MRS BULLETIN

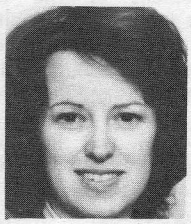
MATERIALS RESEARCH SOCIETY VOL. VII NO. 5

**FEATURES**

**PROFILES**

*of Von Hippel Award winner*

*of 1983 officers, councillors*



**NEWS**

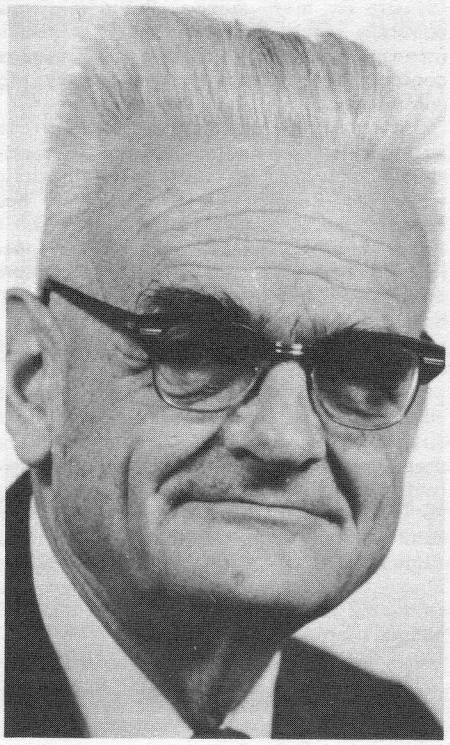
*intercalated materials*

# VON HIPPEL WINNER

*Zener receives MRS's most prestigious award*

The Materials Research Society is honored to bestow its 1982 Von Hippel Award on Clarence C. Zener, Emeritus University Professor at Carnegie-Mellon University. Zener will receive the award at a special presentation in Boston as part of the Society's annual meeting.

Zener's contributions to the physics of metals and to mathematics among the most fundamental and original of any 20th-century scientist. At once a brilliant theoretician and an enthusiastic experimenter, he performed the definitive work on internal friction in solids, and invented the Zener diode as part of a line of research that may be said to have laid the foundation for the development of semiconductors. At the same time, he made substantial contributions in many other areas, notably ferromagnetism. It is the breadth of Zener's work, as well as its exceptional depth, that led the MRS to select him for its prize.



**Theory and application**

Clarence C. Zener was born in Indianapolis in 1905. His first love was mathematics, in which he received his B.A. from Stanford in 1926. His developing interest in physics led him to take his Ph. D. in that discipline from Harvard University in 1929. A brilliant student, he was awarded academic fellowships in Germany (1929-30), at Princeton University (1930-32) and at England's Bristol University, to which he traveled in 1932.

It was at Bristol, scarcely out of school, that Zener began to perform the work in internal friction that established his reputation as one of the boldest thinkers in physics. John K. Hulm, director of research for Westinghouse and a friend of Zener's for more than 30 years, pointed out in a telephone interview, "This was a time when the theory of solids was

*[Continued on Page 3]*

# The Science Establishment Flunks

**Rustum Roy**

It has become fashionable--within the space of less than six months--for prominent leaders among scientists to be concerned with science education as distinct from research. On all sides we hear of the desperate straits of science education among the general American populace.

By and large, especially in relation to the developed nations, I believe that the U.S. citizenry and its leadership are indeed below the average elsewhere in a balanced understanding of science and technology and their impact on society. However, the main response of the science community to this situation is an appeal to government and to industry for more money. But non-scientist, politically astute observers detect a peculiar inconsistency in all this recently acquired concern for science education by this community.

How can it be, they reason, that the university science and engineering community should find itself in such desperate straits, when the Reagan administration has been relative kind to science budgets? For two or three decades, science was well funded; indeed, the seeds of this problem were planted during the plush years of science's growth. Surely money is not the only problem. Is it not in the values and priorities of the scientists themselves?

Have they shown a concern for the education in science of the general public? After all, the Public Understanding of Science program was judged by the science community itself for many years to be worth one-tenth of 1% of the budget of one agency (NSF) and zero in all others. Even the Reagan elimination of the National Science Foundation's science education directorate amounted to only 6% to 7% of the total NSF budget.

## Do They Really Care?

If, the critics argue, the science and engineering community felt so strongly about any of these aspects of science education, it could easily have shifted resources during the many fat years of science funding to establish the levels of activity that are their new targets.

In the 15 years that the total budget for academic research was growing steeply, the *percentage* of the NSF budget allocated to all science education had dropped from near 50% to nearer 5%. For all those--in Congress and the agency--partly responsible for this change to rediscover education is indeed a turnabout. For them to make the charge that this was due to the "unimaginative" nature of NSF's science education program is ingenuous, to put it mildly.

I believe there is a most instructive lesson in our history of handling science education, and unless and until we in the science establishment radically change our own values (heal ourselves), we will be unfit and unable to mount a meaningful campaign to eradicate technological illiteracy and re-integrate science into the education of all Americans.

The lesson I draw from the facts about our neglect of science education on the general population is that the vast majority of the scientists who have made policy for this nation for the last two decades--as professors, deans, presidents, chairpersons or members of National Academy committees or the National Science Board--did not have any philosophical rationale for or against "science education" for the non-scientist. Most simply didn't think about it or care.

*Until we in the science establishment radically change our own values, we will be unfit to mount a campaign to re-integrate science into the education of all Americans.*

The wholeness of the educational fabric of a technologically advanced culture, from a citizen able to appreciate and criticize technology and science, to the support of esoteric astrophysics Ph.D.s, was not manifest in the science community's reductionist world view. "More money for *research*" was the single goal of most scientists and science-policy makers. And when it came to money for science education, even of scientists, it was a very poor relation indeed compared to more money for research.

Therefore, it is my opinion that giving a little ($100 million) more money for science education of the general public cannot possibly do any good if it is given through this same community. Its gut-level attitudes simply cannot change that fast. Perhaps a Solomonic test would be to ask NSF, NIH and the rest, in a zero-based budget exercise, to see what percentage they would be willing to give up out of research budgets for science education. The government should then match that amount with additional money for science education within that agency. This would provide a mind-focusing exercise and a cathartic self-healing via repentance for both the science community and the nation.

To improve a very bad situation, I believe the executive or the Congress can move fast via a different program in a different agency, and one which has an excellent antecedent. I note first that it is genuinely in line with the concept of the new (or old) federalism. A new initiative on nationwide technological literacy could be modeled on former Assistant Secretary of Commerce Herbert Holloman's invention: the State Technical Services Act (STSA).

I propose that an analogous State Science Education Act (SSEA) be enacted with two components. One will provide (on the basis of a formula incorporating the number of school students, high-school graduates, two-year technical graduates and college degrees) a grant to be matched on a three-federal-dollars to one-state-dollar basis, for state-run programs designed to eradicate technological illiteracy and upgrade science education for the non-specialist at every level.

## Volunteer Contributions

The second part, somewhat along the lines of the STSA, would provide federal grants with an even higher matching ratio to consortia, regional associations and national groups, for programs agreed upon as being of value to any *group* of states.

Such programs might involve, for example, development of course content and teaching materials for print or TV. Using block-funding mechanisms, perhaps a five-person federal bureaucracy could run the whole office out of the Commerce Department. Moreover, having 50 states run the SSEA program, would move the action away from the research-oriented Washington bureaucracy, toward the level of government that in any case has the responsibility for much of science and general education.

Due to the shortage of science teachers nationwide, the only mechanism for rapid improvement of the national posture is through the volunteer route. The vast majority of our school districts could find in local industry, community college or university, scientists and engineers who would give up several hours a week to teach science at the local school and help in local cable TV, newspaper or other community programs. Such volunteer contributions would count as matching money in kind, to qualify for extra state grants. Moreover, this scheme would not disturb the basic structure of the existing science teachers' employment, while permitting a gradual expansion of the personnel capable of explaining and interpreting technology in the context of society.

The bottom line comes down to this: In an era of fixed intellectual and financial resources, can the high science research community be entrusted with the science education of the American people?

*This essay originally appeared in The Wall Street Journal of Oct. 8. Roy, an MRS councillor, is a science fellow of the Brookings Institution, as well as director of Penn State's materials research laboratory.*

# ZENER GIVEN VON HIPPEL PRIZE

*[Continued from Page 1]*

just being put on a quantitative basis. This was very early work."

Zener's achievement was two-fold. On the one hand, he developed the theoretical models that would explain the causes of internal friction in solids, particularly metals. He designed many of the experimental programs necessary to verify his hypotheses and, with such distinguished collaborators as Nobel laureate Neville Mott and Harry Jones, carried the experiments out. On the other hand, he then applied his own theoretical work to the design and engineering of the most original application of this work, the Zener diode.

"Clarence is really a *brilliant* physicist," Hulm said. "There are so many causes of internal friction--it is influenced by things like metallic defect, grain boundaries and dislocations, vacancies--and he essentially untangled all the various factors and calculated their influence, and in various experimental programs with his co-workers he verified much of the theory."

**Classroom and laboratory**

Despite his insatiable interest in laboratory work, Zener in 1935 accepted the first of a series of academic appointments that have implanted in generations of his students a relish for theory *and* application--and have created a network of lasting friendships that transcend boundaries of age, discipline and nationality.

Zener was a member of the physics faculty of Washington University in St. Louis, City College of New York and, when the Second World War broke out, Washington State University. In 1942 he joined the Watertown, Mass., Arsenal, becoming principal physicist there. For his war-time contribution, the War Department bestowed on him its Exceptional Civilian Service Award. In 1945 he was appointed professor of physics at the University of Chicago.

In 1951 Zener joined Westinghouse to lead the expansion of its basic research program, becoming director of the laboratories in 1957. In his fifteen years with Westinghouse he built a staff and a research institution among the best in the world, while at the same time continuing his own research, which has ranged from atomic physics and dielectric breakdown to solid state diffusion, the thermodynamics and kinetics of metallurgical transformations, plastic deformation and the invention of geometric programming.

Texas A&M called Zener back to academia in 1966, appointing him Dean of Science. Two years later, he was persuaded to return to Pittsburgh as University Professor at Carnegie-Mellon.

When Zener was nominated for the Society's Von Hippel Award, "the reaction was electric," said H.J. Leamy, MRS first vice president. "Zener's work is so broad, so profound, so much the embodiment of what the award represents to us--we were very excited and, when we learned he would accept the award, very honored."

The author of more than 125 papers and books in addition to his famous monograph on internal friction, Zener has received the Bingham Award of the Society of Rheology, the Wetherill Medal of the Franklin Institute, and the Albert Souveur Achievement Award and the Gold Medal of the American Society for Metals. He is a fellow of the American Physical Society and a member of the National Academy of Science.

# PROFILE OF CLARENCE ZENER

*"Those of us who know Clarence regard him as a great man," said Carnegie-Mellon University Institute Professor William W. Mullins, a long-time friend and colleague. As evidence of Zener's wide-ranging intellect he noted that, "To assess his contributions, it is necessary to consult a number of scientists in different fields."*

*As much as Clarence Zener is revered by his students and fellow scientists for the originality of his thinking, he is loved by his friends for his self-effacing grace. "You get very emotional about Clarence and Ruby [his wife of more than 50 years]," said Westinghouse's research director, John K. Hulm. "Let me tell you a story about them.*

*"When I was going over to Chicago in 1949 [like Ruby Zener, Hulm is English], we'd just had a baby and when we thought about Chicago we thought about, you know, gangsters and so on. I mean, we knew nothing about where we were going to live.*

*"Then we got this letter from Ruby, to my wife. Now, Zener wasn't even my sponsor; my sponsor was Prof. Long, a chemist. But we were all together at the Institute for the Study of Metals, and Clarence was the resident theoretician.*

*"Ruby's letter said, 'Don't worry; we've found an apartment for you, we'll have a crib for the baby.' The Zener's rented that apartment with their own money; they lent us the crib. . . ."*

*Hulm remarked he had visited the Zener's a few days before this interview on their farm outside Pittsburgh. He said Zener described with animation the latest research he was pursuing. "He's as active today as he was 30 years ago," Hulm said. "He hasn't given up one jot."*

*"He's simply a wonderful man, tremendously stimulating to be with. His wife happens to be the same. Clarence and Ruby together," Hulm reflected, "they're simply the world's greatest people."*

# MRS OFFICERS FOR 1983

The duties of MRS officers and councillors are enumerated in the Society's By-laws, and for your convenience are summarized here.

The *President* is the chairman of the council and its Executive Committee. Acting as the principal representative of and spokesman for the Society, the president guides the Society's development, its functions and services. One of the position's chief responsibilities is the appointment of members to committees. The president, alone among the Society's leadership, is not directly elected: the first vice president automatically assumes the position at the end of his one-year term.

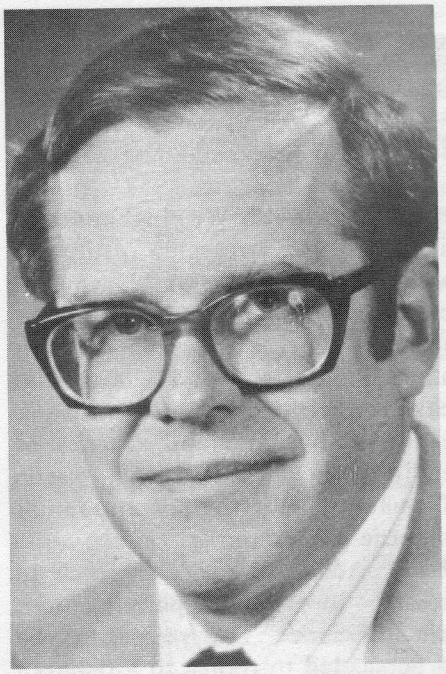
The *First Vice President* acts for the president when the latter is unable to carry out his duties, and assumes the post if it becomes permanently vacant. Like the *Second Vice President,* he assists the president in the business of the Society.

The *Secretary* keeps the official minutes of meetings, maintains the records of the Society, conducts the annual election and carries on all of the Society's correspondence as directed by the president and the council.

The *Treasurer* acts as custodian of the Society's funds, maintains its financial records, receives its revenues and disburses its expenditures. The treasurer provides financial reports to the council at each of its meetings.

The *Councillors* direct the affairs and activities of the Society. The council meets formally at least three times a year, but the demands upon its members are much greater. Aside from committee work, they are consulted by the officers throughout the year as decisions affecting the MRS must be made.

Of the officers, all serve one-year terms except the secretary and treasurer, who serve for two years. Councillors serve three-year terms; five are elected each year.



**C.W. White**
*First Vice President*
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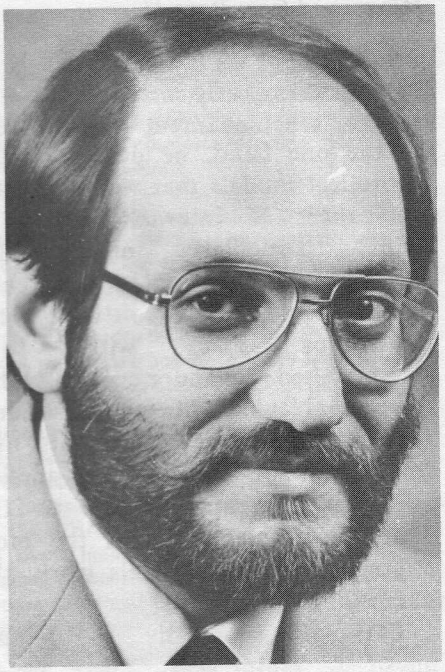
C.W. White received his B.S. degree in physics from MIT in 1962 and his Ph.D. in physics from Duke in 1967. He joined the technical staff of Bell Labs, where he was involved in studies of low energy ion-surface and ion-atom collisions, surface physics, ion implantation and atomic physics.

In 1975 he joined the solid state division of Oak Ridge National Lab. His present research interests include laser annealing, ion implantation, ion beam surface layer analysis, surface physics and ion beam modification of materials.

A member of the MRS council for the past two years, White was a program committee member in 1981 and chairman of the publications committee in 1982.



**Elton N. Kaufmann**
Second Vice President
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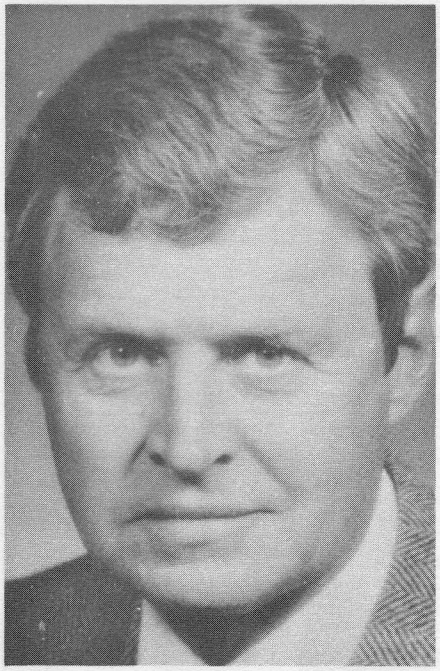
Kaufmann earned his B.S. from Rensselaer Polytechnic Institute and his Ph.D., also in physics, from the California Institute of Technology in 1968. He joined Bell Laboratoried, where he studied materials properties using hyperfine interactions, ion-solid interactions and laser-solid interaction techniques. In 1981 he joined the materials science division of the Livermore Lab, where currently he is studying the application of directed energy processing methods to materials.

Author of more than 80 technical publications, Kaufmann is editor of the journal *Hyperfine Interactions.* He is co-chairman of this year's annual meeting, and chairman of the MRS Corporate Participation Committee.

# OFFICERS AND COUNCILLORS



**Richard L. Schwoebel**
Secretary
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Schwoebel took his B.S. in physics and math from Hamline University and in 1962 his Ph. D. in physics from Cornell University, where he was subsequently a visiting professor in the department of materials science. He is presently director of the materials and process sciences directorate at Sandia Labs.

A member of honorary scientific fraternities, Schwoebel is a fellow of the American Physical Society and the American Institute of Chemists, and a senior member of the American Physical Society. His biography is contained in American Men and Women of Science.

**Kathleen C. Taylor**
Treasurer and councillor
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General Motors Research Laboratories
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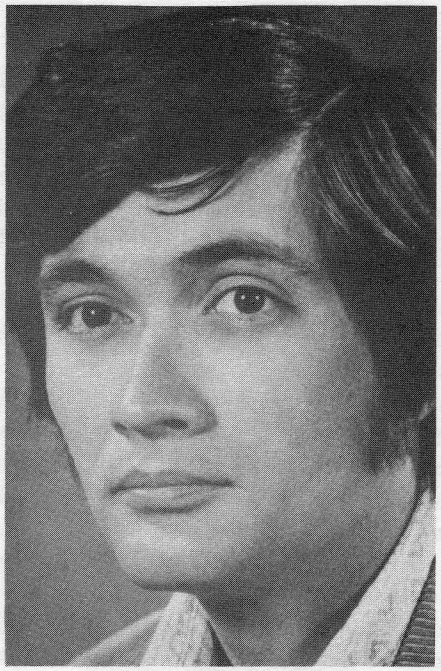
Taylor received her A.B. degree in chemistry from Douglass College of Rutgers University in 1964, and her Ph. D. from Northwestern University in 1968. She joined General Motors in 1970 and has been assistant head of the Physical Chemistry Department since 1975. Her experience has been in the area of heterogeneous catalysis, surface chemistry and automobile exhaust emission control.

Taylor has served the Materials Research Society as a councillor, annual meeting program co-chairman, symposium co-chairman and treasurer. She is also a member of the American Chemical Society, the Chemical Society (London), the Catalysis Society and the Society of Automotive Engineers. She has written 19 publications.



**R.C. Ewing**
Councillor
Department of Geology
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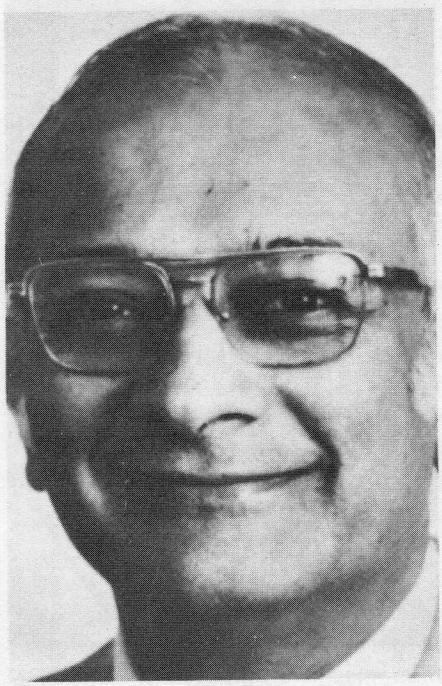
A decorated Army veteran who served as an intelligence officer and translator in Vietnam, Ewing received his B.S. in geology from Texas Christian University in 1968 and his M.S. and Ph.D. from Stanford, the latter degree in 1974. Presently he is chairman of the Geology Department at New Mexico, and is a visiting scientist at Oak Ridge National Lab and Hahn-Meitner Institute in Berlin.

Ewing's principal research interests center on the disposal of radioactive waste, and he was a member of the program committee for the Berlin meeting on nuclear waste management and an editor of its proceedings. He is the author of numerous publications on the metamict state, radiation damage in crystalline materials and related subjects.

# NEW COUNCILLORS FOR 1983



**Rustum Roy**
Councillor
Director, Materials Research Laboratory
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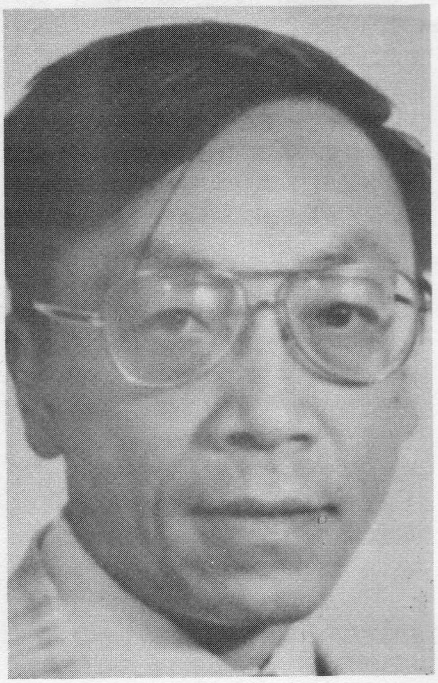
Roy earned his bachelor's and masters degrees in chemistry from Patna University and his Ph.D. in ceramics from Penn State in 1948. After service in his native India, he returned to Penn State, where he is presently Evan Pugh Professor of the Solid State, Professor of Geochemistry, and Chairman of the Science, Technology, and Society Program, in addition to his responsibilities with the materials research laboratory.

Author of some 350 technical papers and several books, Roy's research activities include materials preparation and characterization; crystal chemistry, synthesis, stability, phase equilibria, and crystal growth in non-metallic systems; ultrahigh pressure reactions in solids; and chemistry and physics of non-crystalline solids.



**Leroy L. Chang**
Councillor
IBM Research Center
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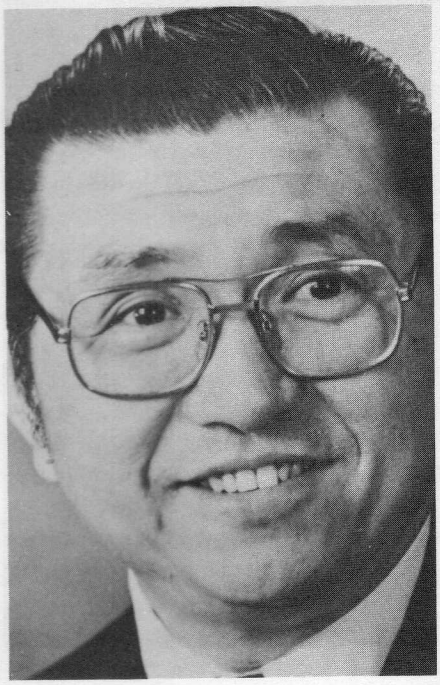
Chang joined IBM's research department in 1963, after taking his Ph.D. in electrical engineering from Stanford. He has served as an associate professor at MIT and as a member of the National Academy of Sciences' solid state physics delegation to the People's Republic of China.

Since 1975 Chang has been manager of semiconductor microstructures for IBM. His research has involved materials, physics and devices of semiconductors; diffusion, tunneling spectroscopy, field effect and interface properties; and materials aspects of epitaxial deposition and physics aspects of electronic properties. He first synthesized and demonstrated the formation of semiconductor superlattice by molecular beam epitaxy.



**Franklin F.Y. Wang**
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Wang is professor of engineering and former chairman of the department of materials science at Stony Brook, which he joined after extensive industrial experience with A.O. Smith Corp. and one of its subsidiaries, and with Sperry Rand Corp. His Ph. D. in ceramics is from the University of Illinois, and his other degrees from Pomona College and the University of Toledo.

Editor of the new MRS-affiliated journal, *Materials Letters,* Wang is interested in semiconductor materials and processing, defects in silicon, polycrystalline silicon and microstructurals in electronic ceramics. Active in professional affairs, he is a fellow of the American Institute of Chemists and the American Ceramic Society.

# BRIEFS

IS RUSSIA building its military forces with Western technology? Yes, a National Academy of Sciences panel found -- but the problem is less one of the free flow of scientific information than trade (some of it illicit) and espionage.

The 19-member body's report, entitled "Scientific Communication and National Security," which was released Sept. 30, found, "There has been a substantial transfer of U.S. technology -- much of it directly relevant to military systems -- to the Soviet Union from diverse sources."

Dale R. Corson, the panel's chairman and president emeritus of Cornell University, told a Washington press conference, "'these transfers have occurred' through legal sales of products to the Soviet Union in periods of detente, through illegal sales of proscribed products, through transfers of American technology to the Soviet Union by third countries and through Oct. 1.

The Academy's report exculpates scientific publication, saying, "There is a strong consensus, however, that universities and open scientific communication have been the source of very little of this technology transfer problem. Although there is a net flow of information from the United States to the Soviet Union, consistent with the generally more advanced status of U.S. science, there is serious doubt as to whether the Soviets can reap significant direct military benefit from this flow in the near term.

MATERIALS SCIENCE technology was cited by Allied Corp. as one of the reasons the chemical maker is acquiring Bendix Corp., according to New York Times columnist Barnaby J. Feder's report Sept. 30.

"Everything is made of materials, so your concept of where you are going in materials science is very important," Feder was told by L. James Colby Jr., Allied's senior vice president in charge of technology.

Colby said Allied was interested in Bendix' work on high-performance plastics and composites and advanced materials processing.

The Times account noted that Bendix is the first of the several corporations acquired by Allied in recent years with its own substantial research staff. Allied chairman Edward L. Hennessy Jr. has promised an expanded research and development effort for the combined companies as a result of the acquisition.

NATIONAL LABS may decline in coming years, a victim of federal spending cutbacks, the Wall Street Journal reported Sept. 30.

In a story on Los Alamos Natiional Lab in New Mexico, the Journal noted that the staff there has declined to 6,900 from 7,200 two years ago, and another 400 to 500 workers could lose their jobs later this year under Reagan Administration plans.

Every national lab presently has a "technology transfer" division responsible for finding other institutions to take over some of its research projects. The Administration's proposed dismantling of the Department of Energy, which funds the labs, further endangers their future, the Journal reports.

"Administrators of the Los Alamos Laboratory worry that it and the national labs on New York's Long Island; in Oak Ridge, Tenn.; Livermore and Berkeley, Calif.; Richland, Wash.; Argonne, Ill.; and Albuquerque, N.M., may have seen their best days," the Journal's front-page report concludes.

MARTIN C. STEELE, formerly in charge of the semiconductor electronics group at GM's research laboratory, has been appointed acting director of the Institute for Amorphous Studies at Bloomfield Hills, Mich.

Steele, a fellow of both the American Physical Society and the Institute for Electrical Engineers, will direct the planning of the institute's programs and the recruitment of faculty. The institute, founded by Energy Conversion Devices Inc., will begin operations this fall.

MRS BULLETIN

**VOLUME VII NUMBER 5**

*The Materials Research Society Bulletin is published bi-monthly by the Materials Research Society for its members and others interested in materials science. Correspondence and submissions are invited. They should be brief and typewritten (double-spaced), and the author's affiliation must be indicated. Address all material to the Editor.*



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# INTERCALATED MATERIALS

*Papers sought for 1983 Thermal Society syposium*

The 1983 Symposium on Thermal Behavior of Intercalated Materials will be held Sept. 25 - 29, 1983, as part of the Twelfth Annual Conference of the North American Thermal Analysis Society.

Symposium chairman--and MRS member--D.D.L. Chung, Department of Metallurgical Engineering and Materials Science, Carnegie-Mellon University, said the meeting will provide an interdisciplinary forum for scientists and engineers interested in the thermal behavior of the intercalation compounds of graphite, transition metal dichalcogenides and polymers. Applications include electrical conductors, battery electrodes, chemical reagents, catalysts and thermal insulators, among others. Aspects of thermal behavior include phase transitions, thermal stability, specific heat, thermal expansion and thermal conductivity at high and low temperatures. The relationships of the thermal properties with electronic, chemical, mechanical and other properties will likewise be explored.

**Papers solicited**

Chung said papers on fundamental and applied topics are solicited. Twso hundred word abstracts should be sent to her by Feb. 28. Carnegie-Mellon University is located in Pittsburgh, Pennsylvania. The Zip Code is 15213. Chung's telephone number is (412) 578-2710.

She noted that manuscripts for publication in the conference proceedings are due May 23. Publication in the proceedings does not preclude subsequent publication elsewhere.

Intercalated materials are of particular interest to many MRS members, Chung noted. At the MRS annual meeting in November, a symposoium on Intercalated Graphite will be chaired by M.S. Dresselhaus, M.J. Moran and J.E. Fischer.

**The Thermal conference**

The joint Twelfth North American Thermal Analysis Society Conference and Calorimetry Conference will be held Sept. 25 - 29, 1983, at the Williamsburg Hilton, Williamsburg, Virginia.

Other symposia on the program include Liquid Crystals and Liquid Crystalline Polymers; Physical Aging Processes in Molecular and Atomic Glasses; Applications of Calorimetry and Thermal Analysis to Catalyst Studies; Thermochemical Studies on Fossil Fuels; Multiphase Polymers and Composites; and Combination Techniques in Thermal Analysis.

For more information about the conference, write to the program chairman, A.R. McGhie, University of Pennsylvania, L.R.S.M., 323 Walnut Street, Philadelphia, Pennsylvania 19104, or call him at (215) 898-6461.