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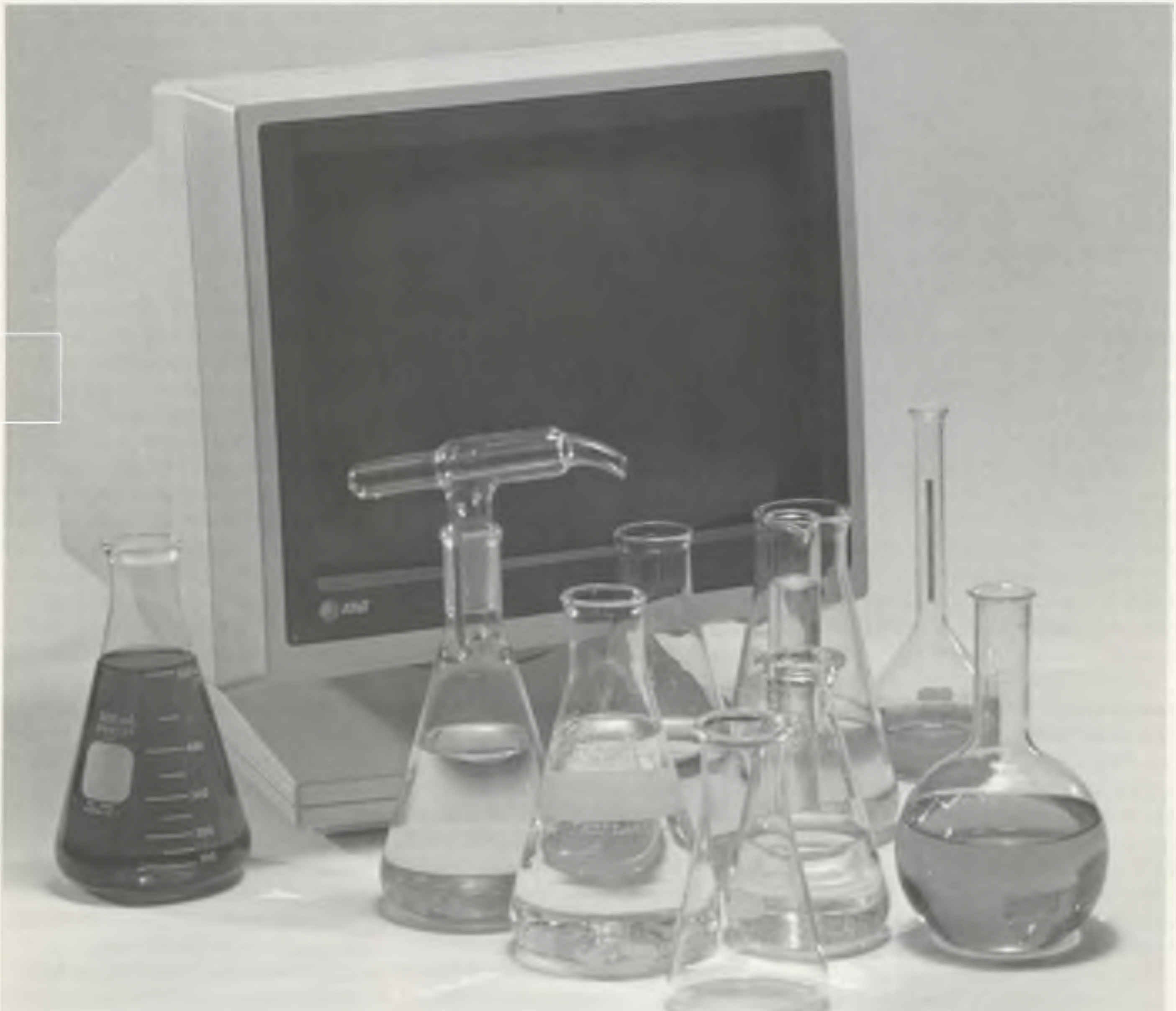

Six Variations on the Scientific Quest

By Harriet Jackson Scarupa

That scientific research is one of the prime functions of a university is a truism. Yet, to many, there is something mysterious about the whole enterprise.

Its practitioners are often tucked away in near-hidden laboratories wrestling with problems that seem indecipherably obscure or abstract, using equipment that seems indecipherably complex, communicating in language that just seems plain indecipherable.

In an attempt to demystify the scientific quest, we set out to take a closer look at some members of the Howard University faculty who are engaged in research in the natural sciences and, in one case, in engineering. We wanted to find out what exactly they're studying, how they're going about it, what they're finding out, what its importance is. We also wanted to find out how they initially got interested in their subjects and what continues to fuel that interest.

The six researchers we focus on in the following pages are a diverse lot in terms of their academic specialities, the recognition they've received, the funding they've attracted. They also vary in age, race, nationality, personality. Yet they seem to share the same passion: the passion to know.

The six researchers we focus on in the following pages . . . share the same passion: the passion to know.

They somehow have been able to retain the curiosity of the child ["Why is the sky blue? How do birds fly? What makes cars go?"] and honed it into a lifelong motivating force. As one of them remarked, "I don't think you should ever turn your back on extending man's understanding of his world. You can't foresee where that knowledge might lead."

These, then, are people of faith—faith in the value of their own research, in the scientific process, in the potential of that process to somehow better humankind and the world in which it dwells. They know, as Max Planck (1858-1947), the Nobel Prize-winning German physicist, once wrote:

"Anybody who has been seriously engaged in scientific work of any kind realizes that over the entrance to the gates of the temple of science are written the words: *Ye must have faith*. It is a quality which the scientist cannot dispense with."

These six men and women are also, of course, teachers. In this is a source of conflict. They sometimes feel torn between the pull of the classroom and the pull of the laboratory. But in this is also a source of satisfaction and, even joy. For the roles of teacher and researcher often reinforce each other. Research makes the teaching more relevant, more dynamic. Teaching gives the research more clarity, more purpose.

The intersection of these two roles also provides these researcher-teachers with another link to posterity. Not only are they advancing knowledge themselves, but they also are engaged in training a new generation to go out and do the same.

KENNETH R. SCOTT

Title: Professor of medicinal chemistry, College of Pharmacy and Pharmacal Sciences, Graduate School of Arts and Sciences—
Education: B.S., pharmacy, Howard University; M.S., pharmaceutical chemistry, State University of New York at Buffalo; Ph.D., organic chemistry, University of Maryland
Research specialty: Anticonvulsant drugs

Kenneth R. Scott's father suffered from epilepsy, the result of a childhood blow to the head from a baseball bat. Scott initially remembers being frightened when his father would go into convulsions. "Dad wasn't himself and I just didn't know what to do," he recalls. "Later, with training, I was able to handle it a whole lot better."

Today, Scott is a medicinal chemist and his speciality is anticonvulsant drugs, a choice he traces directly to his father's condition. "Yes," he acknowledges, "I had a very strong interest and motivation for doing work in this area."

Epilepsy, a collection of syndromes leading to different types of seizures, is believed to stem from an event that damages the central nervous system, sometimes years earlier. Such events include head injuries, stroke, infection, lead poisoning, temporary loss of oxygen when a baby is in the womb or during delivery. In addition, some types appear to be linked to a genetic predisposition, although that link has yet to be firmly established.

Scott has turned his attention to drugs that are used to combat epilepsy caused by head injuries, the same type of epilepsy that plagued his father. "Right now," he explains, "there are very few selective drugs for this type of epilepsy. And although there are some on the market, we felt better and safer ones were the order of the day.

His "we" includes Jesse M. Nicholson, chairman of Howard's chemistry department; graduate student Jo Ann Lee-Joyner; postdoctoral fellow Patrick Kodwin; and a number of undergraduate students.

Scott and the members of his research team specifically have been working with valproic acid, a drug that has been on the market since 1978. "It's very effective in stopping the convulsions," he says, "but it has a serious side effect: liver toxicity. In some cases, particularly with children, the drug is being taken up by the liver and causing the liver to essentially die. So what we've been doing is taking the known compounds in valproic acid and modifying them chemically."

Going into greater detail, he adds: "We've developed a separate molecule which has incorporated the anticonvulsant effect of the parent valproic acid but without the metabolic breakdown [damaging to the liver] of the parent drug. In addition, this new molecule is effective for a longer period of time."

He describes what this all means with a readily understandable image: "If you can imagine valproic acid to be a kite with a long tail attached to it, what we've done is taken that tail, which is the part of the molecule which is detrimental to the liver, and essentially looped it upon itself so that instead of having a kite with a tail, now it's a kite with a circle."

To reach this stage involved synthesizing more than 20 compounds. "So it was quite trial and error, he says. "We had the idea but to get the actual compound took a lot of work." And such equipment as a gas chromatograph, infrared spectrophotometer, nuclear magnetic resonance (NMR) spectrophotometer and microbalances—all spread over three laboratories.

The researchers, augmented by a number of outside collaborators, also have tested their valproic acid analog, as the modified drug is called, on rats. They've infused the drug and injected it directly into the vein that leads to the rat's liver, monitored it over a 24-hour period and, after autopsy, compared the liver of that rat with one injected with unmodified valproic acid.

After tests on about 40 rats, they've been able to demonstrate that the liver of a rat treated with the analog shows far fewer signs of deterioration (e.g. far fewer large globules of fat incorporated into the cells) than the liver treated with the unmodified drug.

The researchers are readying their findings for publication in a peer-reviewed journal [They've already published papers on other aspects of their valproic acid research], while their work has been supported by grants from the Epilepsy Foundation of America, the Minority Biomedical Research Support program of the National Institutes of Health and by Howard's own Faculty Research Program.

Eventually, they plan to scale up their research by testing the valproic acid analog they've developed on primates and then on human subjects, the customary progression in new drug development.

Meanwhile, they are taking a look at a related problem. "We're trying to find out how—on the molecular level—valproic acid actually works, that is, at how it actually stops convulsions," Scott explains. Some of their tentative answers, he says, are "very exciting."

In fact, "very exciting," seems to be the way he characterizes drug research itself. Says the 55-year-old registered pharmacist of his decisions to go beyond his initial B.S. degree in pharmacy and to pursue research: "I just wasn't going to be satisfied with dispensing a drug and saying, 'Take it three or four times a day, etc., etc.' I was nosey. I really wanted to find out how drugs acted. And that's basically where I am."

Then there's another reason he's been lured to the research side of pharmacy. And when he talks about it he apologizes for being "clichéish."

"You want to leave something to posterity," he says. "You don't want to be a person who was here and then died and that's it. You want to be able to say, 'Well, O.K., I was here; I made a contribution that advanced man's/woman's knowledge.' " □

JAMES A. MOMOH

Title: Associate professor of electrical engineering, School of Engineering, Graduate School of Arts and Sciences
Education: B.S.E.E., Howard University; M.S.E.E., Carnegie-Mellon University; Master of Systems Engineering, University of Pennsylvania; Ph.D., electrical engineering, Howard University
Research specialty: Applying artificial intelligence to solve problems of power systems

There's a mural on one wall in **James A. Momoh**'s Howard laboratory that shows these scenes: a city being supplied with electric power; the control center of an electric power plant; a windmill and other alternative sources of power; some complicated mathematical formulas.

It's an appropriate mural for Momoh's research: applying artificial intelligence (AI) to power systems' operation and planning.

AI, a relatively new field, has been described by one of its leading theorists [Marvin Minsky of the Massachusetts Institute of Technology] as "the science of making machines do things that would require intelligence if done by men." The machines, in this case, are computers. Hence the notion that AI is an attempt to make the computer "think" independently.

Consider one thrust of Momoh's work in AI that of "expert systems." As the Nigerian-born engineer explained to a writer for TOPIC, the magazine published by the United States Information Agency for distribution in Africa:

"An expert system, combines the knowledge of all the experts in a given field into a computer data base—a knowledge base consisting of all the rules and facts that these experts use to make decisions. Then, through what we call in computer terminology 'an inference machine,' we can gain access to that knowledge base and use that information to solve a given problem."

In the power industry, Momoh further explained, "an operator must watch over a massive control board filled with dials and gauges, monitoring power usage every minute of every day. Any variation in the power supply or use must be quickly noted and corrected, and this is a very complex operation. If all of the knowledge of anyone who had ever worked at that control board has been accumulated and stored in a knowledge base, then that information could be accessed and used when a crisis arose in the future."

That's the challenge for Momoh and his group of researchers as they combine the disciplines of electrical engineering, mathematics and computer science in his Howard laboratory. That laboratory is essentially a room filled with computers—and people: two postdoctoral fellows, two Ph.D. students, three master's degree students, three undergraduate students and a visiting professor from Ahmadu Bello University in Nigeria.

Sitting before their terminals, the researchers call up such questions as these: "Is there a flow violation?" "Is there a voltage violation?" When a researcher hits another key, numbers and symbols fill the screen.

This is the concept of expert systems in action. It's about feeding data that the researchers get from power companies into their computers. It's about drawing on this data and combining it with the researchers' own knowledge of how power systems operate in order to identify problems—such as blackouts and brownouts—and determine what's causing them. It's about trying to come up with solutions to these problems in the quickest, most cost-effective way possible. And it's all done by simulation. It's all done by juggling a bunch of numbers and symbols on a computer screen.

In professional journals and at professional meetings, the researchers have begun to report on some of the practical tools they're developing to assist power systems' planners and operators. One of them—transient analysis by sampling technique—reduces the computational time necessary to do certain calculations related to power system dynamics by half, Momoh says. It also reduces the manpower needed to do the job. "We hope that industry will adopt this method," he adds.

Already the linkages between the Howard laboratory and the power industry are strong. The data Momoh and his fellow researchers are working with comes from three major power companies: Los Angeles Water and Power, the Bonneville Power Administration [Portland, Ore.] and New England Power Service. The three companies also are funding much of the research. Other funding has come from such diverse sources as the Department of Energy, Westinghouse Electric Corp., the Electric Power Research Institute and the National Science Foundation (NSF).

The NSF, in fact, in 1987 awarded Momoh one of its prestigious Presidential Young Investigator Awards. The awards, which cover a five-year period, are designed to fund research by gifted young scientists and engineers and to encourage them to remain in academia.

Only two of the 200 awards announced that year went to those engaged in research on power systems, Momoh says. "Most of my colleagues — when I was in school — always thought that the problems in power were solved or were not challenging," recalls the 38-year-old engineer in discussing his attraction to the field. "But when it comes down to asking people to provide models that will be efficient, that will be fast, that will be cost-effective, that will be secure, that will dictate the causes of voltage collapse and so forth and so forth, they don't have that tool. So there's still a lot of work to be done.

"Coming from Africa, I especially see the need for this type of research. You can imagine the frustration that people have in some other parts of the world where they don't have a very reliable energy system." □

Momoh (standing, right) delivering impromptu lecture in his laboratory.


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SONYA K. SOBRIAN

Title: Associate professor of pharmacology, College of Medicine, Graduate School of Arts and Sciences
Education: B.A., psychology, St. John's University; M.A., experimental psychology, St. John's University; M.A. equivalent, pharmacology, Ottawa University; Ph.D., psychology, Carleton University; postdoctoral fellow, developmental neurobiology, Princeton University.

Research specialty: Environmental assaults on the developing brain.

Attached to the wall behind **Sonya K. Sobrian**'s desk in her Howard office is a saying: "A woman has to do twice as much as a man to be considered half as good. Fortunately it isn't difficult." Nearby, as if to confirm the saying, is a copy of a biographical sketch highlighting her research career.

Sobrian is a developmental neuropharmacologist. Much of her research focuses on the effects of prenatal drug exposure on the developing brain. "It's an area in which it's difficult to get at mechanisms," she says, "because instead of working with one unit you really have three — the mother, the placenta and the fetus."

"It's interesting that most of the people working in developmental neuropharmacology are women," she adds. "Maybe they have some biological predilection for the field."

The 43-year-old researcher, who was trained as a physiological psychologist, also studies the effect of stress on the developing brain and how that stress impacts behavior.

While it may look as if she's flitting from one research topic to another, "I've never changed my area," she says. "The questions I'm trying to answer are the same: Do environmental assaults alter the hard wiring of the developing brain, and if they do, what's the long-term effect of it? Sometimes I'm looking at pharmacological assaults and sometimes at other environmental assaults."

Almost all of her research is done with rats, whom, incidentally, she considers "marvelous." "I hate mice because they stink and they bite," she quips. "But rats? They adapt. They have personalities. I mean they're just incredible."

Be that as it may. She uses rats in her experiments, as in the case with all animal research, she says, to develop a good model that can be extrapolated to humans. Nowhere is this more obvious than in her current research on the "Neurobehavioral and Immunological Effects of Prenatal Cocaine Exposure in the Rat," to cite the title of a paper she delivered last November at a meeting of the Society for Neuroscience in Toronto. It's a topic of obvious societal impact, given the escalating increase in cocaine use among women of child-bearing age.

Working with her on this research has been a shifting cast that has included a high school student, medical student, two salaried research assistants and the College of Medicine's assistant dean for research, Warren K. Ashe.

When a woman who uses cocaine gives birth to a baby with developmental problems, it's difficult to know if these problems were caused by her use of cocaine, per se, or by other factors that so often accompany cocaine use. Among them: poor nutrition and abuse of other drugs and alcohol. But in animal experimentation, Sobrian points out, researchers can control these factors. Consider the experiment she described at that Society for Neuroscience meeting:

She and members of her research team injected rats with cocaine in the last third of pregnancy, which for them is a week. This is the period marked by the biggest brain development spurt, Sobrian explains. The researchers injected other rats in the same stage of pregnancy with a saline solution. Both groups received the same amount and quality of food in order to rule out any possibilities of malnutrition.

The researchers then compared the offspring of the two groups. And what they've found is not "gloom and doom," Sobrian says, but something far more subtle. "We find changes in reflex development and, unfortunately, it's accelerated. Now that can be good and that can be bad. We also find changes in the immune function which suggests that cocaine somewhat compromises it."

Overall, she says, "The changes that we do find are never profound. But they are at least reliable. You can get them over and over again."

The next step in the research, she says, is studying the impact of prenatal cocaine exposure on rats at other stages in their development.

Meanwhile, she's trying to find time to write up the results of her research on stress and the immune system which she did at the Immunology Research Center in Belgrade, Yugoslavia, in 1987 when she was a visiting Fulbright Scholar. And there's still more work to be done on the effects of prenatal antiepileptic drug exposure which she's doing under a grant from the National Institute of Neurological Diseases and Stroke of the National Institutes of Health.

"I try to keep more than one thing going because if you're stuck doing the same thing day after day, you'll go bananas," she says. She adds that the creative part of science is not the day-to-day benchwork in the laboratory, which she says can be "boring as hell," but coming up with the questions to ask and knowing where to go next.

"The *ideas!*" she exclaims. "It's the *ideas* that are exciting—coming up with something that's different, that hasn't been done before or putting a new twist on something because you look at it from a different point of view."

Today, she goes by many names — "experimental psychologist," "physiological psychologist," "developmental pharmacologist," "neuroscientist."

She's also been — and is — a proselytizer.

"Oh, it's marvelous to turn people on to science, *truly* turn people on to science," she says. □

SISIR K. DUTTA

Title: Professor of molecular genetics, College of Liberal Arts, Graduate School of Arts and Sciences; professor of human genetics, College of Medicine

Education: B.S., plant genetics, Dacca University [in what is now Bangladesh]; M.S., biochemistry/genetics, Kansas State University; Ph.D., biochemistry/genetics, Kansas State University; postdoctoral fellow, biochemistry/radiation genetics, University of Chicago; postdoctoral fellow, biochemistry/radiation genetics, Columbia University
Research specialty: Recombinant DNA

Sisir K. Dutta is a foot soldier in the international campaign to bring about the second green revolution.

The first green revolution, he explains, increased crop yields through breeding and plant genetics. The second green revolution aims to increase them further through the tools of genetic engineering, that is, by manipulating and altering the genetic makeup of plants.

For the past dozen years, the 61-year-old botanist and molecular geneticist has been working with recombinant DNA, the mind-boggling technology that involves taking genes from one organism and inserting them into another to develop new forms of life.

Consider the case of rice, which has attracted his particular attention as a researcher. "Rice is a plant that does not produce its own nodule, which means it cannot fix atmospheric nitrogen on its own," he observes. "The dream is that through these new biotechnologic techniques, we can add a gene that can help it to fix nitrogen and that that gene could be cloned—that is, an exact replica could be made—and introduced into other plants."

Already, he points out, some microorganisms associated with rice plants have been genetically engineered to fix more nitrogren, an important step towards the realization of that dream.

The outcome of such research promises not only plants that will be able to produce more rice, but a cheaper and safer growing process because it will no longer be dependent on nitrogen-based fertilizers. "If you add chemicals year after year, then they go into the subsoil and they can make drinking water poisonous," he elaborates. "This is a problem all over the world—whether in the developed or the undeveloped world."

Improving rice production, though, has a special urgency in the Third World where rice is the number one food crop and hunger often a constant threat.

Reflecting this urgency was the conference he organized on "Biological Nitrogen Fixation Associated with Rice Production," which brought experts from all over the world to the Central Rice Research Institute in Cuttack, India, for four days last December. Sponsors of the conference included Howard, the National Science Foundation, the U.S. Department of Agriculture (USDA), the Rockefeller Foundation, the Ford Foundation, the Indian Council of Agricultural Research and the International Rice Research Institute, among others.

At the conference, Dutta read a paper entitled "Molecular Cloning of Rice Ribosomal RNA Genes and Varietal Identification," which described some of the research he and his fellow researchers at Howard's molecular genetics laboratory have done. These researchers have included undergraduate and graduate students, a postdoctoral fellow and a salaried research assistant.

Underlying this research is the notion that before you can even begin to clone a gene you have to be able to identify it. Using a setup called a gel apparatus and other equipment that is standard for advanced research in microbiology and biochemistry and a technique called DNA restriction fragment length polymorphism, Dutta and his fellow researchers have been able to clearly identify varieties of rice by analyzing the makeup of their DNA [deoxyribonucleic acid, the master chemical of genes.]

"This is a big contribution," he believes. "It means you don't have to go into the field to plant a seed and wait for the plant to grow in order to determine what variety of rice it is. It can all be done in the laboratory in much the same way chemical analysis of the DNA isolated from human blood gives you clues to identify potential hereditary diseases."

"There's a long process before you can get to the stage where you can begin cloning genes to create new plant varieties," he adds.

Already, with the support of a grant from the USDA, he and a USDA scientist have successfully cloned genes in chickpeas, another Third World staple.

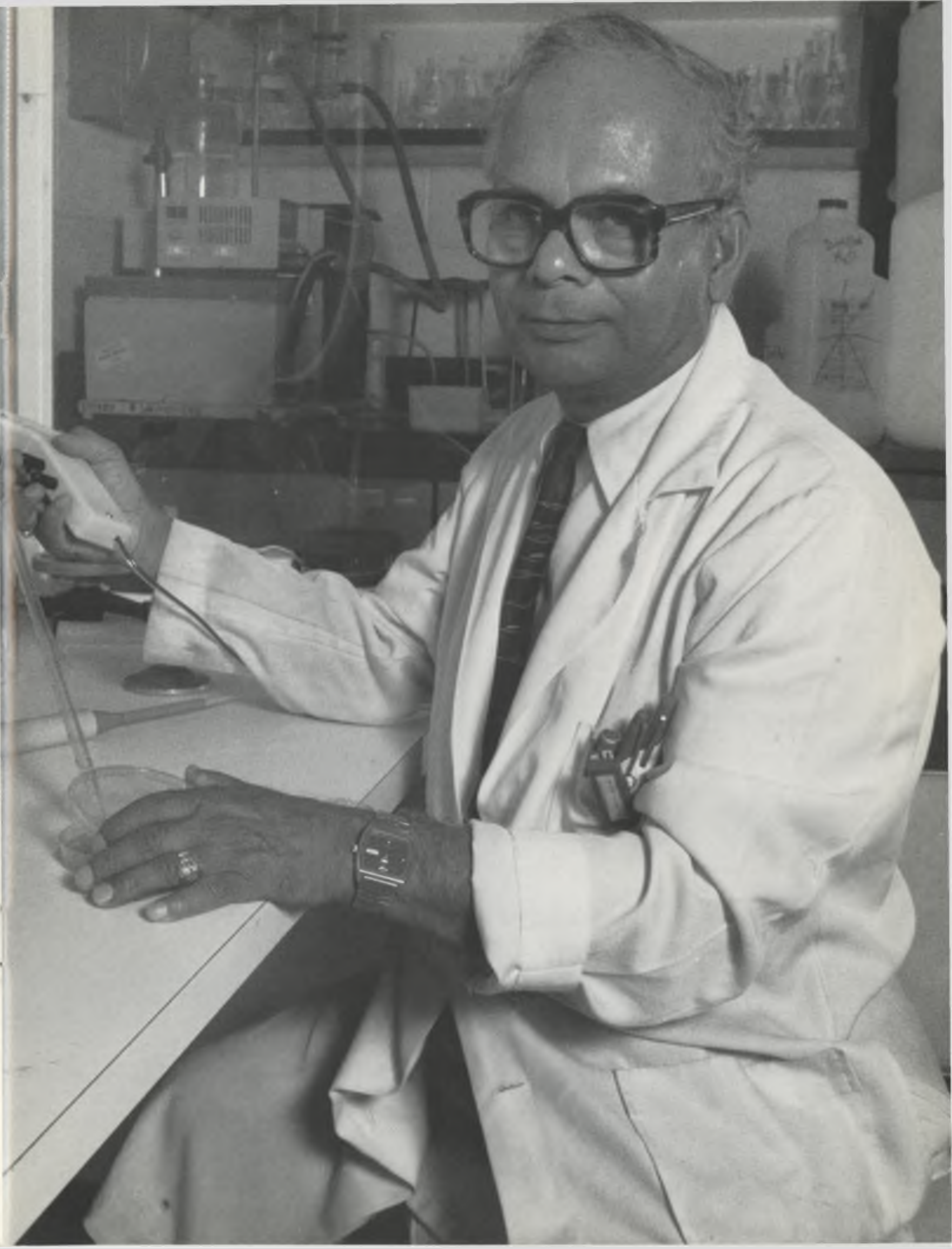
Dutta recently has received a grant from the Environmental Protection Agency to support research on what seems a totally unrelated subject. He is investigating whether exposure to electromagnetic fields (via the common light bulb, for instance) alters the genetic makeup of human brain cells in a way that can cause them to develop cancers.

Rather than a departure, Dutta sees this project as definitely related to the work he's done with rice and chickpeas. "It's still molecular genetics," he says. "It's still about the clone. I'm exposing these genes to see—at the molecular level—if there are any changes."

His laboratory for this work is in Howard's Cancer Center. His other laboratory is in Howard's biology building a few blocks away. So, Dutta gets his exercise. Through science, of course, he also gets to exercise his mind.

Propelling all the research he has done, says the Indian-born scientist who is the author of several books and more than 100 papers in professional journals, is "the eagerness to discover." Also propelling it, he says, is "the tremendous eagerness to contribute new knowledge where benefits to humankind are involved.

"That's the ego, the ambition, scientists can have—that you can contribute something to humankind during your lifetime." □



JAMES W. WHEELER JR.

Title: Professor of chemistry, College of Liberal Arts, Graduate School of Arts and Sciences
Education: B.S., chemistry, Antioch College; M.S., organic chemistry, Stanford University; Ph.D., organic chemistry, Stanford University; NSF postdoctoral fellow, Swiss Federal Institute of Technology; NSF postdoctoral fellow, Cornell University; NIH postdoctoral trainee, department of chemistry, Cornell University

Research specialty: Chemistry of pheromones.

"In general, what we do is work on stinks and smells."

That's the way **James W. Wheeler Jr.**, in one of his more jovial moods, describes the work he and his colleagues in the field of the chemistry of pheromones are doing. [Pheromones are naturally occurring chemical compounds in animals that serve as a stimulus to others of the same species.]

To further explain: the 54-year-old researcher specializes in communication in insects and communication in mammals and reptiles. But it's not communication as most people understand it. It's communication by chemical message.

"We work on the gland contents of various animals, identifying the chemicals that these things secrete," he explains. The gland contents he's studied, he says, represent a virtual "potpourri." They've come from elephants, moose, camels, hyenas, alligators, crocodiles and all sorts of insects—ants, bees, wasps, hornets, bark beetles, ticks.

Indeed, having a deliveryman stop by his Howard lab with a package containing an animal gland packed in dry ice seems to him to be a perfectly ordinary occurrence. And that gland may come from a place as near as the National Zoo, a few miles from the lab, or as far away as a crocodile research center in Louisiana or a game park in South Africa.

Much of his research, at least on insect secretions, is done in collaboration with Richard M. Duffield, an entomologist in Howard's zoology department. Explains Wheeler, "I specialize in the chemistry of it. I identify what these glands are secreting and he tries to find out what it's being used for."

He gives an example of one of their joint research projects: "There's a sex specific compound in a bee, a compound the male puts out which the female doesn't have. So what we're trying to do is to see what the bee does with the compound—whether it's an aggregation pheromone which brings them together or whether it's some kind of sexual signal the male sends out to the female."

Wheeler is also collaborating with Paul J. Weldon, a zoologist at Texas A. & M. University, on the contents of the paracloacal gland of the American alligator. The gland expands under water, which Weldon believes is some sort of communication device, Wheeler says. The Howard researcher's task is to identify the compounds in the gland and make up a synthetic mixture that can then be tested on alligators.

The underlying rationale for all such research, Wheeler explains, is "for control." That is, to find some chemical means to keep unwanted populations of animals in check. (Consider the alligators that are overrunning parts of Florida.)

Yet what seems to most fuel his enthusiasm is not so much the potential long-term applications of his research as some of the intriguing—even quirky—discoveries he's making here and now. When he relates them, he switches back to his jovial mode:

"We've [he and Duffield] identified a compound from an ant which is also in cocoa. So this ant smells like chocolate. They make chocolate covered ants, but we have ants that you don't need to put chocolate on.

"Then we have a compound from another ant around Frederick [Md.]. We collected about 50,000 of the damn things. You collect them by aspirating them—you suck them up through this device that prevents the ants from coming into your mouth—and we kept getting sore throats. Once I found out what the compound was, I understood why. It is related to nicotine."

To identify such compounds, Wheeler uses a procedure called gas chromatography mass spectroscopy. After a gland has been extracted with a solvent or milked with a syringe, the glandular material is diluted down so it can be examined. This mixture is then placed at the top of a machine called a gas chromatograph which separates the mixture into individual components. These are then fed one by one into another machine called a mass spectrometer which breaks the compound down so it fragments. From the way it fragments, an experienced researcher can identify what the compound is.

If it all sounds complicated, it is. One of the beneficial side effects of his research, Wheeler says, is that "it provides a vehicle for students to learn mass spectroscopy, which is a very important tool for chemists to know, and for handling minute amounts of material." Indeed, he's just completed training his 40th graduate student and through the years some of the students who have worked in his lab have been listed as coauthors in the 70 scientific publications he lists on his curriculum vitae.

Through the years, too, he's received support for his research from a number of sources, among them: the National Science Foundation, the U.S. Department of Agriculture and the Minority Biomedical Research program of the National Institutes of Health.

Wheeler dates his own interest in the chemistry of pheromones to his days as a postdoctoral fellow at Cornell when he had the opportunity to do some research on a cockroach sex attractant. "I found that exciting: to try to get a compound that would control cockroaches," he recalls. That particular compound turned out to offer no such promise, typical of the wrong turns that often characterize the scientific quest. But Wheeler's overall interest in the general subject remained—and remains—undiminished.

"I really feel ebullient when I hit something, when I solve a chemical structure," he says. "I get a real high from that." □

JOAN MURRELL OWENS

Title: Associate professor of geology, College of Liberal Arts, Graduate School of Arts and Sciences
Education: B.S., art, Fisk University; M.A., guidance and counseling, University of Michigan; B.S., geology, George Washington University; M.Phil., geology, George Washington University; Ph.D., geology, George Washington University
Research specialty: Deep water solitary corals.

When **Joan Murrell Owens** was a child growing up in Miami, Fla., she was fascinated by the life of the sea. She was particularly fascinated by corals, the tiny plantlike marine animals that grow on the sea floor. [Their skeletons also are called "corals" and it is some types of these skeletons that are fashioned into prized jewelry.]

Today, after a circuitous route, that fascination has become the motivation for her lifework. An invertebrate paleontologist, she is one of the few researchers in the country specializing in deep water solitary corals.

As she explains, "When you say corals to most people, they think of coral reefs, which are in shallow water and which are formed by colonies of corals. The ones I'm studying are a family of solitary corals that has migrated from shallow water to deep water, and my research—when I was doing my Ph.D.—was on the evolutionary changes that allowed these corals to make this migration.

"In order for them to migrate this way, there had to be some kind of accommodation in terms of structure. And one of the things they did was require less and less calcium carbonate to build their skeletons."

Asked how she was drawn to such a seemingly obscure subject, she answers, "I think it's exciting to see the way nature works." "I knew I wanted to do coral study," she adds. "Everybody was working on coral reefs. Then I learned of the strange case of this little thing starting in shallow water and the changes in the family as it migrated into deeper water. So I thought, 'Here's an interesting group that few people have been working on.' When I talked to some people at the Smithsonian, they said they had a vast amount of material they were anxious to have someone study. So everything came together."

Despite her long interest in the life of the sea, Owens' research in this area has been relatively recent. She had earned a master's degree in guidance and counseling and had worked as a reading specialist, educational administrator and editor when she decided to return to school to get the knowledge and skills that would enable her to do what she *really* wanted to do.

So, in 1970, when she was in her mid-thirties, she began studies leading to a B.S. degree in geology. Next came a master's degree and, finally, in 1984, a Ph.D.

"I finished high school in 1950 and at that time to go into marine biology or geology or something like that was not a very realistic plan," says the 56-year-old researcher. "When I decided to go back to school, things had changed. There were more opportunities for Blacks and women in these areas." Still, when she delivers papers at professional meetings, hers is usually the only Black face in the crowd. Indeed, she is believed to be the first Black American woman to earn a Ph.D. in geology.

These days Owens is working on a collection of deep water coral specimens originally obtained in a British scientific expedition in the 1880s. "What I'm doing now would be considered taxonomy," she explains. Specifically, she is identifying specimens as belonging to a particular family or a particular genus [the category below family and above species]. When she comes across a specimen that has never been described in the literature before, she describes its characteristics and gives it a name.

One group she's working on now, for instance, she plans to name in honor of her husband. Hence, *Microbacia rotatilis franksia*. As she explains the Latin name, "*Microbacia* tells the genus. *Rotatilitis*, the species name, describes something unique about the structure, in this case, its very, very round, wheel-like appearance. *Franksia*, the name designating this particular variation of *Microbacia rotatilis*, is for my husband; his name is Frank." She adds: " 'Owens' " would go at the end, since I was the first person to describe this variation of the species."

A typical specimen she studies is about 70 million years old, she says, while a "recent" one, a mere 10,000 years old. Which brings up one of the reasons for studying corals in the first place. "Corals are used for interpreting paleoenvironments—past environments," she says.

It is for this reason that coral study has practical applications for the oil industry, explains Owens, who in 1987 received a grant for continuing research from Mobil Oil. "The oil industry is interested in certain types of corals because they will tell us whether an environment at some past time was the kind of marine environment we know will give oil."

But even if coral research has little or no immediate practical applications, she still believes such research is important.

"As a scientist, I tend to think all knowledge is important—even for the sake of knowledge," Owens observes. "Many people don't look at it that way. You ask me the question, 'What is this research on deep water solitary corals good for?' Well, it's not going to make anybody rich; it's not going to be a cure for cancer; it's not going to lead to anything like that. But it's knowledge. It's information. It's information, in particular, that provides insights into our 'last frontier,' the Earth's oceans.

"I don't think you should ever turn your back on extending man's understanding of his world. You can't foresee where that knowledge might lead. The more man knows, maybe the better he'll behave in terms of preserving his world, and the more he might see an analogy that he can use for himself." □