

CMS News

A Publication of The Clay Minerals Society

June 1991

Houston beckons



Bill Reynolds, Charles Curtis, Warren Huff, and Mrs. Reynolds, Jackson, MS, 1986.

High Iron Photos



Paul Nadeau, Robert Klimentidis, and Alain Baronnet obviously discussing clays, Columbia, MO, 1990.

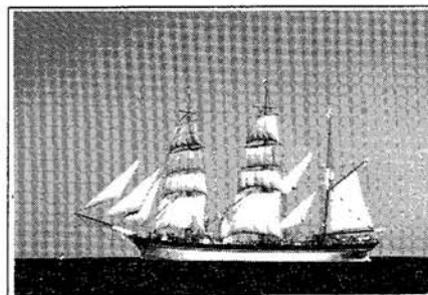
High Iron Photos

One of the major attractions of the CMS Annual Meeting is the chance to meet informally with colleagues and friends from around the world, and for students and newcomers to the field to meet with more senior clay scientists. This year's annual meeting will be in Houston from October 6-11. For more information, contact the Society Office at 303-444-6405 or Dave Pevear at 713-965-4452.



M. G. Reed and M. L. Jackson, Columbia, MO, 1990.

High Iron Photos



Tall Ship Elissa in Galveston Bay, part of the Houston Spouse Tour.

Courtesy D. Pevear

Georgia Kaolin Company sale consummated

Georgia Kaolin Company, a prominent name in the kaolin industry since 1902, has been sold. The company operated

four production facilities in Georgia: the original wet processing plant at Dry Branch, Georgia, a

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Book prices to go up

The Society regrets that increased publishers' prices for two of the books that we carry will force us to raise our prices. The office has 45 copies of Moore & Reynolds' *X-ray Diffraction and the Identification and Analysis of Clays*, and four copies of Newman's *Chemistry of Clays and Clay Minerals* at the old prices.

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The Clay Minerals Society



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The Clay Minerals Society

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month, **Digital Instruments and In-
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A note on our artists

Readers often comment on the
drawings and photographs in *CMS
News*. We are happy that science and
art coexist comfortably here.



M. J. (Marti) Nash is the artist who,
working from photographs, draws
portraits of our interview subjects.
The wife of USGS geochemist Tom
Nash, she is also the award-winning
coach (Colorado Coach of the Year)
of the state championship girls' high
school soccer team. Training in the
mountains where she lives, she ran in
the Boston Marathon this Spring,
qualifying to run again next year.
She has just finished a one-woman
show and is currently illustrating chil-
dren's books.

Marti's sensitivity and humor can
be felt in all of her portraits. After
studying each new set of photographs
and working on preliminary sketches,
she begins to "know" her subject,
usually becoming fond of him or her,
and chooses a style to match the sci-
entist's personality.

High Iron Photos is really a
pseudonym for Don Scafe, CMS Sec-
retary. People attending the annual
meeting may have noticed him unob-
trusively wandering around the
crowds taking informal shots.

The name "High Iron Photos" re-
flects Don's lifelong interest in trains.
He is an avid cyclist, often riding the
three miles to work at the Alberta Re-
search Council in Edmonton. Mar-
ried to a gourmet cook, Georgie
Scafe, Don also enjoys good food and



his extensive wine cellar.

His photos are notable for their
clarity and their ability to catch the
spirit of the occasion, whether it be a
friendly encounter, an amusing esca-
pade, or a historic meeting of great
clay minds.

The CMS is privileged to be the re-
cipient of the talents of two artists
who portray the personalities and
spirit of the Society so well.

Thanks...

To the following
people who contri-
buted to this issue:

Pat Costanzo
Joe Dixon
Dennis Eberl
Fred Huege
Warren Huff
Bryant Mather
Dick Merriman
Dewey Moore
Haydn Murray
M. J. Nash
David Pevear
Tom Pinnavaia
Rich Pollastro
Jeff Post
Sue Rimmer
Don Scafe
Darrell Schulze
Vlado Sucha
Ken Towe

W. L. Haden Memorial

Dr. Walter Linwood (Lin) Haden, Jr., Fellow of the Research Department of Engelhard Corporation, passed away at his home in Westfield, New Jersey, on March 24, 1991, after a short illness.

Dr. Haden, an active supporter of and contributor to The Clay Minerals Society for many years, is best known for his pioneering work in the synthesis of zeolites from kaolinite. The *in situ* process which he invented is still a cornerstone technology for the production of petroleum cracking catalysts.

While Dr. Haden achieved recognition mainly for his work in catalysts, his scientific interests were much more diverse. He received 37 patents over an industrial career that spanned five decades.

Dr. Haden was born in Richmond, Virginia, and graduated from the University of Richmond in 1936. In 1941, he received his Ph.D. in physical-inor-



ganic chemistry and joined the research staff of the Columbia Carbon Division of PPG. He remained there until 1949 when he came to the Research Department of Attapulugus Minerals and Chemicals Corporation in Camden, New Jersey. Attapulugus Minerals and Chemicals was one of the predecessor companies of

what is now Engelhard Corporation. Lin rose through the ranks of the Research Department, becoming Associate Director in 1958—a position he held until 1971—when his significant technical contributions were recognized by his being named a Fellow of the Research Department. More than being an inventive genius, Lin was an inspiration to a great many co-workers and associates. His unassuming personality, encyclopedic knowledge, rare sense of humor, agility of mind, and reliability as a confidant and advisor combined to make him a unique talent and a very valuable resource.

Lin and his wife Elvera always enjoyed attending the annual Clay Mineral Society meetings where they would renew old friendships and develop new ones. He will be remembered fondly, and sorely missed by his family, friends, and scientific associates.

*Fred Huege
Irving, Texas*

Katherine Mather Memorial

On February 14, 1991, Katherine Mather passed away.

She was the President of The Clay Minerals Society in 1973. Before that, she was Vice President, Secretary, and a Charter Member of the Society. She took over the Presidency a year earlier than expected, when Bill Bradley died suddenly.

Katherine Mather was born in Ithaca, New York, in 1916. She graduated from Bryn Mawr College in 1937 with an A. B. in Geology and was a graduate student in geology at the Johns Hopkins University from 1937-1940, where she completed her preliminary examination for a Ph.D. and, in 1938, was elected to Sigma Xi. She received an Honorary D.Sc. from Clarkson University in 1938. She became a Registered Professional Geologist in Georgia in 1976, No. 18. She was a Life Mem-



ber of The Mineralogical Society and a Fellow of the Mineralogical Society of America, as well as a member of AIPEA and the Clay Science Society of Japan.

After working as a Research

Assistant at the Hopkins (1939-40) and at the Field Museum of Natural History (1940-41), in 1942 she joined the staff at the Concrete Laboratory, U.S. Army Corps of Engineers, where she worked until her retirement in 1982.

She was awarded the Department of the Army Decoration for Exceptional Civilian Service in 1962, the Department of Defense Decoration for Distinguished Civilian Service in 1964, and the Federal Woman's Award in 1963, with which came a reception at the White House hosted by Mrs. John F. Kennedy. She was the first Waterways Experiment Station Woman of the Year in 1974 and was elected to the WES Gallery of Distinguished Former Employees in 1984. President Johnson appointed her to the President's Study Group on Careers for Woman in 1964.

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Interviews with the clay scientists

Kenneth M. Towe

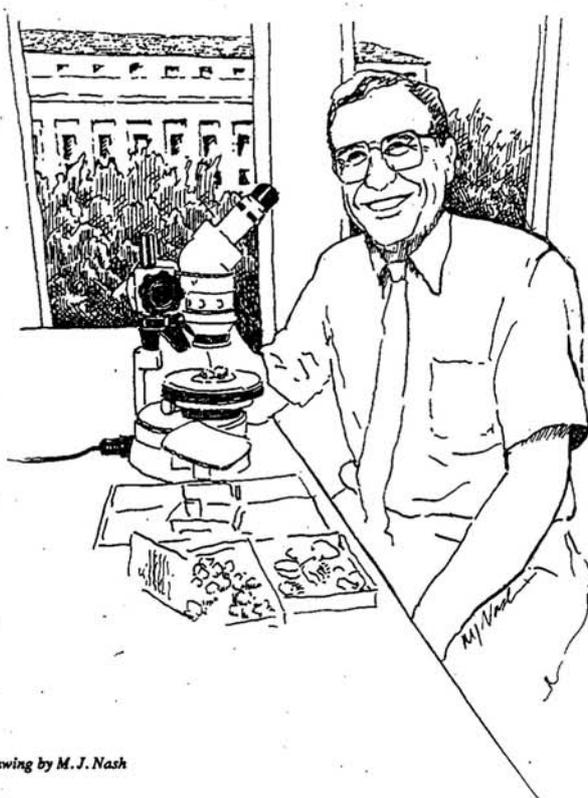
K. M. Towe, a Senior Research Geologist at the Smithsonian Institution, has been Treasurer of the CMS for over ten years. In addition, he volunteered to take the position, for one year, as Editor-in-Chief of Clays and Clay Minerals, when F. A. Mumpton resigned last fall. The interview was conducted by David R. Pevear, Research Associate at Exxon Production Research Company and Vice President-Elect of the CMS, assisted by Jo Eberl, in Columbia, Missouri, October 1990.

CMS: I'd like to know what you worked on while you were a student at the University of Illinois, because I haven't got a clue. What was your thesis about?

TOWE: My thesis was on lateral variations in clay mineralogy across facies in the Devonian of New York State. I chose this area because G. Arthur Cooper had done all the stratigraphy, making my field work easier.

CMS: So you worked on the Devonian Hamilton Group at Illinois with Grim. You know, I always wondered if there was any relationship between clay minerals and such things as facies or sea-level changes.

TOWE: I sampled along what Cooper had said was a time line, so I was going across facies, along the time line, in theory. I just sampled from what were terrestrial beds, through the paleoshoreline out into the deeper water facies.



Drawing by M. J. Nash

CMS: Did it work?

TOWE: I thought it worked. The thesis was accepted and the paper was published.

CMS: Where was it published?

TOWE: In *The American Journal of Science*, 1963.

CMS: I've never seen it.

TOWE: Yes, you did, when you were in Montana. John Hower told me it was a real nice piece of work, and all of a sudden I started getting reprint requests from everybody in Montana. No one else in the world read it, but people in Montana did.

CMS: The first paper of yours that I

remember is the "Forest for the Trees" paper. One of the points of the paper was the importance of looking at the whole rock and not just the clay fraction.

TOWE: Well, this point was important to me because I had been working on so-called Horizon A, which was a cherty Miocene...

CMS: Ah, that's another wonderful story.

TOWE: ...deposit. I was checking for possible evidence for altered volcanic ash, and I was looking for zeolites, specifically clinoptilolite. I knew there were certain coastal plain formations of similar age,

based on the stratigraphy. Duncan Heron, who was one of my teachers when I was at Duke, had done the clay mineralogy of that deposit. I called him to ask if he'd ever seen any zeolites in one specific formation. He said he hadn't. I asked if he had run just the less-than-two micron fraction, and he said yes. I asked him if he had any of this stuff left, would he mind running it again, using a coarser fraction. He did, and it was full of zeolites.

CMS: I've had similar occurrences with kaolinite. You can lose the kaolinite if you take a fine fraction.

TOWE: Well, as that paper points out, the less-than-two micron fraction was chosen for one purpose—to get

continued on next page

Towe, *continued*

rid of almost everything except the clays.

CMS: That paper verged on being an editorial, and usually editorial papers don't continue to get cited over the years. I think it's amazing that it's been cited so much.

TOWE: I think it's amazing that anybody read it.

CMS: You've often been credited with being the first to suggest that shales might be a source of cement in sandstones. A lot of people don't cite you for that, but a few people have caught on.

TOWE: That was one of the first papers I ever published, and it was published in the *Journal of Sedimentary Petrology* in '62. Jack Hough was the editor then, and he was one of my profs at Illinois. I guess that's why I submitted it to that journal. I had discussed that idea with Herman Roberson and Rod Tettenhorst, both of whom were graduate students with Grim when I was there. I had just received my masters degree at Brown, where I'd been working on sandstones in the Pennsylvanian Narragansett Basin of Rhode Island and Massachusetts, so I was tuned in to sandstones. The idea just dawned on me. I'd read Siever's papers and that kind of stuff; the SEPM volume on *Silica in Sediments*, and so on.

CMS: Did you suggest in that paper that it was just shales, or did you actually suggest that it was the smectite-to-illite reaction?

TOWE: They didn't call it smectite then.

CMS: Montmorillonite?

TOWE: No, it's the diagenetic transformation....Hower used the same thing, the tetrahedral substitution of aluminum for silica changes the site of charge distribution.

CMS: To change the subject, how long have you been at the Smithsonian? Was that your first job?

TOWE: When I left Illinois, I had a post-doc at Caltech for two years, and then I went to the Smithsonian. That was in 1964.

CMS: I always wondered why a clay mineralogist would be at the Department of Paleobiology.

TOWE: It's a long story, really, but it goes back to an assistantship I had in the Chemistry Department helping out with the electron microscope. I worked under G. L. Clark,

the guy who wrote *Applied X-Rays*. I didn't know anything about electron microscopy when I started. I learned a lot there. Grim took advantage of that; every once in a while he'd give me some odd-ball clay of his to look at. I started getting interested in looking at other things, such as microfossils. I published one of the first papers on foram shell structure, using the EM.

Jobs were tough then, and I applied for the post doc at Caltech. I had a proposal written up to work with Egon Degens, and what I wanted to do was to work with feldspar weathering reactions. When I got to Pasadena, Egon was just finishing his geochemistry book and was leaving for Woods Hole. I had to find someone else to work with. Heinz Lowenstam had just found magnetite in the teeth of chiton mollusks. He got me interested in the project, and I started doing TEM work on the various stages of development of these "iron" teeth.

The early stages contained a very finely divided iron mineral that we could not identify, so I started to look into

I wanted to put a mineral name on it, but Bradley was very reluctant to do that, probably because of the illite difficulty that he had encountered.

the literature. I couldn't find anything. I couldn't figure out what it was. By pure coincidence, other people working in the electron microscope laboratory where I was doing the work were studying an iron storage protein in plants. They asked me if I would try to get an electron diffraction pattern on that, and I did, and the pattern I got was identical to the pattern I got from the chiton, neither of which could I identify.

I started to really get interested, and they got interested, and I started to synthesize a whole bunch of oxides from recipes that had been in the older literature. I found one that really matched pretty well. I finally was able to synthesize a product with electron diffraction and X-ray patterns that agreed with the two natural samples.

CMS: What was it?

TOWE: Well, I'm going to tell you. I got the chemist in the geochemistry lab to do a chemical analysis. I kept going around scrounging equipment in different places, infrared equipment in Chemistry, the super-sensitive balance in Biochemistry, X-ray patterns on the natural and synthetic material in Geology. I was all over the place, which as a graduate student you could get away with be-

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Towe, continued

cause you're poor, you don't threaten anyone, and you promise to stay out of their way. So I was working at night a lot...anyway I was trying to index the diffraction pattern myself, and I couldn't do it simply because they were powder patterns; no single crystal data. And, I really didn't know what I was doing at that time (and I'm not sure I do now, even if I went back to it). So I took whatever information I had and I went to see Barclay Kamb, a good crystallographer (and also Linus Pauling's son-in-law).

I told Barclay the story that Lowenstam has this thing and these are the data. I showed him the d-spacings, relative intensities, etc. I said, "What does it look like to you, do you have any insight, anything you can share with me about these patterns?" He said that I really needed to get some single crystals. But this was colloidal material.

After that, I ran into Bill Bradley, whom I had known, of course, at Illinois, at a meeting some place. He said to send him the X-ray patterns, densitometer traces, and the other data. About a month later I got a letter back from him—everything handwritten. He had drawn on a piece of graph paper what he thought the structure was. He was excited about it. He said there was a meeting of the ACS colloid people coming up in Buffalo, and he thought we



Ken Towe at Jackson, MS, 1986

High Iron Photos

on it. I did sneak one into the manuscript: I called it protohematite, because its structure is very similar to hematite. Well, the Russians jumped on it pretty quick, and they named it ferrihydrite. So that's the story of the discovery of ferrihydrite, but the Russians got credit for the name. They cited us, of course. I think that was one of the better papers I published. I know it's one of the most highly cited papers.

CMS: I had no idea about that, none at all.

TOWE: It was serendipity in a way, because I was working on the TEM in a molecular biology group where other guys were working on similar things. It just all came together. I got a job as a result of these studies, and as a result of working on biomineralization, for which

Lowenstam is famous, but mostly as a result of my experience with the electron microscope. The Smithsonian was looking for somebody to set up an electron microscope facility to work jointly with the people on the staff. They had the money to buy the microscope, and the space to put it in, so I interviewed. And that's how I wound up in the Paleobiology Department. I continued to work on colloidal iron compounds.

CMS: How do life forms use ferrihydrite?

TOWE: Ferrihydrite occurs in an iron storage protein in your body. The body stores iron in a protein called ferritin. Ferritin is like a tennis ball; it's hollow inside. Each molecule is a sphere of protein that's about 120 angstroms in diameter. Inside each "ball" is a little crystal of ferrihydrite. This is the same stuff the guys at Caltech had found in plants—phytoferritin.

CMS: You're kidding!

TOWE: No, I'm not. When I had finished the paper with Bradley, I heard about some of the other people working on ferritin. A crystallographer in England by the name of Pauline Harrison had been trying to figure out the structure of the so-called ferritin micelle, the ferritin core. I

continued on next page

Ferrihydrite occurs in an iron storage protein in your body. The body stores iron in a protein called ferritin. Ferritin is like a tennis ball; it's hollow inside.

ought to give a paper up there. I said, "Well, Bill, if we talk about the structure, you've got to give the paper. If we talk about the rest of it, I'll give the paper." I didn't feel comfortable talking about a structure that I couldn't determine, but that he had worked out. He said, "No problem," so he gave the paper, and it was published in the *Journal of Colloid and Interface Science* in 1967.

I wanted to put a mineral name on it, but Bradley was very reluctant to do that, probably because of the illite difficulty that he had encountered. So we didn't put a name

Towe, *continued*

sent her a copy of our paper in press, and she published a paper immediately in *Nature* with what she thought was the structure. Her structure was different from ours, but ours has survived the test of time. In one of her review papers recently on ferritin, she used the Towe-Bradley structure, so our structure has been more-or-less accepted as the structure for the core. This protein is found in all kinds of animals and plants as an iron storage protein; it's even been found in bacteria. The iron core is ferrihydrite, with phosphate adsorbed on it.

CMS: Not only did I not know that, but I never would have predicted that that was what you'd been working on. That's pretty far afield for a clay mineralogist.

TOWE: But there are a lot of papers on ferrihydrite in the clay literature now.

CMS: It's become a popular mineral, for soil people. It's almost the "in" mineral among the soil-oxide researchers.

TOWE: If I had it to do over again, I would have insisted to Bill that we put a mineral name on it, and submit it to the International Commission. I never tried to push him on it, but I could tell he was reluctant. He just wanted to stick to the inorganic aspect of it, to the material that was synthesized, even though he knew that it occurred in the teeth of chitons and in the protein ferritin. He didn't want to deal with it as a mineral. Subsequently it was discovered elsewhere in nature. Walt Keller wrote a paper on it; he and one of his students found it as a weathering product of basalts, where lichens had grown over the basalt.

CMS: At an early age in my scientific development, I became a fan of Heinz Lowenstam, a person who was a mineralogist and a biologist and who wanted to know what the mineralogical composition of every living thing was, and classified it. What was he like?

TOWE: He's still very active. He was given the Paleontology Society Medal a few years ago, and he asked me to be his citationist. I'm very proud of that.

CMS: Oh, fabulous!

TOWE: As a result, I had to dig into his background. He's a person who has a deep intellectual curiosity; he's like a little boy although he's in his seventies. You can't keep him from wondering about things. I feel the same in a lot of ways—I wonder about things.

CMS: I can remember as a grad student writing him for a

reprint, a booklet, I think.

TOWE: It was in 1963; it was published as part of a symposium. There's an electron micrograph in it of aragonite that I took. Lowenstam is a wonderful guy, a very nice person. If you go into his office, you figure, here's one of the most disorganized guys in the world, because there's stuff all over the place. There's a joke that goes around Caltech about a grad student who was visiting his office when the phone rang, and it took a few minutes for Heinz to find the phone, after looking under reprints and various other huge piles. We worked together well—he's great.

CMS: What is the environment like at the Smithsonian? It's a rather specialized kind of job to have. A bunch of people work at oil companies, or at universities, or at the USGS, but not very many people work for the Smithsonian. Is it a research-type environment?

TOWE: Oh, it is definitely a research-type environment. Most of the people that are at the Smithsonian are curators

Lowenstam is a person who has a deep intellectual curiosity; he's like a little boy although he's in his seventies. You can't keep him from wondering about things.

responsible for specific collections, so there's a curator of brachiopods and a curator of bryozoans....

CMS: Now don't tell me there's a separate curator for brachiopods! That's amazing.

TOWE: Why is that amazing?

CMS: I can't imagine it, especially when you think of all the possible things in a museum that could be curated. Do they have a quartz person?

TOWE: No, the Mineral Sciences Department is different from most of the others in that respect. The Paleobiology Department, which, of course, studies fossils, is made up of curators who have taxonomic specialties.

CMS: That's probably a holdover from the 19th century?

TOWE: Sure it is. But I think that's typical of all muse-

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Towe, *continued*

ums; you have a curator of birds, of sponges, of worms. As I said earlier, the job that they had open was for somebody to come and work as an interdisciplinary individual to help with the electron microscope.

CMS: That's a great job to have.

TOWE: Yes, it's a wonderful job. I have a lot of freedom to do what I want, and I have worked with a lot of people on a wide variety of topics. I've published papers on coccoliths, mollusks, bryozoans, and brachiopods. I even have a genus of coccolith named after me—*Toweius*. I worked on coccoliths at Illinois with Bill Hay. Bill since has gotten away from coccoliths into big picture global circulation models, but we published some of the first electron micrographs of coccoliths in the early 60's. I think Bill's the one who named that genus after me.

CMS: You also were working on the Burgess Shale. Is that work still going on? I believe you told me that the Burgess Shale might be non-marine in some sense.

TOWE: Well, the thing that has always bothered me about the Burgess Shale, and the fauna in the Burgess Shale, is the preservation of soft body parts. The usual story is that these unusual animals were washed into an anoxic basin, which then preserved them. It never set well with me, because if that were the case, you should find Burgess Shale-type faunas all over the place because anoxic basins are not all that unusual. So I began to wonder why these fossils were so well-preserved, and I wanted to know more about the chemistry of the rocks.

There was a graduate student at George Washington

I've published papers on coccoliths, mollusks, bryozoans, and brachiopods. I even have a genus of coccolith named after me—Toweius.

University, John Kelafant, who was looking for a thesis, and I suggested this topic to him. I wrote to Harry Whittington at Cambridge, who had been up to the Burgess Shale deposit on a collecting trip that was sponsored by the Canadians at Charles to re-collect Walcott's old sites. Harry and his students had published all kinds of papers on these fossils. I asked Harry if he had any Burgess Shale samples that were suitable for destructive analysis, that didn't have fossils in them. He sent me back 12 or 14 samples of shale that were vertically separated, and where he had measured their locations to the nearest inch. He

knew exactly where they came from. I gave them to John. He did the clay mineralogy, and then we started to do some geochemical work. I had been looking for something that would tell me about the environment of deposition, and I remembered a paper that Degens, Williams, and Keith had written on the shales from the Appalachian coal fields, published in the AAPG back in the 50's. They had done trace and minor element analyses, and illite-kaol-

One of the things that is interesting about the preservation of the Burgess fossils is that many of them have a silvery, very shiny film on them....It's a pure illite.

inite ratios, and so on, trying to sort out the fresh water from the marine and brackish water shales from that area.

I thought that maybe we could apply this approach to the Burgess. John started doing some minor element analyses. The ones that seemed to work for Degens were boron, of course, and gallium, and the ratio of boron to gallium. We did these plus a few others that fall out anyway. In addition, I had John run the organic carbon-sulfur ratios because Bob Berner had demonstrated that there was a relationship between the carbon-sulfur ratio and the fresh water versus marine-euxinic type of deposits. John dutifully ran all these things and came back with the results.

He came in puzzled himself, but when I looked at the results, I couldn't believe it. I said, "John, you've made a mistake; I'm sure there's something wrong. The carbon values are too low, and the sulfur values are low also. This is a shale that's supposed to have a lot of organic matter in it." And he said, "Ken, I know I ran them right. We calibrated everything and ran 'known' specimens." I said, "Run them again." He ran them again and got the same results. The carbon-sulfur ratios, if you looked at them on a Berner-type C/S plot, were all clustered right near the origin. They didn't tell us much of anything about the marine vs. freshwater, but they're certainly not indicative of an anoxic environment, by most standards anyway.

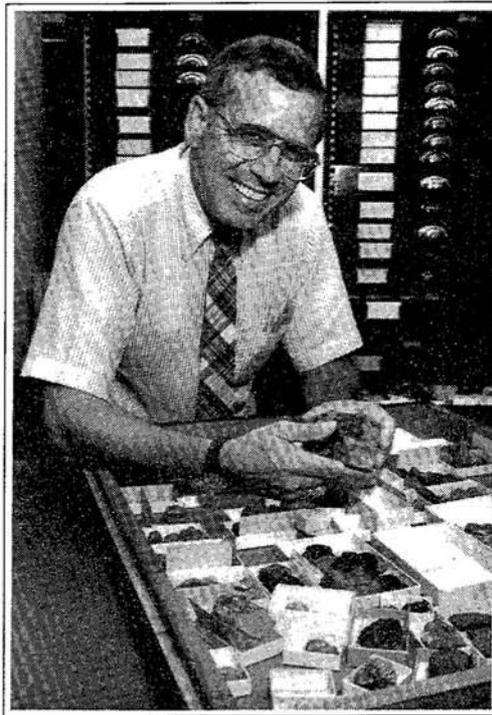
CMS: Possibly not even a marine environment?

TOWE: Well, the boron values were not at all marine. Using trace and minor elements to determine origin is dangerous, and using any one element is exceedingly dangerous; but when we started putting it together, we had low carbon-sulfur ratios, and we had boron that was indicating freshwater deposition. The gallium was brackish;

continued on next page

Towe, continued

boron-gallium ratios were brackish. John then found length-slow chalcedony, and he found, as I remember, some zoned dolomites. These indicated a hypersaline or evaporite situation. It's a very peculiar deposit. I don't know why I'm talking about this because they're unpublished results, and mostly they're John's results. John wrote his thesis up, got his degree and immediately took a job with a consulting firm. He walks around in a suit and tie with a briefcase, and I can't get him to write his thesis up for publication. But it's a fascinating rock, and there's something screwy going on. We're working on a paper together, but it's slow going.



Ken Towe at the Smithsonian

CMS: I don't know of any other published description of the Burgess petrography

TOWE: One of the things that is interesting about the preservation of the Burgess fossils is that many of them have a silvery, very shiny film on them. Harry Whittington wanted to know what it was. So I scraped the silvery film off with a very fine needle and mounted it on a Gandolfi camera. It's a pure illite.

CMS: Isn't that interesting!

TOWE: Yeah, really—very pure.

CMS: Probably a precipitate.

TOWE: Yes, no doubt about it. Whereas the shale itself is the typical illite, with subordinate chlorite and a little kaolinite maybe. It's a normal Paleozoic shale, but the silvery film that's on the fossils is really a pure illite.

CMS: Well, this is definitely not your usual clay mineralogist we're talking about. Let's change the subject again. It's funny, you see people at meetings year after year, you talk with them, but sometimes you don't know much about them. Like, do you have any hobbies?

TOWE: I like to play golf. I'm not very good at it, but I like to play it, and I'd like to play more of it. I play tennis

in the winter, just to have something to do in Washington in the cold, in one of those indoor bubble things with a bunch of other guys, doubles, once a week in the evening. I don't collect stamps or anything like that.

CMS: Getting back to the Smithsonian, when I went there, I looked at the giant topaz crystals that were cut into foot-long gems, and the Hope Diamond, and maybe a few other things. Do they have clays?

TOWE: They have clay minerals in their collections. As you know, one of the most famous ones is the Black Jack beidellite. Maybe not famous exactly, but one that a lot of people would like to get a piece of. It's now down to the bitter end. They have a lot of clays, but it's not unreasonable to observe that most of the people in the Mineralogy De-

partment are interested in minerals that are visible to the naked eye, or that have some intrinsic beauty or rarity to them. Clays have taken the back seat, there's no question about it. Jeff Post is chairman of the Department, and he is sensitive to the clays, but as a group they are not really interested in clays.

CMS: It's interesting, years ago when I was a kid, I used to go to the American Museum of Natural History, because I lived in New York. I used to take one bus to the other bus to another bus so I could take the subway and get off at 79th Street or whatever. Their mineral display was ancient—now they've changed it—but back then they had actually tried to display *all* of the minerals. Somebody decided, "Since there are 2000 minerals, we'll show all 2000. That's what a good museum should do." So they had these flat cases, kind of dingy, and you'd look in and there'd be a little bottle in there that said hubigloberite or something, that looked like bread crumbs. That's the way it was—they had the clays. Now they have a display that's beautifully made, and has a tunnel full of crystals that looks like a cave, but I don't think they have any clays, or maybe just one so they can say "clay."

TOWE: The clays are, of course, difficult to exhibit. You'd have to do it with an SEM or something like that, and eventually I suspect they'll do that. But the reference collections at the Smithsonian, of course, far exceed any-

continued on next page

Towe, *continued*

thing on exhibit. They have a huge reference collection, and in the clay area, that's what could be improved. So all you guys out there with your analyzed samples that you've got in a drawer somewhere, send 'em to the Smithsonian.

CMS: Tell us about your recent article in *Nature*.

TOWE: Well, that doesn't have anything to do with clays. That has to do with the early Precambrian atmosphere. Our atmospheric oxygen came from photosynthesis, after life evolved. In order to explain the amount of carbon and iron we see in Archean rocks, you have to in-

I was then a geologist in the middle of molecular biologists, at a period of time when molecular biology was advancing by leaps and bounds.

voke something to intercede to get rid of some of the oxygen from photosynthesis. Iron has been the traditional "sink," but carbon is the only thing that can really do that. There's too little iron in sediments. You have to use the process of aerobic respiration, which is the dominant process that is used today to keep oxygen from "going bananas" in the atmosphere. If all organisms that use oxygen stopped breathing, and photosynthesis were allowed to continue, you'd just keep pumping oxygen into the atmosphere, and it would double in a very short time. The point is that the balance between respiration and photosynthesis is very important in maintaining the equilibrium. The iron and carbon found in Precambrian rocks seems to tell us this balance has been around a long time. It won't work, however, under anoxic atmospheres.

CMS: What do you find most fulfilling about your work? Why do you like to be a scientist?

TOWE: Oh dear.... The thing that I enjoy about it the most is satisfying my curiosity about something and finding an answer or a solution to something. It's a very rewarding experience to pick a problem and find the answer. It may not be the right answer, it may not be the answer other people would accept as the answer, but it's satisfying.

CMS: What is the process that you use? Is it very logical, step-by-step, or a leap of imagination, or what?

TOWE: It's hard to say. I don't have a prescribed way

of dealing with a problem. I remember when I visited the University of Texas many years ago, I went into Bob Folk's office. He had a sign on the wall, saying, "Chance favors the prepared mind." The more things you know, the broader your background, the better. Something from over here will click in my mind that may help me with something I'm doing over there. I don't know how it works. I don't know that you can train somebody to do it, but that's what I do. I'll see something, and I'll start to think about it in another context, in the context of some other problem, sometimes not even a problem that I happen to be interested in at the time. Once I get going on something, of course, I try to get the literature, do the research, or find the experiment that will help me along; but in finding the problem, a lot of it is chance and serendipity for me. Maybe something you're born with; I don't know.

CMS: Now that you mention it, you *are* different than some types of scientists. Probably the way you were before you became a scientist has had some influence on your approach, but by going to the Smithsonian, where you were a person who interfaced with biologists, mineralogists, whoever was there, you became vastly broader in your outlook than most scientists. You are going about your way, and suddenly you see something and think, hey, this fits with that other thing. That is a different approach, that's the Folk approach that was on the board, the prepared mind.

TOWE: Some of the things I've done I've been forced into, so to speak, like when I went to Pasadena; to do the electron microscopy. The Geology Department there didn't have an EM at that time. They had to go to the molecular biology people and say, "We have a post-doc here. We'd like him to be able to use your equipment. Is that all right?" The guy in charge of the electron microscope facility was Alan Hodge, an outstanding microscopist. He interviewed me and wanted to know what I knew about microscopes. I convinced him that I knew what an electron microscope was, and that I knew how to work with it.

But the point is, I was then a geologist in the middle of molecular biologists, at a period of time when molecular biology was advancing by leaps and bounds. I sat with these guys at coffee every morning, I was invited to their parties. In fact, I spent more time with the molecular biologists than I did with the geologists. You can't help but pick up things, and learn things and learn different approaches. I'm not saying that the people in geology weren't creative or inventive, but it's just a different way of looking at things, and I think I passed a few things along to the biologists, too. So that helps in research from my point of view. I think the interdisciplinary approach is a good one. However, I don't think you can force it or

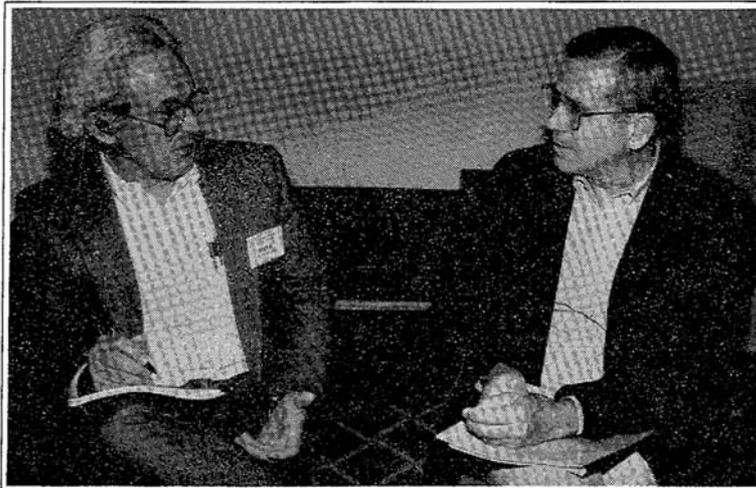
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Towe, continued

dictate it.

CMS: Your situation at the Smithsonian—your particular niche—engenders that approach, and other people might not be in an environment where they can get away with that.

TOWE: You're using the electron microscope to look at the shell structure of brachiopods, or whatever, because the guy you're working with is interested in it from a taxonomic point of view—he wants to know how it might help him classify these groupings. If you're trained as a mineralogist, you can't help but see mineralogical things while you're doing that, and you can make observations about the way minerals form in biological systems and stuff like that, unless you've really got blinders on. So I think people who have a background in clay mineralogy, if they go into another field, what they know they'll put to use. It doesn't happen intentionally. It's not as if someone says, "Here, I want you to come in and put your background to



Dave Pevear interviewing Ken Towe, Columbia, MO, 1990

High Iron Photo

haven't, quite frankly, been doing that much research in clays *per se*. I read the papers, try to follow them. I even ask intelligent questions once in a while. If you're interested in sedimentary geology, it's hard to find a rock that doesn't have some clay in it. Clays are in shales, sandstones, in almost anything—the clays are there.

CMS: I've heard many people say that there is something—of course this sounds corny—that there's something special about the Clay Minerals Society, that it has a sort of friendliness that other societies don't have. Now I don't know if that's true...

TOWE: When I gave Spike Jordan [Pioneer Lecturer 1990] his honorarium check this afternoon, he said the same thing. He volunteered it to me, and said he thought that the Clay Minerals Society was one of the nicest groups. I said, "Well, why?" He said, "I just think everybody's so friendly, by and large."

CMS: I can't imagine why the Clay Minerals Society should be any friendlier than any other society. Maybe I can see why it would be more friendly than a society of geophysicists.

TOWE: One reason might be that they're not all working in the same area. You've got clay organics, diagenesis, crystal structures, crystal growth. It's a diverse group, but it's still small. You don't have everyone working on the same problems, and all fighting with one another.

CMS: I have one last question. What is your favorite clay?

TOWE: Actually, my favorite clay is attapulgite. I can remember when I was taking the TEM pictures for Dr. Grim's book, I used the replica method. I was absolutely fascinated with the length and flexibility that some of the fibers exhibited—these long spaghetti-like things. And I've always been impressed with the fact that it was used to manufacture carbonless copying paper. It's sort of a fun mineral. The rest of the clays are mostly a bunch of flakes.

I think the interdisciplinary approach is a good one. However, I don't think you can force it or dictate it.

use, and discover something." The kind of collaboration I mean only works if it's allowed to proceed in an unforced way.

CMS: You're involved in so many different disciplines and several societies, but you're considered one of the more dedicated members of this Society. What's the foundation of your commitment? Do you shower this kind of dedication on all the societies you're involved with?

TOWE: No, I think it goes back to Illinois again. There was a group of people there that were fun to be with; all interesting people, all working on clays, and Dr. Grim was such a wonderful guy. I got involved with the Society very early and I've stayed involved, even though I

Definitions of Allophane

The following discussion was prepared by Dr. Roger Parfitt, DSIR Land Resources, Private Bag, Lower Hutt, New Zealand, and submitted by Joe Dixon, Dept of Soil & Crop Sciences, Texas A & M University, College Station, TX 77843. Comments and suggestions on the definitions are requested and may be sent to either Parfitt or Dixon.

Round table discussions on the definition of allophane were held at the IXth International Clay Conference, Strasbourg, August 1989, and 14th International Congress of Soil Science, Kyoto, August 1990. As a focus for further discussion, some definitions of allophane are listed. Under the header (A) are some definitions based on the broad concept that allophane is the name of a group of materials (Ross and Kerr, 1934; Van Olphen, 1971). Under (B) are some tentative definitions of distinct types of allophanes which are becoming increasingly well defined (Yoshinaga, 1986).

(A) Ross and Kerr Definition 1934

"Allophane is an amorphous material that is commonly associated with halloysite. It has no crystal structure and no definite chemical composition. The name allophane should be restricted to mutual solutions of silica, alumina, water and minor amounts of bases, but should include all such materials, even though the proportions of these constituents may vary."

Van Olphen Definition 1971

"Allophanes are members of a series of naturally occurring minerals which are hydrous aluminum silicates of widely varying chemical composition, characterized by short range order, by the presence of Si-O-Al bonds and by DTA curves displaying a low temperature endotherm and a high temperature exotherm with no intermediate endotherm."

Farmer and Russell Definition 1985

Allophane is a group name for non-crystalline clay minerals consisting of silica, alumina, and water in chemical combination.

Wada 1989

Allophane is a group name of hydrous aluminosilicates consisting of hollow, irregularly spherical particles with diameters of 3.5 to 5 nm, and with a molar Si/Al ratio typically of 1:2 to 1:1. A member or mixture of allophanes is referred to by its Si/Al ratio.

Parfitt Definition 1990

Allophane is the name of a group of clay-size minerals with short-range order which contain silica, alumina, and water in chemical combination.

Kyoto Draft Definition 1990

Allophane is the name for the group of hydrous alumino-silicate clay minerals which are non-crystalline.

Notes on Kyoto Definition: Bailey (1980) states that "clay mineral" is the common name for the hydrous layer silicates, part of the larger family of phyllosilicates.

Short-range-order materials have long range disorder, and Brindley (1980) gives muscovite and glass as two examples. Since the term "short-range order" has been used for such a wide range of crystallinity, it would be confusing to use the term in the definition of allophane. For allophane, both X-ray diffraction and electron diffraction data indicate no repeat of structural units in any of the three dimensions of space. Therefore "non crystalline" is more appropriate than "short-range order" in the definition of allophane.

The range of chemical composition given by Yoshinaga (1986) for naturally occurring allophane is $Al_2O_3=35-42\%$, $SiO_2=31-41\%$, $H_2O=14-19\%$. Soil samples examined by Parfitt and Kimble (1989) had a wider range of composition. Broad characteristic X-ray bands occur near 3.5, 2.2, and 1.4Å.

continued on next page

(B) 1. Proto-Imogolite Allophane (Imogolite-like Allophane)

An allophane with a structure close to that of imogolite $(\text{OH})_3\text{Al}_2\text{SiOH}$ but not having the crystal order of imogolite. The chemical formula is $\text{Al}_2\text{O}_3, 0.6-1.0 \text{SiO}_2, 2.5-3.0 \text{H}_2\text{O}$. Powder X-ray diffraction data compared with imogolite is as follows:

Proto-imogolite allophane		Imogolite	
dÅ	I	dÅ	I
12vb	70	16vb	100
4.3	10	7.9	70
3.4vb	100	5.6	35
2.2vb	50	4.4	10
1.9	10	4.1	10
1.7	10	3.7	20
1.4	20	3.3vb	65
		3.1	5
		2.6	5
		2.25vb	25
		2.10	5
		1.73	5
		1.40	10

Natural samples have the morphology of hollow spherules, 35-50 Å outside diameter. NMR and infrared spectra are similar to those of imogolite. First reported Farmer *et al.* (1977).

References to names and properties are Farmer *et al.* (1978), Parfitt (1990).

2. Hydrous-Feldspathoid Allophane

An allophane with Al-for-Si substitution of up to approximately 1:3. Analysis gave Al_2O_3 35-45%, SiO_2 34-39%, H_2O 20-24%.

The chemical formula is: $1.1-1.7 \text{Al}_2\text{O}_3, \text{SiO}_2, \text{SiO}_2, 1.6-2.3 \text{H}_2\text{O}$.

Powder X-ray diffraction data is as follows:

dÅ	I
3.4vb	100
2.2	30
1.4	10

Formed at pH near 6 and above where $\text{Al}(\text{OH})_4^-$ is the dominant species in solution. First reported Wells *et al.* (1977). References to name and properties are Farmer *et al.* (1979). Childs *et al.* (1990).

3. "Defect Kaolin Allophane" or "Halloysite Like Allophane"

This allophane has a formula close to $0.5 \text{Al}_2\text{O}_3, \text{SiO}_2, 1.4 \text{H}_2\text{O}$. The silicate is polymerised (NMR, infrared spectra). The aluminum is largely in octahedral sites. It is not clear if samples can be obtained that are free of proto-imogolite allophane and hydrous-feldspathoid allophane.

continued on next page

Powder X-ray diffraction data is as follows:

dÅ	I
12	10
3.4vb	100
2.2	30
1.9	5
1.4	10

Natural samples have the morphology of hollow spherules, 35-50 Å outside diameter (Wada, 1979; Parfitt *et al.*, 1980). Names are discussed by Yoshinaga (1986), Parfitt (1990).

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Crystallography Scholarship Fund of JCPDS-ICDD

Qualifications: To be awarded to graduate student with major interest in crystallography (crystal structure analysis, crystal morphology, modulated structures, correlation of atomic structure with physical properties, systematic classification of crystal structures, phase identification, and materials characterization).

Requirements: Submission of one-page proposal by graduate student describing type of crystallographic research to be partially supported by scholarship. Supportive letter from sponsoring professor from an accredited university or an institute of technology. No restriction on country, age, or sex. Term of scholarship: one year with only one renewal if approved at the end of the first year on the basis of the student's written accomplishments during the first year. The scholarship stipend of \$2000 is to be paid to the graduate student to help defray tuition, laboratory fees, and registration fees to accredited scientific meetings related to crystallography, but not for travel. Two scholarships available.

Application: Applications should be mailed, prior to October 31, 1991, to: Secretary, ICDD, 1601 Park Lane, Swarthmore, PA 19081-2389, USA. For more information, contact the International Centre for Diffraction Data at the above address or at 215-328-9400, or FAX 215-328-2503.

What about clay research in Czecho-Slovakia?

There are few things which have not been destroyed by the communist regime in our country. In spite of this, clay science has come through that time relatively well.

In the beginning of systematic clay research (1950-1955), most Czecho-Slovak clay specialists concentrated on kaolin deposits—important ceramic raw material. Deposits of the highest quality are situated in the western part of the Czech Republic; thus Prague became the center of this type of research (M. Kuzvart and J. Konta). Later, in connection with investigation not only of new kaolin deposits, but also of bentonites, the interest of clay geologists extended to the whole territory of Czecho-Slovakia.

The development of clay research was directed, especially in Slovakia, by the existence of many very high quality bentonite deposits. After 1960, a strong group of clay mineralogists formed in Bratislava around I. Kraus (geological aspects of research) and B. Cícel (crystallochemical and technological aspects of re-

search). In Ostrava, a small group deals with the clays of coal basins. (J. Kralik, Z. Weiss). Clay research in our country is connected mostly with the ceramic and chemical industries. Unfortunately, this research is used neither by soil science nor in oil prospection.

Czecho-Slovak clay scientists have organized regional clay conferences more or less regularly. Eleven conferences were held, in addition to the Euroclay meeting, which was organized in 1983. From these conferences, nine proceedings (representing more than 3000 pages) have been published. Our clay conferences are quite popular abroad, especially in Central Europe. For example, at the last conference, which was held in 1990, 50 foreign (eleven countries) and 100 domestic specialists took part.



Howard May, Dennis Eberl, Bill Johns, Vlado Sucha, Strasbourg, 1989.

Participation at our clay conferences offers a chance for you to become familiar with the work of most clay scientists in Central and East Europe. The next conference will be held in summer 1992 in Bratislava. Everybody is very welcome. You can take part not only in the conference, but also in an interesting excursion to Hungarian clay deposits.

Vladimir Sucha
Bratislava

Katherine Mather, *continued from page 3*

In the American Concrete Institute, she was a fellow, an Honorary Member, a Director (1968-71), and a member of many committees. She received, with Tom Kennedy, the Wason Medal for Research for 1955, and in 1982, the Arthur R. Anderson Award.

In both the American Society for Testing and Materials and the Transportation Research Board of the National Research Council, National Academy of Sciences, she served on numerous committees and received numerous awards.

In the Mississippi Academy of Sciences, she was Editor and Director 1960-66, and received Awards for Distinguished Service to the Acad-

emy, 1980, and to Science, 1986.

She was honored, with her husband Bryant Mather, at an International Conference on Concrete Durability at Atlanta in 1987, the Proceedings of which were issued as ACI SP-100 (in two volumes with 2179 pages), and from which came the Katharine and Bryant Mather Fellowship of the American Concrete Institute.

She received the Distinguished Alumna Award of St. Catherine's School, Richmond, VA, 1971; Woman of the Year Award of the Jackson, Mississippi, Business and Professional Women's Club, 1968; Chairman, Papers Review Committee, Cements Division, American Ceramic Society, 1978-79; Chairman

Committee on Cement, Lime, and Gypsum, AIME, 1957. She attended 25 or more international conferences and study tours. The list of her accomplishments and awards is too extensive to be included here. Besides authoring over 200 technical publications, she was the co-author with her husband of the book, *The Butterflies of Mississippi*.

Memorial contributions may be made to the Katharine and Bryant Mather Fellowship, American Concrete Institute, ATTN: Education Department, Box 19150, Detroit, MI 48219.

Bryant Mather
Vicksburg, Mississippi

Very low grade metamorphism takes a nappe

The spring 1991 meeting of the European Union of Geosciences VI in Strasbourg hosted a symposium on Very Low Grade Metamorphism (VLGM), convened by the International Geological Correlation Program, Project 294. Many of the 27 papers and posters presented addressed the main aim of Project 294; that is, to define the pressure-temperature-composition controls on VLGM in contrasting geodynamic and geothermal settings.

As with previous meetings of Project 294, the symposium also proved an excellent forum for interfacing the techniques of classical metamorphic petrology with those of the clay mineralogist. The illite crystallinity



Martin Frey, Doug Robinson, and Ken Livi, in need of the Swiss hammer (binoculars).

Dick Merriman

(Kubler) index is widely used as an indicator of VLGM, and several presentations sought to correlate it with other indicators, such as phyllosilicate assemblages, carbonate composition, and fluid inclusions. Others attempted to characterize the Kubler

index in terms of crystallite size distribution and preferred orientation studies. The importance of characterizing illite size and composition was a recurrent theme of the several isotope studies reported.

The Strasbourg meeting was followed by a three-day field excursion to the Helvetic Alps of Switzerland, regarded by some as the birthplace of very low grade metamorphic studies. Two of the doyens of the discipline, Martin Frey and Bernhard Kübler, led the excursion through structurally and scenically breathtaking terrains. Illite crystallinity and phyllosilicate assemblages have been used extensively to map the metamorphic grade associated with the late Mesozoic and Tertiary nappe emplacement that created the Helvetic units of the Alpine chain. After clear demonstrations of horizontal and vertical variation in grade within recumbent folds several kilometers thick, I have certainly revised my naive view of nappe formation as a simple, one-stage process.

Much discussion centred on the metamorphic temperatures (<350°C) indicated by fluid inclusion studies, and on the timing of metamorphism derived from K-Ar dating of white micas. There was also some lively debate on the nature and movement of metamorphic fluids, during which one of the leaders admitted he was uncertain of fluid composition—"I wasn't there," he confessed. However, of the various contemporary fluids sampled by the party, there was hearty agreement that a perfect balance of nutrients and alcohol was achieved in traditional Swiss fondue.

The next meeting of IGCP Project 294 is scheduled for Auckland, New Zealand, 8-21 November 1991, with a conference entitled, "Low Temperature Metamorphic Processes in Contrasting Geodynamic Settings." In 1992, there will be a Project 294 meeting at the 29th International



Bernard Kübler feeling the width of his peak.
Dick Merriman

Geological Congress in Kyoto, Japan, 24 August-3 September. This will be followed by a symposium, "The Transition from Basalt to Metabasalt: Environments, Processes, and Petrogenesis," to be held at the University of California, Davis, 9-15 September 1992.

Dick Merriman
British Geological Survey
Keyworth, Nottingham, UK

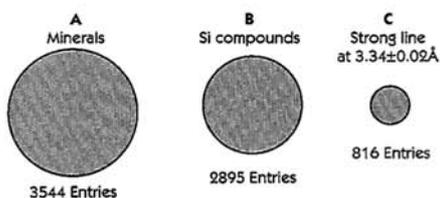
AIPEA newsletter

The AIPEA newsletter is available to new and prospective members of AIPEA. It is a 32-page compilation that covers many events of interest to clay scientists and technicians. Those wishing a copy should write to: Dr. R. A. Schoonheydt, Secretary-General, Centrum voor Oppervlaktechemie en Katalyse, K.U. Leuven, K. Mercierlaan 92, B-3001 Leuven, Belgium.

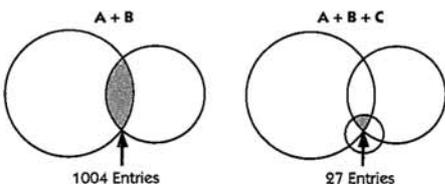
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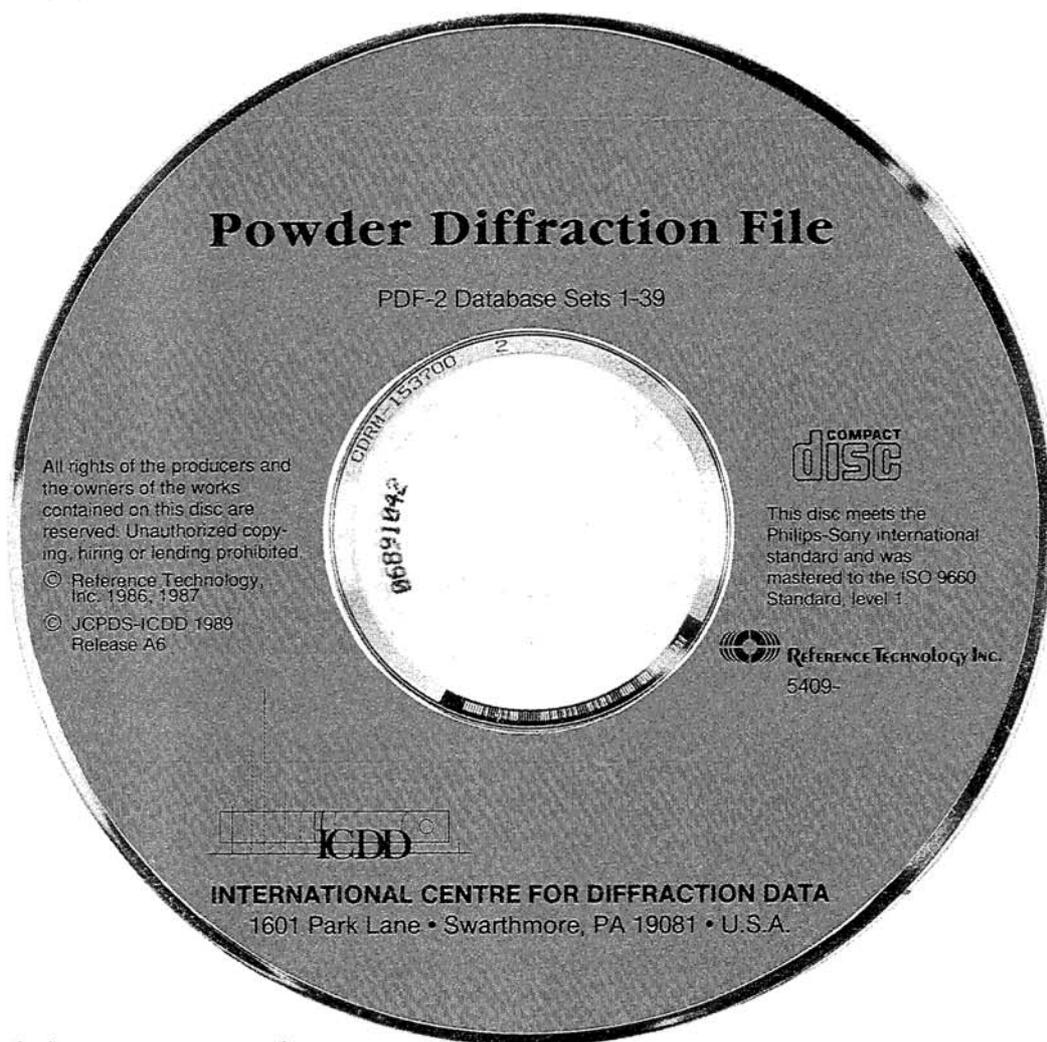
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Ask the Clay Doctor

(Not a real doctor)

Dear Clay Doctor: Since clay minerals are soft when hydrated and hard when dehydrated, where do they rank on Moe's Scale of Hardness?

Curious in Calgary

Dear Curious: First, let me take this opportunity to correct an all too common misspelling of the name of the scale to which you refer. It is properly called the Meaux Scale of Hardness. A Moe, as many scientists know, is the international unit of stooginess and is frequently invoked to describe the behavior of people who have just learned the paper they wish to present at a major conference is scheduled for 4:30 pm on the last day of the meeting. The hardness scale, on the other hand, was invented by the well-known 17th century French mineralogist and darts champion, Jean Pierre Meaux. But to answer your question, no one knows for certain. It is claimed that Meaux himself attempted to test the hardness of montmorillonite by isolating a single flake and inscribing Napoleon's farewell address to his troops on it with the point of a dart. When he got to the very emotional *adieu*, he pressed too hard and stabbed himself in the knee, and subsequently died of blood poisoning. Since then, people have only guessed at the actual value.

Dear Clay Doctor: In reading about the physical descriptions of clays, I note many authors frequently refer to the "top" and "bottom" of clay particles. How can I tell which is which?

Topsy in Topeka

Dear Topsy: There is a seldom-used but very elegant method for determining top and bottom of a clay particle. It is the PB & J method invented by an eighth grader at, coincidentally, Topeka Country Day Middle School, as a science fair project several years ago. Desperate for a unique and creative idea, she combined her knowledge of nutritional matters with mineralogy, and spread peanut butter and jelly (PB & J) on both sides of 100 clay particles. Now she knew from experience that when you spread PB & J on top of a slice of bread and it accidentally falls to the floor, it will always land with the PB & J side down. So she dropped the 100 particles, one by one, from a height of 2 meters and thus identified the top of each particle as the surface facing the floor. Her data was later corroborated by electron diffraction studies done after school in the physics lab.

Dear Clay Doctor: What is the little circle on the top of the "A" that designates the Angstrom unit (Å)?

Lost in Space, Baton Rouge

Dear Lost in Space: The little circle, known as an A-hole, is attached to hooks so that the Angstrom unit, which is very small, can be readily found and used by scientists. However, this device is crude, at best. One solution to the problem of finding the minute unit was to invent a hole that emits a high-pitched whine ("screaming" variety). This invention never became popular because it was too noisy, and sometimes burst into flames. Therefore most scientists prefer the silent kind ("dumb" variety). Whereas some research centers aimed to produce bigger holes, a real breakthrough came with the discovery of the nanometer, a unit that is ten times larger than the Angstrom. However, there is little danger that the Angstrom unit will become obsolete. Many purchasing agents assure us that there will always be an ample supply of dumb A-holes.

Dear Clay Doctor: Another army seems to have gone down the tube. Do you think that this is the halloysite effect?

Wondering in Washington

Dear Wondering: Most armies are too large to fit down halloysite tubes. However, halloysite has been used in modern warfare. Clay physicists working at Lawrence-Livermore Lab invented a nanocannon made of halloysite tubes that shoot grapeshot composed of beta particles. The weapon worked well in the laboratory, but failed miserably under battlefield conditions because the individual halloysite crystals were too fine-grained to be seen by the enemy. Unobserved, the beta particles' wave functions did not collapse, and nothing happened.

The Clay Doctor is available for consultation. Please send contributions to the Society Office.

CMS workshop volumes 1, 2, & 3

1. Quantitative Mineral Analysis of Clays, \$14.00.
2. Electron-Optical Methods in Clay Science, \$18.00
3. Thermal Analysis in Clay Science, \$10.00

To order, send checks made out to The Clay Minerals Society, in US funds on a US bank, for the price of the book plus \$2.00/book handling to CMS, PO Box 12210, Boulder, CO 80303, USA.

Feats of Clay

Sue Rimmer is President-Elect of the Society for Organic Petrology.

Ginny Colten-Bradley and Michael are celebrating the birth of Kara, their second daughter.

Vlado Sucha and his wife also welcome a second child, Katarina. Vlado finished his Ph.D. this Spring.

Ted Eyde is president of the Society for Mining, Metallurgy and Exploration, which has over 20,000 members and is one of the constituent societies of AIME.

Drummer silty clay loam has been nominated the State Soil of Illinois.



Sue Rimmer

New Members

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

Dr. Robert G. Beauchamp
1181 Cameron Court
Atlanta, GA 30306

Ms. Patti J. Burkett
Oceanography Dept.
Eller Bldg.
Texas A & M University
College Station, TX 77843

Ms. Harriet S. Cornachione
Dept. of Geol. Engineering
Geology & Geophysics
Houghton, MI 49931

Mr. Michael J. Dickens
Box 116
Savona, BC V0K 2J0
Canada

Dr. William H. Diment
USGS, MS 966
Box 25046
Federal Center
Denver, CO 80225-0046

Dr. Margaret A. Eastman
Pines Research Group
Department of Chemistry
University of California
Berkeley, CA 94720

Mr. Francis C. Furman
Dept. of Geol. & Geophys.
Univ. of Missouri-Rolla
PO Box 1417
Rolla, MO 65401

Dr. Martha M. Hamil
Engelhard Corporation
Menlo Park, CN 28
Edison, NJ 08818

Dr. Moir D. Haug
Dept. of Civil Engineering
Univ. of Saskatchewan
Saskatoon, Saskatchewan
S7N 0W0
Canada

Dr. Patrick I. Hill
Clay Minerals Studies Unit
Dept. of Geology
The University
Manchester M13 9PL
United Kingdom

Dr. Leighta M. Johnson
Air Prod. & Chemicals, Inc.
7201 Hamilton Boulevard
Allentown, PA 18195-1501

Mr. Ruben M. Kretschmar
North Carolina State Univ.
Dept. of Soil Science
Box 7619
Raleigh, NC 27695

Ms. Gejing Li
Dept. of Geol. Sciences
University of Michigan
Ann Arbor, MI 48109

Dr. Marshall E. Maddock
Dept. of Geology
San Jose State University
San Jose, CA 95192

Dr. Efrain Mendelovici
I.V.I.C. M-581
P.O. Box 020010
Miami, FL 33102-0010

Dr. Simon H. Mitchell
Watts Blake Bearn & Co.
Park House, Courtenay Park,
Newton Abbot, Devon TQ12
4PS
United Kingdom

Mr. Steven V. Moody
Maxim Engineers
2342 Fabens
Dallas, TX 75229

Dr. Kathryn L. Nagy
Exxon Prod. Research Co.
PO Box 2189
Houston, TX 77252-2189

Mr. Arthur J. Nash
Mineralogy Inc.
3228 E. 15th
Tulsa, OK 74104

Ms. Kirsten L. Price
Dept. of Geology
Michigan Tech
Houghton, MI 49931

Elizabeth Sherwood
13 Oak Drive
Geology Department
Colgate University
Hamilton, NY 13346

Ms. Wendy L. Shier
Dept. of Geology
University of Western Ontario
London, Ontario N6A 5B7
Canada

Mr. Darsa P. Siantar
Dept. of Chemistry
Univ. of Wisconsin - Milw.
PO Box 413
Milwaukee, WI 53201

Mr. Balwant Singh
Dept. of Soil Science & Plant
Nutrition
Univ. of Western Australia
Nedlands W.A. 6009
Australia

Dr. Randal S. Stahl
Mail Code EC 3, NASA,
Johnson Space Center
Houston, TX 77058

Dr. Kevin G. Taylor
Postgrad. Research Inst. for
Sedimentology
Reading University,
Whiteknights,
P.O. Box 227
Reading, Berks RG6 2AB
United Kingdom

Lynda B. Williams
Basin Research Institute
Louisiana State University
Baton Rouge, LA 70803

ACS symposium on colloids

The symposium "Colloid and Surface Chemistry of Clays," organized by Dr. Patricia M. Costanzo, Unilever Research US, and Professor Philip Low, Purdue University, for the Division of Colloid and Surface Chemistry of the American Chemical Society, was held in Atlanta April 14-19. The symposium consisted of nine half-day sessions and covered a number of topics of academic and industrial interest. A particular emphasis of the presentations was the interfacial interactions between clay minerals and: 1) water, 2) simple organic molecules, 3) surfactants, 4) more complex organic molecules such as pesticides. In these areas, clays play very diverse roles as adsorbents, stabilizers, catalysts, low permeability barriers, and controllers of rheological properties.

The speakers included a number of well-established experts as well as younger scientists. The participation by foreign scientists was especially evident, and included researchers from Australia, Belgium, Canada,



Philip Low and Pat Costanzo, coordinators of the ACS symposium, "Colloid and Surface Chemistry of Clays"

France, Israel, the United Kingdom, and the Soviet Union. Of particular note was the participation of three leading Soviet scientists: Professors Churaev, Shchukin, and Tarasevich.

All of the 42 presentations were of a very high scientific quality, and discussions were lively and useful. An indication of the high interest generated by the Symposium was that even the last

session, on the fifth day of the ACS meeting, was well-attended. A follow-up symposium will be held in the next three to five years.

Generous financial support came from Unilever, the Petroleum Research Foundation, Proctor and Gamble, the Colloid and Surface Chemistry Division of the ACS, Laporte Industries, B.P. Research, W.R. Grace, and American Colloid.

Pat Costanzo
Edgewater, New Jersey

Science is like a coral reef

When any major discovery in science is made, there is always a number of people who claim that the idea or the discovery was implicit in some previous work they or others have done; very often they are right. Such still-born children of the scientific brain abound, still-born because their author had not the art, the confidence, the enthusiasm and vitality to express his work in such a form that it had a living impact on the world of science. As I sometimes feel it necessary to remind young research students, we are not writing our papers for consideration only by God and a committee of archangels, but for frail fellow mortals... Unless a paper has an immediate effect, it will almost certainly play no part at all in the progress of science and might as well never have been written. Papers of the last generation are only of interest to science historians. Here science is unlike the arts, where the value of original thought is often enhanced by time. Science is like a coral reef, alive only on the growing surface. The work of the past is of course the foundation on which further advance has been made, but it is dead, it has been replaced by a more complete understanding.

W. L. Bragg

Georgia Kaolin, continued from page 1

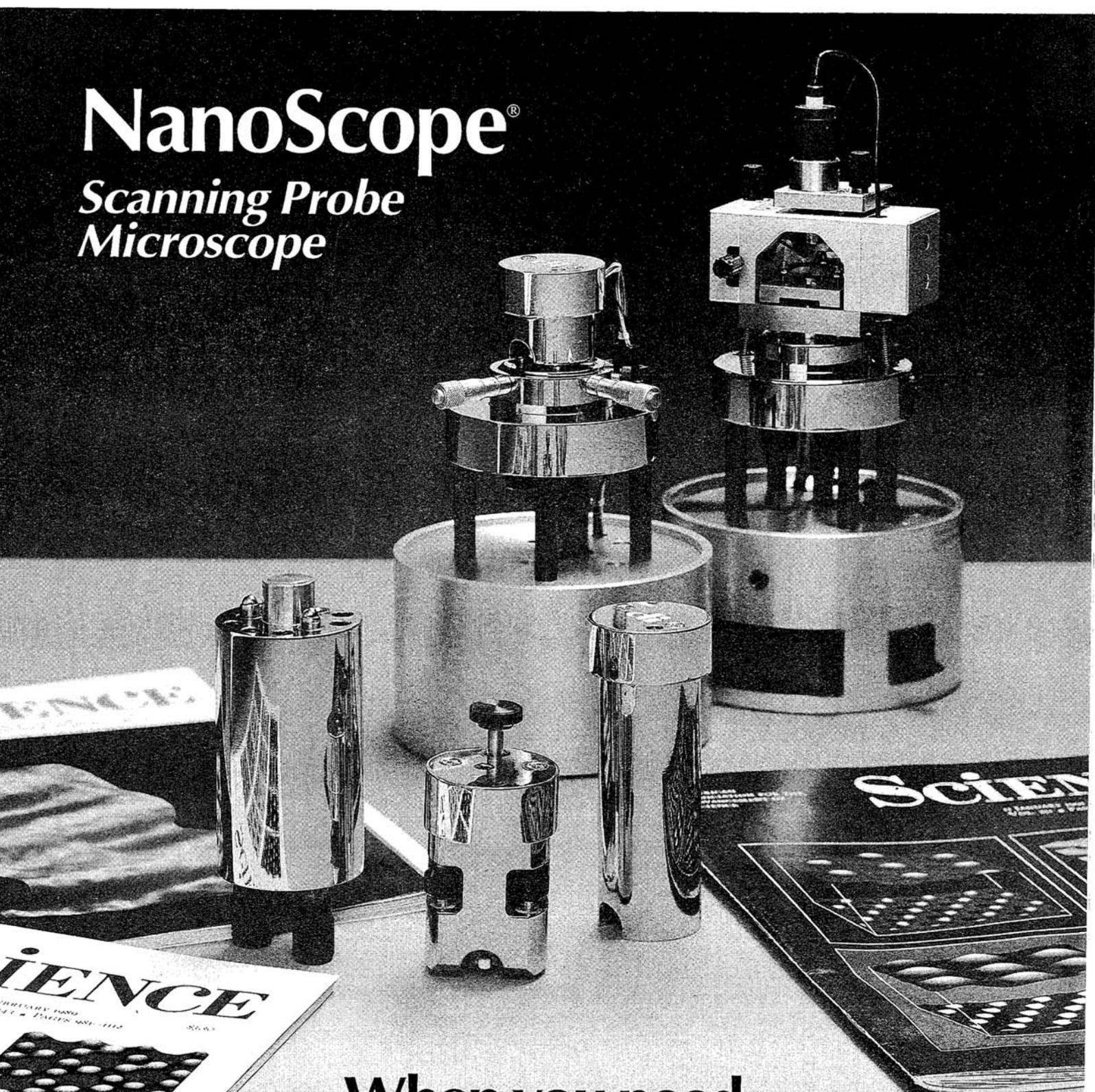
large wet processing plant at Sandersville, Georgia, and two airfloat or dry process plants, one at Sandersville and one at Wrens, Georgia. Three of the plants, along with their associated reserves, were sold to ECC International, a British company, and the fourth plant, at Dry Branch, was sold to Imetal, a French company. Through 1977, Georgia Kaolin Company was privately held, and then was sold to Combustion Engineering. In 1990, Combustion was sold to ABB Corporation (Asea, Brown, and Boveri, Inc.) of Switzerland. Georgia Kaolin Company has provided the ceramic bowls and platters that are presented to each outgoing Clay Minerals Society President.

Wayne Bundy, Vice President of Research and Development, has retired, and Sam Pickering, the Chief Geologist of George Kaolin, has opened a consulting office in Macon, Georgia. Tom Dombrowski, of the research staff, joined Engelhard Minerals and Chemicals research staff in Edison, New Jersey, after the sale, and Bob Pruett, also of the research staff, joined the ECC International research staff in Sandersville, Georgia. Doral Mills, a geologist with GK, is now Chief Geologist of Dry Branch Kaolin Company, owned by Imetal.

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Funding Survey

At last year's CMS Council Meeting, a question was raised about the funding of clay-related research. To ascertain whether or not funding is a problem, we would appreciate your response to the following questions. Feel free to make comments. Please fill out as much of the questionnaire as is relevant, and return to Dr. Patricia M. Costanzo, Unilever Research U. S., Inc., 45 River Road, Edgewater, NJ 07020. Thank you.

1. Are you employed by:

_____ academia _____ government _____ industry

2. What is your general area of interest? _____

3. Do you currently have a grant? _____ yes _____ no

4. If so, in what amount? _____ From what agency? _____

5. How many grants have you submitted in the past 3-5 years? _____

To which agencies? _____ Indicate how many grants were accepted, how many denied,
and by which agencies. _____

6. How many papers have you published in refereed journals over the last five years? _____

7. How many graduate students have you graduated in the past three years? _____

8. Would you be willing to help educate the government and other funding sources on the importance of clay research (in such ways as serving on a committee, writing letters, or making phone calls?)

_____ yes _____ no

9. Do you have other suggestions or comments on this subject?

Meeting Calendar

August 12-16, 1991, Ithaca, New York: **Clay Swelling and Expansive Soils**, NATO Advanced Research Workshop. Co-sponsored by NATO and the SSSA. Application deadline April 15, 1991. Contact: Dr. Philip Baveye, Dept. of Soil, Crop, and Atmospheric Sciences, Bradfield Hall, Cornell University, Ithaca, NY 14853 USA.

August 26-30, 1991, Dresden: 7th Meeting of the European Clay Groups, **Euroclay Dresden '91**. Contact: Prof. Manfred Störr, Mehringstrasse 48, Griefswald DDR-2000, GDR.

September 16-21, 1991, Manchester: **15th International Meeting on Organic Geochemistry**. Contact: Dr. D.A.C. Manning, Dept. of Geology, The University, Manchester, M13 9PL. FAX: (44) 61 275 3947.

September 18-21, 1991, Cologne: **International Congress for Geo-Sciences and Technology, Geotechnica 91**. Contact: Cologne Congress Management GmbH, Geotechnica, Postfach 180 180, D-5000 Köln 1, Germany.

September 30, 1991, Lexington, Kentucky: **Eighth Annual Meeting of the Society for Organic Petrology**. Technical sessions, workshop on density gradient centrifugation techniques, field trip through eastern Kentucky coalfield. Contact: Jim Hower, Center for Applied Energy Research, 3572 Iron Works Pike, Lexington, KY 40511; (606) 257-0261.

October 5-10, 1991, Houston: **28th CMS Annual Meeting**. Symposia: Clay Chemistry, Clay Geothermometers and Geochronometers, Extraterrestrial Clays, and Soils & Clays in Environmental Research. Contact: D. R. Pevear, P.O. Box 2189, Houston, TX 77055; (713) 965-4452.

October 21-24, 1991, San Diego: **GSA / MSA Annual Meeting**. Contact: GSA, Meetings Dept., P.O. Box 9140, Boulder, CO 80301.

November 4-8, 1991, Strasbourg: **15th International Symposium on the Scientific Basis for Nuclear Waste Management**. Abstract deadline: May 30, 1991. Contact: Prof. A. Meunier, Lab. Pétrologie URA 721, CNRS, Université de Poitiers, 40, avenue du Recteur PINEAU, 86022 Poitiers Cedex, France.

November 8-21, 1991, Auckland: **IGCP Project 294 International Symposium, Low Temperature Metamorphic Processes in Contrasting Geodynamic Settings**. Abstract deadline May 31, 1991. Contact: Conveners, LTMP, Geothermal Institute, University of Auckland, Private Bag, Auckland, New Zealand.

February 18-20, 1992. **U.S. Geological Survey 8th Annual McKelvey Forum on Energy Resources**. Houston, TX. Current USGS research on energy resources and "Recent Advances in Plate Tectonics and Continental Crustal Evolution," taught by Warren B. Hamilton. Contact: Christine Turner, USGS, Box 25046 MS 939, Federal Center, Denver, Colorado 80225. 303-236-1561.

August 31-September 4, 1992, Bratislava. **12th Czecho-Slovakian Conference on Clay Mineralogy and Petrology**. Geological, mineralogical, and chemical aspects of clay and zeolite research and its applications. Contact: Vladimír Sucha, Geological Institute, Slovak Academy of Sciences, Dubravská cesta 9, 842 26 Bratislava, CSFR, Czechoslovakia.

Research Assistantship Soil Mineralogy & Chemistry

Project: Phosphate Binding Properties of Ferrihydrite. Ferrihydrite, a poorly crystallized iron oxide mineral, is common in nature and is proposed as a potential phosphate binder for kidney dialysis patients. The objective of the research will be to maximize the stability and P-binding capacity of synthetic ferrihydrite for use as a pharmaceutical. We will study both natural and synthetic ferrihydrites so that our results can also be extended to P dynamics in natural systems.

Duties: Collect natural ferrihydrites in the field and prepare synthetic ferrihydrites in the laboratory. Use instrumental and wet chemical characterization techniques including: powder X-ray diffraction, Fourier transform infrared spectroscopy, pH-stat titration, electron microscopy, differential thermal analysis, UV-visible spectroscopy, and others. X-ray absorption spectroscopy (EXAFS & XANES) may be possible during the latter part of the project.

Starting Date: Immediately.

Contact: Dr. Darrell G. Schulze, Agronomy Department, Purdue University, West Lafayette, IN 47907. Phone: 317-494-8062. FAX: 317-494-6508.

**The Clay Minerals Society
28th Annual Meeting**

October 5-10, 1991 Houston, Texas

SYMPOSIA: Clay Chemistry, Clay Geothermometers & Geochronometers, Extraterrestrial
Clays, Soils & Clays in Environmental Research

WORKSHOP: Mossbauer Spectroscopy

VISIT: Johnson Space Center (NASA) Facilities

FIELD TRIP: Including Historic Galveston

General Chair: D. R. Pevear (713) 965-4452, P.O. Box 2189, Houston, TX 77001

Program Chair: J. B. Dixon (409) 845-8323

CMS student research grant deadline August 1

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.

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, 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 (6 copies) must be postmarked by August 1 and sent to the Society Office.

D. D. Eberl



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