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THE RAP SHEET

A Quarterly Newsletter of the
National Research Council Research Associateship Programs

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Director's Message

As this issue of the RAP Sheet is being prepared, we are just completing our largest application cycle of the year. Rosters of successful applicants have been sent to participating laboratories and applicants are eagerly awaiting notification of an award. It is my pleasure to report that applications have increased by 25% from last year. We hope to maintain this trend and look to our program Advisers for their assistance in continuing to recruit high quality candidates to the Associateship Programs. In this issue of the Newsletter we feature two articles on recruiting authored by Advisers who have been regular participants in the NRC Associateship Programs. We also highlight Associates who participate in our Summer Faculty Program with the Air Force. This year we had more than 90 applications for Summer Faculty awards.

As an adjunct to the increase in applications in this review cycle, we also can report that fewer applications were disqualified as a result of being incomplete. As recently as 1998, we lost almost 5% of our applicants as a result of incomplete application packages. In 2001, this number was down to 1.5%, and we attribute this to the self-managed application process adopted two years ago. As we move to electronic applications, we hope to reduce this number even further.

As I mentioned earlier, we welcomed our review panels at the end of February. Applications were divided among six panels including: Chemistry; Earth and Atmospheric Sciences; Engineering, Math and Applied Sciences; Life Sciences; Physics; and Space Sciences. For this review, we had

110 panelists join us in Washington representing academic institutions and private industry from 35 states, the District of Columbia, Puerto Rico and Canada. Each panelist read 12-15 applications during the 1½-day panel meeting. These same panelists will read applications during mail reviews in May and September.

Elsewhere in this issue of the RAP Sheet, we have highlighted our Operations Staff. At this time of the year, in particular, it is really apparent how much dedication these folks have to our programs. Along with processing all the applications and making sure the paperwork is in place for the review, they have been willing to take on new challenges. Among these are the shorter review cycle and a new procedure whereby applicants send all materials directly to the NRC; Laboratory/Center Review forms are subsequently sent to the LPR's. We hope these changes will benefit our sponsors, and I appreciate the extra effort our Operations Staff has given to make this happen.

In closing, I would like to draw your attention to a few other features in this issue of the RAP Sheet. We have added a section called Associate Awards to highlight achievements of Associates on tenure. Please help us fill this section each issue by forwarding information on awards received by Associates. Please also refer to the listing of professional meetings we attend. We hope that you will take time to visit us at the NRC booth when you are attending one of these meetings.

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NRL RECRUITING STRATEGIES

Dr. Vince Harris, NRC Adviser and Chief, Materials Physics Branch, Naval Research Laboratory, Washington, DC

The role of NRC Research Associates at NRL cannot be overstated. In the Materials Physics Branch (Code 6340) much of the exciting research is carried out in collaboration with these Research Associates. As a result, we strive to identify and encourage outstanding graduate students to apply to the NRC program with the aim that they will join our research Branch.

One particular strategy that has proven successful has been for Code 6340 scientists to become involved with the research activities of the nation's top universities in order to identify those students having unique skills and experience.

The Materials Physics Branch has accomplished this strategy by having our scientists work intimately with DoD sponsored research programs as "Scientific Liaison Officers." In this context, the scientist provides technical oversight and assists in troubleshooting for the participant universities. The sponsoring agency benefits from having an expert assist with overcoming technical obstacles by providing access to NRL researchers and facilities. This approach also benefits the universities by providing them unique resources and training opportunities without requiring the investment of capital. Finally, our scientists benefit from identifying the best candidates early in their career as potential NRC Research Associates.

One such example was when I served as the NRL Liaison Officer to the Office of Naval Research-sponsored MURI (Multidiscipline University Research Initiative) on "Advanced Magnets for High Temperature Applications." Carnegie Mellon University (CMU) was one of the participants. Over the course of this MURI, I assisted CMU in providing access to the NRL sample preparation and synchrotron radiation facilities. This collaboration resulted in valuable insight into the crystallization kinetics of the materials being studied and valuable training opportunities for several CMU graduate students. One of these students, Matt Willard, was recruited, and upon graduation, was awarded an NRC Research Associateship to work with me at NRL. When Matt arrived, he had great skills that were well tailored for the research in Code 6340. In addition, the risk of having a poorly matched Research Associate was minimized since I had worked closely with Matt over his research career. In fact, I served on Matt's thesis committee.

In essence, this approach takes the guesswork out of identifying a Research Associate who has the appropriate skills and personality to work with an NRC Research Adviser.

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Be Honest and Do What's Best for You

Dr. Lloyd Whitman, NRC Adviser and Head, Surface Nanoscience and Sensor Technology Section, Naval Research Laboratory, Washington, DC

As a graduate student in physics at Cornell in the late 1980's, the NRC Research Associateship program was well known. Two, more senior, graduate students in my research group had recently applied to the program when I was considering my future in the fall of 1987. I was familiar with the work of Dr. Ted Madey, a well-known surface scientist at the National Institute of Standards and Technology (NIST), and decided to apply for an NRC Research Associateship with him. After receiving an offer, I visited NIST and felt it would be a good place for me, and therefore turned down another offer from a well-known industrial laboratory.

A few months later, Ted told me he had just accepted an offer to leave NIST for an academic position, but that I should come to NIST anyway and work with a new staff member in his group, Dr. Jory Yarmoff. My first day on the job, as I was unpacking my boxes, Jory casually mentioned that he, too, was expecting an academic offer. Indeed, a few months later he announced his impending departure from NIST! Fortunately, a group with related research interests (in a different NIST division), headed by Dr. Robert Celotta, had an opportunity for a Research Associate to work with another new staff member, Dr. Joe Stroscio. So, to make a long story short, ten months into my tenure I switched both Adviser and project.

Although very stressful at the time, in the end I had a successful time working with Bob and Joe, and our research led to my appointment as a staff member at the Naval Research Laboratory (NRL) in 1991. As I expect is the case for many NRC Research Associates, the work I did with Bob and Joe defined my career for many years to come.

Since becoming an NRC Adviser about eight years ago, I have been through numerous NRC application cycles involving about a dozen applicants, and have advised eight NRC Research Associates. Where did the candidates come from? Some of them sought me out – based on my work, conference presentations, or through colleagues (often their advisers). Others I identified through *their* work and actively recruited. I met and recruited one candidate at a career "mixer" at a Materials Research Society meeting. A few times I have sent "Position Available" emails around to my colleagues, which tends to yield a few queries, but to date has yet to result in an applicant.

How do I handle the selection process? After quickly ascertaining whether a person at least makes sense as a potential applicant, the first thing I do is to explain the NRC selection process in detail. Most of the time the person has only a vague understanding of the process. (The most common misperception is that the NRC funds the whole program.) Then I make sure the person understands what NRL does and what my group does.

After this introduction, if we are both still interested, I decide if a potential applicant is a good fit for the research area of interest and seems like someone with whom I want to work closely for a couple of years. I decide this in the usual ways: talking to them, reading their CV, talking to their academic adviser and others who know them. Something I do not require is a "job talk" at NRL. The NRC process requires a lot of effort on an applicant's part, and I just do not think it is fair to make someone interview for the "privilege" of applying for a competitive award. In the end, I

narrow the potential candidates down and invite (at most) two candidates to apply for a position, making sure they both understand that the candidate with the best review will get an offer first. This approach gives each candidate a decent chance for an offer and provides me with some insurance should the first candidate take an alternate position.

All of my NRC "graduates" have been successful – giving presentations at two or more conferences each year, publishing a number of papers, and getting a permanent job (two in academia and the rest in industrial or government labs). I have enjoyed working with all of them, and hopefully they feel the same way.

Out of my experiences as both an Adviser and an NRC Research Associate, I offer the following advice.

Be honest - As an Adviser, be honest about what you are doing, about the state of your facilities, and about the realistic prospects for your candidates. Do not string people along without telling them what is going on. If you are an applicant, tell your prospective Adviser your true intentions. If an opportunity comes up that is better for you, tell them so they may consider other candidates as soon as possible.

Do what is best for you - I believe that as long as everyone is honest, people may be disappointed if things do not work out, but no one should be upset. For example, if you are an applicant and an unexpected opportunity arises, you do not have to turn it down because you have already completed an NRC application. I always tell my applicants that if it is a good match, what is best for them will also be best for me. And if not, so be it.

Learn the culture - There is more to science than research: the scientific research enterprise is a culture of people. As an Adviser, I spend almost as much time discussing process, politics, and personalities as I do discussing research. Most graduate students are (fortunately) sheltered from this aspect of science by their advisers.

Do good work - It probably goes without saying, but this is what gets you noticed both as an Adviser and as an NRC applicant.

Be nice - Unless you are so outstanding that people will tolerate you no matter what (and there are a few of you out there), you will need to work with others to be successful.

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Research Opportunity Booklets

It's time for our annual revision of the Research Opportunity Booklets and Web site. All Laboratory Program Representatives should have received an E-mail containing a Rich Text Format file copy of their Laboratory/Center's file(s) along with complete revision instructions. The revised manuscripts are due back to us by April 26. If you did not receive this material, please call or E-mail Marla Allentuck at 202-334-3637 or mallentu@nas.edu,

Here are a few pointers to remember when revising the manuscripts. All files should be saved in Rich Text Format (.RTF). When you have finished, please E-mail your revised files to Marla Allentuck. To avoid confusion, individual research opportunities will not be accepted directly from the Advisers. Instead, all revisions should be coordinated through the Laboratory Program Representatives, integrated into the .RTF files, and then forwarded to Marla.

The Roster of Research Advisers was sent to the LPR under separate cover by Clark May. Please return your updated rosters directly to him. If you have any questions regarding Advisers or the

approval process, you may contact him directly at 202-334-3560 or cmay@nas.edu,

For all new research opportunities, please don't forget to list (1) the category into which the opportunity most appropriately falls and (2) a maximum of 10 keywords that best describe the research, as requested on the third page of the Adviser Nomination Form.

In addition to revising your research opportunities, please remember to check the introductory material to ensure that names, addresses, phone numbers, E-mail addresses, stipends, and citizenship requirements are correct. If you have a stipend increase, please include the effective date and also officially notify your Program Administrator or Connie Dawson of the change.

We appreciate your cooperation. With your help, we can make this the smoothest booklet revision cycle yet.

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Professional Meetings

The NRC staff attends more than twenty annual meetings of professional scientific societies to disseminate information about the Associateship Programs and to recruit applicants. At each of these meetings, the NRC has an exhibit booth where we discuss the program with potential applicants. At some meetings, we also participate in the job placement centers, where we can make brief presentations to small groups of potential applicants followed by question-and-answer sessions.

The meetings we will attend for the remainder of 2002 are listed below. Look for the NRC Associateship Programs booth in the exhibit hall if you will be attending:

American Chemical Society	April 8-10	Orlando, FL
American Chemical Society	April 8-10	Orlando, FL
Experimental Biology	April 21-23	New Orleans, LA
American Society for Microbiology	May 20-22	Salt Lake City, UT
American Geophysical Union	May 28-June 2	Washington, DC
Ecological Society of America	Aug 4-8	Tucson, AZ
American Chemical Society	Aug 19-21	Boston, MA
American Fisheries Society	Aug 19-22	Baltimore, MD
Society Advancement of Chicanos & Native Americans in Science	Sept 26-29	Anaheim, CA
World Space Congress American Institute Aeronautics/Astronautics	Oct 14-19	Houston, TX
Florida Education Fund/McKnight Fellows	Oct 18-20	Tampa, FL
Geological Society of America	Oct 27-30	Denver, CO
Society for Neuroscience	Nov 2-7	Orlando, FL
American Society of Tropical Medicine & Hygiene	Nov 10-14	Denver, CO
Society of Environmental Toxicology & Chemistry	Nov 17-20	Salt Lake City, UT
Materials Research Society	Dec 3-5	Boston, MA
American Geophysical Union	Dec 6-10	San Francisco, CA
American Society for Cell Biology	Dec 14-18	San Francisco, CA

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Visa News

Plan Ahead." - How many times have we all heard that? It may seem like a cliché, but it's become even more important since September 11, 2001, for J-1 Associates, their Advisers and LPRs. Plan enough time for initial visa application and security checks, renewals and extensions, and correct documents before departure for traveling Associates and their families.

Visa application - Visa applicants may need to go through certain security checks before visas can be issued to them. For example, male applicants aged 16-45 are now required to submit a DS-157 "Supplemental Nonimmigrant Visa Application" with the usual DS-156 application. Security checks may add 10-30 days or more to the visa application process. Unfortunately, the National Research Council has no control over this process or its success. If an exchange visitor must apply for a new J-1 visa while abroad on a home or professional visit, he or she must allow enough time. The same rule applies to family members.

Renewals and extensions - Advisers and LPRs should be aware of the importance of timely renewals and extensions. There are real consequences for your Associate if the renewal is late or the IAP-66 form has expired. It means that the Associate risks being out of status and cannot be paid. Be sure to submit renewal paperwork to the NRC at least three weeks before the end of tenure or the expiration of the IAP-66 form, whichever is earlier. J-1 Associates are responsible for keeping their immigration documents valid, but laboratory cooperation is important.

Visa application in Canada or Mexico - J-1 visa holders and their families may visit Canada, Mexico or the Caribbean for less than 30 days, and return to the U.S., even if their J-1 entry visas have expired. In the past, they could also apply for new J-1 visas without having to go back to their home country. If a visa was denied for some reason, the Associate could still return to the U.S. with an expired J-1 entry visa as long as he/she held a valid, endorsed IAP-66 and I-94 card. However, effective April 1, 2002, the rules about "automatic revalidation" have changed. Under the new rule, application for a visa at a consulate in contiguous territory makes the applicant *ineligible* for automatic revalidation. This will require an applicant subject to a security review to wait in Canada or Mexico for the decision. If denied, the Associate would be required to travel elsewhere or home to re-apply for a U.S. visa. We encourage you to apply for your visas in your home countries, if possible.

Questions about J-1 visas may be directed to Peggy Wilson pwilson@nas.edu,

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Staff Profile - Operations Unit

For Associates on tenure, those who have been successful in receiving an NRC Associateship Programs award, you are likely to recognize several of the names in this article featuring our Operations Unit. The picture will allow you to put a face with the name. These are the hardworking folks who handle all aspects of the applications process from helping you to fill in the blanks on the application form, to notifying you that your application will be complete when that last reference form is received, and responding to your phone call with helpful advice when you are desperate to meet the submission deadline.

The February 2002 review of applications has just been completed. The Operations staff

successfully processed 477 applications for on-site review in Washington by the 110 scientists and engineers organized by discipline into six panels: Chemical Sciences; Earth and Atmospheric Sciences; Engineering, Applied Sciences and Mathematics; Life Sciences; Physical Sciences; and Space Sciences.

This review presented some special unanticipated challenges, not the least of which was the delay in U.S. Postal Service mail delivery in the months following the events of September 11, 2001. After several weeks of receiving mail delayed by up to 2 months, and envelopes filled with crispy, yellow pieces of paper due to the irradiation process, the NRC set up an interim postal address to receive applications. Despite this postal handicap, this review was one of the most successful ever judging by the very small number of incomplete or unacceptable applications.

The Operations Unit has 7 permanent staff: Mary Cox, Maria Crocco, Jane Dell'Amore, Kevin Kocur, Sally Lytch, Clark May, and Betty Michael. For the February 2002 review, we were assisted by one temporary staff member, George Karos.

The hallmark of the Operations Unit is teamwork. Therefore, it is often hard to describe one specific area of responsibility for each staff member as everyone pitches in to get the job done during review times. Preparing for a review involves receiving and copying applications, checking for completeness of files and following up on missing documents or incorrect information (Mary, Betty, George, and Maria for Summer Faculty, and Sally for NASA applications), mailing proposals to the sponsor laboratories (Jane), data entry (Clark, Sally, Maria, Mary, Kevin, and George) preparing and labeling files (Betty, and Maria for Summer Faculty) and checking files for the panels (Jane, Mary, Sally, Clark, Kevin, George, and Maria for Summer Faculty). Applications continue to be monitored right up until the review to make sure everything is complete.

Once applications are complete, there is much work left to do in preparing for the panel reviews. Each panel has at least two Panel Assistants that facilitate the review process. Staff that work as Panel Assistants meet in advance to assure that all aspects of the review run smoothly. Binders containing instructions are prepared for panelists (Betty) and files are sorted by panel (Betty and Mary). A system is set up to enter the results of the review on-site (Kevin), so that each panel can see the results of the review as soon as it is completed. During the panels, Panel Assistants make sure the applications flow smoothly through the process and keep track of application scoring. Scores are compiled into rosters for each panel (Clark and Maria), and a final overall roster is assembled.

After the review, a roster of successful applicants is sent to each sponsoring laboratory and a decision is made as to those applicants to whom awards will be offered. At this point, the awards process is turned over to the Program Staff. This group will be highlighted in a future issue.

From Left: Mary Cox, Betty Michael, Kevin Kocur, Jane Dell'Amore, Maria Crocco, and George Karos.
Not pictured: Sally Lytch, Clark May.

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NRC Summer Faculty Programs

The NRC administers awards in Summer Faculty Programs for the Air Force and the Environmental Protection Agency. Under these programs, college and university faculty conduct research for periods ranging from 8 to 14 weeks during the summer months at one of the sponsoring agency's research locations. The following series of articles describe the experiences of three Summer Faculty awardees during their tenure at Air Force laboratories.

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What I Did on My Summer Vacation

Department of Electrical and Computer Engineering, University of Delaware, Newark, Delaware

I spent my 2001 summer vacation at the U.S. Air Force Research Laboratory, Materials and Manufacturing Laboratory Directorate at Wright Patterson Air Force Base, Ohio, working on evaluation of metal contacts to silicon carbide (SiC) materials. My research was sponsored by an award from the National Research Council, Air Force Summer Faculty Research Program. My fellowship, which covered a period of twelve weeks, started in early June and ran through August 2001.

Research into SiC has been very intense for some time because of its unique physical properties - a high melting point (2700 °C, Si is 1410 °C), wide band gap (2.8 to 3.2 eV), high thermal conductivity, and high irradiation resistance, which could lead to various civil and military applications. Progress on commercial-ization of SiC has been delayed partly because efforts to obtain suitable contacts, ohmic and schottky, have been unsuccessful. Therefore, the objective of my summer project was to investigate thermal stability of metal contacts on SiC and determine

the implications of using the metals that were studied as high-temperature contacts to SiC devices. The stability of Al, Ta, and Al/Ta on and their interactions with 4H-SiC at elevated temperatures were investigated.

One-sided polished 4H-SiC wafers, about 1.3 inch in diameter and 3.5 to 8° off axis were used in this project. The substrates were oxidized and etched in diluted HF prior to metal deposition. Electron-beam depositions were made in an ultra-high vacuum system with a base pressure of about 5x10-10 torr and about 10-8 during deposition. Thin Al, Ta, and Al/Ta films were deposited on 4H-SiC using either electron-beam evaporation or by sputtering. The thickness of the metal films varied from about 100 to 260 nm. The Al/SiC, Ta/SiC, and Ta/Al/SiC structures were annealed in an ultra high vacuum rapid thermal annealing system at a pressure of about 10-8, in a vacuum about 10-5 torr, or in Ar ambient. The structures were annealed at temperatures ranging from about 600 to 1000°C. These annealing conditions were chosen in order to evaluate the role of Ar ambient or impurities on the interaction of these metals with SiC. The surface topography and morphology of these structures, before and after annealing, were characterized using atomic force microscopy. X-ray photoelectron spectroscopy was used to evaluate the surface chemistry while auger electron spectroscopy was used to profile the distribution of elements as a function of depth.

In the Al/SiC system, Al partly diffuses into SiC and partly evaporates at temperatures above its melting point (660°C) up to about 800°C, while Ta decomposes SiC at about 800°C in the Ta/SiC system to form a Ta-C phase with no evidence of TaSi2 formation. In the Ta/Al/SiC system, a messy "soup-like" mixture of Ta, Al, and C with Si precipitates at the interface and no diffusion of Al into the SiC substrate was observed. These results have two main implications for devices. First, a two-step annealing process may be required for metal contacts that have Al layers next to the SiC surface, as in the case of ohmic contacts to p-type SiC. Second, most refractory metals on SiC may require a Si layer at the interface in order to make it stable for high-temperature applications. Therefore, for SiC to maintain its integrity at high temperatures, a sacrificial layer between SiC and metal layers may be required.

Overall, I had a highly rewarding experience, socially and professionally, in Ohio. The collaboration of the host Adviser, Dr. William (Bill) Lampert and his coworkers, as well as utilization of additional facilities had an extremely positive impact on the success of my project.

Dr. Olowolafe shows the equipment in his lab at the University of Delaware.

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What I Did on My Summer Vacation: Muscle and MEMS

Dr. David B. Reynolds

Department of Biomedical, Industrial and Human Factors Engineering,
Wright State University, Dayton, Ohio

One of the interesting things I did during my Summer Faculty tenure was to study a special kind of "muscle", which in some respects acts like human or animal muscle because when it shortens to produce useful work, it also bulges outward. Its name is pneumatic muscle (PM), or as some researchers like to call it, a pneumatic muscle actuator. The "pneumatic" modifier refers to the necessity of using pressurized gas to cause the contraction. Although the PM itself is very lightweight, when supplied with pressures in the range of 30-90 psi (similar to the range of bicycle tires), it can lift up to a thousand times its weight. Similar to human muscle, the height and speed that it can lift the weight depends on the size of the muscle, the pressure supplied, and the weight lifted. Another advantage of PM systems is that if failure occurs, the person wearing or near the device technology is at a very low level of injury risk.

Originally, pneumatic muscle was developed as an assistive device in the 1950's for a young person afflicted with polio. Problems with controlling the PM's and probably the bulkiness of the gas supply seemed to have stopped research on PM until the late '80's.

We made the PM's from inner tubes for narrow bicycle tires surrounded by the nylon mesh sheathing used for supporting multiple coaxial cables. One end is closed off with a rounded "stopper" (that we designed) and a hose clamp. The end attached to the pressure source has a similar stopper, but with a central hole and tube also attached with a hose clamp. The closed end stopper has a threaded adapter to interface with the load source. The PM's we constructed are about 8 inches long.

We were interested in characterizing the velocity and shortening length of PM when subjected to various combinations of applied load and pressure. Dr. Daniel Repperger of AFRL/HECP at Wright Patterson Air Force Base constructed a test chamber for this procedure, outfitted with a pressure control valve, a pressure transducer for inlet pressure, linear potentiometers for PM length change, load cell for force measurement, and a data acquisition system. The PM was positioned vertically in the chamber with a variable weight stack providing the load. Pressure waveform can be varied using the software developed for the system. A typical protocol is to load the PM with a constant load and activate the PM with a step increase in pressure. This pressure is held constant for several seconds and then the valve is suddenly opened to atmosphere, allowing the gas (nitrogen) to escape from the PM. For a given load, several pressures in the range 30 to 90 psi were studied. When the pressure reached a steady state, we suddenly removed a portion of the weight from the stack using attached ropes. Two people did this simultaneously to assure that the procedure was done as quickly as possible (i.e., to simulate a step removal of some of the load while the pressure was constant). When some of the load is removed like this, the PM shortens more. This procedure allows us to model the characteristics of the PM at a constant activation pressure. The additional shortening also demonstrates control problems inherent with PM: when load changes, the muscle length changes.

The data indicate that at a given pressure, the PM behaves like a spring and dashpot in parallel, with spring constant and dashpot coefficient a function of the activation pressure. We also modeled the effect of the activation pressure by a contractile force generator in parallel with the spring and dashpot. This contractile force could be determined from the overall shortening response of the PM to pressure, using the previously determined spring and dashpot coefficients. The contractile force demonstrates a monotonic increase with pressure. Being able to predict the response to triangular pressure waveforms at least partially validates our model.

Where does MEMS (MicroElectro MechanicalSystems) fit in? It turns out that Dr. Repperger has had specially built MEMS pressure (normal force) sensors to measure pressure distribution between the sheath and "inner tube" of the PM. What he and I didn't expect is that we came up with an idea for a shear force MEMS sensor from studying the mechanism of the pressure sensor. In fact, we suggested that both shear and normal force can be accomplished within the same

device. We built a test stand and demonstrated a weak effect shear effect even in the normal force MEMS sensor. We have elaborated on this concept and have been awarded an Air Force patent. Sometimes it's hard to predict where an NRC Summer Faculty Fellowship will lead.

Dr. Reynolds working on his Summer Faculty project in the lab at Wright-Patterson AFB.

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The NRC - Air Force Summer Faculty Fellowship Program - A Participant's Perspective

Department of Chemistry,
Wright State University, Dayton, Ohio

For the past two summers I have been a recipient of an NRC Summer Faculty Fellowship in collaboration with the Materials and Manufacturing Directorate at Wright Patterson Air Force Base in Dayton, and I have applied again for summer 2002. My previous summer projects centered around the preparation of organic compounds with non-linear optical (NLO) properties, the latter being an unusual property which, in essence, means that the molecules absorb more energy as the incident radiation increases in intensity. In practical terms, such materials are candidates for optical switches and related technologies in optical computing.

Prior to my participation in these summer projects, I had had little exposure to the utility or synthesis of NLO materials; however, I had many years of background in organic synthesis, in general. Most of the chemists with whom I have been involved at the Materials and Manufacturing Directorate have considerable background in the photochemistry side of the project, but the number of organic chemists is small. Accordingly, I felt that there was an opportunity for me to make a significant contribution, as well as to expand my horizons. Thus, each year, after discussion with some of the scientists involved, I have proposed projects that are more speculative than those that would normally be undertaken, but which, in principle, have the potential for a larger payback.

I feel that my participation in the summer program has been beneficial for both sides in that the blending of the different backgrounds has helped coalesce exploration into valuable areas that might not otherwise have been examined. Further, I have acted as a resource for several different individuals looking for insight into areas closer to my expertise. This has been by no means a one-way street. I have been exposed to cutting-edge research topics outside the "norm" of my experience, and I have had the opportunity to interact with leading scientists in both "one-on-one" and group settings. For the latter, I found the "brain-storming" and group presentations to be particularly valuable. In a small academic department like mine, with the M.S. as the terminal degree, it is difficult to devote a consistent, focused effort on research on a daily basis and to a large extent, there is no critical mass for collaborative efforts. Accordingly, the summer programs have been beneficial in that they have allowed me to experience the development of a research

project as a team effort, with concomitant sharing of ideas, protocols, and pitfalls.

Having been exposed to research at a state-of-the-art facility, I have been able to incorporate many of the ideas and techniques assimilated therein into my everyday research activities at Wright State University and in this regard, several of my research students have continued to work on related aspects. Not surprisingly, they appear to find the development of novel chemical processes, coupled with the potential for practical applications, to be a particularly "heady brew." Additionally, I have discussed some of these techniques and concepts in both my introductory and graduate organic chemistry classes. I feel strongly that these extra insights have been enriching for both student audiences. More intangible, but arguably as important, is the increase in enthusiasm that I have brought to my teaching as a result of this program. I have always believed that good teaching, even at beginning levels, is bolstered by exposure to good research, and I have attempted to expose my students (undergraduates and graduate) to as rigorous a research protocol as befits their level of development. While this has been most obvious for my research classes, my regular teaching classes also have benefited from my use of current research topics as discussion points. I feel that a much greater impact has been possible upon all of these audiences due to my exposure to the research-focused environment.

While I have discussed only the effects upon my students, the impact for my university also has been significant. As a community of scholars, a university thrives on interactions between researchers of widely different backgrounds. My time at the Materials and Manufacturing Directorate has helped foster such interactions as well as offering the possibility of extended collaboration over the long term, perhaps involving others of my colleagues. Such collaboration is truly a "win-win" situation, pooling diverse knowledge bases in the solving of "real-world" problems. I recommend the Summer Faculty Fellowship program without hesitation.

Dr. Turnbull is a recipient of an NRC Summer Facutly Fellowship.

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New Associateship Programs

Federal research facilities interested in participating in the NRC Associateship Programs are reviewed by a team of technical experts, and upon receipt of a favorable report, are admitted to the program by approval of the National Research Council's Governing Board. Over the past few months several new sponsors have been approved for participation in the NRC Associateship Programs and a brief description of these programs follows:

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National Security Agency

The National Security Agency (NSA) is the nation's cryptologic organization. It coordinates, directs, and performs highly specialized activities to protect U.S. information systems and produce foreign intelligence information. A high technology organization, NSA is on the frontier of communications and data processing. It is also one of the most important centers of foreign language analysis and research within the Government.

The NSA was formed in 1952 under order of President Truman with two missions: 1) to closely monitor and provide intelligence on foreign adversaries and 2) to provide secure communications and cryptography for US military and diplomatic use. This agency is charged with the task of keeping abreast of all scientific developments and technological advances relevant to communications and cryptography. Because of this mission, the NSA is composed of many technologists (electrical, communications, computer scientists, and engineers) and academic researchers (mathematicians, physicists, and linguists).

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Biological Resources Division - USGS

The mission of the Biological Resources Division (BRD) is to work with others to provide the scientific understanding and technologies needed to support the sound management and conservation of our nation's biological resources. Fulfilling this mission depends on effectively balancing the immediate need for information to guide management of biological resources with the need for technical assistance and long-range, strategic information to understand and predict emerging patterns and trends in ecological systems.

BRD's primary responsibility is to assist resource and land managers-particularly those in the Department of the Interior-by providing them with sound biological information and with assistance in applying the information to their needs. The primary methods of gathering this information are to use scientific methods to monitor resources and conduct experiments. Subsequently, pertinent information must be made available to those who must use it to make important resource management decisions.

BRD research is distributed among five scientific areas: 1) status and trends of biological resources, 2) investigations of biological systems, 3) threats to biological resources, 4) application of scientific information to resources conservation and management, and 5) management and distribution of biological resource data and information.

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Air Force Institute of Technology

The Air Force Institute of Technology (AFIT) located at Wright-Patterson AFB, Ohio, is the Air Force's graduate school, offering both Master's and Ph.D. degrees to Air Force officers, officers in other branches of the military, and civilian federal employees. The Associateship Program will be in the Graduate School of Engineering and Management, a major part of AFIT. While primarily an academic environment, AFIT has a number of basic research programs carried out by faculty and their students.

Research areas specifically approved to participate in the Associateship Program include research

projects in the Department of Aeronautics and Astronautics, the Department of Electrical and Computer Engineering, the Department of Engineering Physics, and the Department of Systems and Engineering Management. Innovative, basic research proposed for the Associateship Program includes projects such as low-speed aerodynamics, pulse detonation engines, estimation and optimization analysis with applications to navigation, the role of coatings in materials protection, chemical lasers and spectroscopy, optical fibers and their application to high-energy lasers, molecular reaction dynamics, ion implanted wide bandgap semiconductors, and groundwater contamination studies.

The AFIT faculty, postdoctoral fellows, and graduate students often interact with the other Air Force Research Laboratory programs located at Wright-Patterson AFB, as well as a number of universities and research laboratories in the United States.

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Federal Aviation Administration, Civil Aerospace Medical Institute

The Federal Aviation Agency's Civil Aerospace Medical Institute (CAMI) is located at the Mike Monroney Aeronautical Center in Oklahoma City, Oklahoma. CAMI conducts research centering on the human factors of aviation safety. Scientists study aircraft crashes and perform forensic toxicology studies to identify causes and to develop ways to prevent accidents or make them more survivable. CAMI psychologists develop tests to assure the validity of air traffic controller selection and performance in air traffic and aircraft environments. Examples of recent research findings at CAMI include: 1) development of a DNA probe capable of detecting the bacteria responsible for the production of ethanol (alcohol by putrefaction) in forensic blood samples; 2) development of the Systematic Air Traffic Operations Research Initiative (SARTORI), which uses radar, weather, and voice data from air traffic control facilities to graphically re-create operational errors and other ATC events; and 3) development of the first-of-its-kind Virtual Reality Spatial Disorientation Demonstrator (VRSDD) which creates a real-time, 3-dimensional visual representation of the cockpit flight environment.

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Adviser Profile - Dr. Ray Wheeler

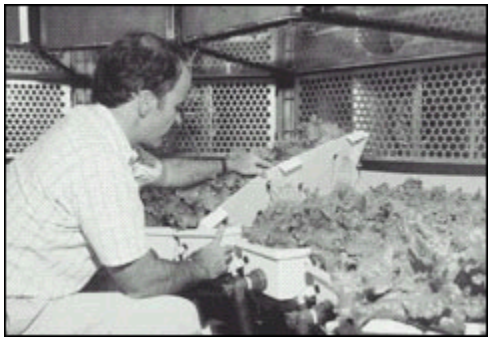
Biological Sciences Branch of the
Science and Engineering Technology
Directorate, Kennedy Space Center,
Florida

Dr. Raymond (Ray) Wheeler is a plant physiologist working in the Biological Sciences Branch of the Science and Engineering Technology Directorate at NASA's Kennedy Space Center (KSC). Ray received his BS from Penn State University (1975) and an MS (1978) and Ph.D. from Utah State University (1981) in Plant Science Ecology. Following graduate school, Ray worked as a postdoctoral Research Associate (RA) in the Department of Horticulture at the University of Wisconsin and the Wisconsin Biotron. Following this, Ray moved to Kennedy Space Center in 1988 to work in NASA's Controlled Ecological Life Support Systems (CELSS) Program. Ray's research over the years involved the use of plants (crops) to regenerate oxygen and food for life support applications, and in particular focused on plant responses to CO2 concentration, light intensity and spectra, and the use of hydroponic culture to improve yields. NASA's research on "bioregenerative" life support concepts has since been consolidated with physico-chemical life support research activities under the Advanced Life Support (ALS) Program administered through NASA's Office of Biological and Physical Research. During his career as a researcher, Ray has authored or co-

authored over 130 scientific papers and book chapters, and nearly 100 abstracts for professional meetings. In addition, Ray received NASA's Exceptional Scientific Achievement Medal (April 1995) and currently holds adjunct appointments at six universities throughout the U.S. and Canada.

Kennedy Space Center joined the NRC Research Associateship programs in 1992 and hence is a relative newcomer to the scene. Over this time, the Center has hosted 17 RAs, hailing from the 12 different countries including the U.S. During this time, Ray has gotten to know each of Kennedy Space Center's RAs, and has been directly associated with 10 of them as an Adviser or a "project" associate. These projects covered a wide range of topics, including studies on the response of native Florida vegetation to elevated CO2 levels, studies of plant carbohydrate metabolism under space flight conditions, growth and development of plants under light emitting diodes (LEDs), studies of nitrogen nutrition in hydroponically-grown plants, sodium tolerance and uptake in plants for waste recycling applications, plant watering systems for weightlessness, and plant responses to low atmospheric pressures. The NRC RA research efforts at Kennedy Space Center have provided invaluable contributions toward NASA's understanding of plants in both terrestrial and space flight environments, and the potential for harnessing plant photosynthesis and crop production for future life support systems. These findings have been published in a range of botanical, ecological, microbiological, and aerospace journals, as well as NASA Technical Memoranda.

Most of Kennedy Space Center's RA positions have been funded through NASA's Office of Biological and Physical Research, but recent appointments have expanded to include positions affiliated with NASA's Earth Science and Manned Spaceflight Offices. Each of these projects has augmented the on-site research efforts at Kennedy Space Center, as well as creating lasting professional relationships between the RAs and Kennedy Space Center's biological research group. Perhaps most satisfying to Ray and his Kennedy Space Center associates is the fact that all of the RAs have either gone on to new jobs in industry and universities, or returned to their home institutions with new research experience and friendships following their tenure with NASA.



Dr. Wheeler inspecting hydroponically-grown lettuce plants inside NASA's Biomass Production Chamber at Kennedy Space Center.

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Associate Awards

Seth Veitzer, an NRC Research Associate at the U.S. Geological Survey Laboratory In Lakewood, Colorado, is a recipient of the first Student Research Award of the American Geophysical Union Technical Committee on Nonlinear Geophysics. This award is given to recent PhD's in recognition of significant advances made in a field of research associated with geocomplexity and nonlinear geophysics. Veitzer's work involves development of a new statistical-geometric theory of river networks. Dr. Veitzer is working on this project with his Adviser, Dr. Brent Troutman.

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Adviser Profile - Dr. Arthur Ballato

Dr. Arthur Ballato, Chief Scientist

CECOM Research, Development and Engineering Center, U.S. Army Communications-Electronics Command, Fort Monmouth, New Jersey

The stars in the flag are not the only things shining in the accompanying photo. Dr. Arthur Ballato not only started as an NRC Adviser in 1986, but was in charge of the entire NRC postdoctoral program at Fort Monmouth until 1997 when the ARL segment moved to Maryland. Since then, he has continued his collaboration with the NRC as an Adviser at CECOM. His generosity of time has included mentoring people at his local community college as well as several NRC Associates. One of his outstanding former Associates, Dr. Ajmal Khan, had noteworthy success evaluating new types of piezoelectric materials, called langasite and its isomorphs, which have the potential for replacing quartz in high stability oscillators. Here is a brief sketch of Dr. Ballato's background and how he has excelled.

Arthur Ballato received the BS degree in Electrical Engineering from the Massachusetts Institute of Technology, Cambridge, MA, in 1958; the MS degree in EE from Rutgers University, New Brunswick, NJ, in 1962; and the PhD degree in electrophysics from the Polytechnic Institute of Brooklyn, NY, in 1972.

He is the Chief Scientist of the U.S. Army CECOM Research, Development, and Engineering Center, Fort Monmouth, NJ, and is principal scientific advisor to the Director and Center management. He also provides technical interfaces with academia, industry, and federal and state governmental elements. He is a member of advisory committees of various universities and Adjunct Professor at Rutgers University. He is author of over 300 technical articles and book chapters, holds more than 50 patents, and is editor of several books.

Dr. Ballato is a member of the American Physical Society, American Ceramic Society, and Sigma Xi. He is a Chartered Engineer and Fellow of the Institution of Electrical Engineers (London), and Fellow of the Acoustical Society of America. He was elected Fellow of the Institute of Electrical and Electronics Engineers "for contributions to the theory of piezoelectric crystals and frequency control." He received the C. B. Sawyer Memorial Award "for contributions in the field of piezoelectric crystals such as stacked crystal filters, electric circuit analogs, and stress effects in doubly rotated plates." Four times he has received the Army R&D Achievement Award, the highest in its category. Dr. Ballato has served as member of the Technical Program Committees of the IEEE Intl. Ultrasonics Symposium, the Intl. Frequency Control Symposium, the Semiconductor Device Research Symposium, and the European Frequency and Time Symposium.

He is an IEEE Ultrasonics, Ferroelectrics, and Frequency Control Society AdCom member, and is its Standards Activities Chairman. He was the Society's Distinguished Lecturer on the topic "Frequency and Time Sources," and received its 1992 Achievement Award for "wide-ranging contributions to the fundamental understanding, in both theory and practice, of piezoelectric materials and their application to resonators, filters, and frequency control devices, and for his energetic pursuit of IEEE standards." He serves also as a Technical Advisory Group member of the U.S. National Committee of the International Electrotechnical Commission, and as a member of Army and DoD advisory groups.


Dr. Ballato, Chief Scientist for Fort Monmouth and Adviser for the NRC Program.

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Annual NRC/Laboratory Program Representatives Meeting

The annual meetings of Laboratory Program Representatives are planned for April 18 (NASA) and April 19 (all other program participants except NASA). These meetings provide an opportunity to discuss any issues that pertain to the Associateship Programs, including updates on any changes that have been made to the program during the year. In particular, we are interested in input from our program Advisers. Please consider suggestions that you may have relative to things we might do to make the program work better for you. Pass these suggestions/comments to your LPR so that they might be discussed at the meetings in April. If you prefer to send comments directly to the Associateship Programs Office, email us at rap@nas.edu, and specify that your input is for the LPR meeting.

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Associate Awards

We will be including a section in each Newsletter highlighting awards that have been received by NRC Associates. Examples are a "best presentation" award, a travel grant, etc. Please send this information to your NRC Program Coordinator, either directly or through your LPR. We look forward to highlighting the accomplishments of our Associates.

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Panel Review Schedule - 2002

Application Postmark Deadlines:
April 15 (June Review)
August 15 (October Review)

Laboratory/Center Review forms due in our office:
May 9 (June Review)
September 6 (October Review)

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The RAP Sheet - Postscript

The objectives of this newsletter are to provide NRC Associateship Programs Advisers and Associates with important information regarding our programs and to provide some insight into the diversity and accomplishments of Program participants. We welcome your input in the form of topics you would like to see addressed or the names of Advisers or Associates you would like to see featured in future issues. Please contact us by email at rap@nas.edu, with your suggestions.

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Ask Dr. J

For future issues, we invite your comments about this newsletter and questions about the Associateship Programs. You may send comments or questions to "Ask Dr. J" at rap@nas.edu, Submissions may be edited for brevity.

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