On another day, it is serving on a consulting board with engineers regarding a foundation problem.

On still another day, it is applying information on the changes on heating clay minerals to shortening and improving the firing schedule of ceramic ware.

In every case the situation or problem involves the properties of clays, and a solution requires an understanding of the factors controlling the properties, and this revolves around the clay mineral composition, the structure and composition of the clay minerals, the susceptibility of the clay minerals to change with a changing environment, *etc.* What one learns today, one applies tomorrow to a new problem.

In 1950 I moved from the Survey to the University of Illinois to develop graduate work in Clay Mineralogy, and to continue my researches. I was delighted to have an opportunity to work with students, and pleased that the University position gave me greater freedom to pursue the application of clay mineralogy in diverse fields. I owe a debt of gratitude to George White, then Head of the Department of Geology at the University of Illinois, who gave me complete freedom to pursue clay mineralogy as I wished, and to the University which provided the necessary research facilities.

Between 1950 and my retirement in 1967, about forty students completed their Ph.D. degree in Clay Mineralogy, and they are now scattered throughout the world—in Universities, Geological Surveys, and Industry. To this group should be added about ten more persons who came to the University for periods of months to years as post doctoral fellows. These people have been added brains, eyes, and hands to me. They have helped immeasurably in keeping me abreast of developments in clay mineralogy, for which I am deeply grateful. I am proud of every one of these scientific children, and my greatest pleasure is to follow their careers.

In the years following my retirement I have continued my researches, both at Illinois and at Texas Tech University, where I was appointed Adjunct Professor of Geology in 1972. In Texas, Dr. Necip Güven and I have been working together preparing a volume on bentonites.

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Presentation of the Mineralogical Society of America Award for 1974 to James J. Papike

DAVID B. STEWART

U.S. Geological Survey, Reston, Virginia 22092

Mr. President, Fellow Members, and Guests of the Society.

My pleasure in introducing to you a colleague and friend since 1964, the 1974 recipient of the Mineralogical Society of America Award, is tempered by the knowledge that the teacher who had a vital role in shaping Jim Papike's career was not certain he would be well enough to make this introduction himself. However, that distinguished crystallographer, Tibor Zoltai, has asked me to personally convey to you his congratulations, Jim, with his hopes that you will continue your excellent applied crystallography.

I will tell you first about the distinguished research contributions for which the MSA Council made this Award. I will then remark on Papike's catalytic role in crystallography and lunar science. Finally, I will give you a few glimpses on the lighter side of things. First—the best part—his distinguished achievements on difficult and important crystal-chemical problems with immediate petrological applications. Papike has focused much of his research on the geologically abundant, geophysically significant, and mineralogically and crystallographically complex amphibole and pyroxene mineral families. These studies began at the U.S. Geological Survey, where together with colleagues Ross, Clark, Appleman, and others, precise structures were determined for the amphiboles glaucophane, tremolite, *C*-cen-

tered cummingtonite, primitive cummingtonite, a potassic and aluminous hornblende, and richterite, as well as 9 ordered clinopyroxenes. The game plan behind this massive team effort on superficially similar minerals was to create a sufficiently large body of high quality crystal-chemical data about the tetrahedral chains of inosilicate structures and the cation coordination polyhedra of these structures so that, added to the limited other comparable data then available, specific important *general* problems could be resolved. Examples were to be the significance of cation ordering and the role of chain stacking in symmetry inversions; exsolution, crystal-chemical limitations of solid solution, and ion exchange mechanisms; the detailed structural basis for similarities in the crystal chemistry of pyroxenes and amphiboles; and finally, to establish a basis for interpretation of the spectral methods which at that time were being intensively developed and applied to minerals. Papike contributed substantially to developing the Survey investigations, selected specimens with geological insight, performed much data collection and reduction, and led the consideration of intracrystalline solution models.

As this work culminated in 1969 it was immediately evident that because no basis existed for extrapolating the crystal-chemical phenomena so carefully ascertained at room temperature into the range of geological temperatures at which the minerals had formed, geological application was seriously hampered. Jim nucleated the formation of a distinguished multidisciplinary team at the State University of New York, Stony Brook, and joined with them and a very fine group of post-doctoral associates and students in a program that among other achievements became heavily involved with mineral structure determinations and symmetry inversions at high temperatures. The first paper appeared within a year, and by 1973 this group had produced structural refinements for at least 2 or 3 temperatures each, up to as high as 1200°C for many minerals, including 8 pyroxenes and 2 amphiboles, as well as olivine and several feldspars. These studies combined with those of other groups have provided the basis for understanding crystal chemistry at petrologically and geologically useful temperatures, in terms of highly variable dimensions and coordination numbers for the cations, and the nearly constant size of silicon and aluminum tetrahedra that must tilt, flex, or rotate to maintain the structure. The scope of this new field of research is well summarized in the special 128 page section on "High-Temperature Crystal Chemistry" which Papike edited for *The American Mineralogist*, July-August issue, 1973.

In 1969 Papike made an enthusiastic and major commitment to the Apollo Lunar program as the principal investigator for a group of his Stony Brook colleagues. This group made many contributions about the epitaxy, exsolution, processes of chemical substitution, chemical composition, and degree of order in the complex lunar pyroxenes. Their contributions have helped to establish pyroxenes as major keys to the petrogenetic interpretation of the formation of lunar crust and mantle.

I can mention only in passing Jim's crystallographic studies of scapolite, prehnite, and boracite, his petrologic studies of lunar soils and breccias, metamorphosed iron formation, or deep sea basalts, but obviously his interests range widely.

He has exceptional organizational ability and staffing judgment that catalyzes teams of diverse specialists to high achievement and prompt publication. Evident from the beginning of the work on chain silicates, his organizational ability was strikingly demonstrated during his 1969-1970 term as Secretary and program chairman for the Vulcanology, Geochemistry, and Petrology Section of the American Geophysical Union, and by his timely arranging of the 5-day symposium on "Pyroxenes and Amphiboles: Crystal Chemistry and Phase Petrology" held in September, 1969, at Blacksburg, Virginia. Papike concurrently edited MSA Special Paper No. 2 which was published the day before the symposium and had the same title. He contributed to 3 papers in that volume. He was co-organizer of AGU's first topical meeting, called "Petrologic Crystal Chemistry." Zoltai and I both believe that Papike's attendance at the Lake Vermillion conference on 'Rock-forming Minerals' focused his career and may explain his continued emphasis on specialized working sessions. I have mentioned Papike's role in assembling the mineralogy group at Stony Brook; he subsequently chaired the Department of Earth and Space Sciences in which the mineralogy group is but one component. The period of his chairmanship from

September '71 to September '74 was one of substantial growth in stature for all parts of that Department.

Papike served 3 years on the Lunar Sample Analysis Planning Team (LSAPT) which was responsible for developing the philosophy and techniques for studying the lunar samples most efficiently and for allocating samples to investigators. His service came during the most active mission period when rapid program evolution was necessary to study the complicated rocks and soils being collected. He also served on the committee for lunar landing site selection, and with the working group involved in planning the astronauts' activities on the lunar surface. In 1973 NASA awarded him its Medal for Exceptional Scientific Achievement for these contributions as well as for his work on the lunar minerals themselves.

Let me tell you a little about his personality. Professionals and students respond to his special kind of enthusiasm, the sense of being where it's at, all spiced with ready praise and humor. Jim learned from his father to love the game of ice hockey, and only a bad knee injury in a high school game kept him from becoming a professional hockey player. Indeed, I have sometimes thought that Jim tends to pursue the gentle and persistent search for natural truth with the vigor typical of the game of ice hockey! Not only does he like to play, he much prefers to win. But if there are winners, there must, unfortunately, be losers. To avoid losing he usually arises at 5 to 5:30 and drives himself constantly to do the job better. He is fortunate to have a most charming and helpful wife, and she surely deserves her place of honor today.

Jim exudes team spirit either as captain or team member, and sometimes board checking is the only defense. I recall an example when Jim gave a talk at the Geophysical Laboratory of the Carnegie Institution, where some pyroxenes have been studied. He announced only half in jest, that some people were now calling Stony Brook "The pyroxene capital of the world." A Geophysical Lab staffer checked effectively: "Name two!"

In the lunar program the rules were being made while the game was being played. Jim was a member of the 'rules committee' (LSAPT), but also was a playing team captain. Many of his LSAPT colleagues, though in similar potentially conflicting circumstances, recognized his competitive instincts by awarding him a big ten-gallon Texan hat—in the blackest shade of black—by which he is now most easily recognized around Houston.

Mr. President, although there is more, I sense I have said too much already about the first decade in the career of this extraordinary young scientist. I present you Professor James J. Papike, the 24th recipient of the Mineralogical Society of America Award, for his research in petrologic crystal chemistry.

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Acceptance of the Mineralogical Society of America Award for 1974

JAMES J. PAPIKE

Department of Earth and Space Sciences, State University of New York, Stony Brook, New York 11790

President Bailey, Colleagues and Friends:

Although, as many of you know, I am rarely at a loss for words, I find giving today's remarks a very difficult task. I say this because it is difficult to be singled out as deserving of the M.S.A. Award when many other equally or more deserving candidates have not received it. The only way I can feel more comfortable in standing here before you is to accept this award more for a philosophy that I deeply believe in, and have advocated, than in any personal recognition.

About a year ago, after an evening of beer drinking with friends, I heard a gentle knock on my hotel room door. I opened the door to see Dave