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Health and the Environment

New Research Directions

An interview with Stephen A. Gage, *EPA Assistant Administrator for Research and Development*

Will preventive health research be an important part of the Agency's R&D in the future?

Yes, without a doubt. During the FY 1980 budget cycle, the Office of Research and Development developed a major public health research initiative. The President's Budget requests $37 million and 44 positions for expanding our research both in health effects of toxicants and in their environmental transport, fate, and effects.

The Public Health Research Initiative is one of the centerpieces of the Agency's budget requests. Administrator Costle and I are going to be pushing very hard in our Congressional hearings for this program.

I think that this is a very important change in the perception of the role of scientific information in the regulatory process. There is now a very clear recognition, by this Administration, that we must make the necessary investments in good scientific information in order to avoid future inadequate regulatory decisions.

Do you anticipate greater cooperative efforts in the future with the National Institute of Environmental Health Sciences and the National Cancer Institute, particularly in the health-related areas?

Yes, we have quite a number of cooperative efforts going on already. I'm proudest of a joint effort that Donald Kennedy, Commissioner of the Food and Drug Administration, and I have undertaken in establishing a research institute for neurotoxicological effects at Research Triangle Park, N.C. Dr. Kennedy and I have pooled our resources for this institute to be located at EPA's research facility in North Carolina. This will create a critical mass of expertise that neither agency was able to bring together on its own.

We also are working closely with the National Cancer Institute. For the last two years, the National Cancer Institute has committed $4 million of its research funding to support research activities needed by the Environmental Protection Agency. In fiscal year 1980, as part of the Public Health Research Initiative, this institute will be committing an additional $15 million in its budget to support EPA in several areas where it has the specific expertise that we need.

We also have a number of other interagency agreements, through which we work with the National Institute of Environmental Health Sciences, the National Institute of Occupational Health and Safety, and others. We find that these interagency agreements are very useful and very supportive of EPA's work to improve public health protection.

Is EPA cutting back on research in ecological fields in order to provide more funds and manpower for strictly human health research?

While there have been some reductions and redirections in our environmental research, it will, in fact, be expanding during the next fiscal year. We have had to redirect certain research from the historical areas of activity to support toxic chemical control. But this is only natural, given the general shift of EPA's concern from the conventional pollutants to the toxic chemicals.

I'm pleased that we have, in our Public Health Research Initiative for FY 1980, a very substantial increase in research on environmental transport, fate, and effects, as such research relates to reducing the threat of exposure to humans. We felt it was critical for EPA with its unique responsibility to address the environmental routes of exposure through a substantial expansion of our efforts in this area.

Would you describe some of the assessment groups now functioning to support EPA regulatory actions?

The Agency has just approved our proposal to establish an Office of Health and Environmental Assessment, which will be built around two successful groups now in operation, namely, the Carcinogen Assessment Group, and the Environmental Criteria and Assessment Office located at Research Triangle Park.

We will be expanding the efforts of this new office beyond carcinogenic assessment and air quality criteria development, respectively, to include risk assessments for other media, especially water. The new office will ultimately have a responsibility for reproductive effects, for chronic effects, and for exposure assessment.

The new health office also includes a second Environmental Criteria and Assessment Office in Cincinnati. That office will focus primarily on the preparation of water quality criteria documents, a responsibility that has grown greatly in the past year as the Agency has been attempting to comply with the consent decree for toxic pollutants.

Are you recruiting nationwide to find somebody to head this office?

Yes, we will be establishing that office and all of its components just as quickly as the Agency's order is signed, and will be recruiting the best people we can find.

Isn't exposure assessment a new tack for the Agency—a new way of using our resources? In the past we have tended to look at the media such as air or water just one at a time.

Very much so. I think the Agency has suffered from taking a narrow viewpoint. We need to focus on the overall effects of a pollutant as it affects humans in several ways. This comprehensive approach is not only more efficient use of the Agency's scarce resources—people, time, and expertise—but also provides more public health protection by truly assessing the total impact of the environmental toxicants on human beings.

This interview was conducted by Charles D. Pierce, Editor, and Chris Perham, Assistant Editor, EPA Journal.

Would you comment on your efforts in recent months to make R&D more responsive to the program offices? For example, I understand you were recently in Chicago discussing plans to help support our enforcement program.

For the past year we have been working very hard to develop a mechanism to provide for joint planning of the research that we perform in support of regulatory activities. We carried out a pilot study involving the establishment and monitoring of five research committees in substantive research areas—pesticides, inhalable particulates, mobile sources, industrial wastewater control, and drinking water. The success we had with these five pilot committees has encouraged us to expand this method of joint planning. The regulatory control offices are supporting our expansion of the concept to include all of the research activities that we conduct for the Agency.

To support the Agency's enforcement efforts, we have taken a somewhat different approach. We have established a task force of some of our key people, who are working with the Office of Enforcement and the Regional Enforcement Offices, in the four highest priority enforcement areas—power plants, steel, pulp and paper, and chemicals. Although this effort is just getting underway, we have already given Regions 3 and 5 considerable assistance in case preparation for the four key industrial sectors.

How has the Zero Base Budget process affected your programs?

Zero Base Budgeting has provided net benefits for the Office of Research and Development. The largest positive impact so far is the Public Health Research Initiative which I mentioned earlier.

On the other hand, there have been some reductions in certain programs. The air ecology program has been converted from an in-house program to a primarily extramural program. The environmental management research program was terminated through the ZBB process. Smaller cuts in our water ecology program have for the most part been offset by increases in the toxic substances ecology program. So, on balance, over the last two years we have benefited budgetarily and have about held our own in personnel. Given the high priorities of the Agency to develop major efforts in toxic substances and hazardous waste regulation, I think that the ZBB process has dealt fairly with us.

Will the laboratories be reflecting the changes you have just mentioned? Are we going to close some down and open others?

No, we have no plans to close any of the laboratories. We have to keep looking continually at how we can effect economies in the laboratories. It is likely that there will be some redirection in some of the laboratories. The Zero Base Budget process for FY 1979 did necessitate some reductions-in-force at three of our laboratories. Reductions at the Robert S. Kerr Laboratory in Ada, Oklahoma, are essentially complete, and we will soon be initiating the reductions in the Las Vegas and Corvallis laboratories.

But I would say, in all three cases, the laboratories have not been substantially harmed by these reductions. In fact, they probably have an enhanced ability to compete for resources in the future.

With fixed personnel ceilings for the last five years, we have not really had the opportunity to think about establishing new laboratories. Our concentration is more on how best to use the laboratories and the scientists and engineers that we do have more efficiently.

Are you satisifed with the performance of EPA's laboratories?

In general, yes. We do face mixed performance. As in any organization with fifteen quite different components, we expect some variation in performance. We have undertaken serious efforts to improve performance through peer review, at the laboratory level, and programmatic review by the Deputy Assistant Administrators and myself. And I think the combination of these review techniques will upgrade the general performance, and bring some of the less satisfactory performances up to acceptable levels within the coming year.

Could you explain what you mean by peer review, and how this is a change in the way things are done in the R&D program?

Many of our scientists do publish their work. However, many reports that we and our contractors prepare are not published and do not receive the careful scrutiny from scientists outside of the Agency. This is in part because of the fast timetables required for much of the research that we conduct in support of the Program Offices. However, what has developed is a massive body of "grey" literature, which has not been carefully reviewed by the best scientists in those areas.

I'm working with our laboratory directors to develop ways in which we can get a larger fraction of our EPA reports and papers reviewed by scientists outside the Agency before publication. This will be a source of strength for us in the future, rather than just another burden placed upon the researchers.

It's absolutely critical in terms of improving the credibility of the Agency, not only to conduct research, but to take regulatory decisions based on those research results.

Do you have any plans for major reorganization of the Office of Research and Development?

My view of organizations is that they must constantly adapt to the changing environment—both external and internal. There is no more dynamic organization than the Environmental Protection Agency, which is perennially faced with changing priorities and requirements. We have made several evolutionary changes during the past year in establishing the Office of Research Program Management and the Office of Health and Environmental Assessment.

We now have under serious discussion a proposal made by some of our laboratory directors to realign their reporting relationships to the Deputy Assistant Administrators. Such a realignment would represent, in my estimation, only a modest evolution in the organization, and thus have minimal impact on morale and productivity. On the other hand, it should help us immensely in integrating our research planning and implementation in health effects; environmental transport, fate, and effects; and environmental control measures.

Is it possible that our scientific knowledge of health and environmental problems has gotten ahead of our ability to solve them? For example, we have learned to detect chemicals in parts per million, although we're only beginning to learn how to protect ourselves from these dangers.

FDA Commissioner Kennedy has put it very well. He says we have become embarrassingly good at identifying chemicals in the environment and workplace. I agree with that view. I would, however, rather know what is there with the new analytical techniques that we have developed in the past decade than not know. I fully recognize that it takes time to develop the rest of the information and, in some instances, the institutional framework, so that one can map out an intelligent regulatory course.

I do not think that ignorance is bliss. We are probably going to be faced in the future with knowing about a lot of problems before we are able to devise and implement solutions.

Is EPA approaching a risk-benefit formula to use in dealing with environmental carcinogens?

In the area of carcinogen assessment, we are in fact following the Agency's interim guidelines, established in 1976, which stated that we would provide risk and benefit analyses, as part of the regulation of carcinogenic materials. That's complicated somewhat by the fact that we regulate carcinogens under at least seven major

pieces of legislation, with quite a wide range of regulatory requirements. For example, Congress did make it explicit that risk and benefits are to be considered in regulating pesticides and toxic substances, namely, products which supposedly have beneficial uses in commerce.

On the other hand, some provisions of the Clean Water Act are driven solely by technology considerations, and some provisions of the Clean Air Act are driven solely by health protection considerations. We do conduct economic impact analyses of each of our regulatory proposals, but are not always able to calculate the benefits. Thus, it is difficult to do a strict economic balancing of the risk and benefits under all of our regulations.

What research is EPA doing in the genetic repercussions of environmental contaminants?

As I mentioned, we are establishing an assessment group on reproductive effects, as part of the new office of Health Assessment for genetic effects. We already have set up a working group with Dr. Gary Flamm, who is on loan from the Food and Drug Administration, to provide guidelines for mutagenic risk. We'll be looking at other aspects of genetic risk in the future. In addition, we do have under way in our health effects laboratories research on the ways toxic chemicals threaten genetic health and on quick and reliable screening techniques to identify genetic risks.

How much of EPA's R&D work is in the physical, hard sciences, and how much is in the softer sciences, such as economics?

At this point nearly all of our research and development is in the area of the physical, biological, and medical sciences. We do have a very small research component oriented towards attempting to determine the economic benefits of pollution control measures, such as the study we've funded at the University of Wyoming. But the bulk of the work on economic impacts of regulation is done in either the regulatory program offices, or by the Office of Planning and Management.

Is there a promising future at EPA for young scientists just getting out of college?

I would say that a young scientist, who could find a position with the Environmental Protection Agency, would have a very exciting future. We have, however, few openings for research-oriented scientists each year in our research laboratories, because of the personnel limitations that we have faced for five years.

There are, of course, a number of new positions in the toxic substances area, but those will be oriented towards regulation, as opposed to research.

I assume that EPA probably gets quite a substantial number of applications, despite the difficulties of getting a position?

Yes, we get many applications. Each one of the new entry-level positions are very highly contested. We're able to attract a high caliber of young scientists into our laboratories. In many instances, the new people coming in are carrying a substantial portion of the workload and are providing a large fraction of the new and exciting ideas.

I noticed Secretary of Energy Schlesinger is saying now that there should be more emphasis on the use of natural gas, indicating that the country may slow up a little bit in converting to coal as a major source of power. Does that have an impact on our research program?

No, I think that the increased use of natural gas, within the United States, will be a fairly short-lived phenomenon, on the order of a few tens of years. Therefore, we must increasingly turn to other forms of energy and conserve natural gas. I think that the use of coal will continue to expand. This, in turn, will put a great deal of stress on the environment if we don't do everything we can to minimize the environmental impacts associated with coal production and use.

In one of your recent speeches, you seemed to be sympathetic to the soft energy paths, endorsing the uses of windmills, solar energy, and so on, and I wondered if this is your personal view, or official EPA policy?

EPA does not have an official policy in this area. I can point, however, to a number of examples where the Agency's policies are reflecting what I personally feel is a growing awareness that large, complicated technological solutions to society's problems are not the only, or even the best, route that could be followed.

I think that the new policy shifts in water pollution control, emphasizing land application of sewage sludges and partially treated municipal wastewater, are a clear recognition of the fact that the huge commitment that society is making to publicly-owned wastewater treatment plants also entails large future obligations.

These obligations are in the form of maintenance and operating expenses which will, in time, become very burdensome. The softer paths, to use your term, such as land application, can capture the nutrient value that exists in the sludge or wastewater, without requiring large capital and operating costs. That's an excellent example of the softer technology path.

I focused on the energy alternatives in that particular speech because I was trying to highlight, from four years of experience with pilot energy studies conducted by the Committee on Challenges of Modern Society (the civilian arm of the North Atlantic Treaty Organization), some lessons which I thought the representatives of the countries involved should know. The pilot studies taught that alternative energy systems such as solar and geothermal could play a very significant role in the future of not only the developing nations but also of the highly industrialized nations.

We understand that R&D is starting to look fifteen and twenty years into the future, regarding research needs. With this new perspective, what critical environmental problems do you see on the horizon?

In our efforts to develop a solid analytical basis for the Research Outlook—our five-year research plan—we are attempting to identify future development patterns and their possible environmental consequences. We see two types of pressures which could have great influence on environmental quality.

The first of these is driven by both increases in human populations, and in their expectations for affluence. This pressure will mean greater demands for food, housing, energy, minerals, etc. These increased demands, around the world, could hold many implications for the environment. For example, an aggressive food production program might have to rely even more heavily than is now the case on chemical fertilizers and pesticides. And we're quite familiar with the environmental damage they've caused.

Pressure on the biological resources in the sea could increase to a point where major ecological balances could be disturbed. Demand for timber, for housing, could lead to massive deforestation and associated climatic changes, especially in such sensitive areas as the Amazon.

The second type of pressure derives from the development of new technologies, which are just now emerging. It's hard to predict in advance what the nature of all these technologies are, of course, and even more difficult to identify what their environmental impacts might be. And I'm speaking of technologies in a very broad sense —weather control, deep ocean mining, advanced energy systems, or genetic engineering. In fact, in the area of genetic research, we could find very dramatic advances, which could improve human health, change industrial processes quite fundamentally, or endanger human health and the basic ecological

systems upon which life depends.

We're going to have to monitor both of these pressures very carefully, and attempt to anticipate the nature of the environmental problems that we might face in the future, rather than wait until those problems overtake us, and then react to them after possible irreversible damage is done.

When you leave your post as Assistant Administrator for Research and Development, some time in the future, what do you want to be remembered for, and what do you hope to have accomplished?

I'd like to be remembered for two things. First, improving the quality of the science and engineering done by the Agency and, second, building the institutions which facilitate the performance of higher quality work.

I believe fundamentally in the scientific ethic, which is built in part on the idea that only quality science can survive the scrutiny of the scientific peers. We have to make that idea one of the operating principles of the Office of Research and Development and of the Agency. As the research component of a critical Federal regulatory agency, we do not have the option of isolating ourselves from the broader scientific community. Quite to the contrary, we must, in fact, be aggressive in seeking out the best scientific criticism we can find anywhere. We're making progress in building our scientific credibility but we still have much to do.

An important aspect in improving our science is creating a truly professional environment throughout the Office of Research and Development. We have many laboratories and specialized instruments, but we still have much to do in building our human institutions—we need a cadre of highly professional and committed scientific managers, who are excited about their work. We have some outstanding examples of that type of individual now, but I would like to leave behind a stronger heritage of professionalism and performance. □

The Team Leaders and Laboratories

Dr. Gage has four Deputy Assistant Administrators to aid in the direction of the Office of Research and Development. They help manage the Office's 1,752 employees and the $314 million annual budget. The Office of Research and Development has 15 major laboratories and numerous field stations that are devoted to scientific study. Approximately one out of every five EPA employees works in these labs.

Dr. Thomas A. Murphy

Deputy Assistant Administrator for Air, Land, and Water Use

He is responsible for planning and evaluating the research and development program related to the control of pollution from community and agricultural sources; determining the nature, fate, and interaction of pollutants in air and water; providing safe drinking water supplies, and planning and implementing community environmental management systems. He also oversees development of incentives for environmental cleanup, methods for integrated environmental planning and analysis, and plans for the disposal and management of hazardous and other waste material.

Dr. Murphy joined the Federal Water Pollution Control Administration, an EPA predecessor agency, at its Edison, N.J., laboratory in 1967 as a biologist, later becoming Chief of the Oil and Hazardous Materials Research. In 1971 he was appointed Special Assistant to the Assistant Commissioner for Research and Development at the Federal Water Quality Administration. He was Chief of the Program Development Branch of EPA's Office of Research and Monitoring in 1972 and 1973, and Director of the Nonpoint Pollution Control Division in the Office of Research and Development from 1973 to 1975, when he assumed his present post.

Dr. Murphy received a B.A. from Knox College, Galesburg, Ill., in 1959, and M.S. and Ph.D. degrees from Yale University in 1964. He has taken law courses at Seton Hall and George Washington Universities.

There are four laboratories attached to the Office of Air, Land, and Water Use. They are:

Environmental Research Laboratory, Athens, Ga. Director: Dr. David W. Duttweiler

The mission of the lab deals with identifying and tracing the movement of pollutants through soil and water and the subsequent changes that take place. Agricultural and silvicultural sources of pollution, and environmental systems to control them, are studied. The staff develop models to help judge the environmental consequences if a contaminant reaches certain portions of a water-soil system. They develop management techniques that could be applied to an entire river-basin to achieve water quality objectives. The staff also work on methods for assessing environmental exposures to toxic chemicals.

Robert S. Kerr Environmental Research Laboratory, Ada, Okla. Director: William C. Galegar

The staff of the lab conduct research, development, and demonstration activities on groundwater, natural systems for treating wastewater, irrigation, the petrochemical industry, and the treatment of combined industrial or mixed industrial and municipal wastes. This research provides basic data for the establishment of guidelines, standards, and criteria. The lab personnel also develop social, economic, and institutional assessments of technological developments.

Environmental Sciences Research Laboratory, Research Triangle Park, N.C. Director: Dr. A. Paul Altshuller

The mission of the lab is to determine the effects of air pollution on the atmosphere, and any subsequent efforts on air and water quality and land use. The staff develop techniques, methods, and instruments to identify and measure pollutants and toxic substances in the air, in addition to studying pollutant transport and fate, resulting in air quality simulation models. The scientists assess the effects of pollution on weather and climate, and develop mathematical models to relate pollution emissions to air quality and to forecast potential pollution crises.

Municipal Environmental Research Laboratory, Cincinnati, Ohio Director: Francis T. Mayo

The lab's mission is to find ways to prevent, control, and treat pollutants that affect communities. This includes developing cost-effective methods of providing safe drinking water, community environmental management, solid and hazardous waste disposal, and wastewater treatment. The staff work to find new and improved technology for collection, transportation, processing, and disposal of solid and hazardous wastes, with recovery of valuable resources. They also seek alternative solutions for pollutants that affect several media, such as air and land or water.

Dr. William B. Murray,
Acting Deputy Assistant Administrator for Health and Ecological Effects.

He is responsible for the research that documents the health risk to people and the impacts on the ecology of pollutants moving through the environment. The research conducted adds to the necessary scientific foundation for health-protective regulatory decisions. In order to formulate control strategies for pollution the Agency must be informed about subtle changes in human physiology that may develop into or worsen illness, as a result of a contaminant that reached people through air, drinking water, or food.

The ecological effects research and health effects research complement one another; the first investigates the impact of disturbances and contaminants on the whole environment and the second determines how these ecological changes and contaminants affect people. Since the effects of pollution can move up through the food chain to people, the ecological research supports preventive health studies. The results of these studies are used in developing water quality standards, effluent guidelines for toxic and hazardous materials, ocean discharge criteria, secondary air quality standards and dose-response relationships for pesticides and other toxicants.

Dr. Murray was most recently Director of the Technical Services Division in the Office of Pesticide Programs, a post he assumed in 1973. He joined the Agency in 1971 as Staff Director of the Hazardous Materials Advisory Committee, and served as Acting Director of both the Criteria and Evaluation Division and the Tolerance Division while in the pesticide office. Dr. Murray has served in numerous positions throughout the Federal Government since 1952, including the President's Cabinet Committee on the Environment and the Federal Committee on Pest Control. He earned a B.S. degree from Juniata College in 1950, and M.S. and Ph.D. degrees from the University of Maryland.

There are six laboratories attached to the Office of Health and Ecological Effects. They are:

Health Effects Research Laboratory, Research Triangle Park, N.C. Director: Dr. F. Gordon Hueter

This laboratory performs studies of problems in air pollution, non-ionizing radiation, environmental carcinogenesis, and the toxic effects of pesticides and chemicals. The staff develop and revise air quality criteria documents for pollutants that are governed by existing or proposed ambient air quality standards. The research staff work to identify the health effects of environmental pollutants. They provide data to assist in regulatory decisions on the registration of new pesticides and review of others now in use. They also conduct health-related studies of hazardous and toxic materials, including the biological effects of microwaves.

Health Effects Research Laboratory, Cincinnati, Ohio Director: Dr. R. John Garner

The staff conduct field and laboratory studies of the effects on human health and welfare of auto emissions, drinking water contaminants, pollution in swimming and shellfish-growing waters, wastewater treatment plant effluents, land treatment and disposal of wastewater and sludge, as well as other pollutants that reach people through more than one media. They develop models and test systems to predict mutation and cancer threats. The research identifies and describes the harmful effects possible from exposure to chemical or biological agents found in the environment.

Environmental Research Laboratory, Corvallis, Ore. Director: James C. McCarty, Acting

The mission of the laboratory is to determine the effects of pollution on terrestrial, freshwater, and marine ecosystems linking air, land, and water, as a basis for setting criteria and regulations. Studies include: air pollution impact on plants, animals, and ecosystems; the social and economic effect of water pollution on aquatic plants and animals; how best to restore dying lakes; defining wetlands and determining the effects of pollution on them; assessing the effects of water pollution from runoff, and finding ways to improve water sanitation and conservation in remote Alaskan Communities.

Environmental Research Laboratory, Duluth, Minn. Director: Dr. Donald I. Mount

The laboratory staff conduct research on the biological and chemical effects of pollution on freshwater ecosystems, especially the impact on aquatic life. They study the effect of toxic substances on freshwater biological systems. This lab has the primary research responsibility for describing the fate and effects of pollutants that enter the Great Lakes. The staff also study the effects that fuel cycles used to produce energy can have on freshwater ecosystems.

Environmental Research Laboratory, Narragansett, R.I. Director: Dr. Eric D. Schneider

The laboratory provides a research base for Agency decisions relating to the use of the oceans, by studying the impact of pollution on marine ecosystems. The staff study the chemical and physical behavior of pollutants in ocean life systems, and general and specific responses of marine organisms to environmental stress. They find ways to monitor the build-up and movement of pollutants in ocean systems, and to determine the impact of pollution incidents.

Environmental Research Laboratory, Gulf Breeze, Fla. Director: Dr. Thomas W. Duke

The staff conduct research on the exposure-effects relationships of hazardous pollutants on marine, coastal, and estuarine ecosystems. This information is used by EPA's pesticide program and by the Agency in setting water quality criteria to protect human and aquatic health in those areas. They especially study the coasts and estuaries of the South Atlantic and Gulf of Mexico, for the impacts of petroleum extraction on the marine populations.

Dr. Steven R. Reznek,
Acting Deputy Assistant Administrator for Energy, Minerals, and Industry

He is responsible for directing research to assess the environmental and socio-economic impacts of energy and mineral resource extraction, processing, conversion, and use. The program develops and demonstrates ways to control the effects of mining, energy production, industrial processing, and manufacturing. He directs research to identify and evaluate alternative systems for producing goods and energy,

as well as ways to conserve the resources that are available. This office coordinates research activities within EPA and among other government agencies relating to the environmental aspects of resource mining, processing, conservation, and use.

Dr. Reznek came to EPA in 1971 as a staff member in the Technical Assistance Branch of the Office of Water Programs, dealing with groundwater hydrology and the transport of chemicals in water. He worked in the Office of Research and Development from 1971 to 1973, planning and managing the air pollution control program and coordinating research work with the Air Program Office. He helped create major EPA regulations on ambient and stationary source monitoring equipment, lead content in gasoline, and non-deterioration of air quality. In 1974 he was a researcher in the Center for Environmental Studies and lectured on formulation of environmental policies in the Civil and Geological Engineering Department at Princeton University. From 1974 to 1976 he was Director of Program Coordination with the National Commission on Water Quality.

Dr. Reznek received a B.S. and Ph.D. in physics from the Massachusetts Institute of Technology, where he was also employed as a research associate in 1968 and 1969. He was a research fellow at the University of Bristol, England in 1969 and 1970.

There are two labs attached to the Office of Energy, Minerals, and Industry. They are:

Industrial Environmental Research Laboratory, Research Triangle Park, N.C.
Director: Dr. John K. Burchard

The staff of this lab work to assess the environmental impact of energy production and industrial processes. They develop timely and cost-effective techniques and process modifications that will conserve energy and help industries to meet environmental quality standards for air, water, solid waste, thermal discharge, and pesticides. The activities of the lab staff also support the Agency's enforcement and regulatory activities.

Industrial Environmental Research Laboratory, Cincinnati, Ohio
Director: Dr. David G. Stephan

The lab staff is concerned with finding ways to prevent, control, or abate the pollution associated with the extraction, processing, conversion, and use of mineral resources, and general industrial activity. They work on closed-loop systems to eliminate waste discharge, and ways to change industrial processes so that less waste is produced. The staff look for cost-effective techniques for removing and disposing of pollutants. The staff seek improved methods for preventing, containing, and cleaning up spills of oil and hazardous materials.

Albert C. Trakowski
Deputy Assistant Administrator for Monitoring and Technical Support

He is responsible for Agency programs in development of environmental monitoring technology and systems, and technical support to the Agency's operating functions. This includes the development of measurement techniques and equipment as well as the application of monitoring systems, including sample analyses, which assess the pollution that people are exposed to. Trakowski is responsible for quality control to assure that Agency data are statistically valid and legally defensible.

Trakowski served as acting Assistant Administrator for Research and Development from May to December, 1974, directing and conducting EPA's research, development, and demonstration programs. He joined the Agency in 1971 as Deputy Assistant Administrator for R&D Program Operations, and managed the resources needed to accomplish environmental research. In 1973, he was appointed Deputy Assistant Administrator for Environmental Engineering, taking over the research into pollution prevention and control technology.

From 1964 to 1971 Trakowski was Vice-President of the Wolf Division of EG&G, Inc., where he was Director of Corporate Development, Project Director for the design and operation of the NASA National Space Science Data Center, and directed EG&G's environmental control program. For 21 years he was with the U.S. Air Force as an engineering and scientific officer in geophysical and environmental technology, pioneering certain developments in atmospheric remote sensing and data analysis systems.

Trakowski obtained a B.S. from the Massachusetts Institute of Technology and Master's level training from the Air Force Meteorology School. He has had extended schooling in engineering, research, and management.

There are three laboratories attached to the Office of Monitoring and Technical Support. They are;

Environmental Monitoring and Support Laboratory, Research Triangle Park, N.C.
Director: Dr. Thomas R. Hauser

This lab provides monitoring and analytical support to EPA air programs and other air pollution control organizations. The staff operates the quality assurance program for ambient air and stationary source measurements and provides analyses, evaluations, and new monitoring developments for air pollution control. It analyzes samples from air quality monitoring networks such as the National Fuel Surveillance Network. The lab supplies rapid response and special techniques of air sampling as needed for emergency situations or enforcement actions, and evaluates commercial air monitoring equipment. The laboratory staff conducts the EPA Fuels and Fuel Additive Registration Program.

Environmental Monitoring and Support Laboratory, Cincinnati, Ohio
Director: Dwight G. Ballinger

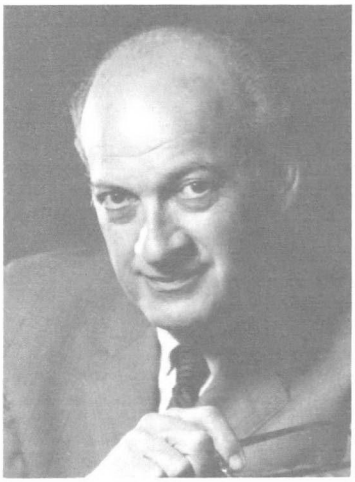
This lab develops tests to identify and measure major pollutants and quality characteristics in water. The staff develops monitoring techniques to detect viruses and microorganisms of health significance in drinking water, ambient waters, and municipal wastes, as well as ways to measure the effect of waste discharges on receiving waters. It prepares official test methods and provides materials to evaluate and maintain the quality of water monitoring data from laboratory testing. The lab provides technical support of water and waste monitoring programs at EPA and other pollution control agencies.

Environmental Monitoring and Support Laboratory, Las Vegas, Nev.
Director: George B. Morgan

The staff of this lab develop monitoring methods and systems that assess human exposure to pollution by studying the movement of pollutants through the atmosphere and their final disposition. The lab develops sophisticated monitoring and analytical capabilities for lab and field studies, and conducts quality assurance for radiation and biological research. It provides aerial support for the Agency and develops monitoring systems for contact and remote sensing, especially for environmental emergencies or pollution spills. The lab also conducts radiological surveillance and studies human exposure to radiation from past and present nuclear testing. □

Research, Environment and Health

An interview with Dr. Philip Handler, President, National Academy of Sciences



Dr. Philip Handler has served as President of the National Academy of Sciences since 1969. The author of more than 200 articles in the field of biochemistry, he also is editor of *Biology And The Future of Man* and co-author of *Principles of Biochemistry*. He has served on numerous scientific panels including the Surgeon General's Committee on Environmental Health Problems, the President's Commission on Heart Disease, Cancer and Stroke, and the President's Science Advisory Committee. After receiving his Ph.D. from the University of Illinois, he taught from 1939 to 1969 at Duke University School of Medicine, where he was Chairman of the Department of Biochemistry. He is the recipient of many honors here and abroad for his contributions to science.

Environmental illness seems to be partly due to geography. Stomach cancer, for example is common in Japan but rare among second generation or Nisei Japanese in this country. Do you believe there should be more funding and emphasis on unraveling this puzzle?

My answer is an unqualified "yes." But let me explain. It is the conventional wisdom of our time that perhaps 80 or 90 percent of all cancer is somehow environmentally related. Whether that is true is more than I know.

Ten years ago, it seemed equally true that much cancer was due to a form of virus infection—viruses which we either pick up from the environment or are with us from birth. Indeed, that was so firmly believed that there's a special building out at NIH which was built for the isolation of such viruses.

That belief was just as firmly held then as the current environmental theory is held today. I don't know what it will be 10 years from now. Having stated that caveat, let me note that there is little doubt that the pattern of distribution of various forms of cancer varies greatly around the world, and varies, rather considerably, even inside the United States.

The best single evidence that these are not the genetic heritages of the people who have concentrated in any one region is the phenomenon that you mentioned; namely, that there is a high incidence of gastric carcinoma in Japan. It's smaller in Japanese in Hawaii, and Nisei Japanese are like all the rest of us here in the United States. But I remind you that the incidence of gastric carcinoma in the United States in the 1920's was as high as it is in Japan today.

Do they know why?

No sir. We did something right and we haven't the faintest idea what it is.

There's something about the way we live, the way we eat, or something that is different than it was in the '20s.

What all that says is that the prevalence of gastric carcinoma is determined by something other than our own inherent biology. And it's extremely important to find out what that is.

The incidence of primary carcinoma of the liver is very high in Central Africa—higher than anywhere else in the world, as far as I know. And it seems important to find out why because it is not true of those of their descendants now living in the United States.

I know of no reason to believe that these differences should be ascribed to the influence of man-made materials. The peak incidence of every form of cancer but carcinoma of the lung happens somewhere outside of the United States in relatively primitive societies. There is surely no reason to think that in Central Africa, the primary cause of liver cancer is some man-made chemical. It's due to the environment, using the word in its broadest sense.

The currently fashionable thinking is that however cancer is occasioned, whether there be a virus or an environmental chemical that really does it, once the neoplastic transformation happens, a genetic change has occurred in the cells that are involved. The genetic controls that previously maintained the cell in its differentiated and nondividing form have been lost. The cell de-differentiates and becomes a relatively primitive cell and grows without constraint. That's a genetic effect, if you will, in the life of that cell.

And it perpetuates itself in the absence of whatever that initial insult was. It is important to know, someday, both what the initiating insults are and just what that transformation is. At this moment, no one can describe it in satisfactory terms.

It is of interest, though, that the initial insult needn't be due to manmade activity.

When Jim Neil was looking around the world for the incidence of chromosomal damage, chromosomal breaks, abnormal bizarre chromosomal structures, the population which showed the most striking and most frequent chromosomal damage was in the Central Amazon valley—people still living very close to nature, as close to the savage state as anywhere on earth at this moment. They showed more chromosomal difficulty than any other population he found. He has no idea why. Again, one has reason to think that it is due to something in their environment, using the word "environment" in its broadest sense, but not the man-made environment.

And, again, it is imperative that we learn, one day, what that is about.

There have been recent efforts to impose new Government regulations on science and medicine such as prohibiting some kinds of DNA research. Do you think these regulations are needed?

I have insisted, from the very beginning, that no regulation of research with recombinant DNA and no legislation was needed, for several reasons.

The principal one is that the risks were utterly imaginary. They were all in the realm of science fiction without a scrap of evidence that indicated there was any reason to believe in their reality. The people who called the whole matter into question were the most knowledgeable scientists so engaged.

It was they who said, "Let's stop a moment and consider what we're doing." They did stop. They did think. And when they completed their analyses, they said, "Well, there seems no basis in reality for our concerns. Those concerns were real concerns of the moment. But now that we've thought them through, we can't see that they have any substance."

Hundreds of such experiments have been performed in the United States and elsewhere. There's hasn't been a single untoward incident. It all seems a bizarre and strange episode to me.

The organism with which all this work is done, Escherichia coli, is about the most helpless, innocuous organism known to man. It cannot survive except in a laboratory under carefully cultured conditions. If you put it in water, it dies.

More to the point, we have no regulations with respect to guarding what happens every day in every hospital in the whole world where doctors, nurses and technicians minister to individuals who are, indeed, infected with genuine, infectious, dangerous organisms, real pathogens.

Technicians draw blood and culture it. Nurses and interns, residents and attending physicians are all in contact with people who are infected with genuine, virulent organisms. And yet their infection is extremely rare.

The rationality of all this has been lost on me. And I am delighted that the Congress has avoided passing legislation to protect us against hazards that no one can show to exist.

How do you feel about the occupational safety regulations further applied to university laboratories as compared to industry laboratories? Should they be the same?

I think it's time to study that question rather than to give you an answer. It's a legitimate question. I don't really know what the answer is at this time.

The OSHA regulations, which were intended to protect the workplace, are appropriate, for example, in a factory that's making benzene or using benzene as a solvent day after day after day.

It's rather another thing to try to understand how best to safeguard those who work in a laboratory that never does the same thing twice. The shelves of the stockroom in my biochemistry department must have contained at least 50,000 different chemicals.

We would use some of them in microgram quantities and some in gallon quantities. And we never did the same thing twice. Prescribing how life shall be conducted under those circumstances seems to me to be a reasonable question but for which, as yet, I haven't heard quite acceptable descriptions.

I think what is required first is a careful examination of those, with some retrospective understanding of what hazards there may have been all the while. And then ask, "Well, how can you minimize those hazards without making it impossible to work in those laboratories, or so inordinately expensive as in effect to make it impossible?"

You were very successful when you were in the Duke University School of Medicine Department of Biochemistry in hiring women for research. Can you comment on this latest NAS study of employment trends for women and minorities in science in the 1970's?

Rather briefly, what it says is that, because of the internal dynamics of our own country, the altered aspirations of women and minorities, ever larger numbers of women and minorities are seeking advanced education in science. And it is clear that, as they leave school, they may have an advantage over a young white male in getting the first step on the employment ladder.

As a sociological phenomenon, what is clear is that they get up onto the first rungs of the ladder easily, but they climb the rest of the way with much more difficulty than their white male colleagues. I have a second comment which relates to a perhaps more subtle phenomenon.

The truly important contributions to science are made by a relatively small number of people. Those who have compiled 'scientific family trees' are always struck by the fact that with surprising frequency, the people who do important science were trained in the laboratories of other people who did important science.

The word science means many things. The habit of mind, of taking a broad view, of asking yourself what is the most important unsolved problem which may be amenable to attack at this moment, is a habit that must be inculcated young.

It is awfully easy to find all kinds of other scientific busy work to do. Useful busy work, but not great science. It makes its contribution; it's needful that it be done. But the great science is done by those few people who, when very young, got into this way of life.

That process is not inculcated in graduate school, formally, by going to lectures. It is not what happens even in the laboratories of distinguished scientists. It happens in the camaraderie of the laboratory. It happens at the end of the day, while drinking a glass of beer.

It's what happens during the relaxed off-moments, not in formally structured seminars, but in the informal kind of seminar. From what I have been able to see so far, relatively rarely do the young women in the laboratory as easily participate in that aspect of the life of the laboratory as their male peers do.

But it happens. The young ladies aren't quite as comfortable and they aren't quite as welcome. They are dealing with male mentors, in the main. The male mentors, having been 20 years older, or more than that, have lived a different life. And they are not quite yet wholly comfortable with the young ladies in their shops. In consequence, the easy give and take by which, socially, there is imparted the very best of what makes for good science is not quite as available to young women as to young men even now.

I don't mean that there are no important women scientists. Far from it. As a gross statistic, there is a bridge that only a few have crossed. The process is very subtle. My most cherished experiences as a graduate student were in Farwell's Soda Shop just across the street from the chemistry building at the University of Illinois. In the middle of the morning and the middle of the afternoon, the great and the near-great of the chemistry department could be found there having a Coca Cola or coffee.

The banter around those tables was much more important in making me what I became than what happened in the classrooms. And so there's a barrier; an invisible but functioning barrier, which is still there, because of which the number of women elected to this Academy will still be a small fraction of the total for some years to come.

"We surely do have a handful of horror stories in which certain chemicals have been handled rather cavalierly and done undisputed harm to relatively small groups of people. No one has a license to do that, or should have."

How would you say the United States ranks in scientific research now?

The usual thing that one does in response to such questions is to point to the Nobel Prizes; they are self-evident.

In the aftermath of World War II, only one nation came through whole, and that was ours. With the stimulus of the atomic bomb and later, the stimulus of Sputnik, the American people, through their Government, invested in science in a way no people in the world had ever previously invested.

And with that, we built the most remarkable, the most exciting and the most successful scientific enterprise the world has ever known. We're still riding on that crest. There is no field of science for which I would say, the quality of such-and-such of some other country is decidedly better than the quality here. There is no such country, no such field.

But there surely is developing competition. As there should be. The magnitude, the number of people and the amount of money for science in the totality of western Europe is now approximately equal to that of the United States. And the quality of their work is rising very, very rapidly.

We know that in the Soviet Union, they have made an enormous investment in science.

Their fusion research, for a while, was ahead of ours. I doubt that it is any longer. They are very good at some forms of chemistry and have done well at it. They do great mathematics. They have cultivated mathematics in the Soviet Union. It's an old tradition which was never broken. In the whole of biology and biological science, they are still way behind us and have a long distance to go. But to get there, they're making immense investments, of a kind we never made, in the ability to do biology tomorrow. And I assume it will pay, and that in due time, they will take their place on the world scientific scene. So far, the return on their investment is not as good as the return on ours. We have a tradition that young scientists should go as fast as they can go. They have no such tradition. They still have large institutions, where the nature and pace of research is heavily dominated by their leadership. We don't do that. They are beginning to understand that that's a problem for them.

Japan is rather a different matter. Japan uses its money differently. The Japanese population is one half ours, and they have the same number of scientists and engineers per million that we do. So they have a scientific engineering labor force half the size of ours.

But they do no military R&D. And they don't put nearly as much money into basic science as we do because they've been using our basic science. Therefore, they have concentrated their technical force on applied R&D,—an enterprise which therefore comes out as big as ours.

If you discount our basic science, and you remove military R&D, then the size of the research endeavor in this country isn't much different from that in Japan, excepting theirs is largely employed to drive their domestic economy.

The argument is sometimes made that nature, itself, is a major polluter: dust from volcanic eruptions, hydrocarbons from vegetation, natural radiation, and so forth. And therefore we should keep things in perspective and accept manmade pollution with more equanimity.
What is your reaction to that point of view?

It's a half truth. Man has not simply taken the world as it was given to him.

If one drives around Germany, France, Italy, or takes a boat ride up the Thames, one is impressed by the beauty of the landscape and what seems to be the quality of the natural surroundings. You must understand that it isn't. That's a manmade surrounding. The whole of what one sees has been reworked by man's activities. And we like it rather more. Thus, we don't have to take nature as given, in an aesthetic sense, or for food and timber production —but on the other hand we can't control volcanoes.

We can hope to discover what the natural environmental contributions to cancer may be, and minimize those if we can. I don't know of any Americans who would decide not to live in Denver because the radiation background is twice that of what it is in Washington.

I am unaware of anybody who refuses to work in Grand Central Station because the radiation background inside is higher than is permitted on the outside of a reactor.

Natural radiation?

Yes. The radioactive potassium in the granite. We accept those hazards. But if they are responsible for some fraction of carcinogenesis, we may never know. It is intrinsically extraordinarily difficult to find that out. For example, there are no data that say that people who live in high altitudes have more cancer than people at low altitudes, except for suggestive data concerning skin cancer. Nevertheless, we don't have to run down into lead mines to escape, because the risk, however real, seems very small. On the other hand, there is no need to accept unnecessary, unwarranted abuse of nature by man.

We, here and everywhere else in the world, took the natural environment as what, in economic terms, is a 'free good.' And I suppose if we had it to do all over again, we would do it all over again. It made possible the very rapid development of our economy with immense benefit to the quality of life for the most of us.

My mother was one of nine siblings in southern New Jersey, all of whom had typhoid at the same time. That three-holer was probably the culprit. I see no reason to accept that as a state of nature. The natural environment is hostile.

We have learned how to curb natural hazards fairly well, and mold much of the Earth to our own ends. That makes it possible for four and a half billion people to live on the face of the earth, but it doesn't give us a license to pollute.

"At the bottom of much current environmental concern is the American phobia against cancer. Not because cancer is an important statistical cause of death, but because of our horror of this way of dying."

As a scientist, do you think that total elimination of pollution, as proposed by some persons, is a feasible goal?

It's not feasible, necessary or even desirable. What is certainly true is that it would be extraordinarily expensive. There is no way to do that without investing an immense fraction of our total economy in the effort.

And I cannot see that there would be any payoff. In your first question, you spoke of "environmental illness." The magnitude of "environmental illness" is unknown to me. I have yet to see any studies that persuade me that we know what that magnitude is, not even 'ballpark' figures that one can trust. I do not know what the health consequences of air pollution have been. I do not know whether the people of New York who have invested heavily in reducing the level of sulfur oxides in their ambient air have bought any health protection whatever from that action.

Environmental questions deal with conservation, with which no one can quarrel, aesthetic practices to see to it that the world we live in is attractive and pleasing to us, and health protection against noxious materials. Our heightened concern with respect to manmade chemicals arises out of the fact that the rate of introduction of new chemical species into the economy in the U.S. since World War II has been prodigious. Admittedly, for most of them, we have little understanding of what the potential for good or ill may be in the environment.

We surely do have a handful of horror stories in which certain chemicals have been handled rather cavalierly and done undisputed harm to relatively small groups of people. No one has a license to do that, or should have. And so we have been attempting to achieve "protection of the environment," which really means protection of ourselves, to seek wise regulatory practices despite a background of ignorance and lack of raw data for understanding.

Given all the attention we have paid to air pollution and

water pollution in the last decade, the fact remains that if you would like to state with confidence what contamination of water and air has done to the American people, you would be hard put to give numbers in which anyone has any reason for confidence.

We can be sure that none of the pollutants are good for us. Therefore, minimizing them is intrinsically good since there is no excuse for their presence in a positive sense. But the amount of effort that should be directed into reducing that presence, the goals to be established for that reduction must reflect, somehow, the magnitude of risk to which we've been exposed and how far we would like to reduce it.

Unhappily, matters become murky at that point. And we are unable to formulate that problem very well, largely for lack of data. Until recently, we had no motivation for gathering such information and nobody would either pay for or do the necessary research.

Secondly, the scientific problems haven't held great intellectual attraction. This was epitomized by a friend, whom I shall not name, at a meeting of the President's Science Advisory Committee about 10 years ago, who said, "I've been looking at the stars too long to start looking down sewers now."

That more or less characterizes the attitudes of our most talented scientists. Environmental pollution was not a natural lure for the scientific mind and society was unwilling to put money into such research until recently.

But we will have to justify the actions necessary with respect to those pollutants that will require great expenditures, and not on a merely one-time basis. And that can only be done by expanding the data base, which means spending enough money to acquire reliable data that might help.

At the bottom of much current environmental concern is the American phobia against cancer. Not because cancer is an important statistical cause of death, but because of our horror of this way of dying. If cancer were to be abolished tomorrow, the increase in life expectancy of Americans would be rather small—the statistical increased life expectancy.

Why is that?

Because it's a disease of older people even now. The number of young people who die of cancer is very small.

We would like to reduce the incidence of cancer. That's a clear national goal; it's been expressed again and again, not only in expenditures through EPA and OSHA but through the National Institutes of Health, one-half of whose budget goes to the cancer program, deliberately thrust upon the NIH by the Congress and several Presidents.

That's what the American people want. Therefore, we should assist them in getting it. And to do that, it becomes imperative to understand the low dose end of the dose-response curve for carcinogens. The problem is not cancer due to inadvertent accidental large-scale exposure to carcinogens, it is chronic exposure to very low dose levels, the consequence of which is not known.

It is surely time we explored the low level end of that dose response curve with experiments done on a large enough scale to know what to believe.

Usually we test 50 or 100 rats at the maximum dosage that will not kill them acutely, and then we reason from the results. Then, the argument holds that chemicals are rather like radiation. A single ionizing event happens to hit the right cell in the right place and triggers off the neoplastic transformation. And for radiation, that seems true.

If you irradiate enough animals, there will be some for which a single ionizing event will have done it. And maybe that's responsible for part of the background rate of cancer which Americans have always known.

If you examine a list of a half a dozen carcinogens and look at their chemistry, arsenic, butter yellow, methylcholanthrene, vinyl chloride, saccharin if it's true—chemically, they are so different, it is fantastic to think that they operate by doing the same thing.

Butter yellow is a carcinogen?

Yes, sure. Butter yellow isn't used anymore to color butter, but it used to be. It caused liver tumors; that was discovered in the '30s.

But I cannot imagine that these diverse compounds operate by an identical molecular mechanism by which they cause whatever they cause. Cancer is the ultimate expression of what must be many different cellular reaction mechanisms. If that be true, it does not follow that necessarily, for all of them, the dose response curve goes through the origin.

We are surely aware, now, that all cells contain very effective mechanisms for repairing damage to the DNA, such as the enzyme that Arthur Kornberg discovered.

If we have DNA repair mechanisms, and if carcinogenesis is the result of a mutagenetic change in DNA, presumably we can compensate for some amount of mutagenesis. If so, very low doses would have no untoward consequences. I would like to know for at least a few chemicals, once and for all, and stop the argument.

What's your reaction to the argument that if pollution controls become too strict, major industries will move from America to some developing country?

I guess it's a half-truth, again. There are other countries anxious for such development, all too eager to repeat our mistakes. In a country where mean life expectancy is below 45, repeating our mistakes may look charming.

That there are such places, I wouldn't doubt. That American companies will walk away from large investments here and seek that opportunity abroad, remains to be demonstrated. I'm a little skeptical.

This interview was conducted by Truman Temple, Associate Editor of EPA Journal.

That isn't the kind of thing that's drawn Americans to go outside this country. American companies have gone abroad for cheap labor costs time and again.

Environmental costs are costs, and if manufacturers could escape them to be more competitive, they would. But if they have to write off a huge capital investment at home in the doing, they will think twice about it.

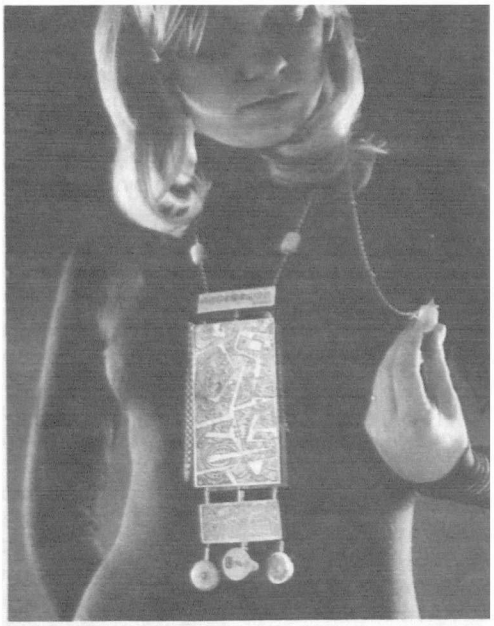
The other side of that question is I would think more than twice before forcing any company into making that choice. I certainly wouldn't do it unless I were absolutely convinced that the risks to be mitigated are real and of a magnitude commensurate with what you are about to do.

Are there any laws that you would suggest we still need in the environmental area?

We are having problems enough existing with the ones we have. I don't know whether the battery of them is complete, but, certainly, we have yet to learn to live with the measures concerning water pollution, air quality, surface mining with the Toxic Substances Control Act, and so forth.

That's a good deal for us to digest and learn how to live with and implement wisely. There's an ironic aspect to all of this. As one examines the current scene, you come to the conclusion that every regulation and every act was certainly put on the books with great, good intention, that every one actually may be commendable; it isn't their individual nature which is a problem. But collectively, they may be imposing a burden we don't know how to live with. That's a political judgment; not a scientific judgment. Likewise, here at the Academy, our business is to help the country go down a path in which we expand the knowledge base so that we understand as fully as possible what the risks are and how we might minimize those risks and what the consequences would be if we didn't. The political machinery must take it from there. □

Personal Pollution Monitoring



This silver pendant contains a photocell that senses air pollution and alerts wearer with an electronically triggered sound device. The monitor also contains a small oxygen mask and a 10-minute supply of oxygen to allow the wearer to escape to safety.

EPA scientists are evaluating the usefulness of personal air pollution monitors, some of which can be worn as necklaces or wrist bands.

The Agency recently held a symposium on portable monitors at Chapel Hill, N.C. Purpose of the symposium was to acquaint environmental managers and researchers with the advantages of using personal air monitors as supplements to fixed-station monitors such as those placed along streets or attached to buildings.

Approximately 35 reports dealing with the development and capability of personal physiological and air pollution monitors were presented at the meeting by representatives of the Federal and State Governments, private industry and research firms.

Congressman George E. Brown, Jr., Chairman of the House Subcommittee on Environment and the Atmosphere, told the conference that the demand "for personal monitors is going to skyrocket and the technology is going to have to respond to meet that demand."

He said that while the rate of advance in the technology of monitoring devices has been swift, "this is a technological initiative which has not reached its peak." He called for the development of wrist monitors that measure the amount of any pollutant in the air and then store the information.

The Congressman said there is a need to determine more precisely at what point pollutants affect human health. He added that personal monitors might help solve this problem.

Dr. David Magee, senior scientific advisor at EPA's Environmental Monitoring and Support Laboratory at Research Triangle Park, N.C., said that "numerous studies have called attention to the need for greater use of personal monitors.

"In downtown San Jose, Calif., for example, researchers have found that pedestrians breathe carbon monoxide at levels 60 percent higher than levels shown on the nearest fixed monitors.

"On the other side of the country, in Boston, pedestrians were exposed to levels about 40 percent higher than those recorded at fixed stations."

He noted that in similar studies people in both urban areas and small towns in South Carolina and Connecticut received higher exposures to particulates (mainly because of indoor pollution) than those recorded at fixed locations.

"All of this points out the need for a device capable of accompanying people on their daily rounds and sampling the air in their own immediate breathing zones."

Some of the personal monitors now available were displayed at the symposium. Most of the devices use sensors which respond to environmental conditions.

Among the environmental jewelry displayed at the workshop was a pendant which senses polluted air, warns the wearer with a buzzer and includes a mask and 10-minute supply of oxygen.

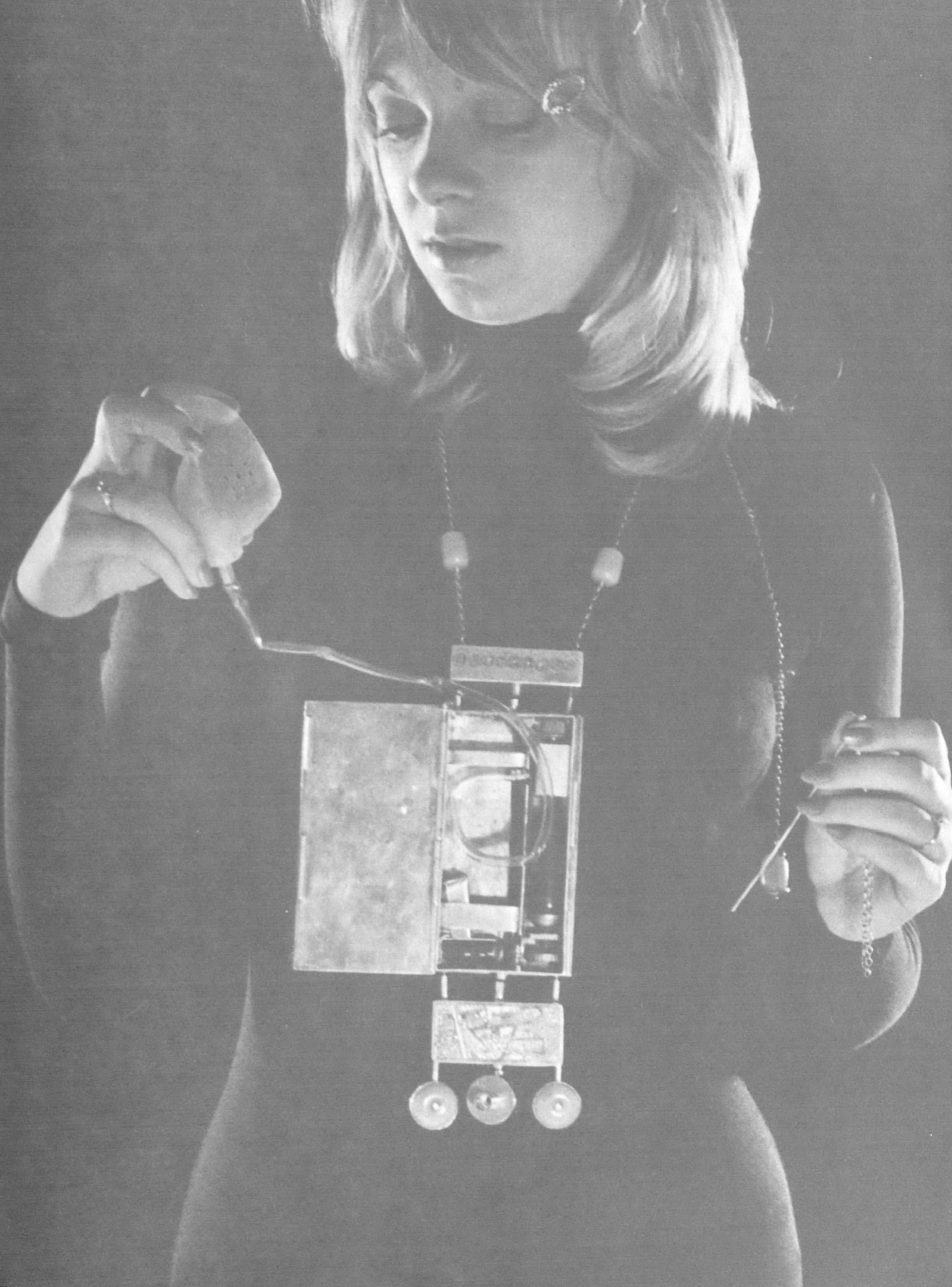
Speakers at the meeting noted that these devices could be especially useful to people with a variety of lung or heart problems who need to know when they are in danger so they can seek prompt medical help.

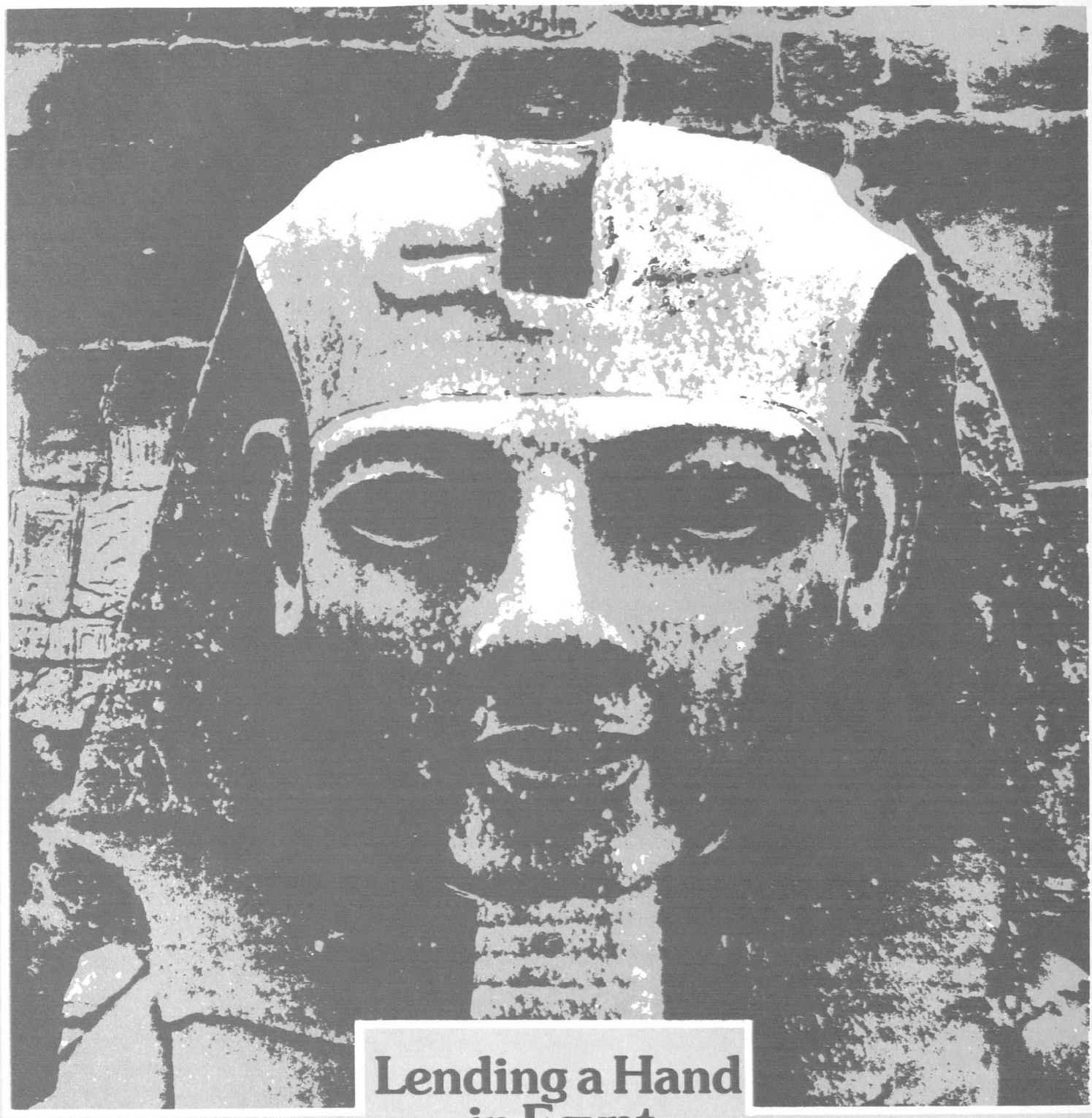
Cost of these monitors ranges "anywhere from a dollar up," according to Dr. Magee. The cheapest devices are small tubes with chemical absorbents.

Among those making a presentation on the more developed devices were Dr. George S. Malindzak, chairman of the Department of Physiology at Northeastern Ohio Universities' College of Medicine and Mary Ann Scherr, Professor of Art at Kent State University. Mrs. Scherr is a designer of jewelry containing personal monitors.

The symposium was sponsored by two EPA laboratories at Research Triangle Park, N.C., the Health Effects Research Laboratory and the Environmental Monitoring and Support Laboratory.

These laboratories conduct monitoring, human studies and biological research to determine the health effects of exposure to air pollutants, pesticides, toxic substances, and non-ionizing radiation. □





Lending a Hand in Egypt

By Truman Temple

Nearly a dozen major environmental research and development projects in Egypt are being supported by EPA under its Scientific Activities Overseas (SAO) Program. Since 1973, the Agency has obligated more than $7.2 million in helping Egypt deal with its many environmental problems while allowing EPA scientists to learn from unique environmental or pollutant exposure situations.

EPA's projects in Egypt have so interested the International Communication Agency (formerly known as the U.S. Information Agency), that it dispatched a film crew there in January. The team, headed by Robert Butler, producer and director of ICA's TV and Film Service, will be interviewing scientists in environmental projects including those dealing with phosphate mines near Luxor, reuse of process water at a poultry processing plant in Alexandria, the Aswan dam, and studies of wastewater treatment at the Moharrem-Bey Industrial Complex in Alexandria.

The EPA projects in Egypt are funded by credits built up over the years in Egyptian currency, chiefly from United States exports of agricultural products under the Public Law 480 program. At one time EPA was assisting half a dozen countries in environmental research under this type of funding, but the work is now concentrated in Egypt, Pakistan and India. Interestingly, two other nations, Poland and Yugoslavia,

found the programs formerly financed by this type of funding so valuable that they have created special funds of their own to carry on the work.

The program in Egypt is directed by EPA's Office of International Activities, headed by Alice B. Popkin, Associate Administrator. Individual projects are supervised by staff members of the Office of Research and Development, the Office of Air, Noise and Radiation, and several Regions.

"I'm encouraged by the usefulness of this program in Egypt," declared Mrs. Popkin. "Not only are these scientific studies of local conditions of direct concern to the Egyptian people, but they also are broadening our own knowledge of similar environmental problems we encounter in the United States."

If one looks at a map of Egypt, it is immediately obvious that the EPA-sponsored research extends throughout the length of the land. Several projects are under way in the north along the shores of the Mediterranean. One study has been analyzing desert ecosystems since 1975. Its overall purpose is to improve land management in areas now hard-pressed to produce food, fiber, and basic minerals, according to Dr. Norman R. Glass, EPA project officer. Seventeen staff members of five Egyptian universities, aided by 40 research scientists, are involved.

Dr. Victor J. Cabelli, of EPA's Health Effects Research Laboratory in West Kingston, R.I., is project officer for additional studies at Alexandria looking into illnesses associated with swimming at polluted beaches there. Thousands of individuals have been interviewed by public health and social workers to correlate information on their exposure and any subsequent illness. Scientists also have tested water quality, and the collected data are being used by the Egyptian government in the design of a new sewage disposal system for the city. The results of this study, when added to similar ones in the United States, are being used to develop water quality criteria which may have world-wide applications.

Population and industrial growth have made increasing demands on scarce water resources in Egypt. A study of the potential for water recycling and reuse is under way in Alexandria at a modern poultry processing plant. The EPA project officer, Jack L. Witherow of the Ada, Okla. Research Laboratory, explains that the poultry industry in Egypt is encountering a unique problem because new plants and farms will be located in remote areas as part of an overall plan to renew the deserts. The shortage of water and the need for large amounts of it in this industry make the study of pressing importance. Scientists at Alexandria University are evaluating the process water characteristics and will focus on a multiple water reuse system.

Doctors check an Egyptian girl for signs of schistosomiasis, a disease carried by water snails.

August Curley of EPA's Health Effects Research Laboratory at Research Triangle Park, N.C. is project officer for three studies. In one, researchers at Alexandria University are seeking to determine the safe use of insecticides and to study their effects on animals, fish, poultry, insects and plants. Another study by the Regional Radioisotope Center in Cairo is investigating the health hazards of pesticides that are important to both Egypt and EPA. The third, being carried out by the Plant Protection Institute in Cairo, is monitoring levels of various toxicants in the environment such as water, soil, and agricultural products before and after aerial and ground application of pesticides.

Curley, who helped organize an international symposium last November in Egypt on the hazards of pesticides to the environment and human health, said there is an increasing use of chemical pesticides in that country to protect crops. "Coupled with this trend," he added, "are reported instances of indiscriminate use of pesticides, leading to contamination of food crops and the immediate environment. In Egypt, as in our country, there is a growing and continuing concern about the hazards of pesticides to human health, not only to field workers and pesticide applicators, but also to the health of the people generally exposed through contaminated food, water and air."

The rapid growth of industry in Egypt in recent times has made air pollution an important public health concern. Taking advantage of 13 air monitoring stations already in operation in Alexandria, a team of researchers under direction of the Egyptian Department of Occupational Health

Two Egyptian farmers load a pack animal near a modern water pumping station in the Nile Delta.

Truman Temple is Associate Editor of EPA Journal

has been sampling ambient air pollutants and examining persons suffering from chronic respiratory diseases. Dr. Carl G. Hayes of EPA's Health Effects Research Laboratory in Research Triangle Park is project officer. The purpose of the investigation is to help define the relationship between the pollutants and disease. Since Alexandria is the second largest city in Egypt and contains about a third of all industry in that country, the project is of special significance in public health.

During the past decade, fish production in Lake Mariut, which lies just southeast of Alexandria, has declined by about 75 percent, due primarily to the discharge of industrial wastewaters from the adjacent Moharrem Bey Industrial Complex. In addition the lake has ceased to be an important recreation area because of its offensive odors and unsightly algal growth. The lake is economically important as a source of food, and Egyptian scientists and engineers now are investigating a number of alternatives for treating the industrial wastewater pouring into the lake. According to Dr. James D. Gallup of the Effluent Guidelines Division, the EPA project officer, the industries include food oil and fat production, paper reprocessing, textile finishing, yeast and starch production, and other facilities. The alternatives under study include pretreatment of effluent before discharge to the lake; in-plant modifications, and combined treatment of both industrial and municipal wastes in the city's sewage treatment plant. The study thus is laying the foundations for a comprehensive and far-reaching restoration of an essential resource.

The rapid rate of industrialization and agricultural development in Egypt to provide her millions with food, jobs and consumer goods ironically has polluted some of those very sources of food. Inland, changes in Nile River drainage patterns have led to salinization of lakes that formerly produced high yields of freshwater fish. Under this program, Egyptian scientists are now investigating the impact of pollutants on saline waters to determine how marine life is being affected. The project officer, Dr. Gerald E. Walsh of EPA's Environmental Research Laboratory at Gulf Breeze, Fla., describes three geographically distinct study areas in the project, each with its own laboratory for research into specific problems.

The first includes Lake Quarun and Wadi El-Rayan in the Western Desert about 65 miles southwest of Cairo. "Lake Quarun, the world's oldest artificial impoundment, was begun over 5,000 years ago by shunting of Nile River water to a large natural depression," Walsh explains.

"At that time, its impounded water was used to irrigate crops during the dry season. Lush vegetation grew in the newly-watered area, and the site was used as a vacation resort by the pharaohs. Now, the lake is as saline as the ocean and cannot be used for crop irrigation, but marine fish and shrimp, introduced from the Mediterranean, grow in it." The current project is aimed at increasing the yield of fish by application of sound fisheries management practices. It also is investigating the effects of pesticides that enter the water as agricultural runoff.

The second area is a fishing village on the Red Sea named Al-Ghardaga. A laboratory there is studying the effects of pollutants on marine biota and also the ecology of reefs. Data obtained will be used to estimate the impact of pollutants on marine life, and also to set water quality standards. The third area embraces the Mediterranean coast of Egypt, where a branch of the Institute of Oceanography and Fisheries is monitoring and analyzing water conditions and relating them to marine life.

Further to the south, an EPA project is looking into another environmental question involving radiation from phosphate mining and manufacturing. The project officer, Richard J. Guimond of EPA's Office of Radiation Programs, explains the situation this way:

"Historically, the Egyptian phosphate industry was quite small because of the great fertilizing effect of the Nile floods. However, the halt to the annual flood increased the country's need for fertilizer. Further, fertilizer is considered a good export product for the country. As a consequence, the industry is growing in Egypt."

Phosphate mines are located along the Nile near Luxor, known as the Valley of the Kings; along the Red Sea to the east, and in the central desert west of the Nile. Manufacturing facilities are located around Cairo and Alexandria. Egyptian scientists are especially interested in studying operations because phosphate is radioactive, environmental controls now in use are poor, the facilities are near heavily populated areas, many workers are employed in the industry, and phosphate production is expected to increase. Guimond also noted that information acquired on the exposure of thousands of Egyptian workers could help EPA in evaluating health risks to the U.S. population from phosphate.

Near Egypt's southern border where the Nile encounters the famous and controversial Aswan Dam, EPA is sponsoring a broad study of how the dam has affected the region, for ill and for good. The project officer, Dr. Walter M. Sanders of the EPA Environmental Research Laboratory in Athens, Ga., explains that the study is examining the effects of the Aswan project "along the lines of hydrology, water quality, aquatic ecology, public health, agriculture, and social implications."

The Aswan is a major force in Egypt's life. It has created one of the largest reservoirs in the world. It provides about half of the nation's electric power. It causes 100 million metric tons of silt to be deposited annually in Lake Nasser Reservoir. Because the dam is in an arid region, evaporation losses cause the Nile to increase about 10 percent in salinity as it passes through the reservoir. Lake Nasser Reservoir shows a high rate of algal production. At the same time, food fish production has increased there from 750 metric tons in 1966 to 20,600 tons in 1978. The city of Aswan a few miles north of the dam has mushroomed from 30,000 to 620,000 between 1960 and 1976. The impact of industrial and domestic waste discharge and farmland drainage have become evident not only in the main river but in its irrigation canals and drains.

Egyptian scientists in the EPA project are studying how the Nile's ecology is changing. They are determining water quality characteristics above and below the lake and comparing them with earlier data before the dam was built. Researchers also are developing a water resources model, and seeking to predict future trends in water quality and how they will affect the region. Later they will propose a comprehensive river plan on how to manage this vast water resource most effectively.

The public health survey completed by the project staff of over 15,000 rural Egyptians located in 41 villages from Aswan to the Mediterranean showed an average drop of about 50 percent in the overall prevalence of schistosomiasis (snail fever disease) since 1937. The current prevalence in the north central delta is 42.1 percent, in upper middle Egypt 26.7 percent, and in the Aswan region 4.1 percent. The survey showed that infections were significantly lower in populations obtaining their domestic water from protected sources.

The Aswan Dam has regulated the water flow in the river so that there is a continual supply of irrigation water year-round. The agricultural studies have found that this increase in use of water has caused the water table to rise. Where the table once lay about 250 centimeters or more than eight feet below the Earth's surface, it now lies only 40 to 70 centimeters down (about 16 to 28 inches) in large areas where tile drains have not been installed. These undrained soils are increasing both in salinity and alkalinity, causing a decrease in crop productivity.

From Alexandria south to Aswan, from the Western Desert eastward to the shores of the Red Sea, EPA scientists have joined with their colleagues in Egypt to help that nation cope with its many environmental and health-related questions. There is no question that both countries are finding unexpected rewards in the experience, both in environmental knowledge and in international cooperation. □

Hunting Pollution in the Great Smokies

By Charles D. Pierce

"A few steps or a three-mile round trip on an easy-graded surface will take you away from the sights, sounds, and smells of your everyday world, along one of America's loveliest streams. You will be walking into one of the last great wilderness areas remaining in the East. . . ."

So reads a National Park Service sign as one enters the Ramsey Cascade area of the Little Pigeon River in the Great Smoky Mountains National Park.

A small group of scientists from EPA and the National Park Service trod this path last spring on their way to key monitoring tests, one step in a global effort to find the impact of pollution on the relatively isolated areas of the world.

This quest was part of an international effort known as the Man and Biosphere

Amy Cross, an EPA scientist, gathers vegetation samples in the Great Smoky Mountains National Park.

Dr. Bruce Wiersma of EPA's Environmental Monitoring and Support Laboratory at Las Vegas, Nev., sets up monitoring equipment.

Program, established by the U.N. Educational Scientific and Cultural Organization in 1971.

Under this program the Great Smoky Mountains National Park was designated as one of 117 biosphere reserve sites, pristine areas which have been designated at various locations around the world.

An important goal is to use these reserves as a record of the environment in its natural state and to monitor these areas to measure global pollution fallout that might be masked in more heavily polluted areas.

Monitoring and sampling performed by the EPA-National Park Service team last spring and on a preliminary visit in 1977 have discovered evidence of relatively high concentrations of lead in the park.

While the source of this lead has not been determined so far, EPA scientists believe there are two main possibilities:

The lead particles were borne by wind from either the heavy auto traffic in the park or industrial and urban sources outside the Great Smokies.

Pierce, Editor of EPA Journal, accompanied the scientific team on their journey into the Great Smoky Mountains National Park.

Some lead is also found from natural sources. The results of testing for other types of pollutants are still being analyzed and assessed. Additional monitoring in the park will be undertaken this spring.

The scientific team investigating the health of the Great Smoky Mountains National Park carried heavy monitoring equipment by back pack because even horses or burros couldn't climb the heavily forested 60-degree slopes that led to some of the isolated sampling sites.

The team members, led by Dr. G. Bruce Wiersma of EPA's Environmental Monitoring and Support Laboratory at Las Vegas, Nev., were often drenched in sweat as they climbed up root- and rock-studded trails and steep banks.

However, occasional torrents of rain helped cool the climbers. At some points the downpour was so heavy that the group had to huddle under tarpaulins, wait till the storm passed and then slog on along trails which had been transformed by rain run-off into swiftly flowing rivulets.

It is water vapor from the frequent rains and natural emissions from vegetation that give the park the haze responsible for its name, Great Smoky.

The group crossed and re-crossed the roaring and foaming Little Pigeon River on crude log bridges as they scrambled their way to the monitoring sites under a dripping canopy of towering trees.

In addition to giant hemlock and tulip poplars and a rich variety of other trees, the park has a wealth of shrubs and wild flowers. Waves of Wake Robin (red trillium) bloomed in shady areas.

The animal life includes salamanders in many different sizes, shapes, and colors; a dazzling variety of warblers and other song birds, wild boars and black bears.

The air pollution monitoring equipment set up in the park by the team at exposed sites was placed in a tepee-like construction of steel rods specially rigged with barbed wire to discourage intrusion by the inquisitive bears.

Drinking water taken from the park's swift flowing streams had to be treated to kill the bacteria left by the wild boars which wallow in the headwaters. The boars invaded the park after escaping from a nearby hunting preserve.

The team of scientists visited 10 research blocks in the park, each about one square kilometer in area, where they took multiple samples of air, water, vegetation, soil, and forest floor litter. Approximately 1,200 samples were taken.

The soil, forest floor litter, and vegetation samples were placed in plastic bags and carried out in back packs. The researchers used plastic gloves to avoid contaminating the leaves and other plant material collected.

Plants gathered included such varieties as New York fern, witch hazel, asters, moss, mountain laurel, dogwood, and rhododendron. In some cases the moss was gathered from the logs of huge American chestnut trees, which had been killed by a blight many years ago and are still rotting on the forest floor.

In addition to bottling samples of the water from the park streams for later analysis, the team left rain gauges at some of the sampling sites to compare findings with those obtained from air filters.

At most of the air sampling sites, filters were tied around trees and air was drawn through them by battery-operated pumps. Four filters were used at each site.

In order to determine the size, distribution, and composition of metallic air-borne particles in the park, the monitoring plan provided for one filter to be analyzed by scanning electron microscopy at the University of Iowa, one by conventional atomic absorption methods at the "clean" laboratory facilities at Carnegie-Mellon University in Pittsburgh, and one by x-ray fluorescent spectrometry at the Environmental Monitoring and Support Laboratory at Las Vegas. The fourth filter was provided in case of damage or loss to one of the

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The monitoring team stopped for rest along a scenic trail.

other three or in case a more extensive analytical examination was required.

Water samples were analyzed at EPA's Environmental Research Laboratory in Athens, Ga.

Of the 10 sampling sites chosen, four were on the north slope (Tennessee side) of the mountain range at various high and low altitudes in mixed hardwood forests. An additional four were on the south slope (North Carolina side) at corresponding elevations and in the same type of vegetation as those on the north exposure.

The final two sites were high elevations, one on a mountain top and one in a naturally cleared area known as a "bald."

All of the sampling areas were at least three miles from the nearest heavily traveled roads.

Although the high altitude air sampling sites were protected with barbed wire, EPA scientists found that a bear cub had gotten through the wire at one location and turned over the batteries and pump. However, even in this overturned position, the equipment continued to function properly for an eight-hour period.

In addition to Dr. Wiersma, members of the science team participating in the Great Smoky Mountains monitoring expeditions were Kenneth Brown and Amy Cross, both of the EPA Environmental Monitoring and Support Laboratory at Las Vegas, Dr. Sue Bratton, a Park Service ecologist stationed at the park, and Don Kilgore, a Park Service seasonal technician.

While the project is being conducted under an interagency agreement with the National Park Service, a number of other organizations are also contributing consultation and analytical support.

Biosphere Reserves such as the Great Smoky Mountains National Park were identified to: provide a permanent record of the natural state of the environment; ensure undisturbed areas from which background data on pollutant levels could be obtained; serve as early warning sites for more dangerous buildups in higher impact areas, and provide repositories for natural sources of genetic pools of animal and plant species.

These reserves will be key units in the Global Environmental Monitoring System now being set up as a result of proposals by the U.N. and several other international groups. □