CMS News

A Publication of The Clay Minerals Society

March 1990

Jacksons endow midcareer lectureship

The Clay Minerals Society is pleased to announce that Dr. Marion L. Jackson and his wife Chrystie M. Jackson have contributed $20,000 to establish a new lectureship for The Clay Minerals Society. The award will be presented to a clay scientist in midcareer, between the ages of 37 and 60, and will be called the *Marion L. and Chrystie M. Jackson Midcareer Clay Scientist Award.*

Dr. Jackson, who was a member of the National Research Council Committee of the National Academy of Sciences that was the precurser to The Clay Minerals Society, says his hope is to encourage and inspire midcareer scientists. Mrs. Jackson adds that they have planned to do this for many years.

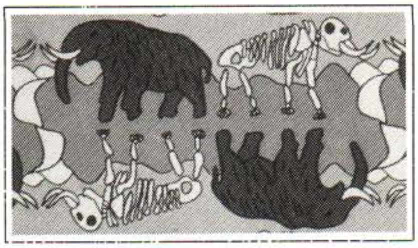
Brij L. Sawhney, President of the CMS and a former student of Jackson, says that the award will be presented at the annual meetings and that the awardee will be asked to present a lecture. The lectureship will be accompanied by a cash award. The first presentation will not be made until the 1991 meeting, in order to give the Society time to appoint a committee to make the nomination. However, a formal recognition of the award and the Jacksons will take place at the 1990 meeting.

Jackson, Professor Emeritus at the Soil Science Department, University of Wisconsin, says that his wife has always been a full partner in his work. She usually attends the CMS annual meetings, and since 1939 has entertained the over 50 graduate students who have studied with her husband.

Marion L. and Chrystie M. Jackson

Jackson is well-known in the soil science and clay science communities. Among the many honors he has

continued on page 16



Mastodons in plane group p2gg, one of the 17 symmetrically unique ways of repeating a motif.

Mastodons and violets demonstrate crystallography principles

Art and science meet in the remarkable new slide set, *Symmetry Drawings of the Seventeen Plane Groups* by Audrey Rule, creator of the Mica Polytype slides. Published by The Clay Minerals Society, the set offers 17 bright full-color drawings, each illustrating one of the plane groups of symmetry—the 17 unique ways of repeating an object in two dimensions. The set of 18 slides (17 symmetry drawings plus one extra slide illustrating symmetry operations) comes with explanatory text and symmetry keys for all the drawings.

The slides are useful for teaching mineralogy, crystallography, chemistry, and mathematical group theory,

continued on page 11

The Clay Minerals Society

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Many thanks to our advertisers this month, **JCPDS, Nature's Own,** and **R. C. Reynolds, Jr.**, for helping make the newsletter possible.

Letters

Finicky, vegetarian clay

Editor:

Will Ms. Editor please ask the bright, young, 1990-model minds of CMS members to enlighten me (who retired from teaching and learning clay mineralogy back in 1970) on the possible genetic relationship of abundant land plants in geologic time with the age and origin of commercial-size deposits of surficially weathered kaolinite? What is the age of the geologically oldest commercial-size deposit of surficially weathered kaolinite? Is it Pennsylvanian, or older when land plants were less abundant? Why involve land plants? Two possible reasons are suggested, first the speculative one.

Kaolinite is rich in oxygen (55.8% O_2 by weight compared to orthoclase at 46%), so there had to be (?) an adequate concentration of gaseous O_2 in the atmosphere for kaolinite to form by weathering. Land plants release O_2 during photosynthesis, so what was the geologic time when enough land plants were releasing oxygen to the atmosphere to stabilize the formation of kaolinite by surficial weathering? Was Pennsylvanian the earliest time for O_2 concentration to meet the requirements? Iron-band silicates were formed during the Pre-Cambrian, but Fe combines with O more actively than other elements, such as the AlSi pair. Hence the question: were, and if so, geologically when, were plants, gaseous O_2, and surficial kaolinite a compatible genetic trio? Or, is that too speculative to merit cogitation?

Our David Houseknecht (UMC) has pointed out that the prevalence of arkoses in early Paleozoic rocks represents physical weathering more than chemical weathering in older geologic time, whereas in later, younger ages, chemical weathering

continued on page 11

Clay mineralogist approaches THE SURFACE
Cartoon by Peggy L. Buschman

Thanks...

To the following people who contributed to this issue:

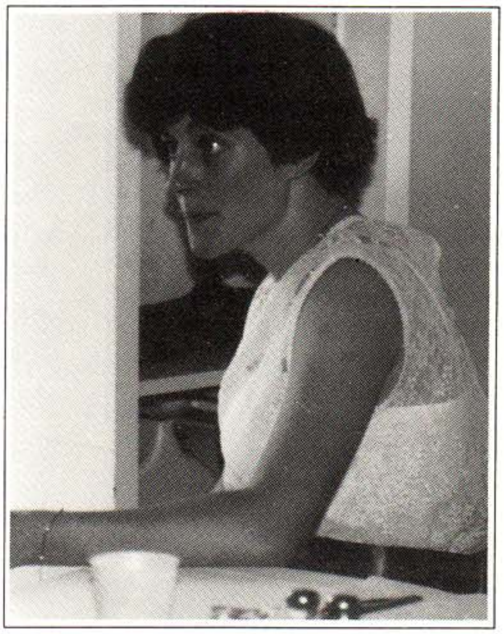
Richard H. April
Lelia M. Coyne
J. B. Dixon
Dennis D. Eberl
Michelle M. Hluchy
Marion L. Jackson
Walter D. Keller
Richard M. Pollastro
Audrey C. Rule
Don Scafe

Memorial to Norma Vergo 1959-1989

I first met Norma Vergo in September of 1979. She had just transferred from SUNY Oneonta to spend her junior and senior years majoring in geology at Colgate University where I was then a junior faculty member. Norma was enrolled in my mineralogy course, and although there were more than sixty students in the class that year, it didn't take long for me to realize that this intelligent and strikingly beautiful young woman would develop into one of the Department's finest geology majors. In the weeks and months that followed, I was to learn how deeply interested Norma was in the workings of the natural world and of the reasons for her coming to Colgate for the remainder of her undergraduate career. It is rare for someone twenty years old to be so determined about the future, but Norma was. And from the moment she set foot into the Geology Department at Colgate, Norma effused a verve and love for life that enveloped and affected all who were fortunate to know her.

Norma effused a verve and love for life that enveloped and affected all who were fortunate to know her.

Norma finished her junior year with aplomb and signed up for the department's 1980 off-campus field program—fondly referred to as the "O.C." It was during that summer of geologic mapping and outcrop hopping, ten weeks of camping and driving around the northeastern United States and living with 25 other students for 24 hours a day, that Norma developed many close friendships that were to last the rest of her life. On my two-week section of the O.C., I took the group down to Connecticut for a day to inspect the contact metamorphic aureole surrounding the basalt intrusions of the West Rock sill. Norma seemed intrigued with the area and later that day talked to me about the possibility of conducting an independent research project on the hornfels zone. Early in the fall we went back to Connecticut to collect samples. The eight hours of driving there and home were filled with chatter about life, family, geology, Greek food, bartending, friendships, and aspirations for the future. I think it was then that I fully realized the depth of experience, compassion for people, and love of life that this lovely woman held inside.



Norma Vergo in 1988 *Photo by Michele Hluchy*

Once back, Norma set to work, and by the end of the year she had come up with some very interesting results concerning transformations of clay minerals within a meter or so from the basalt-mudstone contact. We submitted an abstract to the Northeastern Section meeting of the GSA that was to be held in Bangor, Maine, in the spring of 1981, and after some cajoling, I convinced Norma that she should give the presentation. I'll never forget how nervous she (and I!) was as the talk preceding her own was about to end. We had practiced and practiced the day and morning before, but, as many of us know, there is no elixir to calm the butterflies in one's stomach when about to present one's first professional talk at a scientific conference. It was time, and I wished her luck. Norma, with her back straight and her shoulders square, walked up to the podium, took a very deep and audible breath, and proceeded to give a flawless and magnificent talk. For those who teach, you know that there is nothing more exhilarating than when one of your students excels under the scrutiny of the members of the academic profession. Oh, was I proud!

With the GSA meeting behind her, it was time for Norma to chose a graduate school. She had applied to four or five schools, but had narrowed down her choices to the Universities of Illinois and Massachusetts. John Hower and Richard Yuretich had both spoken with her, and each had offered her a research assistantship. It was time to decide, but it was a difficult choice. As a graduate of the University of Massachusetts myself, I was able to tell Norma all about the Amherst area, the univer-

continued on next page

Norma Vergo, *continued*

sity, and the geology department. But Illinois was an unknown. And so, with Norma sitting in my office, I picked up the phone and called one of John Hower's Ph.D. students who had graduated from Colgate just two years earlier. I spoke with him for a moment to explain the situation, handed the phone to Norma, and told her that he would be most happy to talk with her about Illinois—and oh, by the way, his name was Stephen Altaner.

Norma graduated from Colgate in 1981 with a B.A. and honors in geology and went on to the University of Illinois where she earned her Master's degree. Over the next few years she produced some fine work on hydrothermal ore deposits, methods of clay analysis, and the nature of clay minerals. While in graduate school, Steve and Norma dated and fell deeply in love, and in 1984 they were married. Two years ago Norma and Steve had their first child, Sammy, whom they loved dearly.

I last saw Norma at the end of the summer in Strasbourg, France, where the Ninth International Clay Conference was being held. It was late August, nearly ten years to the day since she first walked into my classroom and into my life. She loked radiant and wonderfully content with little Sammy in tow, Steve by her side, and the knowledge that she was carrying their second child. I could not have been happier for them, my two former students, now my two dear friends. We all had such a marvelous time that week, meeting so many new people at the conference, admiring the sights, dining together in fine Alsatian restaurants with good friends and new acquaintances from all over the world. But soon it was time to leave, and on a fine summer's evening, after a walk back to the city center from the Petite France section of Strasbourg, where a group of us had gone for dinner, we said our good-byes, and I hugged and kissed Norma for what was to be the last time.

There is nothing more exhilarating than when one of your students excels under the scrutiny of the members of the academic profession.

Norma Vergo died on Sunday morning, January 28, at Barnes Hospital in St. Louis, Missouri, after courageously battling an illness that had kept her hospitalized for two months. She was thirty years old. Those of us who were fortunate to have known Norma are heartbroken and deeply saddened by her death. I know I speak for all of us in extending Steve, Sammy, and the parents and families of both Steve and Norma our heartfelt sympathies and the consolation that Norma was loved by many and will be thought of often and always.

Richard H. April
Hamilton, New York

Norma Vergo Prize in Geology

Norma's friends and colleagues have started a fund in her memory to establish the Norma Vergo Prize in Geology at Colgate University, which will be awarded each year to a geology concentrator who significantly contributes to the spirit of excellence among fellow students in the department. Inquiries about this fund can be addressed to Michelle Hluchy, Department of Geology, Alfred, New York 14802 (607-871-2838), or contributions to the fund can be sent directly to Ruth Ann Loveless, Development Office, Colgate University, Hamilton, New York 13346. Checks made payable to Colgate University should be accompanied by a short note indicating that the contribution is for the Norma Vergo Prize in Geology.

Mineralogical Society of America Short Course on Mineral-Water Interface Geochemistry

The Mineralogical Society of America will sponsor a short course entitled, "Mineral-Water Interface Geochemistry," October 25 through October 28. The course will take place just prior to the MSA/GSA Annual Meeting in Dallas, Texas. Speakers from the U. S., Canada, Australia, and Switzerland will discuss fundamental aspects of important geochemical reactions that occur at mineral-water interfaces including sorption, ion exchange, dissolution, precipitation, catalysis, and electron transfer (oxidation-reduction). Applications of these topics to more applied subjects, such as the geochemical cycling of the elements, ore deposit formation, and the mobility of pollutants in groundwater, will be explored. The meeting is being convened by Michael Hochella, Jr. (Stanford University) and Art F. White (USGS, Menlo Park).

Registration is limited to 115 individuals. For further information and a registration form, please contact the Mineralogical Society's business office at 1625 I Street, N. W., Suite 414, Washington, D. C. 20006, or call (202) 775-4344.

Council resolutions passed in Sacramento

At the CMS Council Meeting, Sunday, September 24, 1989, in Sacramento, California, several motions were passed that relate to operations of the Society.

The Publications Committee recommended that a free subscribing membership to CMS be presented to the winner of the best student paper at foreign clay society annual meetings. Moved by Pat Costanzo, second Warren Hüff that a one-year free subscription to *Clays and Clay Minerals* be awarded to the winner of the best student paper at selected foreign AIPEA-member clay society annual meetings. Carried. The CMS Program Advisory Committee is to develop the program for selecting foreign societies that can offer the award.

The Program Development Committee reported that Dick Berry of San Diego State University has offered to host the 1993 CMS meeting. Moved by Tom Pinnavaia, second Pat Costanzo that the offer of Dick Berry to host the CMS meeting in San Diego during the summer of 1993 be accepted. Carried. The meeting could be a joint meeting with the MSA.

The Policy and Administration Committee recommended two changes to the by-laws to cover how the chairpersons of the Finance and Budget Committee and of the Nominations Committee are to be appointed. Moved by Brij Sawhney, second Pat Costanzo that the recommendations of the Policy and Administration Committee be accepted. Carried. The recommendations are that, "The chairperson of the Nominations Committee who is appointed by the President shall be a senior member during his/her last year of service," and that, "One member of the Finance and Budget Committee shall be appointed as chairperson of the committee each year and shall be eligible for reappointment without limitations."

With the resignation of Sue Wintsch, the position of office manager will become vacant after the Sacramento meeting. Moved by Ken Towe, second Tom Pinnavaia that Jo Eberl be appointed as office manager and that the Society office be moved to Evergreen, Colorado. Carried. The President is to appoint an office advisor.

The Brindley Lecture Committee recommends Alain Baronnet, who has been performing pioneering research in using TEM to study crystal growth of phyllosilicates, as the 1990 Brindley Lecturer. Bob Reynolds is recommended as the alternate speaker. Moved by Warren Huff, second Pat Costanzo that the recommendations of the Brindley Lecture Committee be accepted. Carried. The Society is to provide return air fare and an honorarium. The local committee is to cover the cost of the hotel and registration.

Four grant requests were received by the Research Grants Committee from students at SUNY Buffalo, University of Cincinnati, University of Illinois, and University of Montana. The grant requests total \$8958. Moved by Pat Costanzo, second Gray Thompson that the four grants listed in the report of the Research Grants Committee be approved. Carried.

Don Scafe, Secretary CMS
Edmonton, Alberta

X-ray patterns wanted

Jim Wood and Reed Glasmann would be interested in seeing the X-ray data on samples collected on the field trip during the Sacramento conference. If you have made X-ray studies of these samples, please send xerox copies to Reed or Jim at Union Oil of California, P. O. Box 76, Brea, California 92621.

Dues paid?

A number of members have called the Society Office to see if they have paid their 1990 dues. If your name is circled in red on the address label, it means your 1990 dues have *not* been paid. Contact the Subscription Office at 1-800-627-1244 for renewal information.

Interviews with the clay scientists

Lelia M. Coyne

Lelia M. Coyne works at NASA Ames Research Center, and is affiliated with San Jose State University. She is interested in problems concerning clays and the origin of life. One of her discoveries (together with Lahav and Lawless; see Nature, 1981, v. 292, 819-821, and subsequent papers) is that certain clays emit bursts of light when stressed. The interview took place at the Sacramento meeting.

CMS: Your research is unusual, to say the least. Do you think that energy actually is stored in clays, and that it can be released by grinding, or by wetting and drying?

COYNE: There is no question that electronic energy is stored in clays. The questions are, how much and how useful? There are gentle environmental conditions that will promote the release of this energy. With grinding, there is a question as to whether prior stored energy is being released from the clay, or whether the grinding itself is serving as an excitation source. That's a very important issue, obviously, with respect to surface chemistry.

CMS: How do you know that the energy is being released?

COYNE: We know that the energy is being released, because under relatively gentle conditions, ultraviolet light is given off by the clay over a period of minutes, to hours, to weeks, to months, depending on the nature of the perturbation. That is direct evidence of energy release. Couldn't be more direct.

CMS: How does this energy get into the clay to begin with?

COYNE: Again, a certain amount of speculation, because there are so many possible triggers for the excitation and for the release. The most likely source is natural gamma ionizing radiation. That's the best known one, and is used as the basis for thermoluminescence dating. I would be very interested to find that some of the energy was getting into the clay by mechanical processes, because that would be a real upgrading of energy. One thinks of mechanical stresses as being frictional, dissipative and heat-producing. If there is a way to get this low-grade energy into separated charge pairs that could be released as photons, then this would be a profound development.

Drawing by M. J. Nash

CMS: Why would this be profound?

COYNE: Because geology is rife with mechanical processes and because one is upgrading "low-grade" energy sources. With a well-defined photon, representing a well-defined energy state, one can do photochemistry, rather than thermal-type chemistry. There would be the potential for driving chemical reactions in specific ways that do not result in equilibrium product distributions.

CMS: You mean that one could use this effect as a very specific catalyst?

COYNE: Yes, and it could be used as an energy source for chemical reactions that could not be performed efficiently otherwise. Stored energy is a source both for facilitating thermodynamic-type reactions, and for producing various forms of photochemical reactions. The energy centers trapped in the clay crystals, even without releasing their energy, may serve as catalytic sites, depending on their charge distribution and their structure, because they are metastable excited states in the material.

CMS: So you could make one organic chemical out of another by mixing it with the clay and shining a light on it?

COYNE: That's right. Even by "shining" a gamma

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Coyne, *continued*

source on the clay and mixing it with organic chemicals later. Light is only one way to promote the energy release. Grinding is another. Wetting and drying operations are others. The natural cycling phenomena that occur in nature, such as rainy and dry seasons. Gentle heat. Once you have big photons trapped in the crystal structure, there are lots of ways of rearranging that energy and releasing it.

CMS: How did you discover this photon release from clay?

COYNE: It was, interestingly enough, a predicted phenomenon, not to make it simpler than it was. I was at that time married to a high-energy physicist, and I was just reading a publicity blurb on the wall by Harshaw about the thermal luminescent dosimeters, and it made the statement that many materials are thermoluminescent, including common bricks. The association was: bricks—clay—energy—light release—electronic energy stored in the crystal lattice. I wondered if there was enough energy to drive chemical reactions.

I was working then out of an origin of life group, and becoming a little bit dismayed at the amount of chemistry that had to be done in such a short period of time, and thinking that there must be ways to speed the process up, to make it more specific and more efficient. The idea of doing photochemical reactions on the surface of a mineral was very appealing to me; so I started investigating thermoluminescence, and came to the conclusion that it would not be terribly useful, because you would have to heat the clay to a very high temperature such that the organic material would be decomposed to get the light out. Also, it's a one shot affair, because once you've heated the mineral up to get the energy out, you can't do it again unless you re-excite. It just didn't sound very useful.

Then I talked about these ideas to one of my colleagues, who said, "Oh, TL, you mean triboluminescence." I said, "No, I mean *thermo*luminescence." And he said, "Tribo!" And we started arguing back and forth. He said "I know TL means tribo, because I went to a party, and we did the wintergreen lifesaver experiment." You know the wintergreen lifesaver experiment? This is crazy, but this is what happened. I said, "No, what's that?" He said, "You crunch a wintergreen lifesaver between your teeth, and you get a flash of blue light. Here, I'll prove it." He pulled a paper out of the *Journal of Chemical Education* on triboluminescence from common sugars. I read the paper, and I thought, this is not a joke. This is the real stuff.

The photon that they were getting off was an atmospheric nitrogen emission. It would have taken eleven electron volts to excite it directly with light, and here they were exciting it with mechanical stress. I thought, "This is amazing! This is an upgrading of energy!"

Well, it turns out that the people doing the work in organic triboluminescence also were trying to use it as a photochemical energy source. They had not been very successful. But I got very excited about the possibilities with minerals, which could store energy. We were doing wet-dry cycle experiments in which we were able to drive a certain chemical reaction, the peptide bond formation, only by this wet-dry cycling protocol. The guy who told me about the wintergreen lifesavers was the one who was actively doing these cycling experiments. This was Dave White, who has since died at 42 of a heart attack.

About that time, Noam Lahav, from Hebrew University in Israel, came through the lab. He, with Dave White and Sherwood Chang, had been the originators of the wet-dry cycling protocol to make peptide bonds. I asked Noam if there was any way of putting mechanical energy into the system during wetting and drying. He said,

There is no question that electronic energy is stored in clays. The questions are, how much and how useful?

"Well, maybe just the wet-dry cycling itself. You've seen mud cracks when clay is dried. Wouldn't that give you light by your hypothesis?" I said that these processes are very capricious. Who's to say? He said that he knew a simple experiment.

We went into a dark lab to look for visible light. We did all kinds of experiments over two days. We would do this and that. He would think of something; I would think of something, and he would think of something. And we didn't see anything. Finally he said, "You know, I did the luciferin experiments one time. We could just take a wet clay, put it into a scintillation counter, and let it dry out." I said that it was a great idea, because the counter would be much more patient.

We were going to do it with smectite; but we couldn't find any, so we put in some wet kaolinite. We just had a tiny, thin paste in the scintillation counter. We turned on the photon counter and watched it. The count rate at first was going down because of artifacts of room heat and light, and suddenly the count went up! The two of us just nearly.....neither one of us believed it! The reason we hadn't seen anything previously is that we weren't sensitive to ultraviolet light, but the scintillation counter was.

We started reproducing it. We tried it with smectite,

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Coyne, *continued*

which didn't work for a lot of reasons we think we understand. Then Lahav went mad, taking every mineral he could find off the shelf, and stuffing it in the scintillation counter to see if he could get light off of it. And I went into a state of total paranoia: "This has got to be a photon-counting artifact," so I went madly around to see how much heat could be released. So, by virtue of our different personalities, we were doing what we had to do to verify the effect. I don't think the discovery would have happened without either one of us. We were both the right people, at the right time, with the right attitude and the right backgrounds and, very fortunately, the right equipment.

Once you have big photons trapped in the crystal structure, there are lots of ways of rearranging that energy and releasing it.

CMS: Did other minerals work besides kaolinite?

COYNE: No other minerals. I have since found one other material that does work, and I think that this is very significant. The other material that gives this effect is coal, given to me by the Institute at Kentucky State in Bowling Green. Coal is fascinating, because some intercalation agents that also induce light release, like potassium acetate and hydrazine, the same things that split apart the kaolinite layers, will cause swelling in coal.

CMS: But did the kaolinite that you used have anything intercalated in it?

COYNE: Well, no. There are multiple triggers. This is not a simple problem, and there other sources for triggering energy release: heat, mechanical stress, solid-state interfacial effects, chemluminescent surface reactions.

The next step was to try other kaolinites. Noam did this back in Israel, and found that, yes, every kaolinite he looked at did it. He found that the better crystallized ones did it better. At the time, I was trying to grind up all of the kaolinites we had in the lab, and I was noticing that the more we ground, the more we found a monotonic background emission that would decay with time. The various things that I was doing to the clays, such as sonication and grinding, would increase this emission and change its time profile. I talked to Noam when he came back, and he said, "Oh, so it's mechanical stress, too!" I said, "That's right."

CMS: Mechanical stress to release the energy from the clay, or to put it in there?

COYNE: Haven't answered that question. I know the experiment to do, but I just haven't had the time and the support to do the experiment. So his approach, always very forthright, was to take a lump of clay, smack it with a hammer, and put the chips in the scintillation counter. Sure enough, that did it too, but instantly, not after a delay period.

I gave a talk at an ACS meeting in Houston, and Phil Jones and Max Mortland were sitting in the audience. Phil and Max took me out to dinner, and Phil said, "You know, this sounds like my thesis work." He started telling me about the O-minus centers, the EPR work, and the temperature dependence. I said, "Phil, this is fantastic!" I had just gotten into this business of considering what the trapping centers and their population might be. So I read Phil's papers, and learned a lot. With the help of Roger Kloepping and Alan Ling of the Nuclear Sciences Facility at SJSU, I was able to correlate luminescence and EPR signals.

Then I began to worry that it was an impurity in the kaolinite that was causing the effect, rather than the clay itself. I still have occasional night sweats about bacteria, but the reversibility to heat and gammas pretty well assuage them. In Bologna I just happened to sit down to lunch next to some fellows from ECC. They invited me to Cornwall, and Brian Jepson gave me some very pure, highly-crystalline, Cornish research kaolinites. These clays gave me a hundredfold enhancement in the photon count, over that which we found for the original Fisher kaolinite, as they went through a critical moisture content during drying.

Having those kids gelled my resolve to do the science. It made me be efficient in a way I had never been efficient. So it was a mixed bag.

Then I went over to San Jose State to reproduce the work with a student—Wendy Hovatter—because what if we had an artifact from the scintillation counter? Noam had done it in Israel, but, still, I hadn't done it, and by then we weren't too close, and I didn't want to trust. I tried the Fisher clay: no effect. Stuck in the Cornish clay: good signal. It turned out that the counter at San Jose had pyrex

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Coyne, *continued*

windows on the phototube. With the Fisher clay the luminescence was too weak to see. If we had done the original experiment at San Jose State, we never would have seen the effect.

About that time, Max Mortland came through and talked about dewatering clays by putting on amines. I am embarrassed about the experiments that followed, because they were poorly controlled: the proportion of amines to water were totally screwed up, and, frankly, the reasoning to some extent. You're flying high, and just having fun playing games at this point.

So I went up to my friendly organic chemist, Glen Pollack, and got a whole series of amines. (These extra chemicals now get thrown out for "safety" reasons). We put the clay and the amines in the scintillation counter and we got light off—for minutes to hours, not just in one delayed burst. Just by putting the amines on! I thought, gee, this is really exciting! It's a whole different thing, because it is monotonic rather than delayed bursts.

Hydrazine was completely different from all the rest, because it had both the strong, monotonic release, and then a delayed burst on top of it. So I went back to van Olphen's book to find out what is special about hydrazine, and found out that hydrazine intercalates. Got excited about that, and thought, "Well, we took water off and got light. What if we take the amines off? Will we get light?"

We took the amines off with sulfuric acid, and, sure enough, we got a delayed burst. Then I went into a state of total panic all over again, because the thermodynamics of getting light from the clay when I added liquid, and light again when I took the liquid off—this was the problem of Maxwell's demon. That made me ask about the mechanism of light release, and made me get more deeply into the solid state theory. That's why I came up with the interfacial band bending model. It made me see the profound degree to which electric fields must be connecting the interior of the mineral with its surface.

CMS: You have two children. What is it like being a scientist and a mother?

COYNE: Being a scientist and a mother: I don't know how you do it. It is not something that is easy to do. Fortunately, things have worked out for me, by virtue of some other strange aspects in my life, given that I was following this high-energy particle physicist who was teaching double loads at Princeton, and then going to California to do his research.

I was fortunate enough in the period of having my babies to get a teaching job at Princeton, and then to get leaves of absence. I would teach five months in the time that we were at Princeton, and then I would have seven months in the time when we went off to California where I could be with the kids, and do volunteer work, or work on my own.

When they were being born, and when they were toddlers, which is the hardest time, teaching would be just terrible, because the child care situation could be extremely difficult and unstable. I'd have to take risks that I did not want to take. There were crises that I didn't want to deal with. On the other hand, having those kids gelled my resolve to do the science. It made me be efficient in a way I had never been efficient. So it was a mixed bag. I don't know if I would ever have put my career together without the kids. On the other hand, it was very hard to do it with the kids. The society in this country does not give you a hand with that, and I have some hair-raising stories of child care. But I also have stories about the jewels who hand-held my life together, Rosa and Kristine.

A lot of what you do and how you do it depends, on the one hand, on effective team cooperation between the married couple. The other necessity is having a person you can trust with the kids, in a child care situation that is effective. It also helps if there can be some breaks, not necessarily so that you can take some time off, but so that you can have flexibility during the time that they are young, if you need it. I think it is better to keep working, so long as you are not driven too hard, because professions demand that constancy, and it's hard to get back. I think it's better to keep working, but you do need some help.

I find that men have always had to make family sacrifices in developing their careers. They have always been deprived, and in a way, they don't even get to experience the fact that they are deprived.

It sort of worked out that periods of enforced unemployment came in those early years, so that I was with them a lot. It also happened that I worked enough that I have always felt deprived of the kids, so that it was a pleasure to be with them. I never got to the point of climbing the walls because of toddlers and cabin fever, because I never had quite enough of them. It worked, but it takes a toll on where you end up, on your mastery of the field, and on your capacity to do the moving that you need to do.

There are not simple answers. Now that I've talked to other women, I've found out that they don't have any easier time; and I find that men have always had to make

continued on next page

Coyne, *continued*

family sacrifices in developing their careers. They have always been deprived, and, in a way, they don't even get to experience the fact that they are deprived. This society just hasn't worked out how you handle these personal things. Dual careers are too new. It's hard.

CMS: Where did you go to school?

COYNE: I was raised in Kansas. I spent two years at the University of Kansas. I got married. I was a teenage bride. I dated my ex for one year at Kansas, and then he went to Caltech for graduate school. He insisted that I move to California after my sophomore year, and so I went to UCLA. Couldn't get into Caltech then—wouldn't have wanted to if I could have. So I commuted to UCLA for two years, and got my degree.

Then it turned out that he was still in graduate school, and was going to be there for a long time; so the question would be what I wanted to do. I ended up in graduate school at Caltech in chemistry. They admitted me in the first year they admitted women on an equal competitive basis to the graduate school. Each of the graduate departments took two women.

I hadn't planned to go to graduate school. I had planned to work. Willard Libby (Nobel Prize winner at UCLA) called me into his office (I had never taken a course from him), and said, "Where are you going to graduate school?" I said, "I'm not." He said, "Why not?" I said, "My husband is tired of having me commute on the freeways here. He said he doesn't like that, so I can't go to UCLA or USC, and Caltech doesn't admit women." He said, "Well, we'll see about Caltech admitting women. Go see these two people." One of the people was Don Yost, and the other was Norman Davidson.

Don Yost, who was about 89 or 93 at that time, said, "Well, we love the ladies. We really love them, but we don't have enough bathrooms here."

CMS: I heard that one at Dartmouth before women were admitted.

COYNE: Norman Davidson said, "Just go ahead and apply. We're going to let some women in this year. If you get in on your own merits, fine. If you don't, we'll hire you as a tech and get you in the back door." I applied, made it during the second round, and finished the Ph.D. there.

CMS: What did you do after Caltech?

COYNE: I did some work as a technician, because I couldn't get a postdoc in Berkeley. Then came one of the hardest things, even harder than having kids for the dual professional: the phasing of when it is time to move on. One person needs to go, and the other person needs to stay. That phasing is just terribly difficult. I was traditional enough in my background that I felt that his career was more important, even though I would fall behind professionally. He would say where he wanted to go, and I would find something there that was consistent with my interests. If that meant a change of field when we moved, I changed fields; or if it meant a phase problem, I just lived with that. I wasn't completely happy with it, but I didn't see a choice.

I taught one course at San Francisco State, and then Dan got the Princeton faculty job. I went there, and it just turned out that they had a nasty job that none of the faculty wanted to do. They said, "Hey, our problems are solved. We'll lay it on her." So I hired on.

The thing that has kept this research moving is the way The Clay Minerals Society operates and treats newcomers, and the way it treats new ideas.

You could only be hired as an instructor for two years. They were going to promote me to lecturer, with rank as assistant professor. They sent it over to the Deans, who were enlightened, and the Deans said, "You can't do this. If she's good enough to keep, give her an assistant professorship; and if she's not, fire her. It's past the time when you can play these scams." They saw right through it. The Department gave me a special, terminal, assistant professorship because I was "only" doing curriculum development as research, which didn't bother me. I had my kids and no time for research. I didn't care.

I was a token woman—I was the first women on the physical sciences faculty there, but not in a normal tenure track position. The Deans were sitting there looking, and I go and get pregnant. The Deans thought, "Well, what are going to be the rules about women and child care?" They developed what I consider to be some very sensible rules: they would give a tenure break, delaying a tenure decision for one year for each baby up to two. My first baby was a child of the Department. With the second baby, they were looking at me as if I were some kind of rabbit.

I didn't take a leave. I was back three weeks after the first baby, one week after the second. Then every year I would stumble through until the end of the term and go to California. In the meantime, the Deans were looking at

continued on next page

Coyne, *continued*

the situation, and making reasonable sorts of decisions. I would rather have had a maternity leave than a delay in tenure decision, since there wasn't going to be a tenure decision anyway.

Then I got back into research, and ended up at NASA in the origin of life program. I got a senior fellowship that paid enough to pay for the kind of child care that I needed. It took over half of my take-home pay, but it didn't matter. You've got to be paid enough not only to keep yourself going, but to do something for those kids.

I'd like to say one more thing. I came into this field of many specialties with no specific background in any one of them, but just with a good conceptual overview of what could be happening. Also, I have been working in a lab in which there is neither good equipment, nor very good personnel support. The thing that has made the work possible has been the enormous warmth and support coming from this Society: the trust; getting samples from people like Pat Costanzo, and from industry—Brian Jepson, Arlyn Rice, Phil Jones; Benny Theng, and other people, like Tom Pinnavaia and Max Mortland, sitting down and arguing with me about possible artifacts. The thing that has kept this research moving is the way The Clay Minerals Society operates and treats newcomers, and treats new ideas. It has been wonderful. That ought to be known and publicized, because in many societies you just wouldn't get off the ground. It has been the collaborations that I have formed through CMS meetings that have made it possible to continue the work.

Crystallography slides, *continued from page 1*

or just for the enjoyment of viewing the artwork and the challenge of figuring out the symmetry of each drawing.

Beautifully designed and colored, each drawing features a different motif, such as chairs, robins, ice cream cones, mastodons, deer, arrowheads, or teapots, repeated in a plane by translational, rotational, mirror, and glide symmetry.

Dr. Rule was inspired by the symmetry drawings of M. C. Escher and originated the idea for the slide set several years ago while engaged in phyllosilicate crystallography as a graduate student of S. W. Bailey at the University of Wisconsin (hence the Dairy State influence on several of the motifs). She presently teaches geology at the University of Alabama in Tuscaloosa.

Symmetry Drawings of the Seventeen Plane Groups, the slide set and accompanying booklet, are available from the Society Office.

Letters, *continued from page 2*

was more active. The Burgess shale is Cambrian in age, but it is not kaolinitic.

For the second reason, we know that land-plant acids, plant roots, plant residues, and the uptake of mineral nutrients by plants promote kaolinization by weathering, apart from the concept of gaseous concentration in the atmosphere; this we learned years ago from "the book." Am I correct that land plants had to be present for a commercial size kaolin deposit to be formed by surficial weathering? And, since land plants were not abundant before Siluro-Devonian time on *Terra Firma* (Latin), or *Gaea,* sometimes spelled *Gaia* (Greek), is there any need for *Homo stupidens* to prospect for sedimentary paper-coating kaolin in the older rocks? Besides being the most important mineral (well, to clay mineralogists anyhow) on earth, clay seems to be finicky and vegetarian in its genealogy.

Walter D. Keller
Columbia, Missouri

Are you going to Beijing?

Editor:

According to the November, 1989, issue of *The Lattice,* the International Mineralogical Association Council has voted (8 to 2) to hold the 15th General Meeting in Beijing, China, this summer as planned. Therefore, it is up to individual scientists to express their feelings about carrying on business as usual under a government that shoots its students. Most of us are aware of the brutal supression that continues in China, but fewer may know about the 40 years of tyranny that continues in Tibet. According to the Dalai Lama in his acceptance speech for the 1989 Nobel Peace Prize:

"During this time, over a million Tibetans have perished and more than 6,000 monasteries—the seat of our peaceful culture—were destroyed. There is not a single family, either in Tibet or among the refugees abroad, which has gone unscathed.... The demonstrations which have rocked Tibet for the past two years continue to be non-violent despite brutal suppression. Since the imposition of martial law in Lhasa last March, Tibet has been sealed off, and while global attention has focused on the tragic events in China, a systematic effort to crush the spirit and national identity of the Tibetan people is being pursued by the government of the People's Republic. Tibetans today are facing the real possibility of elimination as a people and a nation."

Can we go to Beijing to give our talks, present posters, have a banquet, be welcomed by representatives of the People's Republic, while so many people continue to suffer under this corrupt and cynical regime?

D. D. Eberl
Evergreen, Colorado

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* *Ex Officio*

Feats of Clay

Thomas J. Pinnavaia *High Iron Photos*

Tom Pinnavaia has been named Director of the Center for Fundamental Materials Research at Michigan State, where he is a member of the Chemistry Department.

Bob Reynolds, professor of geology at Dartmouth College, and CMS Distinguished Member, has been awarded an endowed chair established in 1838; he is now the Frederick Hall Professor of Mineralogy and Geology.

Pat Costanzo has taken a position at Unilever Research US, Inc., in Edgewater, New Jersey.

Eric Eslinger has taken a position at Domermuth Environmental Services in Clarksville, New York.

John Janks has moved within Texaco from geological research to environmental technology.

Steve Guggenheim received an award at the AIPEA Conference in Strasbourg for being the first person to send in his abstract.

At Strasbourg, the following CMS members were elected to the new AIPEA Council: **K. Wada,** Vice President; **J. Konta,** Past-President; **R. Schoonheydt,** Secretary-General; **C. De Kimpe,** Treasurer; **D. Eberl, C. Farmer,** and **E. Galan,** Councillors.

Please help us recognize our members' achievements by sending in announcements of awards, grants, promotions, new positions, as well as marriages, births, retirements, and other relevant passages.

New Members

We welcome the following new members who have recently joined The Clay Minerals Society.

Mr. Clifford P. Ambers
Indiana University
Bloomington, Indiana

Mr. Herbert H. B. Bucksch
Brühl, West Germany

Mr. Ric W. Bush
Maxim Engineers
Dallas, Texas

Ms. Rosemary French
Petroleum Recovery Institute
Calgary, Alberta, Canada

Ms. Sara E. Gruenhagen
University of Minnesota
St. Paul, Minnesota

Mr. Shawel Haile-Mariam
Michigan State University
East Lansing, Michigan

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Penn State University
University Park, Pennsylvania

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University of Georgia
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Japan Atomic Energy Research Inst.
Ibaraki, Japan

Mr. John M. Neil
U. S. Geological Survey
Sacramento, California

Dr. Mauro C. D. Santos
Univ. Federal Rural Pernambuco
Recife, Brazil

Dr. Terrence M. Sobecki
U. S. D. A.—S. C. S.
Lincoln, Nebraska

Dr. J. L. Martin de Vidales
Universidad Autónoma
Madrid, Spain

The Clay Minerals Society Research Grants for Graduate Students

Purpose:

The research program is designed to provide partial financial support of masters and doctoral research for graduate students of clay science and technology in United States universities. (Pass this to qualified students).

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 four-member CMS committee and approved by the CMS Council. Members and nonmembers of the CMS are eligible. Applicants must be U. S. citizens and not affiliated with a foreign university.

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. Recipients can apply for grants on subsequent years. Application forms and appraisals (6 copies) must be postmarked by August 1 and sent to the Society Office.

J. B. Dixon

Books available from CMS

The Clay Minerals Society offers the publications below at a significant discount to its members. To order, send a check (in U. S. dollars) for the price of the book(s) desired and $2.00/book postage to: The Clay Minerals Society, P. O. Box 880, Evergreen, Colorado 80439. Please include title, code, and price. For abstracts and field guides, please contact the Society Office.

Crystal Structures of Clay Minerals and Their X-ray Identification, Mineralogical Society Monograph 5, G. W. Brindley & G. Brown, editors **CSCM $70.00**

Chemistry of Clays and Clay Minerals, Mineralogical Society Monograph 6, A. C. D. Newman, editor **CCCM $87.50**

Both of the above, package price CSCM & CCCM $135.00

A Handbook of Determinative Methods in Clay Mineralogy, M. J. Wilson, editor **HDM $90.00**

Serpentines, Chlorites, and other Non-Mica Phyllosilicates, MSA Review Series, S. W. Bailey, editor **SCNM $18.00**

Clay Minerals for Petroleum Geologists and Engineers, SEPM Short Course Notes #22, E. Eslinger & D. Pevear, editors **CMPGE $28.00**

X-Ray Diffraction and the Identification and Analysis of Clay Minerals, D. M. Moore and R. C. Reynolds, Jr. **XDIA $22.00**

Modern Powder Diffraction, MSA Review Series, D. L. Bish and J. E. Post, editors **MPD $20.00**

Iron in Soils and Clay Minerals, J. W. Stucki, B. A. Goodman, and V. Schwertmann, editors **ISCM $90.00** (limited quantity available)

Mica Polytype Slide Set, Prepared by Audrey C. Rule for The Clay Minerals Society **MPSS $15.00**

Crystallography Slide Set, Symmetry Drawings of the 17 Plane Groups, Prepared by Audrey C. Rule for the CMS **CSS $32.00**

Women's reception at Columbia

An informal get-together of women registrants will be held Monday evening (8:00 pm) at the annual meeting. If you know in advance that you would like to attend, please contact the Society Office. Also, if you are interested in child care facilities at the conference, please let us know.

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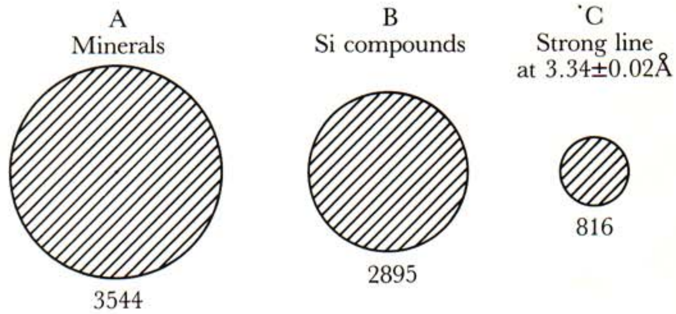

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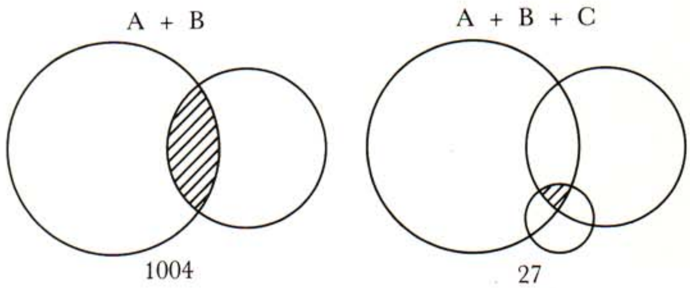

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JCPDS

Jackson, *continued from page 1*

received are Distinguished Member of The Clay Minerals Society (1977), Distinguished Member of the Soil Science Society of America (1983), and election to the National Academy of Sciences (1986). He is also a fellow of both the American Society of Agronomy and the Mineralogical Society of America and has served as President of The Clay Minerals Society from 1966 to 1967.

Jackson's Students

M. L. Jackson was supervisor to over 50 doctoral students during his tenure at the University of Wisconsin. The following is a list of his students: D. G. Aldrich, A. H. Al-Rawi, B. E. Brown, S. C. Chang, S. L. Chapman, C. V. Cole, R. Coleman, R. B. Corey, L. E. DeMumbrum, H. G. Dion, J. B. Dixon, D. L. Dolcater, Paul Eck, H. El-Attar, E. J. Evans, D. S. Fanning, T. A. Frolking, R. C. Glenn, A. B. Hanna, I. Hashimoto, N. N. Hellman, J. H. Henderson, Y. Hseung, P. H. Hsu, P. M. Huang, N. S. Kaddou, A. Kaufman, P. V. Kiely, D. G. Kinniburgh, J. A. Kittrick, S. Y. Lee, C. H. Lim, W. Z. Mackie, L. F. Marriott, H. F. Massey, H. M. May, O. P. Mehra, R. G. Menzel, M. H. Milford, D. L. Mokma, L. E. Orth, R. P. Pennington, K. V. Raman, C. B. Roth, V. A. Sarma, B. L. Sawhney, M. Sayin, K. Sridhar, A. C. Stam, R. W. Starostka, L. D. Swindale, T. Tamura, C. B. Tanner, R. C. Vanden Heuvel, V. V. Volk, R. M. Weaver, J. L. White, L. D. Whittig, W. E. Wildman, and J. C. Zubriski

Bish, Post edit new book

David Bish and Jeffrey Post are the editors of *Modern Powder Diffraction*, the latest book in the MSA Reviews in Mineralogy series.

Contents include "Principles of Powder Diffraction," R. C. Reynolds, Jr.; "Instrumentation," R. Jenkins; "Experimental Procedures," Jenkins; "Sample Preparation for X-ray Diffraction," Bish and Reynolds; "Quantitative Analysis," R. L. Snyder and Bish; "Diffraction by Small and Disordered Crystals," Reynolds; "Computer Analysis of Diffraction Data," D. K. Smith; "Profile Fitting of Powder Diffraction Patterns," S. A. Howard and K. D. Preston; "Rietveld Refinement of Crystal Structures using Powder X-ray Diffraction Data," Post and Bish; "Synchrotron Powder Diffraction," L. W. Finger; and "Neutron Powder Diffraction," R. B. von Dreele.

The volume is available from the CMS office.

Ask the Clay Doctor

(Not a real doctor)

Dear Clay Doctor: The other day I was in the farmyard feeding zeolite to my chickens (zeolite keeps the smell down and helps make the egg shells stronger), and I got to wondering, which came first, the chicken or the egg?
Farmer Brown, Brockport

Dear Farmer Brown: Thank you for the interesting question. Profound thoughts such as yours often occur to people who handle clay-size material. The answer to your question, however, is quite simple and quite obvious: Of course, the chicken came first. How else could there be an egg?

Dear Clay Doctor: I have travelled the world searching for the answer to this one: What is the most fundamental science? Can you help me?
Truth Seeker, Lubbock

Dear Truth Seeker: Physicists especially will be surprised to learn that clay science is the most fundamental science. Why is this so? We know from the work of Cairns-Smith and Hartman *(Clay Minerals and the Origin of Life)* that all life came from clay minerals. Therefore, after a long evolutionary process, the study of clay is nothing less than clay trying to get to know itself.

Dear Clay Doctor: I was riding my motorcycle through New Hampshire when I noticed flashes of light coming from the road cuts. On closer inspection, I found that the flashes were sunlight being reflected from mica flakes! The question then occurred to me: Are there different *kinds* of mica?
Biker, Hanover

Dear Biker: I also have found that, next to the petrographic microscope, the best way to study coarse-grain phyllosilicates is on a bright summer day on a Harley at 80 mph. In answer to your question, there are three major classes of mica: (1) white mica, which includes muscovite, commonly found in granites; (2) brittle mica, which includes margarite, a calcium-rich variety; and, finally, (3) formica, which includes fornikite, commonly found in Australia.

Dear Clay Doctor: I've been having one heck of a time preparing stable clay suspensions. First I disperse the clay in salt walter using ultrasonics, and then I spin it in a centrifuge for the time recommended by Jackson; but when I open the centrifuge, the clay always has settled to the bottom of the centrifuge tube. I've tried it with kaolinite; I've tried it with montmorillonite; and I've tried it with illite—all with the same result. What do you suggest?
Suspended, Paris

Dear Suspended: Have you tried it with hectorite?

Dear Clay Doctor: Regarding your last column, I do not correlate Joe Montana with nontronite. Is it non-throw-tonight—yet that doesn't seem right for Joe? Or is it that Joe Montana's name is "mud" to Coloradoans?
Walter D. Keller, Columbia

Dear Prof. Keller: The reason Joe Montana, given the chance, would study nontronite should be fairly obvious. It is the same reason for which Michael Jordan would study berthierine.

Call for Papers

21st Annual Meeting of the Fine Particle Society
in conjunction with the 1990 summer national meeting and co-sponsorship of
The American Institute of Chemical Engineers
Short Courses and 1990 Particulate and Powder Technology Exhibition
August 21-25, 1990 Sheraton Harbor Island San Diego, California

All individuals, academic and industrial, who are interested in the science and technology of fine particles are invited to submit two copies of a one-page abstract of 200 words with single spacing on or before April 1, 1990, to the **Mineral and Inorganic Colloids** session. Papers will be accepted on any relevant subject dealing with the characterization, properties, and behavior of fine-grained inorganic materials including, but not restricted to, clays, zeolites, silica, and alumina.

For more information, contact Dr. P. M. Costanzo, Organizer and Chairman, Unilever Research U S, Inc., 45 River Road, Edgewater, New Jersey 07020 USA. Phone: (201) 943-7100, Ext. 2677. Fax: (201) 943-5663.

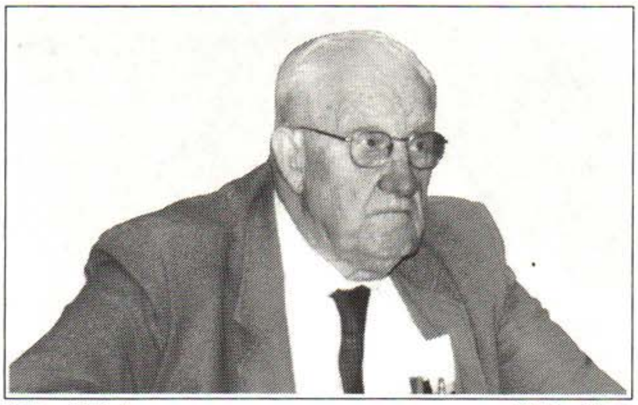
Commentary—Keller's Occasional Brain Storms

(KOBS, the residue left after the kernels of wisdom are harvested from the "Ear of Knowledge")

Clay Mineralogy as Observed in the Rear-View Mirror

In the beginning there was clay."

While recataloguing specimens of clay which I began collecting in 1929-30, a time-frame of clay types took form, which suggested a rear-view mirror type of history of early clay mineralogy. These specimens began for me with Missouri high-alumina clay (diaspore, the deposits of which are now depleted), flint clay, and plastic refractory clay, at that time all commonly called "fire clay" (colloquially pronounced "fawr clay" by miners in the pits, prospectors, and landowners). Refractory clays were one of the relatively elite varieties of clay, commercially worth classifying by alumina content and PCE (pyrometric cone equivalent).



Walter D. Keller *High Iron Photos*

For the first two decades in this century, clays traditionally were geological (!) occurrences that were earthy when dry, plastic to sticky when wet, and too fine-grained to be resolved with a hand lens, Brunton compass, and hammer, the standard instrumental accoutrements of a geologist. With "fancy scientific equipment," such as a petrographic microscope (and blow-pipe), platy particles could be recognized in clay specimens. Most clays were glossed over by most geologists as being kaolin, or kaolinite, the name of the clay long known from Kauling Hill, China. This practice continued until Ross and Kerr differentiated between the kaolin group, the montmorillonite-beidellite group, and the potassium-bearing clay ("Clay Minerals and Their Identity," *Journal of Sedimentary Petrology,* 1931). Likewise, in 1931, the beginning of the third decade, the kaolin minerals were given formal "ID cards" and names by Ross and Kerr in their landmark publication, "The Kaolin Minerals," USGS Prof. Paper 165 E, 1931. Herein kaolinite, dickite, and nacrite were separated, isolated, identified, measured, and characterized, thus conferring upon them the mineral integrity and respectability as was accorded to, for example, the feldspars and quartz.

Genuine clay mineralogy thus sprouted to view in the third decade, after less visible seeding and nurture from second-decade supporting work and, also significantly, by use of new instrumentation, X-ray diffraction. The revelations of X-ray diffraction, earlier explored by Mauguin in 1927-28 for micas, and by Pauling for the chlorites in 1930, made possible the measurement of dimensions and structure of the lattices in clay crystals. Such measurements made it possible to diagnostically establish, for the first time, the integrity and uniqueness of each of the three kaolin minerals, supplementing their earlier described chemical and physical properties. Significantly, new instrumentation in later decades has likewise made possible important new discoveries in the mineralogy of clays.

Mineralogy had long been one of the essential elements within the broad, natural science of geology, and therefore clay mineralogy then necessarily encompassed, or required, full consideration of its geologic or pedologic field history, and the genetic processes and geologic environments of which the subject clay mineral was a part. In contrast, during the last decade, mineralogic studies of clay may begin with the clay as a specimen in a cardboard box—more in a later section on this evolutionary change.

Three years after the kaolin minerals had been formalized as independent clay minerals, Ross and Kerr added halloysite and allophane (USGS Prof. Paper 185 G, 1934) to the "kaolin mineral club." In 1937, the potassic micaceous mineral in clay was described by Maegdefrau and Hoffman, and in the same year was named illite from its occurrence in Illinois shale by Grim, Bray, and Bradley. Bradley (W. F., "Bill") described in 1940 the complex ino-phyllo structure of attapulgite, which he had expertly determined by calculation with a slide rule (not a megabyte computer) from a few, scarcely adequate X-ray data. Bradley is likewise to be esteemed for pioneering the use of oriented clay X-ray mounts, and the use of ethylene glycol to expand, and identify, swelling-type clays. In the next decade, 1940, the montmorillonite group of clay minerals was characterized and formalized by Ross and Hendricks in USGS Prof. Paper 205 B, 1945. In the latter part of this decade, (1949-1951), an effort was made to provide standard reference specimens of clay minerals from which both comparative and discriminatory properties of clay minerals could be measured. This was the American Petroleum Institute (API) set of Reference Clay

Minerals. About 52 clay localities were sampled, 33 in the US and 19 in Europe. Pyrophyllite and palygorskite minerals were included; clay minerals had become more diverse than the "original" kaolin, smectite, and illite groups. C. E. Marshall showed us how to calculate structural formulae of clay minerals from their bulk chemical analyses.

In 1950, Ralph Grim outlined the modern concepts of clay minerals (*Journ. Geol.*, 1950), and in 1953 published the first edition of "The Book" on clay mineralogy, which then served as the text book, reference book, source book, and condensed source of information for thousands of students and professionals in clay mineralogy. Overlapping in time with these 2 publications was a session held at the regular AIME 1951 meeting in St. Louis, on the topic "Problems of Clay and Laterite Genesis" chaired by A. F. Frederickson and Grim. Grim (the "father" of clay mineralogy) pointed out that there was a need for a forum where the increasing numbers of geoscientists interested in clays might report and share their findings. Grim was asked by those at the session "to serve as Chairman of a committee to look into the most desirable means of arranging for and holding such conferences." The National Academy of Sciences—National Research Council welcomed the establishment of a Clay Minerals Committee which would sponsor such conferences. "A recommendation to that effect was made to persons attending the Clay Minerals Conference held in 1952 at Berkeley, California, under the sponsorship of the University of California. Those persons, representing a good cross-section of people interested in clay mineralogy, affirmed the recommendation, and the preliminary exploratory committee was appointed by the Academy—Research Council as the Clay Minerals Committee with some considerable additions in order to obtain representation from all fields and active centers of clay mineral researches. The initial Conference sponsored by the Committee was held at the University of Missouri in 1953." (Excerpt from Grim, page iii, *Proceedings, Third National Conference on Clays and Clay Minerals,* publication 395, NAS-NRC, 1955).

That old, antecedent Clay Minerals Committee fostered growth and stability in the conferences so successfully by 1960 that the NAS—NRC said support was no longer needed—the organization could, and should, stand on its own feet. Accordingly, the Clay Minerals Society was chartered in Washington, D. C., on July 18, 1962. Richard ("Dick") A. Rowland was the last chairman of the Clay Minerals Committee, NAS—NRC, and the first president of the Clay Minerals Society.

During the decade while the Clay Minerals Committee, NAS—NRC, was fostering the intercommunication of clay mineralogists, an innovation in X-ray instrumentation opened most earth science laboratories to clay mineral research. The X-ray diffractometer became available as standard equipment in most clay and soils laboratories, thereby rendering identification of clay minerals and recognition of their variations within different environments a possibility for many investigators. Outstanding among the earlier X-ray researchers was George Brindley, renowned for his work on the structure of kaolinite, editorship and personal publications in books, and his presence on the front row at clay meetings from which he "kept speakers honest." The use of infrared absorption to study *powdered* minerals, such as naturally occurring clay minerals, was pioneered in this decade in the laboratories at the University of Missouri (API Reference Clay Minerals). Innovations in the research areas opened by discoveries were also occurring. For example, whereas it was an achievement in earlier clay-mineral research to distinguish separately smectite from illite, observations by Weaver now showed the abundance of the opposite relationship, i.e., the transitional mixing of those layers within I/S series. Burst recognized the mechanism of illitization from smectite to be a major process of diagenesis, and its highly important role in the formation of hydrocarbon deposits—a very exciting area of present-day research.

The launching of the Clay Minerals Society, its surging growth, and its successes informing clay mineralogists via the publication, *Clays and Clay Minerals,* about foreign and domestic activities (plus AIPEA) supplant for present-day clay addicts the "rear-view mirror" from which the preceding rhetoric has been viewed. Everyone knows, or has access to knowledge of what is going on claywise across the globe. Yet one observation, possibly not so apparent to last-decade clay-mud slingers, may be made between "old vs. new" clay-mineral research. This is the transition from the old orientation of clay mineralogy which was toward "natural" geology and pedology to a new one that explores what can be done by the artificial chemical processing of clays, plus sophisticated "black-box" type of research on them, and not uncommonly starting with the clay sample lifted from the specimen box in a drawer of specimens rather than collected from its nativity, the outcrop. From the perspective of the old horse and buggy days, before a rear-view mirror existed, "the old gray mare ain't (apologies to the grammar book) what she used to be;" she is now a computer-stored memory of X-ray and electron-diffraction, fundamental particles, element proxying, isotopes, catalysis, order-disorder, nms-angstroms, and acronyms, such as DTA, HRTEM, IR, I/S, CEC, NMR, and add your own specialty.

In other words, for present-day, last-decade clay mineralogists, there are new-fangled toys, new games, new lingo, new perspectives, and new discoveries; isn't clay mineralogy, reenforced and projected by the organization and members of the Clay Minerals Society, a glorious lot of continuing fun!

Walter D. Keller
Columbia, Missouri

The Clay Minerals Society
27th Annual Meeting
will be held October 6-11, 1990

It will be sponsored by:
University of Missouri-Columbia
Department of Geology
Department of Agronomy
UMC Research Reactor

The meeting will be preceded on Saturday, October 6, by a workshop on "Neutron Scattering and Diffraction."

Three scientific sessions are planned:
General Session
Clays in Sandstones Symposium
Keller 90-Kaolin Symposium,
the latter to honor Prof. Emeritus W. D. Keller in his 90th year.

On Wednesday, October 10, an all-day field trip is planned to visit deposits of central Missouri refractory clays and related soils.

Inquiries can be made to:
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Tel. (314) 882-3785

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