THE CLEAN AIR ACT
ANNUAL REPORT
1980-1981

Air Pollution Control Directorate
Environmental Protection Service
Department of the Environment

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Minister
Environment Canada

Ministre
Environnement Canada

His Excellency
The Right Honourable Edward Schreyer
Governor General and Commander-in-Chief of Canada

May It Please Your Excellency:

I have the honour herewith, for the information of Your Excellency and the Parliament of Canada, to present the Annual Report on the Clean Air Act for the fiscal year ended March 31, 1981.

Respectfully submitted,

John Roberts, P.C., M.P.
Minister of the Environment

Deputy Minister
Environment Canada

Sous-ministre
Environnement Canada

The Honourable John Roberts, P.C., M.P.
Minister of the Environment
Ottawa, Canada
K1A 0A6

Dear Mr. Roberts:

I have the honour to submit the Annual Report on the Clean Air Act for the fiscal year ended March 31, 1981.

Respectfully submitted,

J.B. Seaborn

HIGHLIGHTS

The long-range transport of air pollutants, in particular the problem of acid rain, was the principal environmental concern during the 1980-81 fiscal year. There were two significant achievements in this regard: the signing of the Memorandum of Intent with the United States on August 5, 1980 and the amendment to Canada's Clean Air Act on December 17, 1980. These developments are expected to add impetus to Canada's efforts to encourage reductions in emissions of acid-causing pollutants in the United States.

The Memorandum of Intent states the intention of both Canada and the United States to vigorously enforce existing legislation governing air pollution and to work toward the development of a bilateral agreement on transboundary air quality.

The Clean Air Act amendment, given swift unanimous passage in the Canadian Parliament, empowers the federal government to take steps to control the emission of pollutants affecting another country. It provides the reciprocity required under Section 115 of the U.S. Clean Air Act.

A federal acid rain control strategies program was launched during the year in cooperation with the provinces. The purpose of the program is to identify, develop and evaluate alternative abatement options and to assess the impact of various U.S. emission reduction scenarios in Canada.

Federal research activities included the monitoring of atmospheric composition and deposition, and the modelling of atmospheric transport and deposition. Emphasis is being placed on developing a greater understanding of the acid deposition problem and the nature of long-range transport and pollutant transformation.

Information activities throughout the year greatly increased the Canadian public's awareness of the acid rain problem. Numerous reports were published and media coverage was extensive.

In other program activities, the implementation of the four federal Clean Air Act regulations continued in cooperation with the provinces. Proceedings were initiated for Crown prosecution of a secondary lead smelter in Winnipeg found to be emitting lead in quantities well in excess of limits specified in the federal regulations.

The National Air Pollution Surveillance (NAPS) annual report (1979) was improved through a new section which analyzes the data with respect to the National Air

Quality Objectives and reports the air quality at each NAPS station in relation to these objectives.

Increasing concerns about the health effects of fine particulate matter may lead to nationwide monitoring in the 1980's. During the fiscal year, seven new samplers for fine particulates were deployed in the major cities of the NAPS network and a pilot monitoring program was begun. Complementing this was a study initiated to determine the sources and emissions of anthropogenic primary fine particulate matter under 15 micrometres in diameter.

A high-hazards laboratory is being established by Environment Canada for the trace analysis of hazardous organic toxic substances. Sophisticated equipment such as a gas chromatograph - mass spectrometer has also been installed in response to the increasing need to identify and analyze toxic substances considered to be hazardous to human health.

An important research activity in the toxic chemicals program is aimed at a better understanding of the atmospheric pathways of mercury and its compounds. An atomic fluorescence mercury monitor is under development and should have greatly enhanced sensitivity and ability to determine different species of mercury present in the atmosphere.

Because of concern over possible emissions of dioxin and dibenzofuran from the combustion of refuse and coal, a project to sample the fly ash from several municipal incinerators and coal-fired boilers was initiated.

Inspection projects conducted on 800 in-use vehicles in Rimouski, Quebec and Charlottetown, P.E.I. showed that about 75% of the vehicles had excessive air pollutant emissions, due to carburetor maladjustment. About 30% had non-functioning nitrogen oxide controls.

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INTRODUCTION

This report, submitted in accordance with Section 41 of the Clean Air Act, covers activities for the period ending March 31, 1981.

The Clean Air Act, proclaimed November 1, 1971, provides the basis for the federal government's air pollution control activities and has three main objectives. The first and foremost is to protect the health of the public of Canada from air pollution. To this end, federal regulations are promulgated limiting the emission of hazardous pollutants such as lead, mercury, vinyl chloride, asbestos and arsenic from specific industrial sectors. The second objective is to promote a uniform approach across Canada in the control of other pollutants. To achieve this and to provide appropriate leadership by the federal government, the Act enables the issuance of industrial sector guidelines which, if adopted by a province as models for legislation, become enforceable by that province.

The third objective is to make provision for the mechanisms and institutions needed to ensure that all measures to control air pollution can be taken. Of major significance is the recognition that provinces have a direct responsibility in controlling air pollution and that cooperative efforts between provincial and federal authorities are required. The Act enables the federal government to enter into agreements with individual provinces and allows the establishment of arrangements for the implementation of regulations made under the Act; the Act also provides for direct action by the federal government when necessary.

Act Amended in December 1980

By virtue of an amendment given Royal Assent on December 17, 1980, the Clean Air Act now empowers the federal government to take steps to control the emission of pollutants affecting another country. This amendment provides the discretionary authority needed to control these pollutants without requiring that an agreement be in place, as previously required under Section 7-1(b). It will only apply to countries providing reciprocal protection. In effect, the amendment to Canada's Clean Air Act provides the reciprocity required by Section 115 of the U.S. Clean Air Act which enables U.S. federal authorities to initiate a process to require state governments to reduce emissions adversely affecting Canada. Because of the requirement for reciprocal authority, the United States previously may not have been able to implement Section 115 for Canada's benefit.

RESPONSIBILITIES OF THE MINISTER

The responsibilities of the Minister under the Clean Air Act include:

a) ensuring the development of regulations limiting the emission of hazardous substances and guidelines indicating limits to the quantities and concentrations of air contaminants that may be emitted from any source;

b) establishing, operating, and maintaining a system of air pollution monitoring stations throughout Canada;

c) collecting, through the operation of air pollution monitoring stations and from other appropriate sources, data on air pollution in Canada and processing, correlating, and publishing such data on a regular basis;

d) conducting research and studies relating to the nature, transportation, dispersion, effects, control, and abatement of air pollution and providing consultative, advisory and technical services, and information related thereto;

e) formulating comprehensive plans and designs for the control and abatement of air pollution and establishing demonstration projects, and publicizing, demonstrating, and making such projects available for demonstration; and

f) publishing or otherwise distributing or arranging for the publication or distribution of information that would serve to inform the public in respect to all aspects of the quality of the ambient air and of the control and abatement of air pollution.

ENVIRONMENTAL PROTECTION SERVICE

The Clean Air Act is administered within the Department of the Environment by the Environmental Protection Service (EPS) through its five regional offices across Canada and through the Air Pollution Control Directorate and the Federal Activities Assessment Branch in Ottawa. A resource summary for the Air Pollution Control Program is shown in Table 1.

Air Pollution Control Directorate

The responsibilities of the Air Pollution Control Directorate (APCD) are divided among three branches.

The **Air Pollution Programs Branch** develops and coordinates Canada's National Air Pollution Surveillance (NAPS) Program and conducts specific ambient air monitoring and source sampling surveys. Nationwide inventories of air contaminant emissions are developed and maintained as prerequisites to the national programs of air pollution

TABLE 1 AIR POLLUTION CONTROL PROGRAM RESOURCE SUMMARY

Fiscal Year	End of year strength	Salaries ($)	Goods and services ($)	Capital ($)	Total expenditure
1971-1972	76	900 000	455 000	660 000	2 015 000
1972-1973	147	1 711 000	644 000	1 079 000	3 434 000
1973-1974	151	1 859 000	1 053 000	958 000	3 870 000
1974-1975	163	2 533 279	1 077 210	1 132 507	4 742 996
1975-1976	176	3 171 686	1 231 818	827 838	5 231 342
1976-1977	165	3 069 500	1 210 300	795 487	5 075 287
1977-1978	156	3 411 000	2 024 800	781 800	6 217 600
1978-1979	147	3 580 000	1 410 000	1 260 000	6 250 000
1979-1980	146	3 800 777	1 126 299	539 395	5 466 471
1980-1981	148	3 681 725	3 452 845	372 354	7 506 924

control and abatement, and serve as an effective means of evaluating the success of control programs. The Branch does air quality trend analyses, population exposure analyses and emission trend analyses for past and future years and also provides data for the development of regulations and guidelines. It coordinates the development and prescription of National Ambient Air Quality Objectives and is also responsible for interservice, intergovernmental and international liaison and coordination. These functions are performed in three divisions: Surveillance, Pollution Data Analysis, and Program Coordination.

The **Abatement and Compliance Branch** is primarily concerned with the application of proven technology to the capture and containment of pollutants from stationary and mobile sources. It is the focal point of engineering and technical expertise on air pollution emissions and control and abatement methods. It prepares technical assessments, state-of-the-art reviews and industry studies used as the basis for the development of air pollution control standards, regulations and guidelines. Government-industry task forces, planned, organized and chaired by the Branch, recommend abatement technology for use in establishing regulations and guidelines. Major stationary sources of air pollution, such as iron and steel mills, non-ferrous smelters, pulp and paper mills, thermal power generating stations and incinerators are under the jurisdiction of three divisions of the Branch: Mining, Mineral and Metallurgical, Chemical Process Sources,

and Combustion Sources. Emissions from motor vehicles, ships, locomotives and aircraft are the responsibility of the Mobile Sources Division. A fifth division, Fuels, develops fuel composition and additive regulations, fuel inventories and emission guidelines for major fuel production or refining sources.

The **Technology Development Branch** has two primary responsibilities. One is to manage a cost-shared program with Canadian industry for the development and demonstration of new air pollution control technology and the other is to provide the technical and scientific services required by the Directorate. These services include the development and certification of analytical techniques required to support regulations and guidelines; the preparation of standard reference materials for analytical laboratories across Canada engaged in the analysis of air pollutants; the provision of a computerized information service on air pollution control; the editing, publishing and distribution of all Directorate scientific and technical reports; the transfer of technical information and technology through seminars; and the training of inspectors, analysts and enforcement officers in federal, provincial and municipal jurisdictions. These functions are performed in three divisions: Control Development, Chemistry, and Publications and Training.

Environmental Protection Service Regional Offices

Contact with provincial environmental protection agencies is maintained chiefly through the five EPS regional offices located in Dartmouth, Montreal, Toronto, Edmonton and Vancouver. Regional Directors provide direction and supervision of EPS programs arising from the Clean Air Act together with policies and commitments resulting from bilateral and international agreements. They also formulate and administer enforcement and other operational programs in accordance with national policies and guidelines.

Federal Activities Assessment Branch

The Federal Activities Assessment Branch, originally established to demonstrate the federal government's resolve to control pollution from its own facilities, now acts in an advocacy and advisory capacity to ensure that the federal government plays a leadership role and that satisfactory control measures are incorporated into the design of federal activities. It is concerned with all forms of pollution and is also responsible for environmental impact assessment of off-shore oil and gas developments, mining activities north of 60° latitude, linear transportation facilities, and the department's nuclear program.

Through both headquarters and regional offices, the Federal Activities Assessment Branch coordinates and provides an overall interface on behalf of EPS for environmental protection matters pertaining to activities of the federal government.

PROBLEM IDENTIFICATION, CHARACTERIZATION AND ASSESSMENT

General

Section 3 of the Clean Air Act makes provision for the collection and publication of data on air pollution. This includes a responsibility for maintaining a continuing record of ambient air pollution levels in urban areas on a national basis, for defining problems through field investigations and emission inventories, and for providing consultative services to federal or provincial agencies on air pollution surveillance.

Emission Inventories

A prerequisite to an effective air pollution control program is an accurate definition of the pollution problem. Such a definition is made by determining the sources and magnitude of emissions, and by measuring the concentration of contaminants in the atmosphere. The latter is accomplished through the NAPS network and ambient air quality studies, which are discussed later, the former by means of national inventories of air contaminant emissions. Inventories are compiled for the five most common air contaminants and for others that are potentially hazardous.

Inventories of potentially hazardous air contaminants. These inventories deal with contaminants that may present a significant danger to human health or the environment. They assist federal and provincial control agencies in developing programs and establishing control priorities. To date, 13 such inventories have been published. During the review period, draft reports for national inventories of the sources and emissions of copper and nickel, cobalt and tin, antimony, bismuth, chromium, barium, phosphorus, chlorine and hydrogen sulphide were prepared. These inventories are expected to be published in the next fiscal year.

A report on the sources and emissions of mercury (base year 1978) was prepared for the purpose of assessing the impact of air pollution control legislation that has been implemented since the original inventory (base year 1970) was written. A final report will be available in the next review period.

Inventories of common air contaminants. One of the first actions taken after passage of the Clean Air Act was to compile and publish a nationwide inventory of air

contaminant emissions in Canada. The first inventory was an overview for 1970 of air pollution problems with respect to the five contaminants most significant in quantity: sulphur oxides, particulate matter, carbon monoxide, hydrocarbons and nitrogen oxides. The inventory was subsequently updated to provide similar overviews of nationwide emissions for 1972, 1974 and 1976. The 1976 inventory was published during the review period and the data are summarized in Table 2. Gridded maps, one for each contaminant, illustrating the emission densities of the contaminants on a 127-km x 127-km grid, were incorporated into the report to give readers a snapshot view of the magnitude and distribution of the emissions across the country.

In addition to showing the magnitude and distribution of emissions, the inventory describes, for each sector emitting any or all of the five contaminants, the process(es) employed, the specific source(s) where the emissions occur, and the type and efficiency of control in place, if any.

National Emissions Inventory System. All inventory information about the five common air contaminants is stored in the computerized National Emissions Inventory System which provides easy retrieval of data and has rapid updating capabilities. In addition to providing information on a provincial or census division basis, the system now has the capability to estimate emissions on a 127-km x 127-km grid cell basis as discussed above regarding the 1976 inventory.

TABLE 2 SUMMARY OF NATIONWIDE EMISSIONS OF AIR CONTAMINANTS, 1976

Category	Emissions (tonnes x 10^3)									
	Particulate matter	% of total	Sulphur oxides*	% of total	Nitrogen oxides**	% of total	Hydro-carbons	% of total	Carbon monoxide	% of total
Industrial processes	1 192	52.2	3 731	70.2	38	2.0	212	8.0	926	6.0
Fuel combustion/ stationary sources	301	13.2	1 499	28.2	652	35.1	142	5.3	266	1.7
Transportation	74	3.2	78	1.5	1 018	54.7	1 037	39.1	8 820	57.3
Solid waste incineration	34	1.5	3	0.1	5	0.3	26	1.0	315	2.1
Miscellaneous	682	29.9	-	-	147	7.9	1 234	46.6	5 071	32.9
TOTAL	2 284	100.0	5 311	100.0	1 860	100.0	2 651	100.0	15 398	100.0

* Expressed as SO_2
** Expressed as NO_2

Information developed for the previously mentioned inventories of potentially hazardous contaminants will be added to the system in the near future.

The inventory is updated biennially; the 1978 revision is in progress.

Long-Range Transport of Air Pollutants

The long-range transport of air pollutants (LRTAP), in particular acid rain and its deleterious effects on sensitive ecosystems in eastern Canada, continued to be the priority of the Air Pollution Control Program in 1980-81. Long a documented problem in Scandinavia and other European countries, acid rain originates principally as emissions of sulphur and nitrogen oxides from such sources as thermal power plants, non-ferrous smelters and motor vehicles. Carried aloft, these pollutants are transformed into acidic substances which fall to the earth often far from the polluting sources.

Federal Control Strategies Program. The federal government of Canada initiated research into acid rain several years ago as a result of new discoveries indicating acidic precipitation to be a far more serious problem than previously believed. In response to the problem of acid rain a Control Strategies Program was launched in cooperation with the concerned and affected provinces. The federal LRTAP/Acid Rain Control Strategies Program is designed to identify, develop and evaluate alternative abatement options and to assess the impact of various U.S. emission reduction scenarios in Canada. The program is designed to provide a clear set of recommendations for domestic programs. Such recommendations would also provide a basis for negotiation of a Canada-U.S. Air Quality Agreement, a goal being actively pursued by Canadian officials.

The Control Strategies Program has four basic components:

1. Source Identification and Application of Control Technology

   An assessment of the major sources of sulphur and nitrogen oxides including non-ferrous smelting, thermal power generation and transportation is nearing completion. Background studies are being conducted in order to assess the size and composition of the emitting industry sectors, the processes used and the resultant emissions. Control technology studies have been designed to review existing, emerging and future methods of emission reduction. Particular emphasis has been placed on putting Canadian industry in a worldwide context.

2. Assessment of Direct Costs and Indirect External Costs of Control

The second component, which is underway, consists of commodity studies, by-product feasibility studies, financial analyses of the application of technological fixes and an analysis of the cost impact of controls on emitting sectors. The data acquired will enable the determination of the social and economic consequences of applying various levels of emission reduction to emitting sources and to other sectors of society.

3. Assessment of Benefits

In the third component, now in the developmental stage, the objective will be to identify the economic and social value of affected sectors of society including such areas as tourism, sport fishing, agriculture and forestry. This information will then be combined with effects information available from scientific studies, and other appropriate sources, to assist in estimating the social and economic significance of the acid rain problem on various sectors of society. The result will provide a base line from which to evaluate the tangible and intangible benefits that would result from various levels of emission reduction.

4. Analysis of Alternatives

Data sets and information gathered in the first three components of the program will be analyzed to develop and evaluate alternative abatement options. Where possible, econometric models will be used to manage economic information.

Federal-Provincial Liaison. In the area of federal-provincial liaison a Canada-Ontario task force was established in August 1980 to assess the abatement options for INCO and Falconbridge Mines. In addition, discussions were held regularly with the affected Canadian provinces to review concerns and progress in both federal and provincial control strategy programs.

Canada/U.S. Acid rain was the dominant issue in Canada's air pollution control activities vis-a-vis the United States during the fiscal year. The Canada-U.S. Bilateral Research Consultation Group's second report was released in November 1980. It confirmed the research results of the first report which indicated that large areas of North America are sensitive to damage from acidic precipitation, and that thousands of lakes in eastern Canada and the United States are already showing the initial signs of

acidification including decreased productivity of fish species as well as spawning failure. In addition, new research has focused on a better delineation of the geographical areas of eastern North America affected by this pollution, and on the ranking of the vegetation, soils and waters there according to their relative susceptibility to injury. These studies are greatly improving our understanding of acidic deposition as an emerging continental problem and are further confirming the importance of classifying the mechanisms by which effects are induced and the way ecosystems are damaged.

On a governmental level, Canada and the United States signed a Memorandum of Intent on August 5, 1980. The Memorandum stated the intention of both nations to vigorously enforce existing legislation governing air pollution and to work towards the development and negotiation of a bilateral agreement on transboundary air quality. To that end, a number of working groups with both Canadian and American membership were formed to study the problems of transborder pollution and provide the information required for the negotiation of an agreement. Their first reports, in a four-stage reporting process, were released in February/March 1981. In brief, they indicated what is known about the problem. Damage to the environment in both countries has been documented and the reports stressed that research must continue in order to develop a clearer understanding of the acid deposition problem.

The amendment to Canada's Clean Air Act in December 1980 was designed to give impetus to Canada's efforts to seek reductions in emissions of acid-causing pollutants in the United States.

A federal interdepartmental LRTAP committee was formed to discuss and coordinate the acid rain programs underway in participating departments. These departments are: Environment, Fisheries and Oceans, Energy, Mines and Resources, National Health and Welfare, Agriculture and External Affairs. Under the management of the main committee are three subcommittees which monitor and coordinate federal scientific, socio-economic and public information activities, respectively. Because of the public information program and the resulting media coverage, public awareness of acid rain increased dramatically as did requests for speaking engagements by the Minister and other senior officials. "Stop Acid Rain" buttons were widely distributed. Efforts aimed at increasing American awareness were intensified, an example being addresses given at the annual meeting of the Air Pollution Control Association, an organization with a predominantly American membership. This meeting was held in Montreal in June 1980. A large acid rain exhibit built by Environment Canada was a feature. The exhibit has since had wide exposure throughout Canada and the United States.

A number of EPS regional and headquarters activities in acid rain are described in the following paragraphs.

The completion of the first phase of the acidification study of 16 lakes in Nova Scotia and southern New Brunswick indicates that all of the study lakes have very low buffering capacities. Sampling of a number of the lakes will be completed in 1981 to determine the effects of seasonal variations.

An analysis of local surface wind direction during the sampling of a rural site in Nova Scotia strongly suggests that approximately 50% of the annual wet deposition of acidic compounds is due to emissions from Halifax-Dartmouth. This indicates that any decrease in acid precipitation in the Atlantic region must come about not only through a reduction in emissions from distant source regions, but also through a reduction within the region itself.

Using modelling techniques, it was estimated that if the planned expansion of the Lingan coal-fired thermal power station does not include sulphur dioxide control, then the increased emissions will result in a 2 to 3% increase in acidic deposition in Newfoundland.

In addition to participating in various committees concerning long-range transport, EPS Ontario submitted a comprehensive report to the Rainy River Water Pollution Board of the International Joint Commission on the effects of acidic precipitation in the Rainy River Basin. The Rainy River Board included a précis of this material in its 29th progress report to the International Joint Commission.

Among the responses to numerous queries from the public regarding acid precipitation was a similar comprehensive review of possible impacts on the Gibson Indian Reserve near Parry Sound, Ontario.

In Quebec, the regional office did an inventory of sulphur dioxide emissions from the combustion of light and heavy oils in the province for the years 1960, 1970 and 1979. Projections were made for the years 1985, 1990 and 1995 for different energy scenarios and control strategies. The study indicated that sulphur dioxide emissions would remain stable or decrease depending on Canadian oil prices, the degree of changeover to natural gas and the reduction in sulphur contents of these light and heavy oils.

In order to verify the national inventory of mercury emissions and improve the data base required for a better understanding of the transport of mercury over long distances, emission factors for two municipal incinerators were determined. The factors were found to be of the same order as those used in the 1970 mercury inventory.

Following extensive literature reviews and discussions with authoritative research scientists and provincial government personnel, it was concluded that acid rain is not presently a large-scale environmental problem in Western Canada. However, the industrial expansion occurring in the West will necessitate careful monitoring of the environment and continued application of strict pollution controls to protect the sensitive ecosystems of the Canadian Shield areas of northeastern Alberta and northern Saskatchewan and Manitoba.

During the review period, the Air Pollution Control Directorate continued work on the identification and quantification of Canadian sources and emissions of compounds implicated in the acid rain problem and in long-range transport in general. Studies focused on both natural and man-made sources in order that atmospheric transport, transformation and deposition can be adequately studied. Comprehensive inventories for sulphur dioxide and nitrogen oxides were completed for use in modelling activities. Reports on natural sources and emissions of nitrogen and organic compounds were published, with further reports on natural mercury and natural particulate emissions to be published in the next fiscal year.

Another significant element of the long-range transport phenomenon is primary fine particulate matter. In order to develop a clear understanding of the severity of this problem, a study was undertaken to determine sources and emissions of anthropogenic primary fine particulate matter less than 15 micrometres in diameter. A study of emissions of organic compounds from anthropogenic sources was also initiated. Organics are a major concern because of their role in the formation of smog through photochemical reactions with nitrogen oxides under irradiation. Reports from these studies will be published in the next fiscal year.

A study to determine the seasonal variation in emissions of sulphur dioxide and nitrogen oxides was completed. Further work on the remaining three common air contaminants will be done in the next review period.

Air Quality Monitoring

The National Air Pollution Surveillance (NAPS) Network. As of March 31, 1981 the NAPS network consisted of 518 air monitoring instruments at 161 sampling stations located in the following cities: St. John's, Charlottetown, Halifax, Sydney, Glace Bay, Fredericton, Saint John, Moncton, Montreal, Hull, Quebec City, Sherbrooke, Chicoutimi, Rouyn, Sept-Îles, Trois-Rivières, Arvida, Tracy, Thetford Mines, Shawinigan, Baie-Comeau, Ottawa, Windsor, Kingston, Toronto, Hamilton, Sudbury, Sault Ste. Marie,

Thunder Bay, London, Sarnia, Peterborough, Cornwall, St. Catharines, Kitchener, Brantford, Oakville, Winnipeg, Brandon, Regina, Saskatoon, Moose Jaw, Prince Albert, Edmonton, Calgary, Red Deer, Medicine Hat, Lethbridge, Yellowknife, Vancouver, Prince George, Victoria, Kamloops and Whitehorse. This coverage includes 43 stations that provide continuous monitoring for all five of the most common air contaminants. An additional five stations monitor all but one parameter continuously. Of the 518 instruments, 85 monitor sulphur dioxide, 51 monitor carbon monoxide, 49 monitor nitrogen dioxide and 47 monitor ozone, all on a continuous basis. Suspended particulate matter is monitored by 115 high-volume samplers operating every sixth day over a twenty-four-hour period.

All NAPS stations except those in the National Capital area, the Yukon and the Northwest Territories are now operated by the provinces and municipalities who receive technical assistance and training from EPS regional and headquarters personnel in the maintenance and repair of monitoring equipment.

Particulate matter is analyzed for lead, sulphates and nitrates. Routine analysis for particulate sulphates and nitrates began in 1980 because they are major contributors to the problem of long-range transport of air pollutants. Information gained will support studies underway to document the effects of long-range transport, particularly the effects of acid rain.

Supporting this particulate sulphate and nitrate monitoring program was a contract report on the evaluation of various filter media available for use in high-volume samplers. The evaluation was based on all available published research results from North American researchers and on experimental field data obtained by APCD.

A complementary project was the analysis of archived high-volume filters for sulphates. Archived filters beginning with the year 1969, the first year of the NAPS network, were all analyzed up to 1979 for nine selected stations across Canada that were in existence throughout the 1970s. This retroactive analysis will serve to define the trend for sulphates.

The increasing concern about inhalable fine particulates as a hazardous air contaminant is expected to bring about the need for monitoring on a nationwide basis in the 1980s. During the fiscal year, seven new dichotomous samplers for fine particulates were deployed in the major cities of the network, and a pilot monitoring project was begun. The results of a field evaluation program previously carried out by APCD to evaluate high-volume cascade impactors for the monitoring of fine particulates were presented in a contract report.

Another special project undertaken in the NAPS network was to relate the ambient particulate lead concentrations measured at the two downtown roof-top stations in Toronto and Ottawa to the lead concentrations that would exist at street level. The data are being analyzed and the results will be reported in May 1981.

NAPS data, to be useful, must be representative, accurate, precise and complete. Accordingly, a formal, continuous quality assurance program is needed to ensure that these criteria are satisfied. The program includes standardization of field calibration materials, routine multi-point calibrations on all continuous gaseous analyzers, and performance audits. Ninety-one monitors were audited and 19 found to be unsatisfactory.

Comprehensive site documentation information collected for 50 major NAPS stations was finalized and will be published early in fiscal year 1981-82. The information, comprising details on instrument characteristics and measurement principles as well as panoramic photographs of each site, will aid in interpreting NAPS data.

New ozone photometer reference standards traceable to the National Bureau of Standards (NBS) were established at the Ottawa calibration laboratories. All calibrations of NAPS ozone monitors may now be referenced to NBS standards as were previously the calibration of all of the other monitors (sulphur dioxide, carbon monoxide, nitrogen dioxide and suspended particulates).

The 1979 NAPS Annual Summary and twelve monthly summaries were published during the fiscal year. Data from the annual summaries, updated to 1980, on suspended particulates and lead are given in Tables 3 and 4 for selected stations. The annual summary was improved through a new section which analyzes the data with respect to the National Air Quality Objectives and reports the air quality at each NAPS station in relation to these objectives.

Headquarters laboratory support to NAPS included analysis of almost 400 fine particulate samples for sulphates and nitrates; 1983 high-volume sampler filters for lead and 2300 filters for sulphates and nitrates.

Air Monitoring Surveys. EPS headquarters and regional staff again took part in numerous air quality monitoring surveys across the country. These surveys are usually in response to severe local or regional problems that have surfaced or been identified by communities or municipalities. EPS staff cooperate by helping to set up equipment and train operators, as well as analyzing samples and advising on controls. Other surveys may

TABLE 3 NATIONAL AIR POLLUTION SURVEILLANCE DATA FOR SUSPENDED PARTICULATES — SELECTED SITES, 1975-80

Location	Annual geometric mean (micrograms per cubic metre)					
	1975	1976	1977	1978	1979	1980
St. John's, Duckworth & Ordinance	*	50	*	37	45	48
Charlottetown, 56 Fitzroy	*	44	39	32	43	*
Halifax, N.S. Tech. College	52	49	47	42	39	*
Sydney, County Jail	*	73	53	52	57	65
Fredericton, York	46	43	52	52	47	51
Saint John, 110 Charlotte	55	53	62	57	58	68
Montreal, 1212 Drummond	101	78	74	76	76	65
Montreal, Duncan & Décarie	136	112	99	121	141	149
Montreal, 2900 boul. Concorde		68	59	62	63	59
Hull, Gamelin & Joffre			*	41	38	42
Quebec, Parc-Autos Paquet-Laliberté	103	85		76	89	93
Sherbrooke, Wellington & Albert	*	54	*	*	*	65
Chicoutimi, 222 Racine				73	68	62
Rouyn, Hôtel de Ville	*	*	*	31	32	34
Trois-Rivières, Hart & Ste-Cécile		72	51	89	71	78
Arvida, Powell & Hoopes		*	*	66	78	62
Tracy, Garneau & Rte 132			56	56	45	48
Shawinigan, Frigon & Laval			*	147	137	113
Ottawa, Slater & Elgin	77	60	63	56	55	57
Windsor, City Hall	80	76	83	79	74	77
Kingston, Queen's University	42	38	36	30	24	36
Toronto, 67 College	71	63	67	65	78	72
Toronto, Lawrence & Kennedy		65	58	60	67	69
Toronto, Elmcrest		*	49	*	61	54
Hamilton, Barton & Sanford	98	101	85	*	96	89
Sudbury, 19 Lisgar	48	46	44	48	51	55
Sault Ste. Marie, 550 Queen St. W.				62	*	*
Thunder Bay, 14 Algoma	54	*	49	42	39	46

*Insufficient data available to calculate valid annual geometric mean concentrations.

TABLE 3 NATIONAL AIR POLLUTION SURVEILLANCE DATA FOR SUSPENDED PARTICULATES -- SELECTED SITES, 1975-80 (Continued)

Location	Annual geometric mean (micrograms per cubic metre)					
	1975	1976	1977	1978	1979	1980
London, King & Rectory	73	64	62	73	77	83
Sarnia, Front				*	67	76
Peterborough, 500 George		*	*	42	60	53
Cornwall, Memorial Park		44	46	43	57	52
St. Catharines, North & Geneva		*	69	60	66	64
Brantford, Dalhousie & Queen		57	53	49	*	*
Kitchener, Edna & Frederick			54	68	*	64
Oakville, Rebecca & Woodside			38	44	50	*
Winnipeg, Jefferson & Scotia		57	43	36	39	36
Winnipeg, 65 Ellen				76	73	78
Brandon, 11th & Princess	49	62	59	*	*	58
Regina, 12th & Smith	64	57	58	47	*	62
Saskatoon, 30th St. & 833 P Ave.	55	63	53	52	58	53
Moose Jaw, airford & 1st Ave.	74	74	65	53	60	66
Prince Albert, 1257-1st Ave. E.	68	73	73	*	*	64
Edmonton, 100 St. & 102 Ave.	117	137	92	63	79	*
Calgary, 316-7th Ave.	*	111	93	94	113	159
Red Deer, 4747 50th	57	63	66	53	68	70
Lethbridge, 13th St. & 9th Ave. S.	37	46	44	45	56	53
Yellowknife, 50th Ave. & 51st St.	*	54	*	*	50	68
Vancouver, 970 Burrard	*	68	69	67	62	70
Victoria, 1106 Cook	*	47	50	44	42	46
Kamloops, 301 Seymour				*	96	95
Whitehorse, Federal Bldg.85	52	51	61	62	102	57

*Insufficient data available to calculate valid annual geometric mean concentrations.

TABLE 4 NATIONAL AIR POLLUTION SURVEILLANCE DATA FOR PARTICULATE LEAD -- SELECTED SITES, 1975-80

Location	Annual geometric mean (micrograms per cubic metre)					
	1975	1976	1977	1978	1979	1980
St. John's, Duckworth & Ordinance	*	0.44	*	0.31	0.26	0.21
Charlottetown, 56 Fitzroy	*	0.24	0.23	0.18	0.11	*
Halifax, N.S. Tech. College	0.30	0.20	0.18	0.16	0.10	*
Sydney, County Jail	*	*	0.42	0.29	0.17	0.18
Fredericton, York	0.76	0.55	0.42	0.32	0.39	0.34
Saint John, 110 Charlotte	0.47	0.31	0.23	0.19	0.21	0.19
Montreal, 1212 Drummond	*	1.01	*	0.73	0.64	*
Montreal, Duncan & Décarie	2.62	2.26	1.61	1.35	1.36	1.35
Montreal, 2900 boul. Concorde		0.57	0.42	0.35	0.35	0.29
Hull, Gamelin & Joffre			*	0.32	0.27	0.26
Quebec, Parc-Autos Paquet-Laliberté	1.03	*	*	0.71	0.66	0.57
Sherbrooke, Wellington & Albert	*	*	*	*	*	0.35
Chicoutimi, 222 Racine				*	0.51	0.59
Rouyn, Hôtel de Ville	*	*	*	*	0.36	0.40
Trois-Rivières, Hart & Ste-Cécile				0.38	0.35	0.36
Arvida, Powell & Hoopes			*	0.47	0.37	0.45
Tracy, Garneau & Rte 132			0.30	0.23	0.21	*
Shawinigan, Frigon & Laval				0.28	0.25	0.25
Ottawa, Slater & Elgin	1.18	0.81	0.67	0.53	0.50	0.39
Windsor, City Hall	0.70	0.60	0.62	0.68	0.38	0.35
Kingston, Queen's University	0.24	0.21	0.13	0.13	0.09	0.10
Toronto, 67 College	0.91	*	*	0.66	0.44	0.28
Toronto, Lawrence & Kennedy		*	*	0.42	0.34	0.28
Toronto, Elmcrest		*	*	*	0.21	0.12
Hamilton, Barton & Sanford	0.88	*	*	*	0.62	0.50
Sudbury, 19 Lisgar	0.65	*	0.37	0.43	0.36	*
Sault Ste. Marie, 550 Queen St. W.				*	*	*
Thunder Bay, 14 Algoma	0.43	*	0.39	0.23	0.22	*

*Insufficient data available to calculate valid annual geometric mean concentrations.

TABLE 4 NATIONAL AIR POLLUTION SURVEILLANCE DATA FOR PARTICULATE LEAD -- SELECTED SITES, 1975-80 (Continued)

Location	Annual geometric mean (micrograms per cubic metre)					
	1975	1976	1977	1978	1979	1980
London, King & Rectory	0.78	*	0.55	0.58	0.47	0.35
Sarnia, Front				*	0.19	0.11
Peterborough, 500 George			*	0.38	0.34	0.30
Cornwall, Memorial Park		*	*	*	*	0.07
St. Catharines, North & Geneva				0.35	0.26	0.15
Brantford, Dalhousie & Queen		*	*	0.29	*	*
Kitchener, Edna & Frederick				0.76	*	0.45
Oakville, Rebecca & Woodside			*	*	0.25	*
Winnipeg, Jefferson & Scotia		0.28	0.31	0.22	0.34	0.29
Winnipeg, 65 Ellen				0.50	0.58	0.52
Brandon, 11th & Princess	0.27	0.22	0.26	*	*	0.33
Regina, 12th & Smith	0.41	0.32	0.25	0.25	*	0.22
Saskatoon, 30th St. & 833 P Ave.	0.15	0.11	0.10	0.10	0.12	0.13
Moose Jaw, Fairford & 1st Ave.	0.29	0.21	0.16	0.15	0.16	0.16
Prince Albert, 1257-1st Ave. E.	0.26	0.23	0.22	*	*	0.18
Edmonton, 100 St. & 102 Ave.	0.32	0.40	0.32	0.35	*	*
Calgary, 316-7th Ave.	*	0.22	0.36	0.33	*	*
Red Deer, 4747 50th	0.17	0.19	0.17	0.21	*	*
Lethbridge, 13th St. & 9th Ave. S.	0.12	0.09	0.05	0.08	*	*
Yellowknife, 50th Ave. & 51st St.	*	0.10	*	*	0.22	0.21
Vancouver, 970 Burrard	*	1.29	0.98	0.80	0.75	0.73
Victoria, 1106 Cook	*	0.61	0.59	0.42	0.42	0.40
Kamloops, 301 Seymour				0.53	0.55	0.47
Whitehorse, Federal Bldg.85	0.29	0.26	0.19	0.24	0.19	0.19

*Insufficient data available to calculate valid annual geometric mean concentrations.

be initiated simply with a view to monitoring potential problems. In most cases the surveys continue for more than one year.

On May 18, 1980, in what has been described as one of the continent's largest pollution episodes, Mount St. Helens erupted with devastating force, spewing millions of tonnes of volcanic ash into the skies over Washington and its neighbouring states. Canada was not to be spared the volcano's effects, as day became dusk even in such distant downwind cities as Lethbridge, Regina and Winnipeg. To monitor the rapidly changing air quality, NAPS particulate samplers operated by provincial agencies were used across the Prairies. For a time, Canadian measurements of suspended particulates (ash) were well above National Air Quality Objective maximum tolerable levels, but whether or not there was any significant impairment to the health of Canadians is not known.

During the summer of 1980, a special intensive ozone survey was carried out in the National Capital area. This survey attempted to establish the means of defining the ozone pollution in an urban area through ground-based monitoring stations and especially to establish the relationship between ozone levels measured at urban NAPS stations throughout the country and the levels that could exist in the whole region surrounding the station.

EPS continued to participate in the Nanticoke Environmental Monitoring Program established several years ago to assess the pollution levels resulting from new industrial activity in the Nanticoke area on Lake Erie. The program to monitor automobile-related pollutants and wood combustion emissions during the cold weather season in Whitehorse continued. It has been found that sharp increases occur in carbon monoxide levels coincident with very cold days when strong inversions trap pollution from automobiles and home heating systems. Monitoring for particulate lead from secondary lead smelters in Winnipeg, and hydrogen sulphide and sulphur dioxide at the Gold River Indian Reserve in British Columbia also continued. Residents of the reserve had raised concerns about these two pollutants which were being released from a nearby pulp mill. The two-year sampling program ended during the fiscal year and data have been sent to Health and Welfare Canada for inclusion in its report on the study.

The ambient air fluoride monitoring program on Cornwall Island continued throughout the 1980 growing season and into the 1980-81 winter season. During the 1980 growing season, the particulate and gaseous fluoride levels were about the same as the previous year. However, for the first time since sampling began, the gaseous fluoride levels at the eastern station were generally higher than those measured at the western

station. The reason for this is not readily apparent so it is hoped that the results of the 1981 monitoring will provide some insight.

The fluoride monitoring network on Cornwall Island was expanded in November 1980 with the addition of a third sampling location. Two types of monitors were installed at this site: a modified sequential sampler similar to those at the other stations but using a flow-control device, and a directional sampler.

Health and Welfare Canada has formally begun a major health effects study on the island. This study along with the air monitoring survey results will be of major importance to concerned parties on both sides of the border.

A B.C. government committee formed in 1978 to assess the potential impact of the proposed Ridley Island coal terminal on a nearby pulp mill published its final report in 1980. Recommendations were made for mitigating measures to be applied to the terminal and the rail transportation system. The B.C. Ministry of the Environment subsequently developed an implementation plan to ensure that coal dust control measures will be incorporated into the design of the coal terminal, rail transportation system and the coal mines associated with the development of the northeastern B.C. coalfields.

The program to monitor coal dust emissions from unit coal trains passing through Agassiz, B.C. continued with EPS support. A close watch is maintained over offending trains and the coal mining companies are notified when corrective action is required. The Canadian Transport Commission has also directed the rail companies to reduce train speeds through the town whenever excessive dusting occurs. These monitoring activities are also applied to other residential areas where complaints are made.

During the period of May 28 to July 9, 1980, an ambient air survey for asbestos fibres was done in Baie Verte, Newfoundland, by EPS in cooperation with the Newfoundland Department of the Environment. Over 90 samples were collected during the study and analyzed by the electron microscope method by McMaster University laboratories in Hamilton. The results of the analysis were passed on to the province for an interpretation of any potential health effects to residents in the area.

A field station for evaluating air monitoring devices under realistic and typical high traffic urban conditions has been set up in the Ottawa area. Air monitors under evaluation at the field station in 1980-81 were nitrogen oxides monitors, data loggers and a new organic contaminants analyzer. Major projects being prepared for the summer of 1981 will evaluate monitors for toxic organic pollutants and fine particulates.

General. Development of standard reference methods for the measurement of mercury, arsenic and benzene in the ambient air continued.

Trend Analysis

During the review period, a national trend analysis of 1970-79 NAPS air quality data was completed. Results for the 1974-79 period are shown in Tables 5 and 6.

TABLE 5 AVERAGE OF THE ANNUAL MEANS OF NAPS STATIONS FOR 1974-79

Contaminant	1974	1975	1976	1977	1978	1979	Change 1978-79	Change 1974-79
Sulphur dioxide (pphm)	1.6	1.5	1.4	1.4	1.3	1.2	-8%	-25%
Suspended particulates ($\mu g/m^3$)	78.6	65.9	65.7	61.9	61.4	66.0	+7%	-16%
Lead ($\mu g/m^3$)	0.68	0.55	0.49	0.46	0.42	0.39	-7%	-43%
Nitrogen dioxide (pphm)	-	-	-	3.17	2.85	2.55	-11%	-
Carbon monoxide (ppm)	2.44	1.89	1.60	1.55	1.53	1.69	+10%	-31%
Soiling Index (COH)	0.38	0.28	0.28	0.27	0.25	0.28	+12%	-26%
Ozone (pphm)	-	-	-	-	-	1.5	-	-

TABLE 6 PERCENTAGE OF NAPS STATIONS EXCEEDING MAXIMUM ACCEPTABLE ANNUAL LEVELS OF AIR QUALITY OBJECTIVES, 1974-79

Objective	1974	1975	1976	1977	1978	1979
Sulphur dioxide (annual)	18	11	10	5	7	4
Suspended particulates (annual)	49	42	37	24	27	34
Nitrogen dioxide (annual)	N/A	N/A	N/A	4	0	0
Carbon monoxide (8 hours)	29	27	16	10	8	20
Ozone (annual)	N/A	N/A	N/A	N/A	N/A	50

N/A - not available

Population exposure analyses were initiated. Further work in this area will be performed in the next fiscal period. Emissions of sulphur dioxide from copper-nickel smelter complexes for the period 1950-2000 were determined and summarized in a published report. Other sectors, including thermal power generation and natural gas processing, will be studied later.

Work began on estimating emissions for the five common air contaminants for the years 1955 and 1965. A report summarizing these data is expected to be completed in the next fiscal year.

TECHNOLOGY

Program for the Development and Demonstration of Pollution Abatement Technology (DPAT). Section 3 of the Clean Air Act provides for federal financial support of control technology development projects. Out of this authority came, on April 1, 1975, the DPAT Program of cost-shared agreements with industry to develop and demonstrate new control technology. In the air sector, emphasis was placed initially on the development of technology for the capture and containment of fine particulates and sulphur dioxide. Later the program was broadened to include pollutants for which regulations and guidelines have been published or are under development.

Fiscal constraints resulted in termination of the program's funding on March 31, 1979; however, the program itself was not terminated and two existing projects were supported by APCD during the fiscal year, as described below.

At the St. Anne-Nackawic Pulp and Paper Company Ltd. in New Brunswick, the collection efficiency of a scrubber, installed on the kraft recovery furnace for the capture of particulates and sulphur compounds, exceeded design requirements. Unfortunately, before optimization studies on the operation of the scrubber could be conducted, it was destroyed by a fire caused by unrelated factors. However, enough information was obtained to confirm that the scrubber performed to expectations and, based on this experience, a number of Canadian kraft mills are now installing similar systems. A report on the project was written.

The other DPAT contract, with the Algoma Steel Corporation Ltd., was for the demonstration of a high-pressure water-jet system for cleaning coke oven doors. During the coking cycle, volatile matter from the coal condenses on the oven doors and door jambs, which are cooler than the oven. To obtain satisfactory door sealing and thereby minimize the emission of hydrocarbons into the atmosphere from leakage, these deposits must be removed, preferably after each cycle. At present, this is done

mechanically by scraping, a method that is not satisfactory. However, this study showed that the high-pressure water-jet system is a much more effective means of cleaning the doors and thus decreasing emissions into the atmosphere.

Projects Sponsored under the Department of Supply and Services' Unsolicited Proposal Program. This program provides bridge financing for unsolicited proposals in science and technology submitted by the private sector that are worthy of support by one or more government departments. The following three projects are now receiving support from EPS.

A study to evaluate the significance of urban road dust as a source of suspended particulate matter in the air in the urban Hamilton area neared completion. The draft final report is expected to appear early in the next fiscal year. Some of the information from the study was presented at a conference on the Hamilton environment held in that city in the fall of 1980. All participants in the project, including APCD and EPS Ontario, the Ontario Ministry of the Environment, Stelco, Dofasco, and the City of Hamilton, believe the findings will be important in particulate control strategies in urban areas in the future.

An agreement was drawn up with the Department of Energy, Mines and Resources and the Department of National Defence for joint participation in a project to demonstrate the capabilities of a low-NO_x burner. The project will involve installation and testing of a limestone injection multi-stage burner at the coal-fired heating plant at CFB Gagetown, New Brunswick. It is expected that this novel burner will reduce nitrogen oxide emissions from pulverized-coal-fired commercial boilers. The project was initiated through APCD's involvement in the International Energy Agency.

A proposal to improve demister effectiveness by cooling tenter frame effluent gases in the textile dyeing industry was submitted by Le Centre de Développement Technologique de l'École Polytechnique de Montréal. Accepted for funding, the project is aimed at providing the textile industry with an effective tenter frame organic emissions treatment system at an acceptable cost for small and medium businesses. A pilot system has been developed and tested under both laboratory and plant conditions.

Other Technology Development Programs. Modifications made to the Enterprise Development Program (EDP) of the Department of Industry, Trade and Commerce now ensure that federal support for the development of pollution abatement technology will be maintained following the discontinuation of funding for the DPAT and CPAR programs in 1979.

Three proposals were supported under the EDP. One, from McMillan Bloedel Research Ltd., involves both the optimization of a two-stage black liquor system to minimize the emission of sulphur compounds from kraft recovery boilers, and an energy-economic analysis, from the air-pollutant emission perspective, of three methods of meeting emission standards for recovery furnaces.

A second, submitted by Syncrude Research Limited, proposes the addition of lime to fluid-bed cokers to contain the bitumen sulphur as calcium sulphide. The petroleum coke formed during the operation will be burned in the auxiliary burners to produce the heat required for the coker operation. The sulphur in the coke is oxidized to calcium sulphate which is impounded instead of being released into the atmosphere as sulphur dioxide.

The third EDP proposal involves the development by Metrex Ltd. (Toronto) of a laser-based instrument to determine, on a continuous basis, the mass emissions of particulates from industrial sources. The successful development of such an instrument would represent a major advance in particulate sampling, which is currently done on a discontinuous basis.

A number of other submissions under the Enterprise Development Program are now in the assessment stage.

Technical Information Dissemination. The Air Pollution Information System, established in 1973, responds to the information requirements of the Canadian air pollution control and research community as well as providing a current awareness service to keep senior management and other staff in the regions and headquarters abreast of new developments. Free searches of the Environmental Protection Agency APTIC file are provided to all levels of government. Searches for any other group are done at cost. During the review period, 200 computerized literature searches were completed and more than 3500 information requests were answered. The system has more than 100 000 documents available on microfiche, a journal collection of over 80 titles and over 6000 documents in hard copy.

This information collection is available to any interested person. Special files are kept on issues of high profile. A series of vertical files on selected air pollution topics has been produced.

Training in Air Pollution Control Technology. EPS headquarters and regions again supported regulatory activities across Canada, by presenting five air pollution control training courses for enforcement officers of the federal, provincial and municipal governments, and industry personnel. There were three on stationary source testing (two

on particulates in Vancouver and one on gases in Sherbrooke) and two on air pollution meteorology, in Bedford, N.S. and Montreal.

Courses for inspectors in the reading of plume opacity were held in the EPS Quebec region during the review period. Thirty-six inspectors were certified. Courses are held at six-month intervals for recertification.

EPS Quebec played a large role in helping to coordinate arrangements for the annual meeting of the Air Pollution Control Association held in Montreal in June 1980 and attended by over 5000 persons. Several headquarters and regional personnel took part in the program.

As in past years, EPS regions participated in numerous regional events such as seminars, conferences and exhibitions, often in cooperation with municipalities.

Publications. During the review period, 26 technical reports in the EPS national series were edited and published by APCD. Overall, about 20 000 copies of reports, news releases, Canada Gazette announcements and factsheets were distributed.

The reports published during the review period were the following:

Regulations, Codes and Protocols Series

EPS 1-AP-73-3 Standard Reference Methods for the Determination of Lead in Automotive Gasoline (Atomic Absorption) (Revised) (Bilingual)

EPS 1-AP-79-1 Standard Reference Methods for Source Testing: Measurement of Emissions of Arsenic from Gold Roasting Operations (Bilingual)

Economic and Technical Review Series

EPS 3-AP-76-6F Assainissement de l'air dans les mines et les usines de broyage d'amiante

EPS 3-AP-77-3F Émissions des incinérateurs compacts et techniques antipollution

EPS 3-AP-79-6 Air Pollution Emissions and Control Technology: Thermal Power Generation Industry Vol. 2 - Particulate Emissions from Steam-Powered Stations

EPS 3-AP-79-8 A Study of Sulphur Containment Technology in the Non-ferrous Metallurgical Industry

EPS 3-AP-80-1 A Nationwide Inventory of Emissions of Air Contaminants, 1976

EPS 3-AP-80-2 Air Pollution Emissions and Control Technology: Asbestos Manufacturing Industry

EPS 3-AP-80-4 National Inventory of Natural Sources and Emissions of Nitrogen Compounds

EPS 3-AP-80-5 Copper-Nickel Smelter Complexes in Canada: SO_2 Emissions (1950-2000) (Bilingual)

Surveillance Series

EPS 5-AP-79-11 and 79-12 National Air Pollution Surveillance Monthly Summaries, November and December 1979 (Bilingual)

EPS 5-AP-80-1 to 80-6 National Air Pollution Surveillance Monthly Summaries, January to June 1980 (Bilingual)

EPS 5-AP-80-13 National Air Pollution Surveillance - A Comparison of 1978 NAPS - Network Data with National Air Quality Objectives (Bilingual)

EPS 5-AP-80-14 National Air Pollution Surveillance - Special Sulphate and Nitrate Study, July 26 - November 11, 1979 (Bilingual)

EPS 5-AP-80-15 National Air Pollution Surveillance Annual Summary, 1979 (Bilingual)

Miscellaneous Publications

National Inventory of Natural Sources and Emissions of Organic Compounds

List of Publications - Air Pollution Control Directorate (Bilingual)

Clean Air Act Annual Report 1979-1980 (Bilingual)

Guidelines for an Annual Air Quality Index (Bilingual)

Étude du marché de l'acide sulfurique produit par les fonderies canadiennes de métaux non ferreux

Proceedings of Second Canadian Government Affairs Seminar: The Regulatory Process and Today's Air Pollution Problems

DEVELOPMENT OF PREVENTION AND CONTROL MEASURES

Regulations for Stationary Sources

Section 7 of the Clean Air Act empowers the Governor in Council to prescribe national emission standards for air contaminants that constitute a significant danger to human health*. The Air Pollution Control Directorate consults with the Health Protection Branch of Health and Welfare Canada to obtain advice on the potential health hazards of such contaminants. To date, based on Health and Welfare Canada's recommendations, action has been taken to regulate lead, mercury, asbestos and vinyl chloride from certain sources. Regulations governing other sources and contaminants have been proposed or are under development, as follows.

Arsenic (Gold Roasting). A major source of emissions of arsenic into the atmosphere is gold roasting. Proposed regulations concerning the emission of arsenic from gold roasting operations have been published in Part I of the Canada Gazette. During the year the standard reference method for the measurement of these emissions was published. Meetings were held with one of the four mining companies involved, for the purpose of developing implementation strategies for the regulations. The final regulations are expected to be published in the next fiscal year.

Asbestos (Manufacturing). Work continued on the development of national emission standards regulations for asbestos manufacturing operations. The industry study was published.

Lead, Mercury and Arsenic (Non-ferrous). The non-ferrous smelting industry in Canada is a major source of emissions of lead, mercury and arsenic. The development of regulations to limit these emissions continued.

The standard reference method for measuring lead emissions was field-tested several times. Completion of the method will follow after a complete review of the test results. The proposed method for mercury was field-tested twice and found to be acceptable. Final preparation of the method has begun. After two field tests, problems continue with the proposed arsenic method. Completion will hinge on resolution of the problems.

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*Report EPS 1-AP-81-1, entitled "The Clean Air Act - Compilation of Regulations and Guidelines", contains all regulations, guidelines and air quality objectives published in the Canada Gazette up to December 31, 1980.

Fuels Regulations

A notice was published in the Canada Gazette on October 25, 1980 stating the department's intention to investigate the merits of developing regulations to reduce the lead content of motor gasoline. Consultants are conducting studies and a socio-economic impact assessment should be completed during the next fiscal year.

Regulations for Mobile Sources

Under the Motor Vehicle Safety Act, Transport Canada is responsible for the administration of the Motor Vehicle Emissions Regulations and Environment Canada for the required compliance testing and technical advisory services in support of the regulations.

The federal government, in the past, followed the policy of paralleling U.S. motor vehicle emission regulations. The Canadian standards for 1975 were established at 2.0, 25.0 and 3.1 grams per mile (CVS-CH test procedure) for hydrocarbons, carbon monoxide and oxides of nitrogen, respectively. In July, 1978, Transport Canada announced that these standards, which reduce emissions to about 72% of uncontrolled values, will remain the same through the 1984 model year. Corresponding U.S. standards for 1981 and later require about 95% control. A new standard designed to limit carburetor maladjustment on in-use vehicles was promulgated by Transport Canada in June 1980, for the 1982 model year.

Guidelines for Stationary Sources

Section 8 of the Clean Air Act makes provision for the federal government to publish national emission guidelines governing emissions of pollutants from certain industrial sources, stationary or otherwise. Each guideline consists of a document specifying emission limits for new sources and an industry study report in which available emission control strategies for existing sources are assessed. The technical review and assessment of control strategies is done by committees of representatives from federal and provincial governments and industry. The limits specified in the guidelines can become enforceable if they are prescribed by other regulatory agencies (provinces or municipalities) as standards or requirements. Guidelines have been published for the cement industry, the asphalt paving industry, the coke oven industry, arctic mining operations, the wood pulping industry and for packaged incinerators.

Packaged Incinerators. National emission guidelines for new packaged incinerators were published in Part I of the Canada Gazette on November 25, 1978.

The draft standard reference method for measuring hydrogen chloride emissions from such incinerators was modified to increase the volume of sample collected. Final preparation of the method has begun.

Wood Pulping Industry. National emission guidelines for new kraft pulping plants, new sulphite pulping plants and new steam-producing combustion facilities associated with these plants were published in Part I of the Canada Gazette on September 22, 1979.

Modifications were made to the TRS (total reduced sulphur) standard reference method. Field testing of these modifications at a kraft mill included a comparison against other TRS procedures. The method is expected to be published in the next fiscal year.

Ferrous Foundries. A draft guideline recommending emission limits for this industry is under study.

Thermal Power Generation. National emission guidelines for thermal power stations were finalized and will be published in the Canada Gazette early in the next fiscal year. As a contribution toward control of acid rain, they specify emission limits for sulphur dioxide, nitrogen oxides and particulate matter. One supporting document, the industry study report on particulate emissions, was published during the fiscal year. Supporting documents on the other two pollutants are being prepared. All three discuss emissions and control technologies.

Petroleum Refineries. Preparation of the industry study report on petroleum refining and identification of emission limits continued. The draft of the standard reference method for carbon monoxide emissions underwent further review.

Natural Gas Processing. The development of recommended emission limits for this industry sector continued. The associated industry study report is undergoing further review.

Other Industry Sectors. Comments on the proposed emission guideline and the background report for the iron and steel industry were received and reviewed. The report will be completed in the next fiscal year. A ferroalloy production and allied industries report, slated for publishing in the next fiscal year, was completed. The fertilizer industry study report was reviewed by the provinces and the Canadian Fertilizer Institute. A review of automotive and light-duty truck surface coating operations has been made,

with a questionnaire to be sent to 13 automobile plants requesting information on emissions of volatile organic compounds. A study of sulphur control in the non-ferrous metallurgical industry was published as a contribution toward the control program for acid rain.

Guidelines for Mobile Sources

There are no direct provisions in the Clean Air Act for the regulation of air pollution emissions from mobile sources. The Act does, however, address itself to mobile sources under its general provisions for air quality objectives, air quality monitoring and surveillance, vehicle emissions, fuel composition regulations and federal-provincial co-operative programs, and therefore allows for the development of guidelines governing these sources.

The development of a proposed guideline for in-use vehicles was completed. It is now under review. The accompanying background report was also completed and will be published in the next fiscal year.

Two projects were carried out in support of the guideline program. In Charlottetown, the P.E.I. Energy Corporation, the Nova Scotia Technical College and EPS cooperated in a survey in which about 500 automobiles were tested and, where possible, minor adjustments were made to improve fuel economy and reduce emissions. A similar test on over 250 cars was conducted in Rimouski, Quebec as part of local Environment Week festivities. Only about 27% of the cars had satisfactory pollution levels. It is estimated that the minor carburetor adjustments improved fuel economy by 2-12% and emissions control by 20-50%. Results from the two surveys were similar to those from inspection projects in other Canadian cities over the past five years.

IMPLEMENTATION OF PREVENTION AND CONTROL MEASURES

Implementation of Regulations for Stationary Sources

Secondary Lead Smelters. National Emission Standards Regulations for Secondary Lead Smelters were promulgated in Part II of the Canada Gazette on July 28, 1976 and became effective on August 1, 1976.

All nine secondary lead smelter plants in the Pacific Region are located in the Vancouver area. They operate under permits issued by the Greater Vancouver Regional District (GVRD) which has applied the requirements of both the federal and provincial standards. In early 1980, one plant terminated its lead melting operations. Annual

inspections were made by the GVRD and EPS and all plants were found to be in compliance. In Alberta, all three plants have been licensed by the province. In Manitoba, test results showed that one plant in Winnipeg was emitting lead into the ambient air in quantities well above limits specified in the regulations. The Crown is proceeding with prosecution of the offender. Lead emissions from the two other plants in the province declined from those of the previous year. In Ontario, the province placed a control order on one of the largest smelters in the province and a significant improvement in air quality in the vicinity of the plant has occurred. Of the two other plants found to be out of compliance in 1979-80, one is committed to control equipment improvements and a source testing program to ensure compliance by the fall of 1982. Source testing was done at the other plant and action is being pondered by the province. In Quebec, there are now ten plants operating, two others having closed during the year. The eight largest smelters were inspected and three were required to undertake emission testing. Overall, all ten plants were found to be in compliance. In the Atlantic Region, a brass foundry in New Brunswick was found to have certain of its processes subject to the regulations. The company has been instructed to install controls. The only other plant in the region previously subject to the regulations is located in Nova Scotia, and equipment required to ensure compliance has been installed.

Mercury Cell Chlor-Alkali Plants. National Emission Standards Regulations for Mercury Cell Chlor-Alkali Plants were promulgated in Part II of the Canada Gazette on July 27, 1977 and became effective on July 1, 1978.

There remain only five mercury cell chlor-alkali plants in Canada, one in each of British Columbia, Ontario, Quebec, New Brunswick and Nova Scotia. All are in compliance with the regulations. A sampling problem at the Quebec plant is being studied by the University of Sherbrooke which has developed and tested an equivalent sampling method.

Vinyl Chloride and Polyvinyl Chloride Plants. National Emission Standards Regulations were promulgated in Part II of the Canada Gazette on April 11, 1979 and became effective on July 1, 1979.

The provinces of Alberta and Quebec have since enacted their own vinyl chloride regulations which are at least as stringent as the federal regulations. These two provinces are enforcing their own regulations in cooperation with EPS.

Alberta has licensed one vinyl chloride and one polyvinyl chloride plant. Compliance tests showed that these plants had excessive emissions of vinyl chloride from

time to time during 1980. However, Alberta Environment is continuing to monitor the situation at both plants.

In Quebec, a compliance test showed that the only polyvinyl chloride plant affected by the regulations emitted permissible levels of vinyl chloride. However, a plant malfunction caused a considerable quantity of vinyl chloride to be discharged into the ambient air. EPS Quebec and Environment Quebec are working together to develop safeguards to prevent such a plant upset in the future.

Ontario has one vinyl chloride and two polyvinyl chloride plants. These plants were not in compliance when the regulations became effective and a schedule that should bring them into compliance has been worked out with EPS Ontario and the Ontario Ministry of the Environment.

Asbestos Mining and Milling Operations. National Emission Standards Regulations for Asbestos Mines and Mills were promulgated in Part II of the Canada Gazette on July 13, 1977 and took effect on December 31, 1978. An amendment to include dry drilling operations was published on April 4, 1979 and took effect July 1, 1979.

The one applicable plant in British Columbia is in compliance. There are no plants in the Prairie Provinces or Ontario subject to the regulations.

In Quebec, 83 emission sources were sampled in the province's nine mills. In 93% of cases the standards were being met. Lax maintenance of the dust collection systems was the cause of all infractions. The offenders have been required to improve maintenance and internal monitoring to ensure full compliance. Indications are that shortcomings and malfunctioning in dust collection systems occur almost always in the mineral drying processes.

At Advocate Mines in Baie Verte, Newfoundland, the final phase of the control program was completed with the installation of the bag filter on the dry rock storage facility in the spring of 1980. Tests showed all sources were in compliance save the dry rock storage which marginally exceeded the regulations. Upgrading the bag filter is expected to solve the problem.

Implementation of Fuels Regulations

Leaded Gasoline Regulations. According to information contained in quarterly reports to Environment Canada by refineries, 24.3 million pounds of lead were added to the premium and regular leaded gasolines in 1980. This was approximately 2.0 million pounds less than in 1979, reflecting the increased use of lead-free gasoline. Fifty-three

samples of leaded gasoline were tested in 1980 and none exceeded the allowable concentration of 3.5 grams per imperial gallon (0.7704 grams per litre).

Lead-Free Gasoline Program. Lead-free gasoline sales, as a percentage of total gasoline marketed, has increased from 5.7% in 1975 to 36.6% in 1980. During the review period, 2161 samples of lead-free gasoline were tested in the national monitoring program. One hundred and twenty-seven (127) samples, or 5.9%, exceeded the allowable concentration of 0.06 grams of lead per imperial gallon (0.0132 grams per litre). In some cases, fuel stocks were seized from the retailers. Samples from refineries, however, were all within specified limits.

EPS Atlantic provided technical assistance to the Nova Scotia Board of Public Utilities in the drafting of a regulation specifying nozzle sizes for leaded and lead-free gasoline. In addition, a survey of 736 cars in Halifax indicated a misfueling rate of 17%, with the main culprit being tampered vehicle fuel inlets as drivers attempted to gain access to the cheaper leaded gasoline.

Nozzle switching, whereby leaded gasoline can be dispensed into cars calling for lead-free gasoline, has been common in certain parts of Canada. However, a survey in the Pacific region showed no incorrect nozzle sizes on 1000 pumps measured.

Fuels Information Regulations. Sections 22 through 26 of the Clean Air Act provide for the regulation of fuel composition and fuel additives and for the necessary administrative procedures to reduce emissions of air pollutants when fuels are burned. In support of this activity, regulations are in effect to obtain the required information on the sulphur content of petroleum fuels as well as their additives. Sulphur data for 1978, 1979 and 1980 are being processed.

A contract study has been undertaken to determine the cost of desulphurizing light fuel oils to 0.3% sulphur by weight and heavy fuel oils to 1.0 and 0.5%.

Data for 129 fuel additives have been reported by their manufacturers or users indicating their purpose, chemical formulation, dosage ranges and quantities used per year.

General. The standard reference method for the determination of lead in automotive gasoline was revised and published during the fiscal year.

Implementation of Regulations for Mobile Sources

Automobile manufacturers are required to certify that new motor vehicles offered for sale in Canada conform to current emission standards. The federal government's compliance monitoring program, operated jointly by Transport Canada and

Environment Canada, is designed to ensure that emission rates from new automobiles do not exceed those standards.

Each year new motor vehicles, representing the most popular makes, models and engines sold in Canada, are tested for compliance with the emission standards. During the review period more than 340 000 kilometres were accumulated on 48 vehicles driven on prescribed urban-rural routes in the Ottawa area. More than 480 emission tests were completed.

Twelve additional vehicles were tested to verify fuel economy claims made by the manufacturers.

Implementation of Guidelines for Stationary Sources

The Yukon Territorial Government is drafting regulations based on the federal guidelines for Arctic mining and asphalt paving. Delayed in 1980, these regulations are now expected to be promulgated in 1981.

There have been no developments with regard to further provincial adoption of the federal guidelines on the cement and metallurgical coke manufacturing industries.

The Alberta Department of the Environment used the federal guidelines on packaged incinerators in establishing conditions for granting permits for new installations in several hospitals throughout the province.

The wood pulping industry guidelines and the accompanying study report are being used as support documents by several provinces.

Control of Emissions from Federal Facilities

By setting a good example in the conduct of its own activities, the federal government can more easily gain support for its leadership role in the protection of public health and the environment. Environment Canada is the department responsible for ensuring minimal adverse environmental effects from all federal establishments, operations and businesses. This is accomplished through the Federal Activities Assessment Branch.

The integrated waste management project at the Ste-Anne-de-Bellevue Veterans' Affairs Hospital continued during the fiscal year. Modifications to ensure that the project meets federal, provincial and municipal environmental requirements were undertaken. Additional modifications, as required, will be made in the next fiscal year.

Branch staff have been working with Eldorado Nuclear at Port Hope, Ontario to improve abatement equipment for the reduction of radioactive dust emission levels.

The Federal Activities Assessment Branch has also been involved in the low-NO_x burner trials at CFB Gagetown, New Brunswick.

Scientific and Technical Advice and Support

During the fiscal year, APCD and the EPS regional offices carried out numerous technical reviews, chemical analyses and advisory activities. These arise not only from planned programs but also from requests from the provinces, municipalities, industry, the public and agencies and groups in other countries. Some of the more important activities are described in the following paragraphs.

APCD is participating in a study with the Canadian Electrical Association, Energy, Mines and Resources (EMR) and the Water Pollution Control Directorate of EPS to determine the fate of trace contaminants in coal-fired power production. The project involves extensive field sampling at four Canadian power plants and will take 30 months to complete. During the fiscal year, the sampling protocol was developed and Phase I of the sampling program was initiated at the Battle River Generating Station in Alberta.

In another major project, APCD, in cooperation with EMR, the National Research Council and the Canadian Boiler Society met with representatives from the U.S. Department of Energy, EPA and the American Boiler Manufacturers Association and developed a U.S.-Canada program to study the emissions and efficiency of boilers utilizing wood refuse in fuel. The program will span three years and involve testing of several boilers in both countries.

In response to concern over possible emissions of dioxin and dibenzofuran from the combustion of municipal refuse and coal, a project to sample the fly ash from several municipal incinerators and coal-fired boilers was initiated. Analysis of the samples should be complete by December 1981 using APCD's high-hazards laboratory. This facility was designed for trace analysis and method development for toxic organic substances.

Chemical analysis of samples for hazardous contaminants during the year included analysis of: transformer oils for PCBs; multi-fuel engine exhausts for aromatic content; coke-oven emissions for toxic organics; tapwater for PCBs and chlorobenzenes; diesel engine exhausts for PCBs and chlorinated hydrocarbons (trial burning of PCBs); power plant and incinerator emissions for polychlorinated hydrocarbons; wood stove emissions for toxic organics; river water samples for selenium; well water for arsenic;

glass fibre filters for lead. Development work on the analysis of total sulphur in fuels using different techniques has been initiated.

The chemical analysis service is assuming greater importance because of pressing concerns about toxic substances in the environment and their effects on health. APCD activities concerning the study and assessment of toxic chemicals generally are carried out in cooperation with the department's newly formed Toxic Chemicals Management Centre to ensure a total ecosystem approach to the problem.

APCD surveillance services included a review of Saskatchewan Power's proposal for continuous monitoring for sulphur dioxide, nitrogen oxides and particulates; analytical services to the province of Ontario in fluoride monitoring; and participation with AES and Eldorado Nuclear in reviewing reports on a haze problem in Port Hope, Ontario. There was also considerable effort in such areas as assessing new monitoring techniques and instruments, testing new reference methods and reviewing solicited and unsolicited proposals for technical merit.

EPS regional offices provided many services. EPS Pacific and Yukon advised the National Harbours Board on air pollution control requirements and ambient air monitoring in support of the Board's plans to expand the Roberts Bank coal terminal. The Board is now moving ahead to implement the pollution control requirements and to complete the environmental impact assessment studies recommended by the Federal Environmental Assessment Review Panel. The Region also participated in initial meetings of the Regional Screening and Coordinating Committee monitoring the developments concerning the proposed Hat Creek coal-fired thermal generating plant under consideration by B.C. Hydro. A formal application under the new B.C. Utilities Commission Act is expected to be made by B.C. Hydro in 1981. The committee, chaired by EPS and with representatives from various federal agencies, will be carrying out environmental assessment reviews on this project. The committee also assisted with reviews of the Quinsam Coal development on Vancouver Island and a proposed gold mine/mill by Consolidated Cinola Mines Ltd. The Region advised the Ocean Dumping Group on the pilot oil spill burning experiment by Dome Petroleum to evaluate a new boom design, and on a proposed barge-mounted incinerator for disposing of solid wastes from ships at Vancouver harbour. It also assisted the Environmental Emergencies Group in a review of a report on the incineration of crude oil and contaminated debris from oil spills.

EPS Northwest undertook a review of the potash regulations proposed by the Saskatchewan Department of the Environment. Meetings were held to evaluate the control strategy options available to the industry. A comprehensive literature review was

also completed on the capabilities of control technology and the regulated emission limits for industries in other potash-producing areas of the continent. Advice regarding the need for more restrictive emission controls than those previously considered by the province was provided. Saskatchewan is one of the world's richest sources of potash.

In view of the deleterious effects of acid rain in eastern Canada, efforts are being made to ensure that a similar problem does not develop in the environment of western Canada. Consequently, considerable effort was expended by EPS Northwest on researching and reviewing acid rain and the state-of-the-art for sulphur dioxide control technology. A report was prepared and presented on the subject to the Manitoba Clean Environment Commission Hearings into Hudson Bay Mining and Smelting operations at Flin Flon. A major recommendation to have the revised order expire at a much earlier date was made.

EPS Ontario continued its active participation in the Nanticoke Environmental Management Program. Extensive air monitoring continued. The overall program will continue for several more years so as to clearly determine the pollution effects of this large industrial development located on the shore of Lake Erie. The Region again worked closely with other federal, provincial and municipal personnel in the Cornwall Island study.

EPS Ontario actively contributed to efforts to resolve the emission problems at Eldorado Nuclear in Port Hope. These ranged from smog problems resulting from nitric acid and ammonia emissions to fluoride and uranium emissions. After considerable effort, the smog problem was corrected; however, fluoride emissions are still somewhat elevated despite the installation of back-up pollution control equipment. Further investigations are underway to pinpoint the problem. A thorough investigation into the cause and potential health effects of elevated uranium emissions was initiated by the Atomic Energy Control Board with the cooperation of EPS Ontario and the Ontario Ministry of the Environment.

EPS Quebec served as an advisor to the Department of Veterans' Affairs on the interpretation of provincial and municipal regulations as well as the federal guideline on packaged incinerators. It has also been participating in the evaluation of the incinerator at the Ste-Anne-de-Bellevue Hospital.

A number of projects under consideration by the Department of Regional Economic Expansion were reviewed by EPS Quebec. These included: the expansion and renovation of the Gulf Canada plant in Shawinigan; the building of a newsprint mill by Donohue Normick in Amos; the expansion of the Fulmen Inc. battery manufacturing plant at Louiseville; the expansion of the Tioxide Canada Inc. plant in Tracy and of a new

sulphuric acid plant; the expansion of the G.L.C. Canada Inc. plant at Berthierville and the construction of a new graphite electrode manufacturing facility. The Region also evaluated a project regarding the building of a plant at Gros Cacouna for the regasification of liquefied natural gas.

EPS Atlantic contributed to a broad range of advisory activities. Some of these were: participation on a technical review committee concerning a Nova Scotia Power Corporation thermal power station; estimating costs of air pollution controls for coal-fired thermal power plants for the Department of Regional Economic Expansion; technical review of an environmental impact statement for a zinc electrolytic reduction plant in New Brunswick; assistance on the required controls and estimated costs for the steel plant and coke ovens in Sydney; technical information and advice to the province of Prince Edward Island on waste oil combustion.

PROGRAM PLANNING, EVALUATION AND LIAISON

National and International Participation and Cooperation

General. Air pollution control is a shared federal-provincial jurisdiction. The National Air Pollution Control Program is therefore developed through consultation and cooperation with provincial environment agencies. Control programs initiated by the federal Environmental Protection Service are implemented by provincial agencies whenever possible.

Federal-Provincial Committee on Air Pollution. The Federal-Provincial Committee on Air Pollution is the principal national mechanism for obtaining federal-provincial cooperation and for promoting provincial participation in specific national projects. Established in 1969, it provides a forum for the exchange of technical and scientific information and methodologies and for the regular discussion of air pollution control programs in Canada. The annual meeting of the committee was held in Ottawa, May 27-29, 1980.

A major achievement of the committee has been the development, by means of its two standing subcommittees, of National Air Quality Objectives designed to protect public health and the environment by setting limits on the concentrations of contaminants in the ambient air. These were published in the Canada Gazette under authorization of the Clean Air Act which enables promulgation of three levels of these objectives, "desirable," "acceptable" and "tolerable" for major air contaminants. For definitions of

these levels and for information on the pollutants involved along with the recommended ambient concentrations for each, readers should refer to Report EPS 1-AP-81-1.

The two subcommittees meet twice a year. The concept and utility of the three-level system of objectives was reviewed during 1980-81 by both subcommittees and following discussion with the parent committee, it was decided to continue with the three levels. The five-year review of desirable and acceptable levels for sulphur dioxide and carbon monoxide was completed. Changes to the existing objectives were felt to be unnecessary. The review of the remaining objectives is underway.

With the publication of the report "Guidelines for an Annual Air Quality Index", the subcommittee on air quality indexes was disbanded. The annual index is being used by APCD in preparing trend analyses of air quality in Canada. New Brunswick and Alberta are using the short-term index.

The Federal-Provincial Committee on Air Pollution also sponsors an inter-laboratory quality control program for methods of analysis of air pollutants. During the review period, about 70 laboratories participated in programs for sulphates, fluoride and non-ferrous smelter dust.

Work continued on the development of the standard reference method for hydrogen sulphide. The revision of the ozone method was completed and will be published early in 1981-82. The hydrogen fluoride method underwent further revision.

As part of a program to provide reliable standard reference materials to Canadian laboratories engaged in analyzing air samples, APCD administered a round robin, using ambient fluoride samples, to approximately forty laboratories. A second round robin of smelter dust samples for heavy metals is in progress.

An important involvement of the committee is the continuing development and operation of the National Air Pollution Surveillance (NAPS) network.

Participation in Canada/U.S. Programs. As discussed earlier in this report, acid rain dominated Canada-U.S. relations in air pollution control in 1980-81. However, Environment Canada continued its cooperation with U.S. agencies in a host of other programs. One of the principal cooperative mechanisms is the International Air Pollution Advisory Board, a standing board of the International Joint Commission (IJC). Air pollution problems that arise along the Canada-United States border are investigated by the Board and reported to the IJC. APCD provides the Canadian Chairman of the Board, one other member and technical assistance. The Atmospheric Environment Service also has a member on the Board.

During the review period the Board reported to the IJC that the epidemiological study to determine the relationship between environmental contaminants and the health of Canadian residents on Cornwall Island had started. Results from the study, however, will probably not be available for at least a year. The U.S. State Department responded to the November 1979 Diplomatic Note from the Canadian Government. The U.S. response stated that the scientific information on damages presented by Canada was insufficient to support the request for abatement of fluoride emissions from the Reynolds Metals Plant in Massena, N.Y.

APCD continued to provide the Canadian Chairman to the International Michigan-Ontario Air Pollution Board created by the IJC to monitor the progress of control programs in the border area. Technical assistance is provided by both APCD and EPS Ontario. In its sixth progress report to the IJC, the Board reported that a regulation for the control of sulphur dioxide had been developed for the Sarnia-Port Huron area and that in January 1980 the State of Michigan had adopted a fugitive dust regulation. In its Fifth Annual Report the Board indicated that it would review the need to address toxic air pollutant emissions in the boundary area. The Board has completed its initial review of the matter and has concluded that at this time there are no transboundary air pollution problems warranting specific control measures by control agencies.

Participation in Other International Programs. Environment Canada contributes to and benefits from a number of international programs dealing with the development of policies and technology for air pollution control. These programs allow participating countries to draw on one another's expertise in arriving at acceptable solutions to complex environmental problems. Studies of control strategies for acid-causing pollutants and toxic substances are currently of great importance.

Participation in such programs is coordinated through the Department of External Affairs and involves the World Health Organization (WHO), the Organization for Economic Cooperation and Development (OECD), the Economic Commission for Europe (ECE), the North Atlantic Treaty Organization Committee on the Challenges of Modern Society (NATO/CCMS) and the United Nations Environment Program (UNEP). The Canadian delegate to the OECD Air Management Group is from APCD as is the delegate to the United Nations ECE Working Party on Air Pollution Problems and the Special Group on Long-Range Transboundary Air Pollution.

Bilateral consultations were held during the year with visiting representatives of environmental protection agencies from Norway, Sweden, Japan, Columbia and France.

APCD continued to participate in the WHO Air Quality Monitoring Project. Air quality data for sulphur dioxide, suspended particulate matter and soiling index from 11 stations, located in Vancouver, Hamilton, Toronto and Montreal, are forwarded quarterly to WHO headquarters in Geneva. In addition, NAPS operates one station in Toronto as a comparison station where WHO standard reference measurement methods are used concurrently with standard instrumental methods.

Other international activities during the review period included:

- continued participation in a subcommittee of the UN-ECE Working Party 29 -- Groupe de Rapporteurs sur Pollution et Énergie -- dealing with motor vehicles;
- involvement in a European Economic Community bilateral working group on the asbestos industry;
- contribution to a UNEP project on non-ferrous smelters and preparation of the chapter on the nickel sector;
- provision of 110 standards from the bank of polycyclic aromatic hydrocarbons in response to requests from Canada and abroad.

Inter-Departmental Negotiation and Liaison. Environment Canada consults regularly with the Environmental Health Directorate of Health and Welfare Canada on public health and risk assessment aspects of air pollution control. In international activities, EPS is the primary advisor to the Department of External Affairs on technical matters and on policies and negotiating strategies related to air pollution control. Of particular significance in this area are the negotiations with the U.S. Government on transboundary air pollution, and in particular, acid rain. Environment Canada is also represented on the Air Subcommittee of the National Research Council's Associate Committee on Scientific Criteria for Environmental Quality.

The Department of Indian and Northern Affairs is regularly informed of EPS activities involving the Yukon and Northwest Territories. Regular contact is maintained with Energy, Mines and Resources and the National Energy Board on energy/environment matters, and with Industry, Trade and Commerce on environment/industrial policy matters, particularly as they relate to the domestic program for the control of acid-causing air pollutants.

Program Planning and Evaluation. The National Air Pollution Program comprises four principal elements:

1) Identification, characterization and assessment of pollution problems;
2) Technology;

3) Prevention and control measures;

4) Program planning, evaluation and liaison;

APCD's operating budget for the fiscal year was prepared using this project planning system. An evaluation system now being developed will provide management with information on the efficiency and effectiveness of resource utilization in achieving program objectives.

During the review period, the development of the decision-making framework continued. It is a means through which air pollution problems are selected with a view to promulgating regulations or guidelines. Mechanisms to establish priorities for subsequent regulation or guideline development are also incorporated into the decision-making framework. There are four phases in the framework:

- the identification of existing and potential air pollution problems and the relative ranking of these concerns in each of three categories: immediate, medium-term and long-term concerns;
- the development of work plans based on the approved list of APCD concerns;
- the detailed assessment of a contaminant or industrial sector of concern and information-gathering activities; and
- the activities that must be completed after the decision has been made by APCD management that a concern investigated in Phase III warrants the development of a regulation or guideline.

The compilation of contaminant and industrial sector profiles for existing and potential air pollution concerns continued. These profiles are two-page summaries of various objective and subjective criteria that justify identification of a concern. A relative ranking of concerns was completed.

ATMOSPHERIC ENVIRONMENT SERVICE

The Atmospheric Environment Service (AES) shares a decisive role within Environment Canada in the protection and enhancement of the quality of the environment. In this context, AES continues to strive toward a better understanding of the atmospheric processes of pollutant transport, chemical transformation during transport, areal distribution of pollutants, and the effects of deposition on the environment. Results of experimental studies are applied in the modelling of atmospheric processes and the

physical and chemical behaviour of pollutants in order to better describe and predict air quality and environmental impacts in a consistent manner.

Much of this work is performed by two branches of AES, frequently in cooperation with other provincial, federal or international agencies. The two branches are: the Air Quality and Inter-Environmental Research Branch which concentrates on research in the lower atmosphere (i.e., the troposphere... up to an altitude of about 10 km); and the Atmospheric Processes Research Branch which specializes in studies of the upper atmosphere, in particular the effects of man-made pollutants on solar radiation and the ozone layer.

Total expenditures by these two branches during the fiscal year were $ 4 351 700, consisting of $ 2 169 300 in salaries, $ 1 778 100 in goods and services, and $ 404 300 in capital. End-of-year strength in the two branches was 78.

Long-Range Transport of Air Pollutants (LRTAP)

Research into the complex problem of long-range transport of air pollutants has generated increasing concern about the effects of acid-causing pollutants on the environment and the need for control action. This concern, on the part of both the department and the public, has led to an increase in the federal LRTAP program and the reorganization within AES of the LRTAP Scientific Program Office into two components: the LRTAP Scientific Coordination Office (LSCO) and the LRTAP Liaison Office (LLO).

The LLO is responsible for providing information on all liaison and financial aspects of the federal LRTAP program to federal and provincial government officials and committees, including the Minister's Office. It also acts as a focal point for the distribution of scientific program information. The LSCO is responsible for ensuring federal interdepartmental coordination of scientific efforts, federal-provincial and international coordination of scientific and monitoring programs, reporting results of the scientific program and for advising the Interdepartmental LRTAP Committee on the same.

AES activities during the fiscal year concentrated on the following major areas: monitoring atmospheric composition and deposition; modelling atmospheric transport and deposition; researching and developing; and providing liaison and coordination of the overall federal program. Substantial effort had been devoted to supporting the activities of Working Group 2 (Atmospheric Sciences and Analysis Group) set up under the Canada-U.S. Memorandum of Intent on transboundary air pollution.

AES LRTAP activities are summarized as follows:

- the operation and maintenance of two Canadian networks continued. These are CANSAP, for sampling precipitation chemistry across Canada, and APN, the event research network in eastern Canada for sampling air and precipitation. The first-quarter 1980 CANSAP data were published and the two most recent APN stations, at Turkey Lakes and Montmorency, came into operation late in 1980. A number of new measurement systems were successfully tested during the summer Persistent Elevated Pollution Episodes experiment.
- a Lagrangian long-range transport trajectory model was applied to determine trans-boundary flows of sulphur compounds and source-receptor relationships.
- an eastern North America sulphur budget for 1978 was completed using the long-range transport model. A more detailed emission inventory is being prepared.
- a short-to-medium-range deposition model for sulphur compounds and statistical and analytical long-range transport models for both sulphur and nitrogen chemistry were developed.
- research and development projects were carried out including physical and chemical process studies, improved field measurement and data collection methodologies, and the studies of dry deposition on natural surfaces and precipitation scavenging processes.
- more than 10 000 copies of LRTAP information reports and publications on scientific activities and summaries of scientific research (such as the 1980-81 Canadian LRTAP Research Catalogue) were produced and distributed.
- arrangements for the American Meteorological Society and the Canadian Meteorological and Oceanographic Society Conference on LRTAP scheduled for April 27 to April 30, 1981, in Albany, N.Y. were coordinated.

Environmental Monitoring

The Canadian Network for Sampling Precipitation (CANSAP) collected monthly samples of rain or snow throughout the year at 54 stations across Canada. Each sample was analyzed for acidity and soluble major ions including sulphate and nitrate to monitor changes in the background levels of these atmospheric constituents in the precipitation. During the fiscal year the whole network was upgraded to the same standard in precipitation collectors. An evaluation of the entire CANSAP network will be conducted in the next fiscal year.

The joint sampling program with the Ontario Ministry of the Environment was concluded and the data are being evaluated by the ministry.

The Inland Waters Directorate (the department laboratory for CANSAP samples) took part in the fifth intercomparison of methods sponsored by the Norwegian Institute for Air Research. A report of the earlier fourth intercomparison indicated that the laboratory compared very well with the other European laboratories.

The intercomparison of precipitation data between CANSAP and the National Atmospheric Deposition Program (NADP) in the United States is to begin in April 1981. The CANSAP stations will be sited at Glacier National Park (Montana), Michigan State University Biological Station (Michigan) and Caribou (Maine). The NADP stations will be at Lethbridge (Alberta), Mount Forest (Ontario) and Kejimkujik (Nova Scotia).

A report was issued on the Canadian Air and Precipitation Monitoring Network, APN, outlining details of network operations and presenting results for the first eight months of operation (November 1978 - June 1979). In Ontario, APN activities were closely coordinated with those of the Ontario Ministry of the Environment and Ontario Hydro.

As part of the background environmental monitoring program of the World Meteorological Organization, sampling was continued at Alert, N.W.T. and Sable Island, N.S. by AES and at Ocean Station PAPA by the Institute of Ocean Sciences, Sydney, B.C. to provide measurements of atmospheric carbon dioxide. The average global concentration of CO_2 is about 335 ppm, with an annual increase of about 1 ppm. Preliminary results from the Alert and Sable Island data support this observation. Additional flask samples were obtained at Cape St. James, B.C. to determine its suitability as a replacement site for Ocean Station PAPA. Flask sampling also began at Mould Bay, N.W.T. to provide a site between Barrow, Alaska and Alert in the expanded CO_2 sampling program of the National Oceanic and Atmospheric Administration (NOAA).

Environmental Impact Assessment (EIA)

AES contributes to the departmental EIA program through the review of the air quality aspects of EIA's, the assessments of air quality impacts of pollutant sources and the development of EIA-related technology for both internal use and transfer to other AES components, other governmental agencies, and the private sector.

In direct support of this program and other agencies, AES reviewed about thirty-five EIA documents. A significant number of these reviews dealt with oil explorations and pipelines (particularly in the Arctic) and some dealt with impacts from

radionuclide releases (such as from uranium mining developments). A review of the Norman Wells Pipeline EIA lead to formal participation at the Environmental Assessment and Review Process public hearings held in Yellowknife.

Impact assessment research on air pollution potential in Canada and on development of numerical models for various conditions continued. A modelling assessment in support of EPS was carried out to estimate impacts of continuous radionuclide releases from the Pickering (nuclear) and Lakeview (thermal) power plants in Ontario.

Environmental Emergencies

In support of environmental emergency programs, the following progress in modelling occurred:

- a puff model was developed for short-range transport and diffusion of radionuclides;
- a dispersion model was developed to calculate exposure and ground concentration due to deposition from instantaneous and continuous pollutant releases. This model was applied to an international benchmark problem describing an accidental radionuclide release at a nuclear plant. Processes of radioactive decay and dry and wet deposition were treated in the scheme and the results compared reasonably well with those of more sophisticated models.

Support was provided to AES Central Region in its assessment of impacts on air quality near MacGregor, Manitoba, caused by an accidental tankcar spill of vinyl chloride, an extremely toxic heavy gas.

Atmospheric Boundary Layer Modelling

The boundary layer is the lowest layer of the troposphere extending from the earth's surface to about 1500 metres aloft. Several numerical models of processes that take place in this layer and that are applicable to the Clean Air Act were developed, tested and in some instances successfully applied to a problem area. Among these are the Monte Carlo model of the transport and dispersion of pollutants in the surface boundary layer. This model has been successfully applied to pesticide transport. Another model which examines the boundary layer airflow in complex terrain can be used for wind energy site selection, design studies for wind stresses on structures as well as for pollution dispersion in hilly regions. Shoreline fumigation has been modelled and a comparison of the results with field and laboratory data for maximum ground-level concentrations in a fumigation zone has yielded good correlations. Similarly, the results of a model of gas

transfer processes between the atmosphere and a large body of water (oceans or lakes) has shown good agreement with laboratory data.

Environmental Contaminants and Toxic Chemicals

AES contributes to the Federal Environmental Contaminants Program established under the Environmental Contaminants Act (1976). Research has been initiated to investigate the behaviour of atmospheric inorganic and organic contaminants interacting with the biosphere. Specific objectives are:

(a) to determine existing loadings and pathways of problem substances in the environment, and

(b) to interpret the significance of problem substances in the environment through effects studies.

The inorganic contaminants receiving particular attention are a number of metals which, upon entry to aquatic and terrestrial ecosystems, build up residues that have long-term effects on the environment and human health. The organic contaminants occur in a multitude of forms, many of which are carcinogenic.

On-going research in support of this departmental program is aimed at a better understanding of the atmospheric pathways of mercury and its compounds. An atomic fluorescence mercury monitor is under development and should be ready for testing in the laboratory during 1981. This monitor should have greatly enhanced sensitivity and ability to determine different species of mercury present in the atmosphere. Measurements were also performed for mercury vapour from an instrumented aircraft during some of the flights conducted as part of the PEPE study in Ontario during July and August 1980.

Organic compounds in the atmosphere are also receiving increased attention. During the fiscal year, the newly acquired gas chromatograph-mass spectrometer was being prepared for operation in a new laboratory facility at AES headquarters. This instrument will permit AES scientists to recognize and identify many of the organic contaminants present in the atmosphere. Two sampling sites (Long Point and Perch Lake, Ontario) are being prepared to obtain vapour phase organic samples suitable for introduction to the gas chromatograph-mass spectrometer.

Based on the AES Toxic Chemicals Measurement Program Task Force report, a proposed outline of AES activities over the next five years in relation to toxic chemicals was developed. The resulting proposals formed the consolidated AES input to the

department's Toxic Chemicals Management Centre. This material is to be included in the 1981 Cabinet submission for approval and funding of the federal program for the management of toxic chemicals.

Air Quality Criteria Documents

AES provides scientific and technical support to the Federal-Provincial Committee on Air Pollution through its Subcommittees on Air Quality Objectives and Air Quality Indices. The latter Subcommittee concluded its work during the fiscal year with the publication of "Guidelines for an Annual Air Quality Index". For the Objectives Subcommittee, a criteria digest describing the effect of combinations of common air pollutants on various receptors is in the final stages of preparation. The review of the existing ambient air quality objectives for ozone has begun with the preparation of a criteria digest. The review of existing ambient air quality objectives for nitrogen dioxide was completed.

Miscellaneous Activities

Canadian Arctic Air Pollution Program (CAAPP). In recent years, widespread particulate pollution has been observed in the Arctic, originating from emissions in mid-latitude regions of Europe and eastern North America. Because of the environmental and climatological implications of polluting the polar cap, the governments of Norway, Denmark, the United States and Canada are cooperating in a joint investigation of suspended particulate matter north of 60°N. The CAAPP is the Canadian component of this joint study.

Measurements of aerosol chemistry and light scattering at Mould Bay and Igloolik, N.W.T. indicate the presence of widespread particulate pollution in the North American Arctic during winter. The major source of particulate pollution in early winter is linked to industrial activity in the U.S.S.R. while in late winter mid-latitudinal pollution sources in North America and Europe also contribute to the problem.

In support of the CAAPP, air parcel trajectories were computed using a recently developed trajectory model. The results indicate that the Arctic atmosphere was more stagnant (self-contained) with lighter winds in spring than in the following winter. This would suggest that air pollutants from industrial activity in Siberia, Europe and eastern North America get injected into the Arctic atmosphere predominantly during the winter months. A seasonal climatology of air parcel trajectories into the Arctic is underway.

Nanticoke Environmental Study. The Nanticoke Environmental Study consisted of a major field program carried out in June 1978 in cooperation with AES Ontario Region, EPS, Ontario Hydro and the Ontario Ministry of the Environment to investigate shoreline effects on the diffusion of pollutants from the coastal thermal power generating station and has produced one of the most comprehensive data sets on coastal fumigation. Analysis of data and preparation of a series of four scientific papers have been completed. Consideration is being given to a follow-up study in 1982.

Great Lakes Water Quality Agreement Program. The 1978 Canada-U.S. Great Lakes Water Quality Agreement (GLWQA) identifies programs and measures required to evaluate the impact of air pollutants upon the Great Lakes and their drainage basin. These measures include identification of pollutant sources, their relative contributions, and more accurate definition of pollutant deposition rates.

AES has been supporting the GLWQA Program through two separate research programs. The first involves the development of an appropriate methodology for monitoring particulate dry deposition over snow, water and ice surfaces. The second is designed to estimate the atmospheric input of certain nutrients, heavy metals and organic contaminants to the Great Lakes and to examine the relative importance of various sources through a comprehensive simulation modelling effort. As a first step in this research, relevant emission inventories and parameterization of physical and chemical dispersion processes are being surveyed.

Storm Transfer Response Experiment. AES has been participating in a Canadian-U.S. experiment called STREX (Storm Transfer and Response Experiment). With the general objective of STREX to understand the physical processes of the boundary layers of atmosphere and ocean in mid-latitude storms, the experiment was conducted in the vicinity of Ocean Station PAPA from November 2 to December 15, 1980. During the period, intensive meteorological and oceanographic measurements were taken from the CCGS Vancouver with a complementary set of data taken aboard the NOAA Ship Oceanographer, located east of the station. Specific frontal events were identified for investigation by aircraft during which time missions were flown in the vicinity of Station PAPA. Arrays of drifting buoys and satellite coverage enhanced the scope of data taken. From these data, significant features and processes will be quantitatively determined and these will be used to develop a model of the boundary layers in storms and to parameterize the vertical transports. Successful results will provide an essential data set for verification of numerical predictions of Pacific Ocean storms. This is necessary as a

first step in understanding the coupling of the ocean and atmosphere on seasonal and longer time scales.

Polynya Heat Budget Experiment. The third year of the three-year Polynya Study was undertaken in cooperation with the Frozen Sea Research Group of Ocean and Aquatic Sciences (Department of Fisheries and Oceans). Wind and temperature profile data were obtained in the lee of open water with fetches ranging from 250 m to 1 km.

A report on the numerical study of the flow over open water in the polynya to estimate flux parameters has been completed. Comparisons of modelling results with experimental data are underway.

Wind/Wave Experiment. Interpretation of the satellite interrogation of the sea surface requires improvement in understanding the dynamics of wind-driven waves. A model has been developed to characterize the waves in terms of the wind stress and the minimum phase velocity associated with the threshold for wave breaking. Comparison with various aircraft-based scattering and emissivity studies is satisfactory. Future work will concentrate on analysis of specific satellite (Seasat) data and a multiple-agency program in support of future satellite systems is underway.

Port Hope Field Study. This study was carried out in March 1980, in cooperation with EPS, AES Ontario Region and Eldorado Nuclear to obtain information on the rise and dispersal of the Eldorado Nuclear pollutants as a function of different wind conditions, the building effects on dispersion of the pollutants, and wind data to support other facets of the total air quality program. The study has produced comprehensive and valuable documentation on the downdraft from a nuclear plant.

Wind Energy Project. This is a cooperative project with the Meteorological Services Research Branch of AES, the National Research Council and the Canadian Climate Centre. By numerical modelling and field studies, the influence of local terrain features on wind energy potential and site selection and the wake interactions between units in generator farms are being investigated.

The complex terrain model mentioned earlier is undergoing modifications to permit input of actual site topography for site evaluations of wind power potential. A semi-ideal test area, near Pincher Creek, Alberta was identified, a preliminary field study conducted, and numerical and physical model evaluations performed in preparation for a comprehensive experiment in February 1981. Further plans call for participation in an International Energy Agency experiment in 1982.

In collaboration with the National Research Council and Hydro Quebec, work was initiated on an evaluation of potential wind energy sites in the lower St. Lawrence

Valley as a part of Project Aeolus. This included the preparation of instrumentation and analysis of procedures for data acquisition from three 60-m towers to be erected during 1981.

Air Quality Services Task Force. The AES Task Force on Air Quality Services was established in October 1980, and charged with the responsibility of assessing the regional and national needs for air quality services. The task force and AES regional staff interviewed selected users and potential users of AES air quality services from across the country. Those interviewed included representatives from AES regions, other DOE services, provincial and municipal air pollution control agencies, research councils, public utilities, consultants, industry and universities. The task force concluded that AES is not responding adequately to user needs for air quality services and recommended the development and implementation of an integrated Air Quality Services Program which would better meet the identified user needs.

Technology Transfer Activities

During the fiscal year, AES personnel participated in about twenty-five national and international conferences on widely varying themes concerning atmospheric pollution and air quality. AES also hosted a number of international guest speakers who gave seminars on current atmospheric research.

The AES one-week course on air pollution meteorology was presented in Vancouver, B.C. and Bedford, N.S. to federal, provincial and industrial representatives. The course was also presented to graduate students and provincial representatives at the University of Calgary in cooperation with the Faculty of Environmental Design. The French version of the course was given in Montreal. Copies of the course material are available from AES, in both English and French.

Initiative was taken to establish a national Atmospheric Interactive Modelling System. The purpose is to place atmospheric models on a central interactive computer system accessible to users across Canada. Implementation of several models is currently in progress. Work continued on the preparation of user's guides for the various models that have been developed.

Stratospheric Pollution and Ozone Monitoring

The stratosphere, the layer of the atmosphere between an altitude of 10 kilometres and 60 kilometres, is a region of major global air circulation. It contains the ozone layer which prevents dangerous levels of ultraviolet solar radiation from reaching

the earth's surface. Gaseous chlorine-bearing compounds such as chlorofluoromethanes emitted into the atmosphere by consumer and industrial processes are chemically destroying ozone in quantities that, although difficult to specify precisely, are predicted to be dangerously large.

High-altitude balloon measurements (or "STRATOPROBE" flights) undertaken by the Atmospheric Processes Research Branch have produced data sets of key stratospheric chemical constituents. These observed values are used to verify information gathered by the NIMBUS VII satellite and to produce theoretical model predictions of present and future ozone depletions. During the fiscal year, the models developed indicate that hydroxyl densities in the 15-to-30-kilometre region are low. The consequences of these low densities on the depletion of ozone have been modelled and evaluated. The predicted depletion at current usage rates is less than 10%, with the expected 1980 depletion less than 1%. A collaborative experiment with NASA Goddard scientists was conducted in Texas in October to test the low hydroxyl density theory.

Daily measurements of the total ozone column in the atmosphere continued at five sites across Canada: Churchill, Edmonton, Goose Bay, Resolute and Toronto. The vertical ozone profile from the surface up to 30 kilometres is measured by balloon-sounding each Wednesday.

Instruments to measure ozone continued to be developed and tested. The new Mark II ozone spectrophotometer has been tested and is ready for commercial production. Interference of sulphur dioxide on the Dobson total ozone measurements has been discovered and evaluated.

Date Due
