United States
Environmental Protection
Agency

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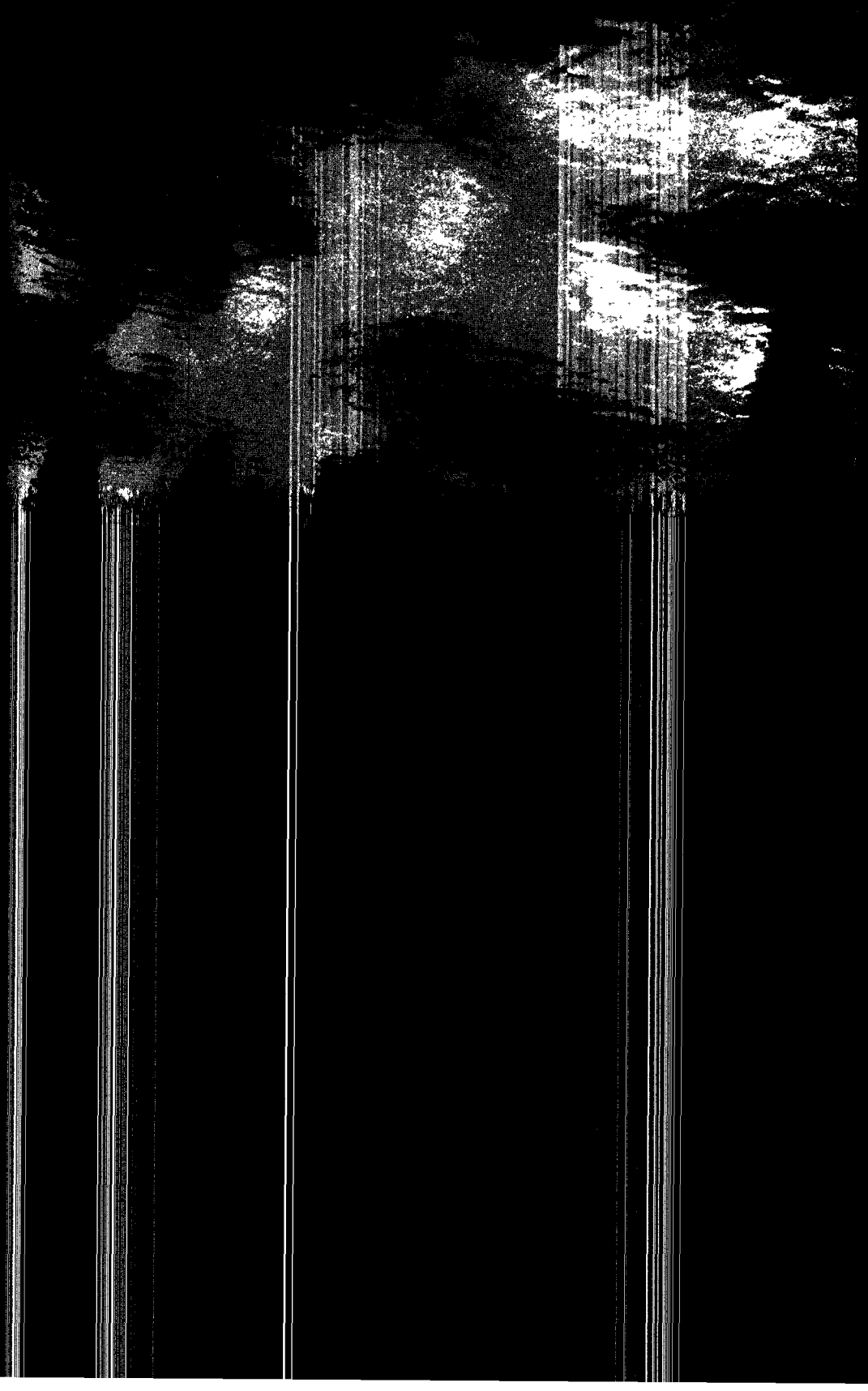
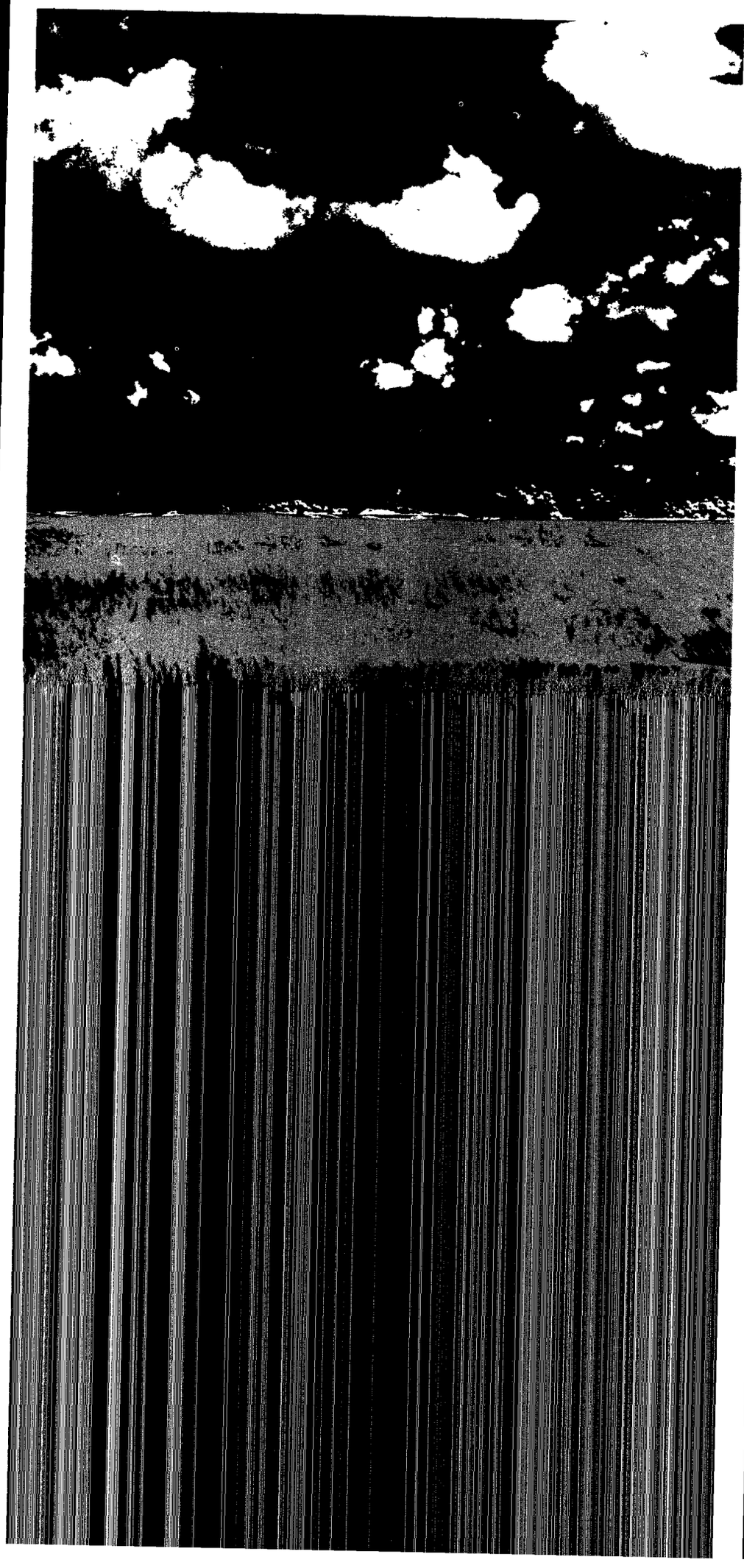
A Global Environmental Concern

EPA's Scientific Activities Overseas Program





Preface

EPA's Office of International Activities (OIA) is involved in many broad ranging and dynamic programs that are designed to allow for EPA participation in international decision making on worldwide environmental issues; provide EPA with the benefits of institutional and technological environmental innovations in other nations, and share the knowledge and experience obtained domestically with other governments.

This report describes one of OIA's international programs that has been instrumental in addressing several areas of EPA's needs while fostering valuable professional relationships with environmental scientists abroad

/s/ Alice Brandeis Popkin

Introduction

Since 1971 the U.S. Environmental Protection Agency has cooperated with a number of other countries in its Scientific Activities Overseas Program to pursue research and development in environmental controls

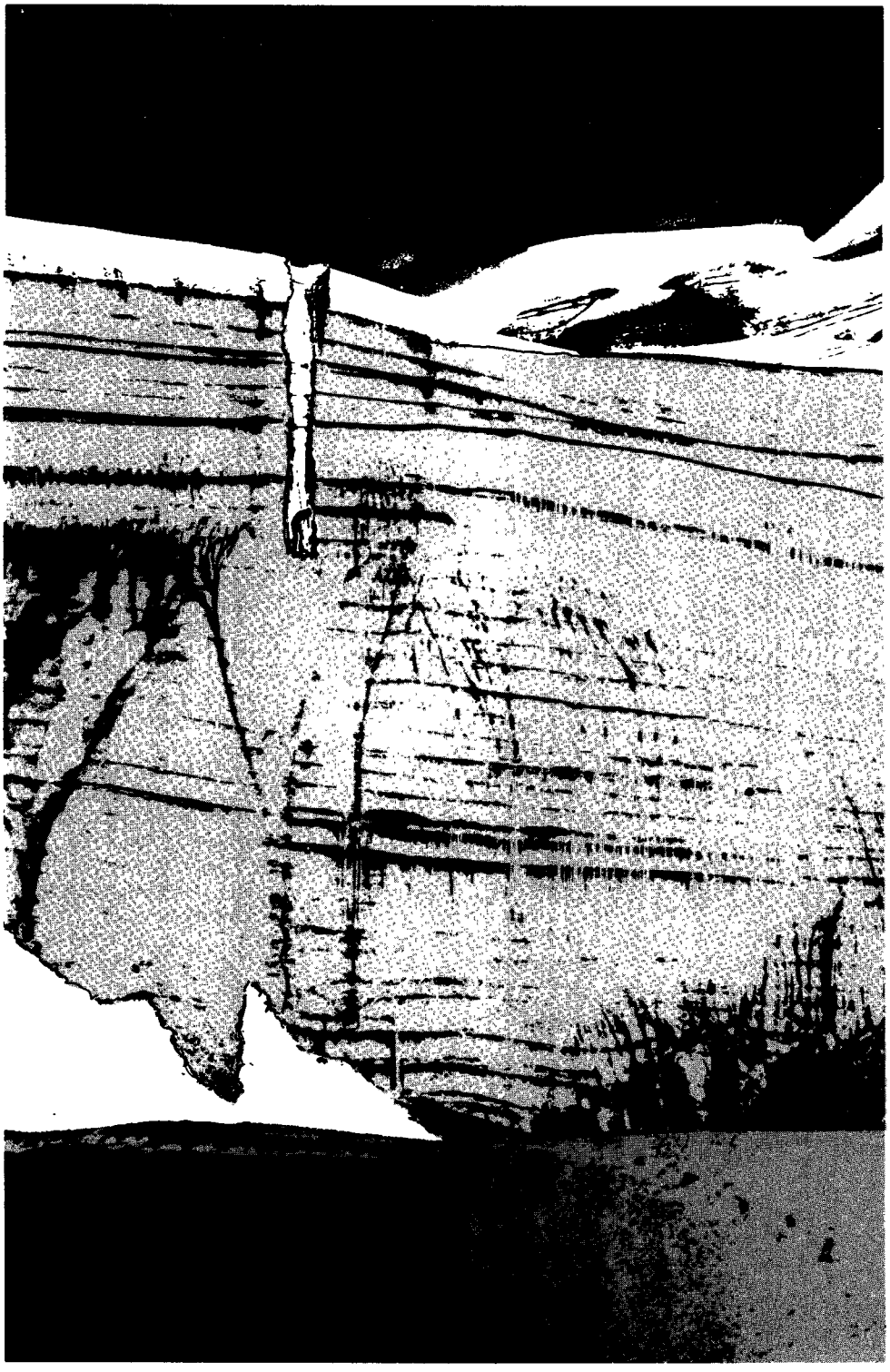
This program, like the character of the environmental movement itself, is worldwide. It transcends ideological and national boundaries. It has brought together scientists, physicians, engineers, and administrators in a common pursuit—to preserve and enhance the quality of the environment.

Scientific Activities Overseas began with funds from excess foreign currencies largely acquired through sales of U S farm products under the Agricultural Trade Development and Assistance Act of 1954 (Public Law 480). From its inception this historic Act has pursued several goals. It has sought not only to develop export markets for U.S. farm goods but also "to improve the foreign relations of the United States, and for other purposes "

The excess foreign currency generated through these sales has been put to work in a constructive way not foreseen by the original authors of the Act, supporting environmental research and development for the United States in half a dozen countries. This report outlines the history of the EPA program, describes some representative projects, and indicates potential areas for future research.

Because the majority of the projects are being carried out in Poland, the work of scientists and engineers in that country have been dealt with in detail.

As a measure of the success of the program, it might be noted that the Polish government is now making direct contributions into a special account to assure that this research will continue. Since U.S.-owned zlotys in Poland were largely used up by the mid-1970's, a bilateral monetary arrangement, the Maria Sklodowska-Curie Fund, was established that extended the life of the cooperative scientific program in that country through 1981. Polish contributions to this joint fund match U S contributions from U.S.-owned zlotys, with each country obligating and depositing approximately 614 million zlotys (about $31 million). The obligation of such money into the joint fund expired December 31, 1976 when the zloty went off the U S. excess foreign currency list.



EPA's Research Program Abroad

Well before the United Nations held its first Conference on the Human Environment in Stockholm in June, 1972, there was widespread recognition that pollution was an international problem.

In 1969 Congress passed, by unanimous vote, the National Environmental Policy Act directing that all Federal agencies "shall recognize the worldwide and long-range character of environmental problems and, where consistent with the foreign policy of the United States, lend appropriate support to initiatives, resolutions, and programs designed to maximize international cooperation in anticipating and preventing a decline in the quality of mankind's world environment"

Shortly after its creation, on December 2, 1970, the U S Environmental Protection Agency continued a far-reaching program of scientific cooperation with other nations to encourage and promote research in pollution control. The mechanism that made this possible was an accumulation of excess, non-convertible currency over the years in certain countries purchasing American products, chiefly farm exports under Public Law 480

EPA has supported environmental research in Poland, Yugoslavia, Tunisia, Egypt, India, and Pakistan through its Scientific Activities Overseas Program by means of this special foreign currency. The program is administered by the Agency's Office of International Activities

This research covers a broad range of investigation including air and water pollution control, the health effects of pollutants, radiation studies, the impact of pollution on vegetation, sludge disposal, and management of animal wastes

EPA-financed engineers have developed methods of removing wastes from textile plant discharge water. Under the Agency's direction, scientists have found and analyzed historic airborne pollution in distant glaciers, and have drawn important conclusions from this about the nature of global pollution Biologists also are finding new information about uptake of heavy metals by vegetables from the soil in industrial regions where air pollutants settle in the ground

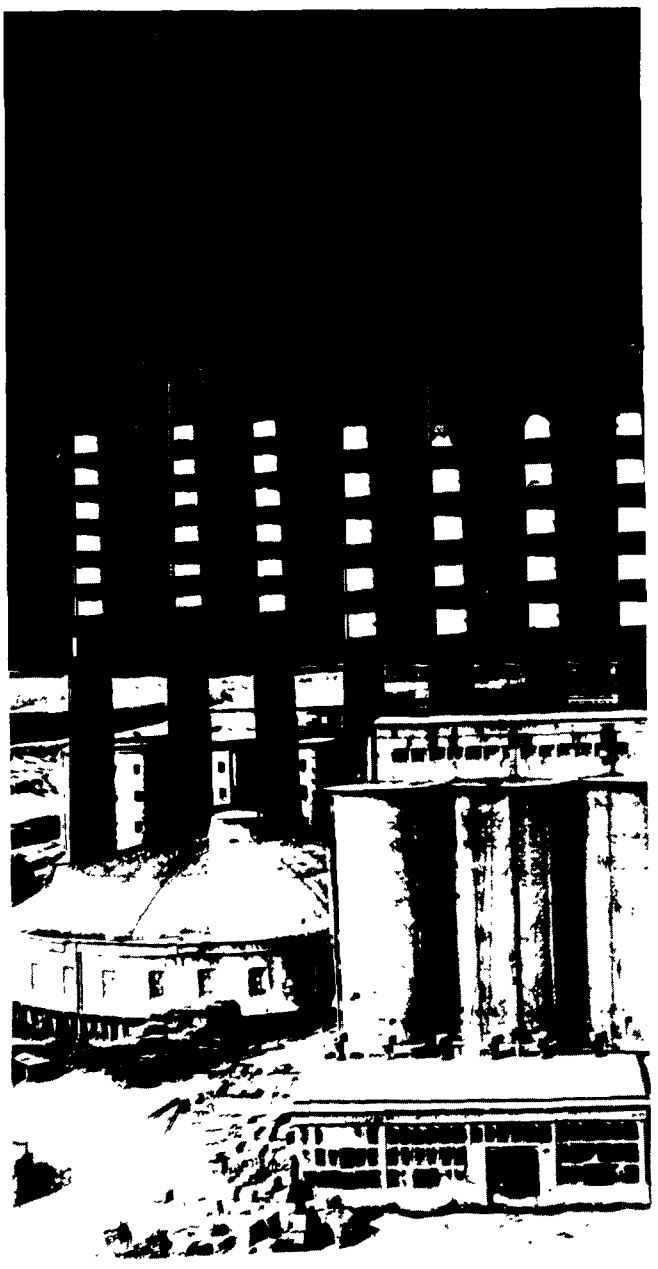
There are several broad philosophies that underlie this program of environmental research around the world One is that by supporting such investigation, the United States furthers its own interests in a direct and concrete way. Many of the individual projects are carried out in industries identical to those found in this country, such as coal mining, textile manufacture, copper smelting, and power generation stations, and the results of environmental research elsewhere can be applied to industry here In addition, research involves areas of public health, such as wastewater treatment and the protection of the public from toxic effects of pesticides, that are common to all nations

Another rationale involves global environment. In the 20th century, pollution crosses international borders without a passport. Scientists have found DDT in the tissues of penguins in the Antarctic, and sulfur mist in Norway blown from coal-burning power plants in countries many miles distant. Because these problems cut across national and political lines, affecting people everywhere, it has been United States policy to cooperate with other nations in a variety of ways to control such pollution. By supporting research abroad, and the mutual exchange of American and foreign scientists visiting research centers, the United States as an advanced industrial nation has manifested its concern and its willingness to cooperate in dealing with this international problem

Historically there is precedent for such international scientific cooperation. The Mutual Education and Cultural Exchange Act of 1961, for example, provided financial support for a broad spectrum of visits and interchanges of specialists between the United States and other countries, of studies and research, by Americans and nationals of other countries, including participation in scientific and technical meetings here and abroad. In this and in PL 480, Congress acknowledged the value of strengthening ties to other nations through financial aid of various types in peaceful activities.

The EPA's Scientific Activities Overseas Program is therefore a continuation of a broad policy that has been pursued for many years by the United States, an expression of the idea that science knows no boundaries, that a laboratory in Warsaw or Cairo or Cincinnati can discover new methods of pollution control that will benefit all mankind.

Following is a description of some examples of research under the Agency's SAO program.



Poland: Environmental Initiatives

At this writing there were more than 30 separate projects in environmental research being conducted by scientists, engineers, and physicians in Poland under the Agency's SAO program. This represented 62 percent of the total projects supported by EPA around the world.

In several ways Poland serves as a model country for the SAO program. First, the nation has a tradition of scholarship and scientific research dating back more than six centuries to the founding of the Jagiellonian University of Cracow. Poland has produced two figures in the history of science whose contributions were epochal: Nicolaus Copernicus, the Renaissance mathematician and astronomer, and Maria Sklodowska-Curie, co-discoverer of radium and polonium. Since World War II the Government of the Polish People's Republic has actively supported research that is directly applicable to the industrialization and modernization of the country, and the intellectual climate is highly receptive to support and encouragement from the United States. Research is conducted by more than 100 institutes in various branches of government.

To deal with environmental problems the Polish Parliament has organized the Ministry of Administration, Local Economy and Environmental Protection. Its activities include protection against water and air pollution, waste treatment, noise and vibration prevention, and protection and recultivation of soils.

The Research Institute on Environmental Development (RIED) coordinates scientific cooperation of all Polish research institutions with EPA

Poland's climate, topography, and industrial base all present challenging conditions in environmental studies. For example, the country suffers from a chronic shortage of water, ranking 20th in Europe in its water resources. This means that during periods of low rainfall, pollution in rivers and streams is heavily concentrated, and as a result water protection is a pressing environmental problem.

The topography of Poland includes a long range of mountains on its southern and southwest border, descending north through foothills to a fertile plain in the central region. Lying at the base of the mountains is Silesia, rich in coal and other mineral deposits and the industrial heart of the nation. This means that the major rivers and streams flow almost immediately from the mountains through the most industrialized sector, where they are contaminated before reaching farmlands on the plains. Scientists and public health officials are therefore confronted with an unusually severe problem in water pollution that begins close to the source of a major watershed.

The rich Silesian industrial complex, which resembles in several ways the coal-and-steel producing areas of eastern United States, also has problems in air pollution. It is in this region that many of EPA's environmental research projects are located. Several of EPA's projects are associated with POLTEGOR, an acronym for Polish Mining Technology, (Polska Technika Gornicza) This large organization conducts research and operates pilot operations in opencast mining, earthmoving, and related activities.

EPA and POLTEGOR jointly sponsored a Polish-U.S. symposium, "Environmental Protection of Openpit Coal Mines," at Denver, Colorado in May 1975 with the assistance of EPA's Region VIII staff. Another symposium, on legal and administrative systems in environmental protection, is scheduled to be held in 1977 in Poland under auspices of the Ministry of Administration, Local Economy and Environmental Protection. EPA also works closely with the Polish Institute of Meteorology and Water Management, where it has 11 projects; the RIED, and the Ministry of Agriculture. A joint Symposium on Wastewater Treatment and Sludge Disposal was held in Cincinnati in February, 1976 with participants from Poland, EPA, several American universities and the American Iron and Steel Institute. Discussions focused on seven water-related research projects being conducted in Poland.

Poland's Coal Industry and Environmental Protection

Poland has very large coal reserves—an estimated total of 100 billion tons plus 30 billion tons of brown coal (lignite)

The fuel plays a significant role in Poland's economy, and the country ranks as the world's third largest exporter of coal Coal-burning power plants accounted for about 95 percent of Poland's electrical generation in 1972, vs. only 2 percent from hydroelectric plants Thanks to the abundance of this fuel, Poland has been able to export electricity in recent years to Czechoslovakia and the German Democratic Republic

The intensive development of the country's coal industry of course carries an environmental cost—in air pollution, mine drainage, underground water contamination, and problems in disposal of coal ash. Polish authorities accordingly have devoted much effort to environmental controls on coal combustion and its byproducts. Approximately $1.5 million of EPA's SAO funds are involved currently in such research in cooperation with POLTEGOR in Poland

One of the most visible problems is the ash and slag wastes from coal-fired power plants The volume of the wastes is large and growing—from nearly 12 million metric tons annually in 1975 to an estimated 30 million tons by the year 1990 POL-

TEGOR scientists and engineers in cooperation with EPA have made remarkable strides in demonstration projects for storing this ash and slag with appropriate environmental safeguards.

In one experiment, these wastes have been deposited in two open sand pits created by surface mining operations at Kotlarnia and Goguszowice. POLTEGOR specialists are monitoring the sites to prevent adverse effects of the wastes on water resources. The factors considered include climate, drainage and soil chemistry. A number of monitoring wells have been drilled to help determine chemical effects of the waste on the subsoil. Ultimately these two sites will be entirely reclaimed with topsoil and plantings of various grasses, shrubs, and trees and made into attractive, ecologically desirable areas.

A related project, in cooperation with POLTEGOR, is the reclamation of the so-called spoil stack—a mixture of waste ash and clay overburden—from the Turow mine in southwestern Poland. This is the largest opencast lignite mine in the country, producing 24 million tons of brown coal annually, and its volume of waste totals more than 70 million cubic meters a year. It is estimated that by the time the Turow operation is completed in the year 2020, the external waste stack will cover an area of more than 7,000 acres to a depth of 320 meters. The waste initially was distributed at ground level, but due to its increasing height, stacking machines must now be used.

These toxic spoil stacks resemble problems found in coal fields in the United States and the development of a reclamation technology is therefore of special interest. Specialists at the Turow operations now are conducting a three-year program to establish farm crops for human consumption on reclaimed spoil stacks. Scientists will measure the uptake of metals by these crops and also will measure the effects of air pollution from a nearby power plant. So a once-ugly blight on the landscape is being turned into healthy, productive land.

A third project with POLTEGOR seeks to develop methods for reclamation of the alkaline ash piles from power plants that burn brown coal (lignite) and bituminous coal. Again, this work is of special relevance to utilities in the United States because power plants now operating here have produced large ash "ponds" with undetermined groundwater contamination. The anticipated growth of coal-fired power stations in the United States, particularly in the Northern Great Plains, is expected to aggravate the problem.

Sites in Poland involved in power plant ash reclamation include one at Konin in central Poland concerned with fly ash from the combustion of the low-grade brown coal. Another at Halemba in south central Poland is dealing with ash from the burning of bituminous coal. These wastes present serious environmental problems not only because of their potential for polluting underground waters and adjacent soils but also the atmosphere since winds carry away dusts and chemical materials from the sites.

To stabilize the ash deposits and convert them to useful land, POLTEGOR specialists have successfully planted a variety of grasses and trees under controlled conditions in numerous plots. With fertilization, there is generally a good growth of grasses and nitrogen-producing species of plants such as alfalfa, with yields equal to those on neighboring farmland. If rainfall is normal, it is anticipated that economically productive crops can be harvested on these reclaimed sites. In 1977 POLTEGOR scientists will evaluate various crops grown on the ash deposits and will be directing their project toward production of food for both humans and farm animals.

The Polish efforts in recent years to manage coal wastes have not been without problems. The projects mentioned have required the extensive use of soils, fertilizer, plant husbandry, and analysis. But it is clear from achievements thus far that this pressing environmental challenge not only can be met but even turned to advantage by the conversion of wasteland to valuable farmland and forests. In the process the POLTEGOR teams have shown that nature can be enlisted to help convert such sites from eyesores and environmental hazards to attractive, productive areas. It is an experiment from which U.S. industry can draw valuable lessons.

Cutting Costs in the Textile Industry

The manufacture of textiles is an important industry in Poland, with production valued at more than 95 billion zlotys in 1972 (about $359 million at the official exchange rate that year), 7.5 percent of the country's total industrial production.

Like textile manufacture in the United States, this industry discharges wastewater with widely varying physical and chemical characteristics. Much of this wastewater is colored and is high in oxygen-demanding properties which endanger the quality of the streams and rivers where it is discharged. The effluent also varies in its acidity or alkalinity and may contain substances difficult to remove by conventional treatment methods.

In 1973 EPA and the Polish Institute of Meteorology and Water Management, Cracow Division, began investigating treatment of textile wastewater by means other than conventional biological methods. Since cities in Poland charge textile plants for purifying their wastewater, with fees directly related to the quantity and quality of the waste purification, this can represent a substantial budget item for an industry Research to achieve lower costs is therefore considered a sound investment. Polish textile technology does not differ markedly from its counterpart in the United States, and the benefits of research may therefore be applied equally well here.

The Polish team set out in 1972 to evaluate several techniques of removing color, detergents and other stubborn pollutants from textile wastewater after primary and secondary treatment They kept in mind not only the effectiveness of the methods but their cost.

The project was set up on a pilot scale near the municipal treatment facility and a textile plant in Andrychow, 40 miles southwest of Cracow, in collaboration with a laboratory at Cracow Polytechnic University The plant produces a variety of textiles from cotton and synthetic fibers, and a host of chemicals are used in manufacture including many dyes (reactive, vat, naphthol, indigo, sulfur and disperse) as well as detergents and caustic.

Initially, municipal wastewater is mixed with textile effluent because the bacterial action of the sewage actually helps to break down the contaminants in the factory waste. At Andrychow the mix is on a one-to-one ratio. After conventional treatment at the municipal plant, various types of advanced (tertiary) treatment are used to remove the most persistent textile pollutants.

The EPA-Polish team innovated by taking seven different types of advanced treatment, installing them at one site, and then comparing their cost and effectiveness on the scene The seven processes were ion exchange, carbon absorption, chemical coagulation, ozonation, chlorination, filtration and reverse osmosis. Investigators ran treatment methods both in parallel and in series.

Among the more important results of this work was the development of a new process in chemical coagulation—multimedia filtration. Normally this requires four tanks, but at Andrychow the work was performed in one. The process removes solids without sedimentation by means of a technique termed "upflow contact filtration" which reverses the normal gravity-fed procedure. The technique provides significant savings, costing about 50 percent less than conventional methods and requiring less time An EPA paper on the system will be published later in 1977.

Since all such methods are developed under joint U.S.-Polish government auspices, the findings of this project are openly available to the public without restriction. This applies to all projects in every country under the Special Foreign Currency program

Energy and Protein from Animal Wastes

The production of pork is an important industry in Poland. Not only is this a major source of food for the population but Polish hams are exported around the globe and have become significant earners of hard currency Exports to the United States alone in 1975 were valued at more than $74 million Poland raises more than 20 million pigs a year, and total exports of ham exceeded 38,000 metric tons in 1975

For these reasons, large farm operations devoted exclusively to swine have become common in Poland, and it is not unusual to find State-owned farms of 10,000 to 35,000 pigs operated by agricultural cooperatives.

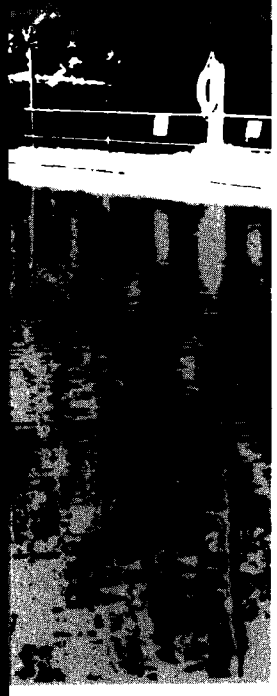
At the same time, the animal waste load from such large operations represents an environmental problem that has compelled authorities to construct special wastewater treatment plants exclusively for swine farms The present method of treating this waste is both expensive and requires a heavy input of energy and chemicals, and authorities therefore have been exploring ways to turn the waste into useful byproducts to offset treatment costs.

Scientists know, for example, that methane gas can be derived from wastewater, thereby providing a fuel for various purposes Engineers working in the U S -Polish SAO project are seeking the optimum method of obtaining methane and using it to heat water at swine farms, which can help to make them more self-sufficient in energy

At the same time investigators also will be exploring ways to recover protein from the waste. By biological treatment they plan to recover protein which can ultimately be fed back to the pigs after processing and removal of certain contaminants like heavy metals.

A third use of the wastewater is for irrigation of crops. The end product of the waste treatment plants now is suitable for irrigation, but it would be much more valuable for this purpose if it contained certain nutrients now removed during purification such as phosphorus, nitrogen and carbon.

So the real challenge to scientists is to determine the correct treatment that will make possible all these valuable uses from a product that now is considered chiefly an expensive environmental burden. The idea of food, fuel, and fertilizer from animal waste holds great appeal both for emerging nations and for U.S feedlot operations



Renovated Water for Industry

As indicated earlier, Poland is a nation poor in water supply. At the same time, its heavy industry—like those in other countries—must use large amounts of water for cooling and other purposes. Poland's rivers are already heavily polluted, and this presents an environmental and economic dilemma.

It means that in some cities such as Walbrzych in Upper Silesia, with a population of 100,000, industry now actually uses sewage for cooling water.

To cope with this problem the Technical University of Wroclaw has been cooperating with Polish industry and municipalities on treatment of such sewage to render it of adequate quality for use in factory processes.

Under another EPA project, investigators have been working to determine the most efficient method of renovating water from city sewage treatment plants so it can be recycled back to industry.

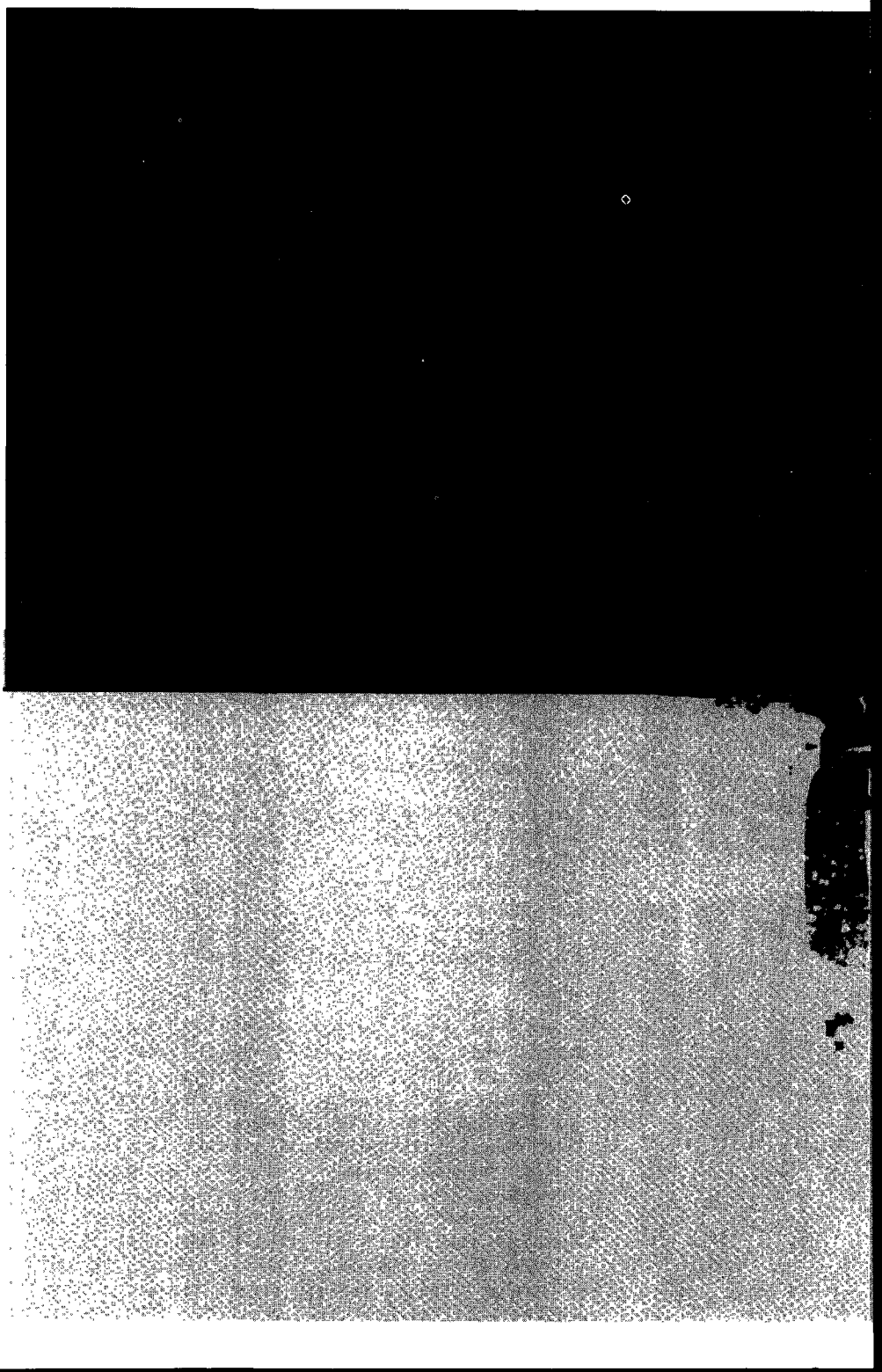
There are extensive operations in Upper Silesia in copper and steel manufacture and also in mining, and the Oder River and its tributaries suffer from heavy pollution as they flow through the Wroclaw area. This means that among other things the wastewater must be neutralized and cleansed of phenols and heavy metals before it can be reused.

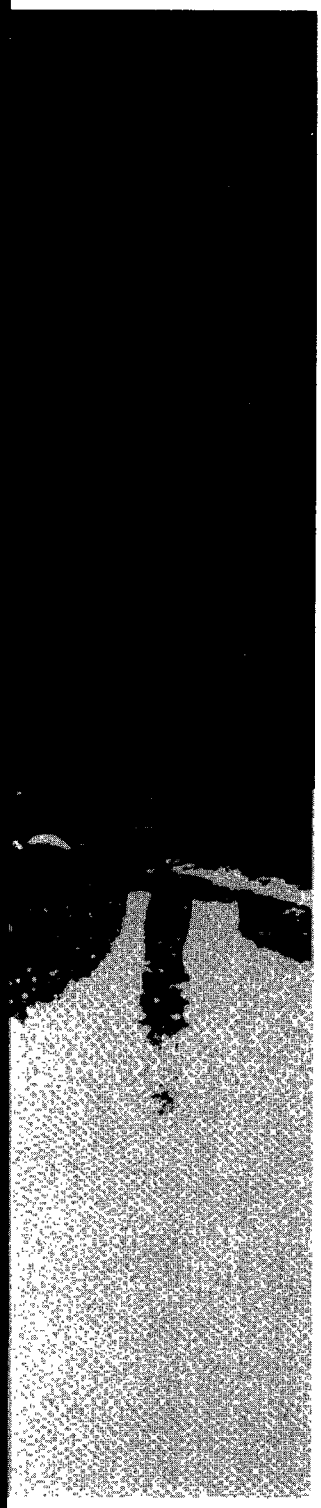
Now under construction and scheduled for completion in June, 1977 is a pilot plant to treat 2,000 cubic meters of sewage per day for industry in Walbrzych. The cost of this facility will total approximately $500,000, and its output will chiefly be used as cooling water in a glass and china factory.

In a second phase, a larger plant with a capacity of 20,000 cubic meters of water per day is also planned for completion in 1978 on the Palecznica River in the same city. This facility, costing approximately $3 million, will provide not only cooling water for a coke plant but also about 10 percent of its output will be used by boilers in the electric generating plant for the same industry.

The use of renovated water is of growing interest in other industrialized nations because heavy industry, particularly steel plants, require enormous amounts of cooling water at a time when this resource is becoming scarce. The Sparrows Point Plant of Bethlehem Steel Co. at Baltimore, Maryland, for example, uses 115 million gallons a day of treated sewage water for cooling purposes.

Because of Poland's unusually severe water shortage, combined with its heavily industrialized southwestern region, the country is therefore serving as a "worst case" model and testing ground to stimulate research in recycling water, and the results of these projects will be of value everywhere to industry and municipalities faced with similar problems





Looking Ahead

The SAO program responds to local needs in each country where it operates. Thus, scientists are studying water renovation and recycling not only in Poland but for food processing in Egypt, where water is also a precious resource. Similarly, eutrophication in the Lake of Tunis is under investigation to assess the potential benefits of diverting sewage from that important body of water in Tunisia. In Yugoslavia, research is being conducted on water pollutants such as silicates, heavy metals, and acid dust. In Pakistan, biochemists are studying sewage water and sludge to establish control measures for protection of public health and marine life.

At the same time the program also remains flexible to adapt to new domestic priorities such as land reclamation in strip mining and synthetic fuel production. The emergence of the energy problem also has made this a special consideration in future research.

The need for energy conservation of course already was being reflected in certain projects, such as research on management of wastes from animal feedlots. It is a factor in systems achieving lower costs of wastewater treatment, since energy is a function of such costs.

In another area, the need for more food to feed a growing population is a part of future research. For example, efforts in Poland under SAO to restore the fertility of lands despoiled by mining are not only environmentally desirable but may open up new acreage to the production of crops and livestock. As noted earlier, the experience of the POLTEGOR organization in land restoration can be of special usefulness to U.S. planners in the exploitation of surface coal in regions such as the Great Northern Plains.

However, the main thrust of future research under the SAO program will be a continuation of those lines of investigation already apparent—in areas already identified by each nation as important to deal with its own particular environmental problems.

The United States will continue to benefit from the fruits of such research. As this report has emphasized, many of the problems under investigation are shared by American industry and American cities, and the knowledge gained in pollution control overseas will be freely available here.

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