as any backlog of scientific knowledge, psychology has very little to offer. Society expects more than we have to provide. It is a very unhappy situation."

Koch, who is a member of the APA council, said he watched with "mixed feelings" the confrontation "with those beautiful black students—these are people who are asking desperately to be taken into our field, but the trouble is that psychology has no answers in respect of the problems that they are concerned about." Koch thinks the main thing psychology can do is to "contribute to our respect for the multiplicity of factors which affect human behavior and the cautions which must be taken into account in describing behavior."

Even if all psychologists were sure how their discipline could be truly relevant to today's social problems, the organization and reward system of their profession, many believe, will have to be drastically changed before much significant work on social issues can be attempted. Kenneth E. Clark pointed out that, in most universities, "the young investigator is taking a grave risk if he takes up a big problem" and that it usually seems more beneficial to one's career to work on smaller problems. Ernest R. Hilgard of Stanford University said his study indicated that most university departments still respect basic research most highly. Hilgard called for independent graduate schools of applied behavioral sciences. In a small group discussion, one psychologist said to Wiesner, "We all have a social commitment, but our department chairman wants published papers so we have to join our colleagues in running rats so that we can get publishable results."

A difficulty which some psychologists encounter in their quest for social relevance is the feeling that "relevance" is too general a word to give them much direction. What they believe they need is some hard thinking about how to take the small, progressive steps necessary to make their disciplines more socially meaningful.

With the continued pressure from student activists and from the social agonies of our age, there will doubtless be a sustained impulse to change the training given by various disciplines in the social and natural sciences and to alter the role of the professional organizations which represent these disciplines. It may not be entirely true, as Charles W. Thomas told an APA meeting, that "the social revolution has caught social scientists in the wilderness resting on a cot of science for science's sake with their proverbial pants down." But it is safe to say that scientists will be arguing for many years about the types of pants best suited to forays through the tangled thickets of social problems that they feel increasingly pushed to explore.—BRYCE NELSON

The Environment: ACS Report Is Practical Anti-Pollution Guide

In the past several years, the public has become increasingly concerned over problems of environmental pollution. Scientists have warned that pollution is disrupting the world's ecology, legislators have taken the first faltering steps toward alleviating the problem, and news media have even assigned specialists to cover the "environment beat." Considerable attention has been focused on the all-too-visible evidence that the environment is deteriorating, but relatively less concern has been given to the question of just what can and should be done to clean up the mess created by a modern technological civilization. Indeed, arguments between conservationists and polluters often bog down in sterile debate over whether various antipollution measures are technologically feasible and economically practical.

Last week the American Chemical Society (ACS) issued a report entitled "Cleaning Our Environment—The Chemical Basis for Action"*—which may make a valuable contribution toward the search for a "cure" for our environmental ills. The 249-page report, which covers air and water pollution, solid waste disposal, and pesticides, culminates a 3-year study by more than 100 experts from various disciplines assembled by the ACS. It reviews the current state of the art of the science and technology of environmental improvement (what is known and how it is being used; what must be learned and how it might be used) and also makes 73 recommendations to accelerate the development and use of that science and technology.

The central conclusion of the report is that technical know-how has advanced to the point where "this country can take enormous strides, now, toward a cleaner environment" if it is willing to devote sufficient energy and financial support to the task. Though the report states that "extensive fundamental research" is still required to "elevate man's understanding of the environmental system," it stresses that "the nation's effort to improve its environment should be concentrated, for the present, on the use of existing science and technology."

The report is aimed at legislators, government officials, industrial leaders, and others who must deal with environmental problems but who are "one or more steps removed from direct involvement with the pertinent science and technology." It also seeks to interest scientists, engineers, and university professors who are not now involved with environmental problems but who may have useful ideas to contribute to their solution.

Lloyd M. Cooke, a Union Carbide scientist and chairman of the ACS subcommittee that put the report together, said the document offers "nothing particularly dramatic . . . no panaceas" but he said it is "probably the most comprehensive study of its kind." Another subcommittee member, Franklin A. Long, of Cornell, described the study as a "concise encyclopedia or handbook" summarizing the results of research and actual experience with pollution abatement. Long said the report contains nothing startlingly original or new, but that the ACS hoped it has performed a useful service by pulling

* Available from Special Issue Sales, American Chemical Society, 1155 16th Street, NW, Washington, D.C. 20036; $2.75.

together scattered bits of information and putting them in context.

However, some scientists and engineers concerned with pollution affairs have grumbled privately that the report is too "chicken-hearted" in its recommendations. They complain that it won't make many people mad and won't get many people excited. Barry Commoner, Washington University ecologist, called the report "Pollyannaish" in its analysis of the degree of environmental contamination and said the report is "inadequately sensitive" to ecological—as opposed to purely chemical—considerations.

The study grew out of conversations late in 1965 concerning how the ACS might best contribute to public affairs. The decision to analyze environmental problems was particularly stimulated by the publication, in November 1965, of a report on "Restoring the Quality of Our Environment," issued by the President's Science Advisory Committee. The ACS seems to have experienced the usual difficulties in lining up experts to conduct the study, but the group ultimately assembled seems reasonably well-balanced between industrial, academic, and government interests. The four-man subcommittee† in charge of the study included three men from industry and one academic. But the 26-man task force that put together the initial drafts included only six representatives from industry with the rest coming from universities or various government bodies.‡ Sections of the report were also reviewed by some 80 additional experts. Participants in the study insist that there were enough conflicting interests represented to prevent blatant bias from creeping into the final product—but if reactions at a press conference are indicative, some conservationists are skeptical.

The report is too wide-ranging to permit easy summarization, but several persistent themes emerge throughout the document. One is that an appalling lack of knowledge is hampering pollution control efforts. There are so few "experts" in solid waste disposal, for example, that the ACS subcommittee was not even able to organize a task force to study that aspect of the pollution problem. That section of the report had to be put together by the subcommittee itself and a number of special reviewers.

The report emphasizes the "primitive condition of our fundamental knowledge of how living things are affected by long-term, low-level exposure to pollutants" and the "even more primitive condition of our knowledge of the effects of pollutants on the ecology." The report says the relationship of contaminants to ecology is "very nearly a total mystery," and adds: "It is possible to conceive of ecological cycles in which the specific toxicity of a pollutant for a single species could cause an entire food chain to collapse, but the extent to which this might happen is unknown. Too little is known of the effects of pollutants on too few species to suggest even how such problems might be attacked. That they must be attacked in the long run is certain. . . . If man were to destroy any of at least half a dozen types of bacteria involved in the nitrogen cycle, say, life on earth could end."

A Lack of Knowledge

In some cases, lack of sufficient knowledge is making it difficult to decide whether proposed antipollution steps would really work. Thus there have been suggestions that phosphates should be removed from household detergents to remove one of the nutrients that leads to excessive growth of algae in lakes and other waters. But the report suggests that other sources of phosphorus compounds may still be enough to cause excessive algal growth, and it concludes that a sound decision for or against phosphates in detergents would benefit from further knowledge.

Even some existing pollution standards have no scientific basis to back them up, the report says. Public health officials, for example, have established certain bacterial quality standards for waters at bathing beaches. These standards are commonly based on counts of the coliform group of bacteria, and the coliform count is interpreted as indicating the extent of contamination from fecal matter. But coliforms can come from many sources, the report says, and the fraction that is of fecal origin can vary from less than 1 percent to more than 90 percent. "There is in fact no significant epidemiological basis for the total coliform standards used to assess the quality of bathing waters," the report says. "Very large sums of money are likely to be spent in the next decade primarily to meet bacterial quality standards for recreational waters. There can be no assurance that the money will be spent wisely unless a sound basis is established for such standards."

Another persistent theme of the report is that the pollution technology currently in use in this country is generally antiquated. The technology used to monitor air pollutants, for example, is largely 10 to 20 years old, and the methods used to handle and dispose of sludges in waste water treatment have been known, if not fully developed, for close to four decades. Yet the report insists that the technology already exists to upgrade pollution abatement programs. "That the need for water management in the U.S. has outrun the application of available technology is due more to negligence than to ignorance," the report asserts. Similarly, the report notes that European nations, under the pressure of urban growth, are already using solid waste management practices that are available in this country but are not yet widely used.

The ACS group recognizes that cleaning up the environment will be no easy matter. For one thing, it is difficult to whip up enthusiasm for pollution control. "People may rail at companies for making detergents that contain the algal nutrient, phosphorus, but how many families have switched from synthetic detergents to soap for that reason?" the report asks. "Companies may rail at the actions of pollution control officials, but how many companies have acted to abate pollution without some inducement . . . be it improved public relations, the possibility of profit, or threat of legal action?" The report also acknowledges that there is not likely to be any dramatic "fiscal profit" in pollution control, just better health, cleaner lakes and rivers, cleaner laundry, longer life for the paint on houses, and less corrosion of electrical

† The subcommittee included Lloyd M. Cooke, Union Carbide, chairman; William O. Baker, Bell Labs; Arthur M. Bueche, General Electric; and Franklin A. Long, Cornell.

‡ The task force was headed by T. E. Larson, Illinois State Water Survey. The air environment group was headed by James P. Lodge, National Center for Atmospheric Research, and included A. P. Altshuller, National Air Pollution Control Administration; Frances L. Estes, Gulf South Research Institute; W. L. Faith, consulting chemical engineer; Melvin W. First, Harvard School of Public Health; Max S. Peters, University of Colorado; Paul W. Spaite, National Air Pollution Control Administration. The water environment group was headed by James J. Morgan, Caltech, and included William L. Klein, Ohio River Valley Water Sanitation Commission; Thomas J. Powers, Dow Chemical; and Richard Woodward, of Camp, Dresser & McKee. The pesticides panel was headed by Daniel MacDougall, Chemagro Corp., and included W. F. Barthel, National Communicable Disease Center; E. P. Lichtenstein, University of Wisconsin; D. J. Lisk, Cornell; Louis Lykken, Berkeley; Robert L. Rudd, University of California at Davis; W. M. Upholt, Federal Committee on Pest Control; and M. R. Zavon, University of Cincinnati. Analytical and instrumentation contributors included David Hume, M.I.T.; Mrs. Foymae Kelso West, Gulf South Research Institute; and Philip W. West, Louisiana State University. Biological aspect contributors included Robert Ball, Michigan State; Daniel Nelson, Oak Ridge National Laboratory; and Charles Renn, Johns Hopkins.

POINT OF VIEW

How To Manage Brainpower

When Charles A. Anderson, president of the Stanford Research Institute (SRI), spoke at the Western Electronic Show and Convention in San Francisco last month on "Research and the Changing Campus Environment," he described himself as a "reluctant authority on this subject." SRI and Stanford are in the process of ending their affiliation as a result of student protests last spring which focused on research policy. In his concluding remarks, he said that, in the climate of opinion now prevailing, "a whole new philosophy of management" will have to be adopted in high technology industry. His reasons are indicated in the following excerpt.

Let me use an idea from a book by Peter Drucker. He pointed out that most of the major industries of today developed from experience, whereas many of the new and growing industries are based on brand-new knowledge and past experience isn't too important. Of these two, certainly I would place the electronics industry in the knowledge-based rather than experience-based category.

Mr. Drucker goes on to point out that the employees in these new industries are valued for their new knowledge, not for long years of experience. This is true of your creative professional scientists and on through your laboratory technicians and computer programmers.

I suggest that this increased emphasis on knowledge as distinct from experience will require—in fact, requires right now, as I'm sure you know—a different kind of management. The traditional, experience-based management styles just might not work so well in the new environment.

. . . I suggest that the people I am now dealing with at SRI, their aspirations, their expectations, their needs, their values—are the types of people that your industry relies on to provide the manpower and brainpower to run your companies. We should look at these people and re-evaluate what it takes to manage them. But first, let me summarize briefly the traits and characteristics I see in these men and women.

- They tend to be young. This figures; it is knowledge that is more important than experience.
- They are highly trained and are highly specialized.
- Their views as to authority, supervision, and discipline tend to be quite different from the traditional concepts. They don't "dig" the "organization man"; they are likely to have more loyalty to their profession or academic discipline than to the organization with which they happen to be associated.
- They feel a commitment to do something about our society. They want to see their professional capabilities devoted to this end and this may be more important to them than contributing to your earnings per share. Indeed, because management's job *is* concerned with earnings per share there tends to be mistrust of management. This is a manifestation of the differences in value systems.

In short, they will more and more come to resemble the campus groups we've been discussing.

. . . And here I am not talking about the radicals. Rather, I am talking about the vast majority of today's students and today's young employees. I respect them and we would be misleading ourselves to think that they are not going to materially and significantly alter our society and influence our economy. And the style of our management processes will certainly change, of this I have no doubt. The rewards will be great for those organizations that can develop a management style that on the one hand will accommodate to the needs of the knowledge professional while at the same time benefiting economically and commercially from his efforts.

and other equipment. The report further cautions that environmental problems "are rarely amenable to sweeping solutions; the benefits of even major breakthroughs in research are more likely than not to be limited to discrete subsystems of the overall system."

For each of the four pollution topics covered, the report analyzes the evidence that pollution is causing ill effects, and makes recommendations for alleviating the problem.

With respect to pesticides, the report notes that the incidence of fatal poisonings in the U.S. has held virtually constant at 1 per 1 million population over a 25-year period, despite a vast increase in pesticide usage. It also states categorically: "There is no evidence that long-term low-level exposure to residues of pesticides such as occurs in the diet or environment in the United States has any undesirable effect on human health." But the report expresses concern at "strong" presumptive evidence that pesticide residues are inhibiting the productivity of entire ecosystems. The report recommends that persistent pesticides "only be used in minimal amounts and under conditions where they have been shown not to cause widespread contamination of the environment." It also calls for better biological and cultural methods for controlling pests. The eradication of just three pests—the boll weevil, the bollworm, and the codling moth—could reduce the amount of insecticide applied annually in the U.S. by an estimated 40 percent, the report says.

The ACS group made no recommendation concerning the growing movement by state and national governments to ban the use of DDT, but at a press conference Daniel MacDougall, head of the pesticide task force, characterized the push for a total ban on DDT as an "over-reaction." MacDougall is research director for the Chemagro Corporation of Kansas City, Missouri, a manufacturer of pesticides though not of DDT. An editor of *Field and Stream* magazine vigorously criticized the pesticide section of the report and implied that the pesticide panel was more interested in protecting manufacturers than wildlife, but MacDougall later stressed that he had reviewed the facts objectively as a scientist and pointed out that his seven co-panelists from government and the universities had all agreed with the report's conclusions.

With respect to air pollution, the report notes that incidents of lethal

accumulation of pollutants have occurred, and it adds that, while "typical urban concentrations are not acutely lethal . . . it is difficult to argue that their lesser concentrations make them harmless." The report also cites evidence that air pollution has damaged plants, rubber, fabrics, dyes, and nylon hose. Unfortunately, such damage is likely to become still more prevalent in the coming years. Though improvements have been made in control of air pollution from industry, the report finds, "the general situation is getting worse because of instances of failure to apply existing control technology, growth of industry, and lack of economic technology in some cases." Similarly, while existing standards restricting automobile emissions will reduce total national emissions over the next several years, the trend is expected to start upward again in the mid-1970's as the number of cars in use continues to increase. Nor is the report very hopeful that new technologies—such as nuclear plants and steam- or electrically powered automobiles—will solve the air pollution problem in the near future. The report calls for more stringent automobile emission standards, and inspection; rapid promulgation of federal air quality criteria so that industry will be goaded into taking action; research on the main contaminants in the atmosphere and on their movements; research on ecological and public health problems; and accelerated development of various technologies that would help reduce air pollution.

With respect to water pollution, the report states that "very little is known" of possible effects on human health of the variety of largely unidentified chemical compounds that enter sources of water supply in municipal and industrial wastes, both treated and untreated. "It is thus impossible to be entirely sanguine about the ability of water treatment plants to cope with steadily increasing chemical pollution as water reuse increases," the report says. The main concern lies in the effects of long-term, low-level exposure. The report urges greater research on sewage treatment "primarily to seek radical innovations, based on fundamental understanding of microbiological processes." It also calls for laboratory and epidemiological work on the effects of long-term, low-level exposure to water pollutants, as well as studies of the movement of enteric viruses in soil and groundwater.

With respect to solid wastes, the report states that, while "a well-defined relationship between solid wastes and human health has not been demonstrated under the conditions that prevail in the U.S.," it is nevertheless "possible to conclude that, for some diseases, a relationship exists." The report finds that "the technology used to handle and dispose of solid wastes in the U.S. lags well behind that used to control air and water pollution," and that the basic science of solid waste handling "remains in relatively primitive condition." Nevertheless, the report notes that "the technology is available to sharply upgrade the handling and disposal of municipal refuse in the U.S."—it is simply not being applied to any great extent. The report calls for education, research, and demonstration projects to spur progress "in this neglected area."

The report is not an unqualified success. It seems to do a much better job of reviewing the current state of the art than it does of recommending steps to alleviate environmental pollution. Indeed, the report's 73 recommendations are, for the most part, addressed to everyone—and thus to no one in particular. Little effort is made to establish priority among the great number of recommendations (58 of the 73 are designated as having the most "immediate import"). And, ironically, for a report that stresses the possibility of taking "enormous strides, now," the vast majority of the recommendations call for research, development, study, investigation, measurement, assessment, and the like—not for the kind of direct action that will have an immediate effect in reducing pollution. The report sheds little light on how the economic and political factors that inhibit pollution abatement might be overcome—indeed, the ACS group ruled such "nonscientific" aspects of pollution control beyond the scope of the study.

No doubt, there will be ardent conservationists who believe the report is too weak, and "public-be-damned" industrialists who find it too strong, but all extremes of opinion in the pollution controversy should find it a useful source of ammunition to buttress their positions. Anyone who disagrees with the report's recommendations can simply read its review of the state of the art and make up his own mind about what should be done next. In that sense, the report constitutes an important addition to the ever-burgeoning literature on environmental problems.

—PHILIP M. BOFFEY

APPOINTMENTS

Frederick P. Thieme, executive vice president, University of Colorado, elevated to president of the university. . . . **John W. Kneller**, provost, Oberlin College, to president, Brooklyn College, City University of New York. . . . **Paul T. Medici**, chairman, biology department, St John's University, New York City, to dean, Graduate School of Arts and Sciences, at the university. . . . **Relis B. Brown**, associate professor of biology, Florida State University, to chairman, biology department, West Chester State College, Pa. . . . **Henry B. Peters**, assistant dean and director of clinics, University of California School of Optometry, Berkeley, to dean, University of Alabama School of Optometry, Birmingham. . . . **James W. Riddleberger**, former ambassador, U.S. State Department, to national chairman, Population Crisis Committee. . . . **Wolfgang C. Sterrer**, visiting assistant professor, University of North Carolina, to director, Bermuda Biological Station for Research.

RECENT DEATHS

Leason H. Adams, 82; former director of the Geophysical Laboratory, Carnegie Institution; 20 August.

Herbert Conway, 65; clinical professor of surgery, Cornell University Medical College; 25 August.

Roy J. De Ferrari, 79; former dean, Graduate School, Catholic University; 24 August.

Amos de Shalit, 42; nuclear scientist and former director general, Weizmann Institute of Science, Israel; 2 September.

Horatio N. Dorman, 83; urologist and fellow of the American College of Surgeons; 20 August.

Michael Hobmaier, 82; emeritus associate professor of comparative pathology, University of California, Berkeley; 15 January.

Hans Hoff, 72; professor of psychiatry, University of Vienna, and former president of the World Federation for Mental Health; 24 August.

David A. Karnofsky, 55; chief, chemotherapy research division, Sloan-Kettering Institute for Cancer Research; 31 August.

Foley F. Smith, 63; former president, Virginia Academy of Science; 9 August.