convenor: Joe B. Dixon, Texas A&M University

Clay Mineral Separation and Purification Techniques

Convenors: W. Crawford Elliott, Georgia State University, and G. Jock Churchman, CSIRO, Australia

Field Excursions

Clay minerals of the Saint-Rémi area, Quebec

Paleoweathering and attendant mineral alteration along the Precambrian-Paleozoic unconformity, Ontario

Classical mineral localities of Bancroft, Ontario

Kaolin deposits in Macon County, Georgia

Canadian Rocky Mountains - geology and mineral deposits

Clay minerals of the Stanleyville area, Ontario

Landslide and soil development in the Champlain Sea sediments of the Ottawa area

Thetford Mines and St. Lawrence Lowlands, Quebec

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Gatlinburg, *continued from page 1*

phere. Some were able to dress more casually than anticipated, and there were special afternoon break treats of ice cream and popsicles. Despite the vacation-like atmosphere of the Smoky Mountains, the meeting, well-organized and chaired by S.Y. Lee of Oak Ridge National Laboratory, held to its usual high standards of scientific content and interactions. I am always stimulated by the excellent quality of the research and openness and genuine excitement shared by colleagues. The annual meeting is always a great way to jolt the mind into thinking in new directions.

The meeting started with a highly successful pre-meeting workshop by Fred Long-



CMS Secretary Don Scafe checks for spelling errors on his Citation of Special Recognition, as President Ken Towe reads.

Jo Eberl for High Iron Photos



George Li and Will Gates listen as Robert Marquez (winner of the Best Student Poster Award) explains his poster.

High Iron Photos

qualities of higher temperature stability and durability. Other nanocomposites possess low gas permeability properties which could potentially impact a variety of industries.

The use of clays in environmental remediation and their role in contaminant transport is gaining more and more attention, as evidenced by the symposium organized by Mark Elless and Chet Francis. There was more creative research discussed than can be represented in this short review. However, over all, the focus is on detailed interactions of organic, metal, and actinide wastes with clay minerals. One talk I found interesting, given by S.Y. Lee, showed that uranium and technetium can be precipitated into a crystalline iron-hydroxide phase during electroki-

staffe and Kurt Kyser on stable isotopes.

The meeting's technical program, well-planned by Paul Bertsch and Claudia Mora, included symposia reflecting the broad-ranging cross-disciplinary applications that we as clay researchers are involved with. It is particularly satisfying to see that many of these research fields have direct applications of importance to present-day and future society.

Gary Beall and Semeon Tsipursky put together a fine group of presentations on clay-polymer nanocomposite materials. The addition of clays to polymers has created a new class of materials with potential to affect us all every day. For example, under-the-hood automobile parts can be constructed of clay-polymer nanocomposites which possess the



Darrell Schulze, 1996 Jackson Mid-Career Clay Science awardee, stands between the sponsors of the lecture, Chrystie and Marion Jackson.

High Iron Photos



Victor Drits, CMS Distinguished Member, gives his address, June 17, 1996, in Gatlinburg. High Iron Photos

netic remediation of contaminated ground waters, suggesting a new stable precipitated form of radionuclides.

With instruments of even finer precision, measurement of isotopic signatures on small clay particles are becoming more useful for applications to paleoclimatic records, hydrologic variability, and diagenesis. Claudia Mora focused our attention on isotope geochemistry and environmental research. Most of this work addresses hydrogen and oxygen isotopic signatures of clays. Some new work in boron isotope geochemistry during smectite-to-illite hydrothermal transformations by Lynda Williams showed that the boron isotopic signature is retained during subsequent heating and may be a way to determine paleofluid pH.

George Guthrie continues to force us to con-

sider the many-sided aspects of health-related mineralogy, a field that is, in my opinion, still taking off from the mineralogic side. As one example of the exciting work in this area, John Naim discussed some interesting results looking at the adjuvancy of various minerals, meaning the ability of minerals to enhance the cell's response to antigens. In another example, Sara Gruenhagen stated that ferrihydrite can be stabilized by coprecipitated Si, thus enhancing its use as a potential dietary P binder for patients with chronic renal failure. I am fascinated by the potential for clay mineralogy research in the field of medicine and hope that this evolves into an even broader effort in the future.

Clay minerals as colloids and their move-



Jean Hsieh, Xiahong Feng, and Libby Stern talk at the CMS '96 Icebreaker in Gatlinburg. High Iron Photos



New President Steve Guggenheim and Jill Banfield. Dave Pevear

ment in fluids was highlighted in a symposium by Paul Bertsch and John McCarthy. It is easy to forget that clays are not necessarily permanent parts of a rock or soil structure. Paul showed how ground water pH and surface charge of matrix minerals can be adjusted by adding selected specifically-sorbed cations to cause preferred mobilization of Fe-oxides, the primary phase containing organic and inorganic contaminants in aquifers. Many other outstanding talks highlighted the fact that colloid transport is often the primary mode of contaminant movement.

Three concurrent sessions on Monday and Tuesday, and two on Thursday morning, kept everyone busy. In reviewing the abstracts for

continued on next page

Gatlinburg, *continued from previous page*

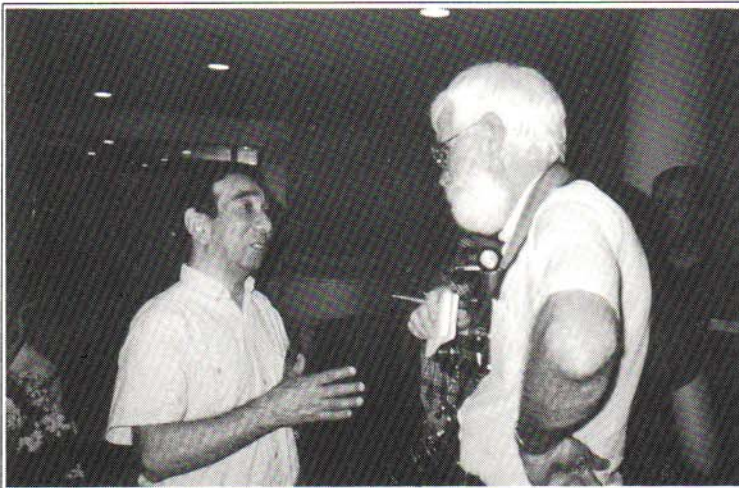
writing this article, I am reminded of how many innovative talks one can't attend simultaneously. Mingchou Lee showed some new data on M(cis) illites that suggested their use as a sign of nearby fault zones that had supported large-scale fluid migration. Brian Teppen presented a poster on empirical potentials for a variety of clay minerals using molecular dynamics computational modeling. Slowly, molecular modeling of clays is gaining momentum, and is an opening area for future research.

The field trip on soils and geomorphology of the valley and ridge province was led by John Foss, Michael Clark, and David Lietzeke. Of those who didn't attend the trip, many had a pleasant day hiking and sightseeing in the



Kurt Kyser, co-convenor of the 1996 workshop and Karen Zeigler.

Dave Pevear



Hideomi Kodama, Chair of the 1997 CMS-AIPEA Meeting in Ottawa, talks to Don Scafe.

Dave Pevear



Max Mortland delivers the Pioneer in Clay Science Lecture.

High Iron Photos

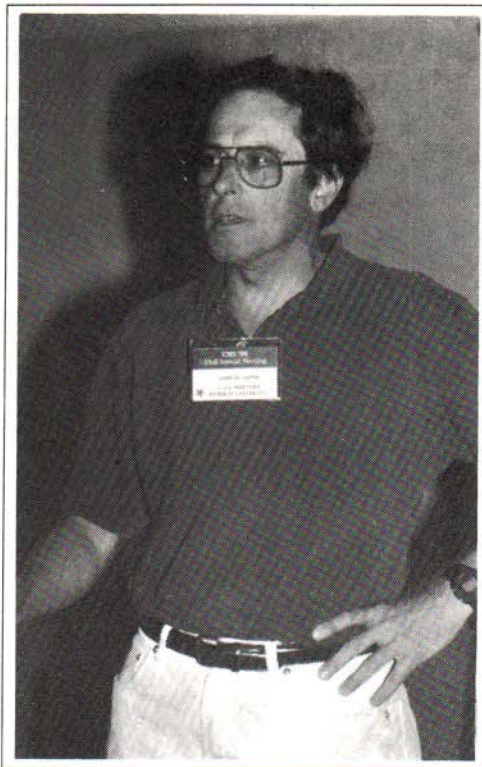


S. Y. Lee, Chair, and Mark Elless, Fundraising Chair, of the meeting.

High Iron Photos

Great Smoky Mountains National Park, not to mention practicing their putting in the dangerous presence of larger-than-life dinosaurs and moonshiners.

Darrell Schulze, Purdue University, received the Jackson Mid-Career Clay Scientist award. His lecture on "Minerals and Plants" perhaps should have been more appropriately titled "Plants and Minerals." Although some may find such a distinction



Sam Savin, 1996 Brindley Lecturer. *High Iron Photos*

subtle, Darrell clearly emphasized the point that in many cases it is the plant that controls the soil mineralogy. I was struck by the simplicity and clarity of Sam Savin's Brindley Lecture, "Sample Preparation is Everything." We all know that clays are the separated fine particle fraction of soils, sediments, and rocks, but Sam reminded us that this finely-separated fraction cannot be too finely-separated! Crystallographic and chemical properties even between 1 and 2 μm -sized particles can be extremely different and vital to the proper interpretation of their histories and formation. Finally, the Pioneer in Clay Science Lecture by Max Mortland on "Clay Reactions I Have Known and Loved" could be a theme song for each of us. Victor Drits received the Distinguished Member Award and provided an entertaining acceptance speech in response to Semeon Tsipursky's respectful introduction.

This year, an opportunity was afforded to those who can access NSF funding sources through a lunch-time interactive session with Maryellen Cameron of the Geochemistry Division of the National Science Foundation. She provided an instructive overview of



Crawford Elliott and Hailing Dong.

Dave Pevear



Michele Hluchy and Deborah Reid at the Icebreaker.

Dave Pevear



Bob Reynolds, Pete Ryan, Dougal McCarty, and Denny Eberl out looking for bears.

Dave Pevear

Gatlinburg, *continued from previous page*

funding opportunities and trends, with emphasis on clay science. It would be great to see this type of discussion continue at future meetings with opportunities to interact with other funding agencies.

As usual, the banquet was excellent and enjoyable. A highlight of the banquet was the Presentation of the Citation of Special Recognition to Don Scafe for his many years of good-natured service to the CMS as Secretary, as well as in his capacity as unofficial historian. His photographs are the major contribution to the CMS Archives. This is a good time to mention our thanks to those behind the scenes at the meeting. Patricia Honeycutt, Angela Beach, and Joy Lee of Oak Ridge National Laboratory worked hard to coordinate activities for accompanying persons, to register attendees, and to distribute meeting information. Likewise, we appreciate all the help from students organized by Cynthia Stiles and Yul Roh from the University of Tennessee.

Of the many types of meetings I attend throughout the year, I have to say the CMS meeting is one of the most gratifying and invigorating. I look forward to visiting Ottawa in June for the 11th International Clay Conference.

Next year's meeting in Ottawa will be a joint



Rick Lahann discusses a point from Lynda Williams' poster at CMS '96.

High Iron Photos



Boris Kornilovich, from Ukraine, and S.Y. Lee.

Jo Eberl



Three tall guys: Dewey Moore, Dave Bish, and Steve Chipera.

Jo Eberl



Bob Ylagan, Dave Pevear, Norm White, John Hillier, and Kathy Nagy studying the abstracts.

Jo Eberl

venture between the CMS and AIPEA, the international clay association, held from June 15-21. For more information, contact Hideomi Kodama, Eastern Cereal and Oilseed Research Centre, Agriculture and Agri-Food Canada, 960 Carling Avenue, Ottawa, Ontario K1A 0C6, Canada; (fax: 613-759-1926; e-mail: kodamae@nccot.agr.ca); or Jeanne Percival, Geological Survey of Canada, 601 Booth St., Ottawa, ON K1A 0E8, Canada (fax: 613-943-1286; e-mail: icc97@gsc.emr.ca). The 1997 Distinguished Member will be Udo Schwertmann, the Jackson Lecturer will be Jerry Bigham, the Brindley Lecturer will be Paul Nadeau, and the Pioneer Lecturer will be Koji Wada.



Fritz Madsen, Rolf Nüesch, and Alessio Menegatti at the Icebreaker. High Iron Photos

The 1998 meeting will be held June 13-17 in Cleveland, Ohio. For information, contact Sam Savin, Dept. of Geological Sciences, Case Western Reserve University, Cleveland, OH 44106 USA (fax: 216-368-3691; e-mail: sms7@po.cwru.edu).

Kathy Nagy, Albuquerque, New Mexico

1996 Ballot Results

Vice President Elect: David L. Bish; Secretary: Richard W. Lahann; Council: Jessica M. Elzea, George D. Guthrie, Cliff T. Johnston, and Kathryn L. Nagy.

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Teaching Clay

The Web Accessible Diffractometer

The Internet is a ubiquitous part of academic life. E-mail, listservers, and local area networks promote the exchange of information and the sharing of resources essential to a modern geology program. The World Wide Web has grown enormously, giving even the smallest departments the opportunity to be publishers of textual and graphical information. Services like the Clay Minerals Web site at <http://ctjrs.agry.Purdue.edu/claymin/clayminsoc.html> provide central gathering points for useful information.

Less appreciated is the ability of the Web to extend sophisticated analytic resources beyond the walls of any single laboratory. Therein lies an exciting opportunity to expand our teaching and research opportunities in the clay sciences. I'll describe here one example involving a Web Accessible Diffractometer.

X-Ray diffraction is an essential part of many clay studies, and all students of clay science must understand the basic principles of diffraction. Unfortunately, a modern diffractometer is expensive, and safe operation requires close supervision of all but well-seasoned, authorized users. Instructors in small and mid-sized departments may not have an X-ray diffractometer at their immediate disposal, and instructors in larger departments may find it inconvenient to schedule large numbers of students to complete a diffraction analysis.

At Indiana-Purdue University Fort Wayne (IPFW) we have interfaced a Phillips APD3520 X-ray diffractometer to a Web server. Remotely located users, whether in a teaching lab in another part of the campus or at a college in another state, can access the diffractometer through the Geosciences home page at <http://www.geosci.ipfw.indiana.edu> The

user needs no specialized equipment other than a computer connected to the Internet running standard Web browser like Web Explorer, Netscape or Mosaic.

The remotely located user controls most of the diffractometer's operating parameters (including step size, count time, steps per degree two-theta, starting angle and ending angle) by making entries through a standard Web form. The diffraction pattern appears in real-time on the remotely located screen where it can be printed. It is also possible to download the raw counts and two-theta data for subsequent analysis and plotting.

Samples are mounted, and the tube current and voltage are set, by a trained XRD operator. Everything else is controlled by the remotely located user. The use of a standard Web form permits error checking and prevents possibly damaging commands from reaching the diffractometer (e.g., extended counts at 0° two-theta). Students and other novice users can 'play' for extended periods without direct supervision.

At IPFW we are using the Web Accessible Diffractometer in the undergraduate mineralogy course. Students have a semester-long project to identify ten thumbnail specimens using the various analytic methods introduced during laboratory exercises. (These more challenging samples are in addition to the several dozen minerals they learn to identify solely by hardness, luster, and other properties apparent in hand samples.) Three of the ten specimens are presented on the Web Accessible Diffractometer. Any student at his or her leisure can access the diffractometer from one of the open PC clusters on campus, prepare a pattern of the currently mounted sample, and use that infor-

mation to identify the mineral. Schedules are quite relaxed, and students can repeat the analysis until they are satisfied with their results.

Faculty at institutions without an in-house diffractometer can send me a sample in the mail to be mounted at some convenient time. (Send an e-mail request to ARGAST@SMTPLINK.IPFW.INDIANA.EDU.) I've received about a half dozen requests for this service during the first full semester of operation. Most requests have come from students who simply want to "play." I encourage this type of "play" as one of the best ways to learn, however, this service is available to any instructor who would like to make diffraction a formal part of his or her course.

Oriented samples can be sent in a properly packaged mailer being careful to protect the sample side of the mount. Powder for an unoriented backpack can be sent in a vial. There is also a slowly growing archive of samples that can be requested. (These are listed on the Web site.) I would be happy to receive prepared mounts for this archive. Such donations could substantially increase teaching opportunities through the site.

A simple Web interface is inexpensive. Ours is run completely on a 486-class PC running Goserve 2.1 in an IBM OS2 operating environment. This single computer controls the diffractometer, processes the counts data into a diffraction pattern, and converts it into a GIF format for the Web site (which also runs on the PC). The diffraction pattern is updated once every minute. A Pentium with dedicated hardware for graphics compression would substantially increase the update rates and access speeds,

continued on next page

though ours runs reasonably well in this simple configuration. Programs for executing the various processes are written in a combination of standard HTML, Basic, C++ and REXX (the native OS2 programming language). The programming is available upon request, though you will probably need local computer support to make the interface with your specific brand of XRD. We are in a very early phase of testing this concept, and the programming is still a bit crude and unwieldy. It may well be that you can improve greatly on the efficiency of operation.

A diffractometer is just one type of

device that can be integrated with the net. Anything whose primary control is through a computer is a candidate for Web access. Indeed, we are currently exploring ways to create a Web Accessible Scanning Electron Microscope.

Sharing equipment through the Web is one way to prosper in a competitive budgetary environment where it may be difficult or impossible to obtain the funding to purchase expensive, yet necessary, instrumentation. It is especially difficult in small undergraduate programs that don't always have a sufficient quantity of teaching and research application to

justify such purchases. Instrument sharing through the Web presents a way to form a consortium with a "critical mass" for funding. It also provides a way for larger, research-oriented, equipment-rich campuses to provide meaningful assistance to smaller institutions within their sphere of influence.

Rapidly developing computer resources hold many keys for improving teaching at all levels of expertise. Exploiting these resources will be an important challenge to clay scientists for many years to come.

Scott Argast

Fort Wayne, Indiana

Meeting Calendar

February 24-27, 1997, Denver, Colorado, USA: SME Annual Meeting. Contact: Meetings Department, SME, PO Box 625002, Littleton, CO 80162-5002, USA; fax: 1-303-979-3461.

March 23-27, 1997, Strasbourg, France: European Union of Geosciences EUG 9. Contact: Dr. Laurence N. Warr, Geologisch-Palaeontologisches Institut, Ruprecht-Karls-Universität, INF 234, 69120 Heidelberg, Germany. Tel: 49-6221-54-4835; fax: 49-6221-54-5503; e-mail: HQO@ix.urz.uni-heidelberg.de; WWW: <http://sparc.ipgp.jussieu.fr/EUG>

April 9-11, 1997, Aberdeen, Scotland: Golden Jubilee Meeting, Clay Minerals Group of the Mineralogical Society. Contact: Dr. Derek C. Bain, The Macaulay Land Use Research Institute, Craigiebuckler, Aberdeen AB15 8QH, Scotland; Tel: 44-01224-318611; fax: 44-01224-311556; d.bain@mluri.sari.ac.uk

May 4-7, 1997, Cincinnati, Ohio, USA: American Ceramic Society Annual Meeting. Contact: American Ceramic Society, PO Box 6136, Westerville, OH 43086-6136; Tel: 614-890-4700; fax: 614-899-6109.

May 25-28, 1997, Parma, Italy: 5th European Powder Diffraction Conference. Contact: EMMEVI Servizio Congressi s.r.l., Viale dei Mille 140, I-43100 Parma, Italy.

June 15-June 21, 1997, Ottawa, Ontario, Canada - Joint AIPCA/CMS Meeting. Contact: Jeanne B. Percival, Geological Survey of Canada, 601 Booth St., Ottawa, ON K1A 0E8, Canada. Tel: 613-992-4496; fax: 613-943-

1286; e-mail: icc97@gsc.emr.ca; www: <http://www.cisti.nrc.ca/ICC97/>

August 4-8, 1997, Steamboat Springs, Colorado, USA: Denver X-Ray Conference.

October 5-8, 1997, San Antonio, Texas: Society of Petroleum Engineers. Box 83386, Richardson, TX. Tel: 214-952-9393. Fax: 214-952-9435.

October 20-23, 1997, Salt Lake City, Utah: Geological Society of America, Mineralogical Society of America. Contact: GSA, PO Box 9140, Boulder, CO 80301. Tel: 303-447-2020.

October 23-26, 1997, Anaheim, California, USA: SSSA Annual Meeting. Contact: SSSA, 677 South Segoe Road, Madison, WI 53711, USA.

November 13-14, 1997, Nottingham, England: Clay Mineral Evolution, Basin Maturity and Mudrock Properties, Clay Minerals Group of the Mineralogical Society. Contact: R. J. Merriman, British Geological Survey, Kingsley Dunham Centre, Keyworth, Nottingham NG1 35GG, United Kingdom; Tel: 01159-363417; fax: 01159-363352; r.merriman@bgs.ac.uk

May 18-20, 1998, Québec City, Québec: Joint meeting of the Geological Association of Canada, the Mineralogical Association of Canada, and the Association professionnelle des géologues et des géophysiciens du Québec. Contact: Mme Agathe Morin, Département de géologie et de génie géologique, Université Laval, Pavillon Adrien-Pouliot, Sainte-Foy (Québec) G1K 7P4, Can-

ada. Tel: 418-656-2193; fax: 418-656-7339; quebec1998@ggl.ulaval.ca; <http://www.ggl.ulaval.ca/quebec1998.html>

June 13-17, 1998, Cleveland, Ohio, USA: Clay Minerals Society Annual Meeting.

Contact: Sam Savin, Dept. of Geological Sciences, Case Western Reserve University, Cleveland, Ohio. Tel: 216-368-6592; fax: 216-368-3691; e-mail: sms7@po.cwru.edu

June 1998, Brisbane, Queensland, Australia: Australian Clay Minerals Society Conference.

August 20-26, 1998, Montpellier, France: World Congress of Soil Science. Contact:

16th World Congress of Soil Science, Agropolis, Avenue Agropolis, 34394 Montpellier cedex 5, France; Tel: 33-67-04-75-38; fax: 33-67-04-75-49; iss@agropolis.fr; Server WWW: <http://www.cirad.fr/iss.html>

October 18-23, 1998, Baltimore, Maryland, USA: SSSA Annual Meeting. Contact: SSSA, 677 South Segoe Road, Madison, WI 53711, USA.

October 26-29, 1998, Toronto, Ontario, Canada: Geological Society of America, Mineralogical Society of America. Contact: GSA, PO Box 9140, Boulder, CO 80301. Tel: 303-447-2020.

1999, Krakow, Poland: Euroclay 1999.

Contact: Jan Srodon, Institute of Geological Sciences PAN, Senacka 1, 31-002 Krakow, Poland. Fax: 48-12-221609; e-mail: ndsrodon@cyf-kr.edu.pl

