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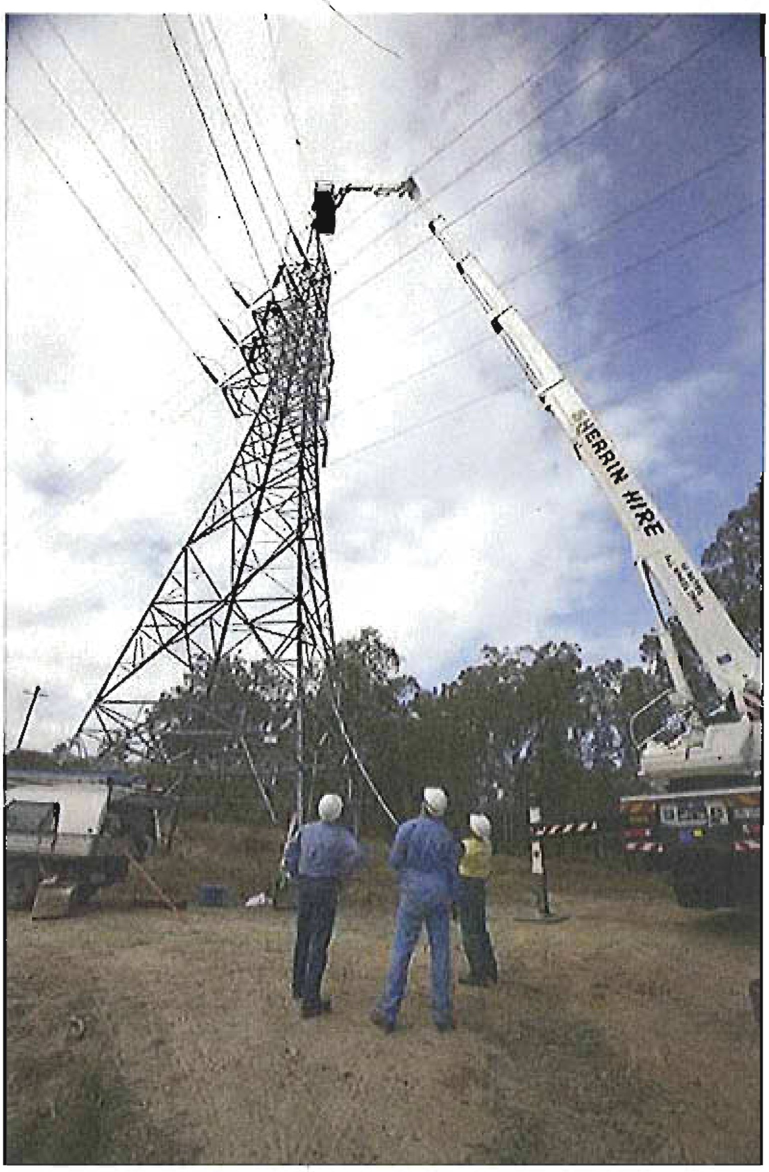
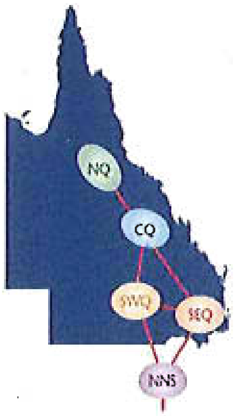
2010 NON LOAD DRIVEN PLAN

Volume 2

Network Strategy and Performance





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1. Introduction

The 2010 Non Load Driven Plan (NLDP) considers capital expenditure matters associated with Powerlink's transmission network that are not driven by the high voltage network demand. As such, it is an integral part of the planning consideration of the replacement, decommissioning or life extension of assets at end of useful life, as well as significant issues such as security.

The resultant network non–load driven projects are predominantly associated with replacement of assets to maintain the capability or capacity of Powerlink's network assets, or to ensure security of Powerlink's infrastructure, or compliance with legislation and statutes. Plant refurbishment projects (operational expenditure) are covered in the Operational Refurbishment Plan. Business Information Technology is covered under the Non–Network Plan.

Volume Two of the NLDP provides a summary of committed replacement projects along with details related with each forecast project including replacement need, the associated analysis and solution identification.

Section 2 Assets Under Consideration provides an overall perspective of the assets in service on the Powerlink high voltage (and operational) networks.

Section 3 Committed Projects is a listing of the project needs that are approved (or are in the process of being approved), and therefore initiated.

Section 4 Planned Projects presents, where available, a lifecycle cost summary for each future project that contains the Net Present Value (NPV) analysis and respective risk assessments.

Section 5 Major Spend by Asset Type – Project Summaries provides a detailed summary of significant projects in each asset type.

2. Assets Under Consideration

There are four major equipment groups to which this document applies:

- *Transmission Lines* – all high voltage transmission line systems including pole, tower and guyed systems, high voltage underground cables and associated easements and access tracks for the line;
- *Substation Plant* – primary plant within the substation, and the substation infrastructure such as buildings, footings, structures and so on;
- *Secondary Systems* – protection, metering, automation, control, SCADA, energy management and monitoring systems;
- *Telecommunications* – telecommunication links and terminal equipment including microwave radios, digital multiplexers and power line carrier technology.

2.1 Transmission Lines

Overhead Lines Profile

Powerlink owns and operates a broad variety of transmission overhead lines and cables at voltages from 22kV, 33kV, 66kV, 110kV, 132kV, 275kV, and 330kV. Powerlink's transmission line age varies, the oldest was built in 1948, the youngest is currently under construction. These lines are built up from a range of associated components: aerial conductors; insulators; attachments; lattice steel towers and their foundations; concrete poles and wood poles.

The overhead lines are grouped into Built Sections and are defined as being constructed to the same original contract and have aligned designs. Each Built Section represents one asset and has the asset value attached to it. Note that the length of Built Sections can vary from as little as a single tower up to more than 350 kilometres.

Table 1 – Route vs. Circuit Kilometres (June 2010)

Voltage	Overhead Lines Route km	Overhead Lines Circuit km
66kV	1	1
110kV	238	416
132kV	2,769	4,405
275kV	5,819	8,037
330kV	347	691
Total Lines	9,174	13,550

Source: 2010 Powerlink Annual Report

The transmission line structures have to be designed in such a way to provide adequate distance between ground and wires and to provide adequate mechanical support for insulators, wires and other hardware. They have to be designed to provide maintenance access to the wires, insulators and hardware.

Powerlink uses different types of transmission line structures such as guyed steel masts, wood, concrete and steel poles, but the majority of structures are self supporting lattice steel towers. There are more than 22000 transmission line structures in Powerlink network, of which just over 1500 are wood and concrete poles. In general, there are two main types of structures, tension and suspension. There are more than 3500 tension structures and more than 17000 suspension structures.

The following trends in Figure 1, Figure 2, and Figure 3 give a perspective of the Powerlink transmission line structures and associated built sections.

Figure 1 provides a perspective of the as constructed numbers of tension and suspension towers in each calendar year.

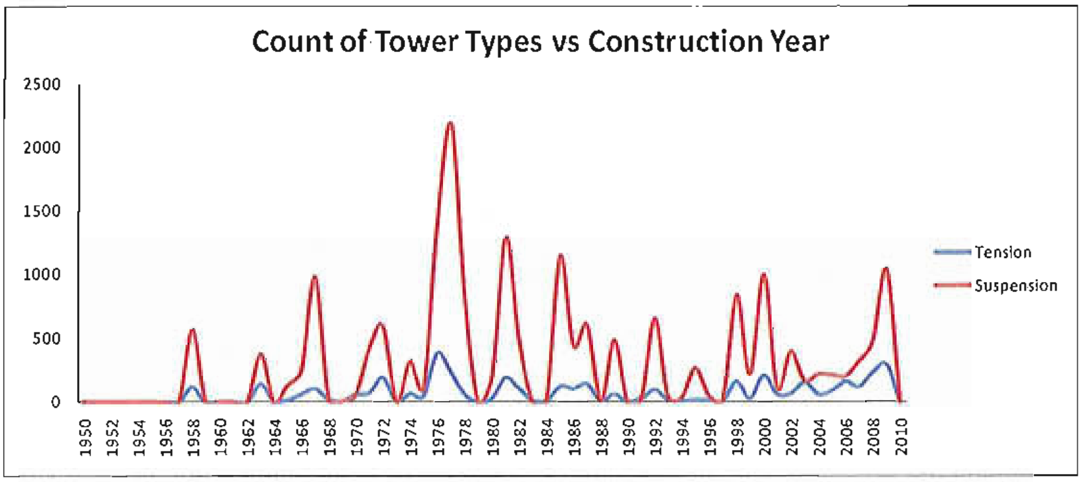

Figure 1 – Tower Types vs. Construction (SAP June 2010)

Figure 2 shows the accumulated line route kilometres grouped via operating voltage.

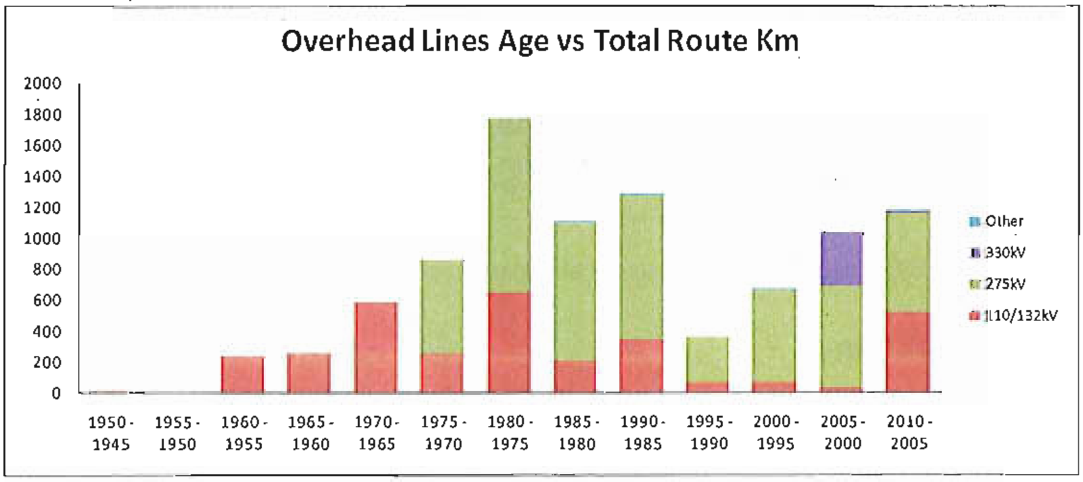

Figure 2 – Overhead Lines Age vs. Total Route km (SAP June 2010)

The following Figure 3 shows the profile of the number of built sections of overhead lines split into the as-constructed voltage level. That is to say, if a built section was constructed suitable for 275kV, but energised at 132kV, the built section is represented in the 275kV data is reflected below.

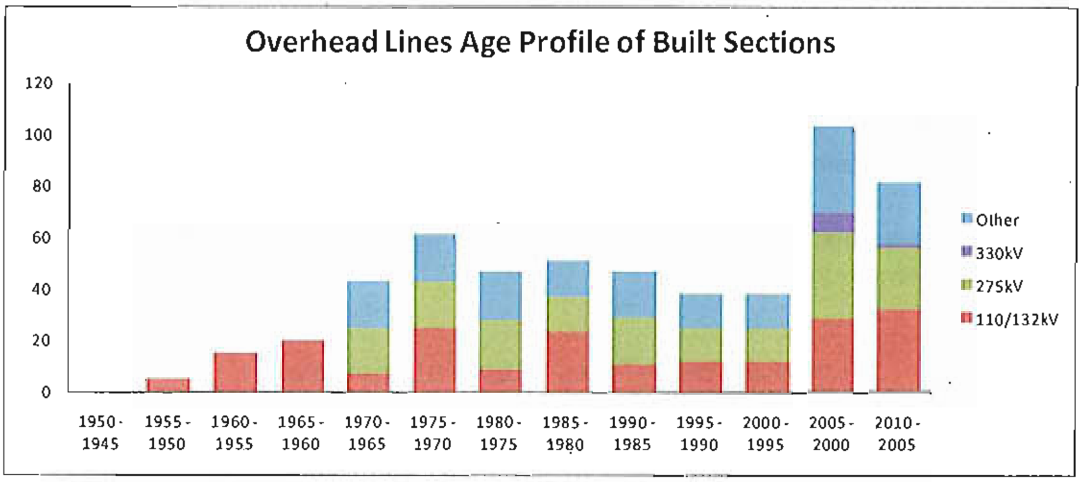

Figure 3 – Overhead Lines Age Profile of Built Sections (SAP June 2010)

HV Underground Cables Profile

Figure 4 shows the number of underground cable built sections installed on the Powerlink network.

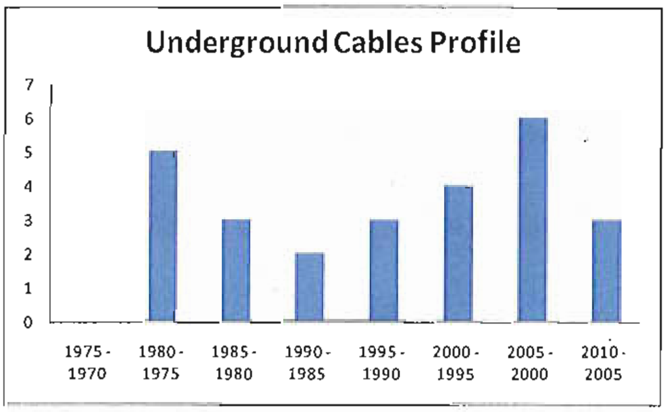

Figure 4 – HV Underground Cables Count of Construction Year Profile (SAP June 2010)

2.2 Substations

Powerlink owns and operates substation plant at a range of nominal transmission voltages including 330kV, 275kV, 132kV and 110kV. Some substation plant also exists in the network at lower voltages for the purposes of providing customer connections, internal local supply as well as for some reactive support equipment.

Table 2 – Substation/switching stations and communications sites (June 2010)

Voltage	Substations	Cable Transition Sites	Communication Sites
330kV	4	0	
275kV	35	2	
132kV	58	0	
110kV	15	1	
Total	112	3	91

Source: 2010 Powerlink Annual Report

Figure 5 provides a perspective on the relative numbers of substations grouped by their nominal transmission voltages.

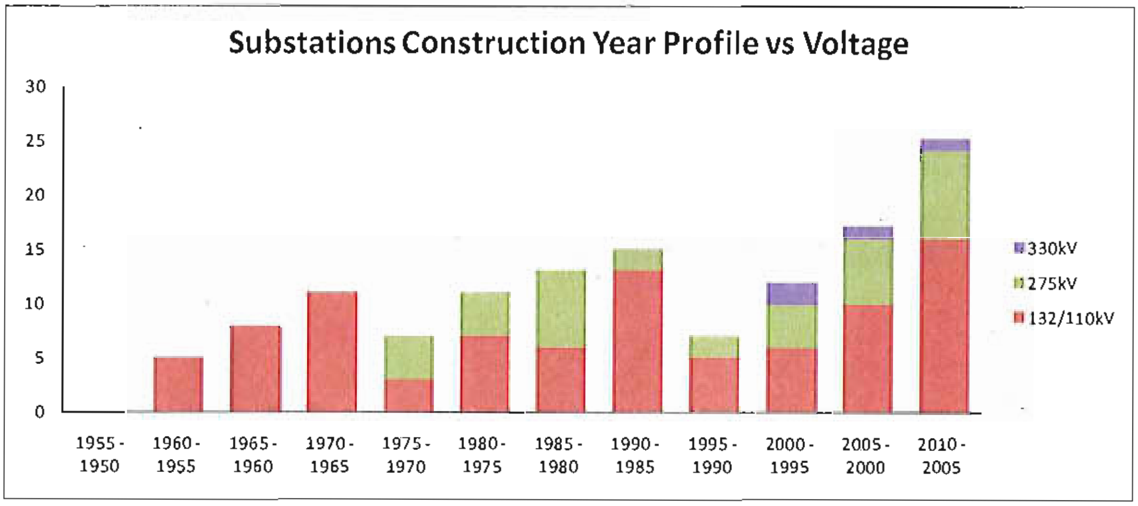

Figure 5 – Substation Construction Year vs. Voltage Profile (SAP June 2010)

The following plant is covered by the Substations asset categories: local supply, earthing and power transformers and associated components; air insulated circuit breakers, disconnectors, earth switches and fault throw switches; hybrid and gas insulated equipment; capacitor banks; series and shunt reactors; static VAR compensators and associated equipment; bus bars, conductors and supports; AC and DC supply systems; instrument transformers and coupling equipment; air compressors and receivers; resistive devices; structures and cubicles; surge arresters; and site infrastructure.

This plant is subsequently rolled up into their respective assets which have the following categories:

- Transformers
- Bays
- Capacitor banks
- Reactors
- Substation infrastructure (e.g. AC/DC supplies, buildings)

Note that transformers, bays, capacitor banks and reactors can have circuit breakers, disconnectors, earth switches and current transformers associated with their respective asset.

Transformer Profile

The following Table 3 – Power Transformers (June 2010) provides the accumulated amounts of MVAr for power transformers grouped by their respective HV winding voltage level.

Table 3 – Power Transformers (June 2010)

Power Transformers		
Voltage	Total Number	Total MVAr Rating
330kV	5	4,975
275kV	70	18,225
132kV	85	5,752
110kV	27	2,000
Total	187	30,952

Source: 2010 Powerlink Annual Report

The following Figure 6 provide a perspective on the numbers of transformers (power and local supply) that have been deployed in the Powerlink network.

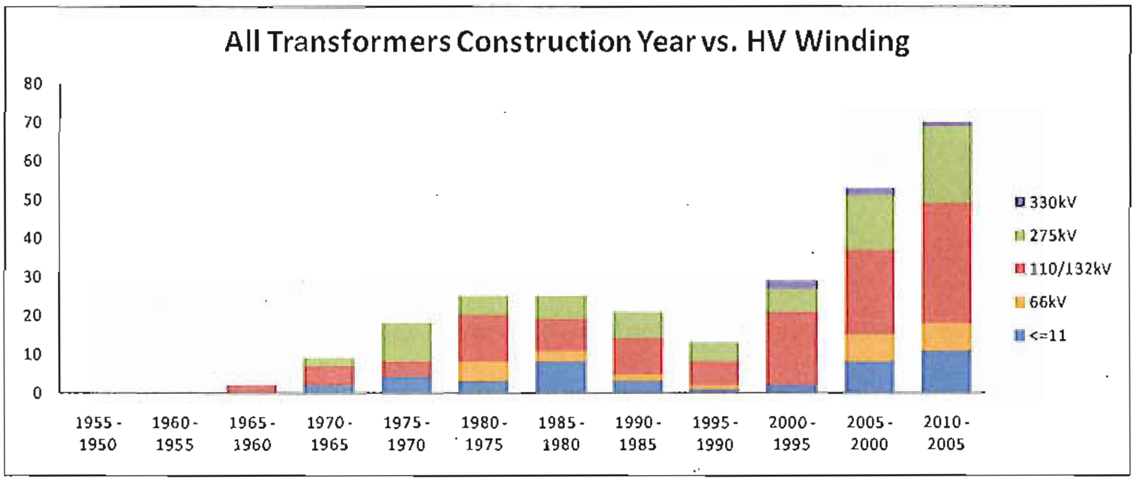

Figure 6 – All Transformers Grouped via Voltage (SAP June 2010)

Circuit Breakers Profiles

The following Table 4 shows the amount of circuit breakers that have been installed on the Powerlink HV network.

Table 4 – Circuit Breakers (June 2010)

Voltage	Circuit Breakers Total Number
330kV	28
275kV	412
132kV	427
110kV	263
<=66kV	27
Total	1,157

Source: 2010 Powerlink Annual Report

The following Figure 7 provides a perspective on the number of circuit breakers on the Powerlink network which have been grouped by their operating voltages.

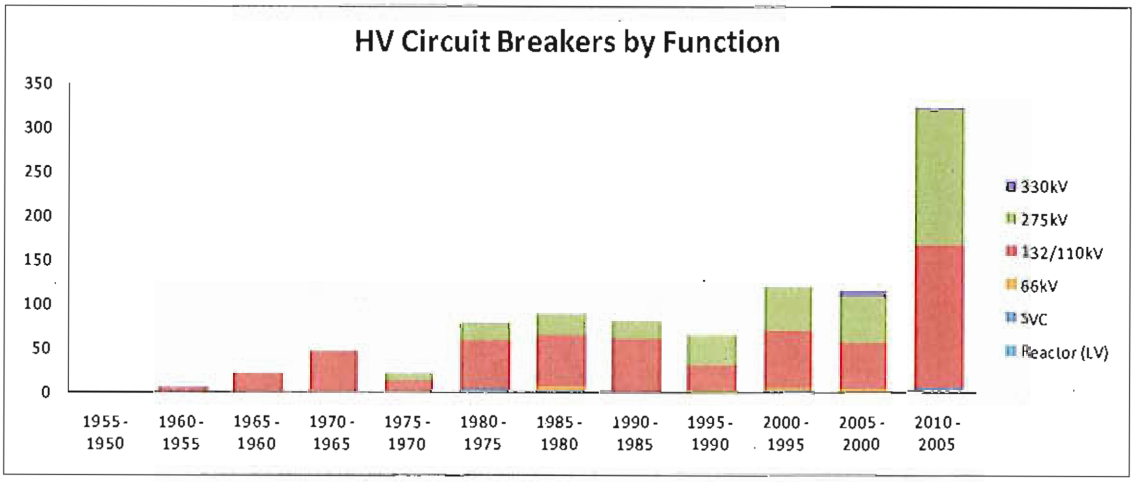

Figure 7 – Circuit Breakers Grouped via Function / Voltage (SAP June 2010)

The following Figure 8 provides a simple view on the count of circuit breakers grouped via their respective medium used to extinguish the arc. This is the same population as described in the previous figure.

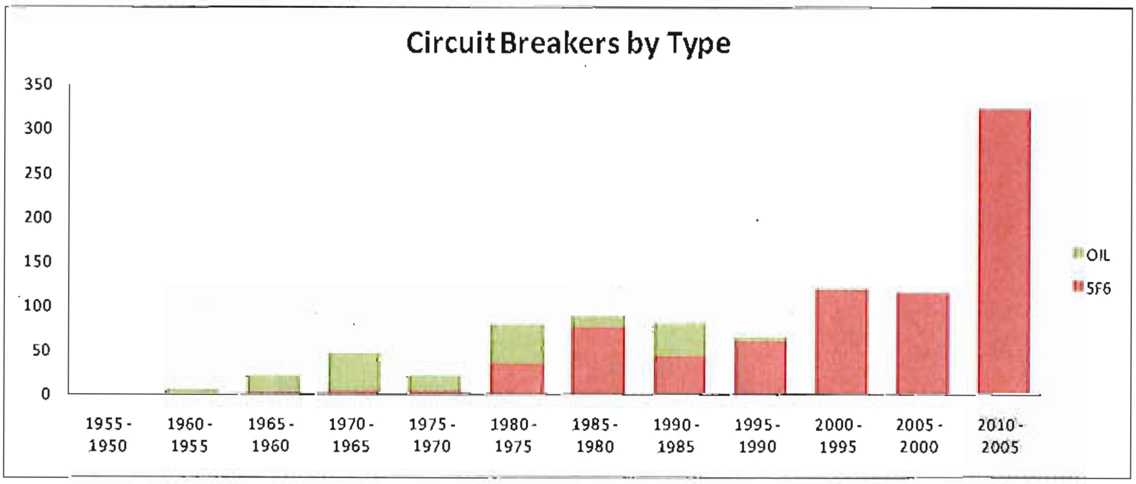

Figure 8 – Circuit Breakers Grouped via Medium (SAP June 2010)

Current Transformers Profile

The following Figure 9 shows the relative counts of current transformers that have been grouped by their nominal operating voltages.

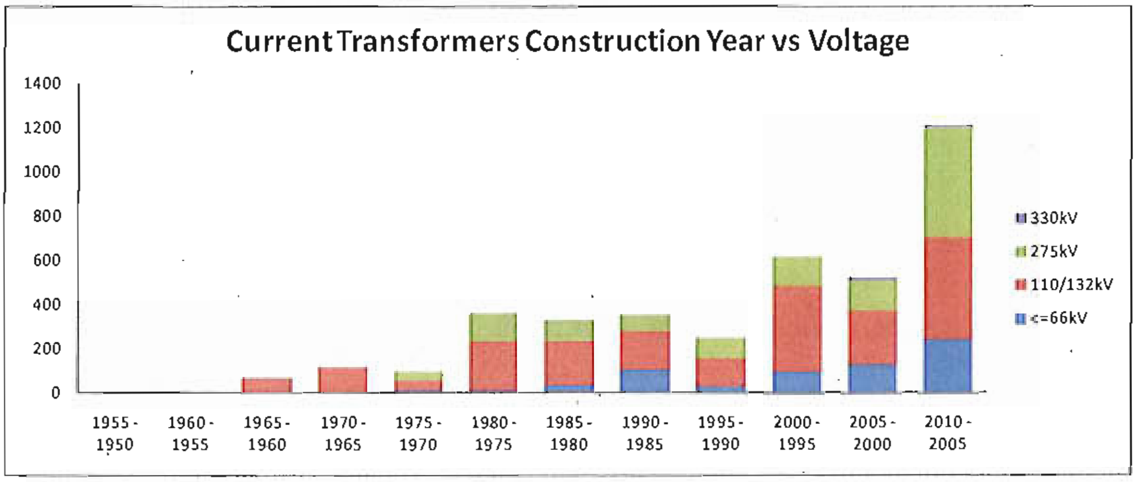

Figure 9 – Current Transformers Grouped via Voltage (SAP June 2010)

Disconnectors Profile

The following Figure 10 is a trend that shows the relative counts of disconnectors (isolators) grouped by their nominal operating voltage.

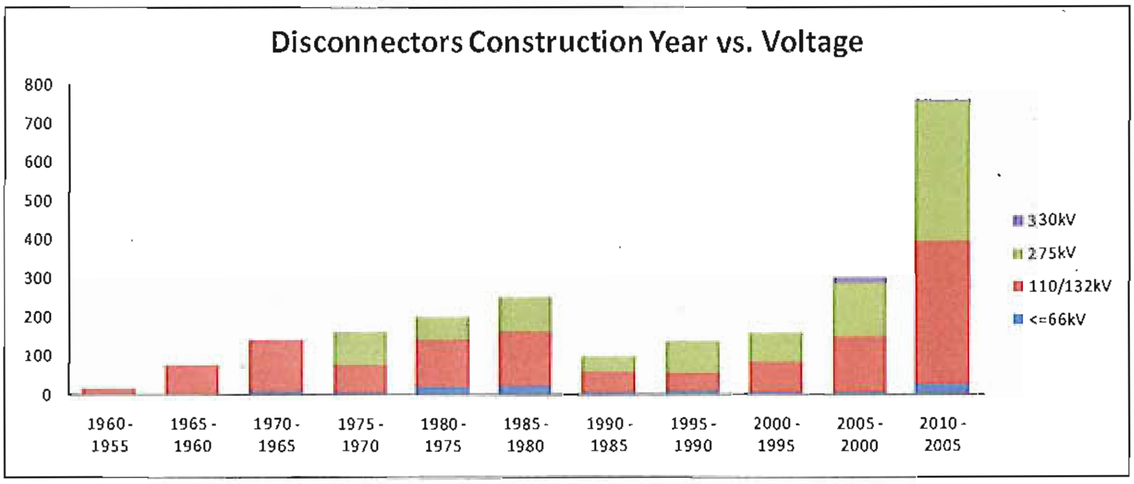

Figure 10 – Disconnectors Grouped via Voltage (SAP June 2010)

Earth Switches Profile

The following Figure 11 provides a view of the relative amounts of earth switches grouped together by voltage.

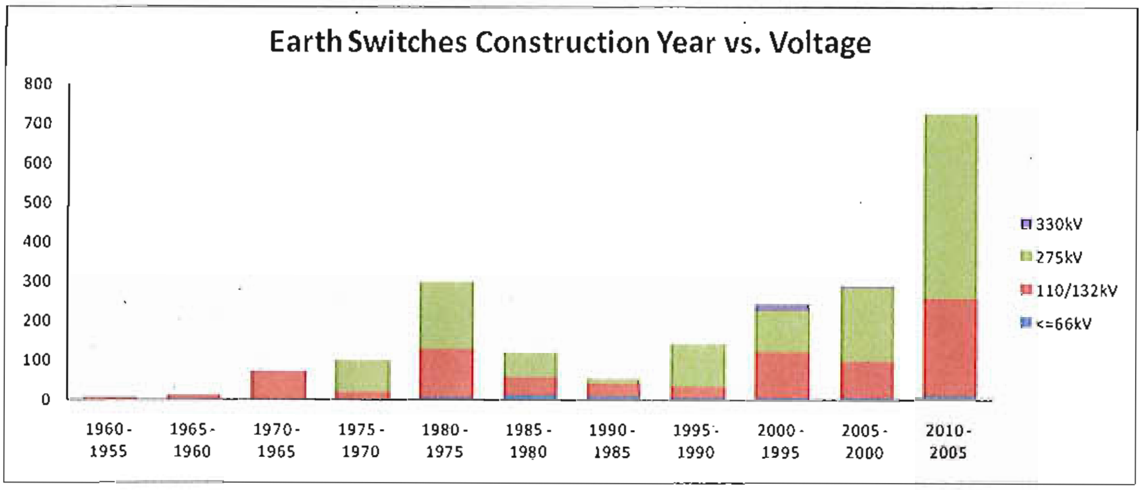

Figure 11 – Earth Switches Grouped via Voltage (SAP June 2010)

Reactive Plant – Capacitor Banks, Reactors and Static VAr Compensators

Table 5 provides a summary of all of the reactive plant grouped by type (Capacitor Banks, Reactors and SVCs) and amounts of reactive power available.

Table 5 – Capacitor Bank, Shunt Reactors and Static VAr Compensators (June 2010)

Voltage	Capacitor Banks		Reactors		SVCs	
	Total number	Total rating MVAr	Total number	Total rating MVAr	Total number	Total rating MVAr
330kV	0	0	4	144	0	0
275kV	26	3,600	15	611	8	2,510
132kV	25	1,113	0	0	11	1,081
110kV	34	1,850	0	0	0	0
<=66kV	7	145	5	120	0	0
Total	92	6,708	24	875	19	3,591

Source: 2010 Powerlink Annual Report

Figure 12 provides a trend on the relative amounts of capacitor banks that have been deployed on the Powerlink high voltage network and have been grouped into operating voltage levels.

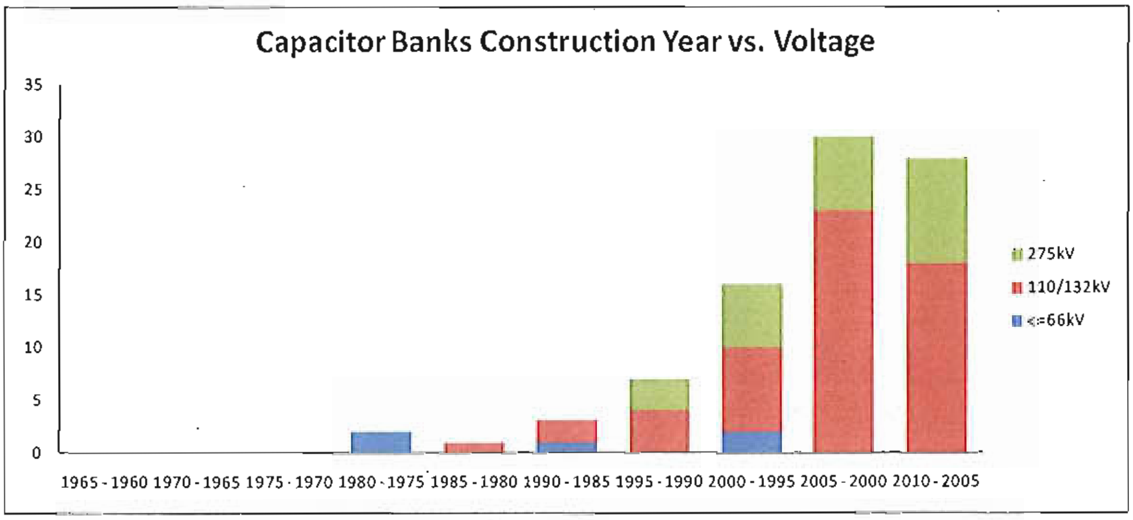

Figure 12 – Reactive Plant Capacitor Banks Grouped via Voltage (SAP June 2010)

Figure 13 is a trend of the number of reactors that have been installed on the Powerlink network. As there are relatively few reactors, they have not been grouped into their relative operating voltages.

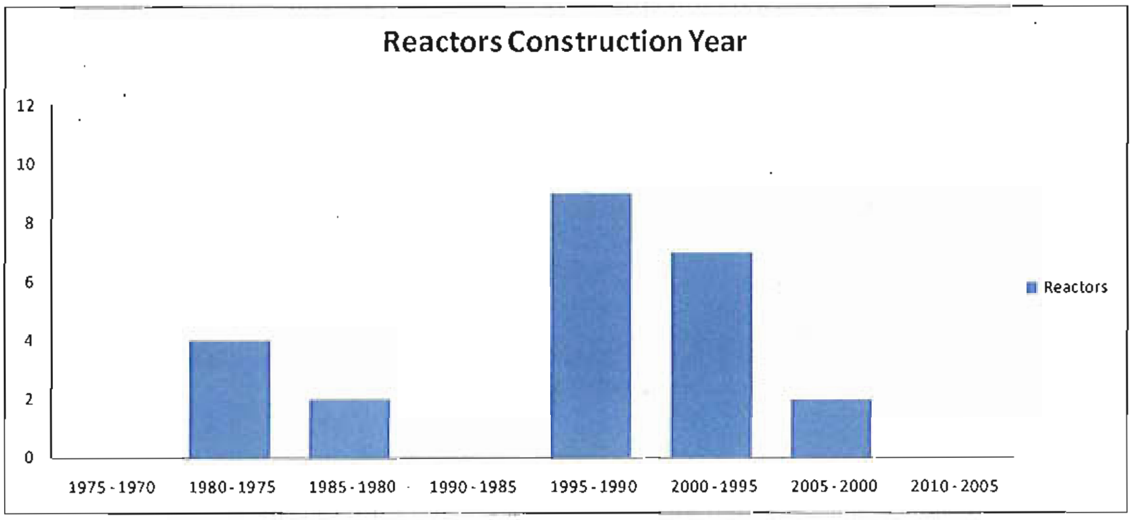

Figure 13 – Reactive Plant Reactors Grouped via Voltage (SAP June 2010)

The following Figure 14 provides a trend on the the numbers of Static VAr Compensators that have been installed on the Powerlink high voltage network. Note that there are a number of SVCs that operate 275kV and the balance operate at 132kV.

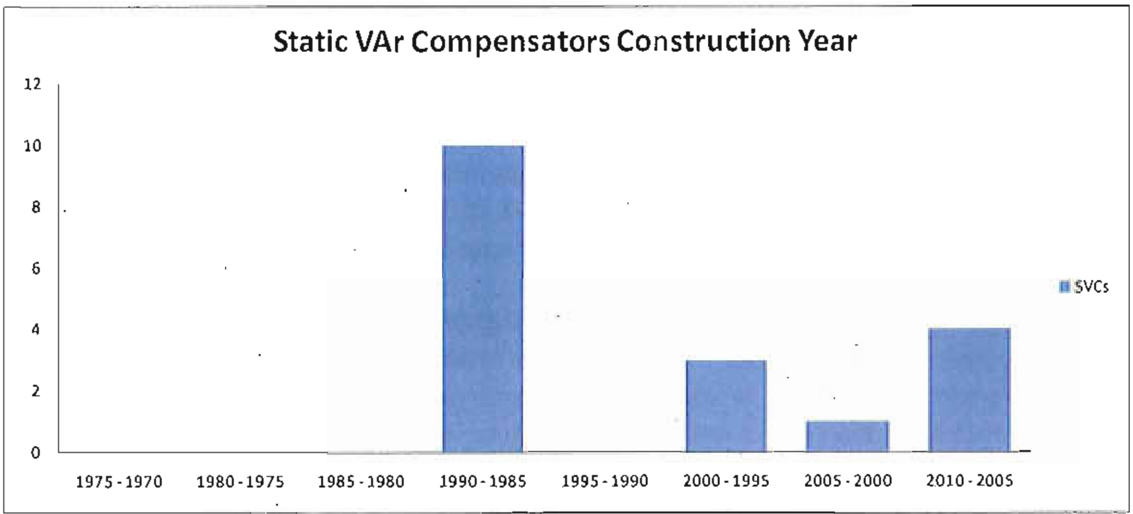

Figure 14 – Static VAR Compensators Construction Year (SAP June 2010)

2.3 Digital Technology

Powerlink owns and operates substation plant at a range of nominal transmission voltages including 330kV, 275kV, 132kV and 110kV. Each of the substation assets has an associated secondary system panel. There are also a range of other panels that cover other functions such as bus zone protection, power system monitoring and so on.

The asset profiles included provide a representation of the current Digital Technology assets located across the business and operational environments. To improve clarity, the profiles have been broken down into the areas of Secondary Systems and Telecommunications. Business Information Technology assets are covered in the Non Network Plan.

Secondary Systems

Powerlink owns and operates a broad variety of secondary systems from discrete electromechanical devices mounted in corridor panels to networked integrated digital systems mounted in swing frame panels. From a financial perspective, assets providing the functions for a bay are grouped to create a financial asset.

Traditional Secondary Systems (1960-1999) – Substations with traditional secondary systems have a central alarm annunciator, a control mimic panel in large substations, a set of panels for each plant element. The set of panels consists of an X Protection panel, a Y Protection Panel and an Auxiliary/Control Panel which are all located in the relay room. There are numerous components mounted on the panels to perform the various functions required. These components include protection relays, overcurrent relays, timers, auto reclose relays, CVT monitors, voltage control relays and follower relays. Protection signalling equipment and the central remote terminal unit (RTU) are mounted in the communications room.

Powerlink substations of this style range from the 1960s to 1999 [redacted]

Turnkey Secondary Systems (1997-2002) – Turnkey secondary systems have been delivered with turnkey substations. Turnkey secondary systems are usually integrated systems with the level of integration varying from manufacturer to manufacturer. Powerlink has [redacted] substations delivered between 1997 and 2002, [redacted] substations delivered between 2000 and 2001 and [redacted] substation delivered in 2000.

Integrated Secondary Systems (2002 onwards) – Powerlink has developed an integrated secondary system where Powerlink integrates the protection and control devices of various manufacturers and mounts them in a single swing frame panel. The panels are arranged one per bay. The first substation of this design was delivered in 2002.

Asset Monitoring Systems (2001 onwards)– [redacted]

Metering Installations – As part of Powerlink's connection to customers, metering installations have been installed to National Electricity Rules requirements. The Rules require that each connection point have a metering installation and that the revenue metering point be located as close as practicable to the connection point.

Energy Management System – [redacted]

Secondary Systems Profiles

Figure 15 provides a perspective on the relative numbers of secondary systems panels that have been installed on the HV network as well as the ancillary panels such as metering and non bay. Non bay includes such functions as bus zone protection, [redacted] the local control facility and remote power system monitoring.

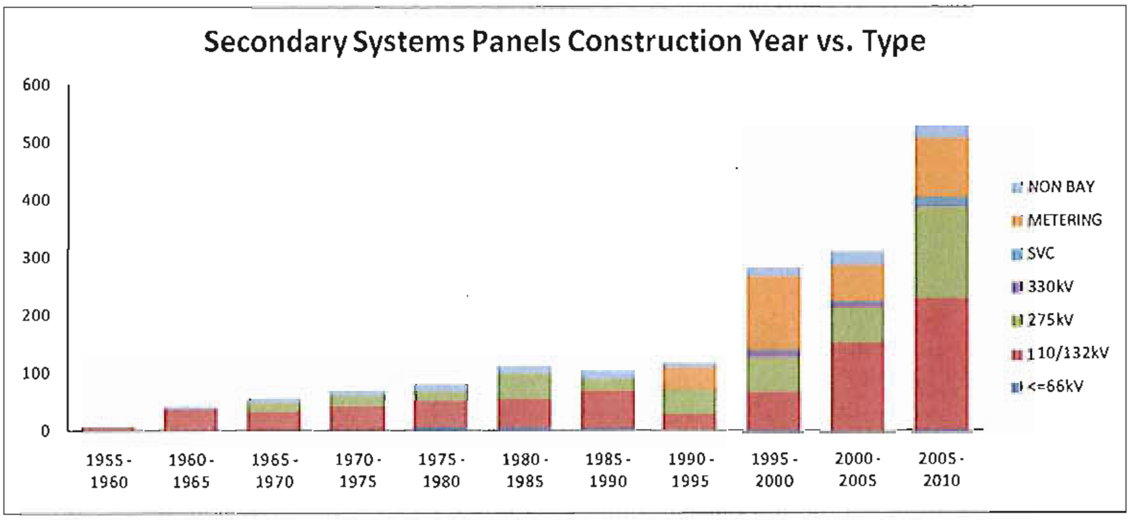

Figure 15 – Secondary Systems Panels Construction Year vs. Type (SAP June 2010)

The following trend Figure 16 provides an aspect of the relative counts of types of protection relays (electronic, electro-mechanical and digital) that are in service on the HV network. It is also worth noting that the electronic and electro-mechanical relays are not solely installed on the traditional secondary systems.

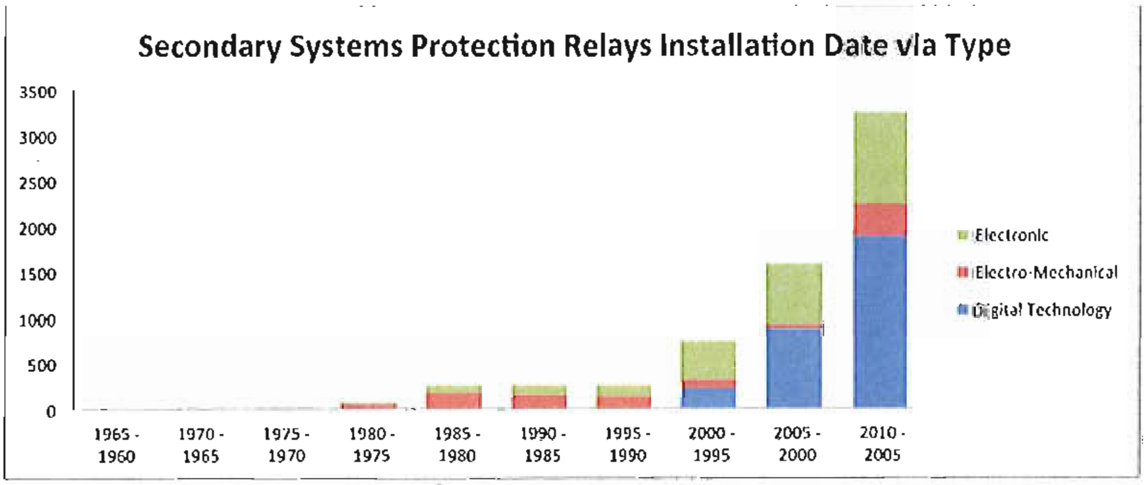

Figure 16 – Protection Relays Install Year vs. Type (SAP June 2010)

Figure 17 shows the numbers of various different types of Remote Terminal Units (RTUs) that are in service. This trend shows the relative dominance of C50s, but that there is also a range of other RTUs in service.

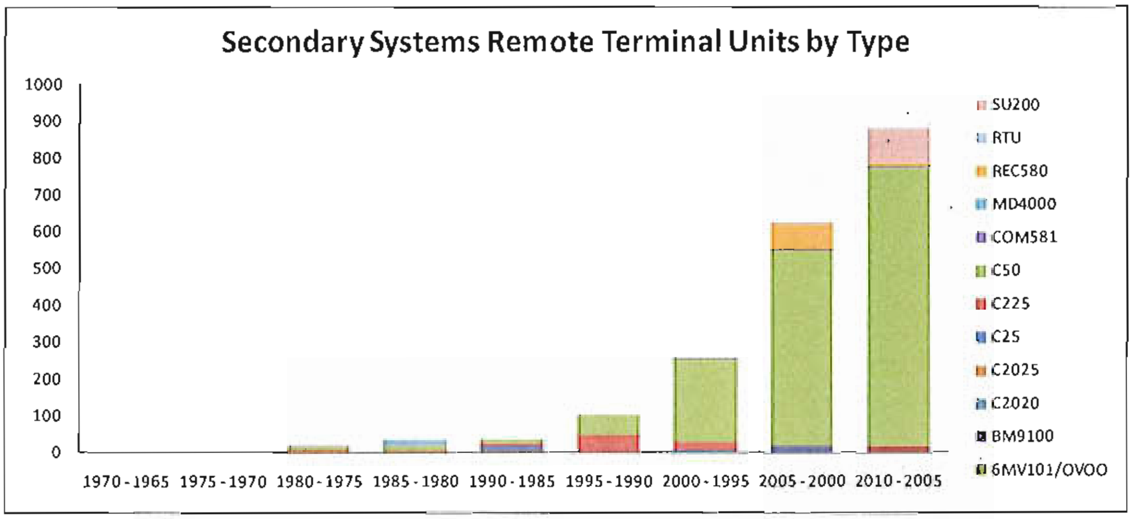

Figure 17 – Remote Terminal Units Grouped via Type (SAP June 2010)

Telecommunications

Telecommunications have a range of differing technologies that are part of the telecommunications assets. This equipment includes: Multiplexers (SDH & PDH); Radios; Telephones; Protection Signalling; Power Line Carrier; Communications Towers and Infrastructure (Batteries).

Telecommunications Profiles

Figure 18 provides a view of the population of telecommunications sites. Note that this does not include the installations of communications equipment on HV substation or co-location sites.

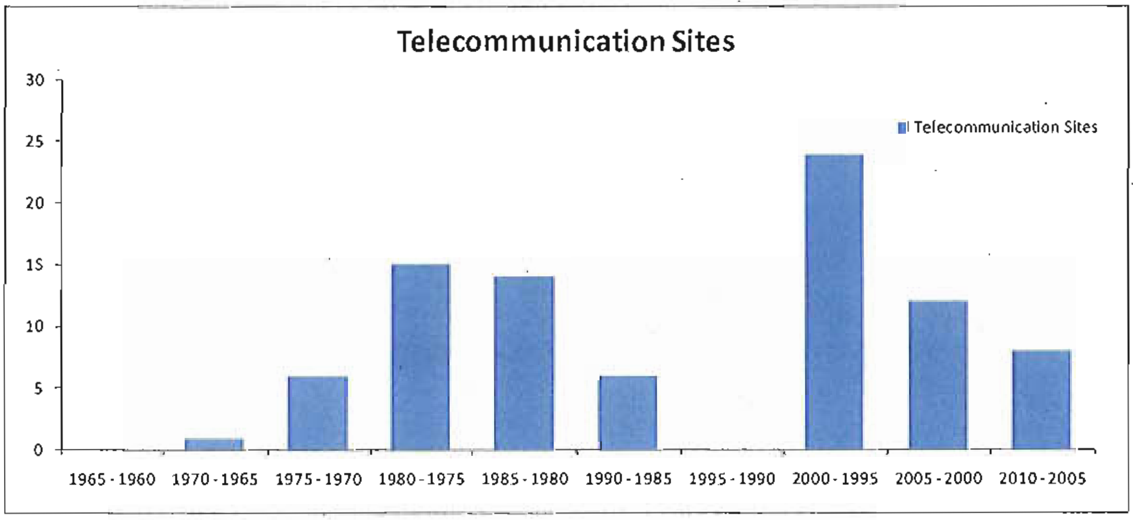

Figure 18 – Telecommunications Sites (SAP June 2010)

The following Figure 19 shows the relative counts of the communications medium (PLC, microwave or digital) that have been installed.

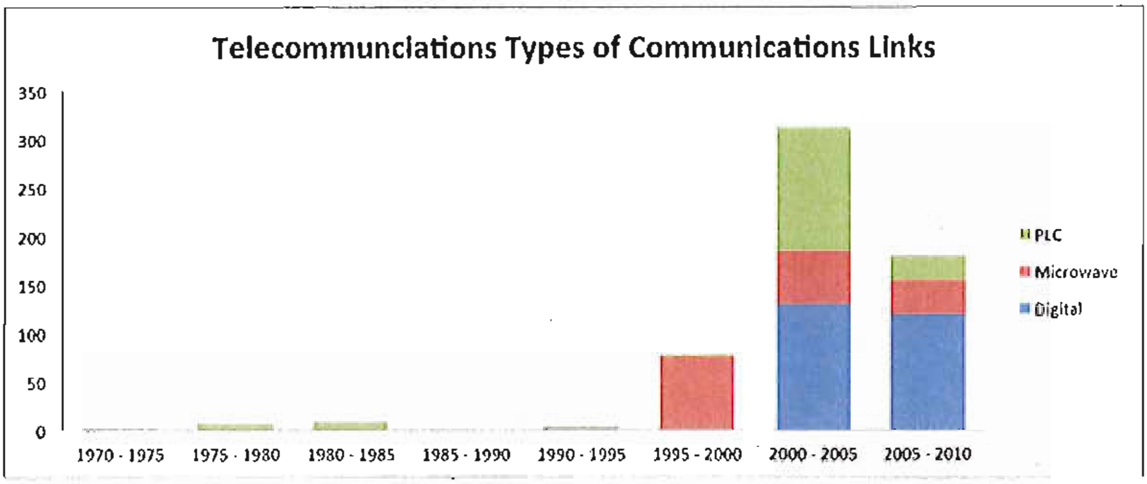

Figure 19 – Telecommunications Types (SAP June 2010)

3. Committed Projects

The following section lists the committed (either already approved or in the approval process) projects with expenditure beyond 30 June 2012.

3.1 Transmission Lines Committed Projects

Table 6 – Transmission Lines Committed Projects

Project Number	Description	Target Commissioning Date	Region
CP.00880	Cardwell – Tully 132kV Line Replacement	30/10/2012	Northern
CP.00882	Ingham South – Cardwell 132kV Line Replacement	30/12/2013	Northern
CP.01246	Mackay – Proserpine 132kV Transm Line Life Extension	30/07/2012	Northern
CP.01345	Kareeya to Chalumbin ADSS Replacement	30/06/2014	Northern
CP.01475	Kareeya – Tully 132kV Line Recovery	31/12/2013	Northern
CP.01420	Woree – Kamerunga Line Life Extension	31/10/12	Northern
CP.01091	Alan Sheriff – Garbutt Line Replacement	31/10/12	Northern
CP.02521	Ebenezer Linesperson Training Facility Establishment	31/05/2013	Southern

3.2 Substations Committed Projects

Table 7 – Substations Committed Projects

Project Number	Description	Target Commissioning Date	Region
CP.01453	Cardwell Transformers Replacement	30/06/2013	Northern
CP.01548	Kareeya Substation Redevelopment	30/10/2012	Northern
CP.01622	Cardwell Substation Line Switching	31/12/2012	Northern
CP.01780	Gladstone PS Switchyard Full Replacement	30/06/2013	Central
CP.01788	Palmwoods Primary Plant Replacement Stage 1	31/10/2013	Southern

CP.02058	Replacement of 66kV Equipment at Tarong	30/08/2012	Southern
CP.02207	Loganlea 110kV substation replacement	31/12/2013	Southern
CP.01163	Swanbank B 275kV Substation Replacement	30/03/2013	Southern
CP.01401	Woolooga No.1 & 2 Transformers Replacement	30/06/2013	Southern
CP.01658	Richlands Primary & Secondary Plant Replacement	30/04/2013	Southern
CP.01732	Runcorn 110kV Substation Replacement	30/04/2013	Southern
CP.02294	Diesel Generator Installation Stage 2	31/10/2012	Southern
CP.02059	Woree and Chalumbin SPAR Implementation	31/10/2012	Northern

Table 8 – Substation Security Committed Projects

Project Number	Description	Target Commissioning Date	Region
CP.01668	Comms Site Access & Security (Part A)	30/12/2012	Security
CP.02068	Substation Security Upgrade – Stage 2	30/06/2013	Security

3.3 Secondary Systems Committed Projects

Table 9 – Secondary Systems Committed Projects

Project Number	Description	Target Commissioning Date	Region
CP.01127	Loganlea 110kV Secondary Systems Replace	30/06/2014	Southern
CP.01135	Redbank Plains Secondary Systems Replacement	30/07/2012	Southern
CP.01161	Rocklea Sec Sys Replacement	1/10/2013	Southern
CP.01292	Broadsound Secondary Systems Refurbishment	30/11/2012	Central
CP.01563	Bouldercombe Secondary Systems Replacement	30/11/2013	Central
CP.01019	Moranbah Secondary Systems Replacement	30/10/2012	Central

CP.01566	Chalumbin Secondary Systems Replacement	30/12/2013	Northern
CP.01918	Strathmore iPASS Secondary Systems Replacement	31/03/2013	Northern
CP.02012	Ross SVC Secondary System Replacement	30/09/2012	Northern
CP.01494	Millmerran iPASS Secondary System Replacement	31/10/2012	Southern
CP.01493	Bulli Creek iPASS Secondary Systems Replacement	31/10/2013	Southern

Table 10 – Secondary Systems Operational Technology Committed Projects

Project Number	Description	Target Commissioning Date	Region
CP.01301	Power Quality Monitoring Stages 1 & 2	30/06/2013	Operational
CP.01471	NMS Common Service Upgrade	30/12/2012	Operational
CP.02489	OpsWAN Security Stage 1	30/06/2013	Operational
CP.02497	Power System Disturbance Recorders	31/12/2012	Operational

3.4 Telecommunications Committed Projects

Table 11 – Telecommunications Committed Projects

Project Number	Description	Target Commissioning Date	Region
CP.01466	Southern Region SDH Loop	30/10/2012	Southern
CP.01310	Metropolitan SDH Loop Upgrade	31/10/2012	Southern
CP.02082	Braemar R–OADM Installation	30/04/2014	Southern
CP.01816	VOIP Deployment Stage 1	30/06/2013	State-wide
CP.02098	MPLS Wide Area Network Stage 1	30/10/2013	State-wide

4. Planned Projects

The following section provides a list of all future project needs by each asset type and these have been further grouped by region.

Consistent with the Asset Management Policy, projects within the following sections have been subject to an economic and risk assessment, based on a number of credible options, where available.

Project Summary sheets have been provided to assist review where applicable in Section 5 Major Spend by Asset Type – Project Summaries.

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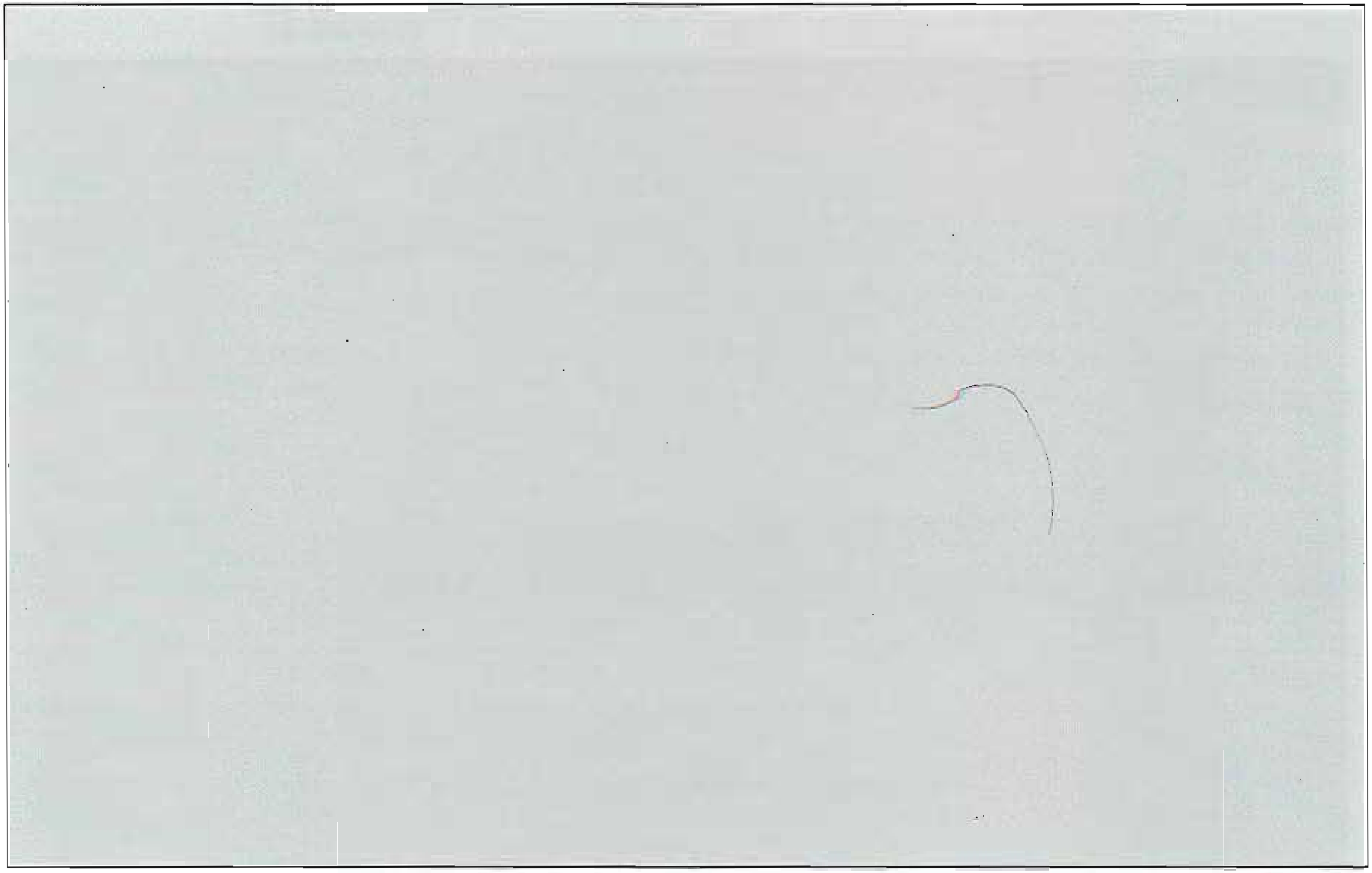

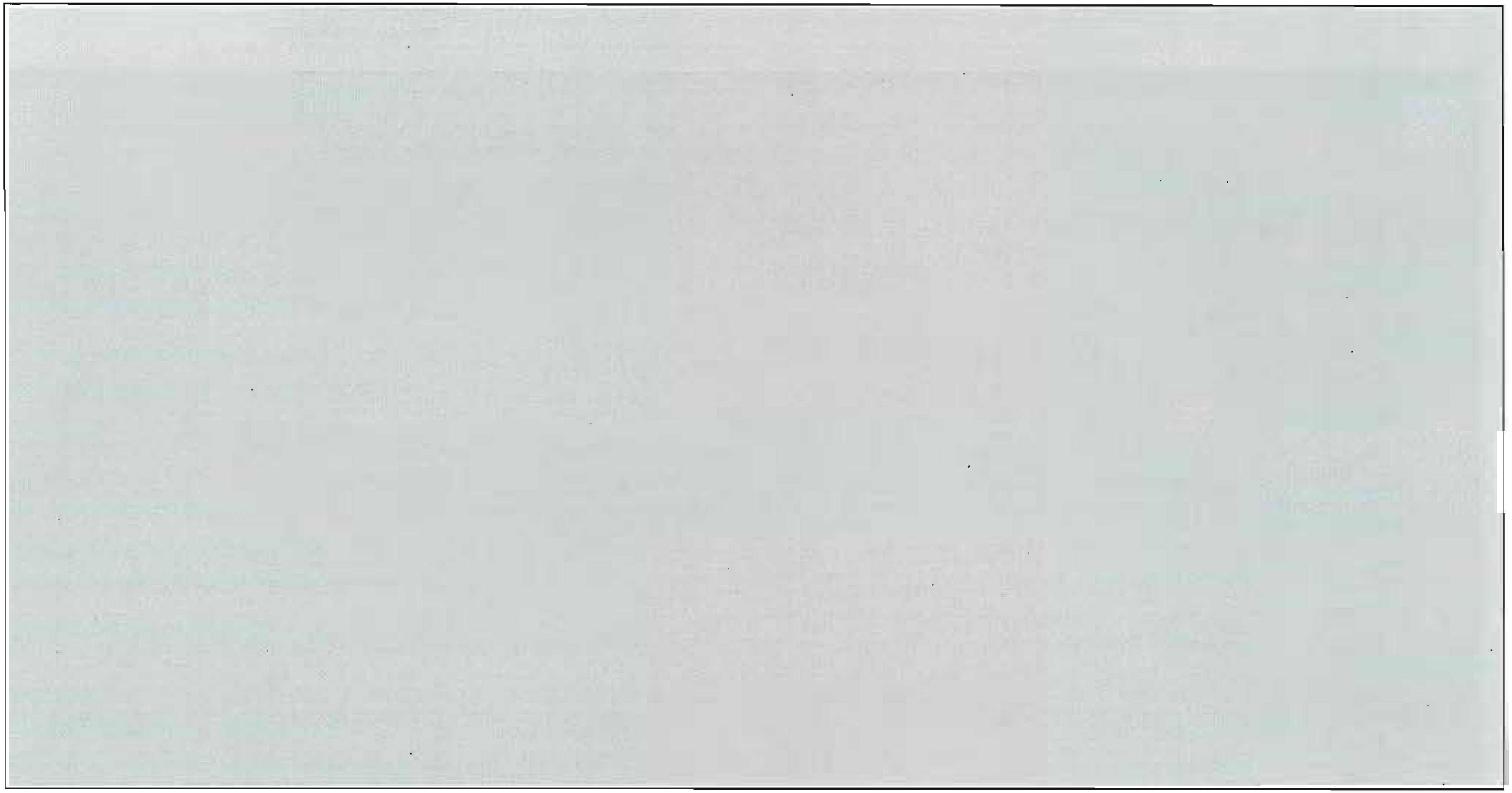

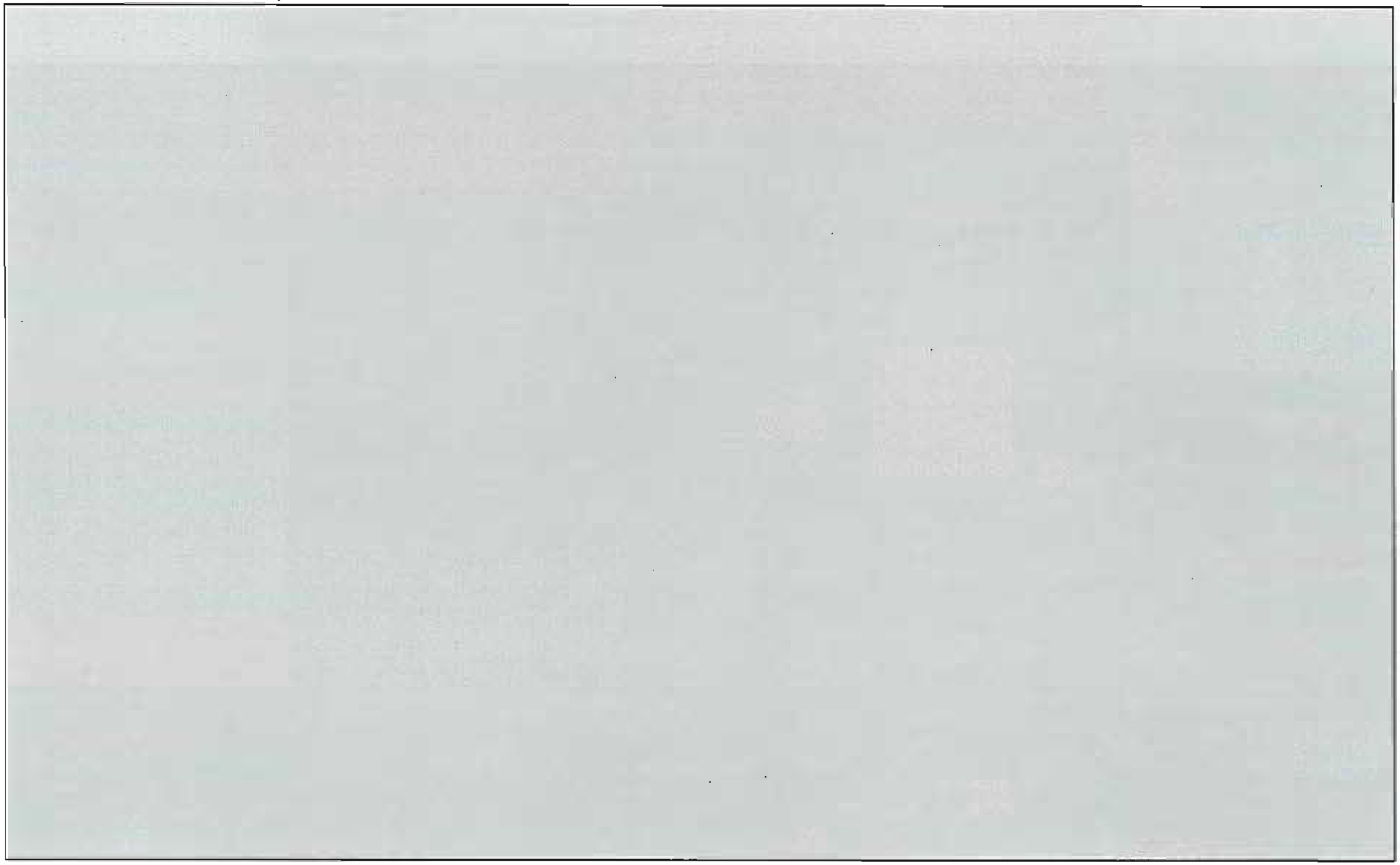

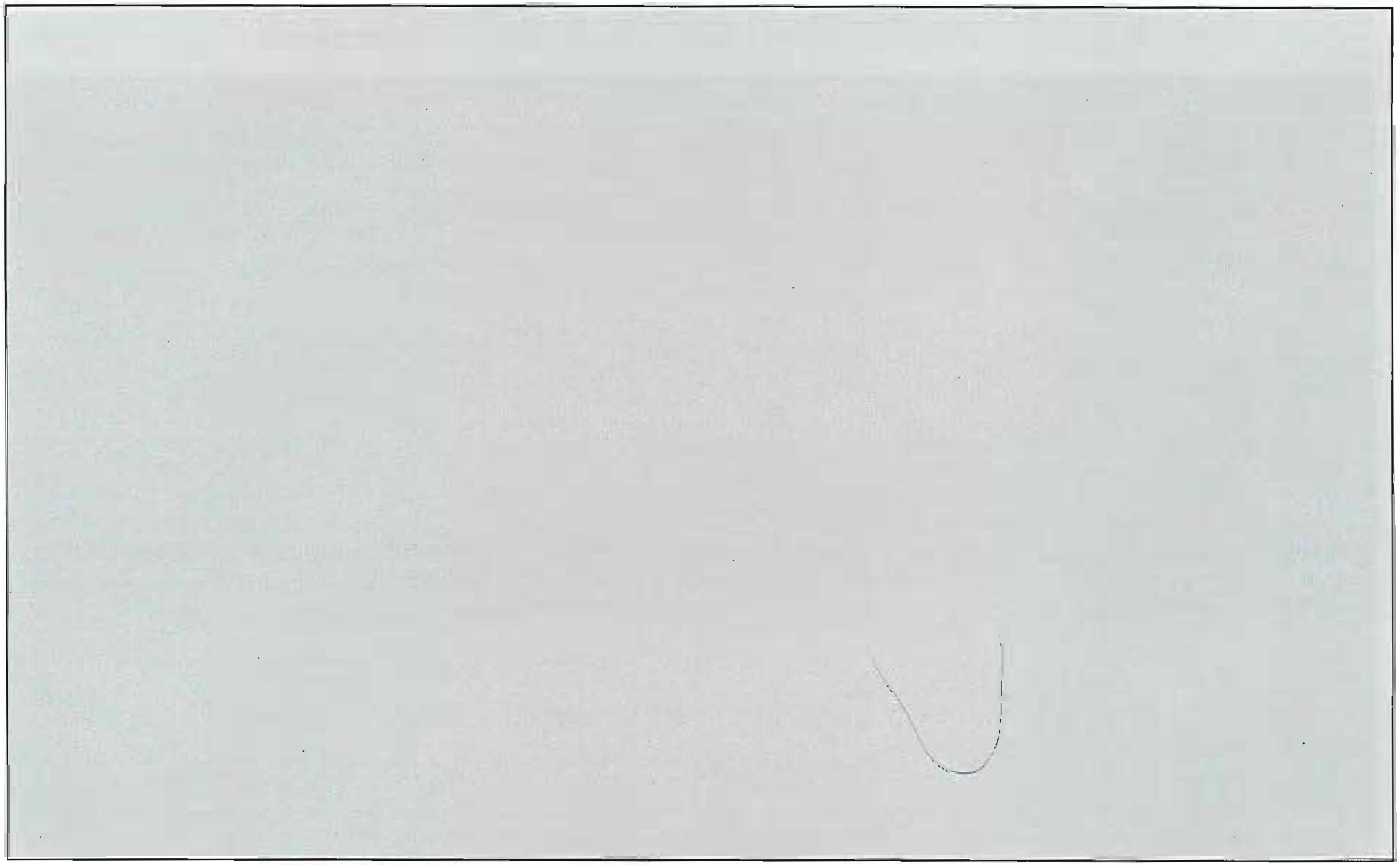

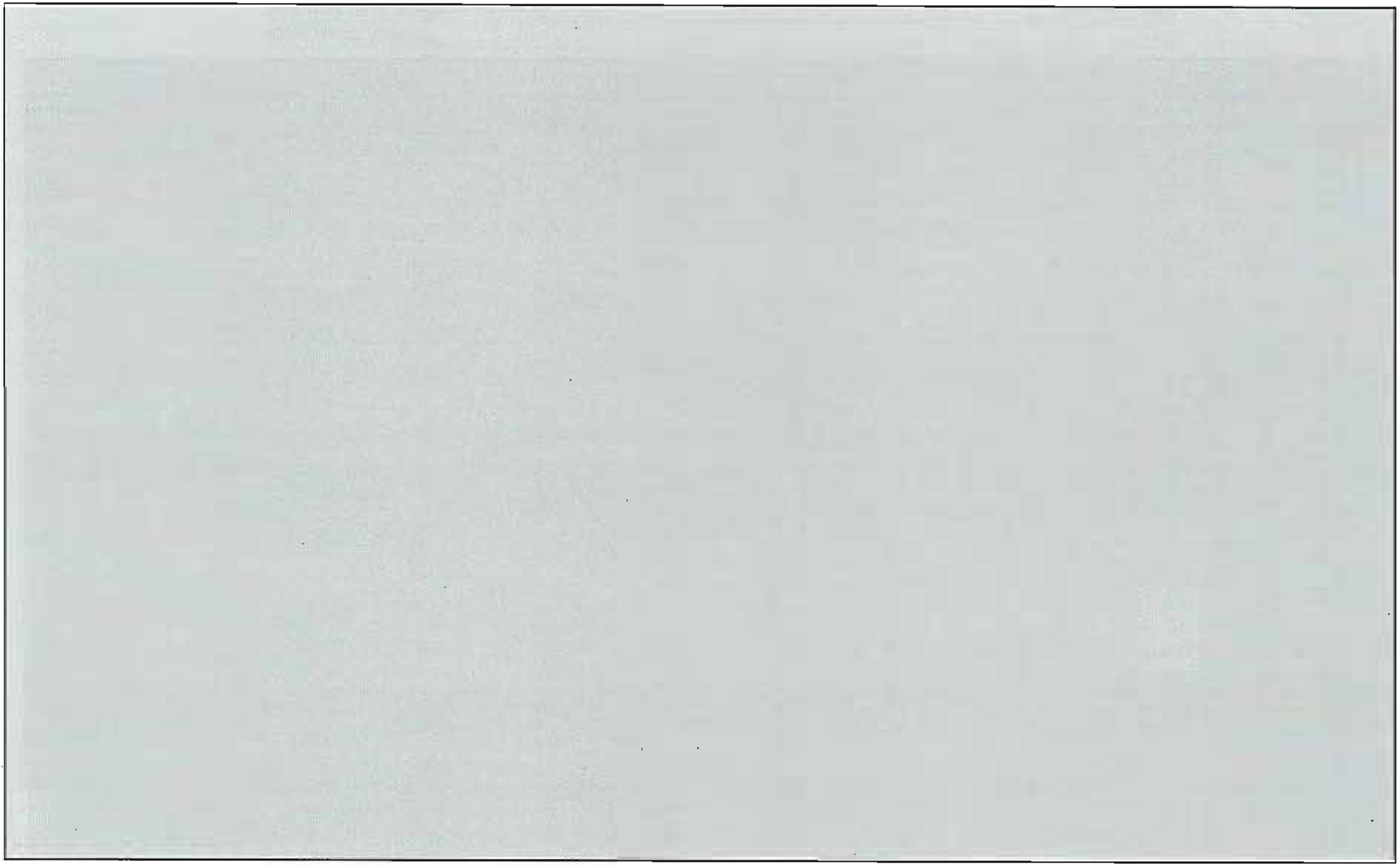

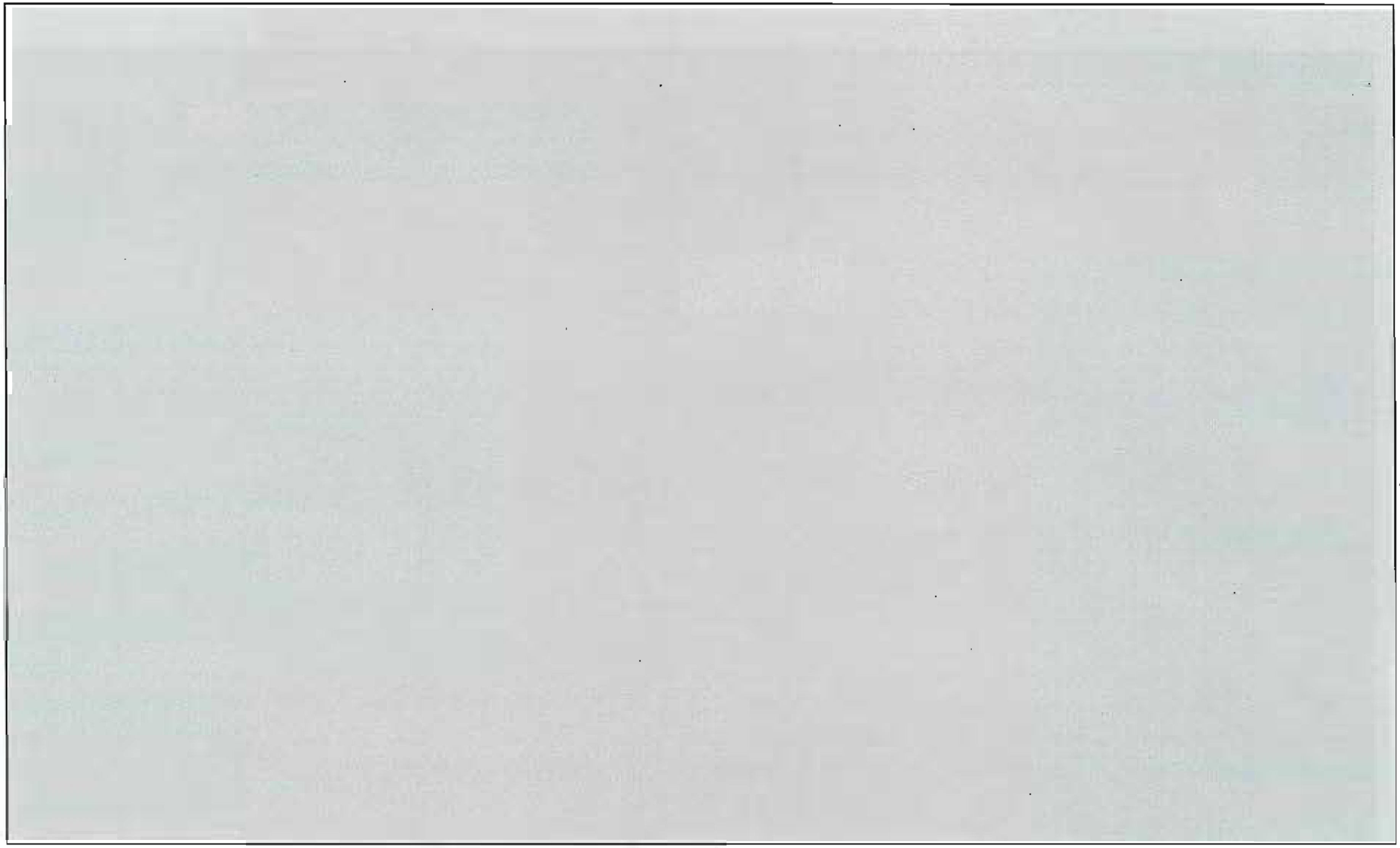

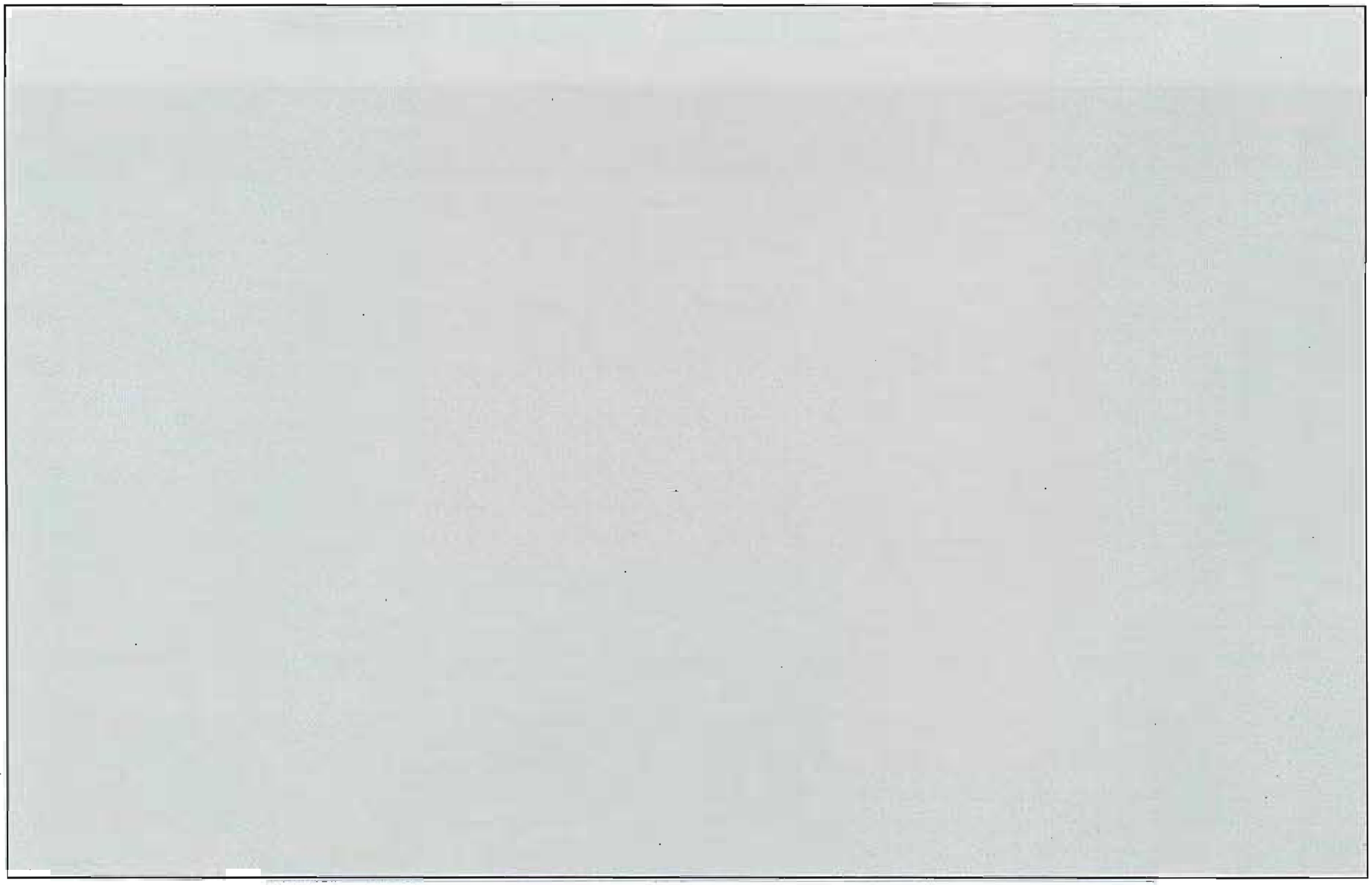

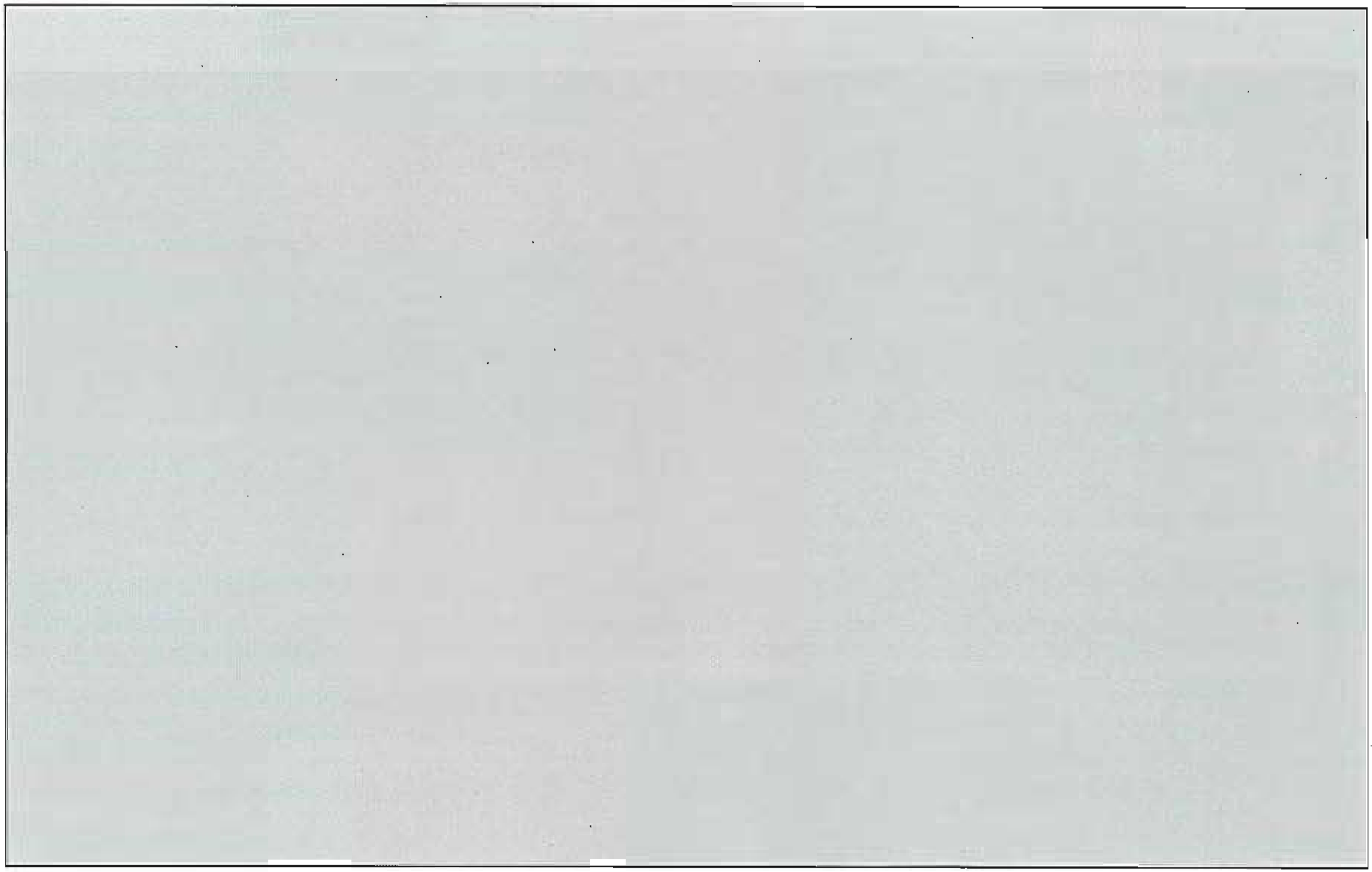

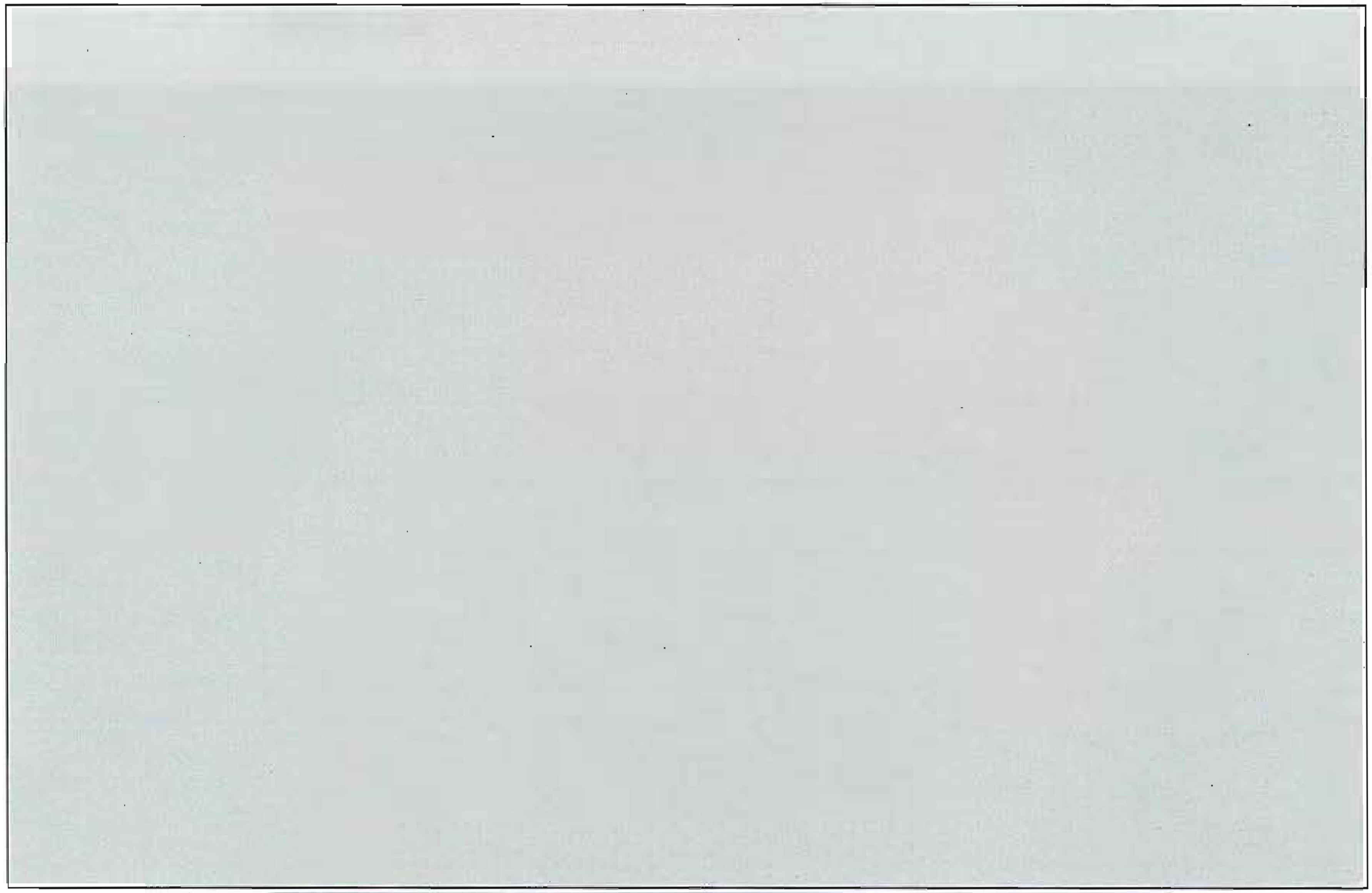

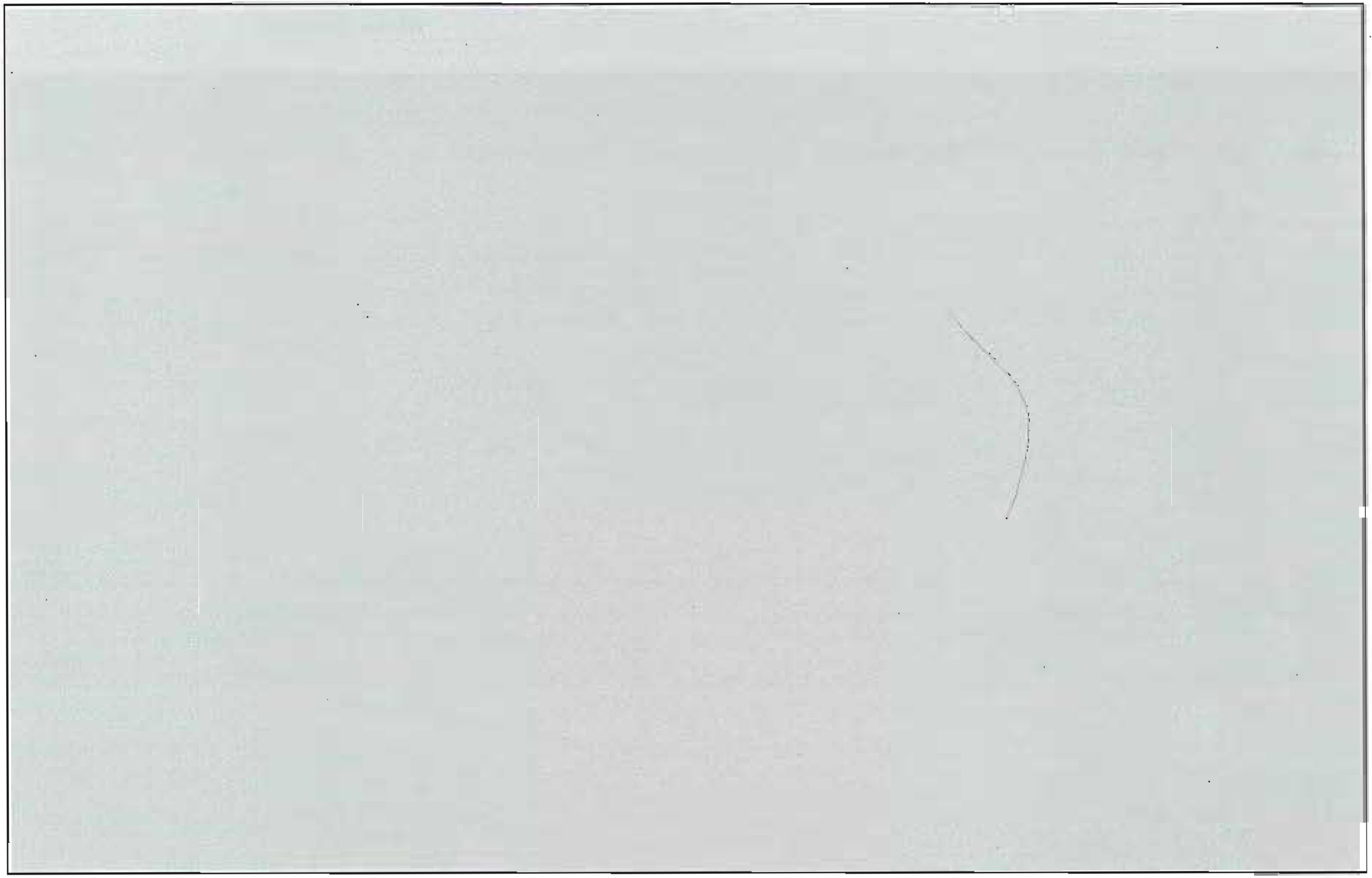

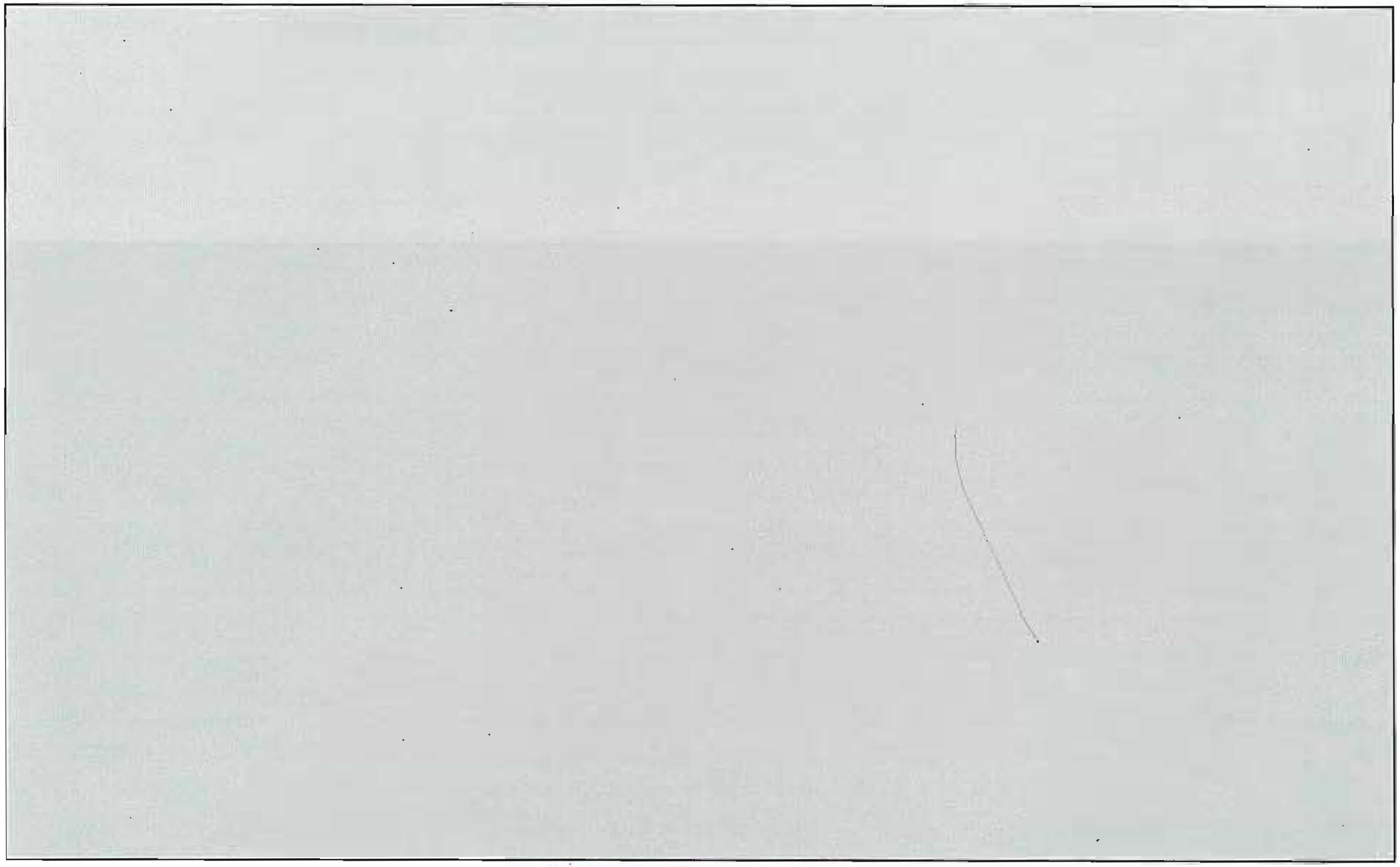

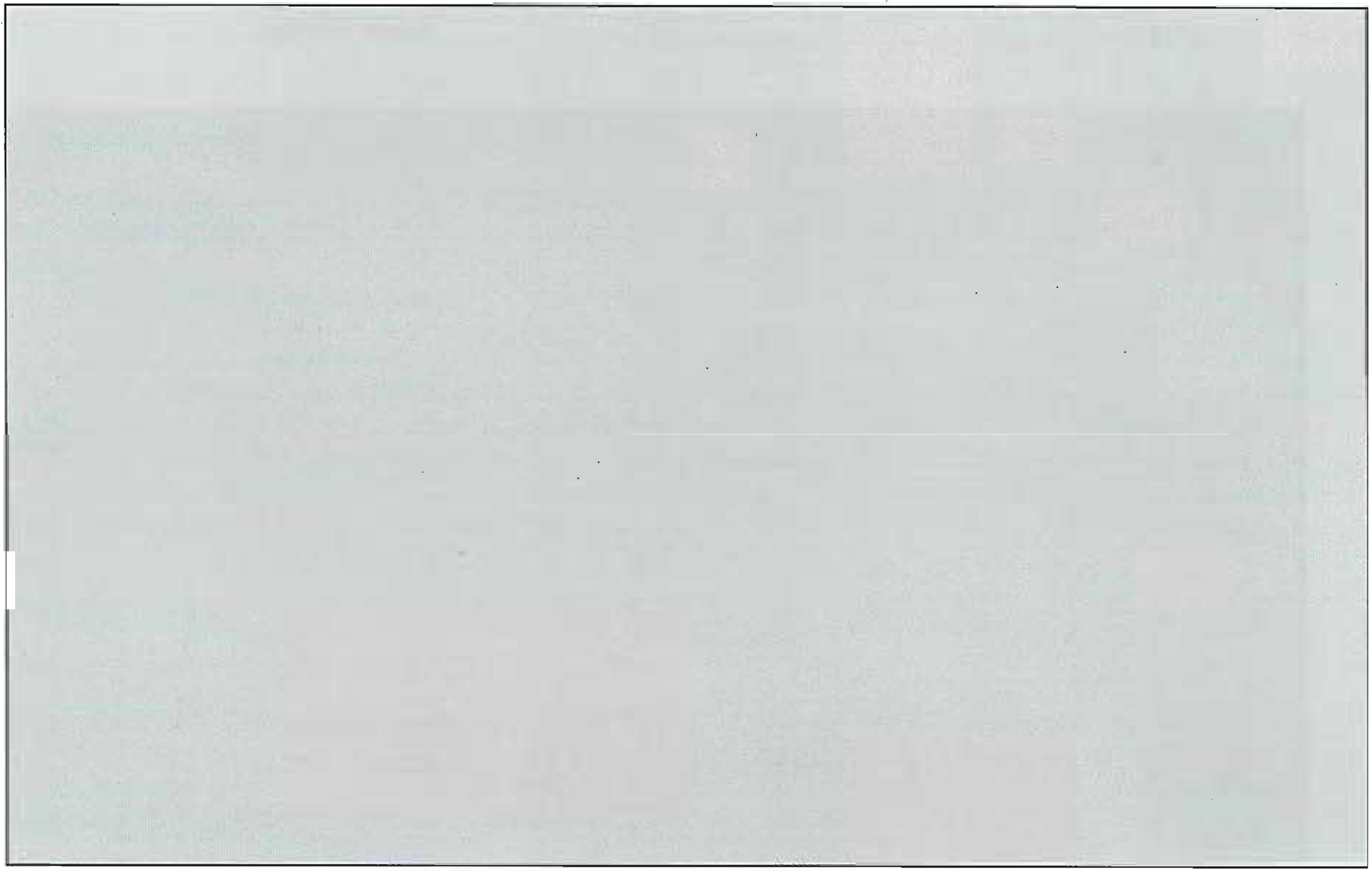

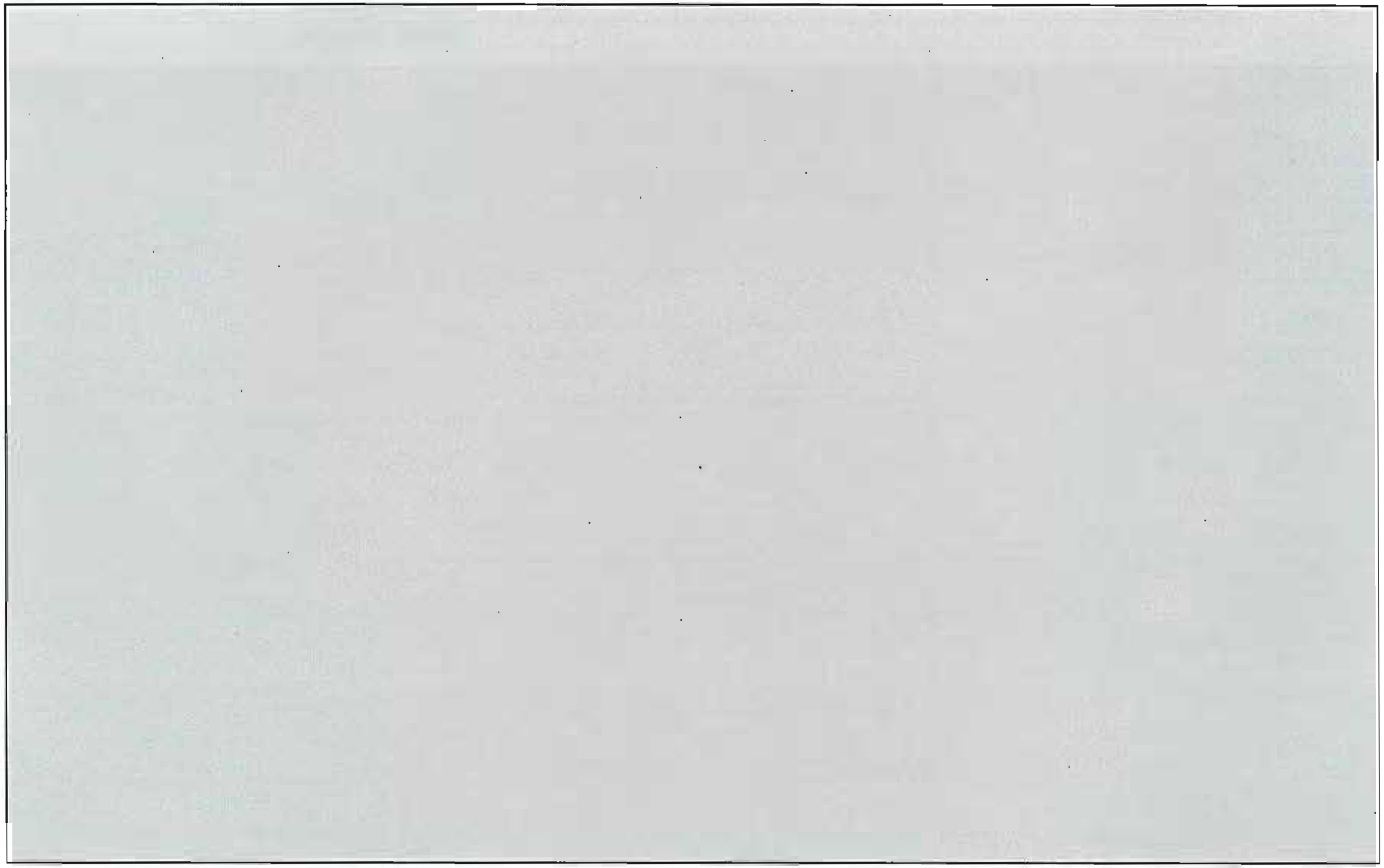

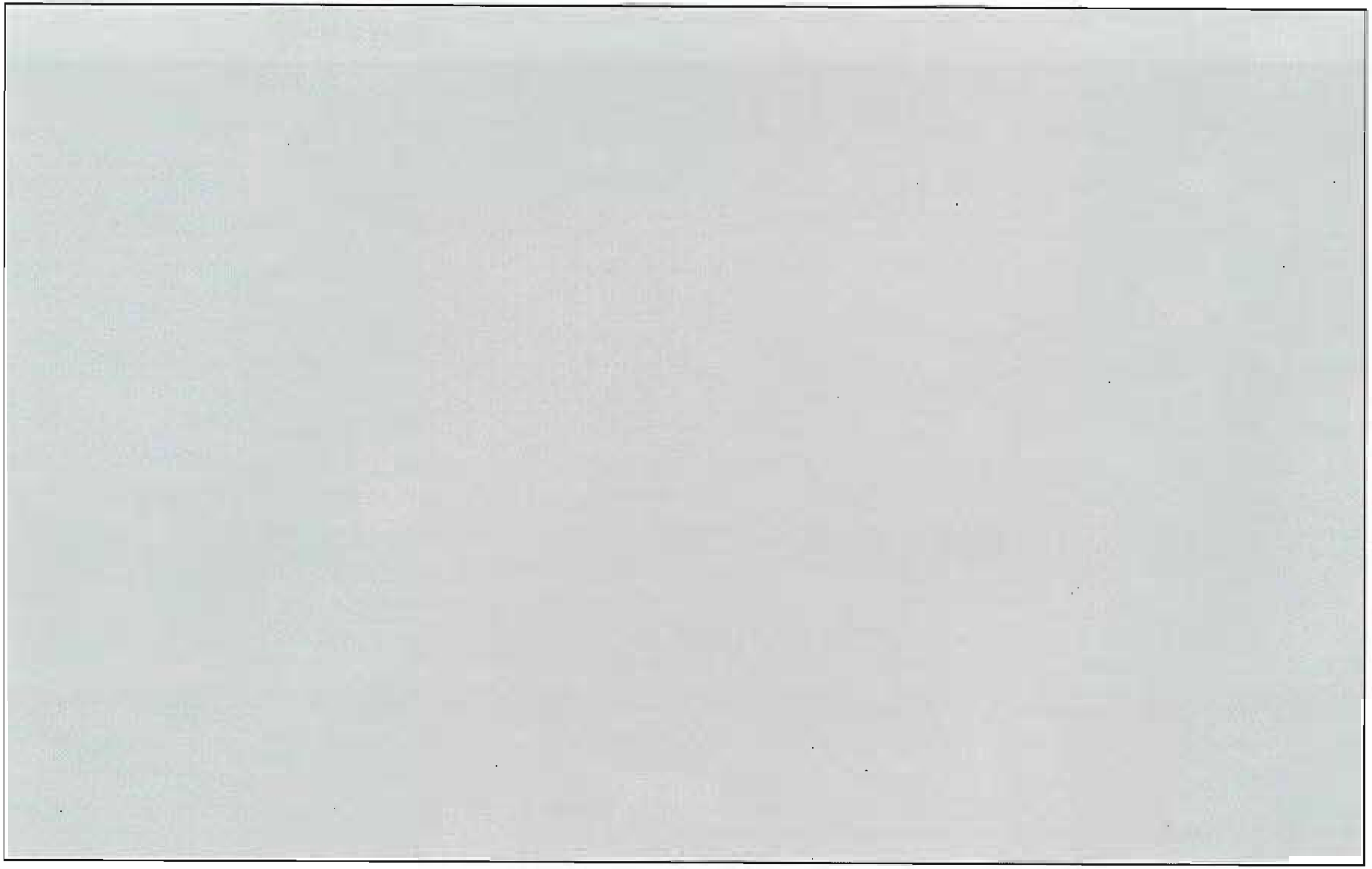

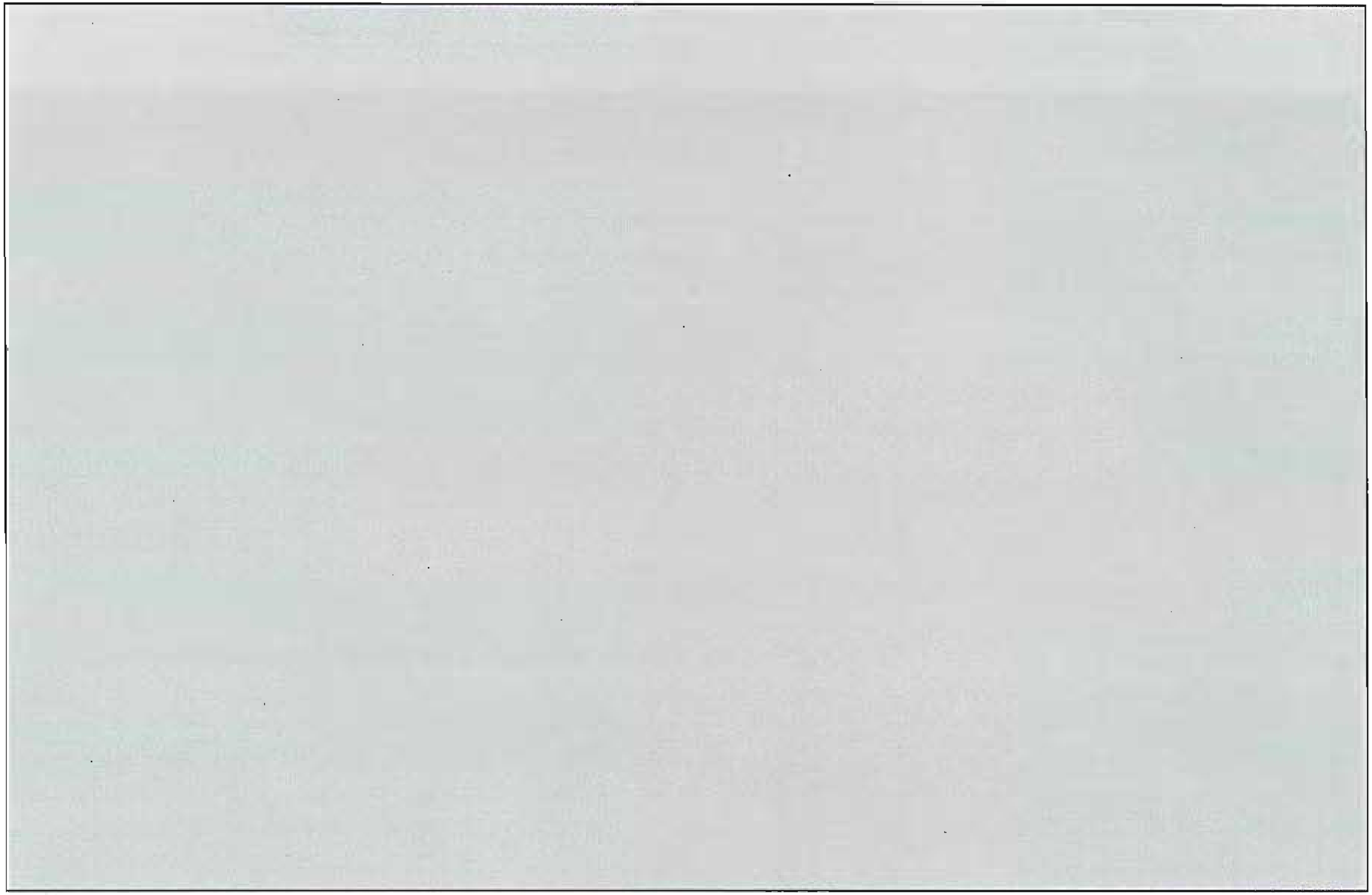

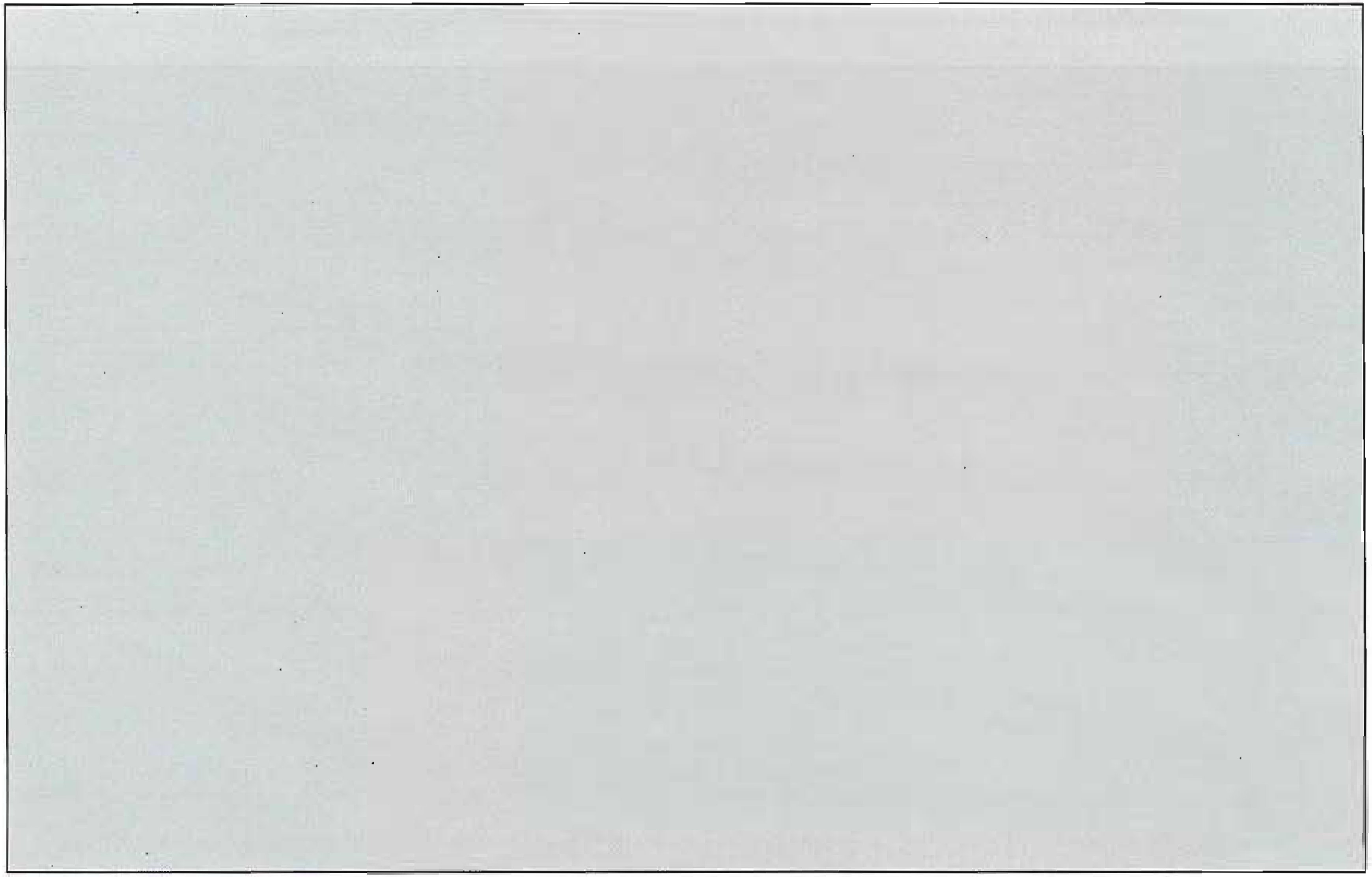

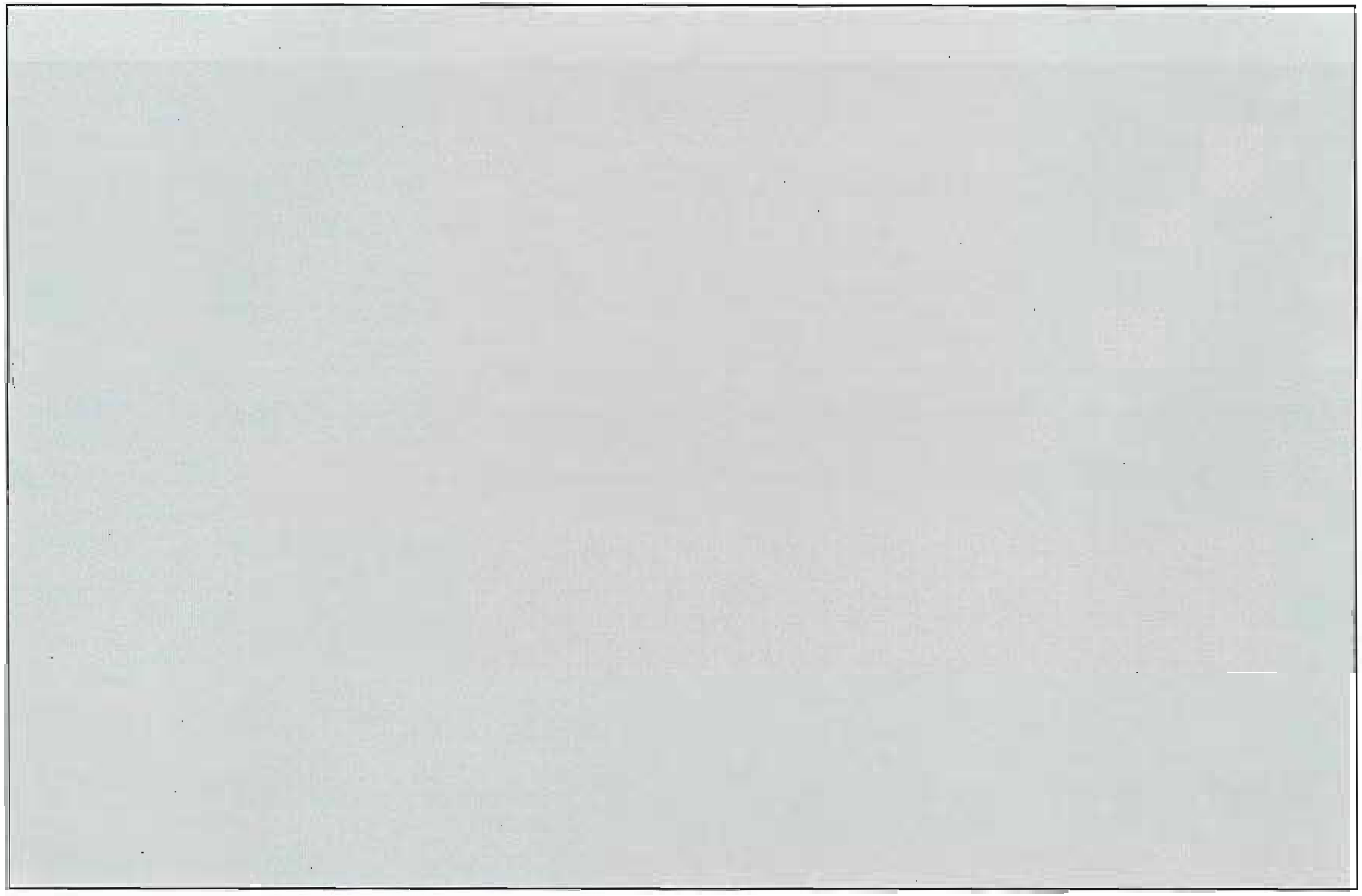

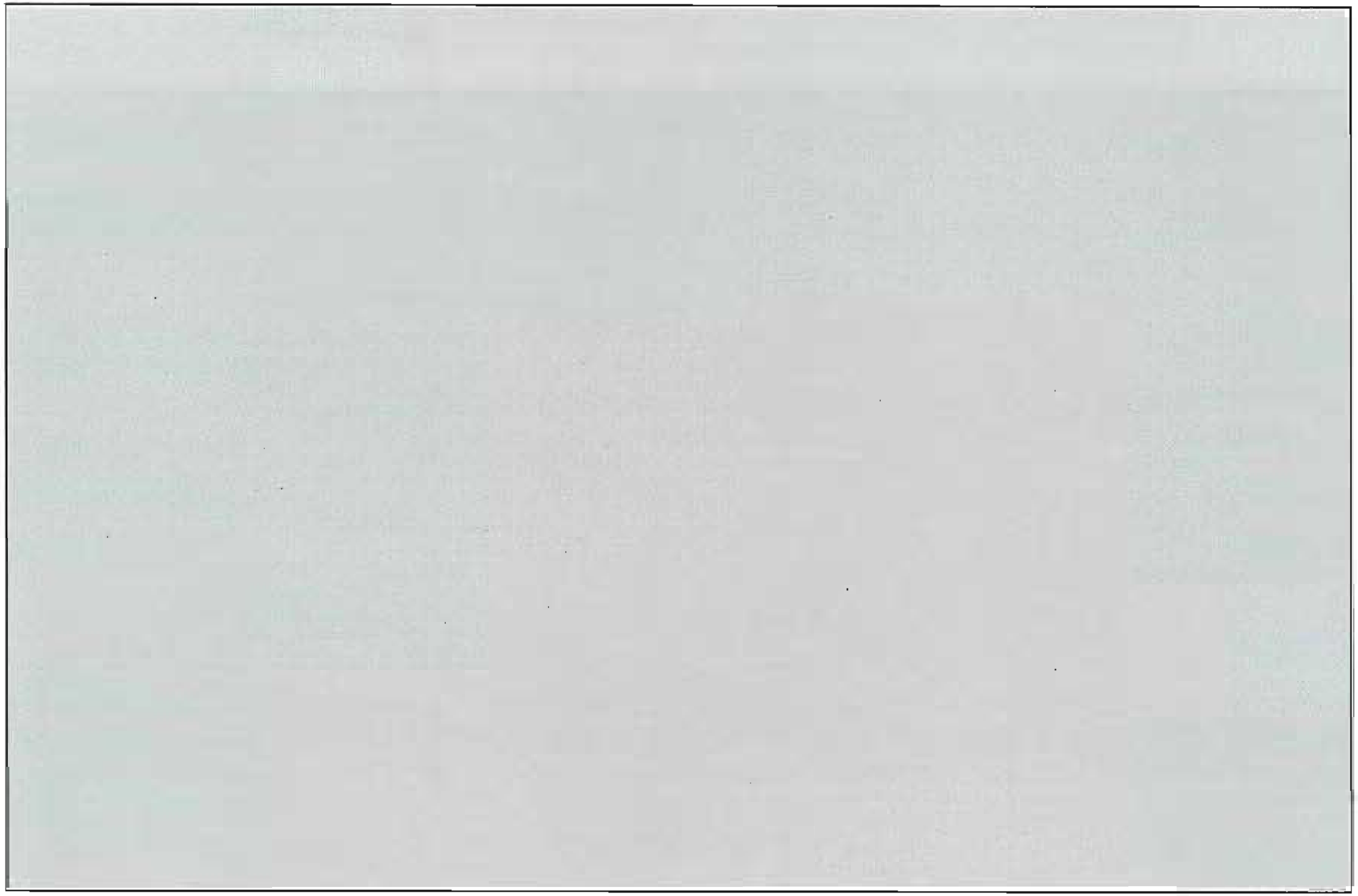

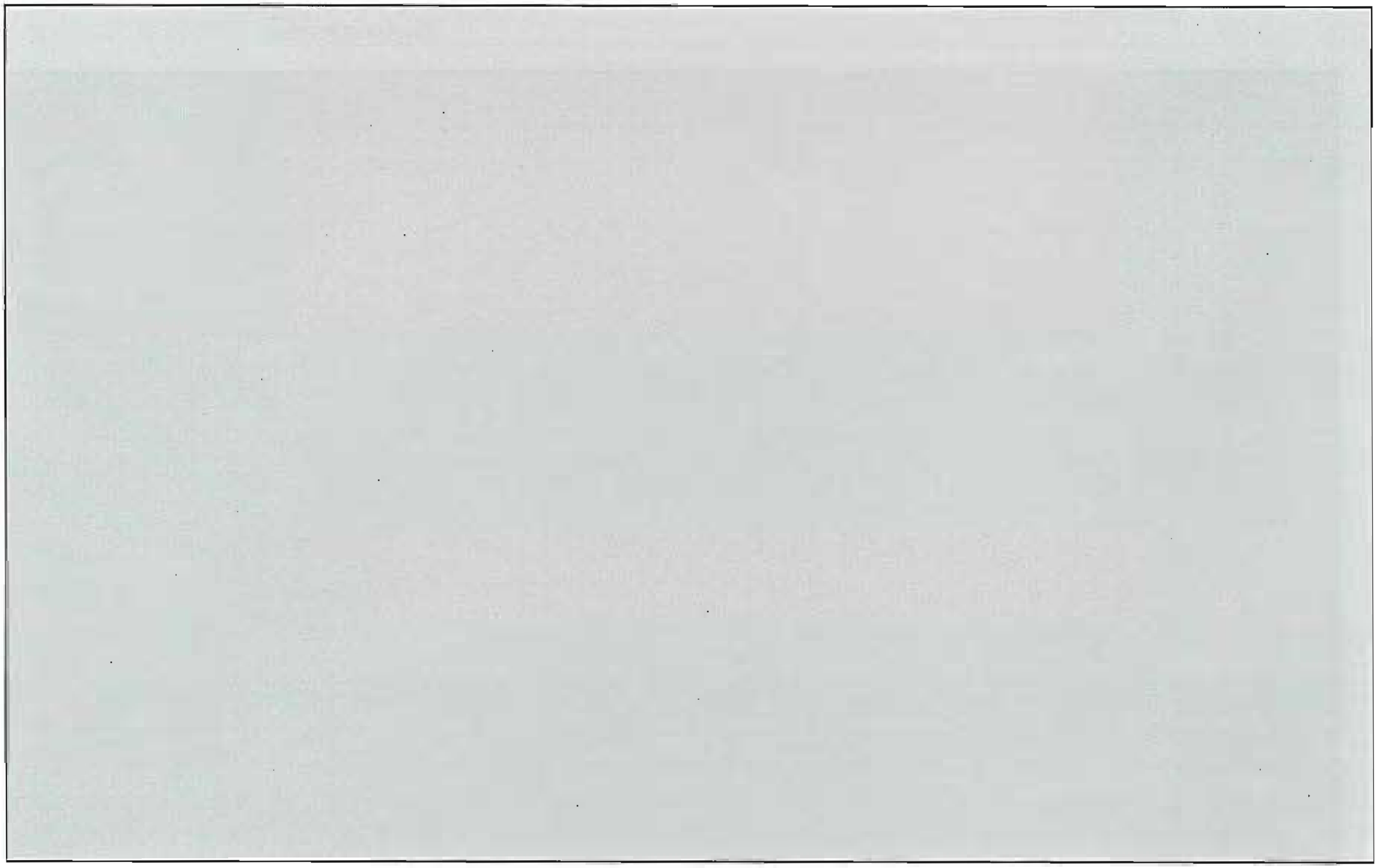

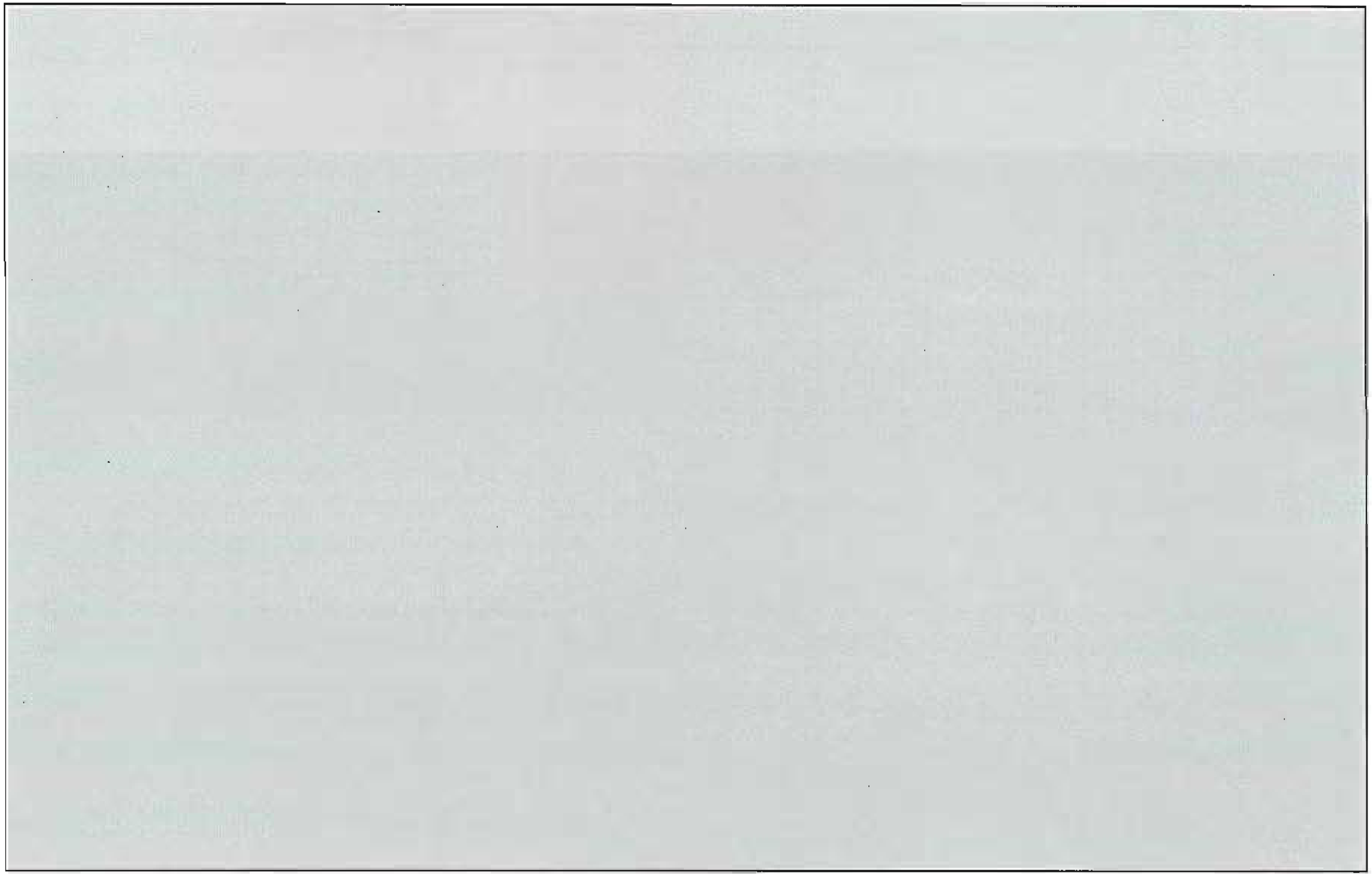

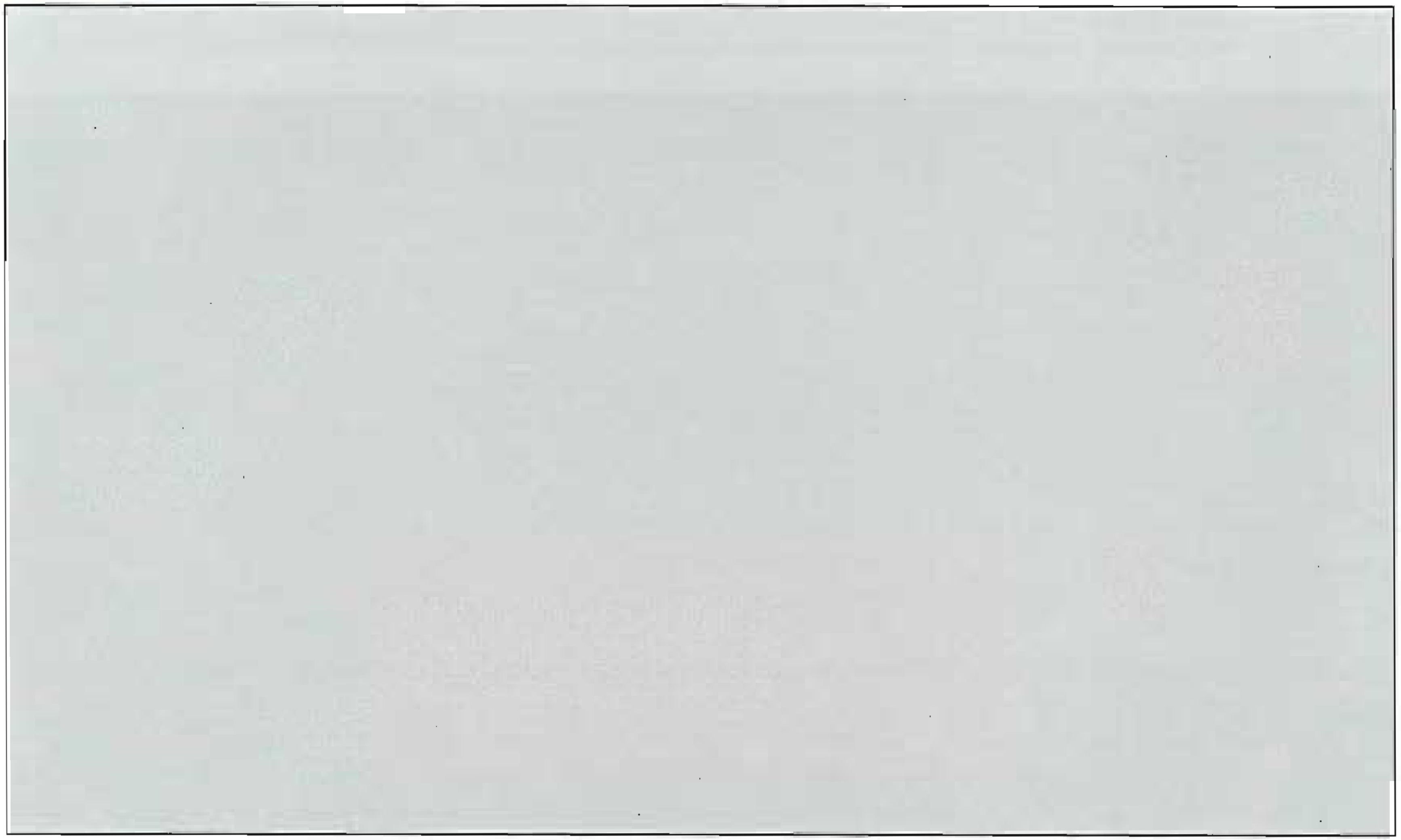

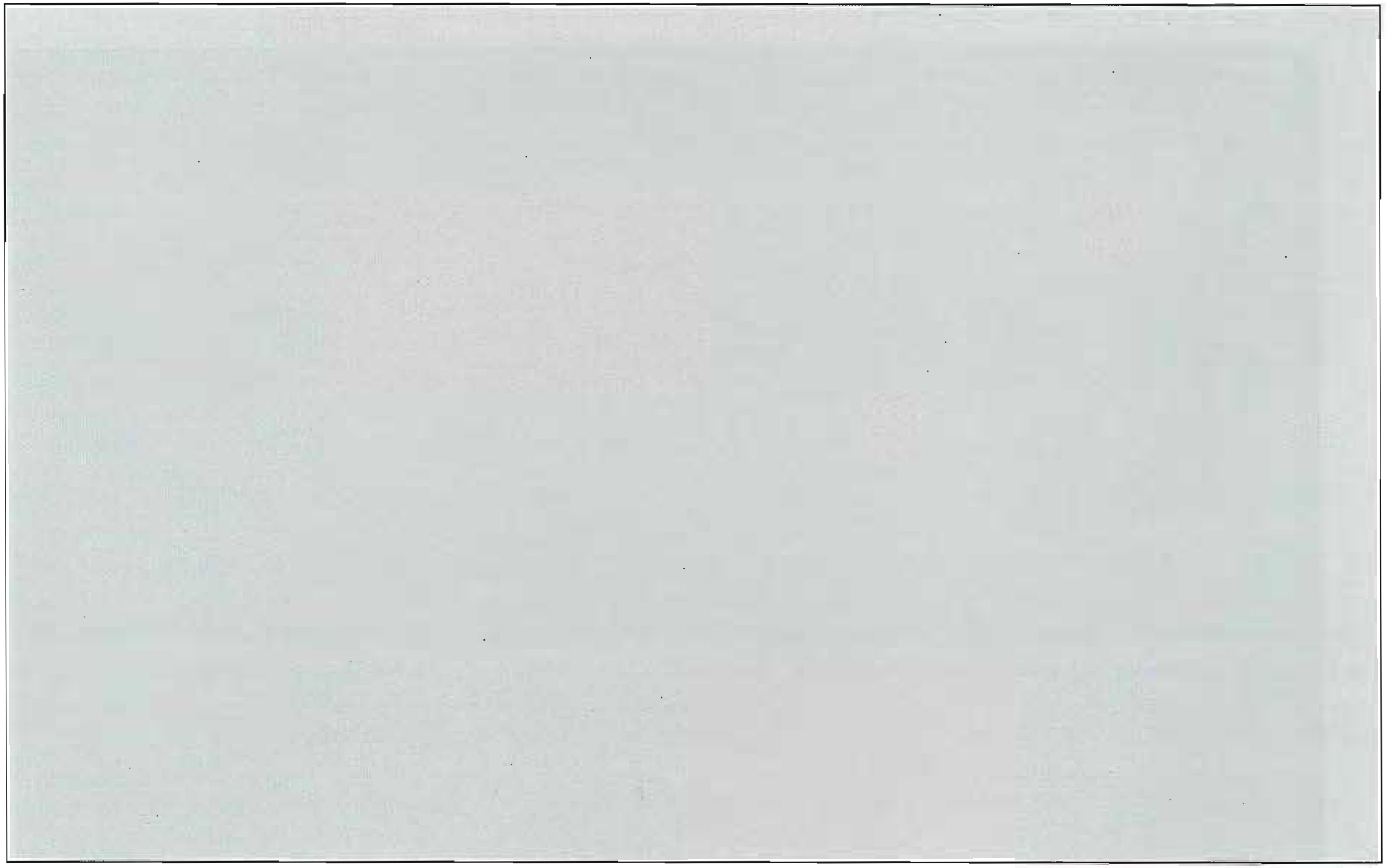

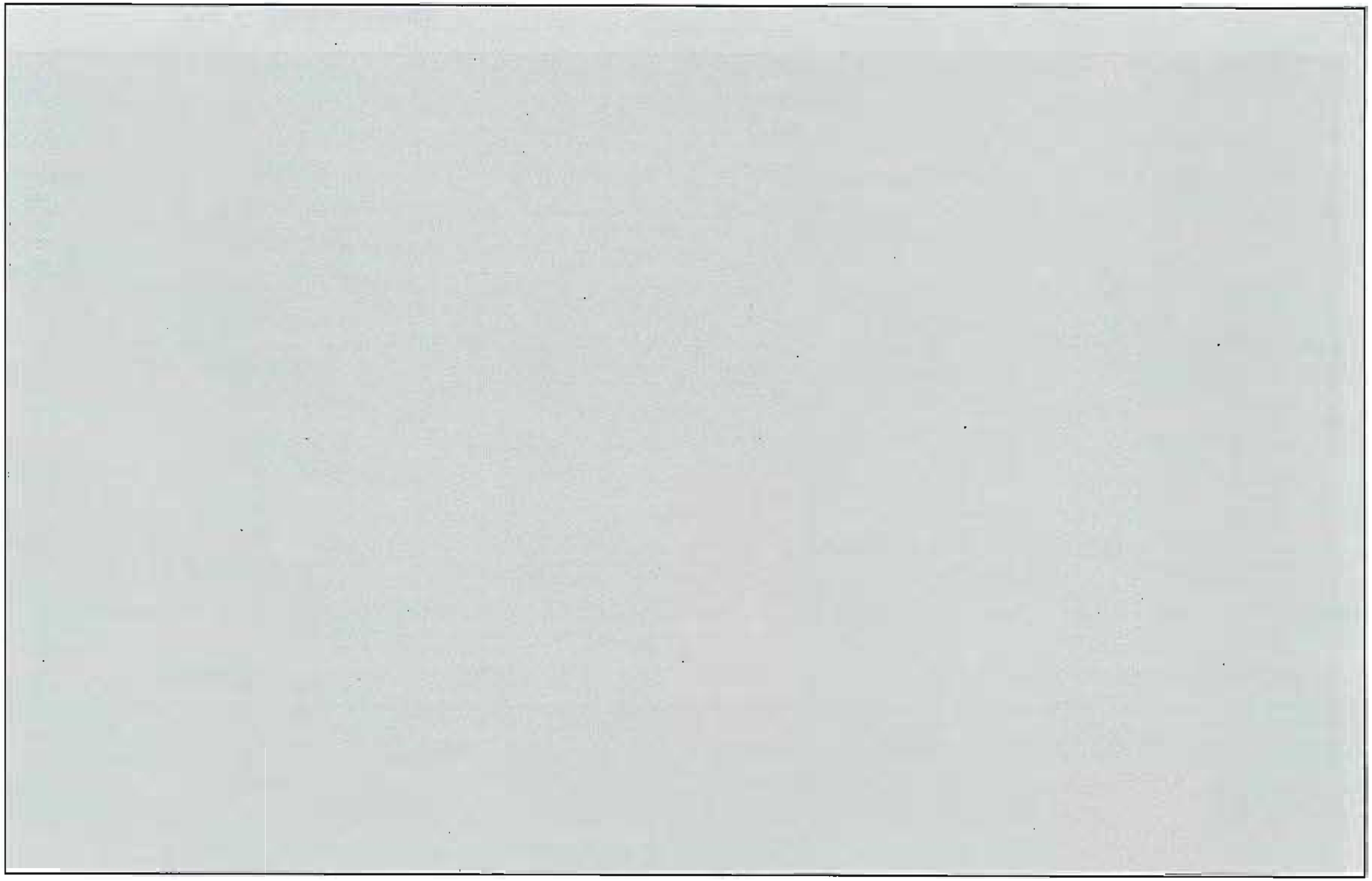

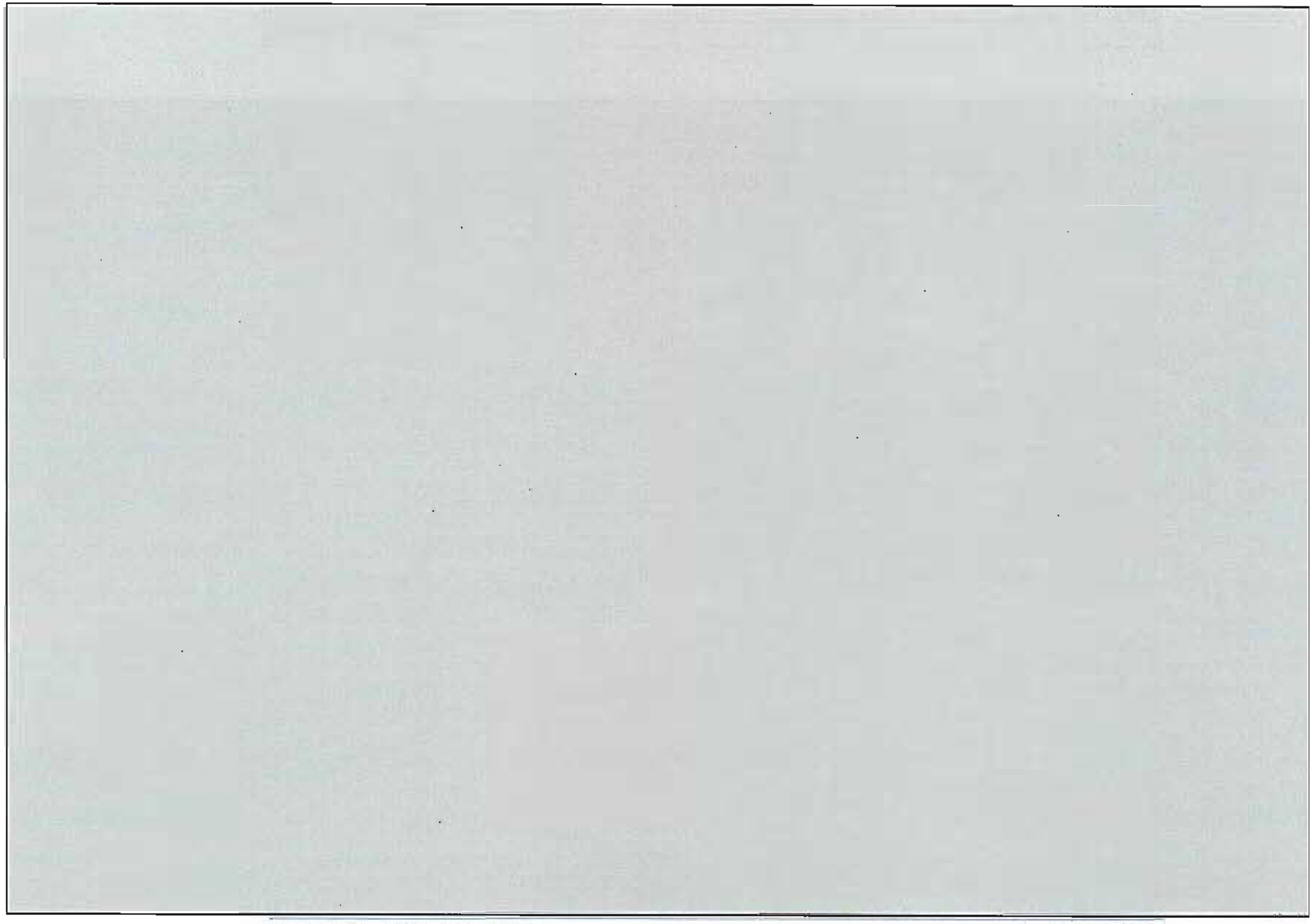

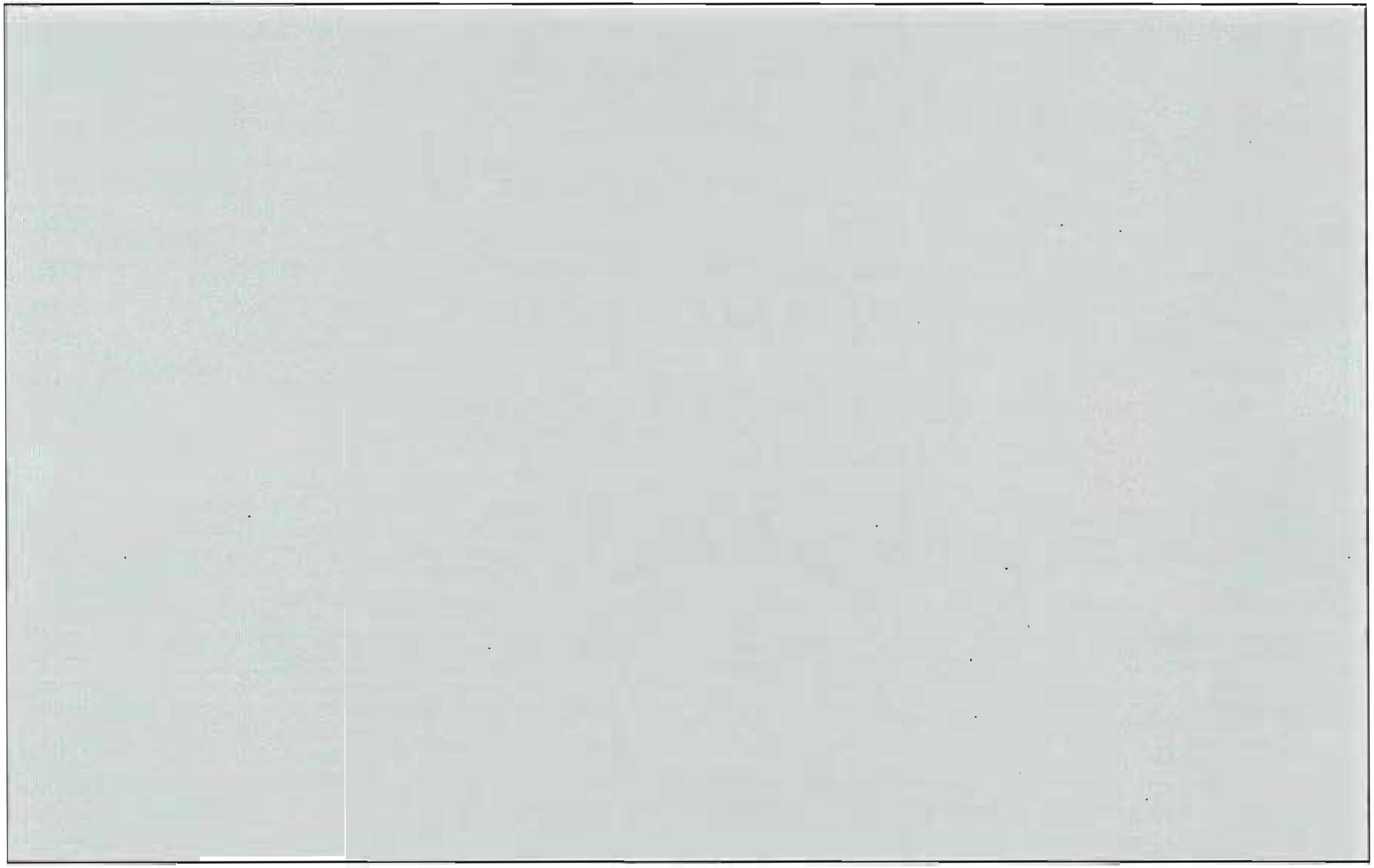

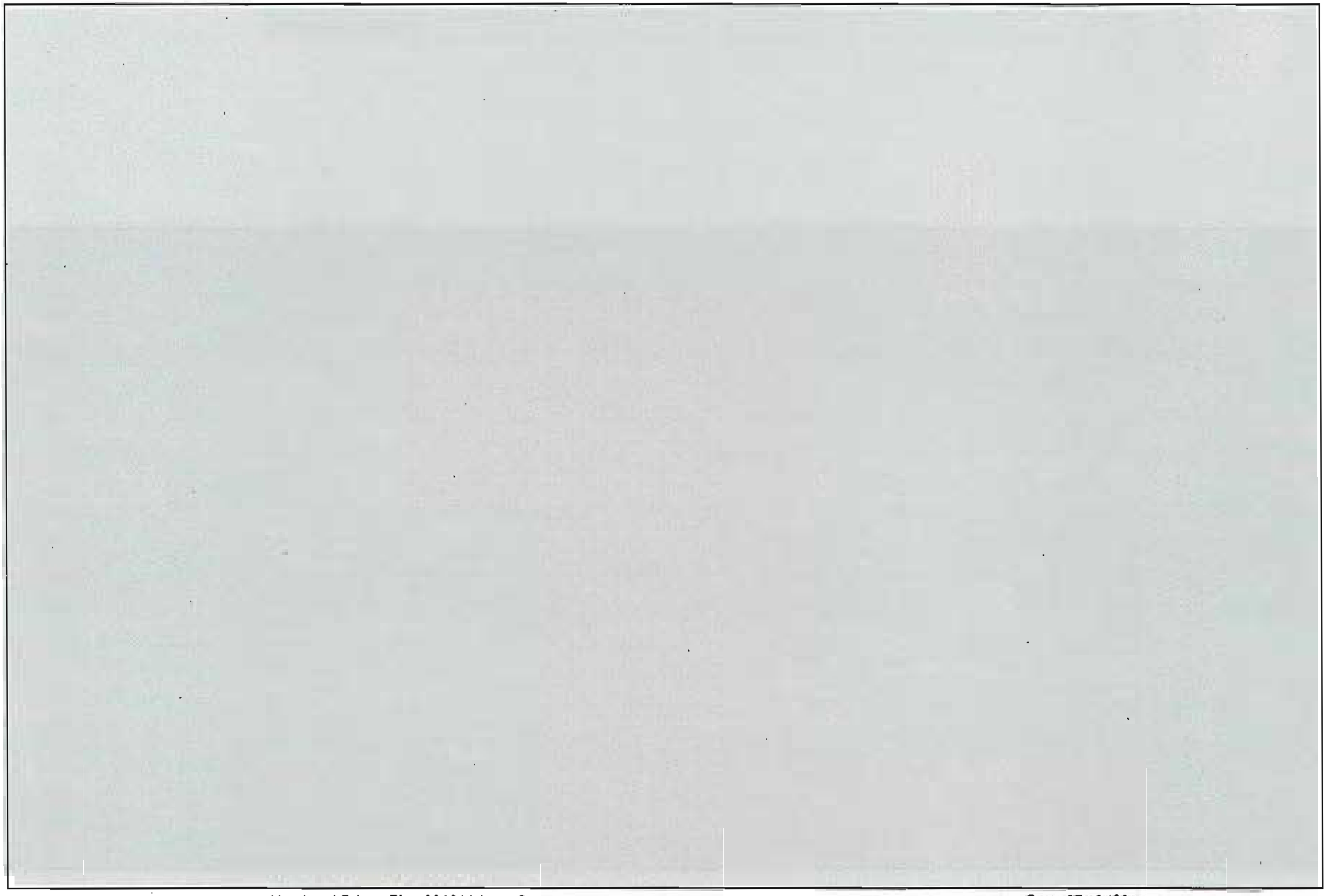

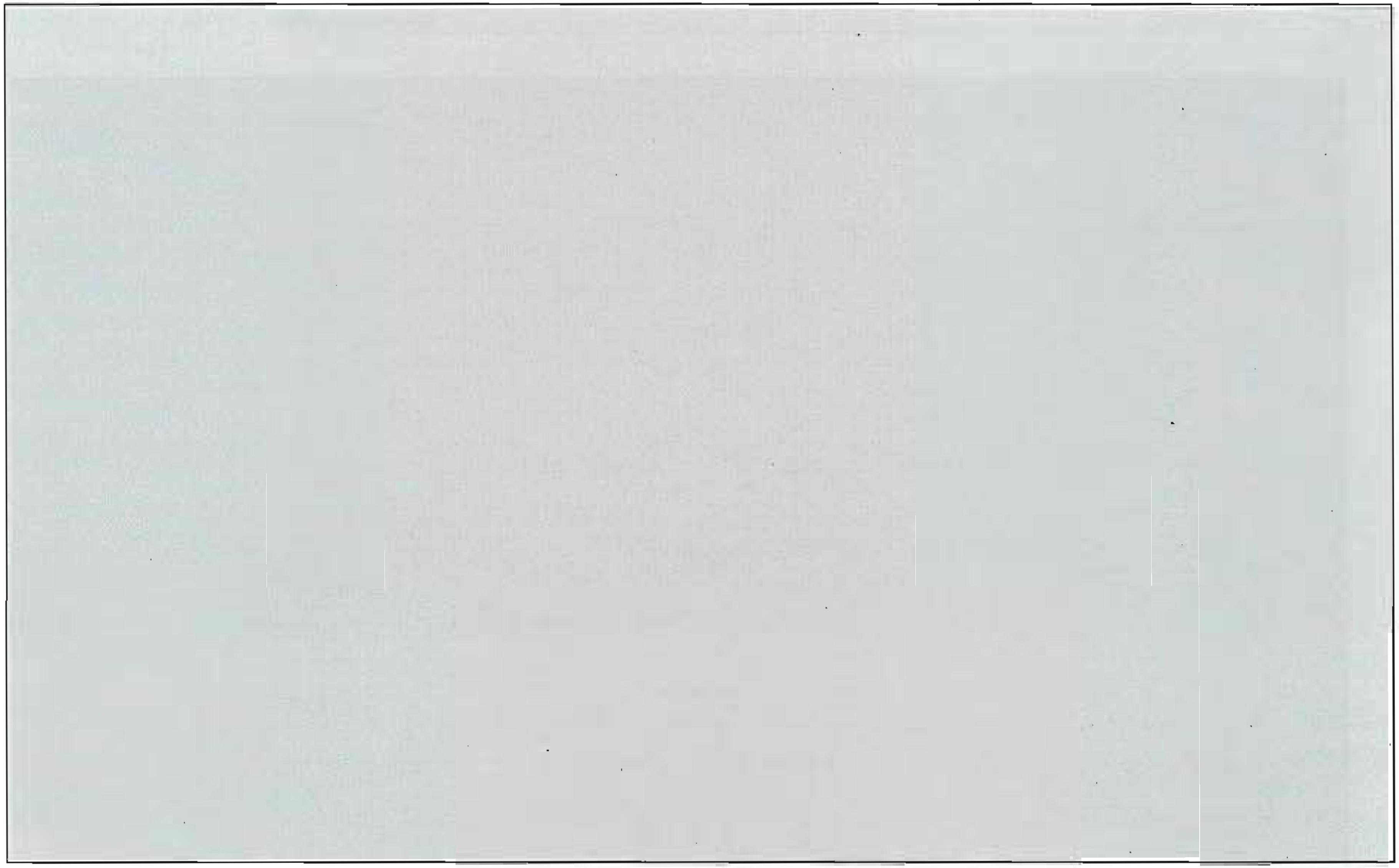

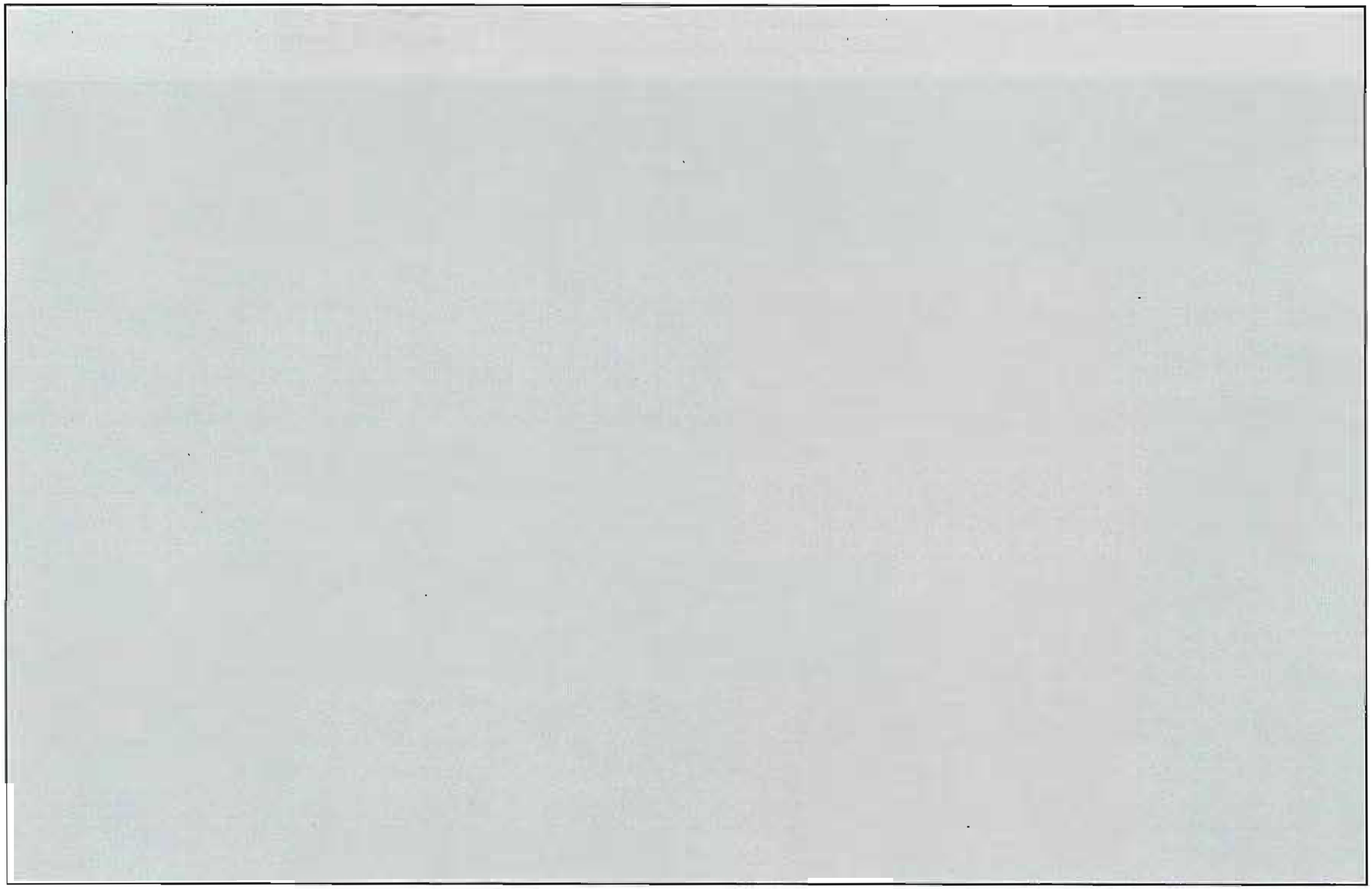

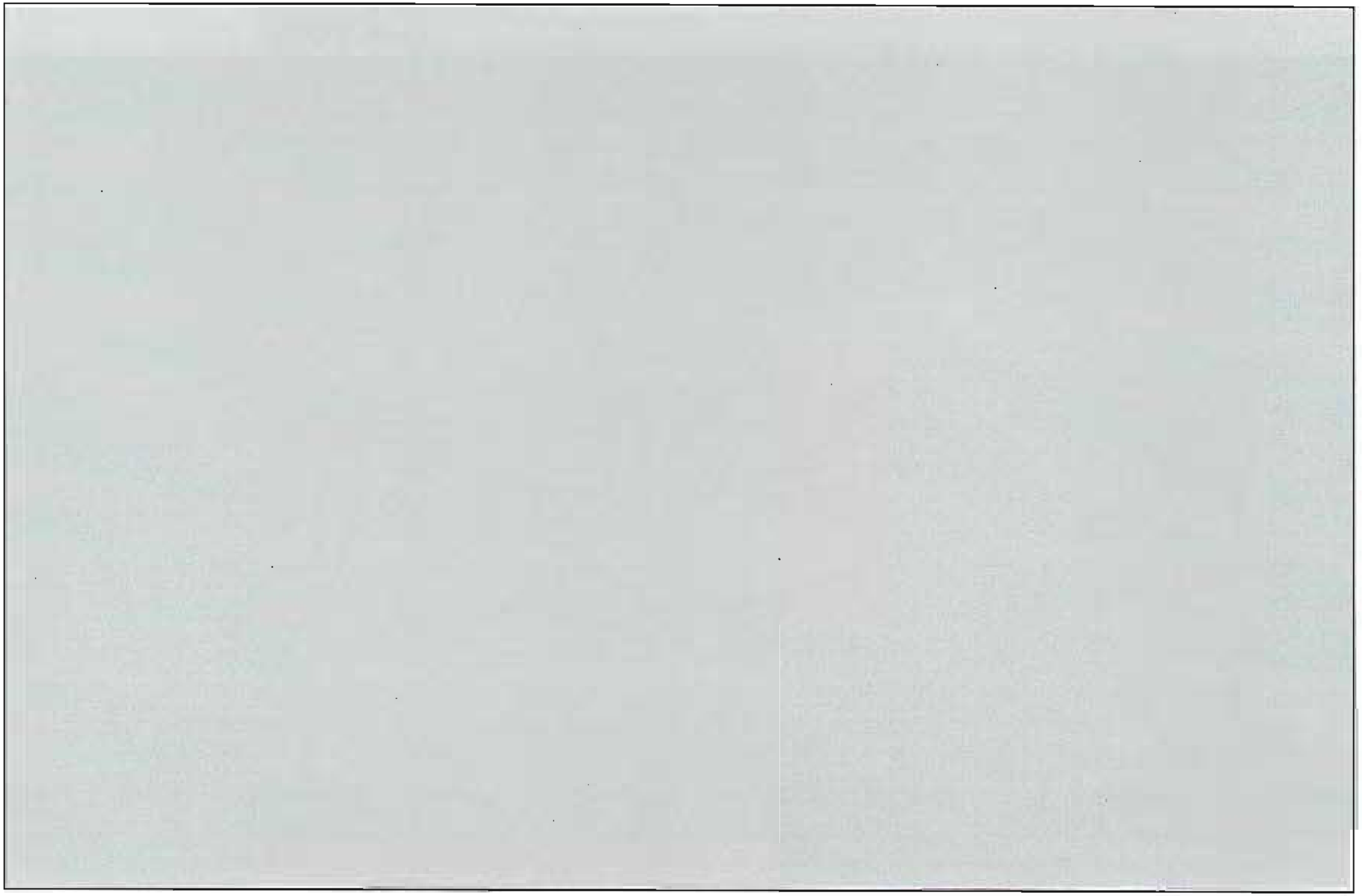

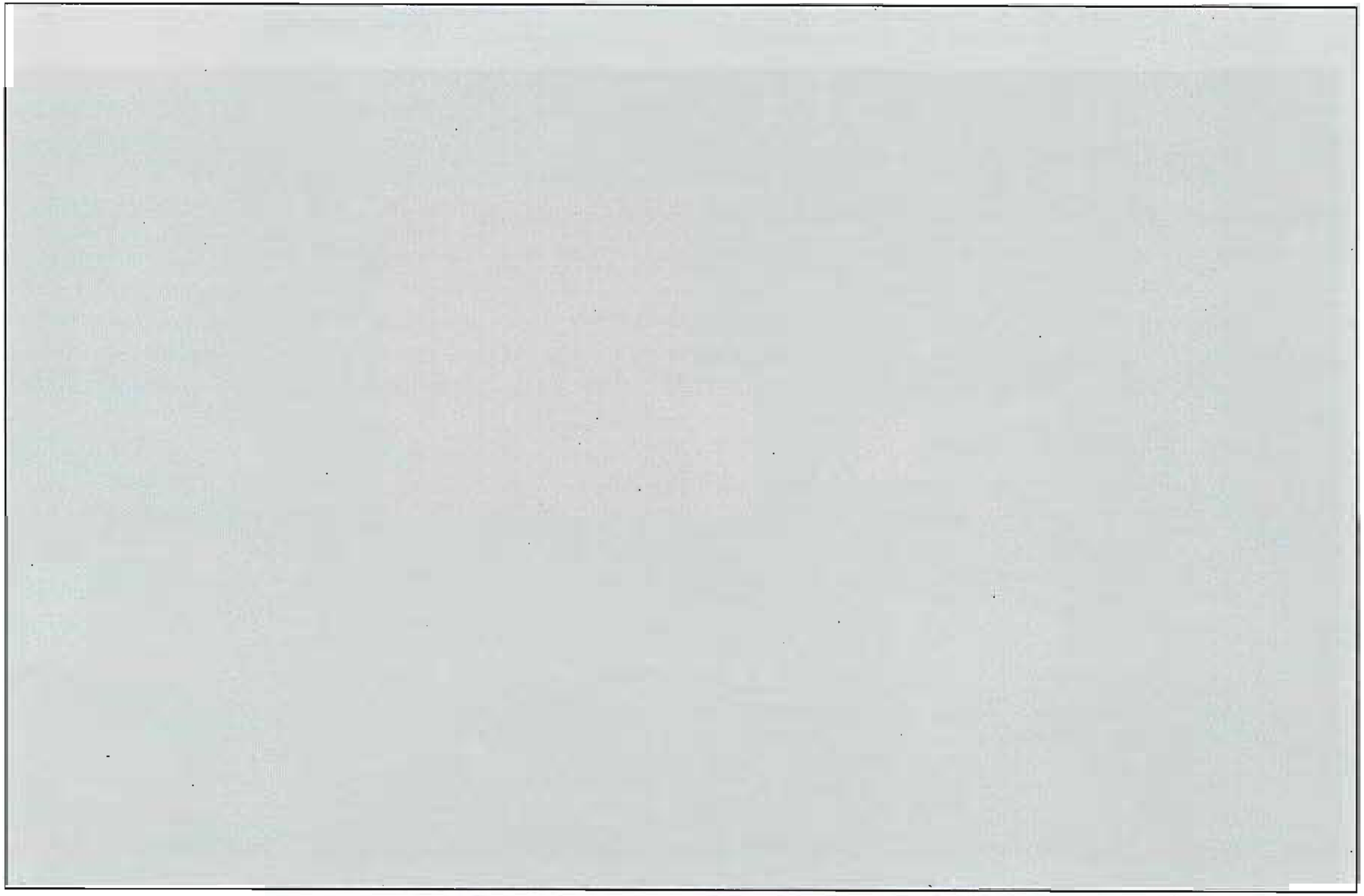

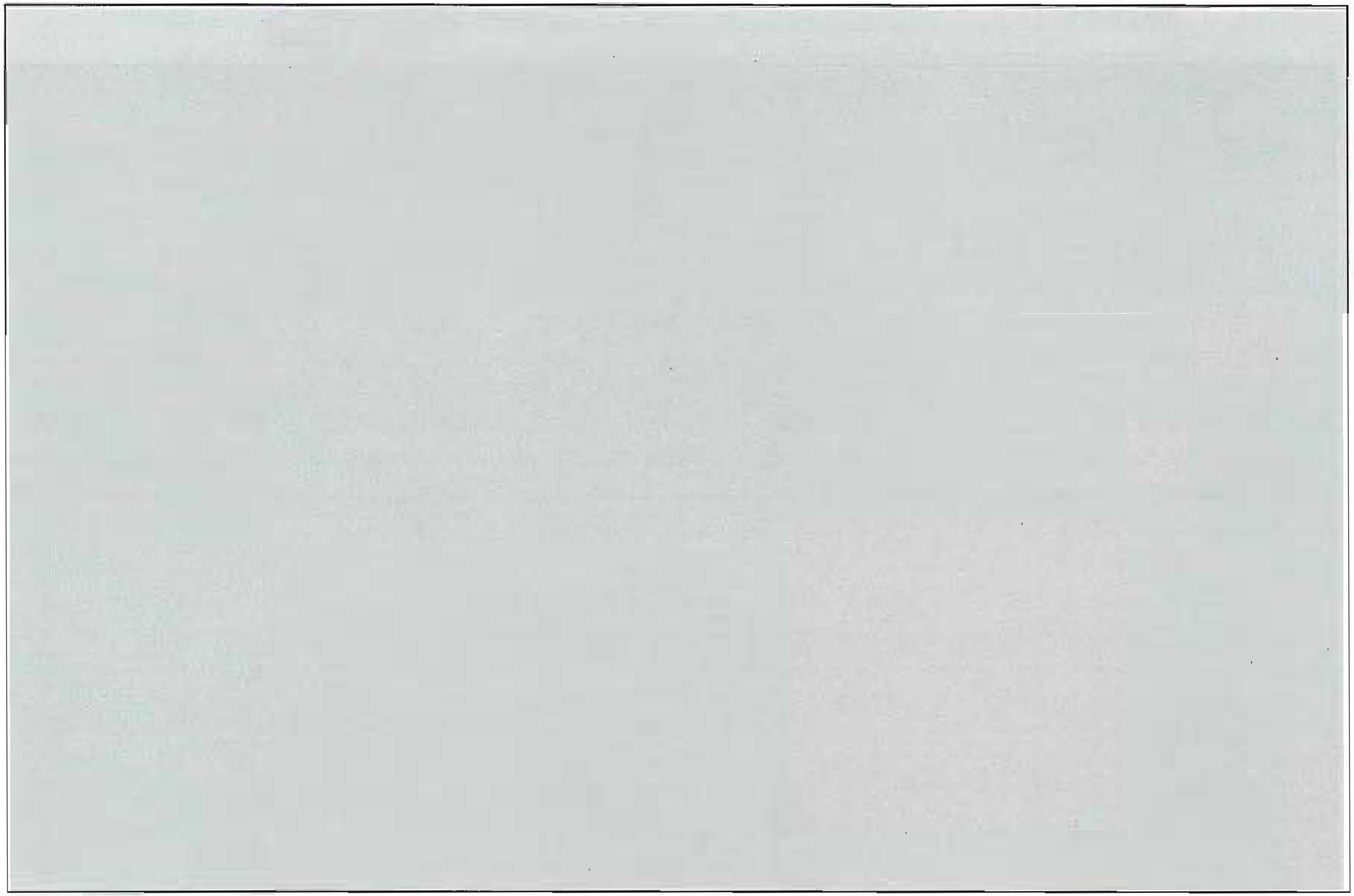

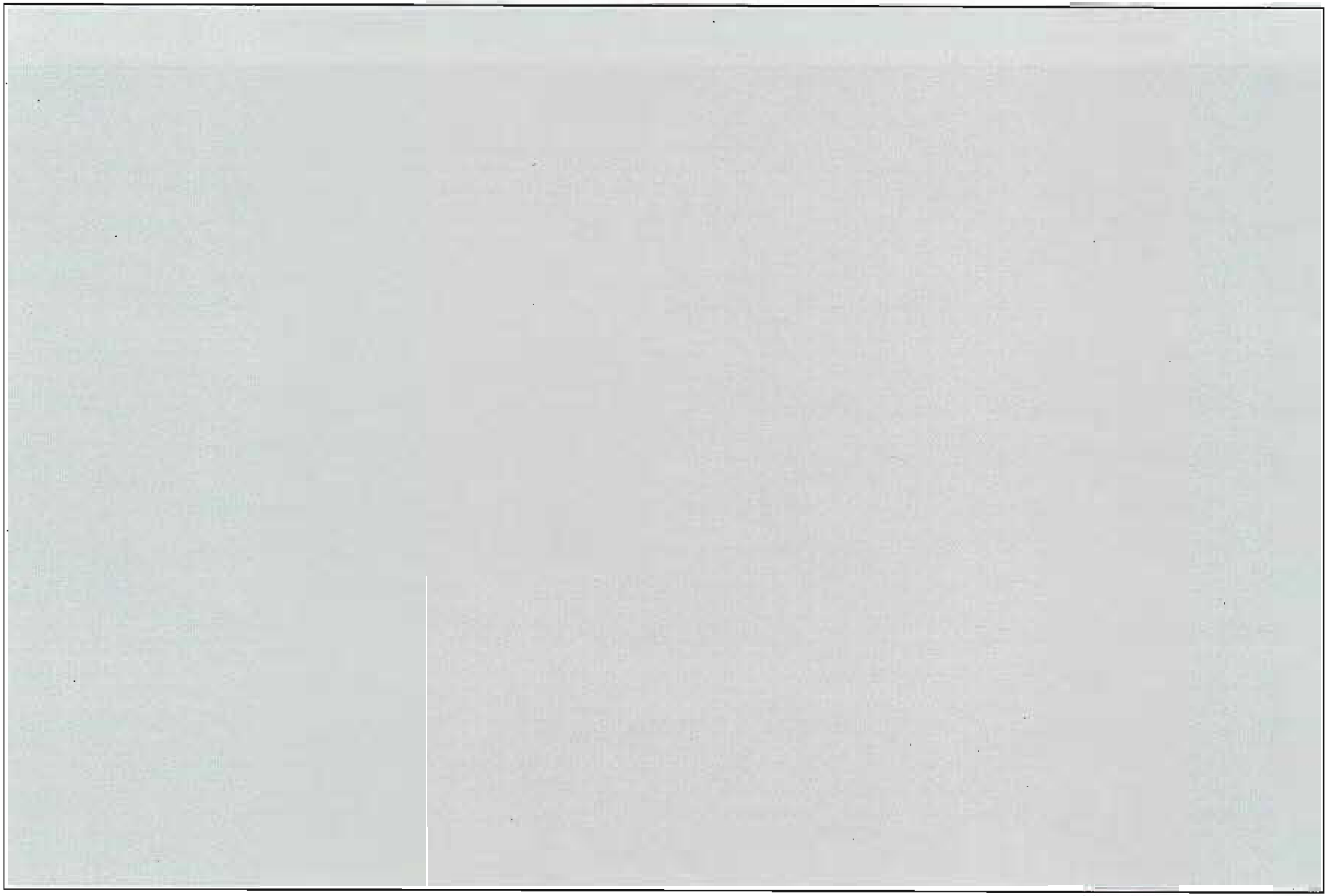

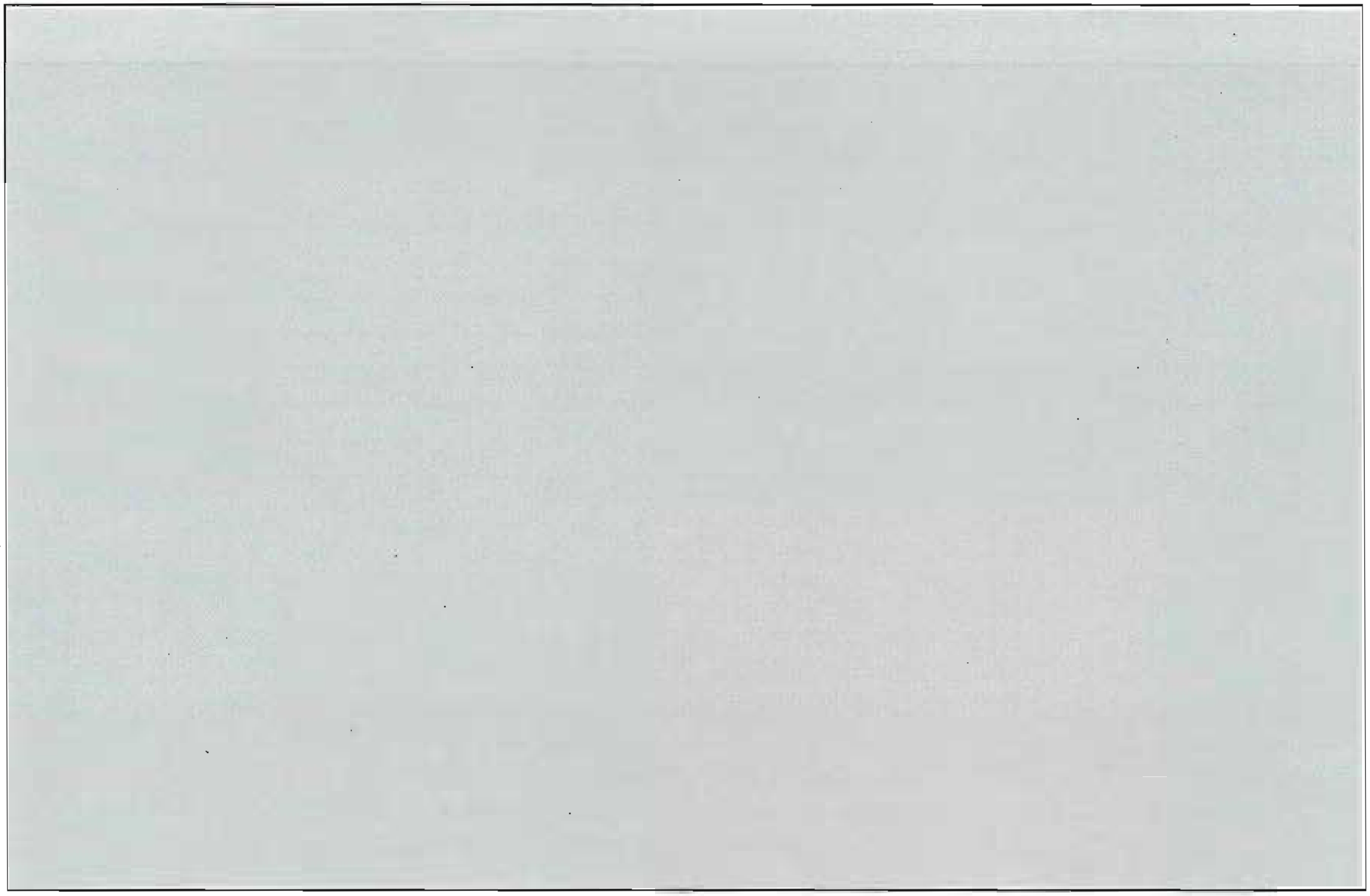

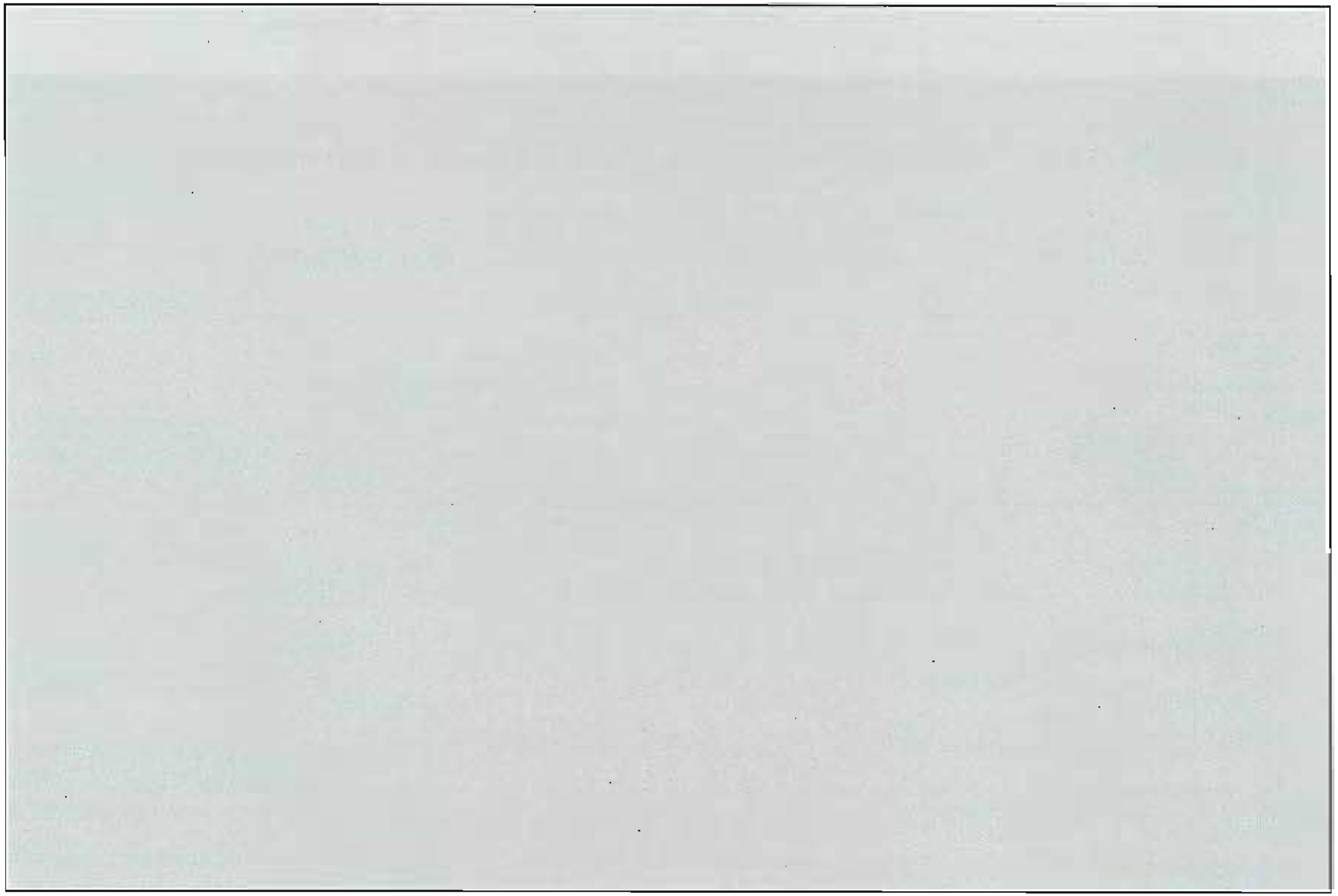

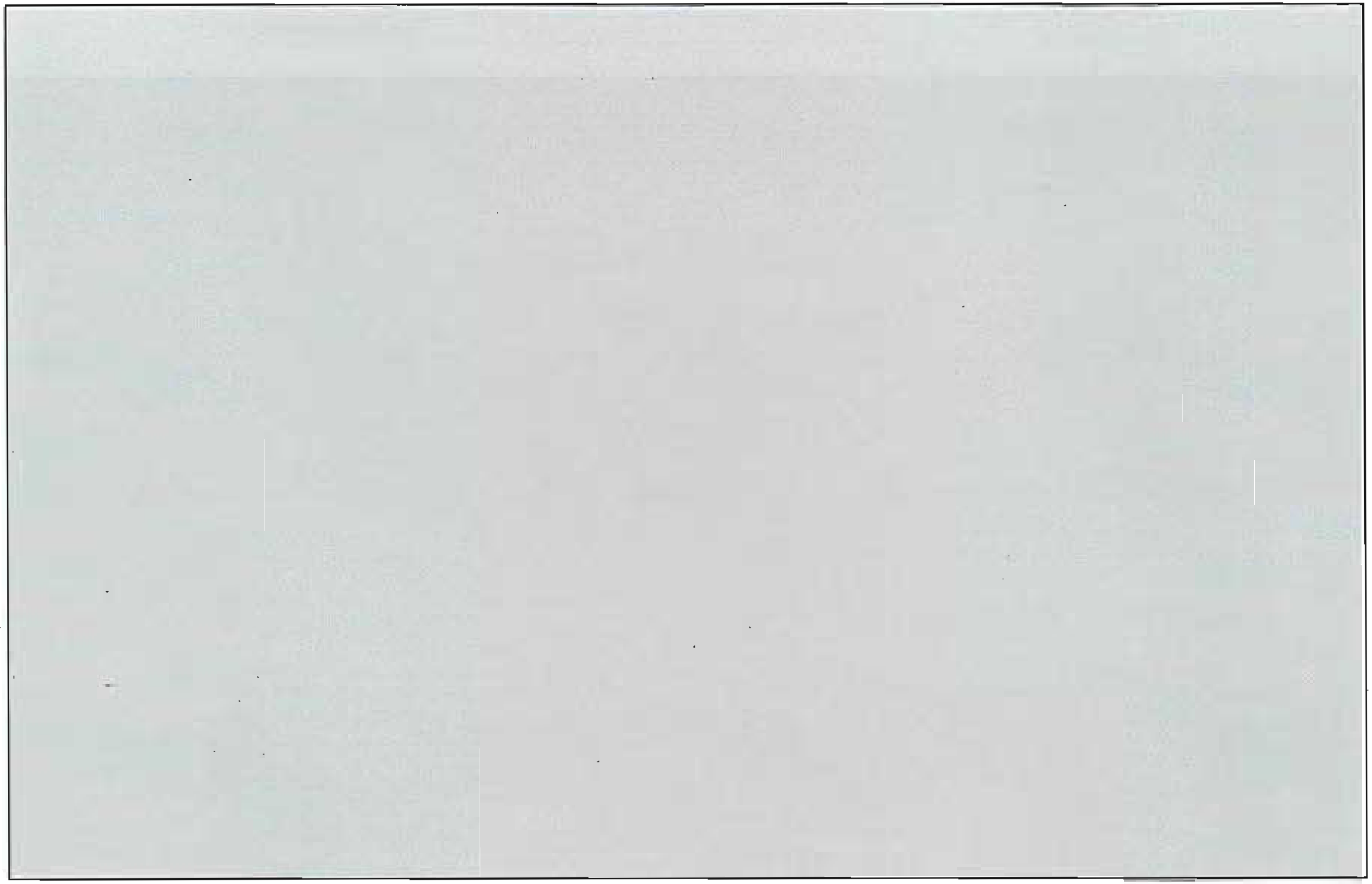

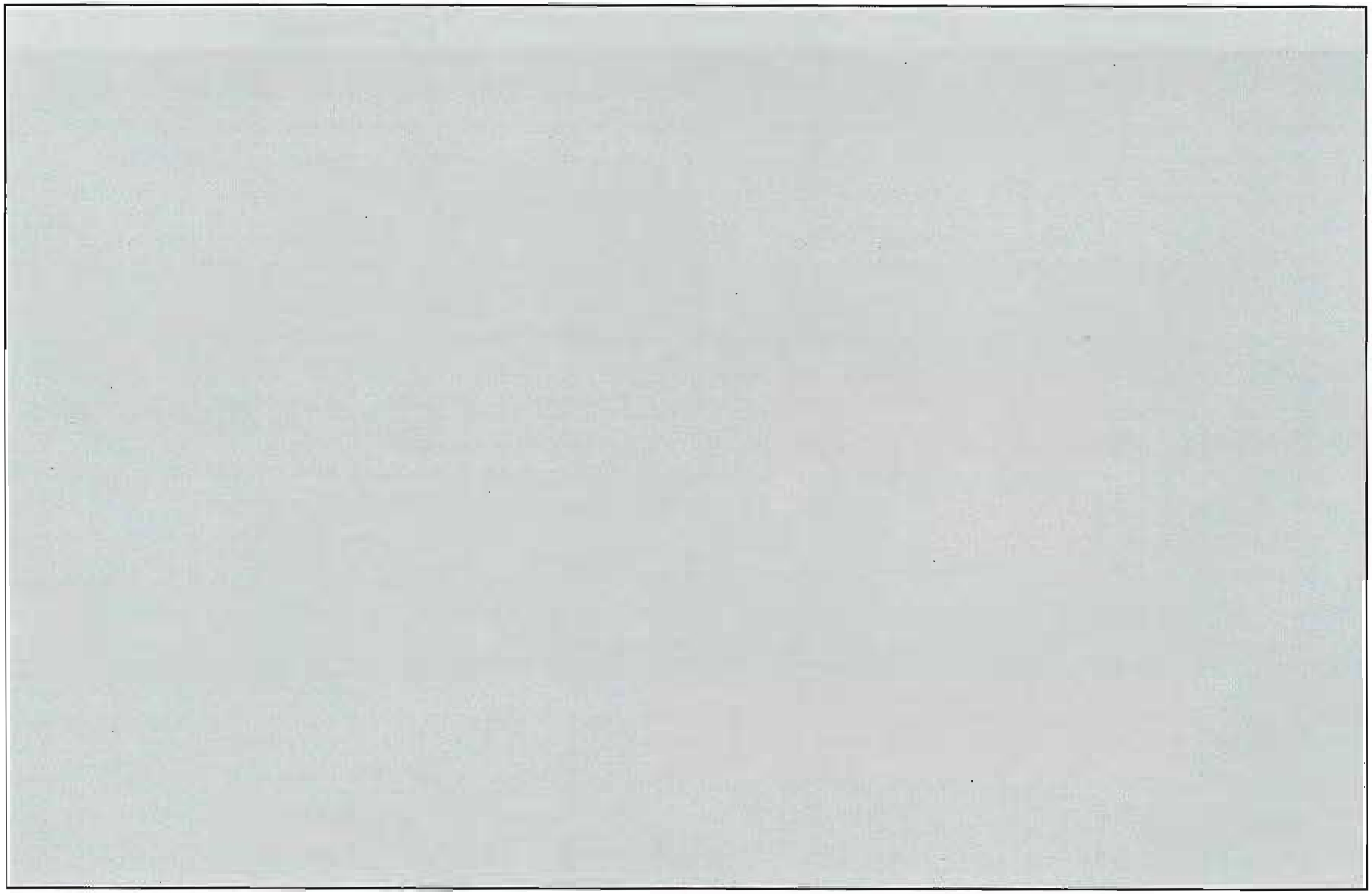

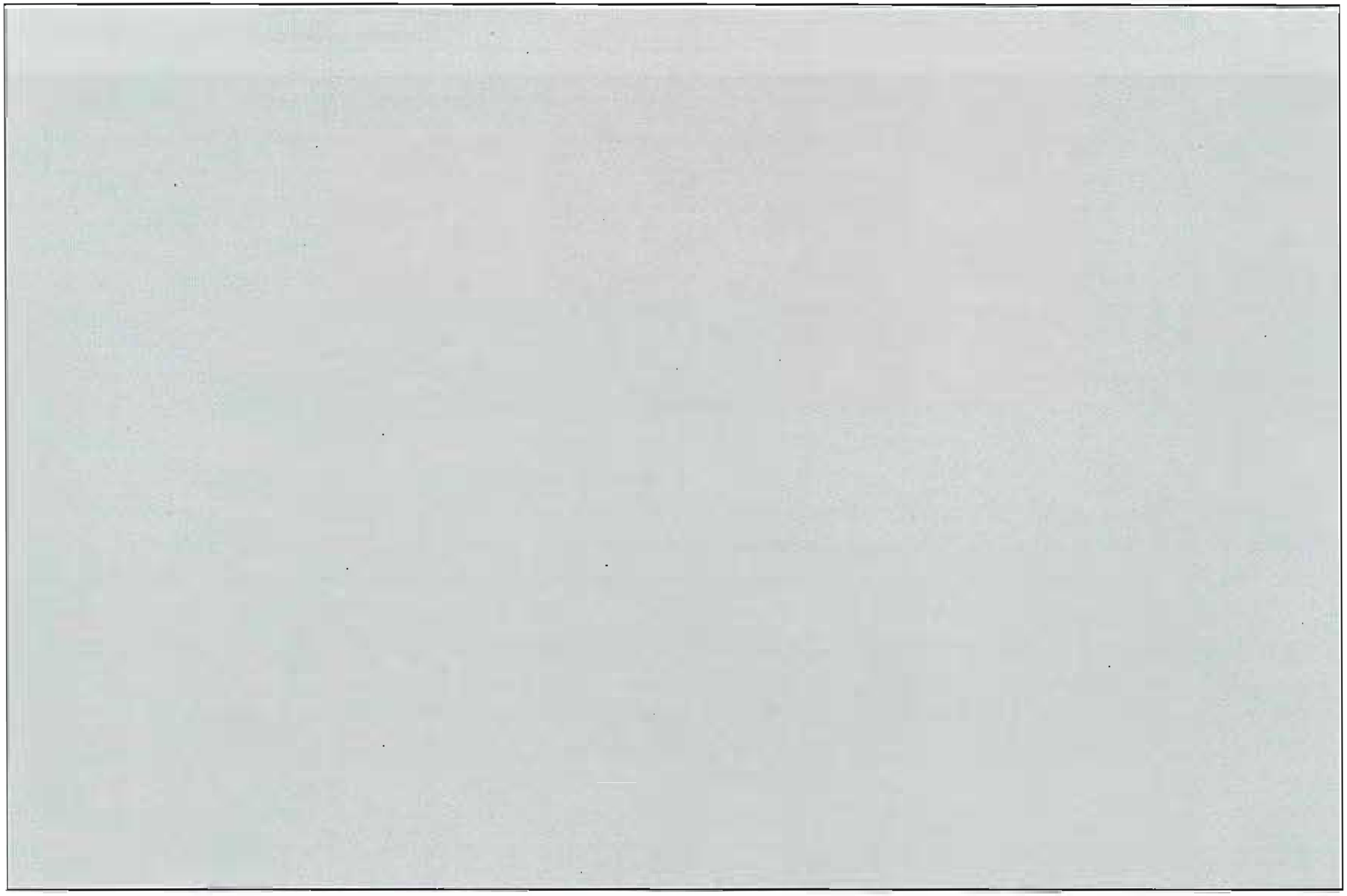

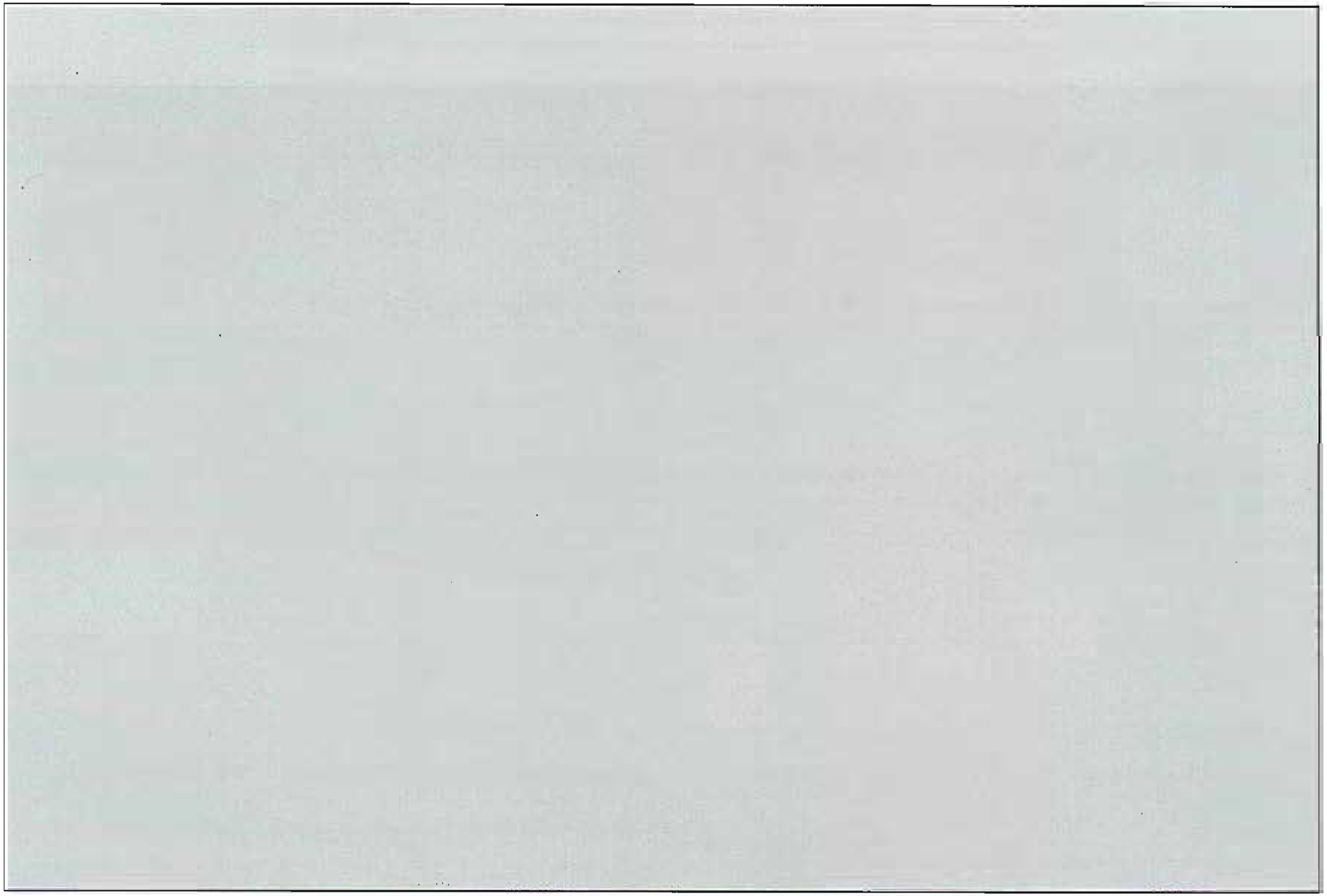

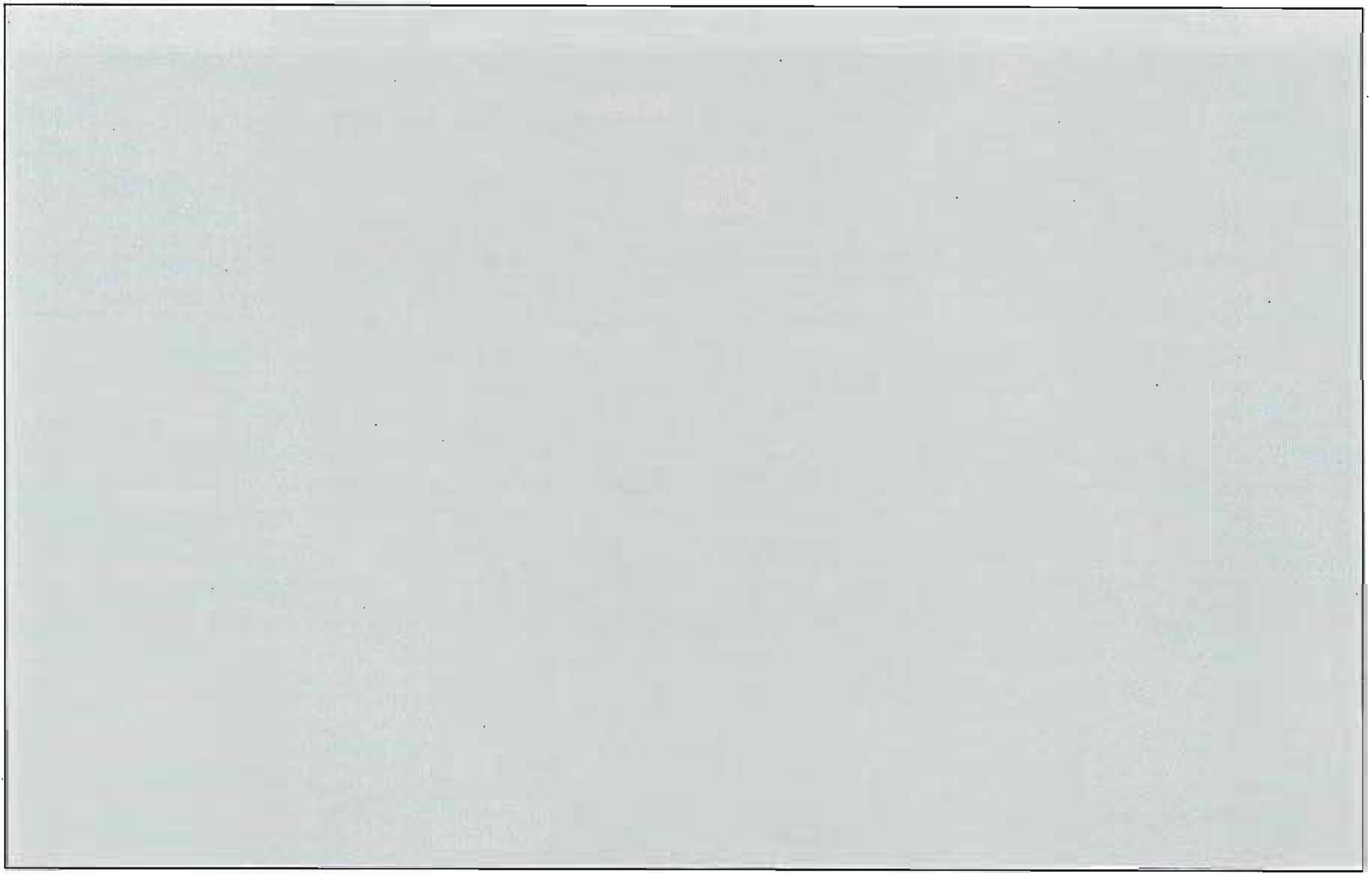

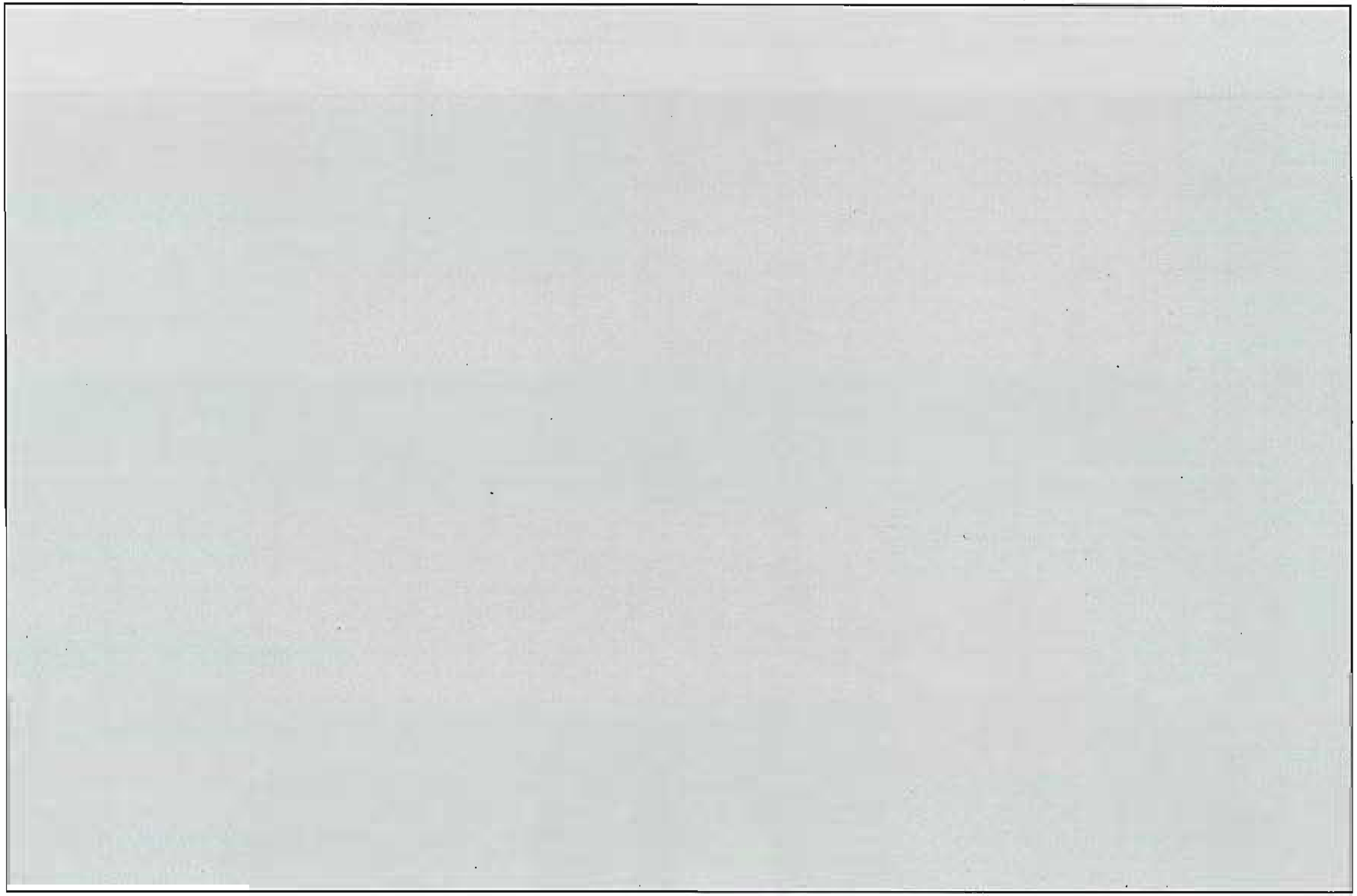

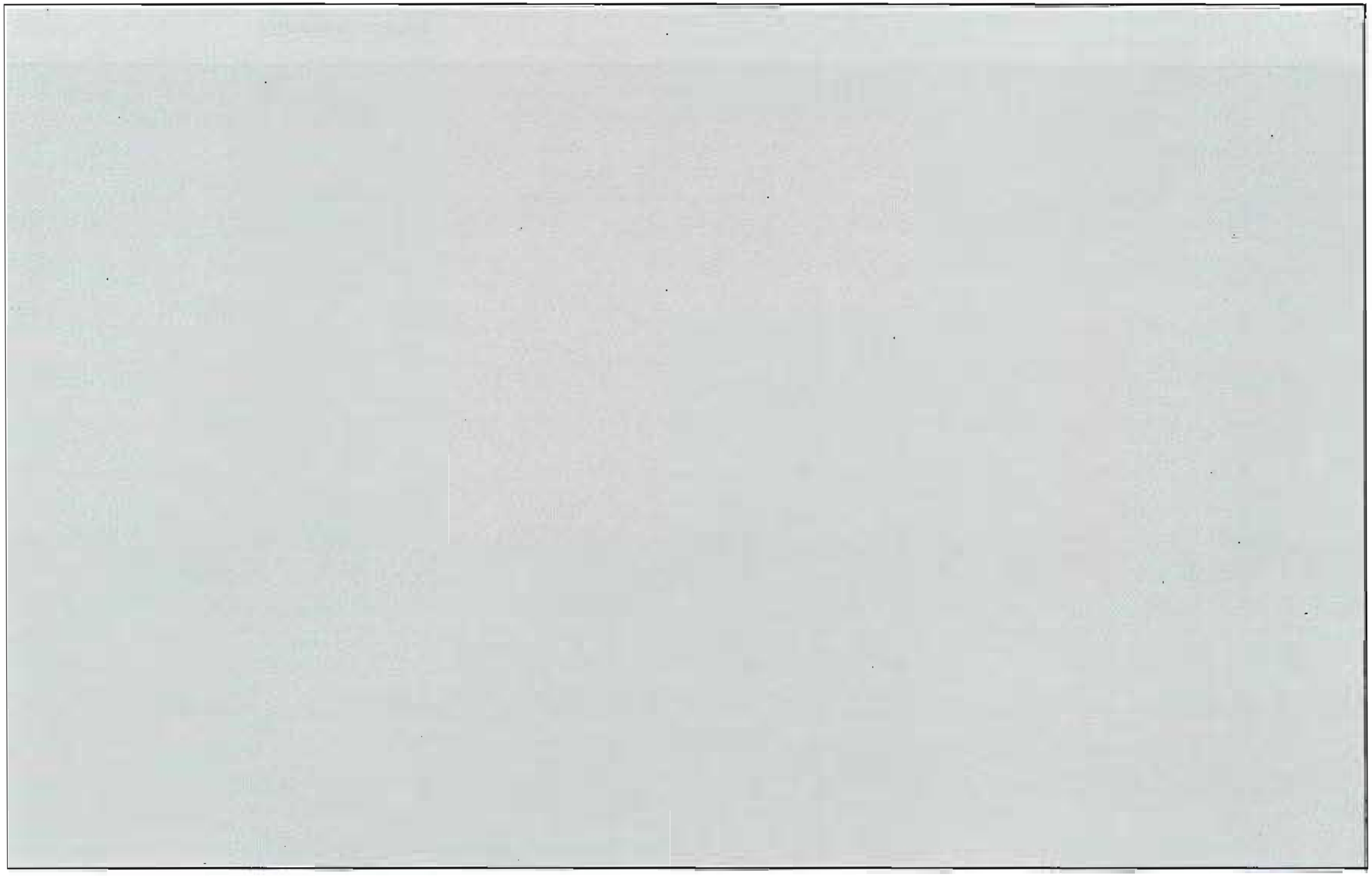

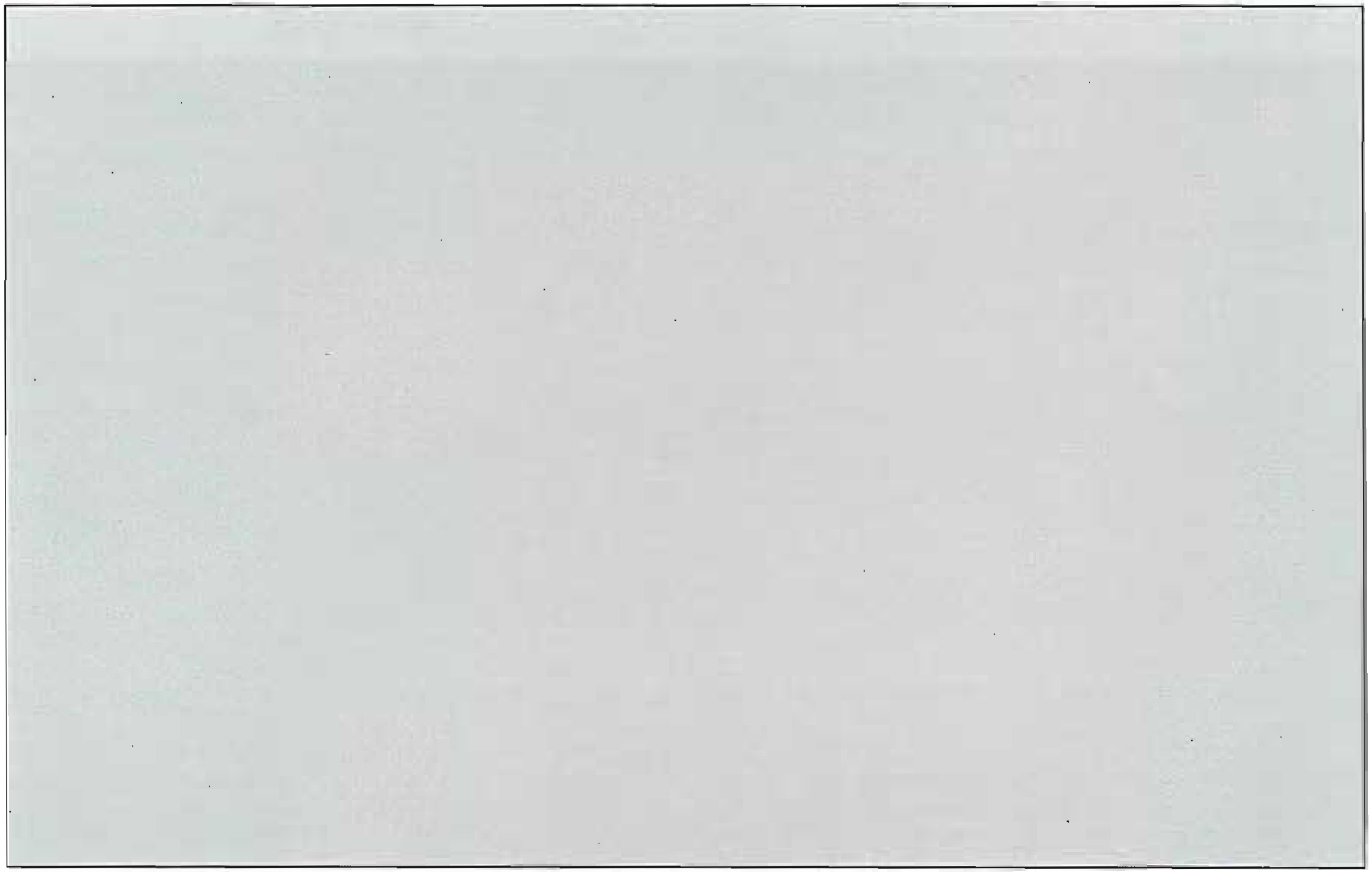

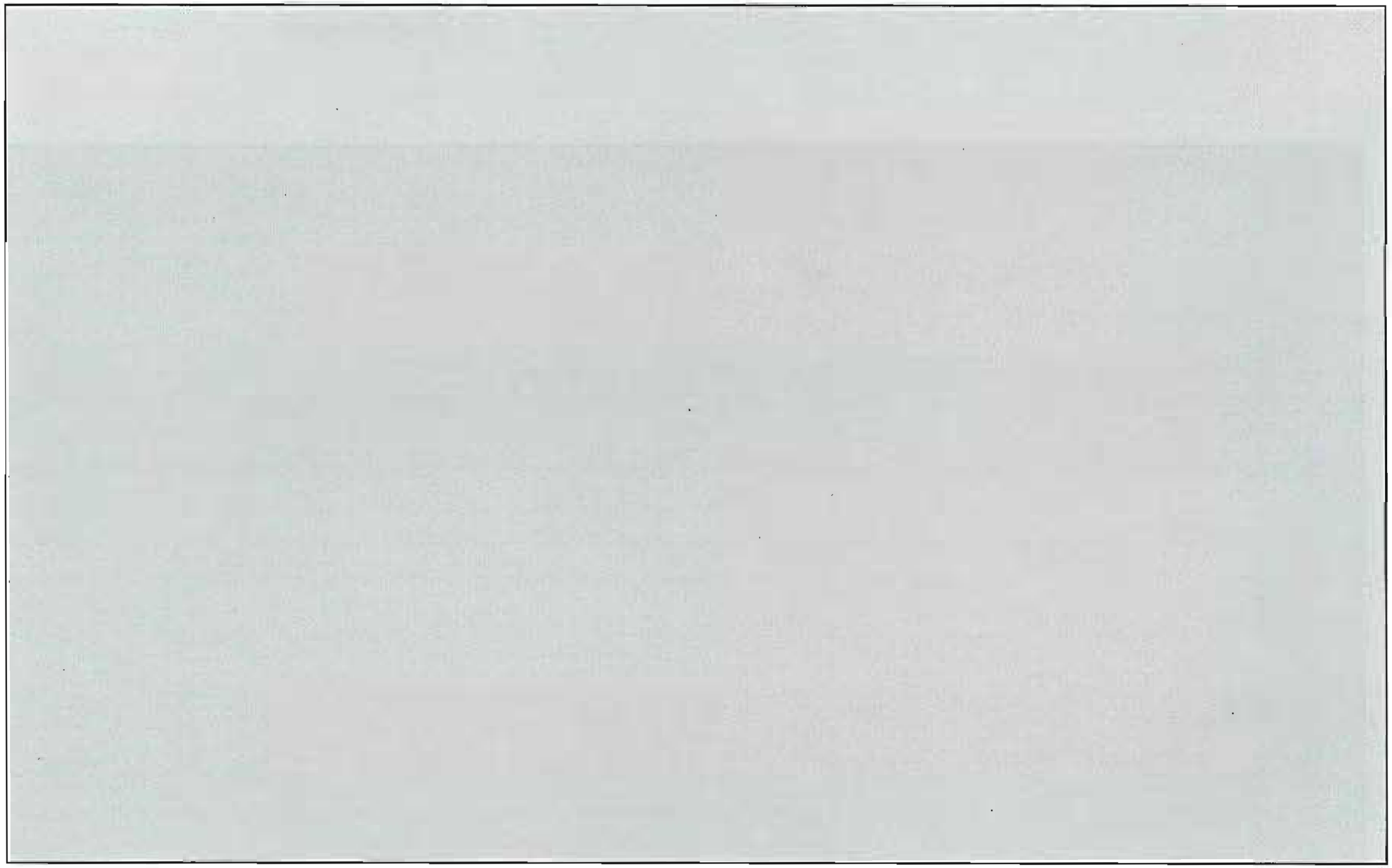

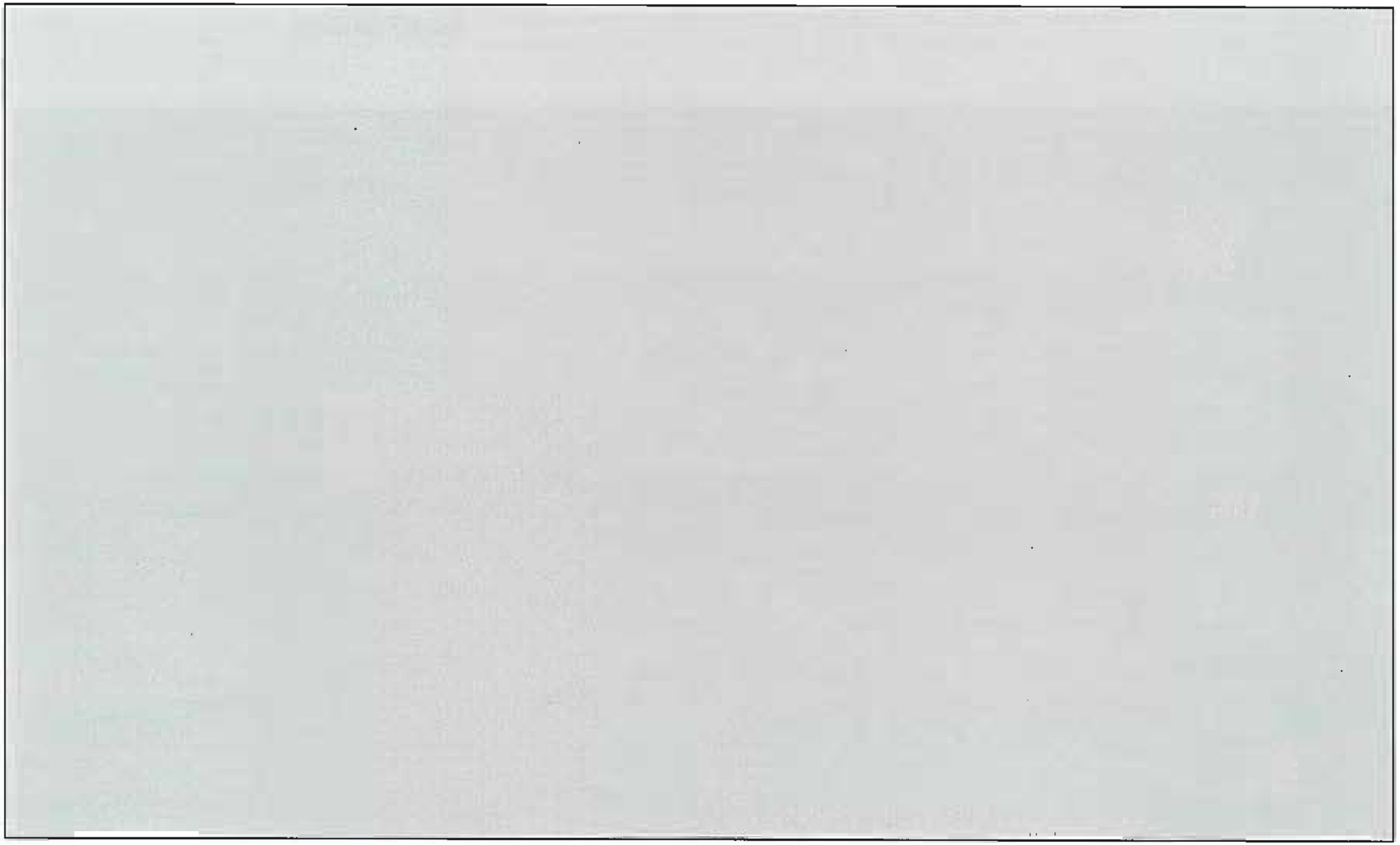

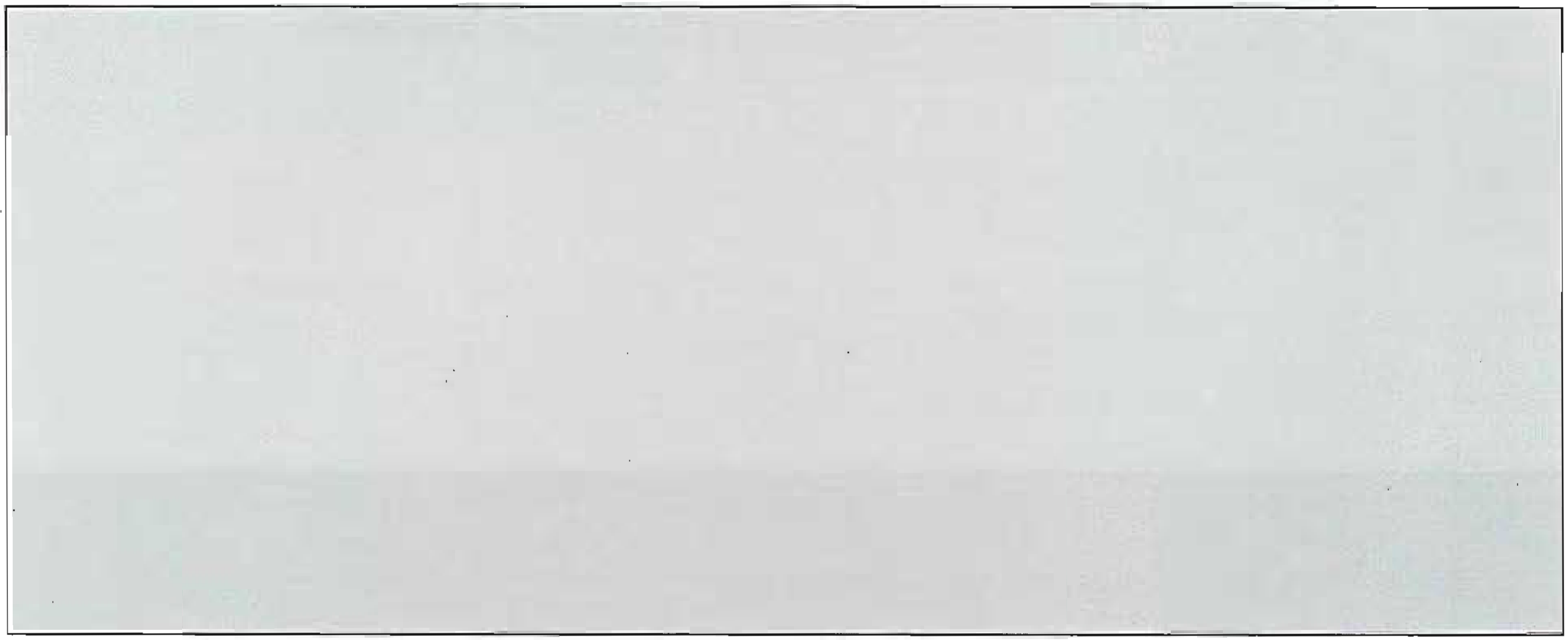

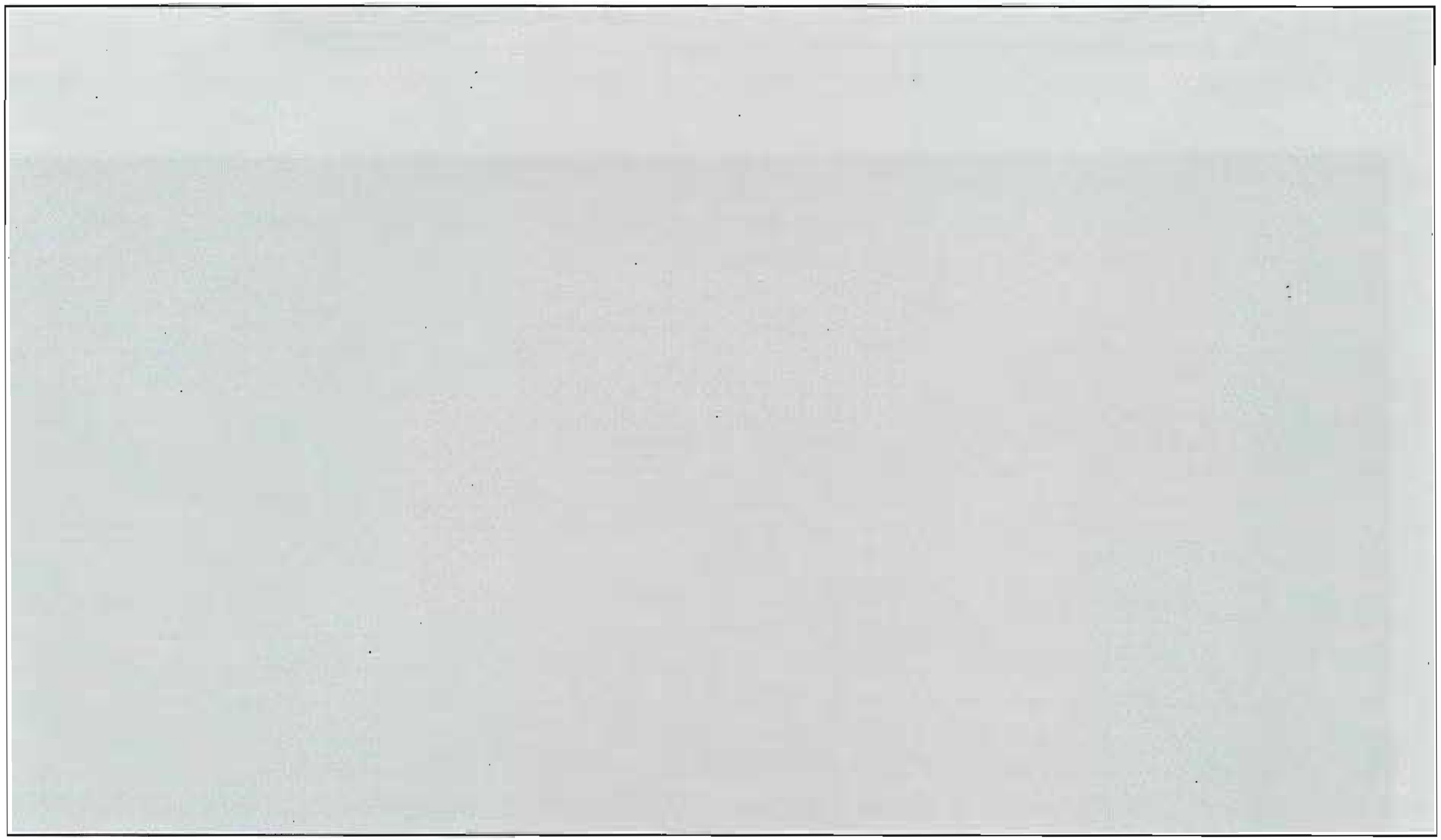

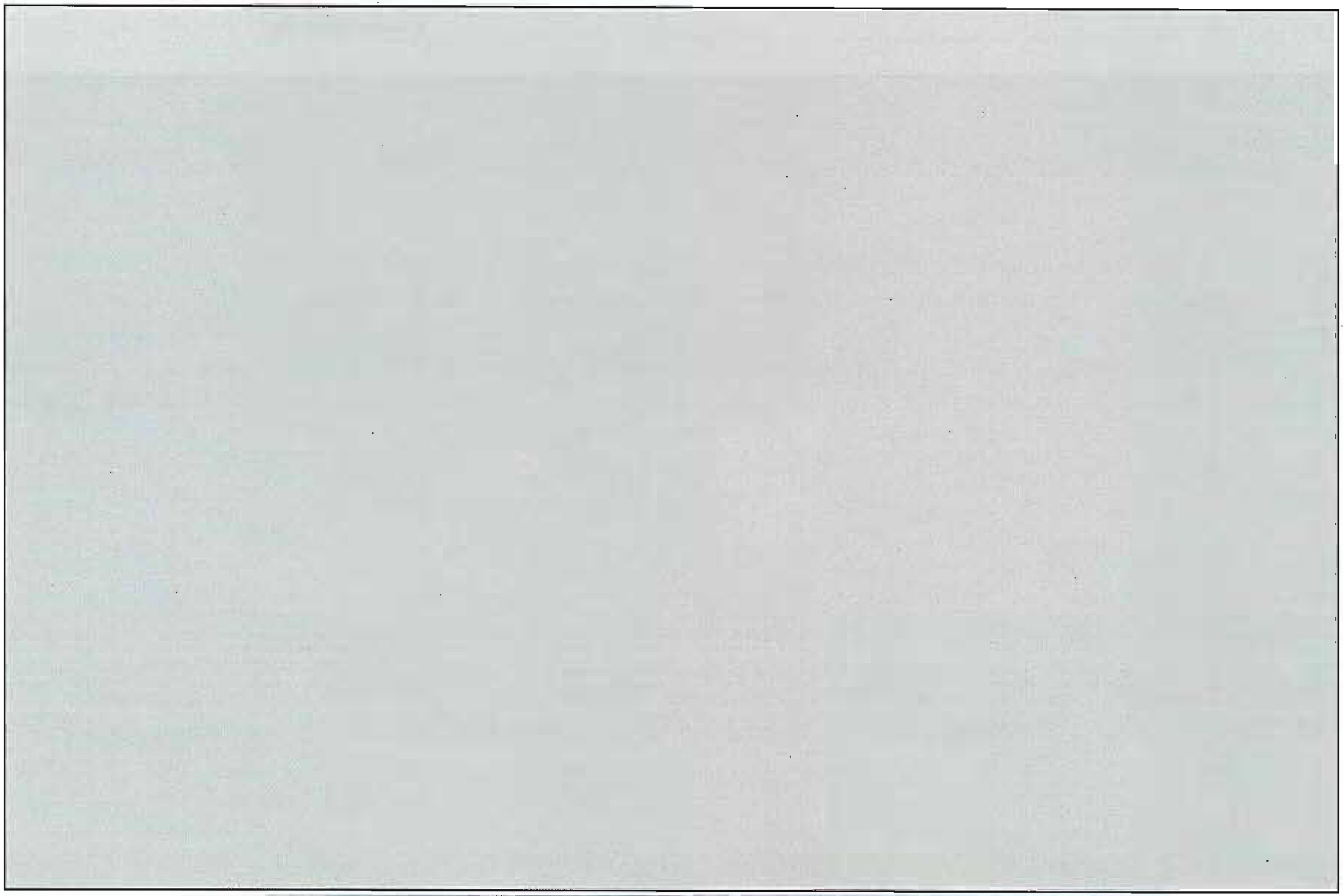

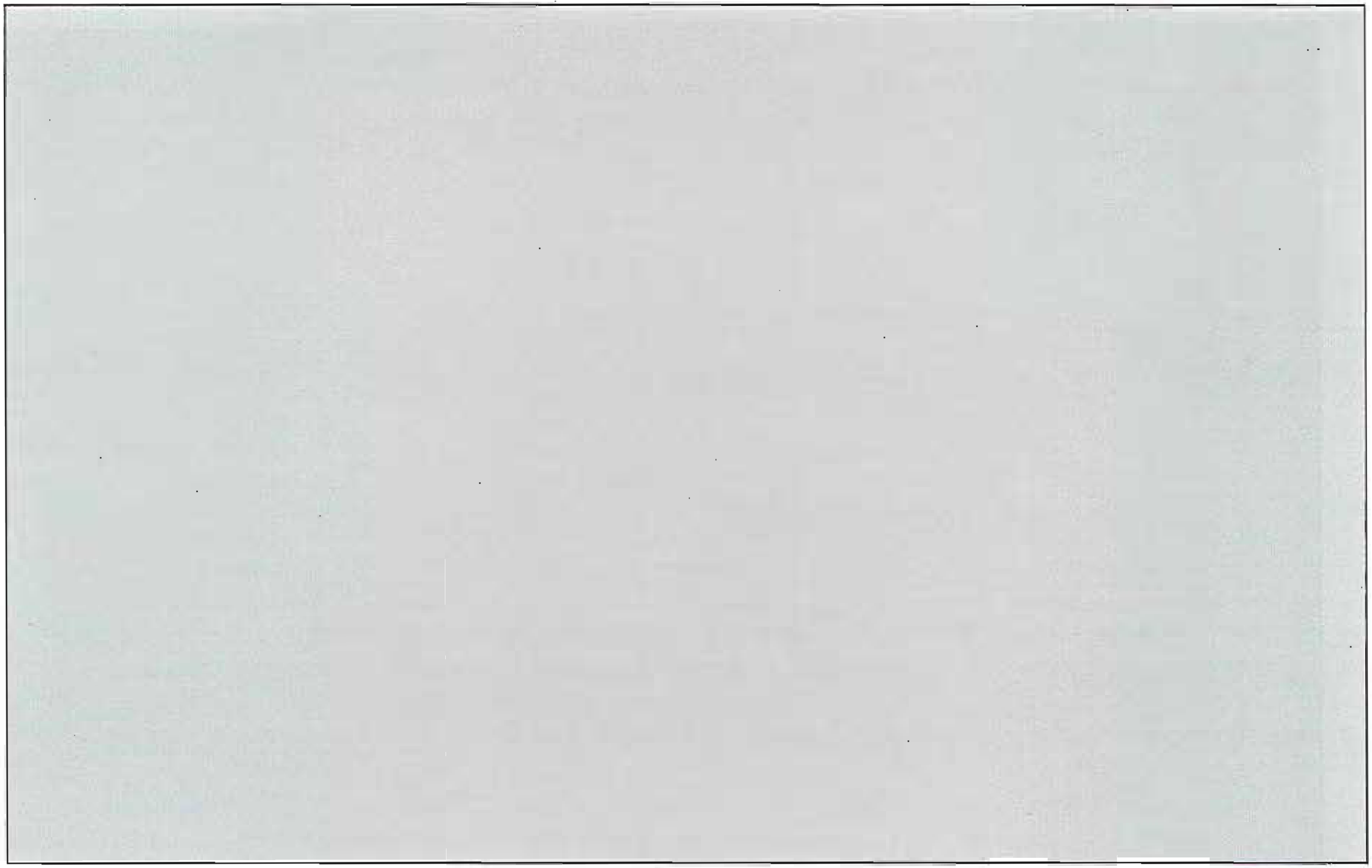

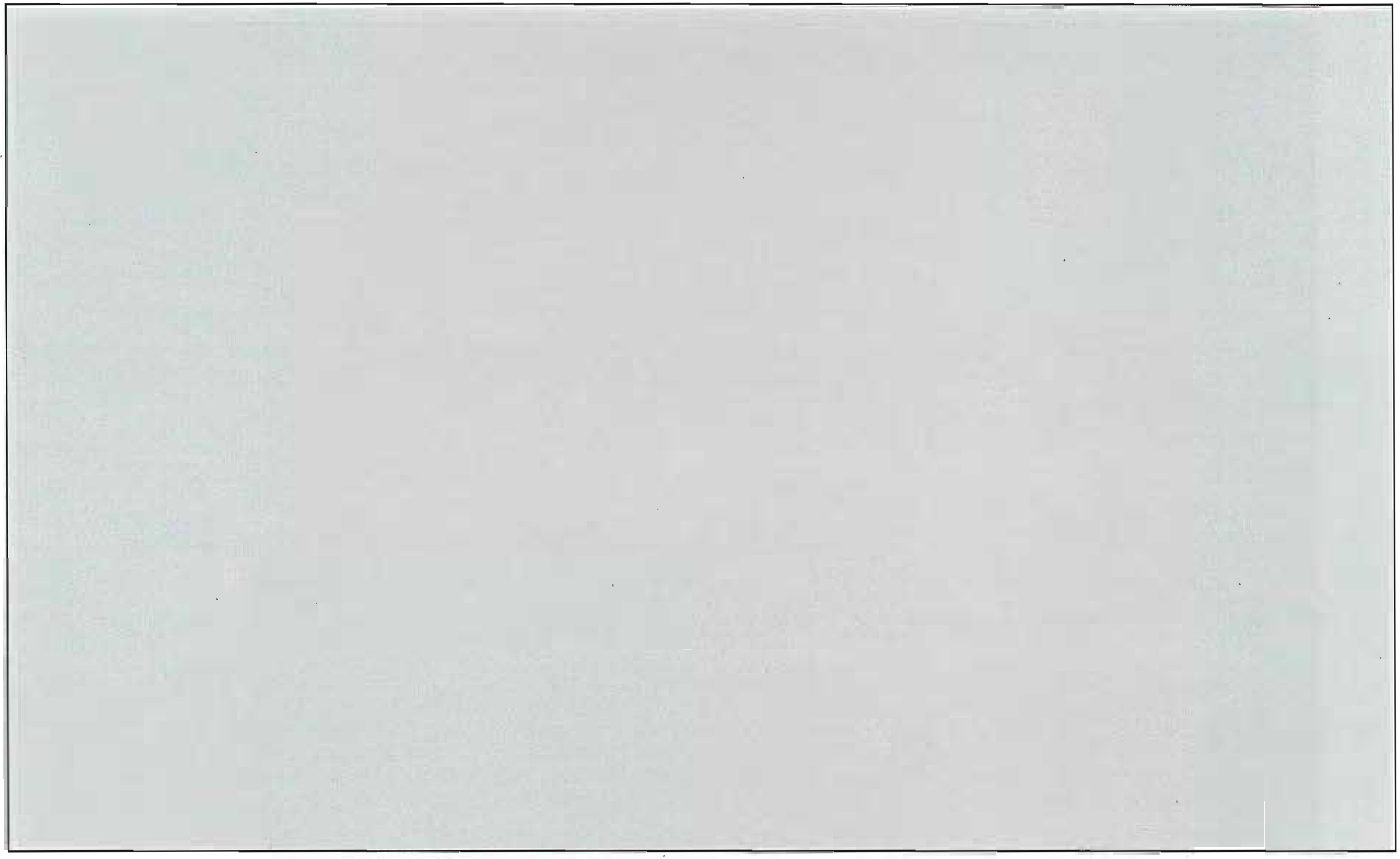

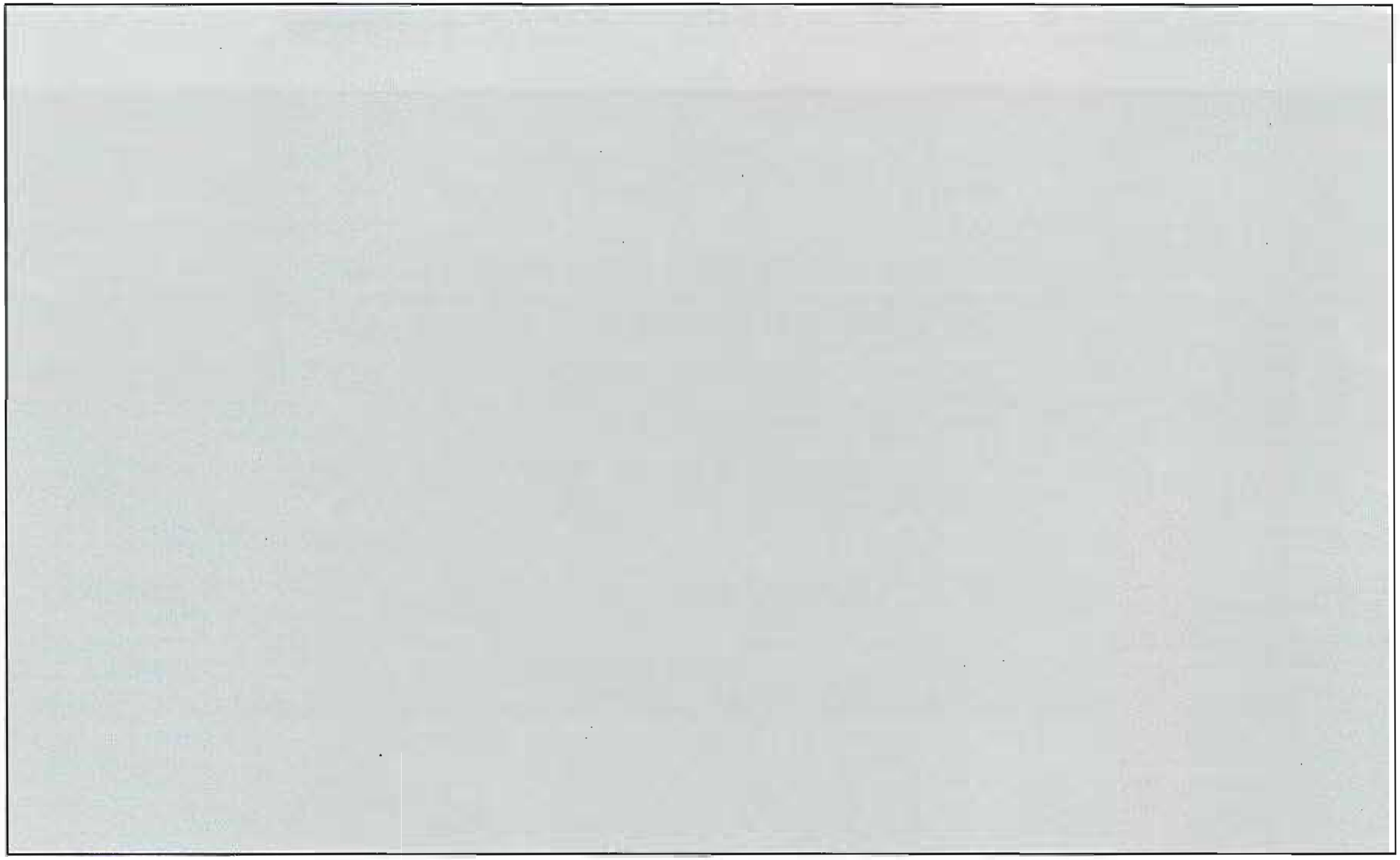

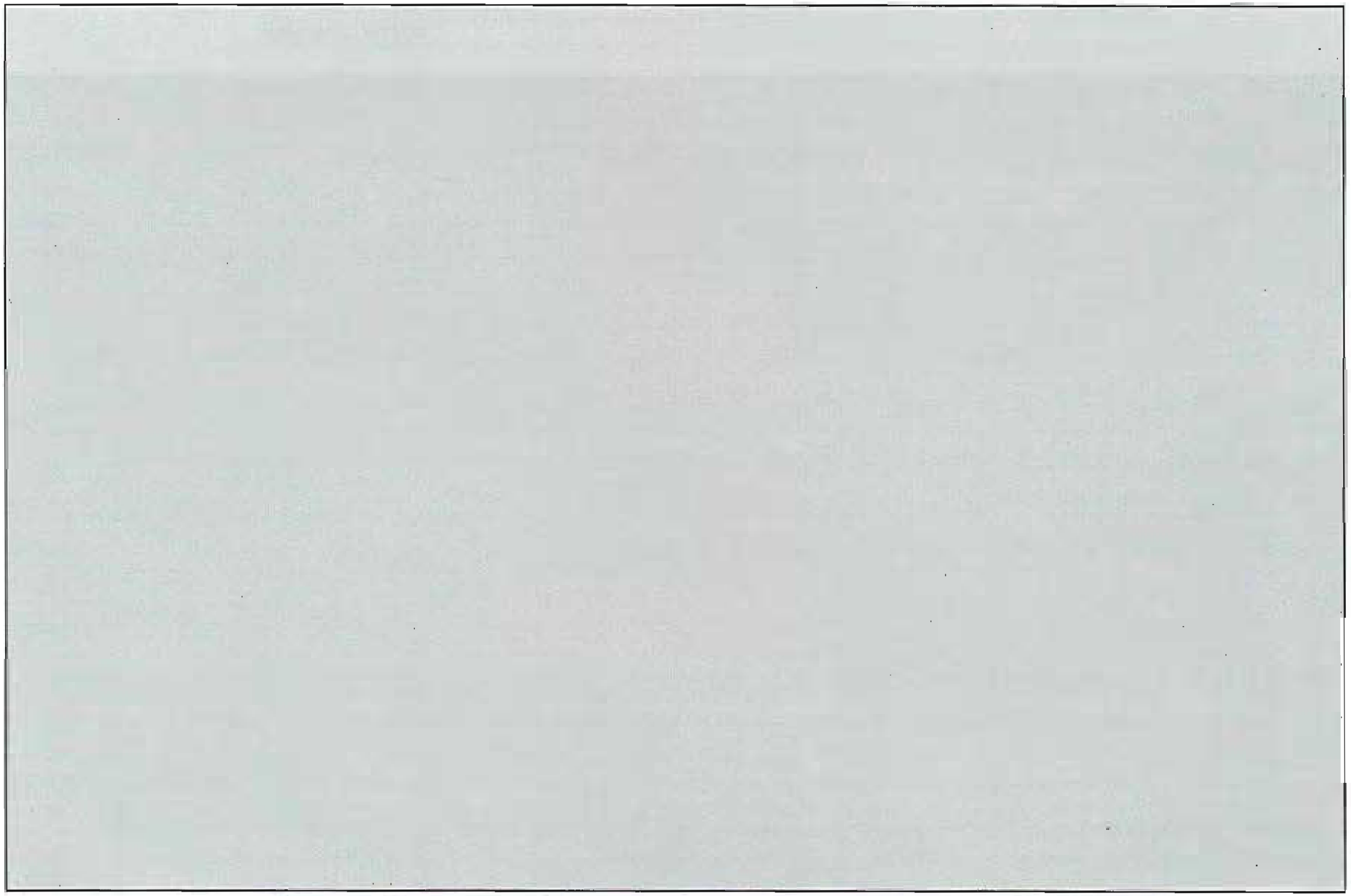

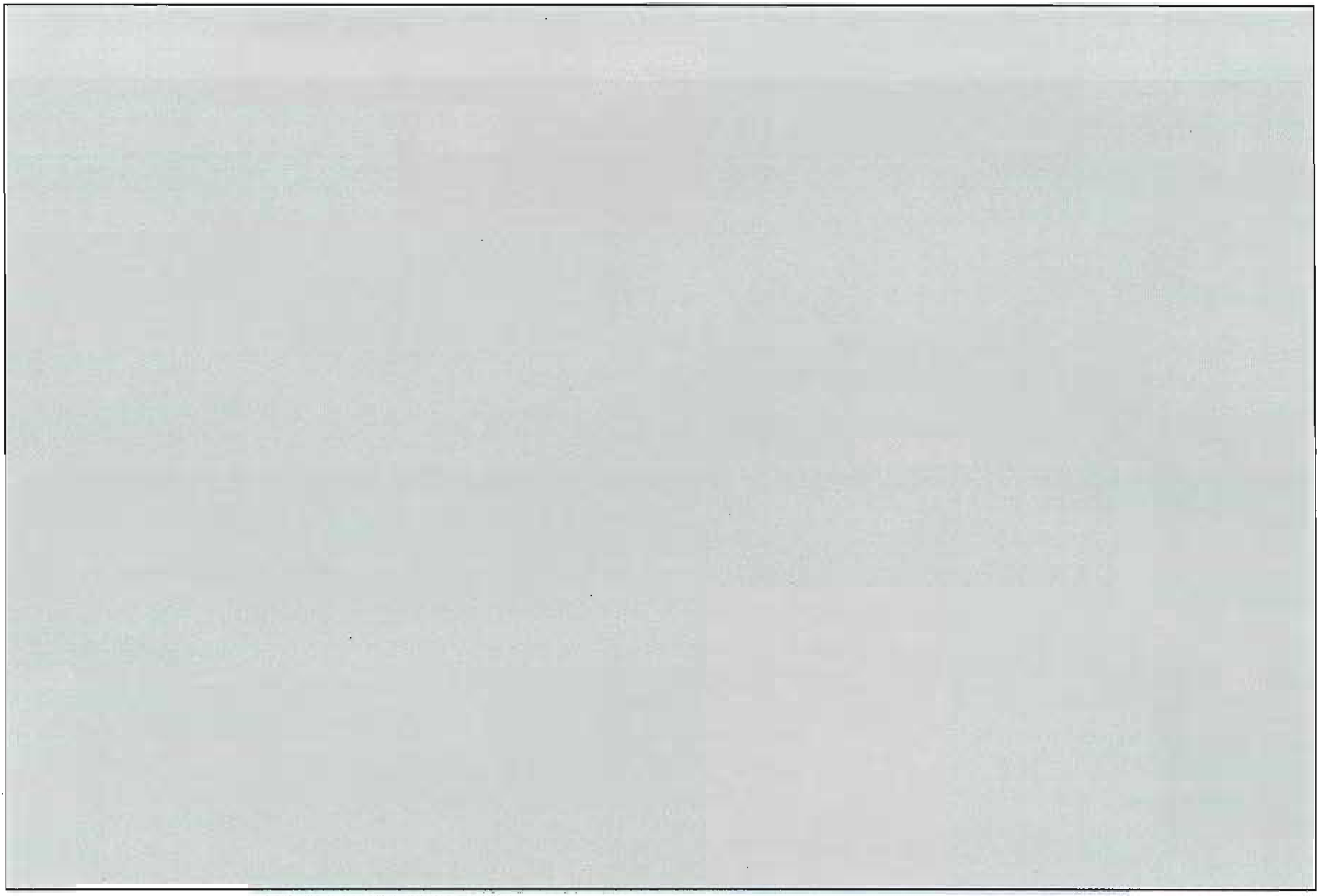

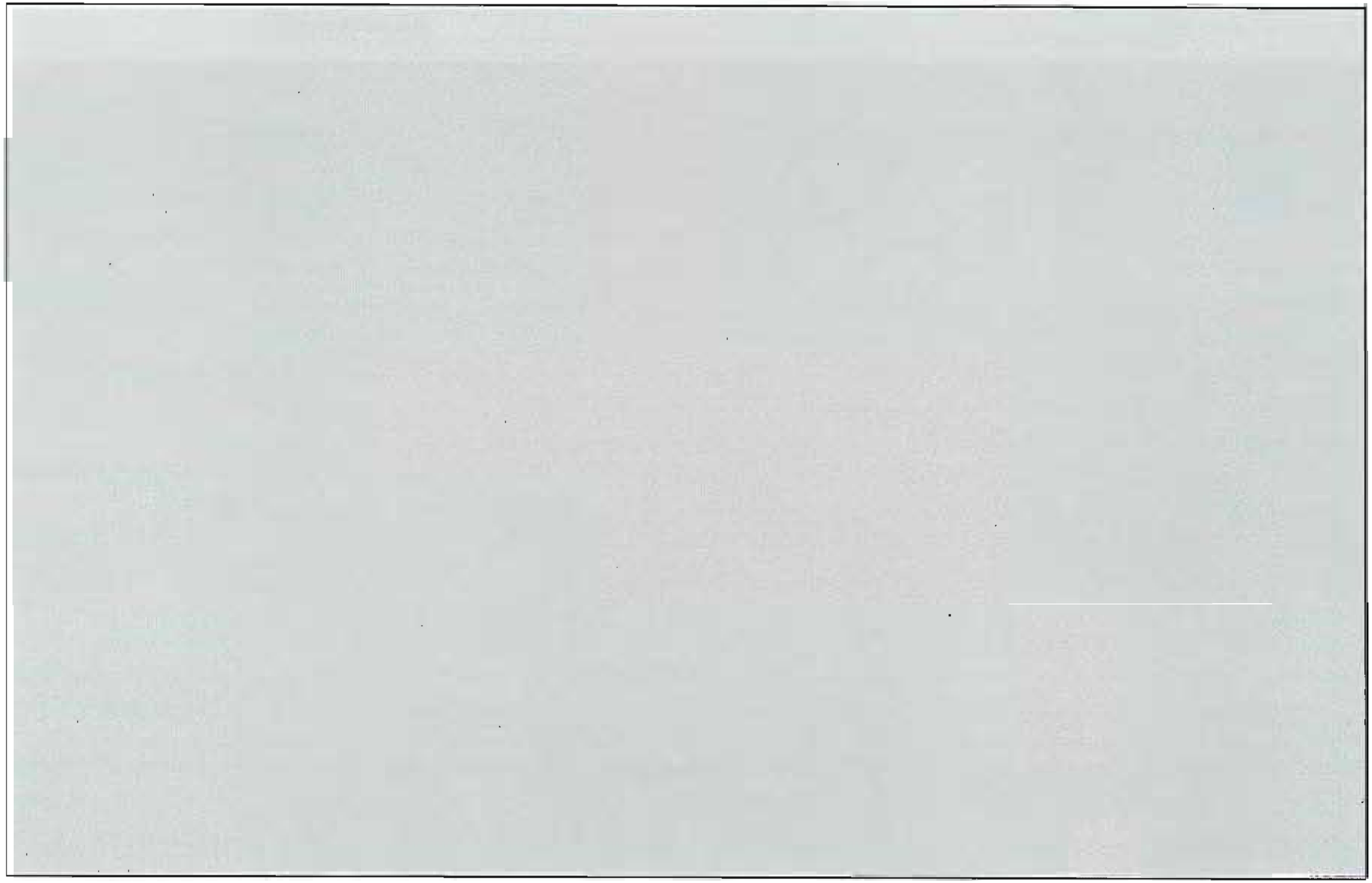

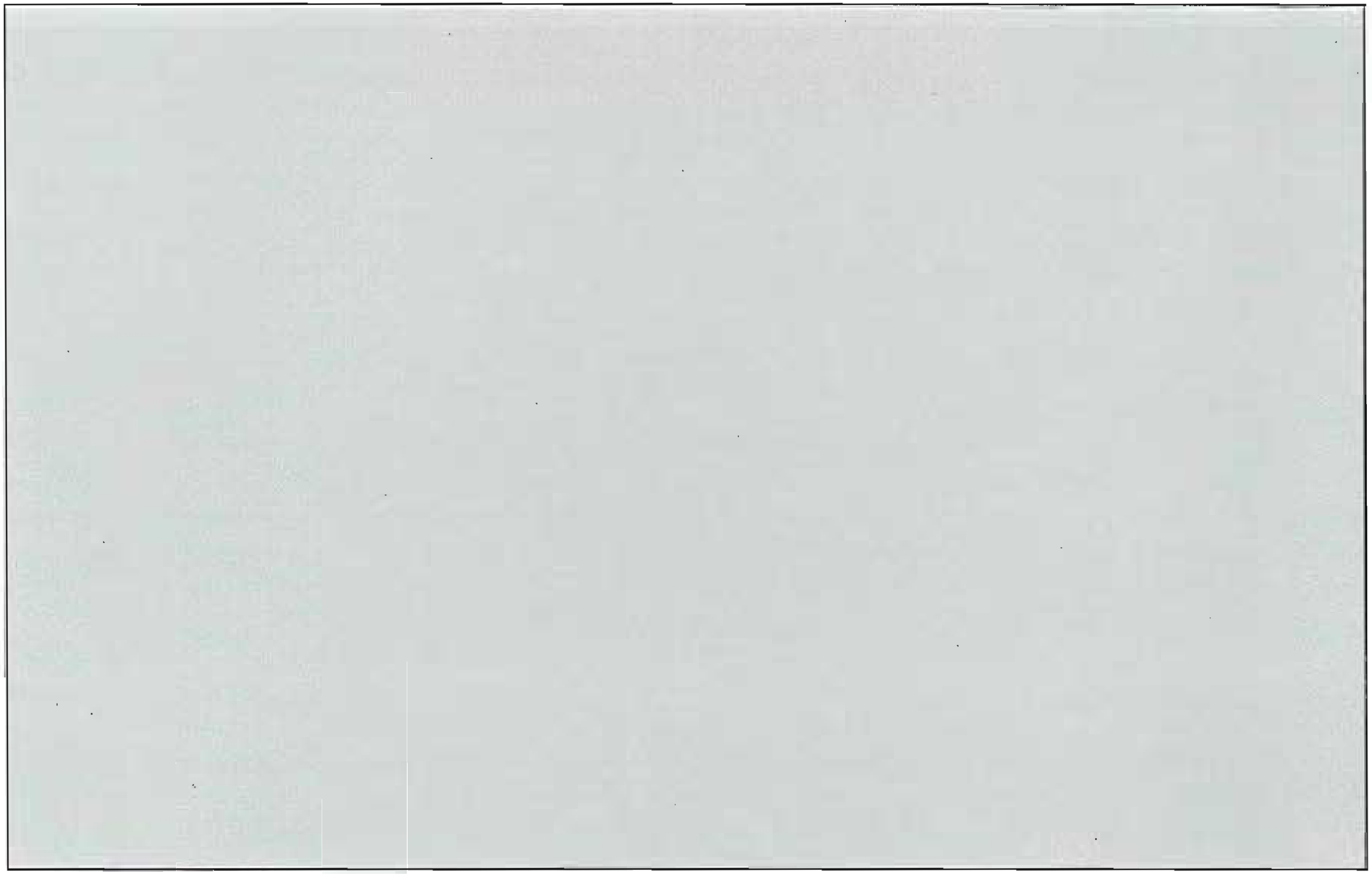

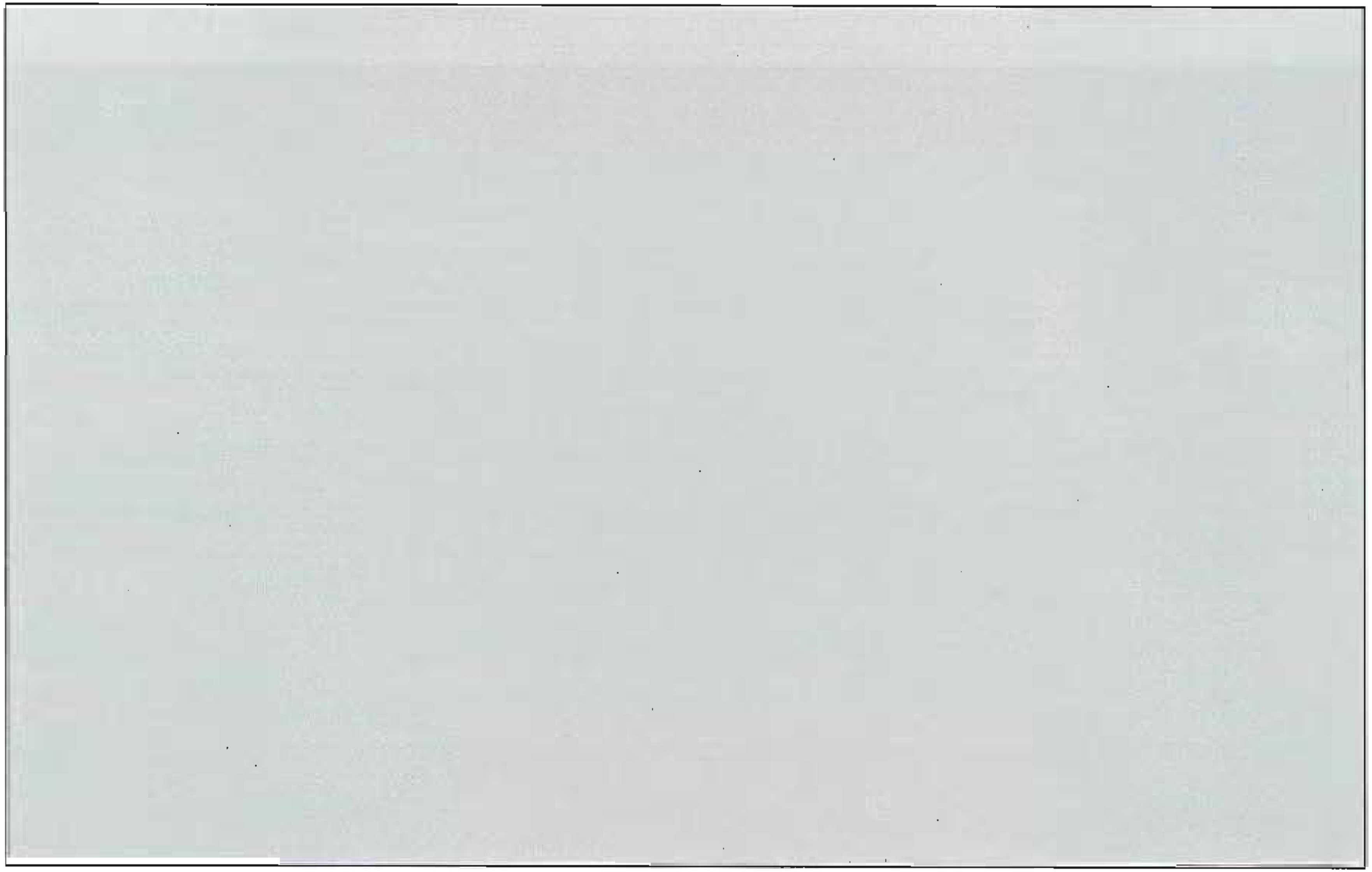

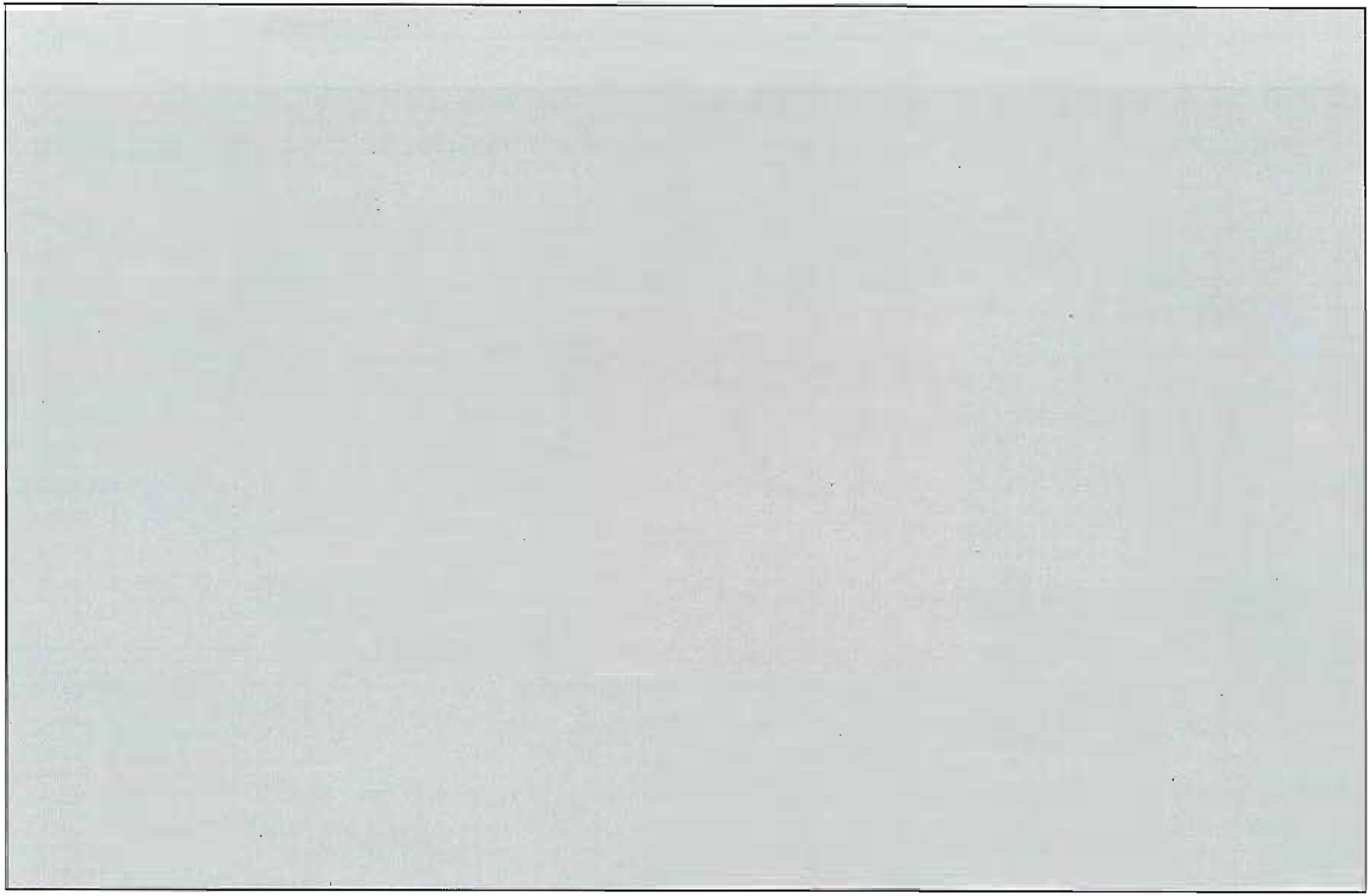

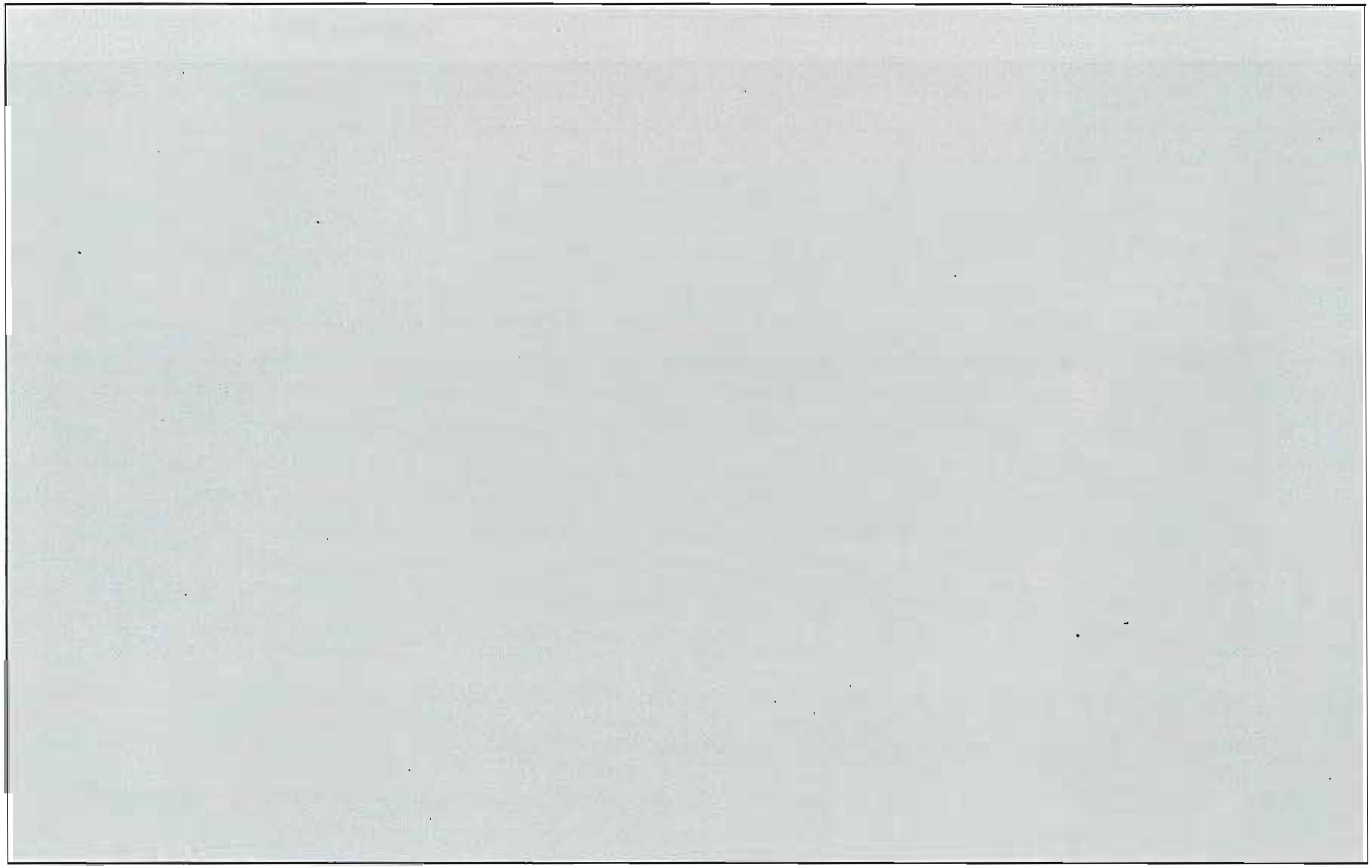

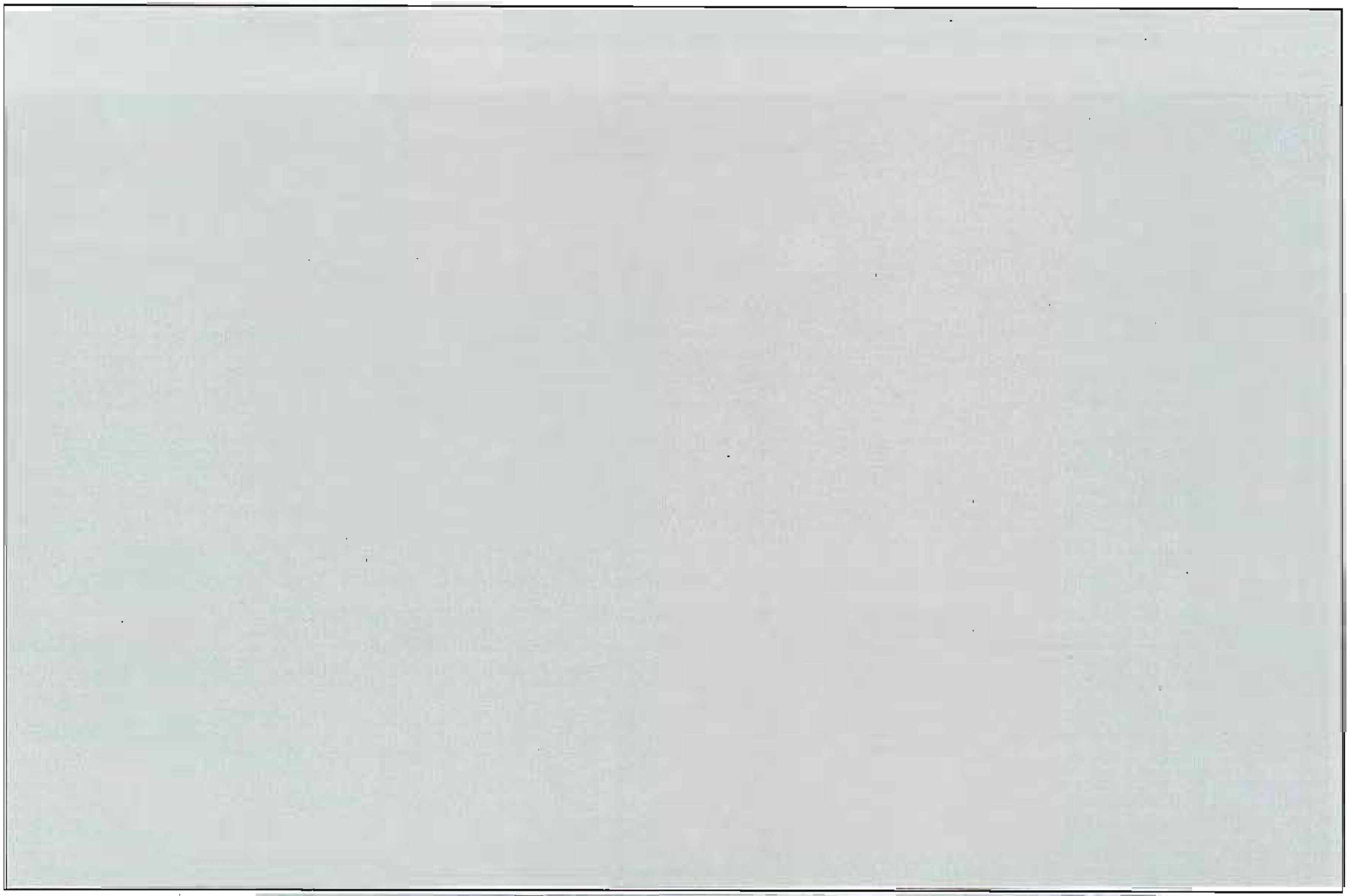

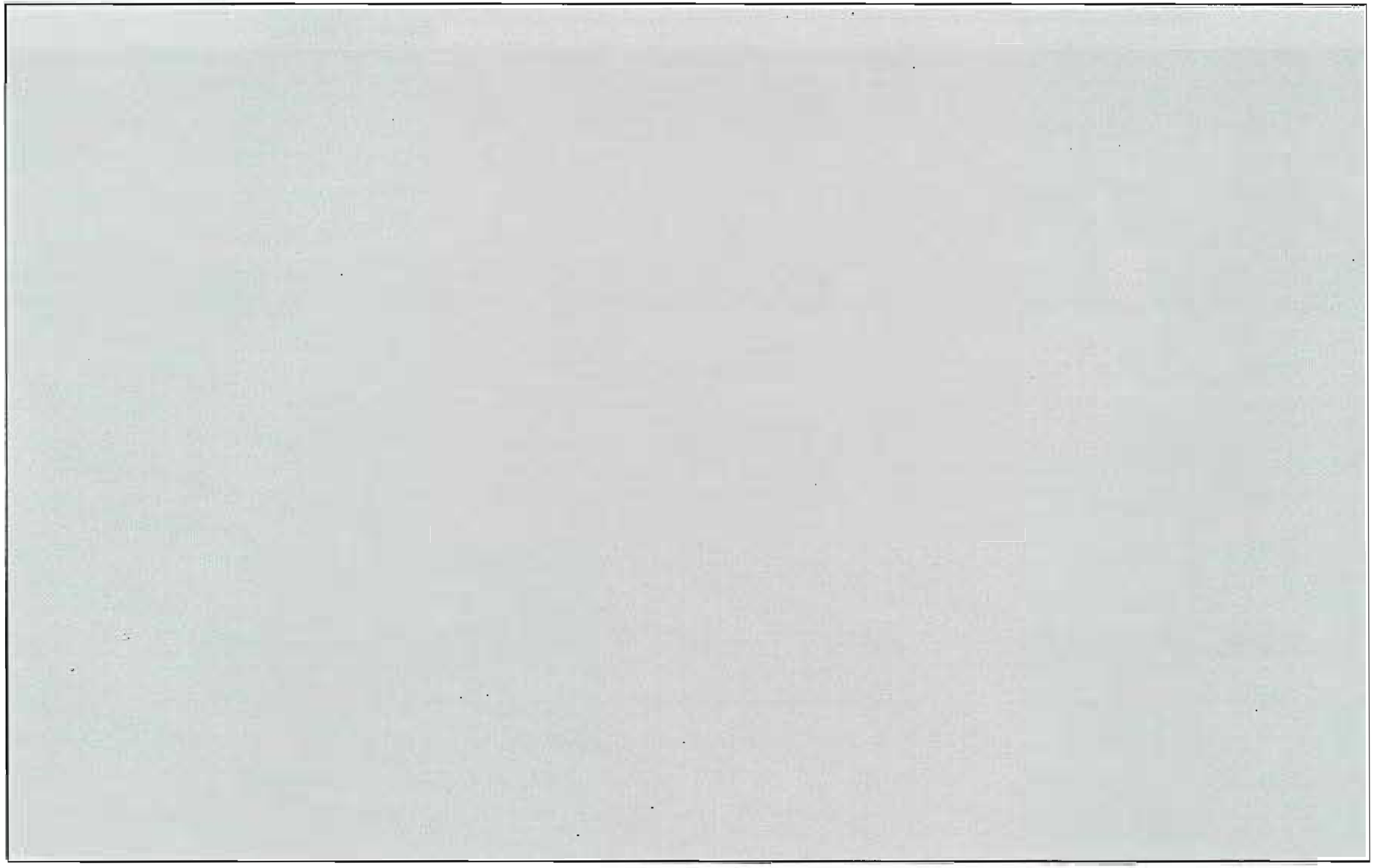

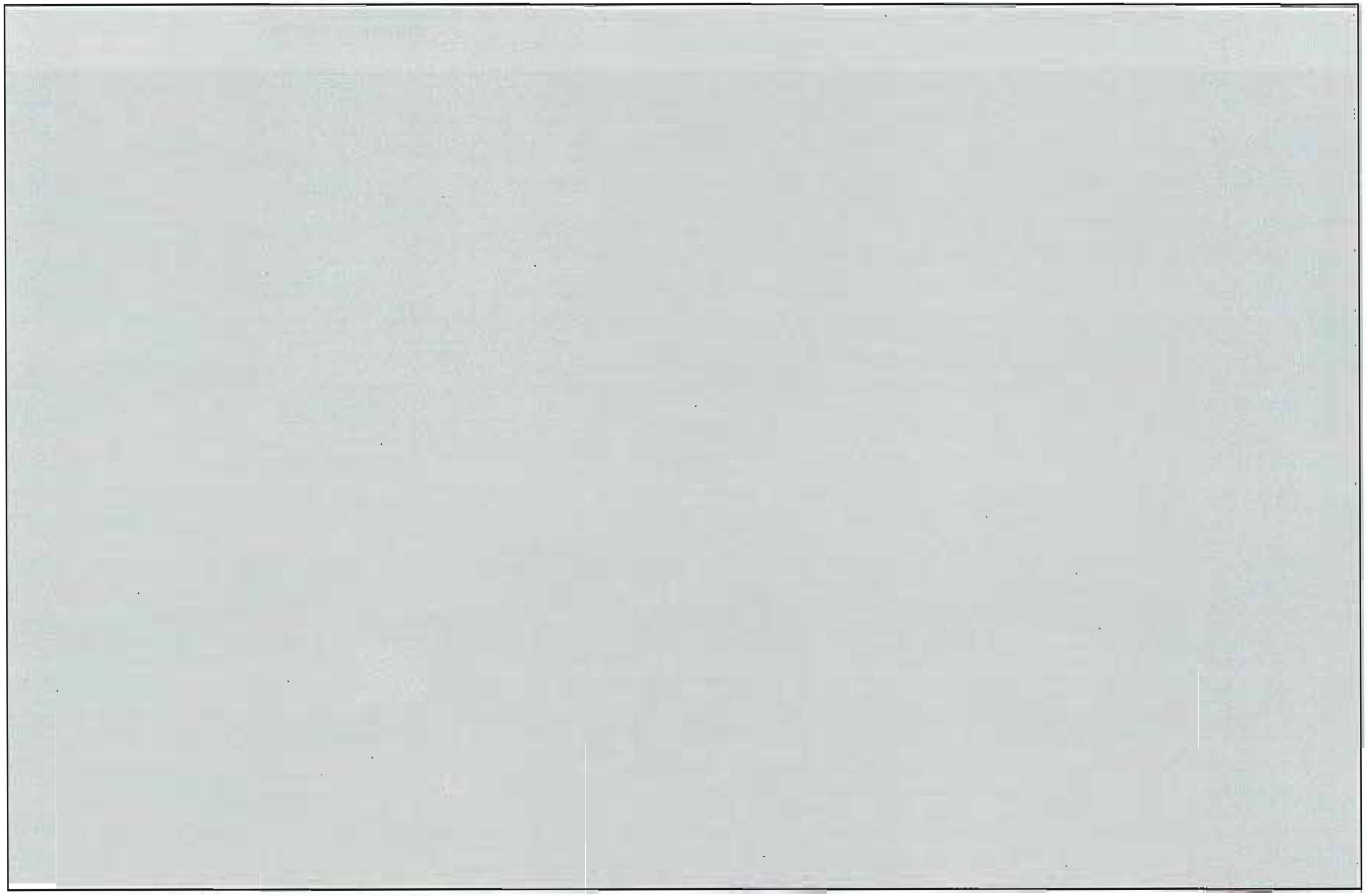

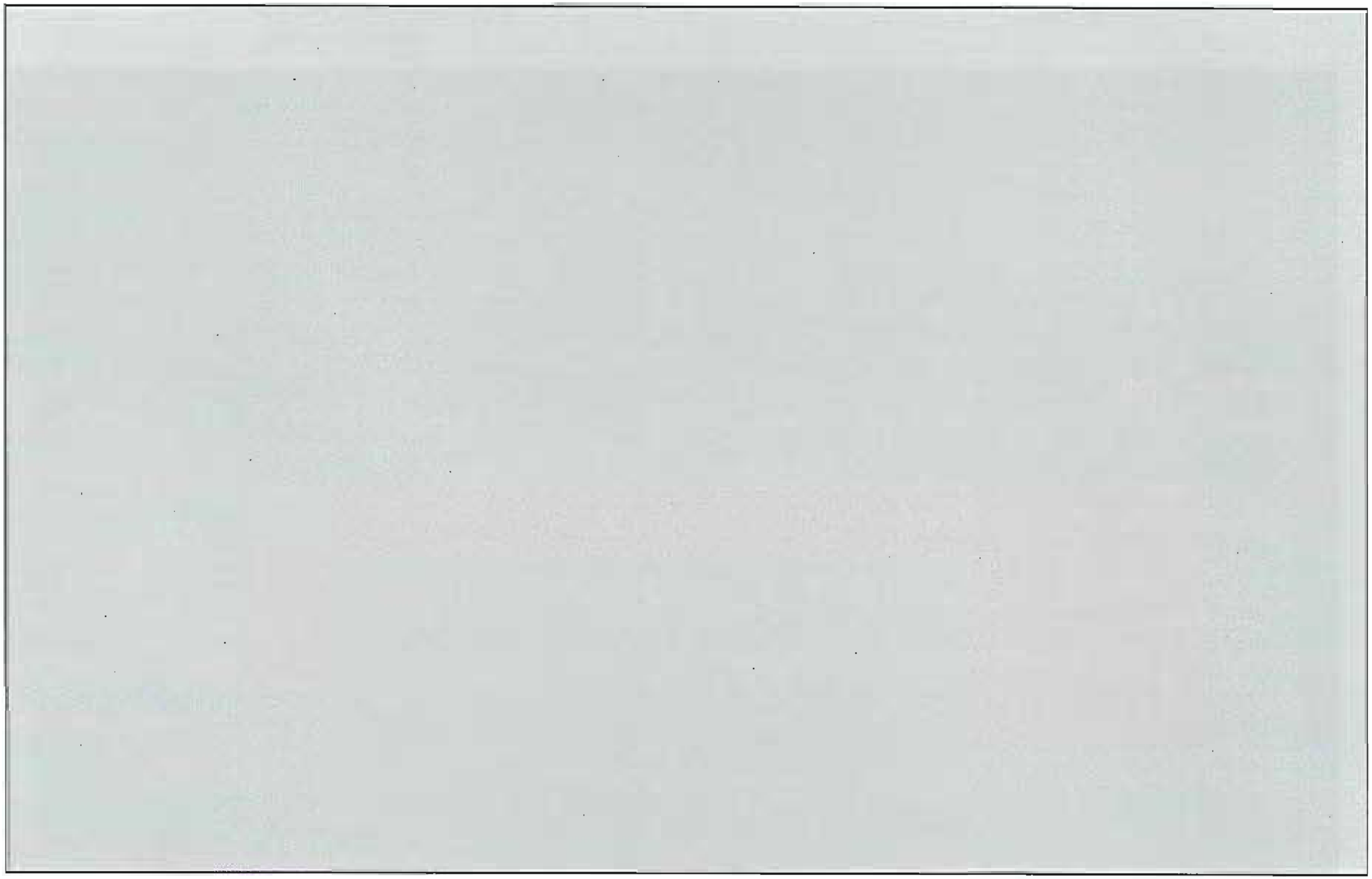

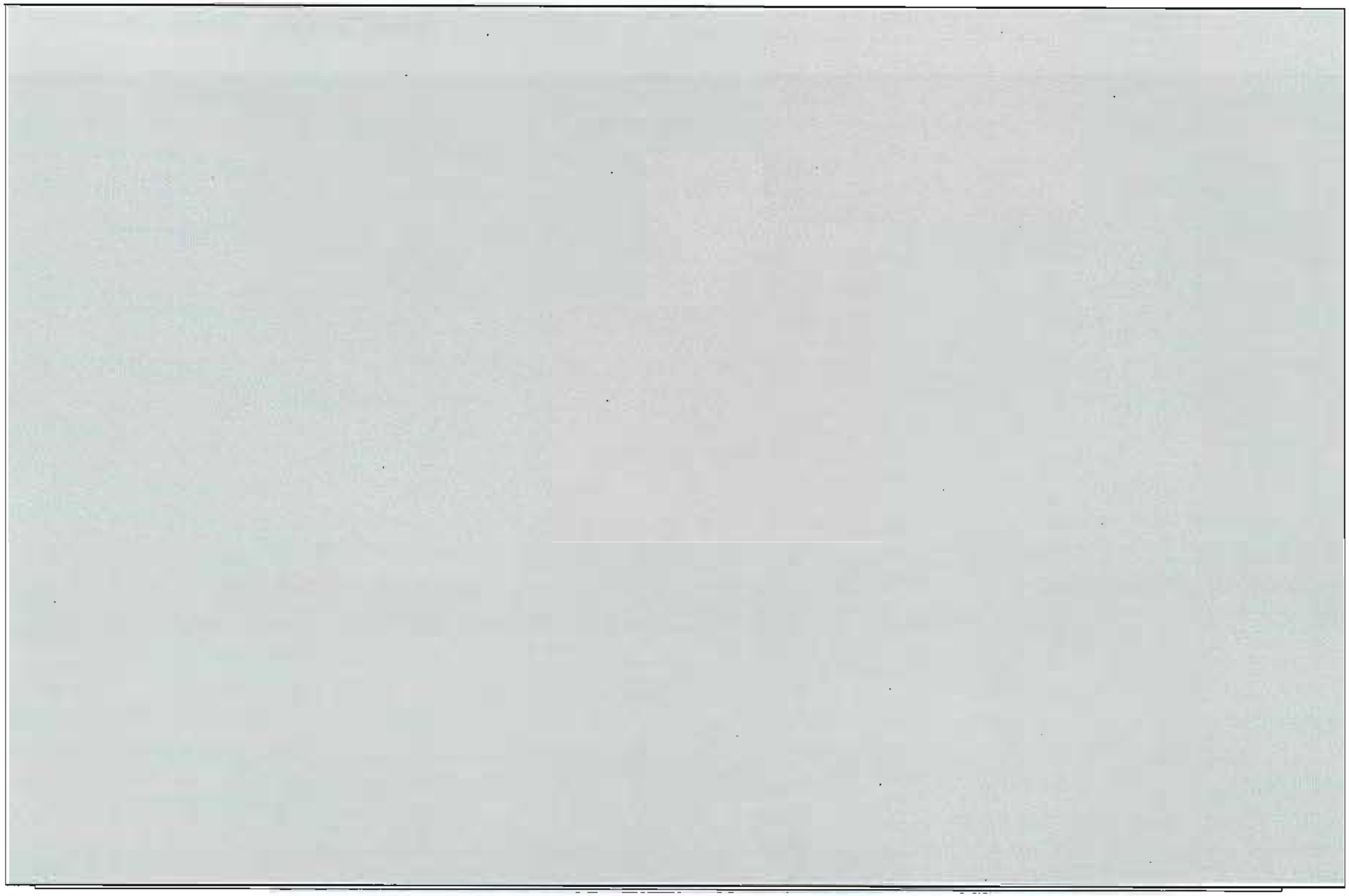

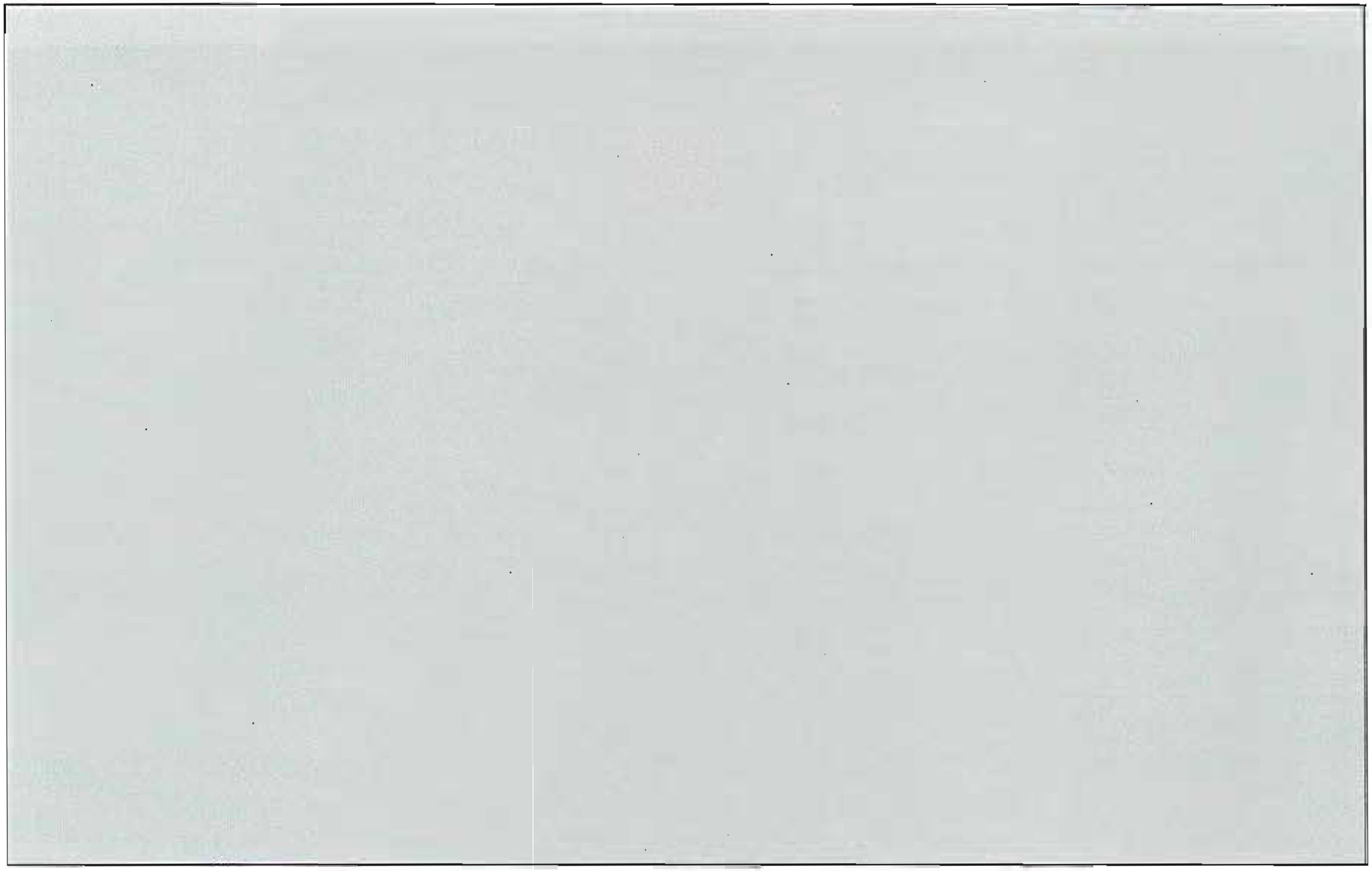

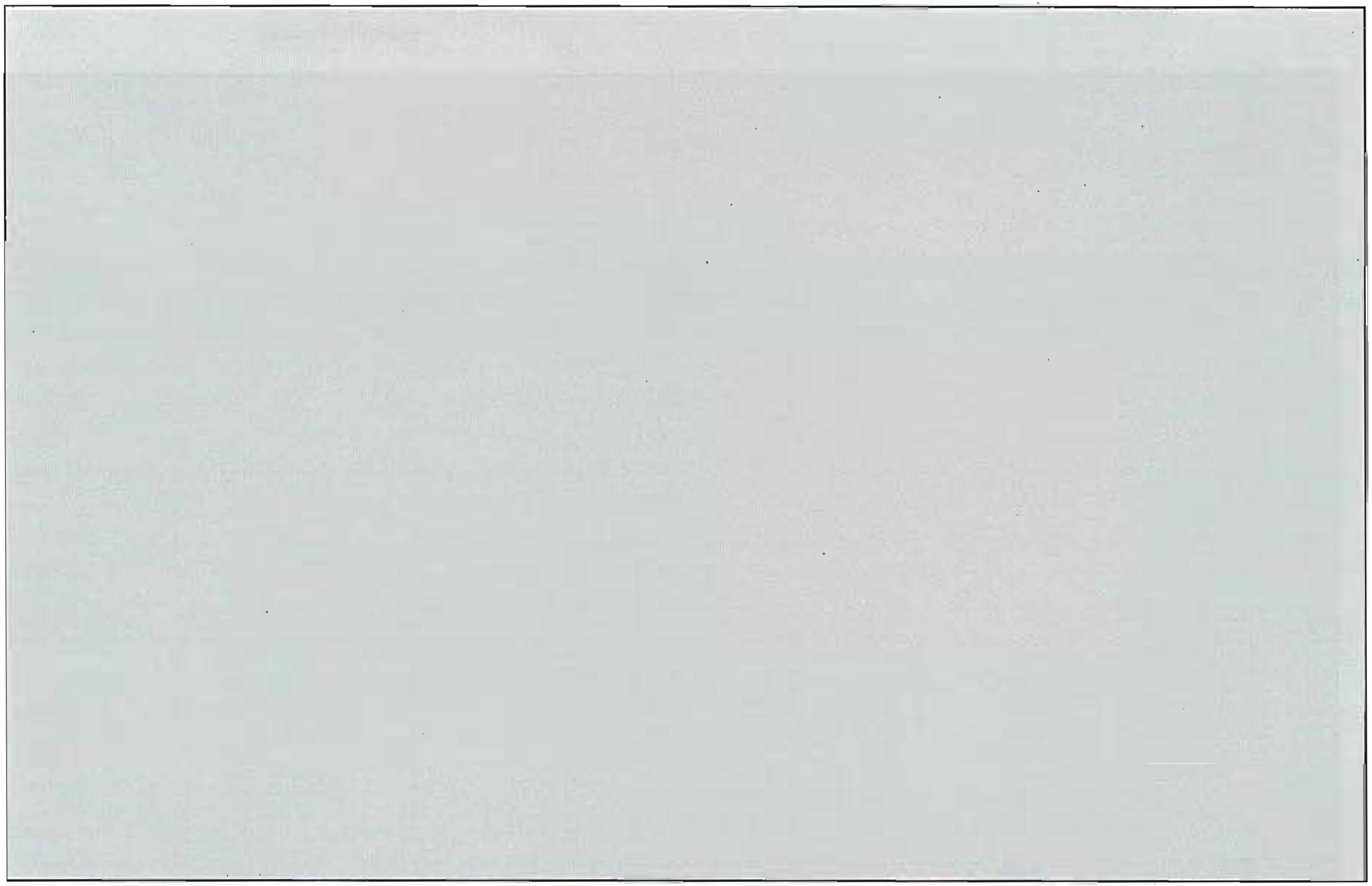

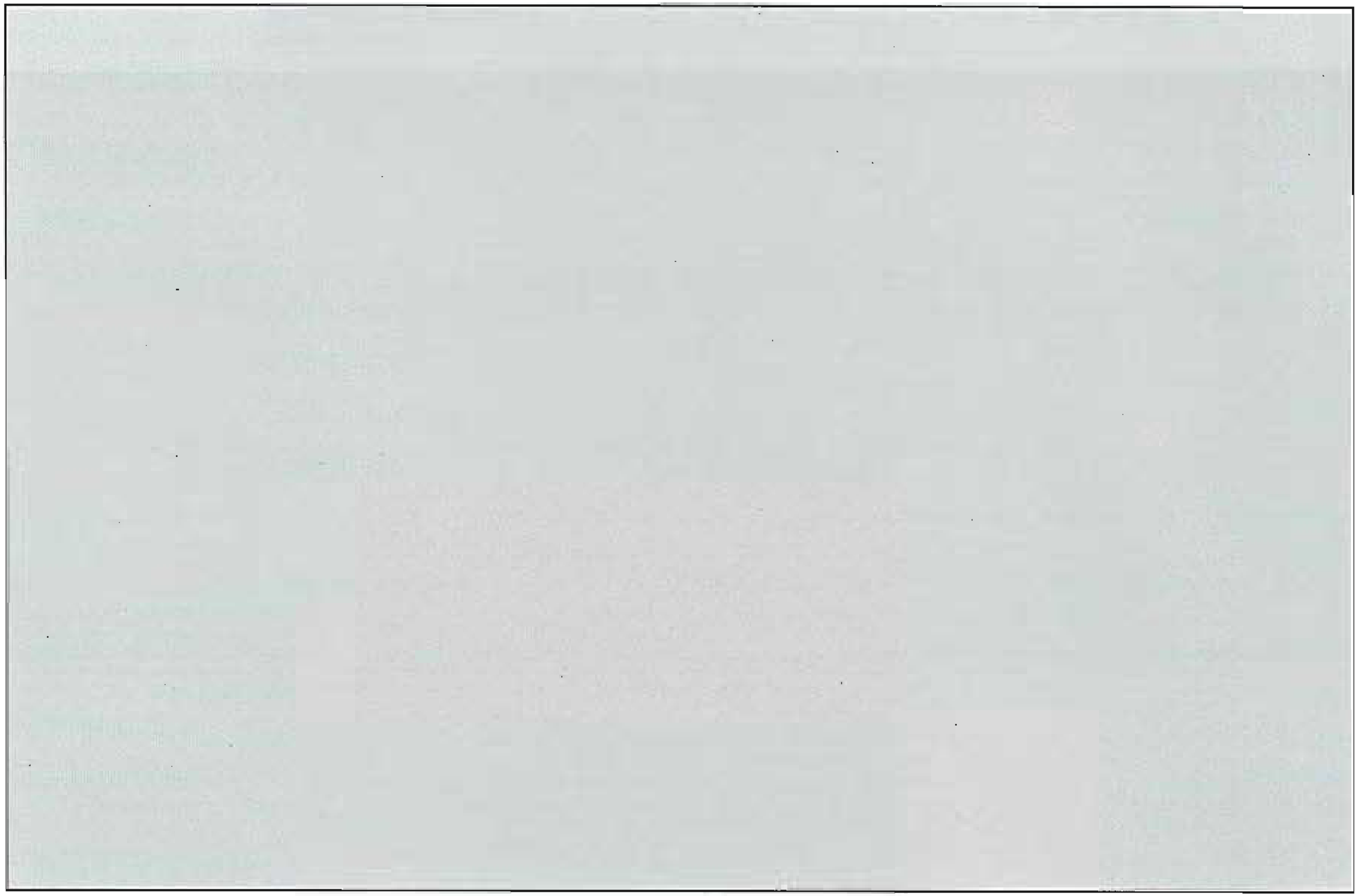

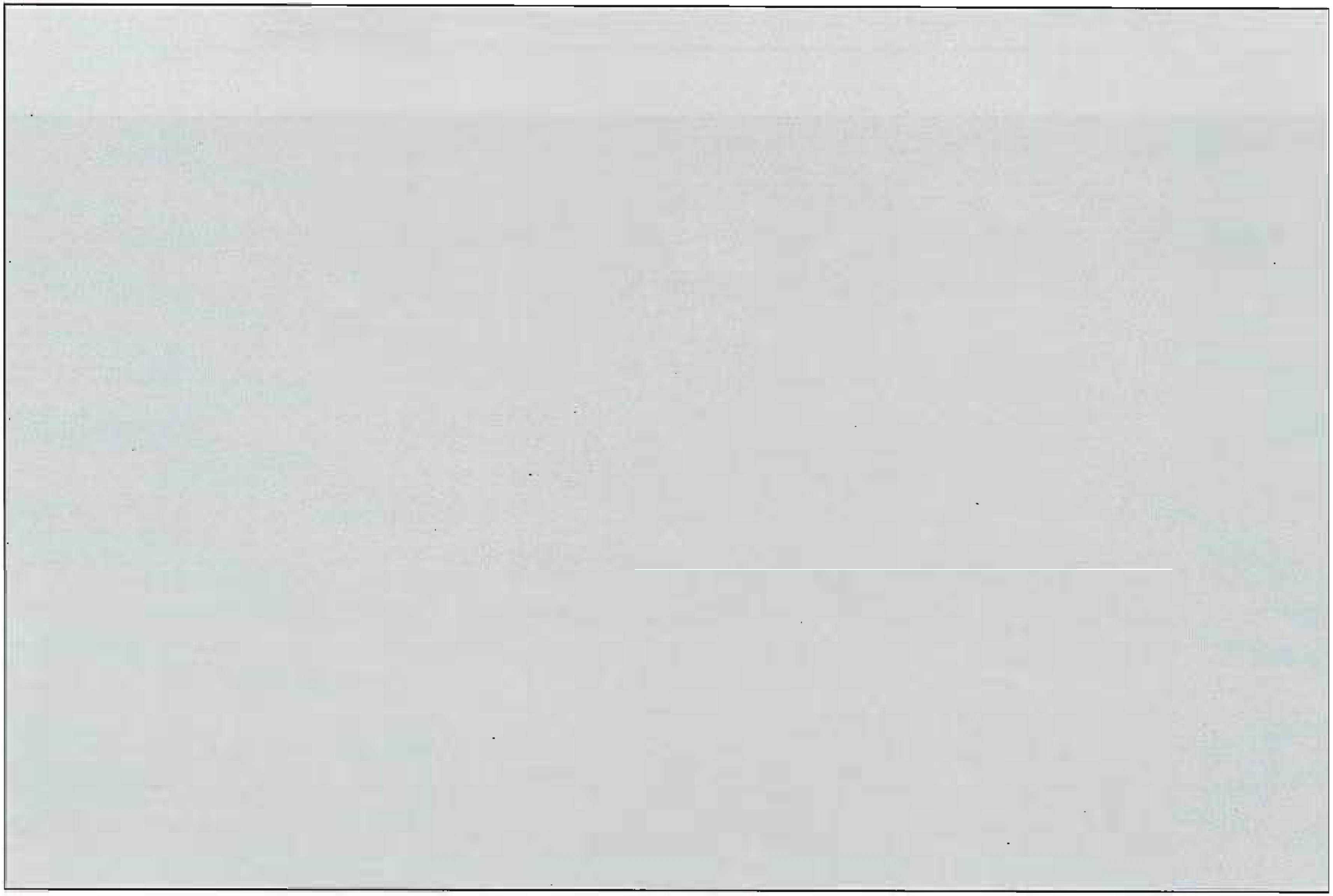

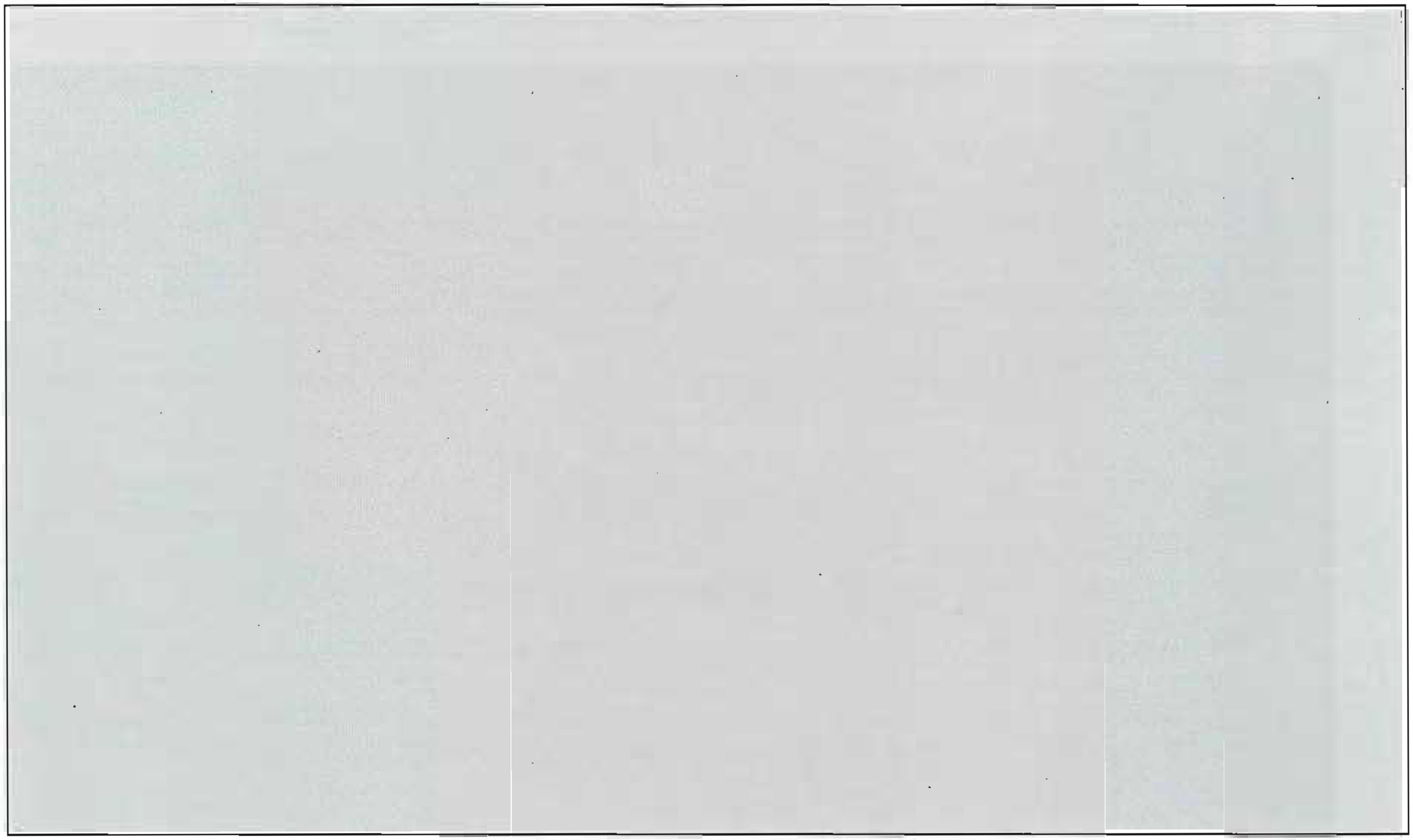

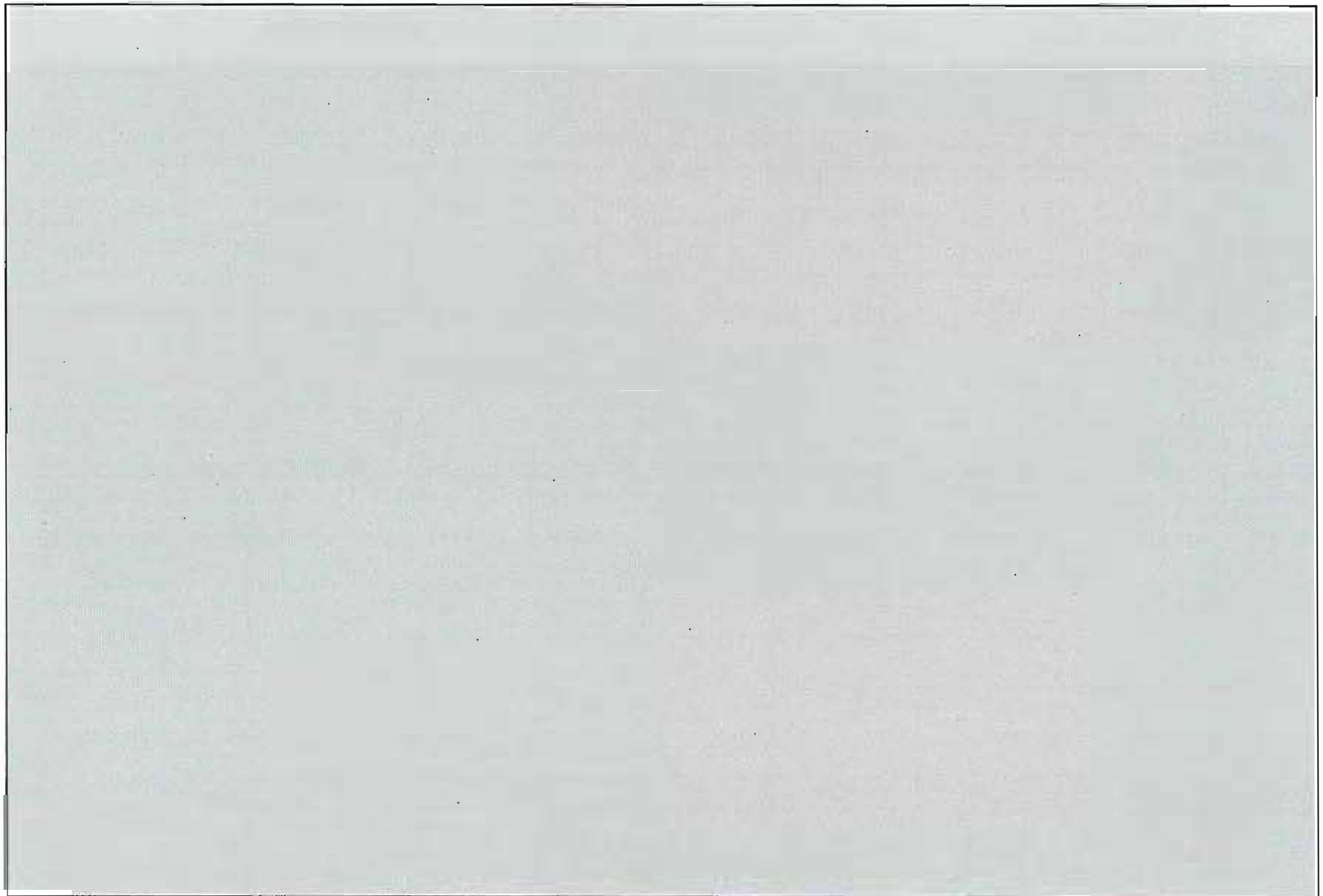

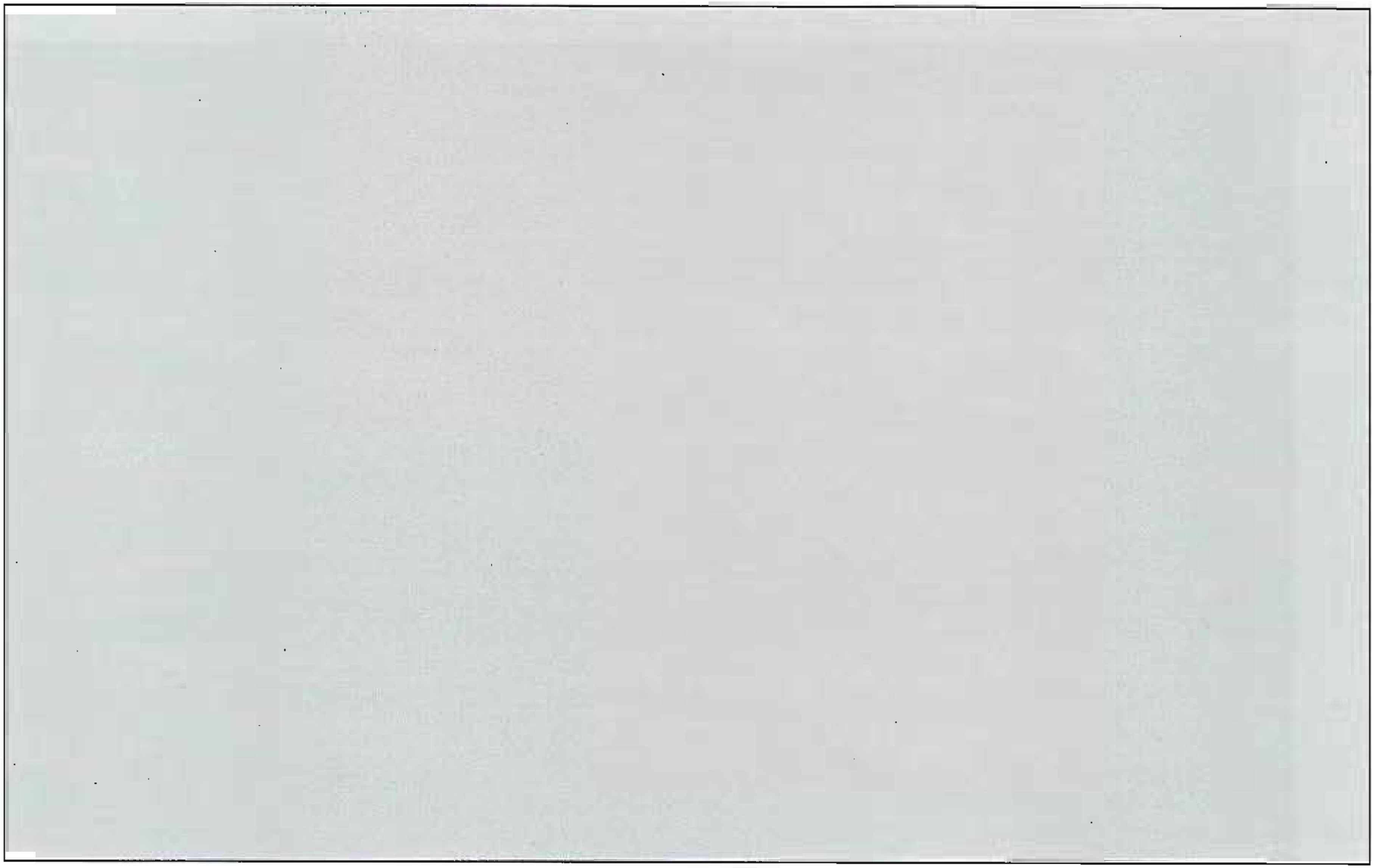

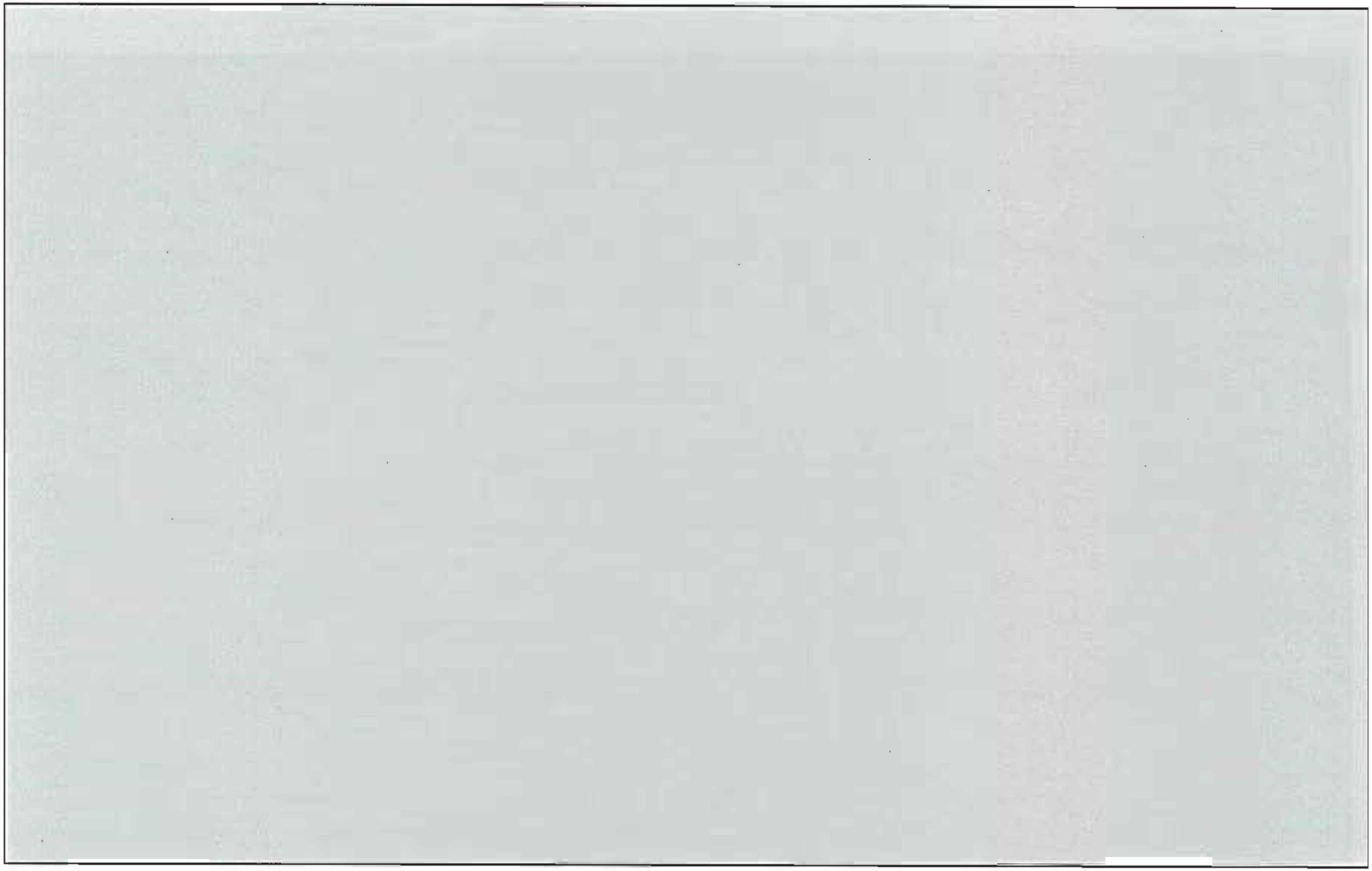

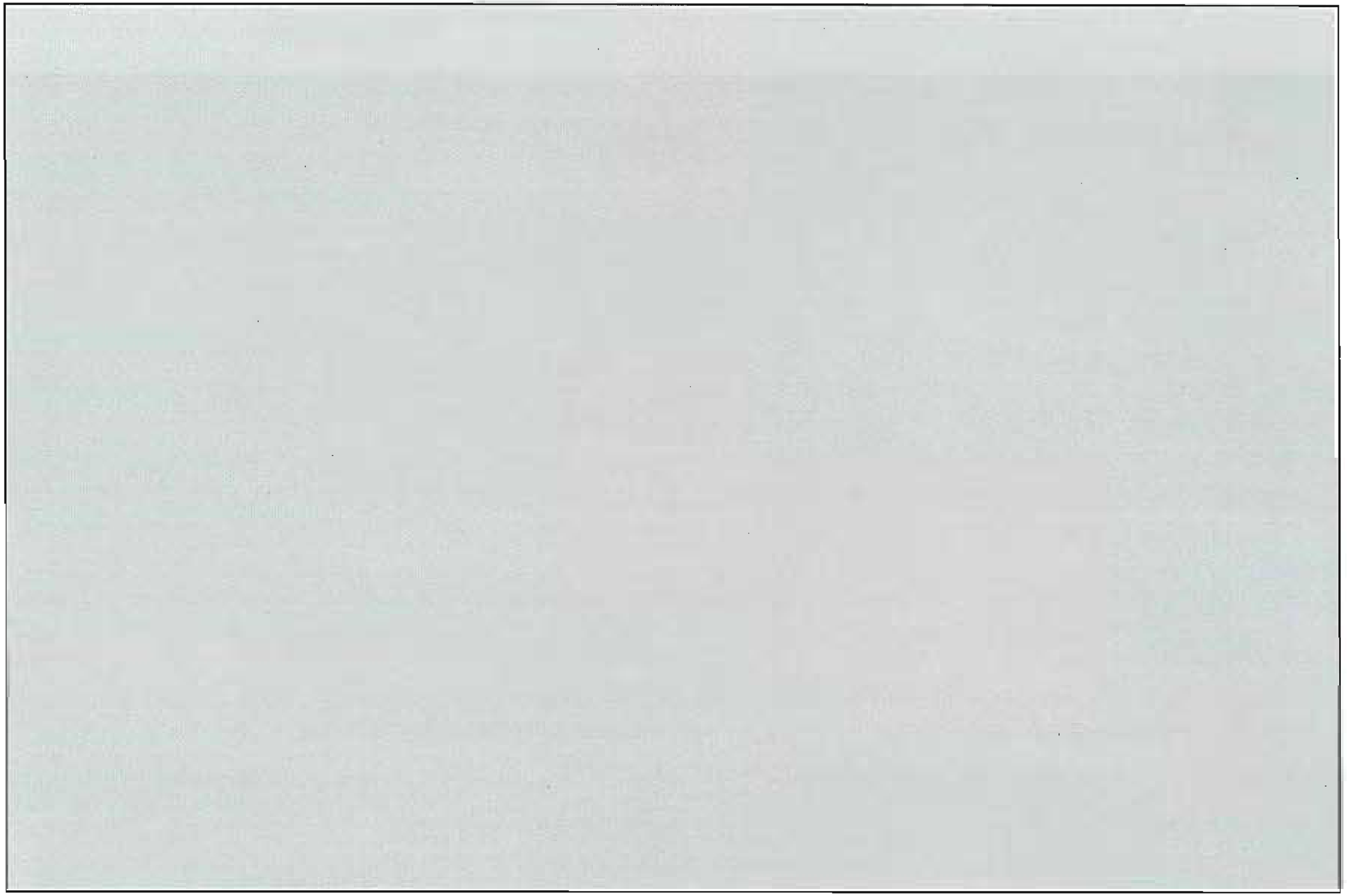

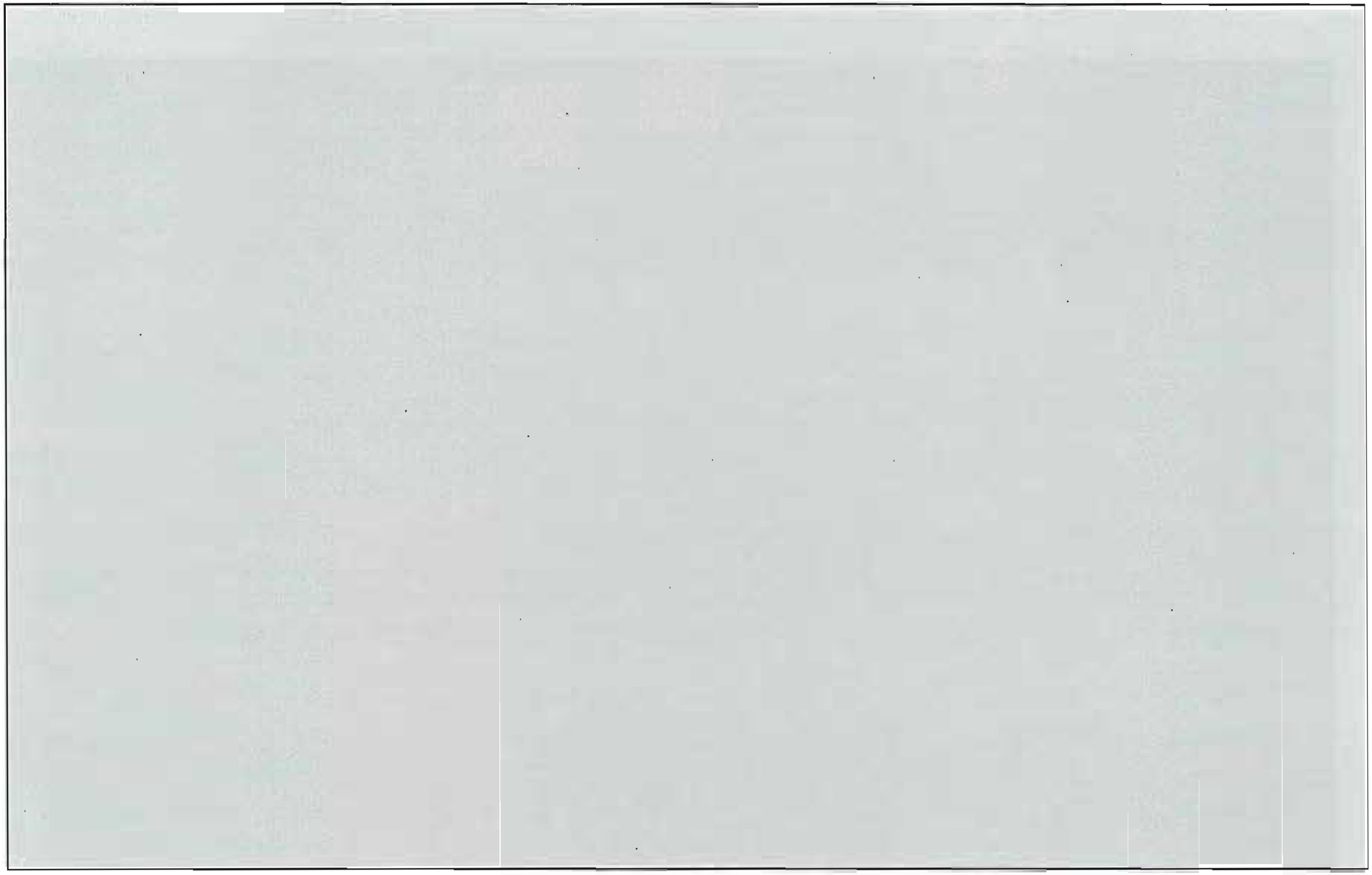

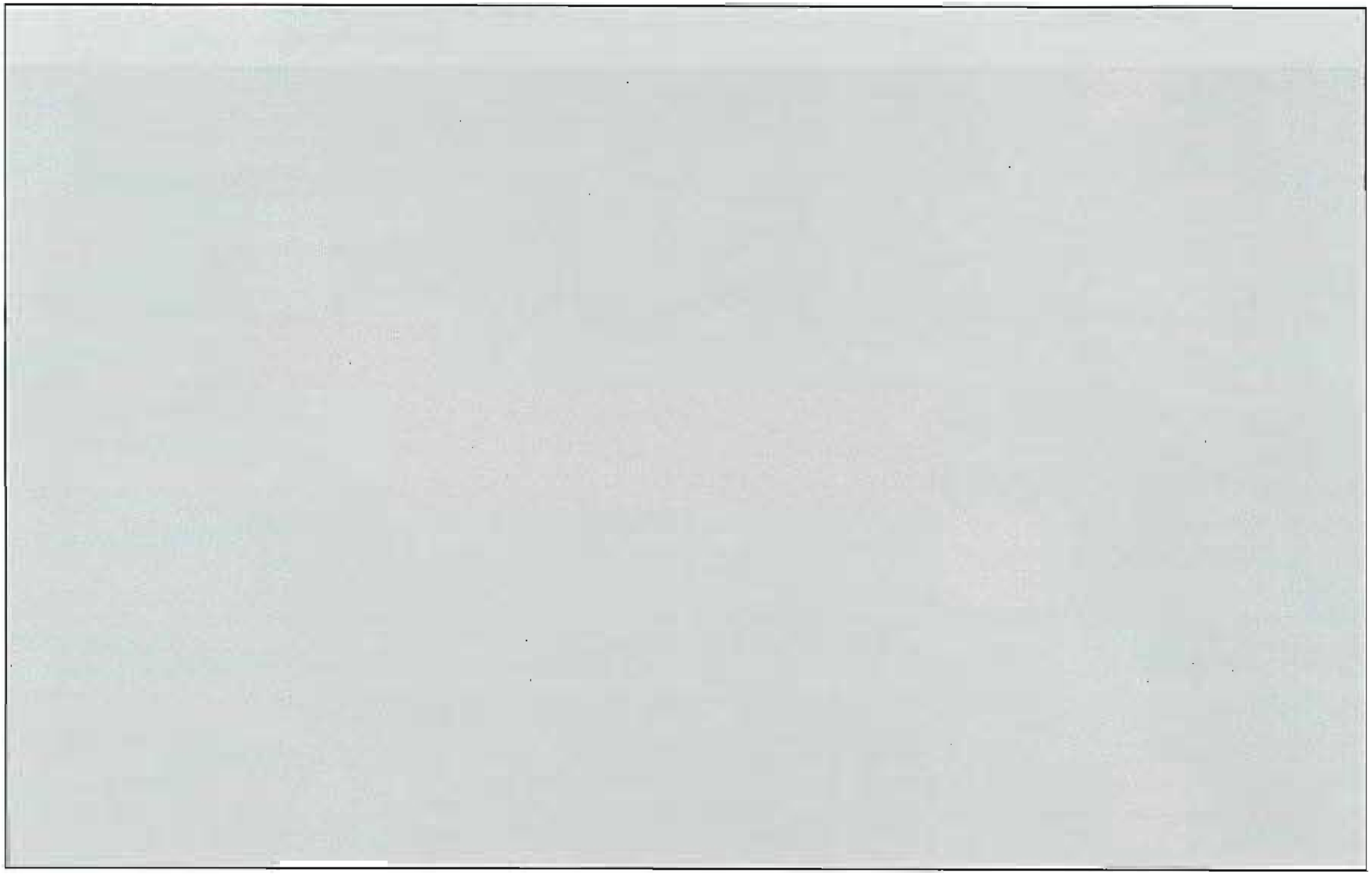

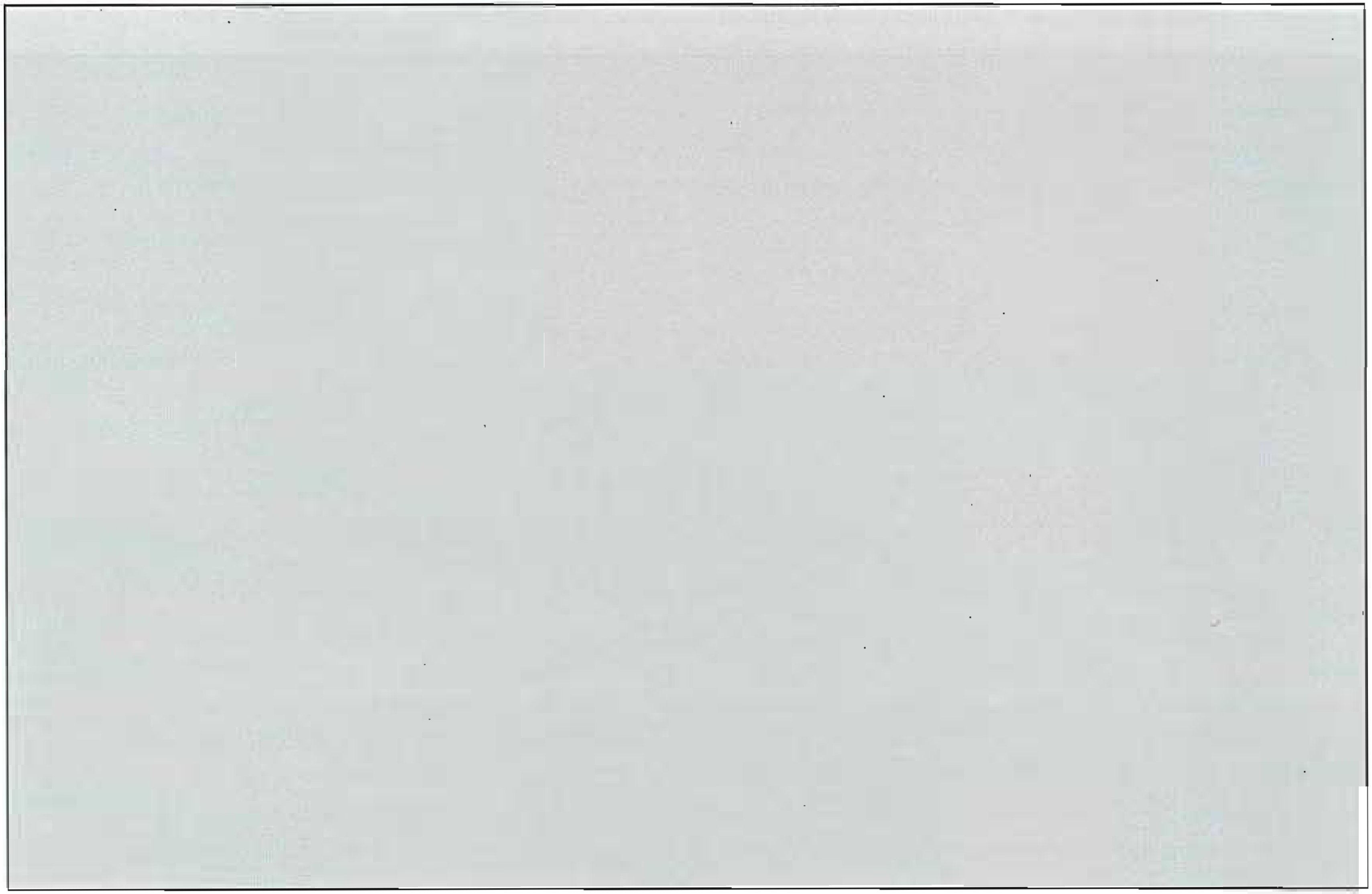

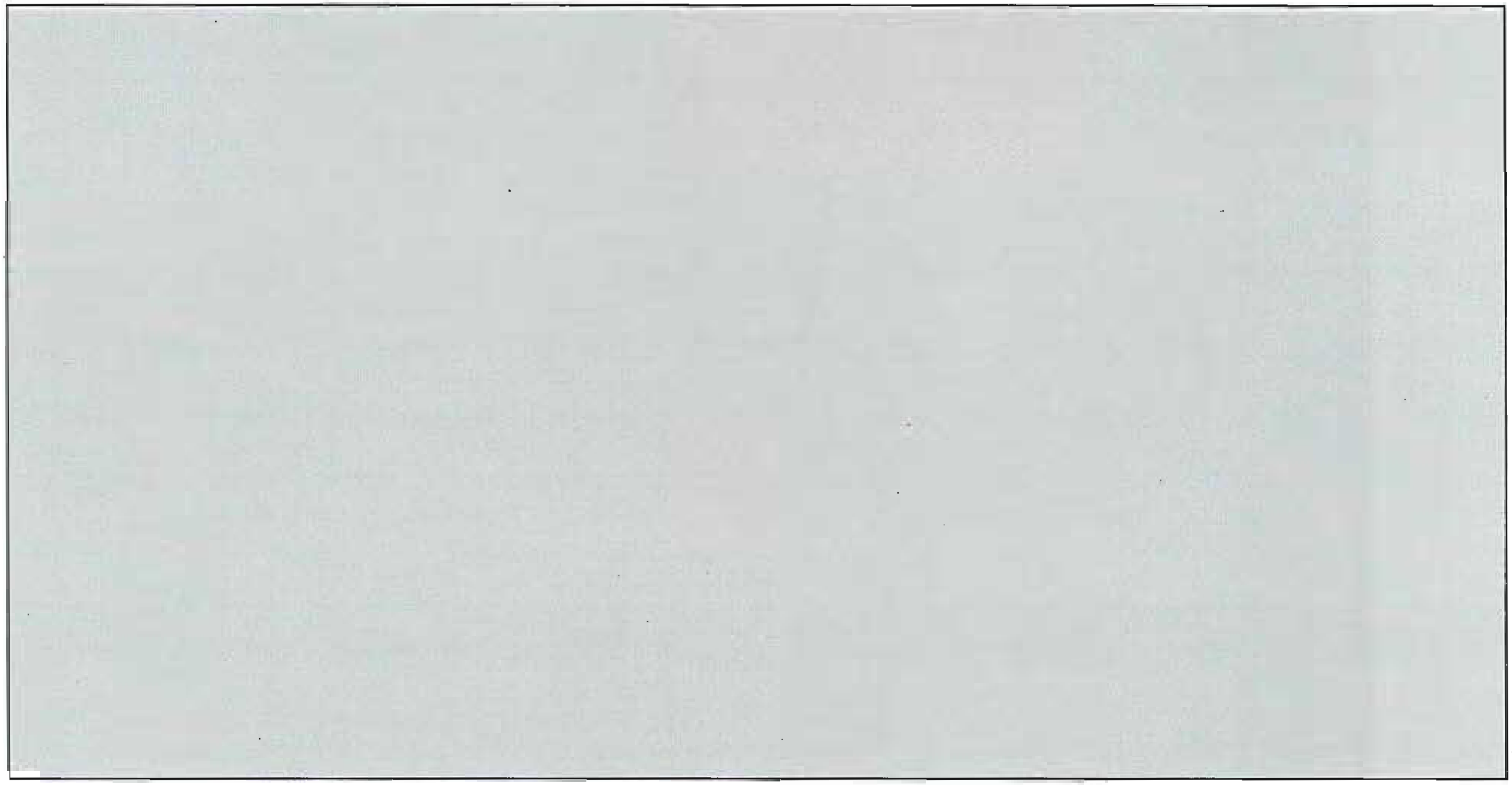

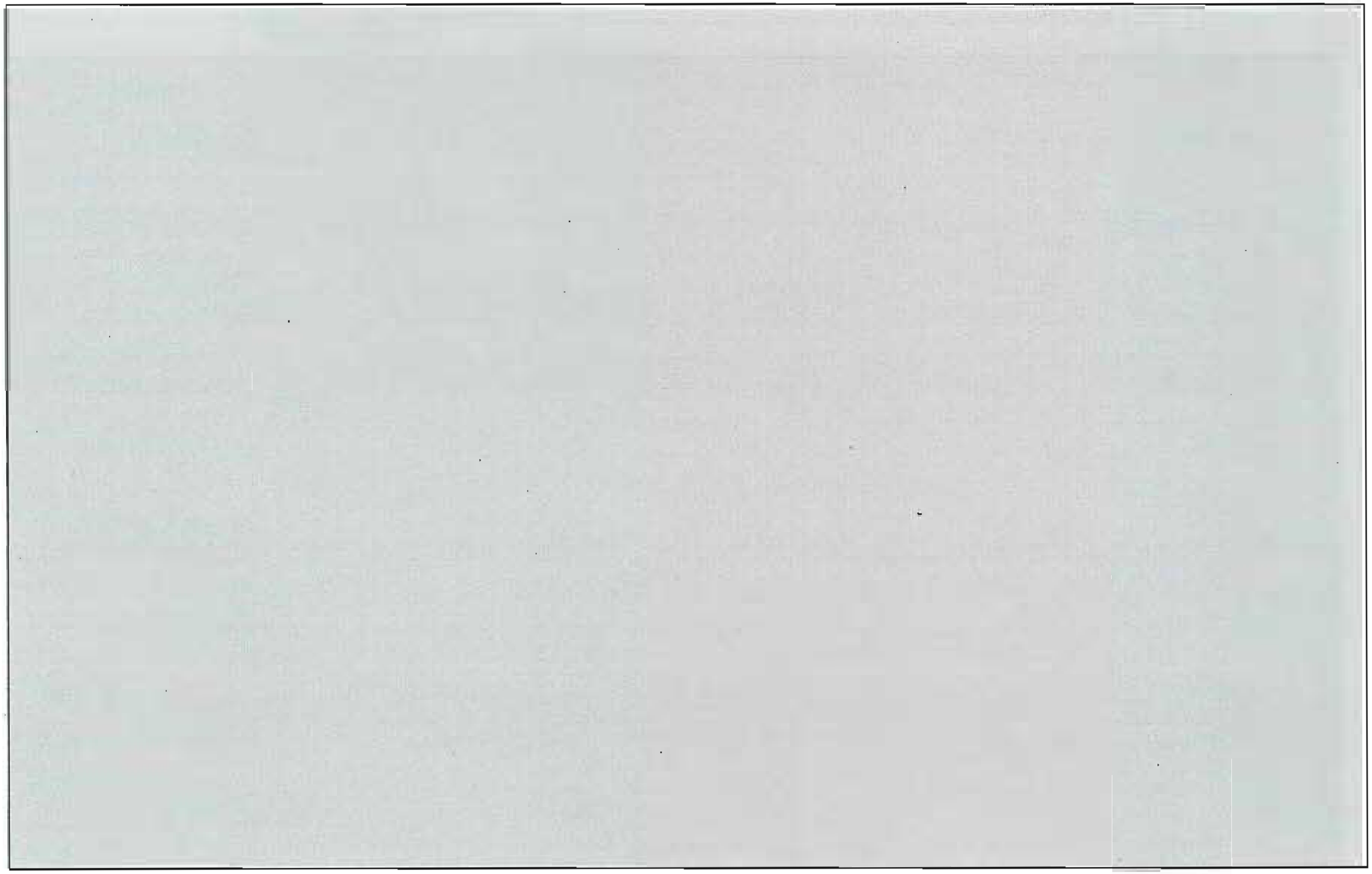

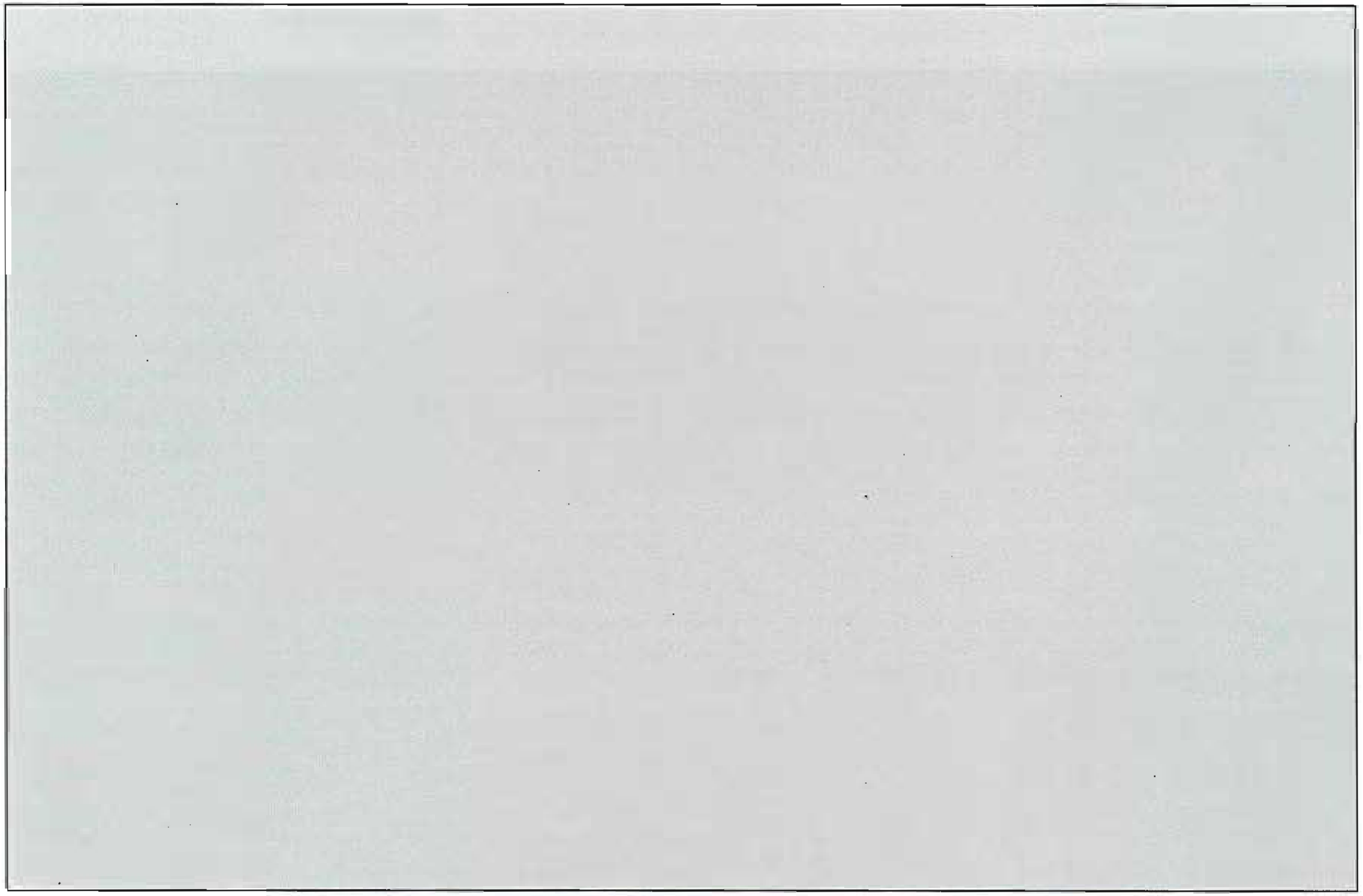

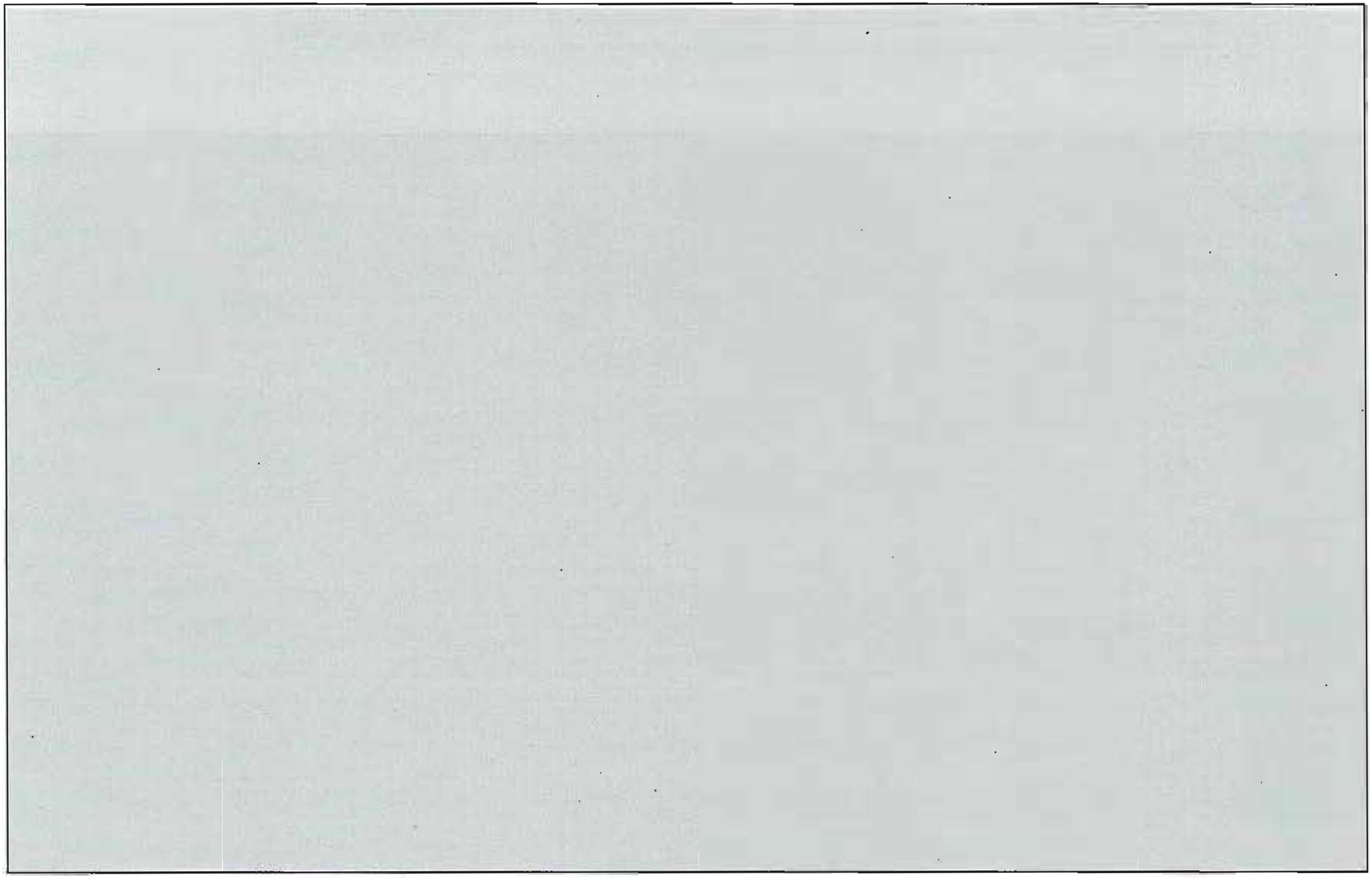

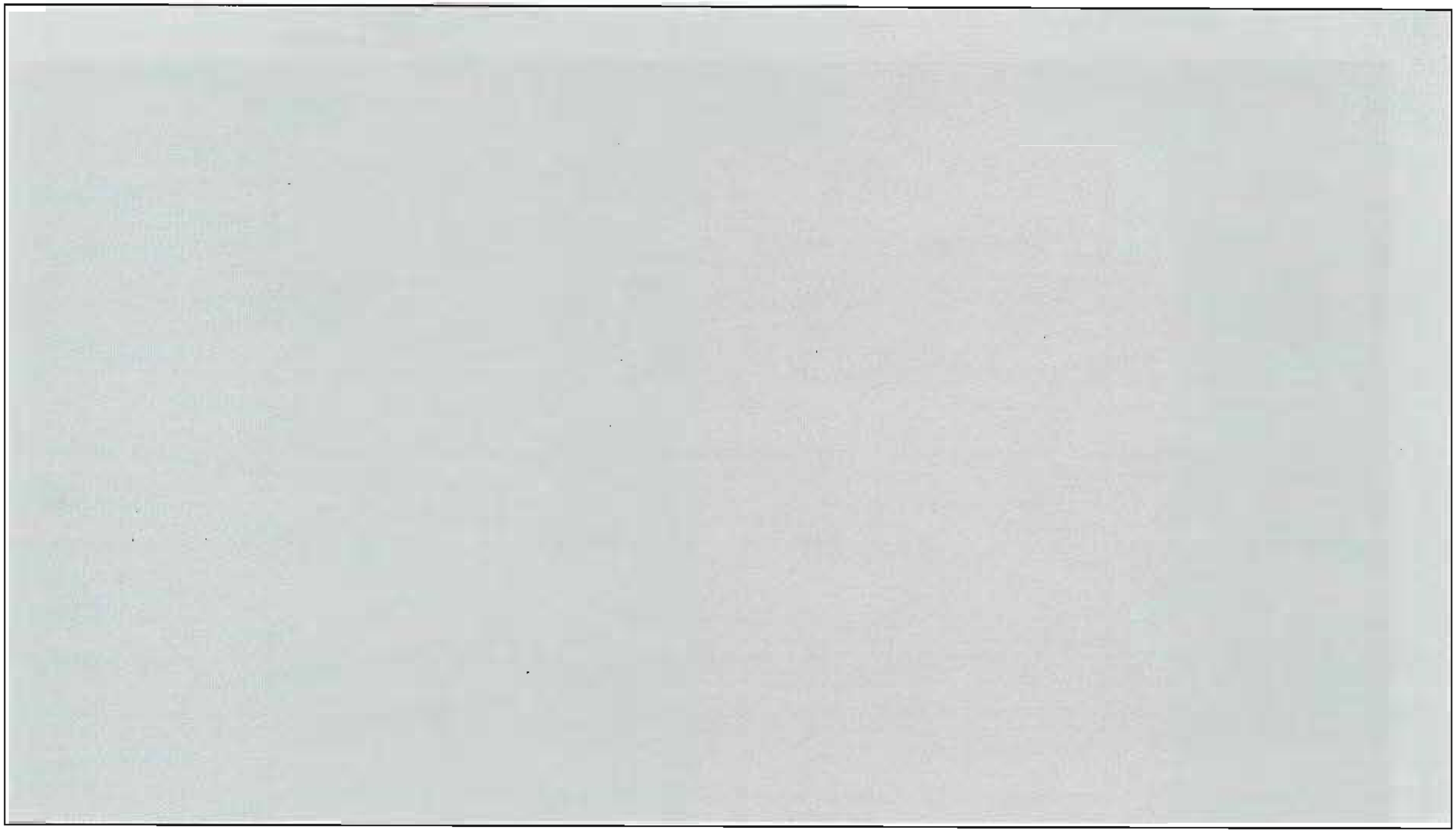

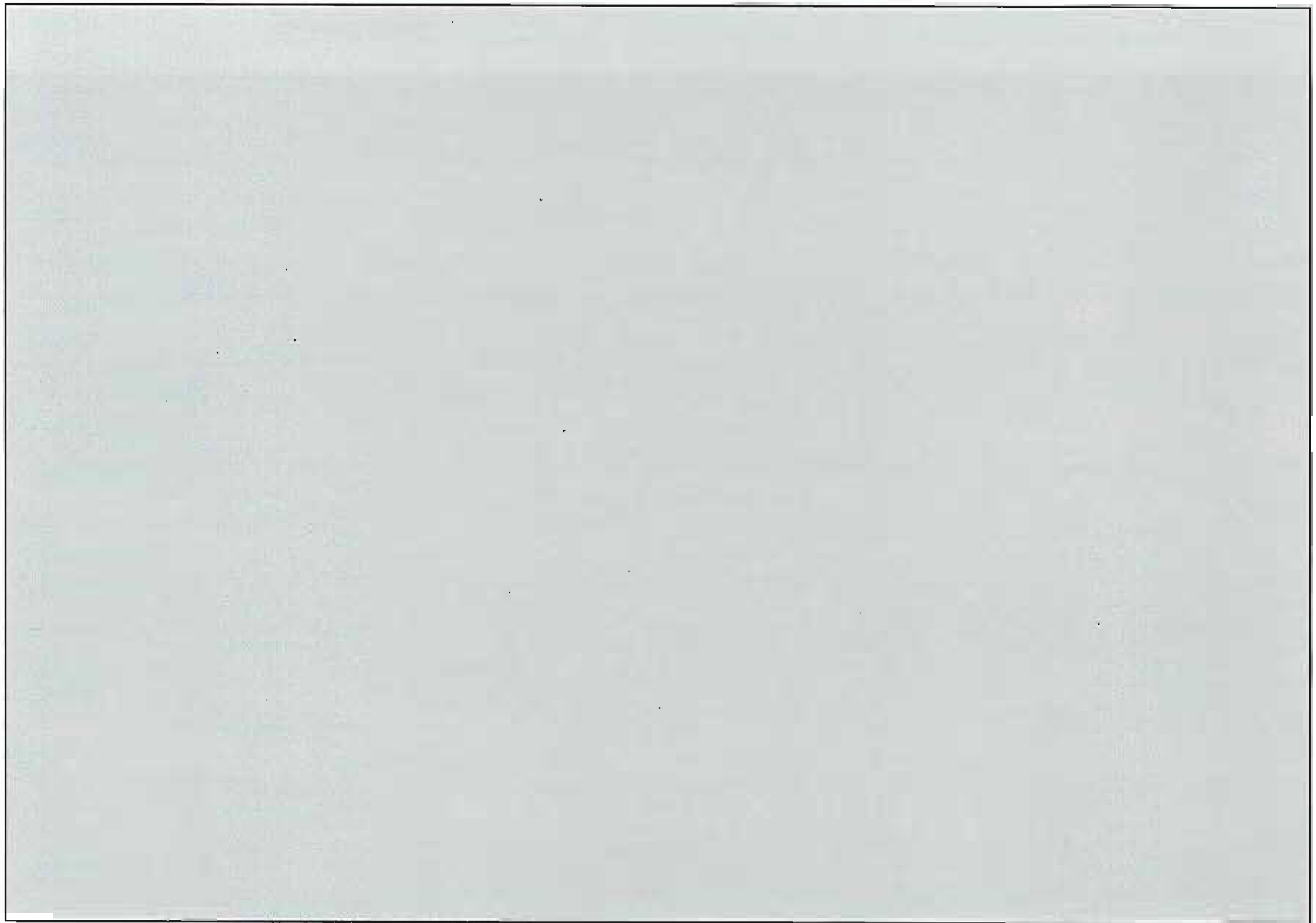

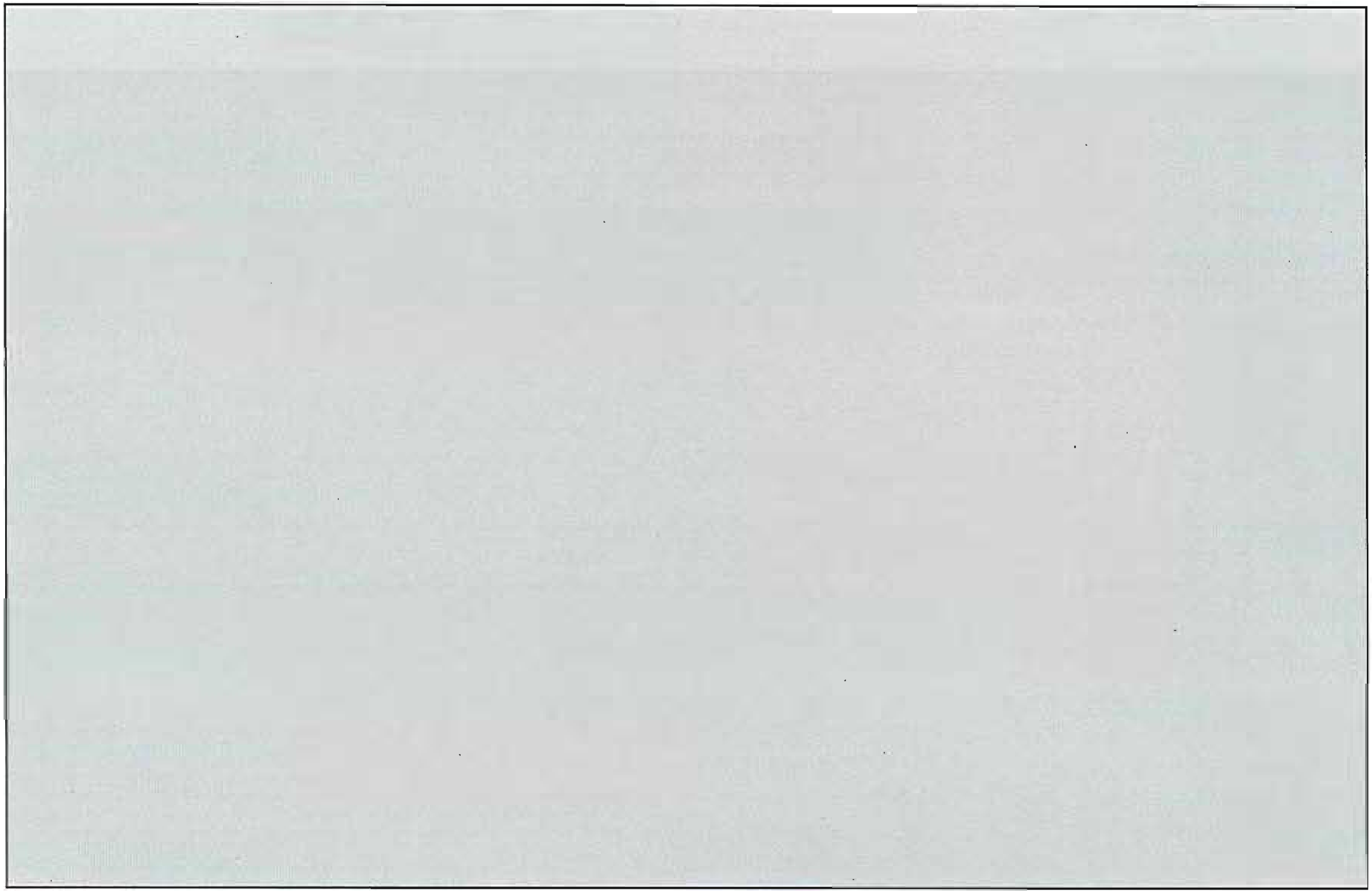

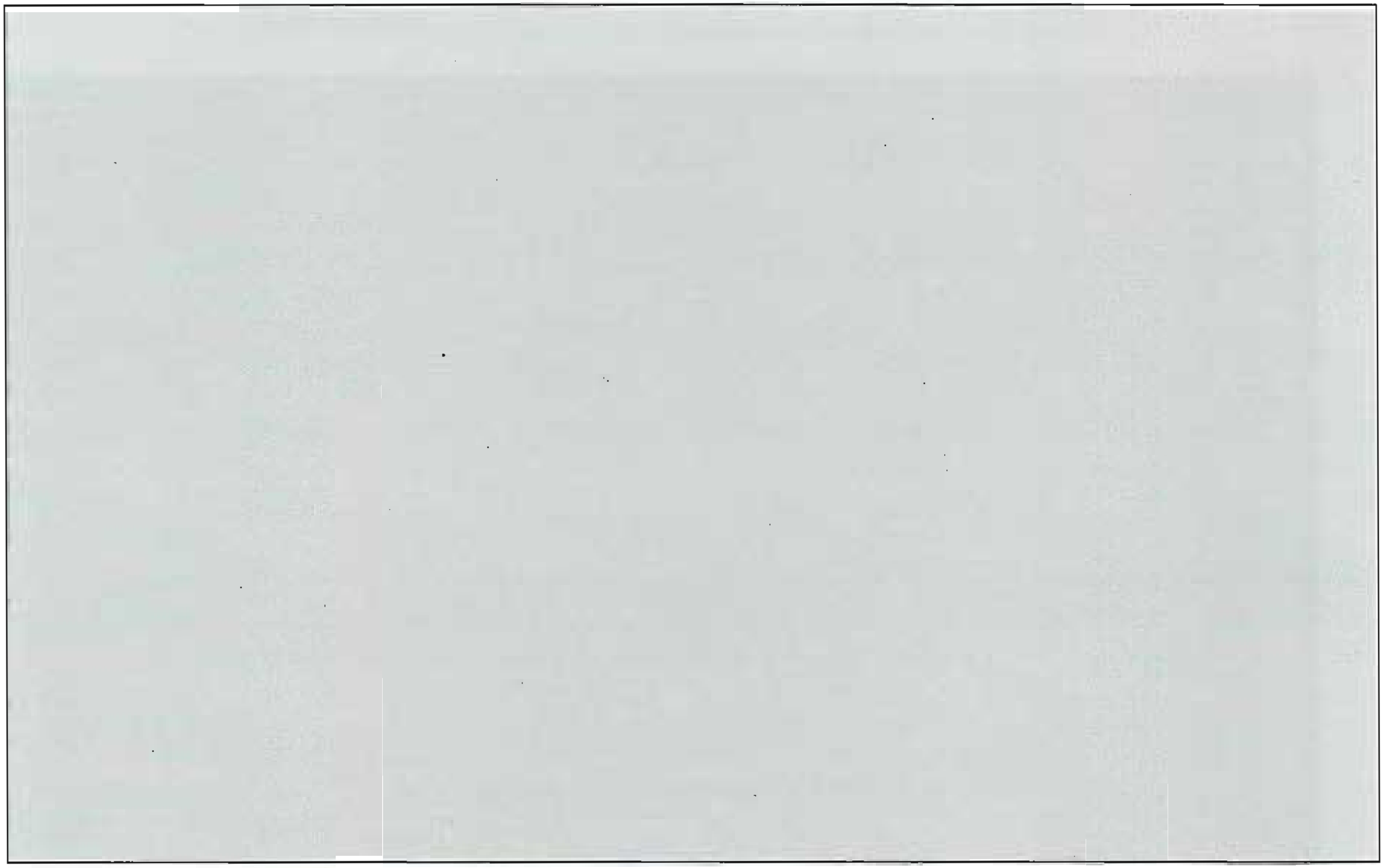

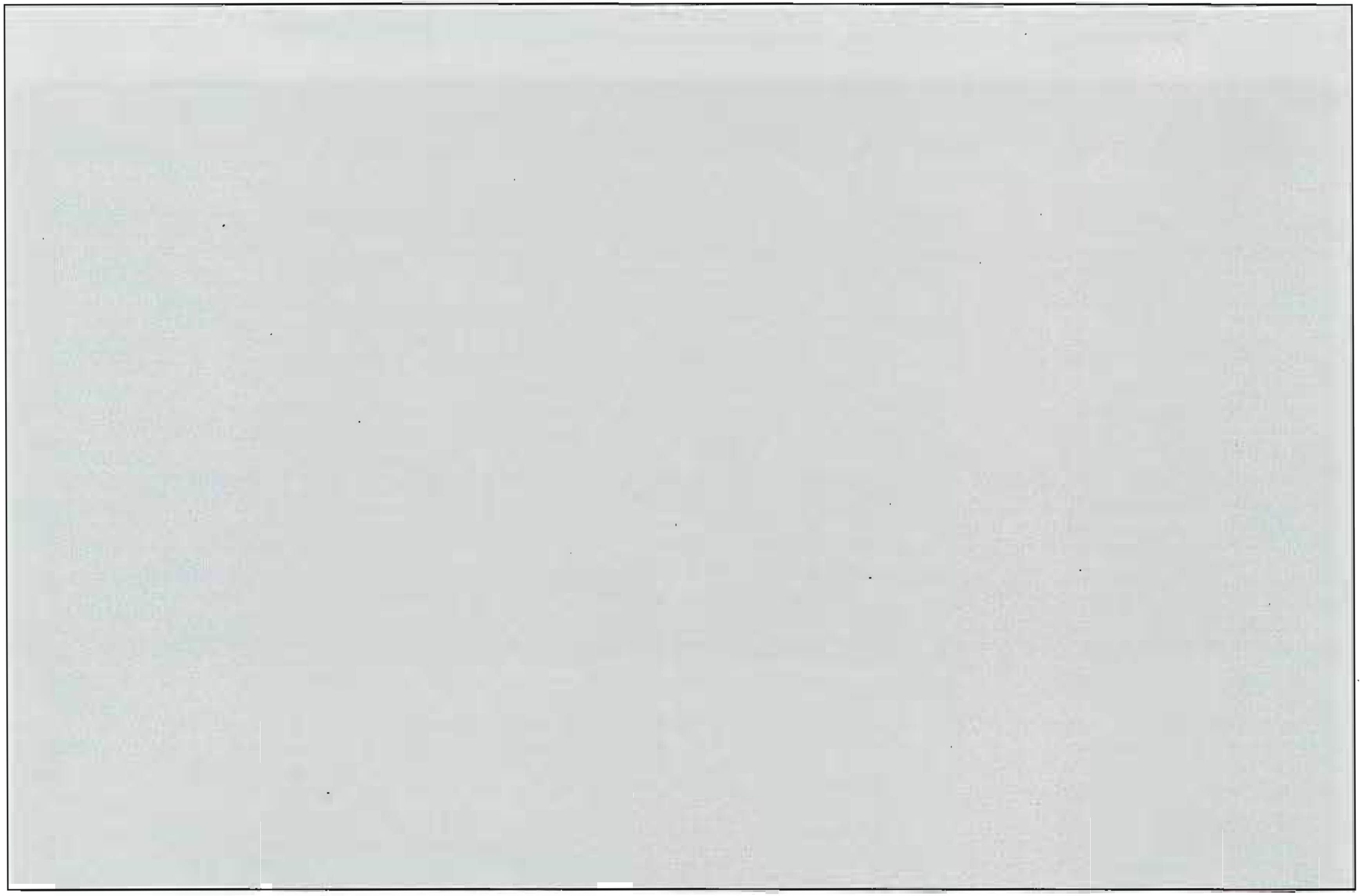

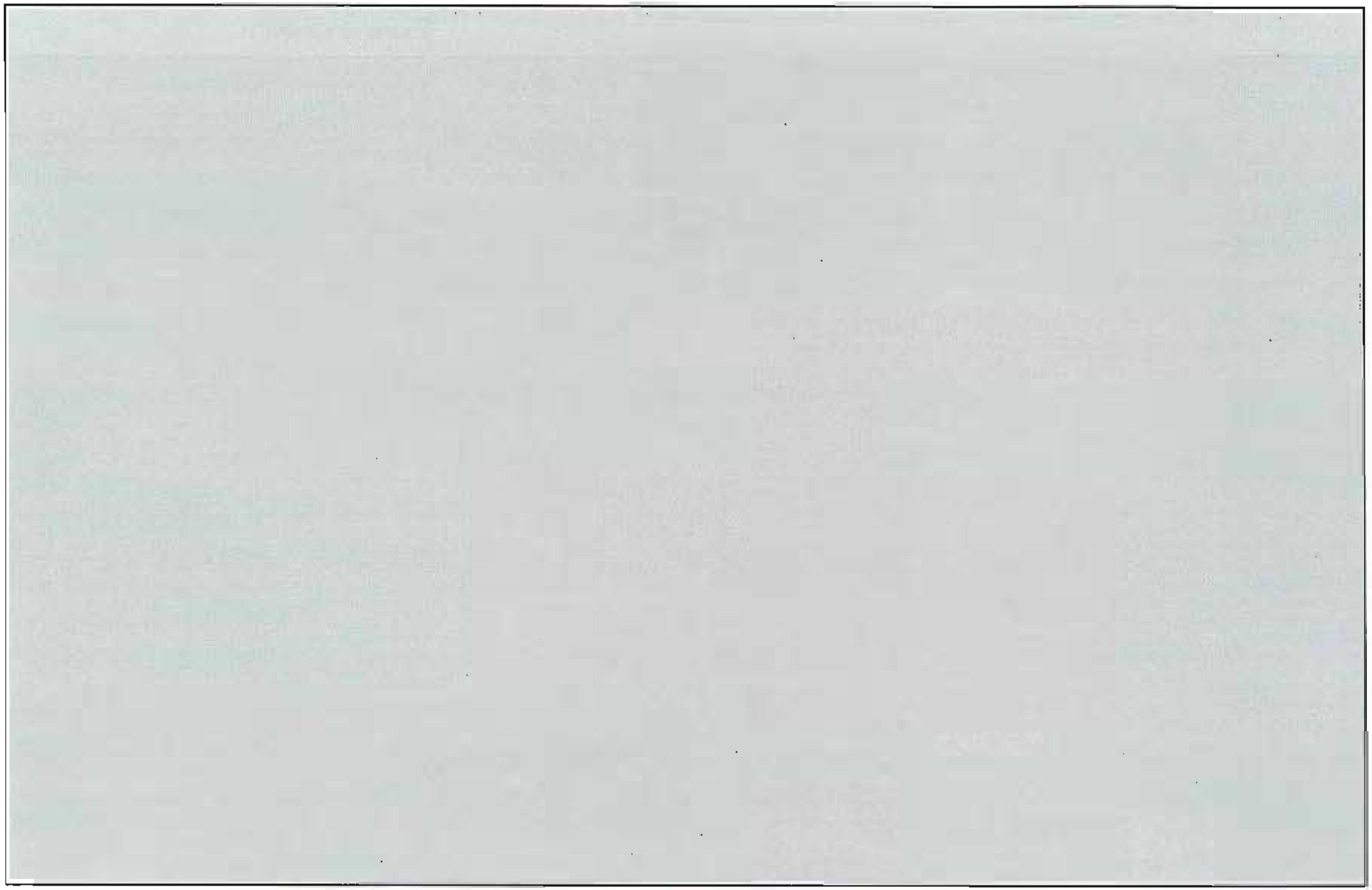

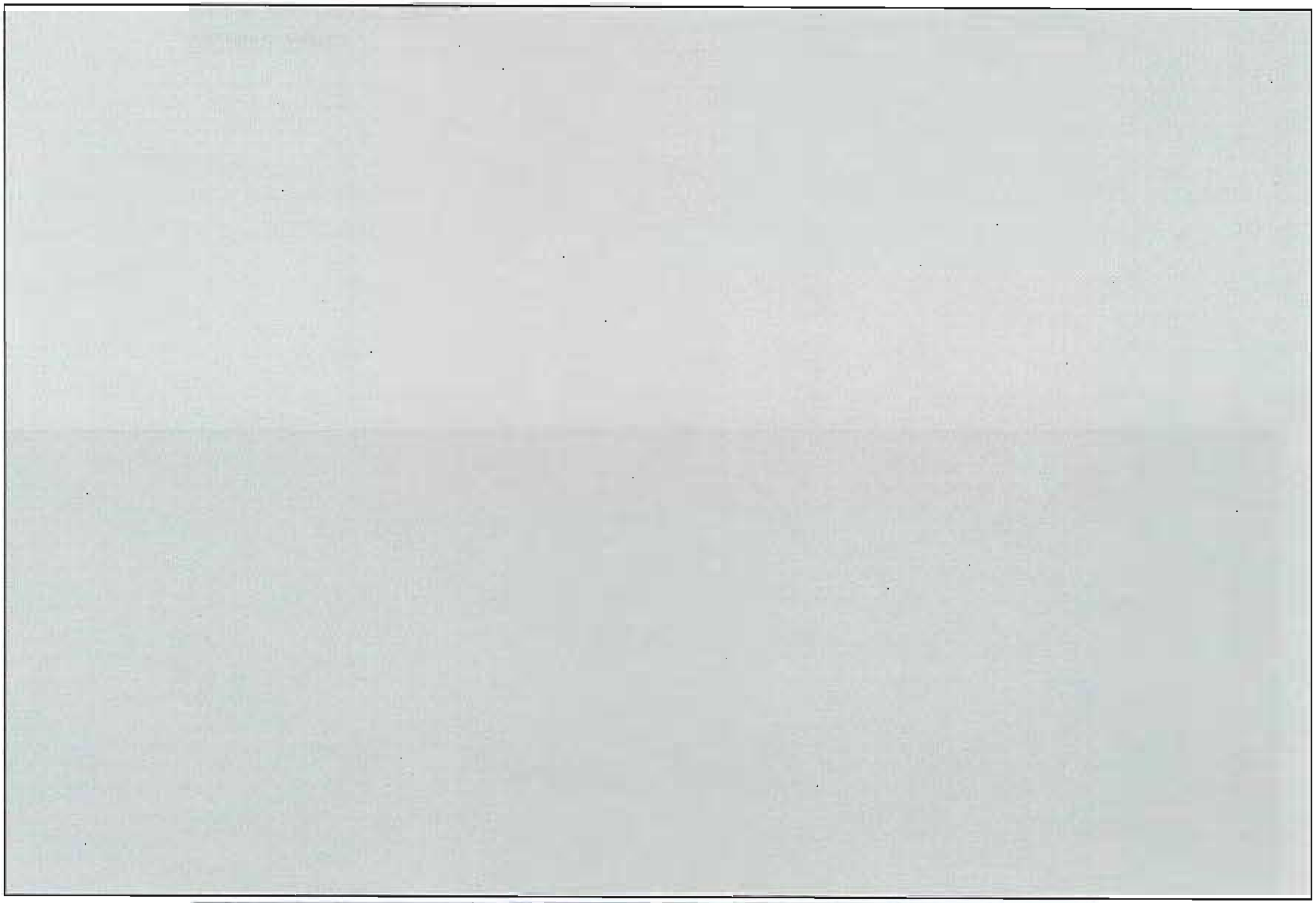

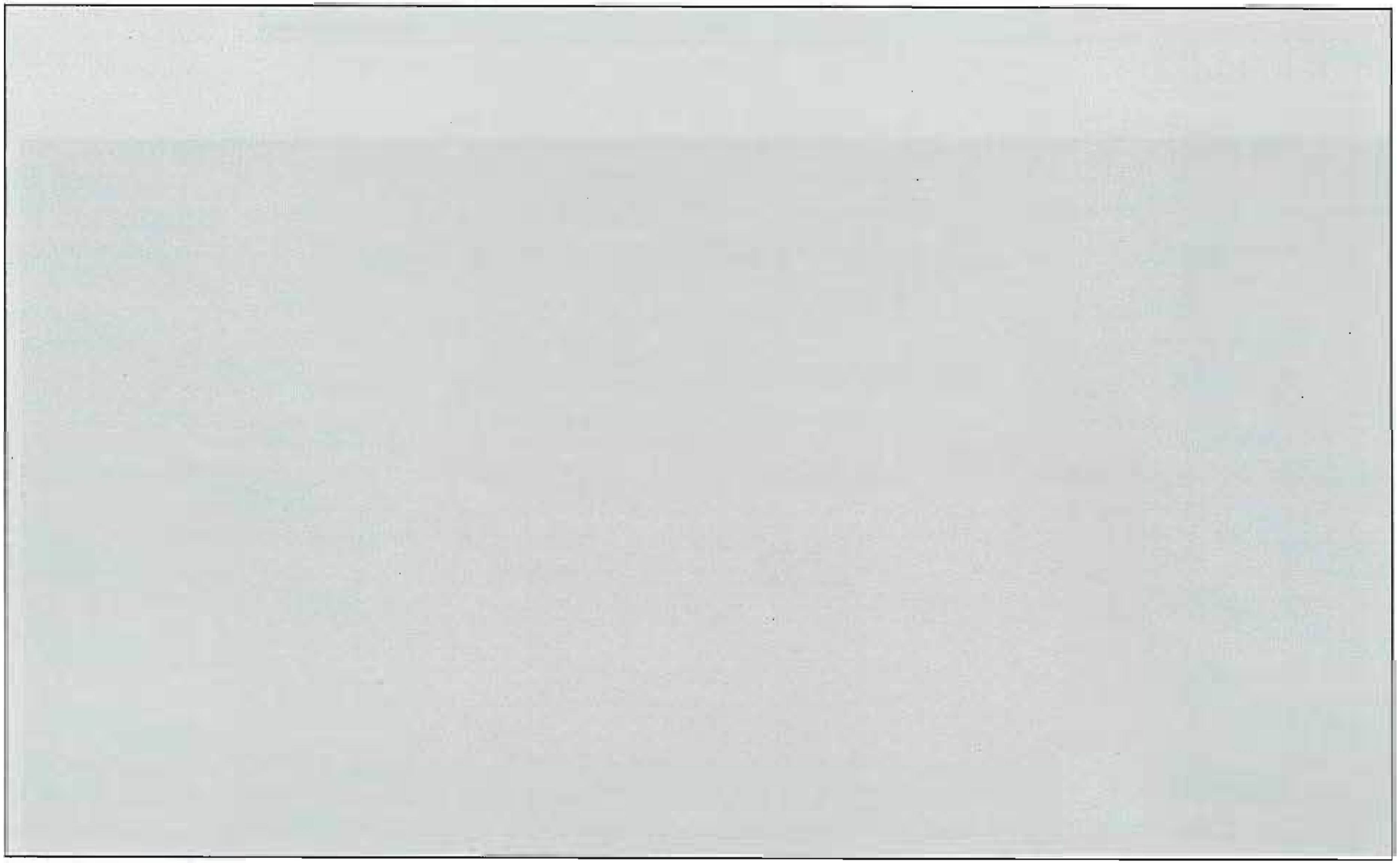

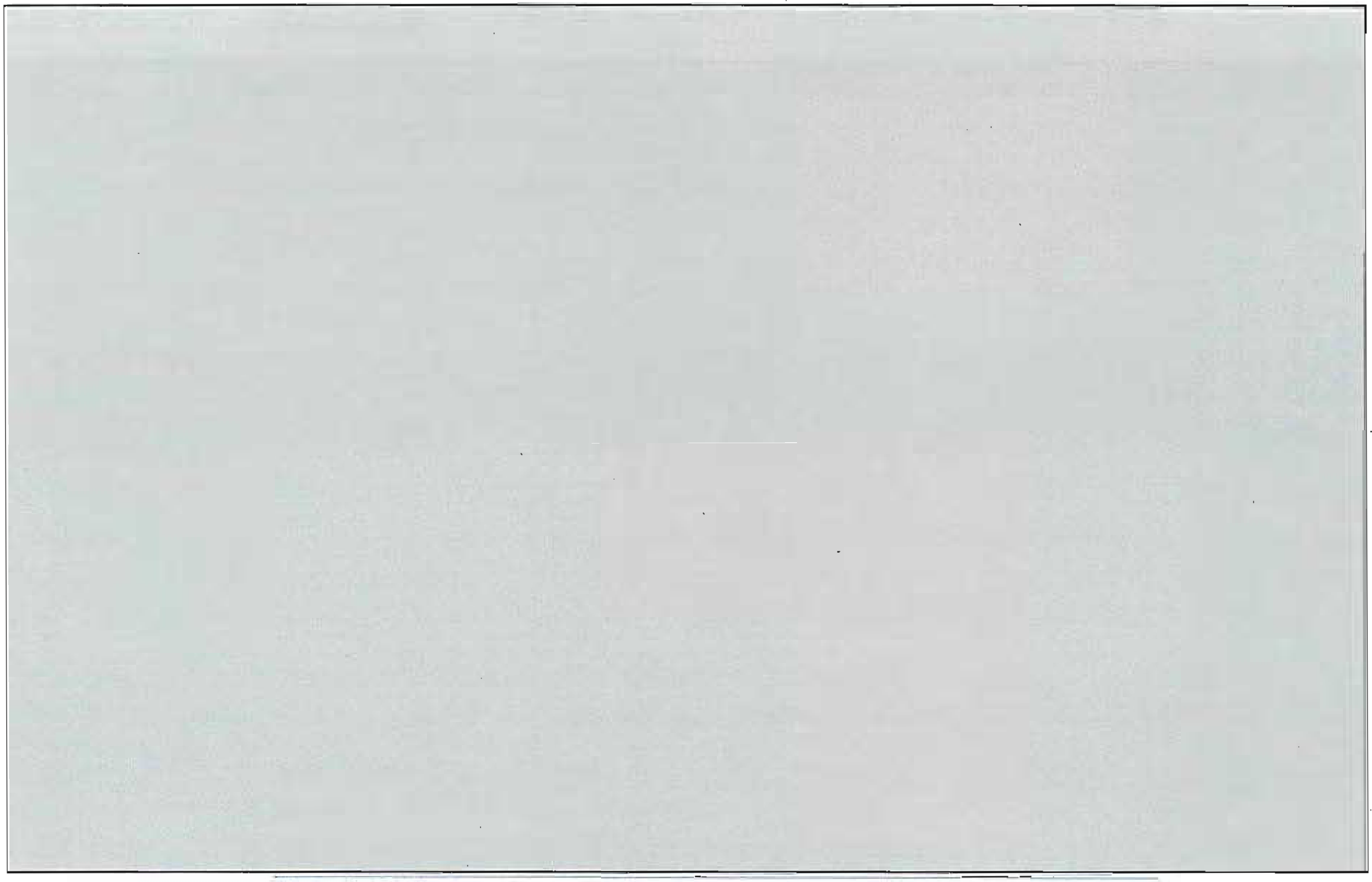

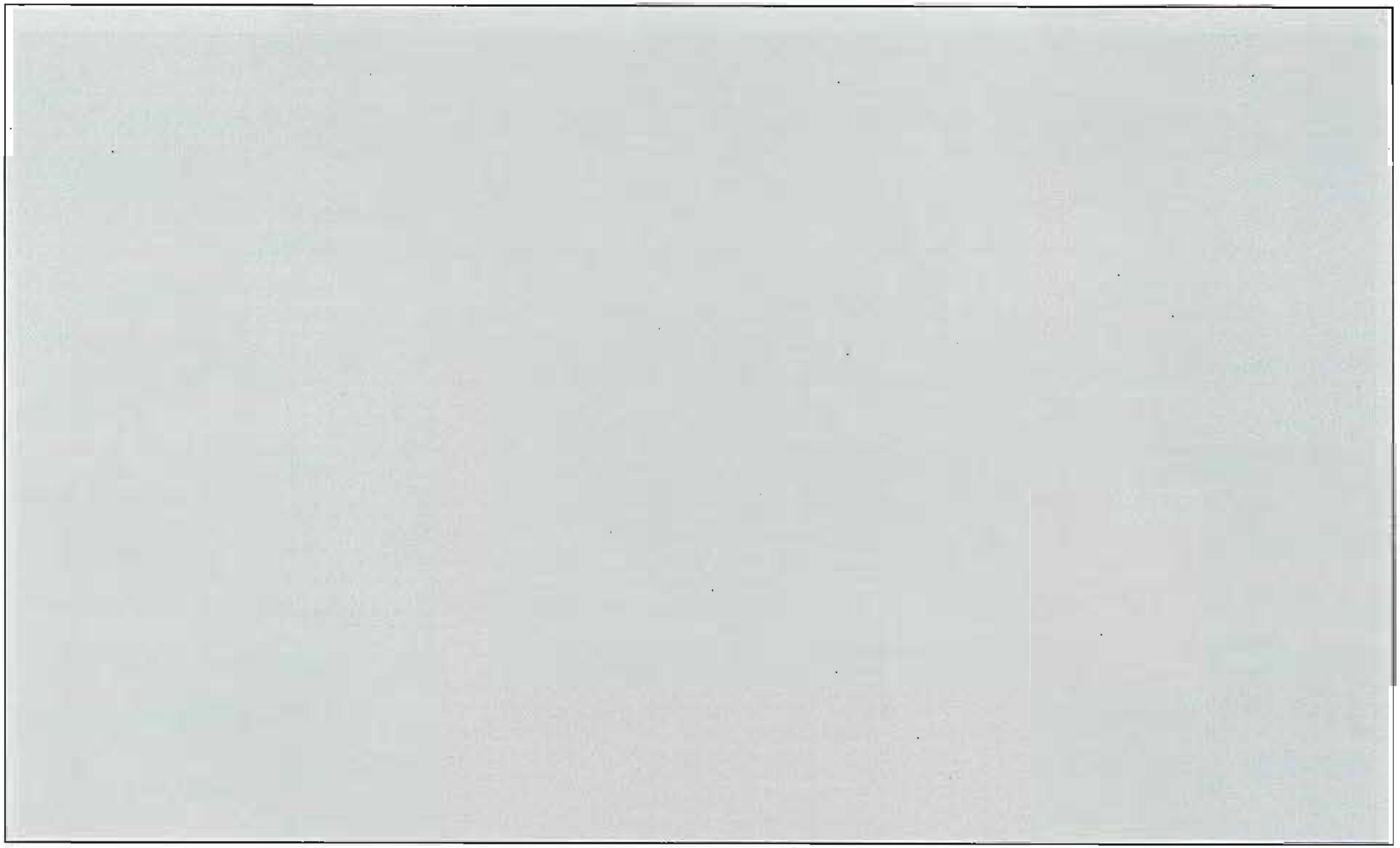

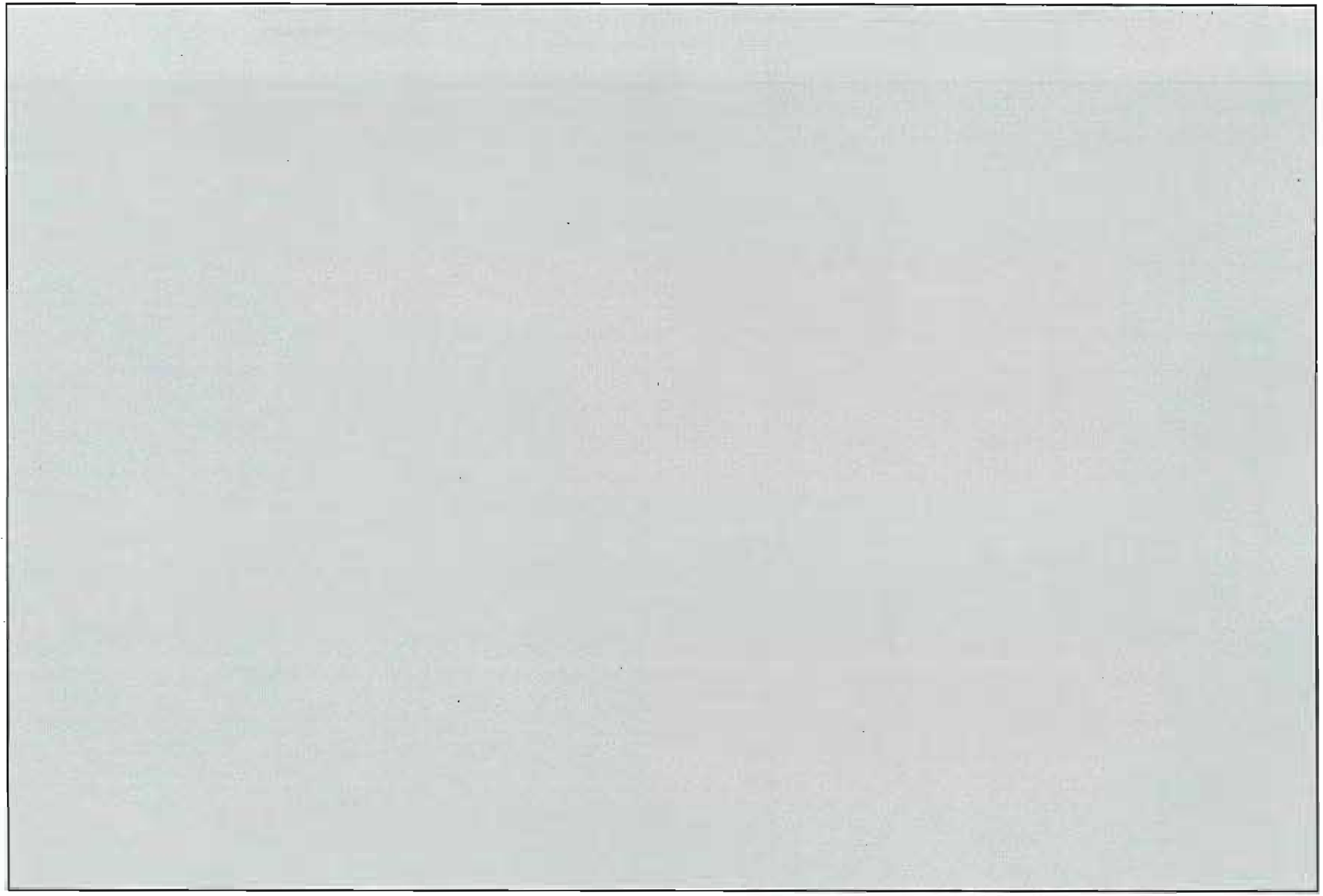

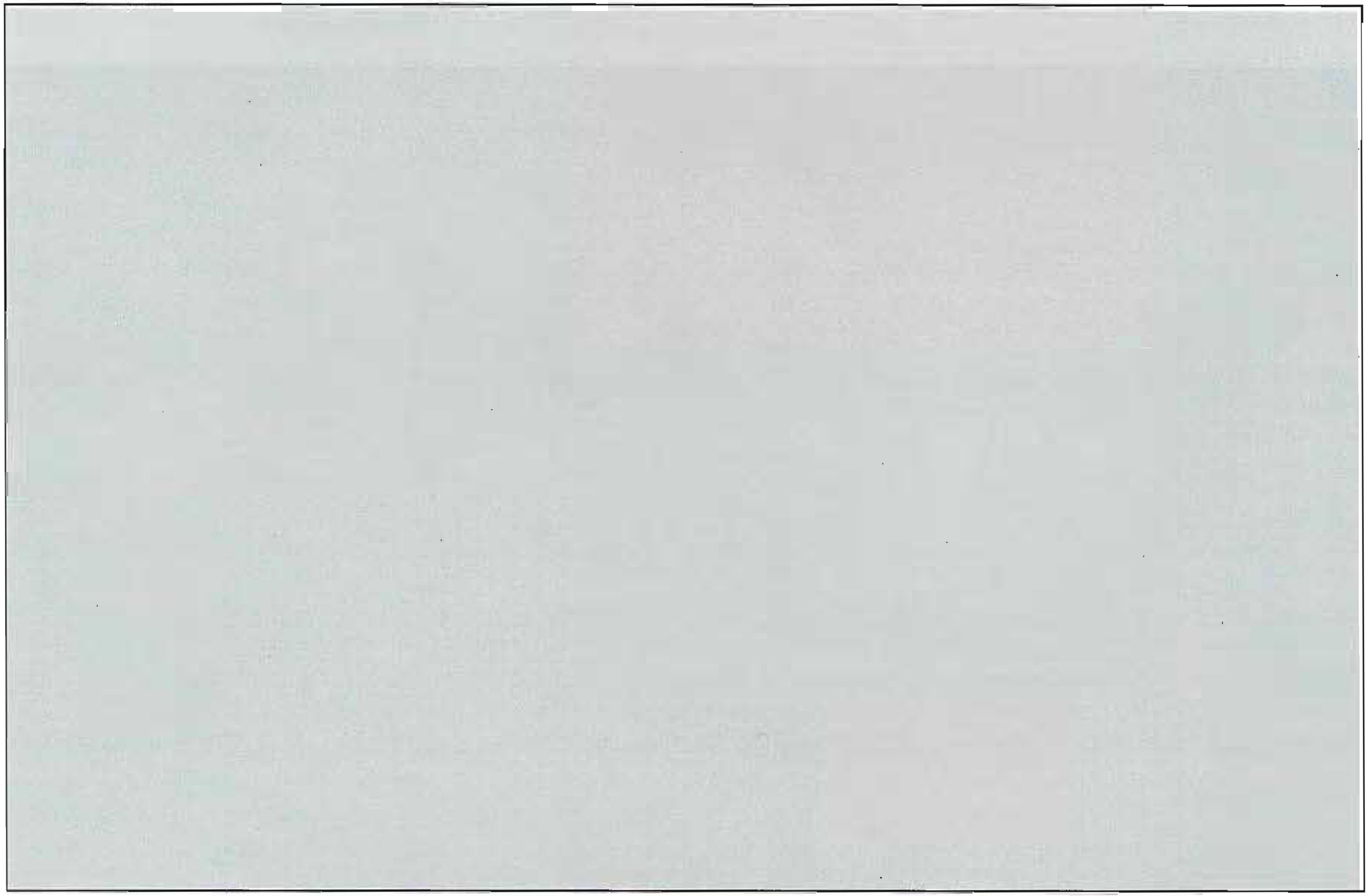

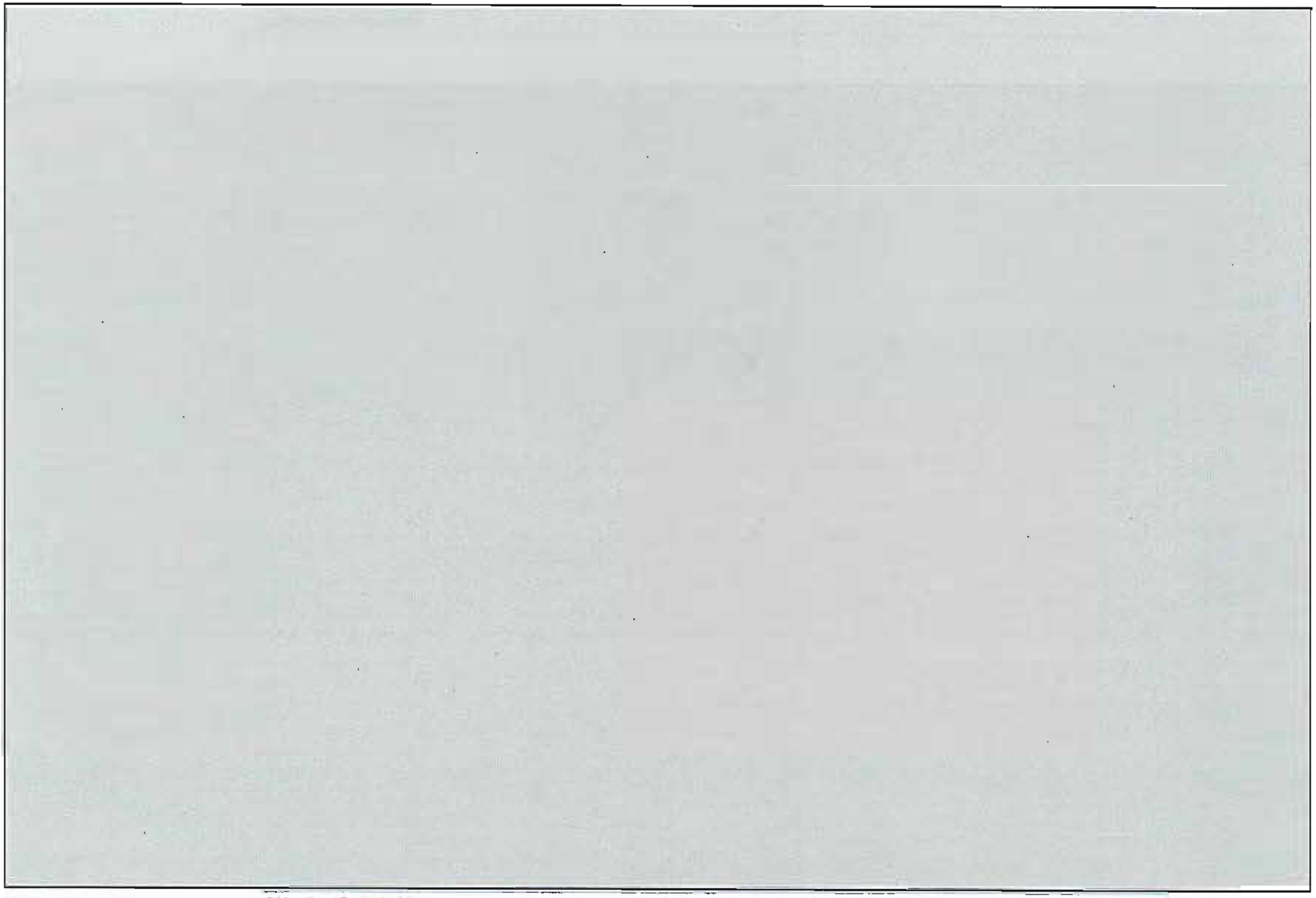

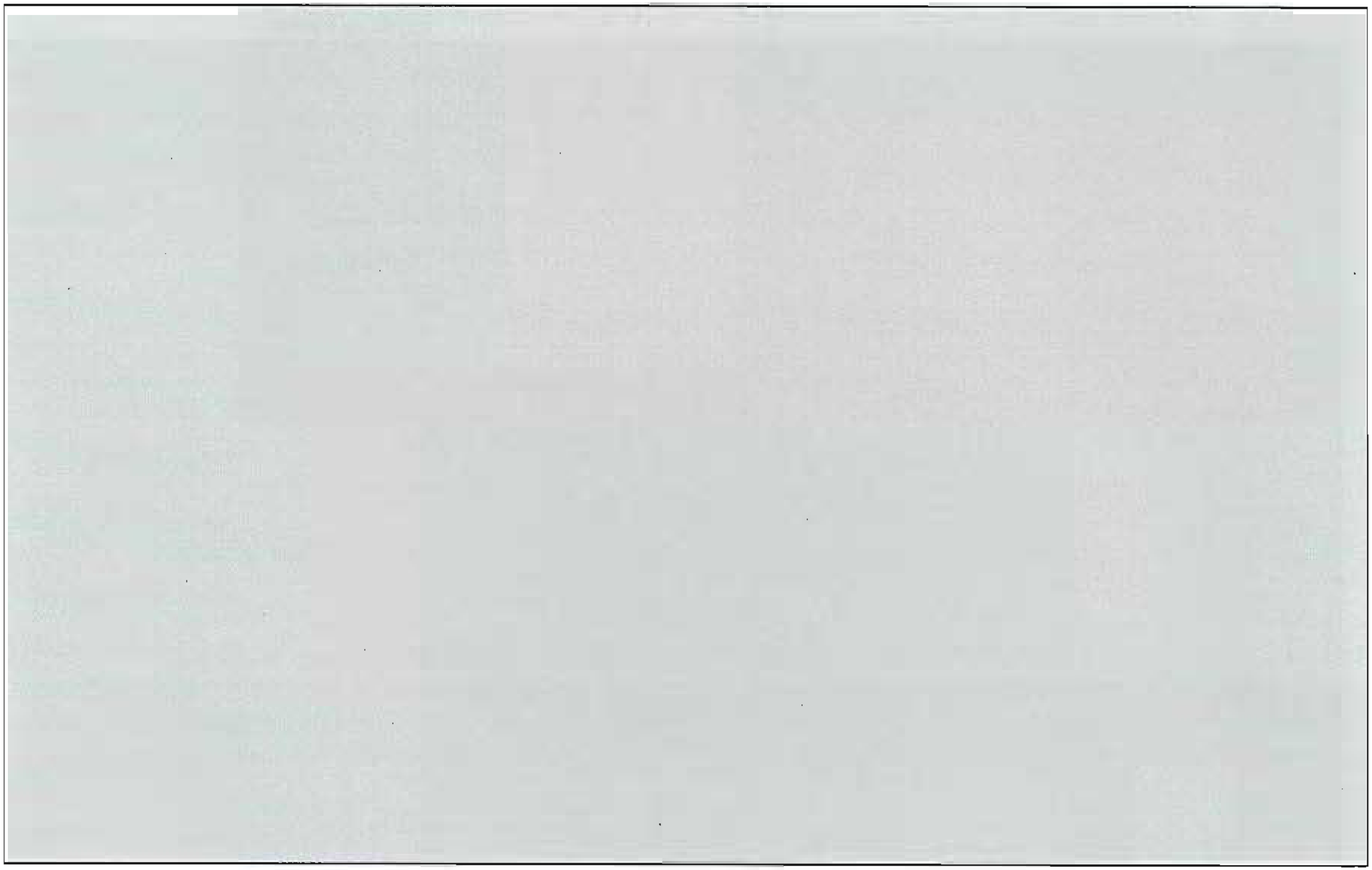

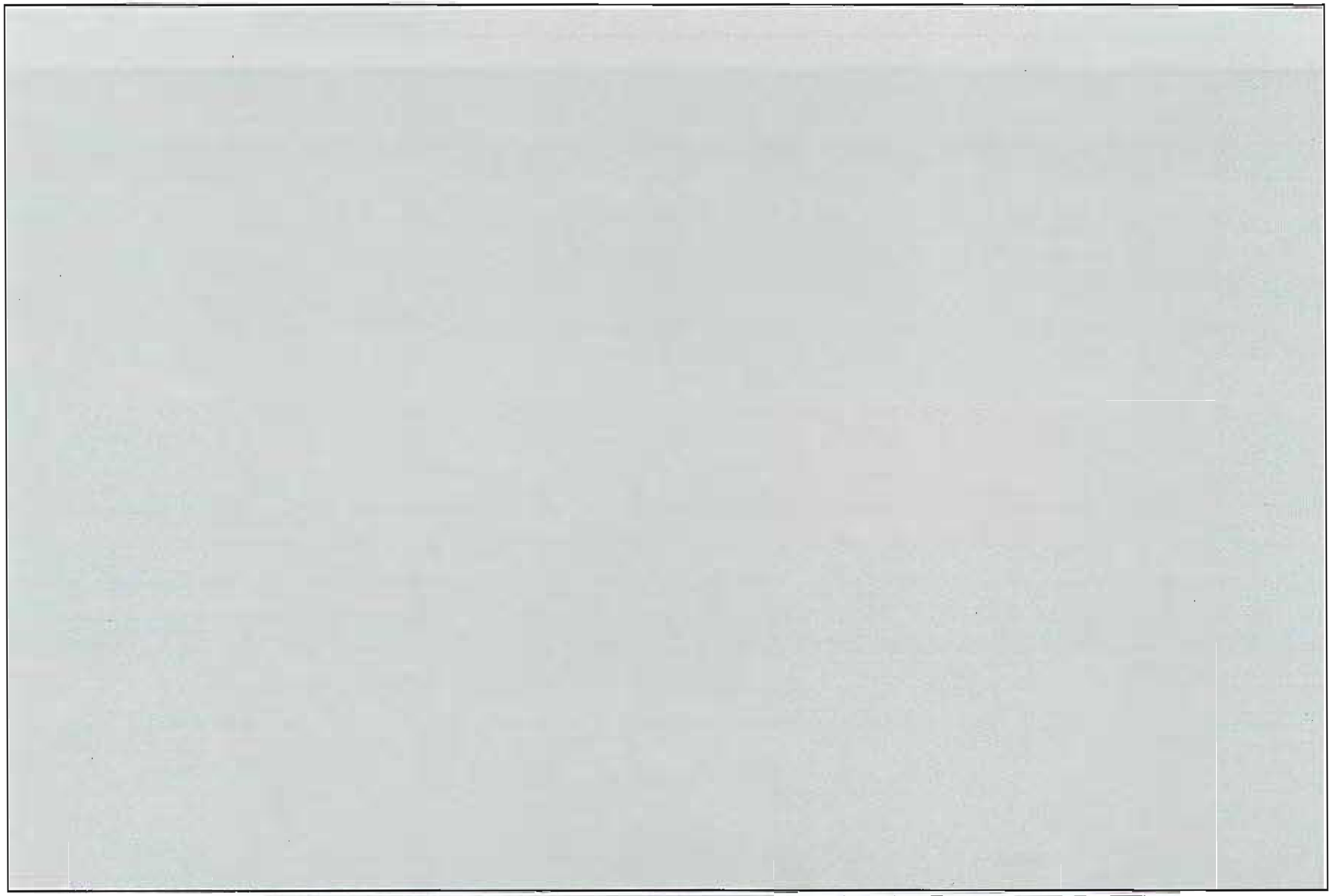

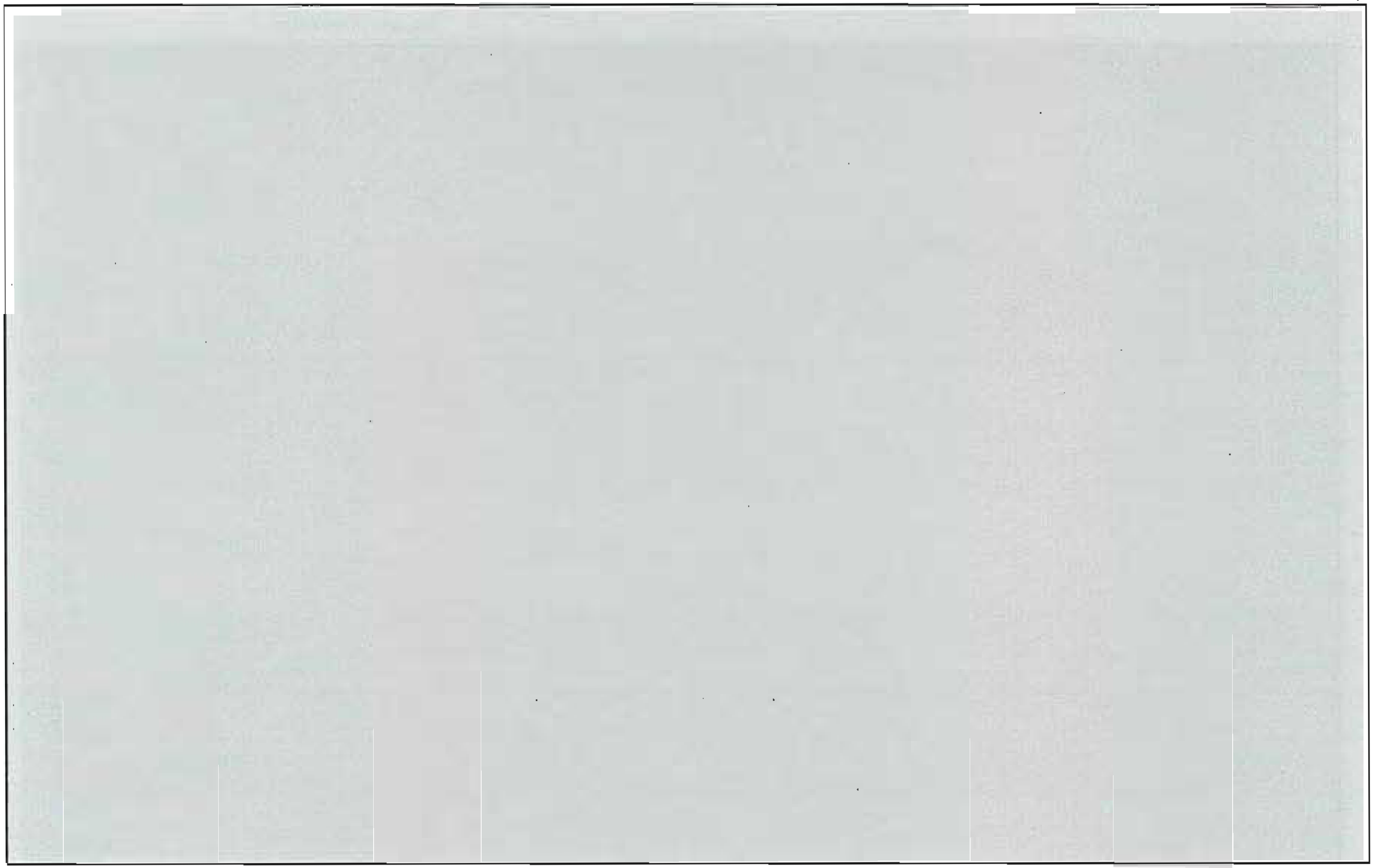

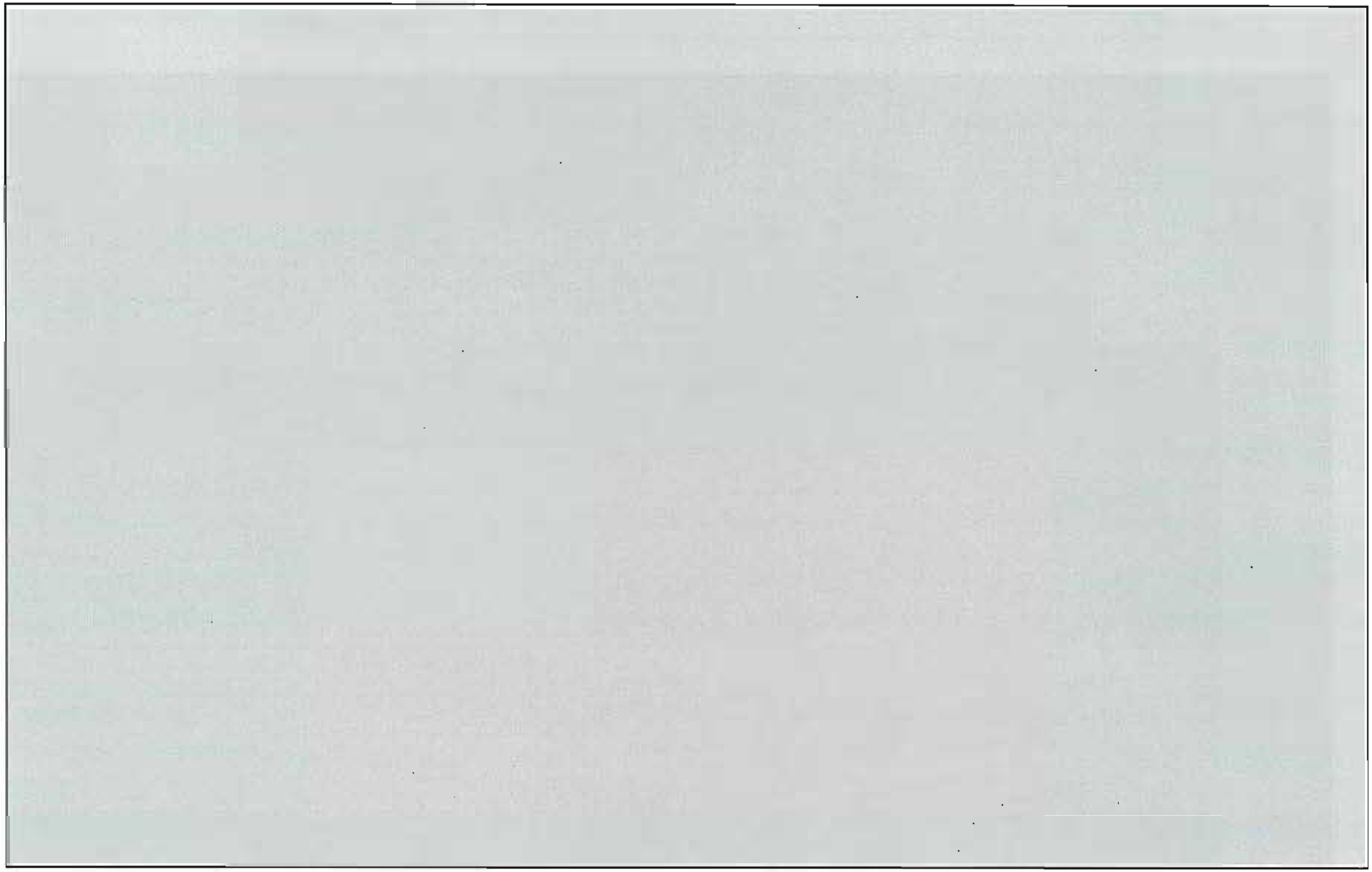

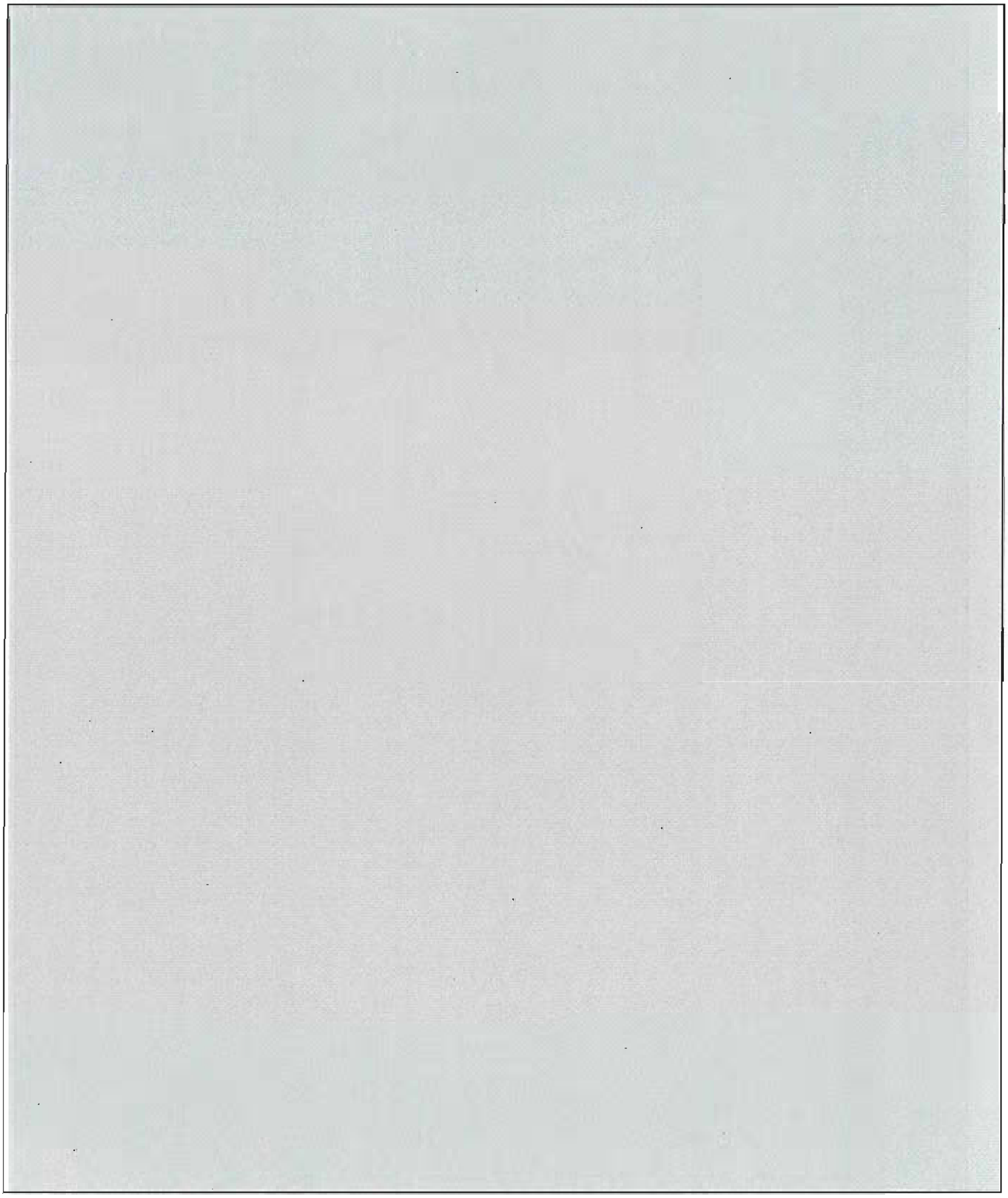

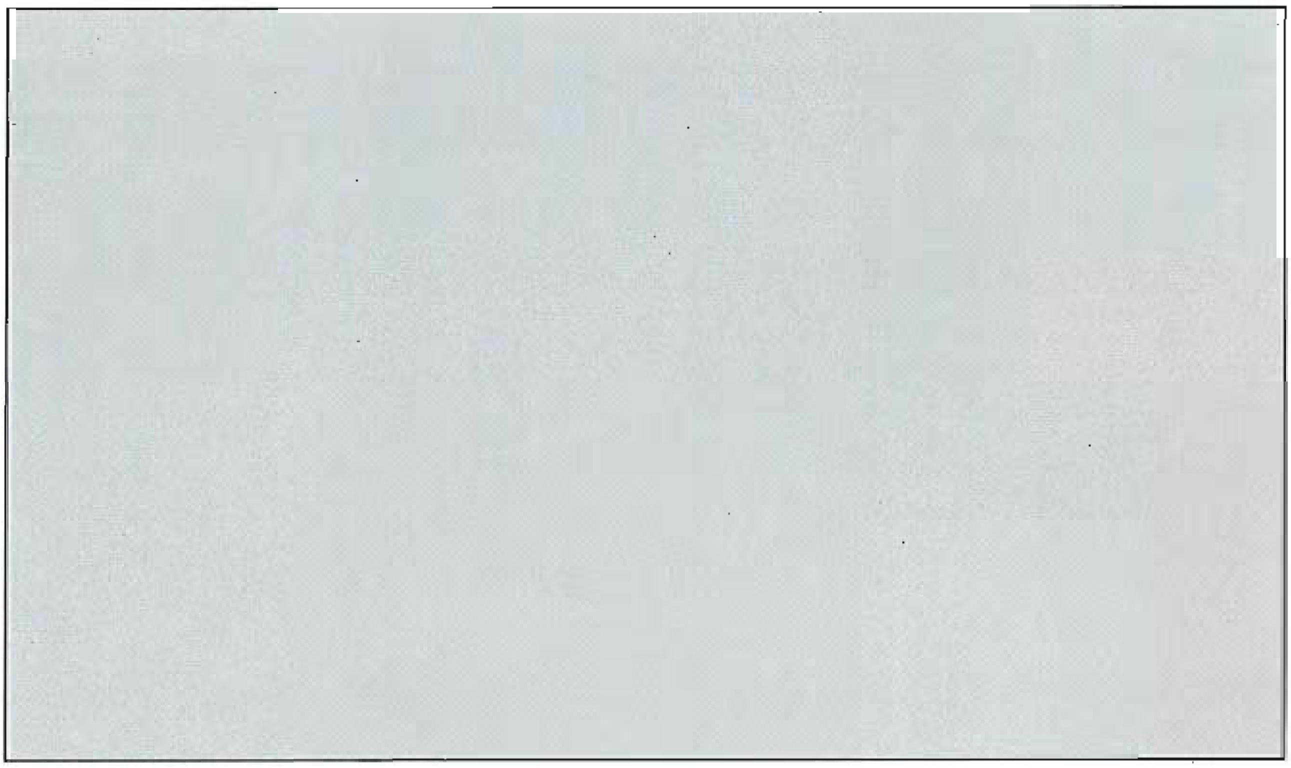

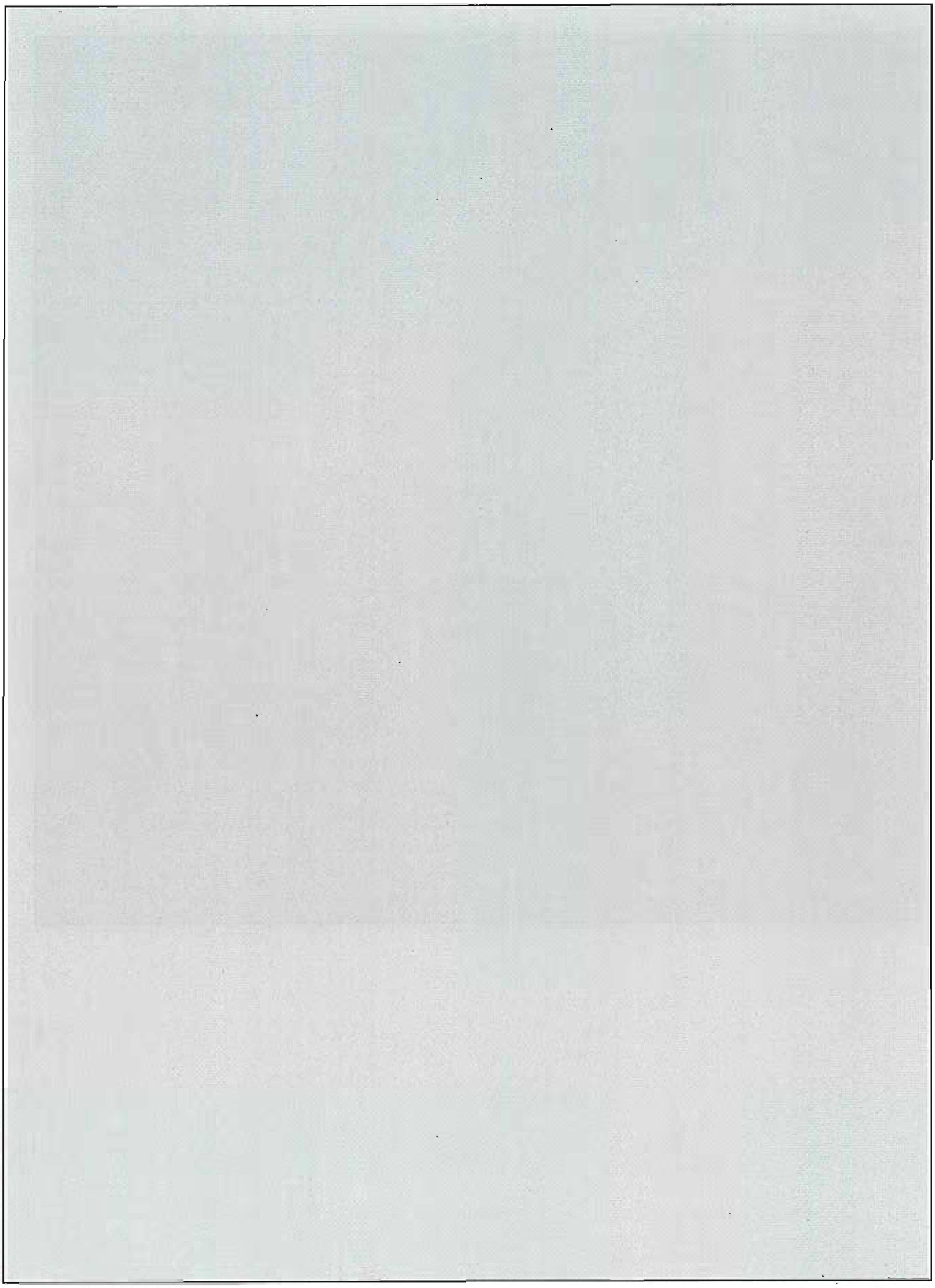

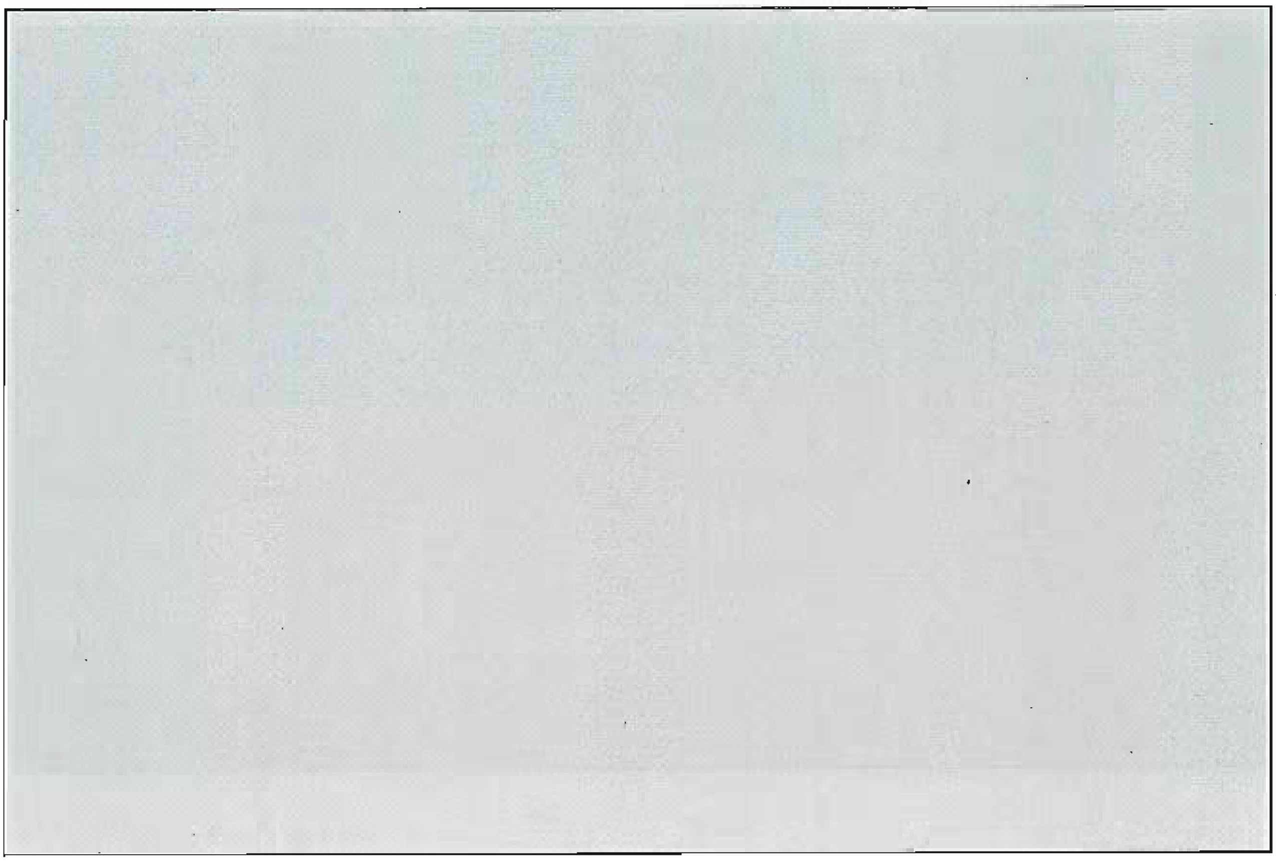

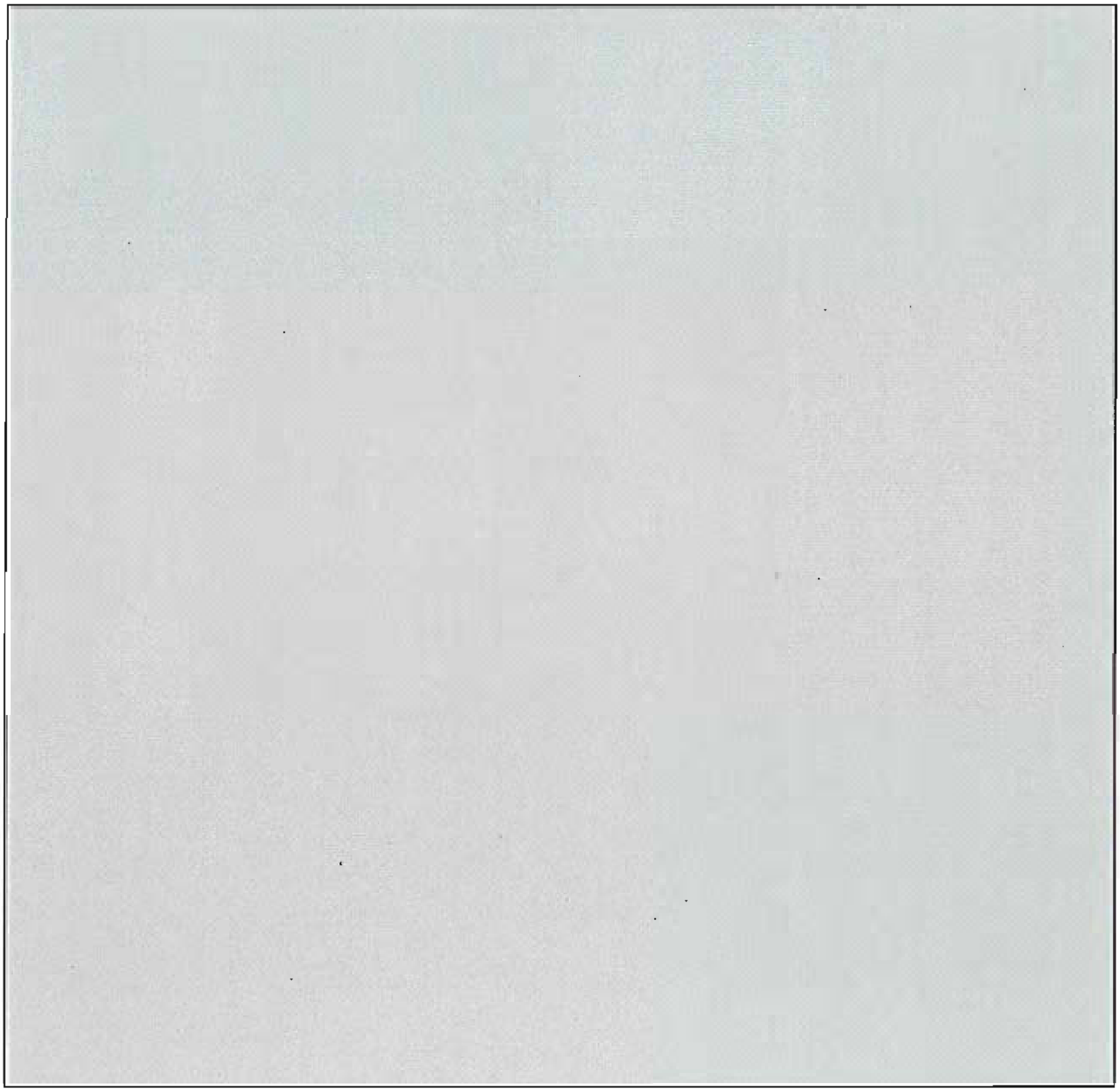

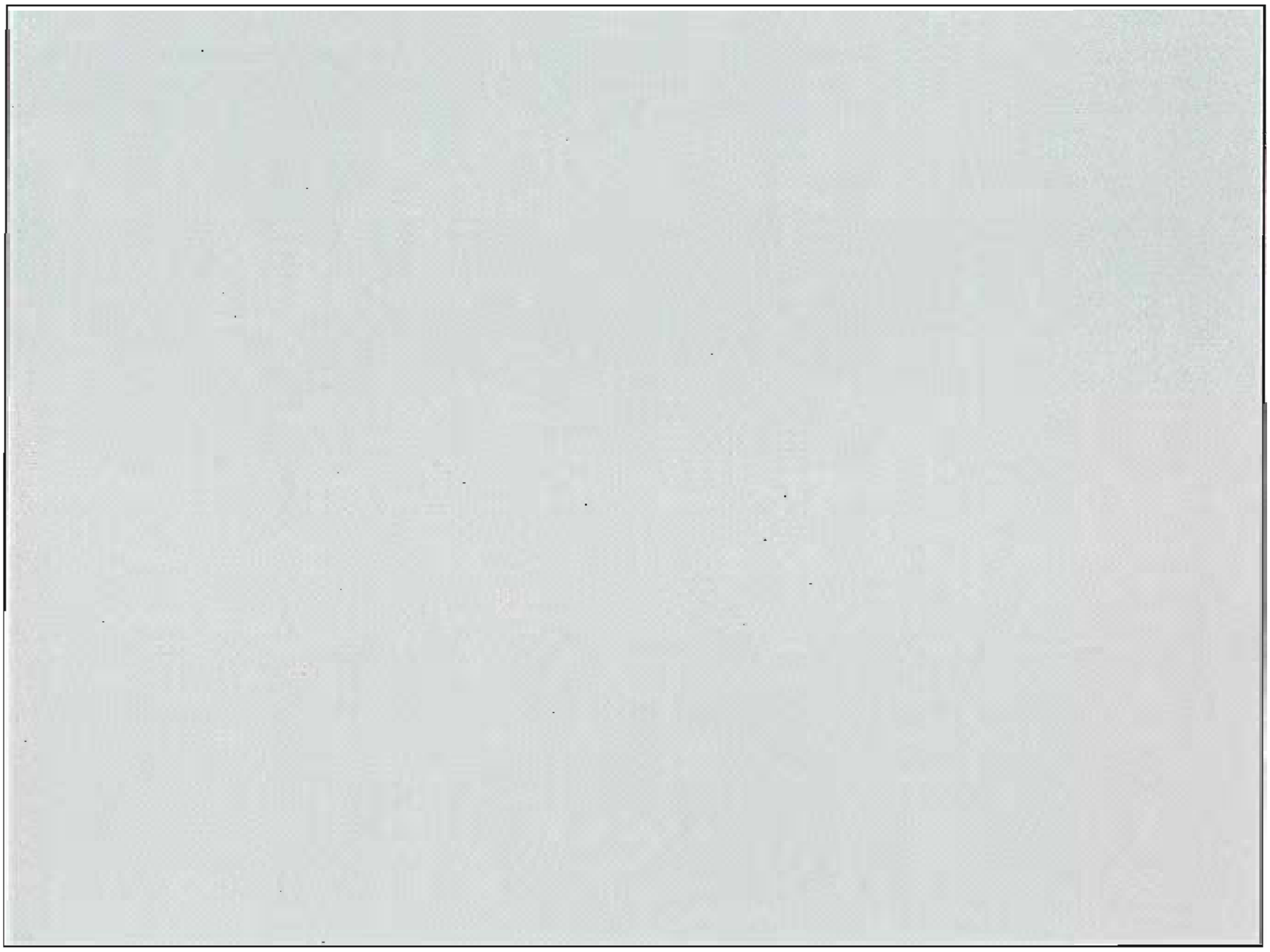

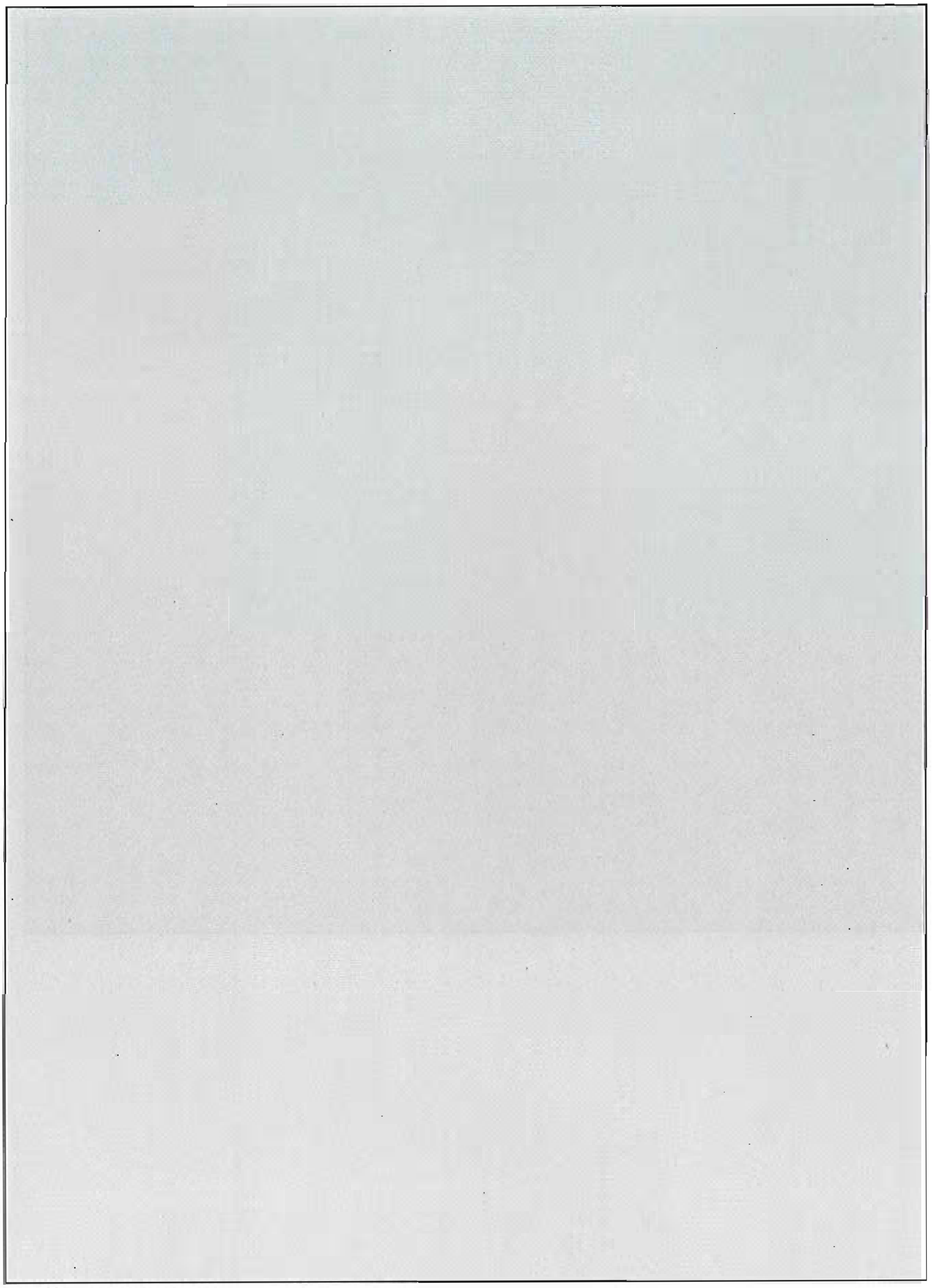

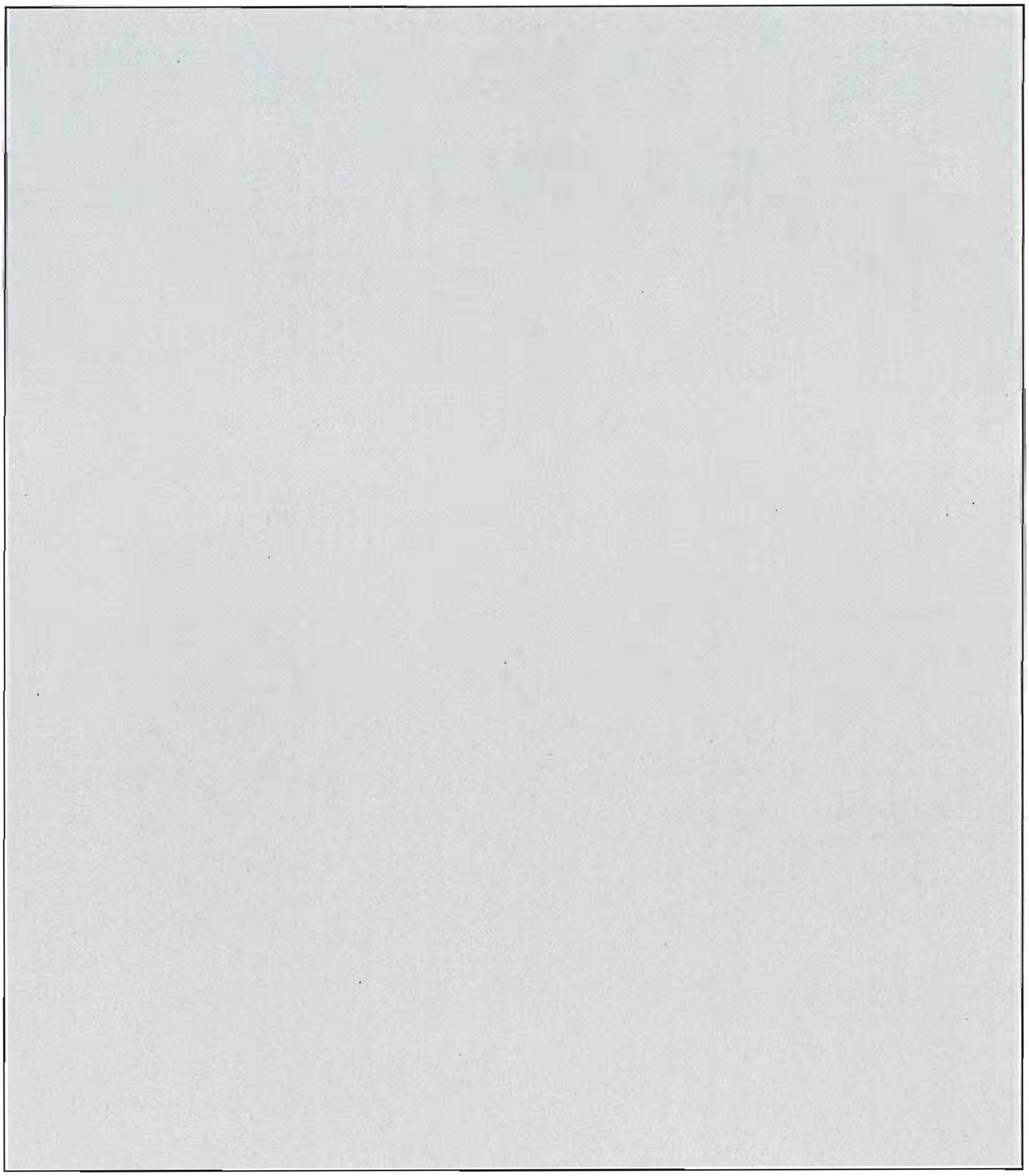

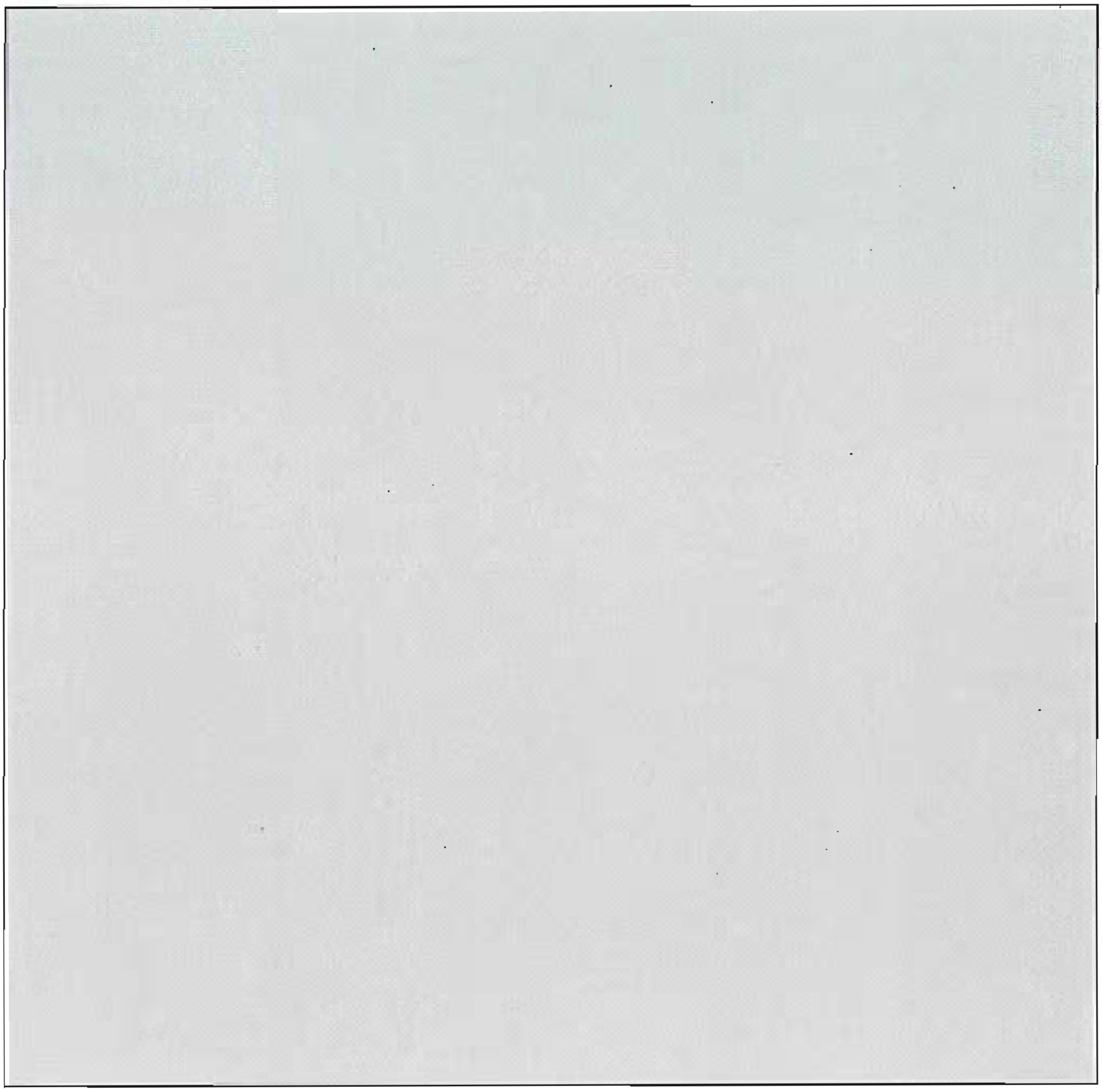

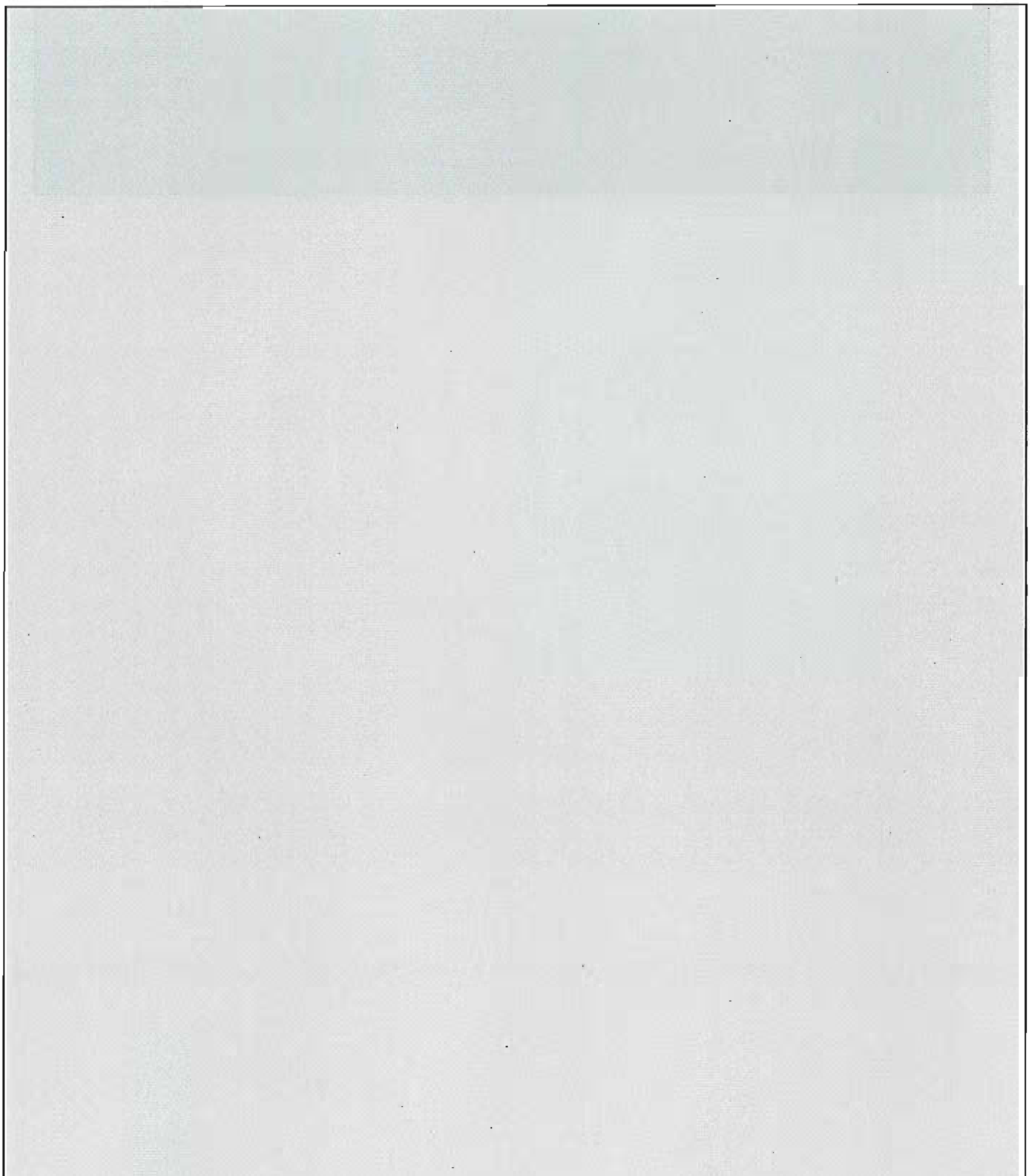

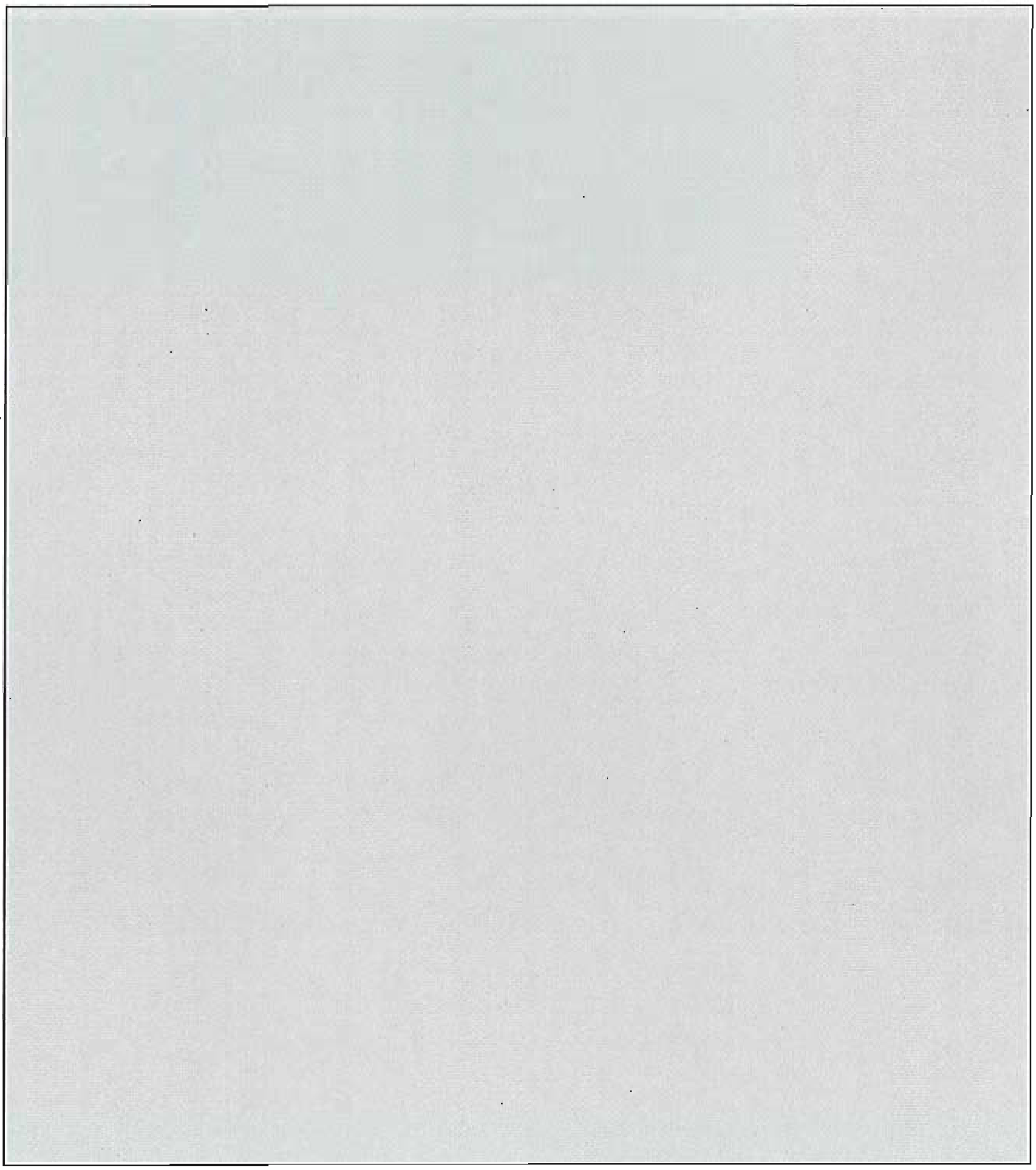

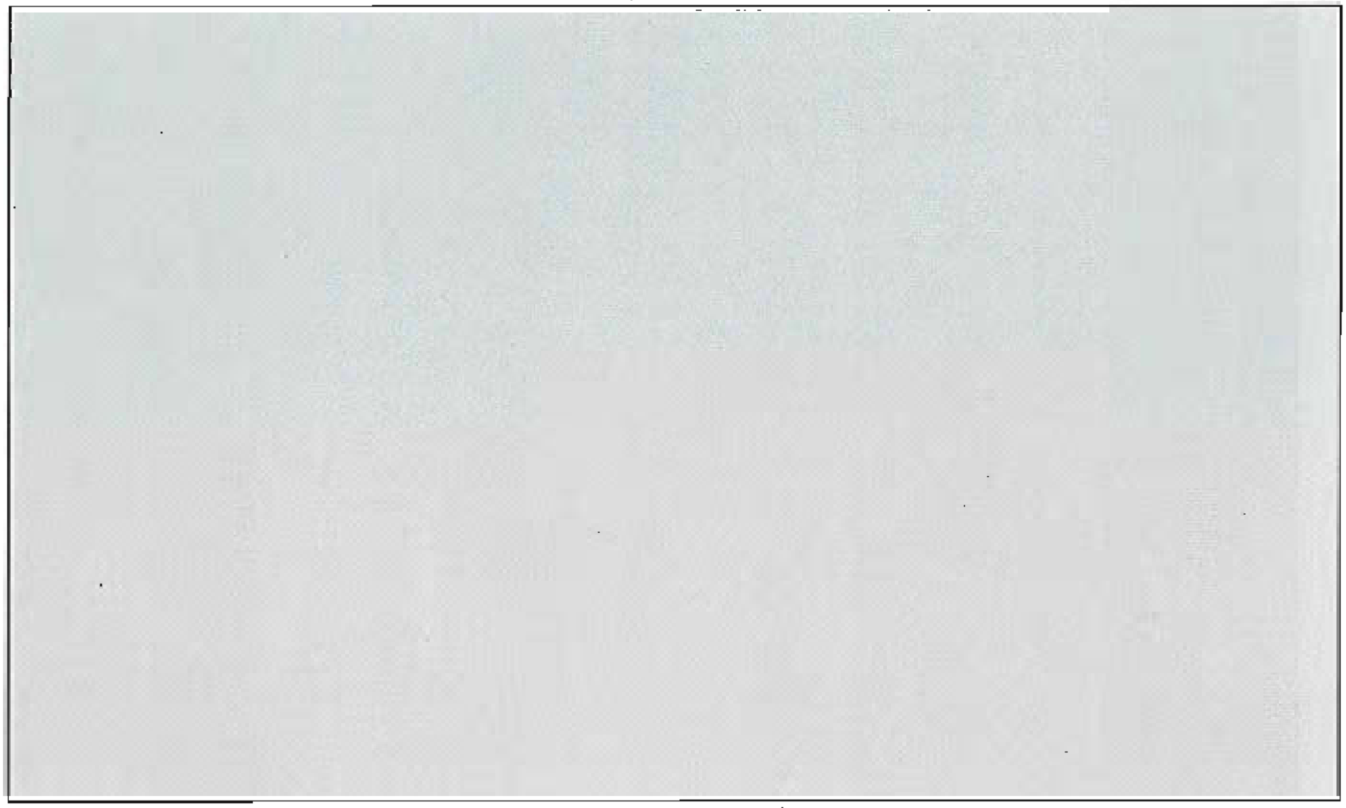

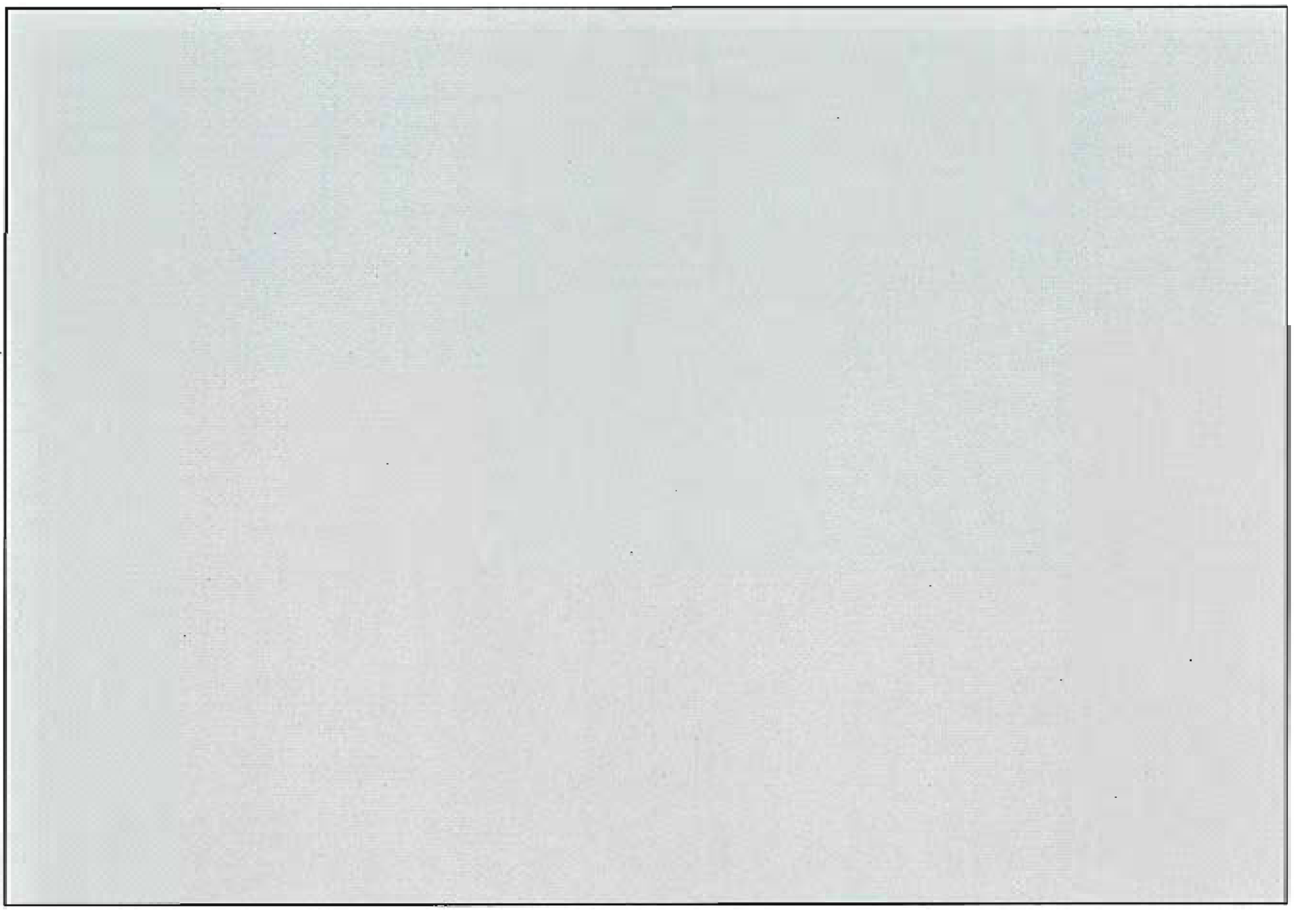

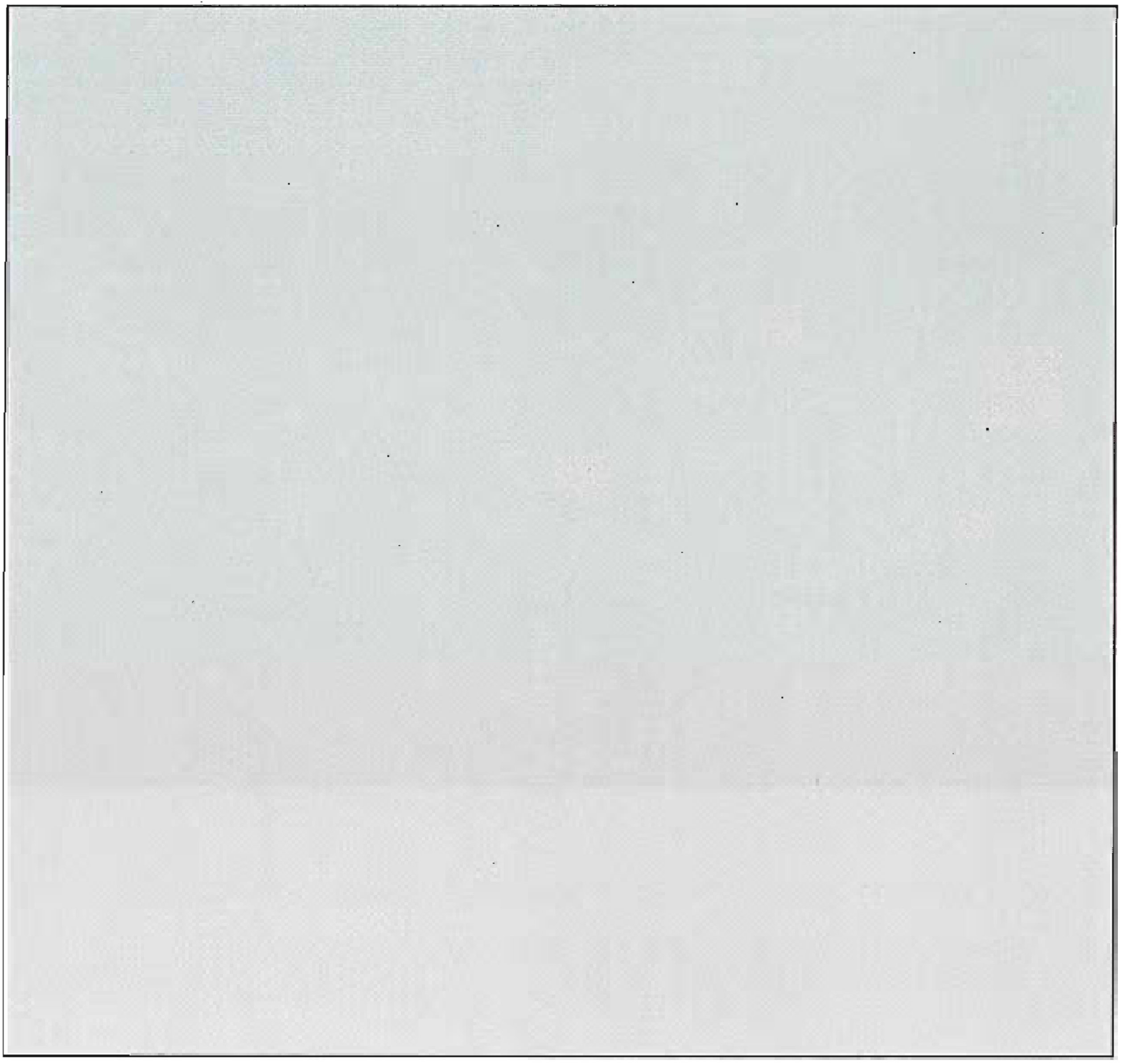

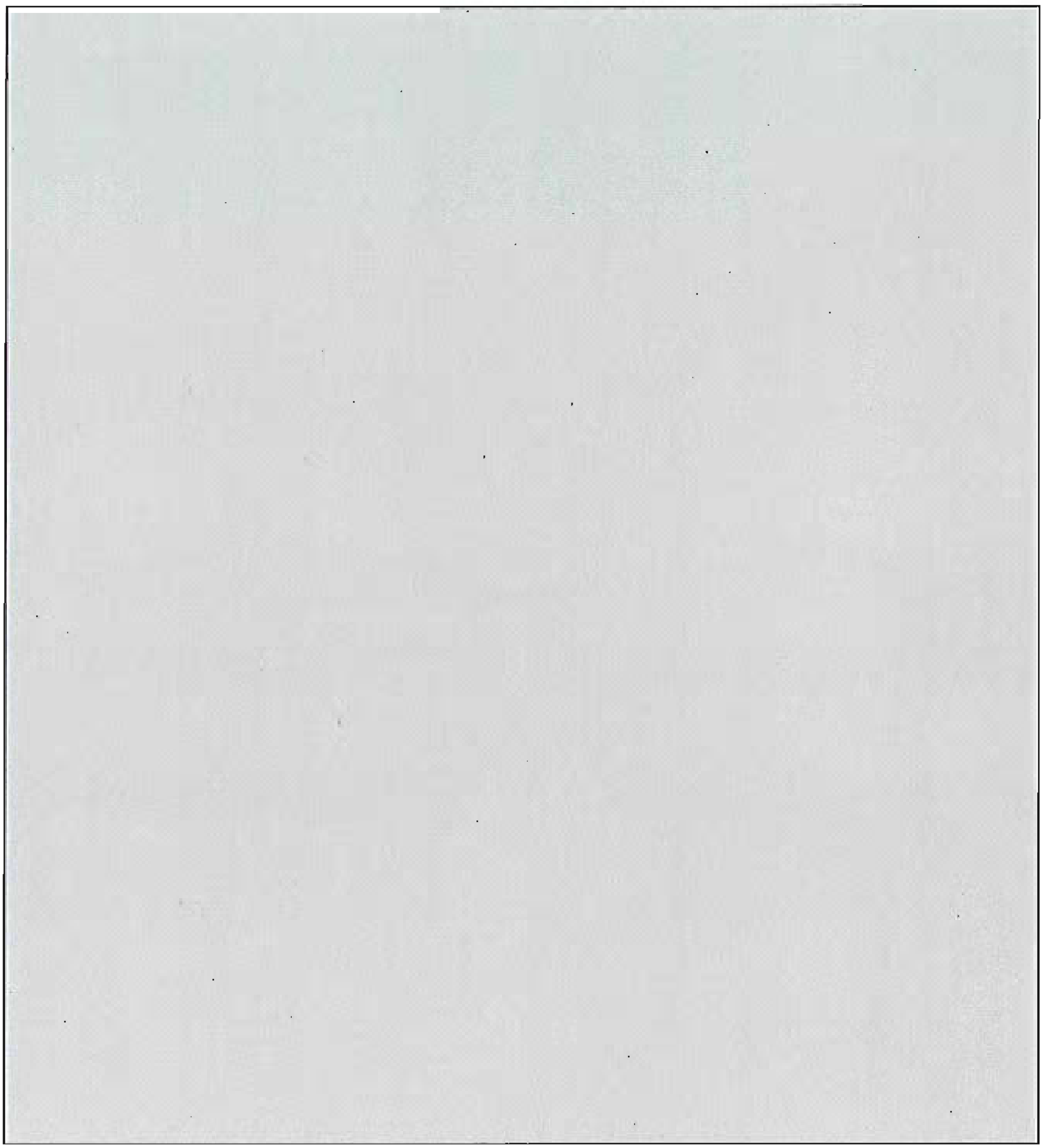

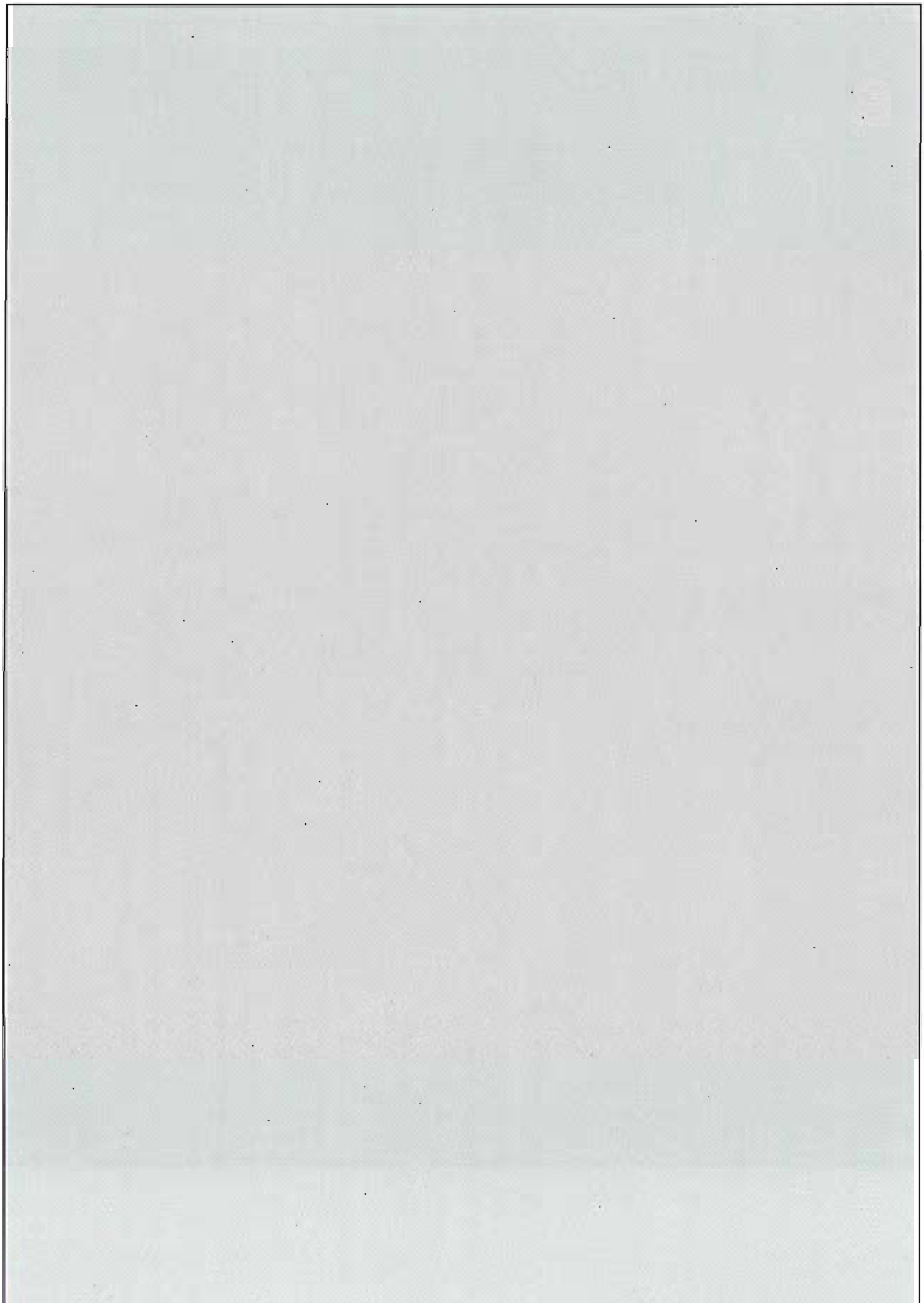

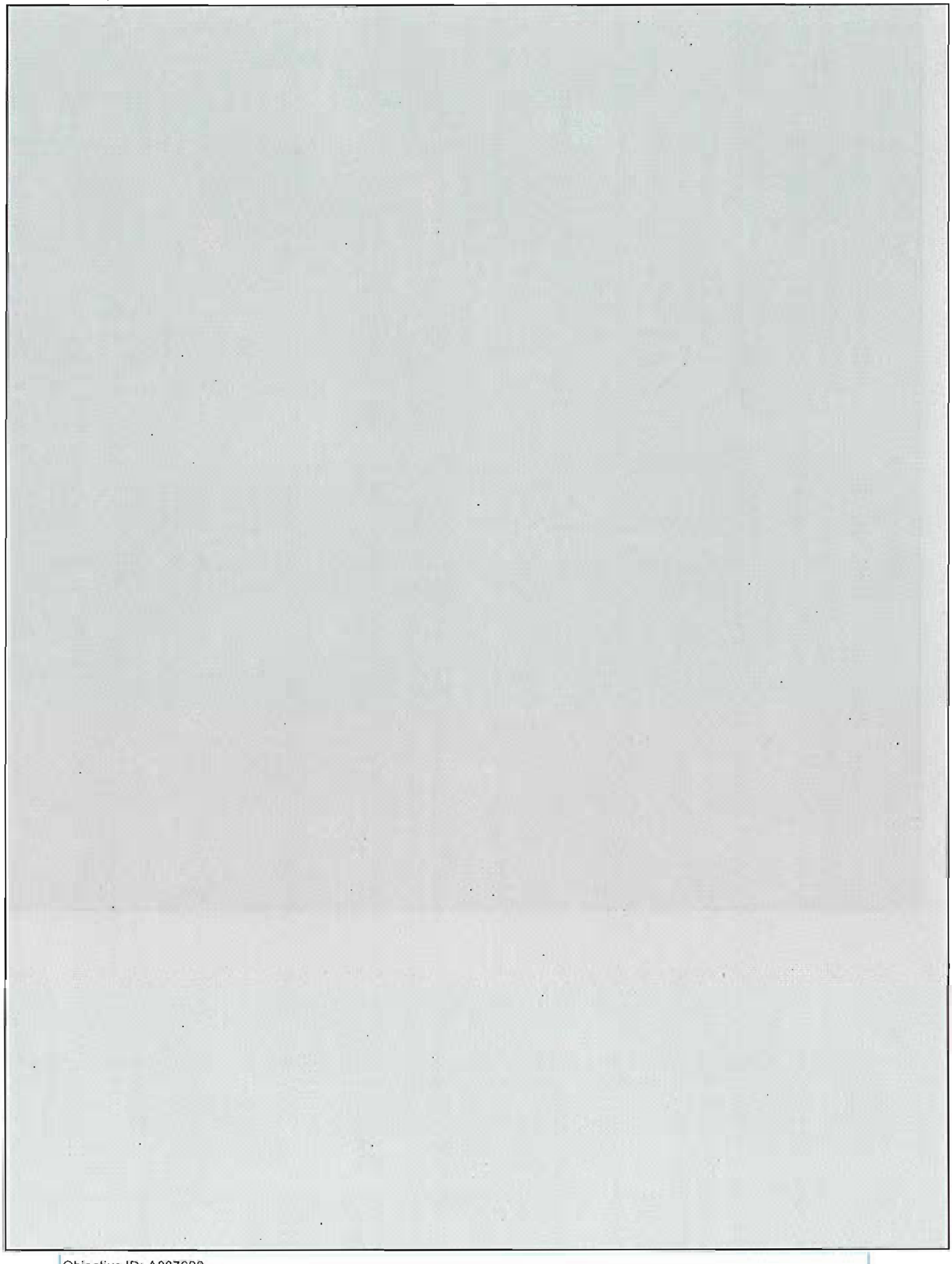

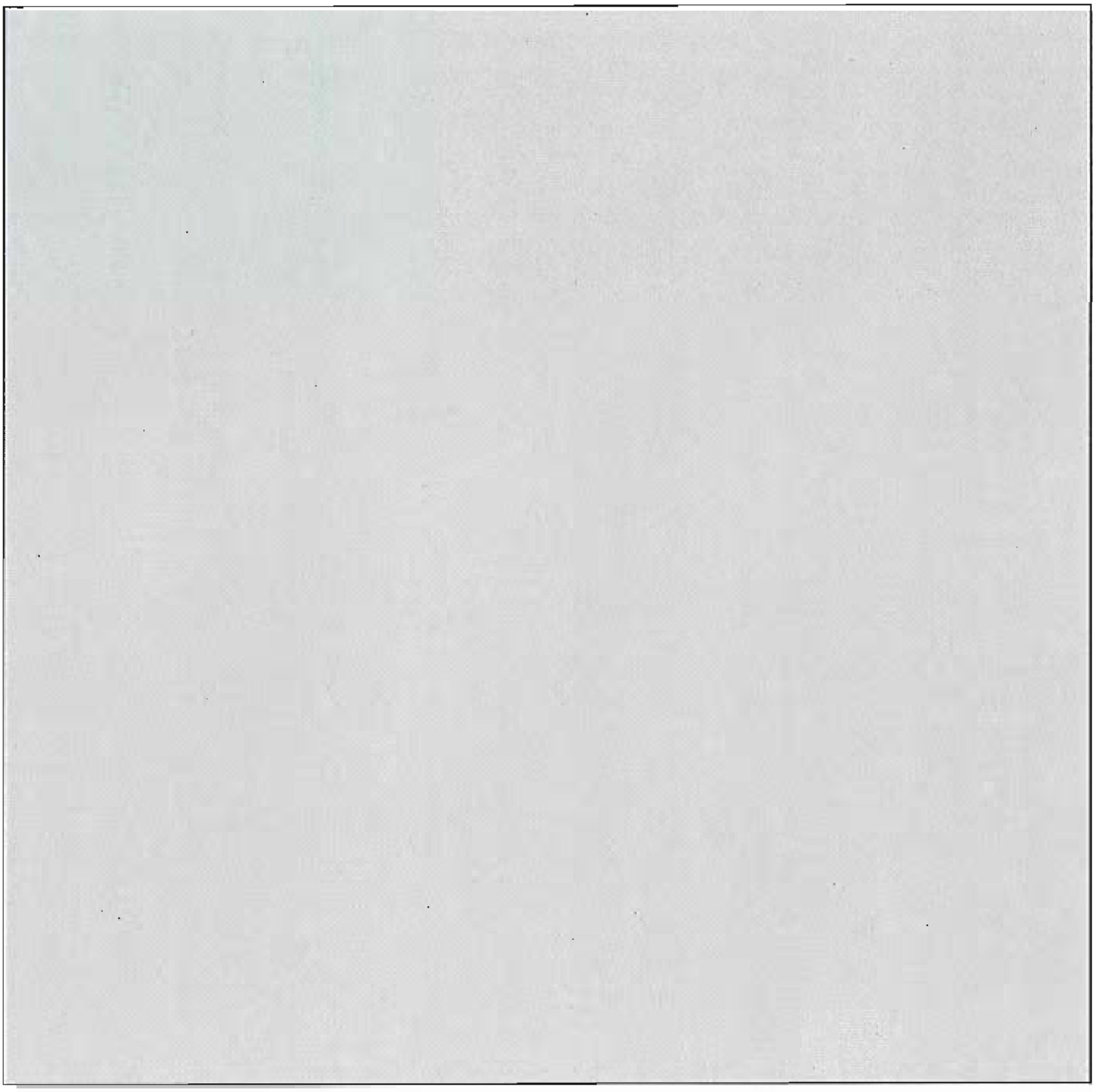

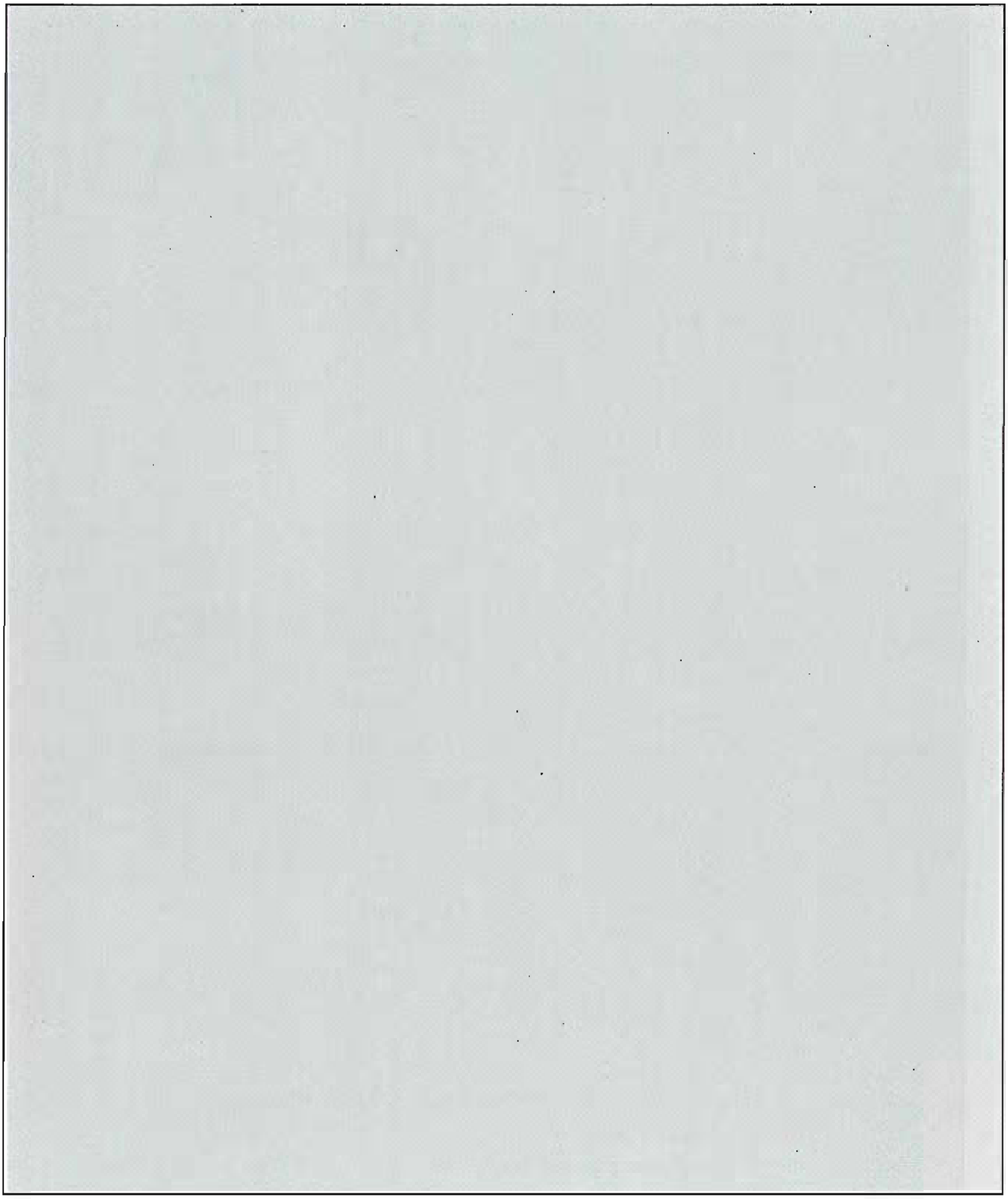

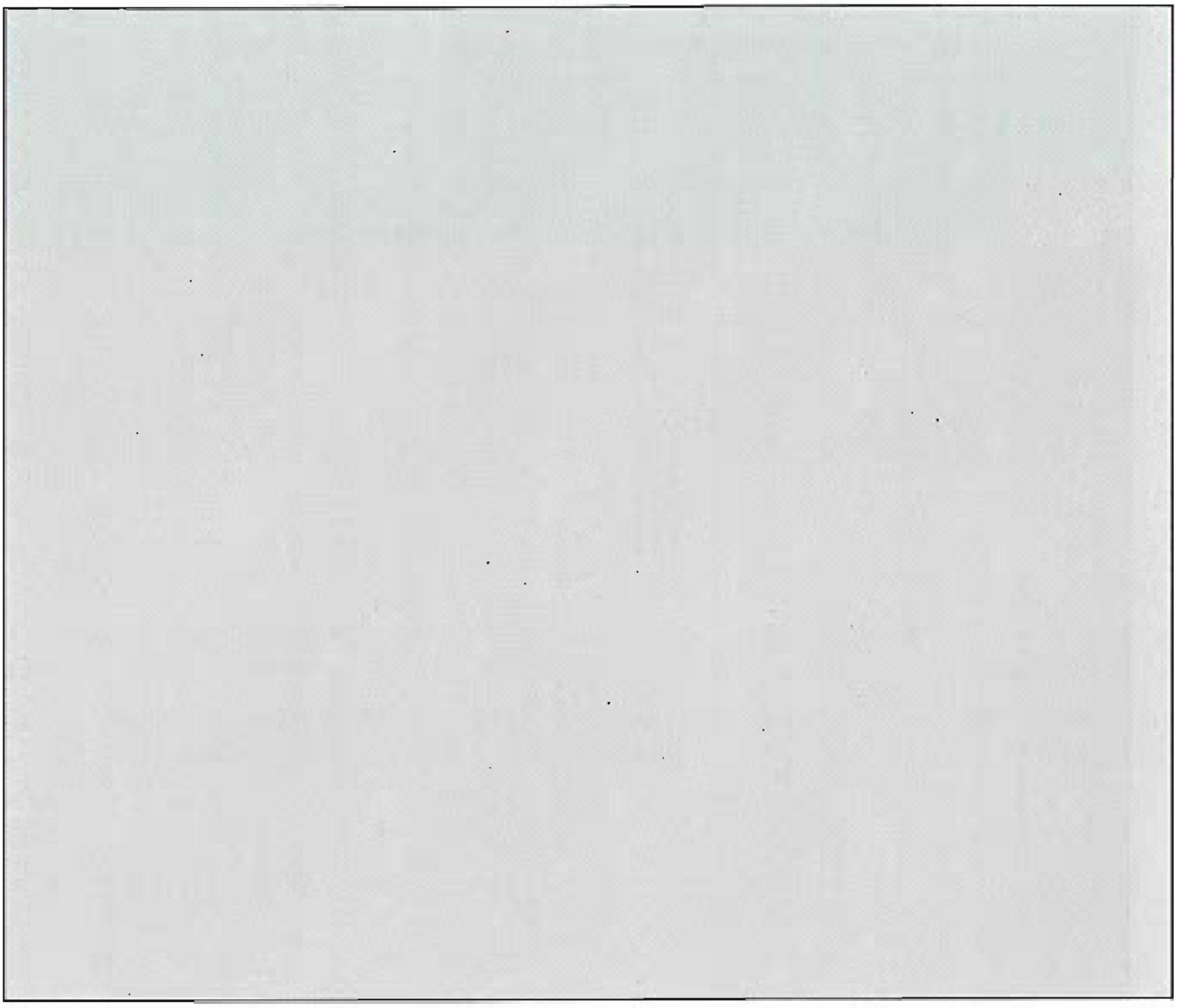

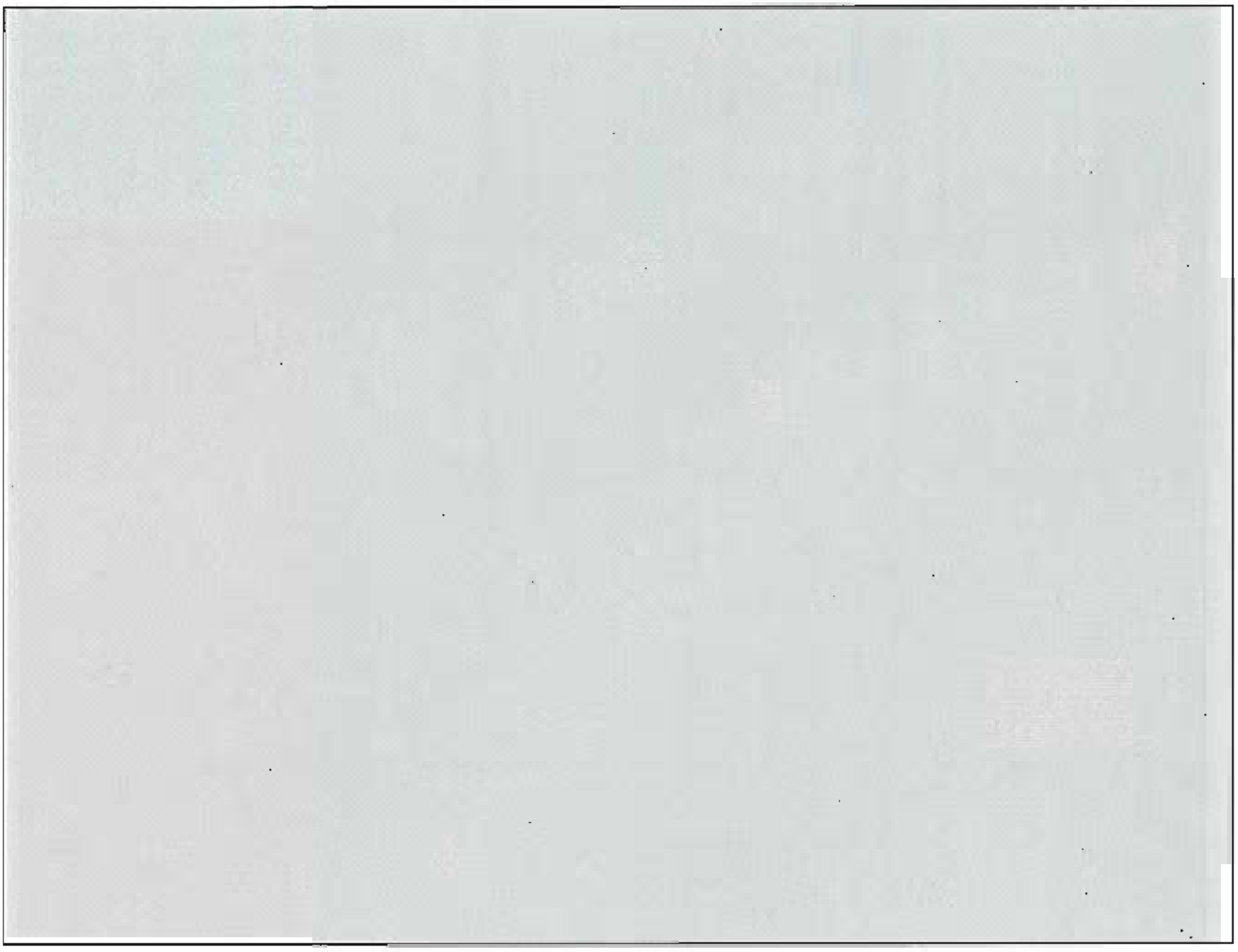

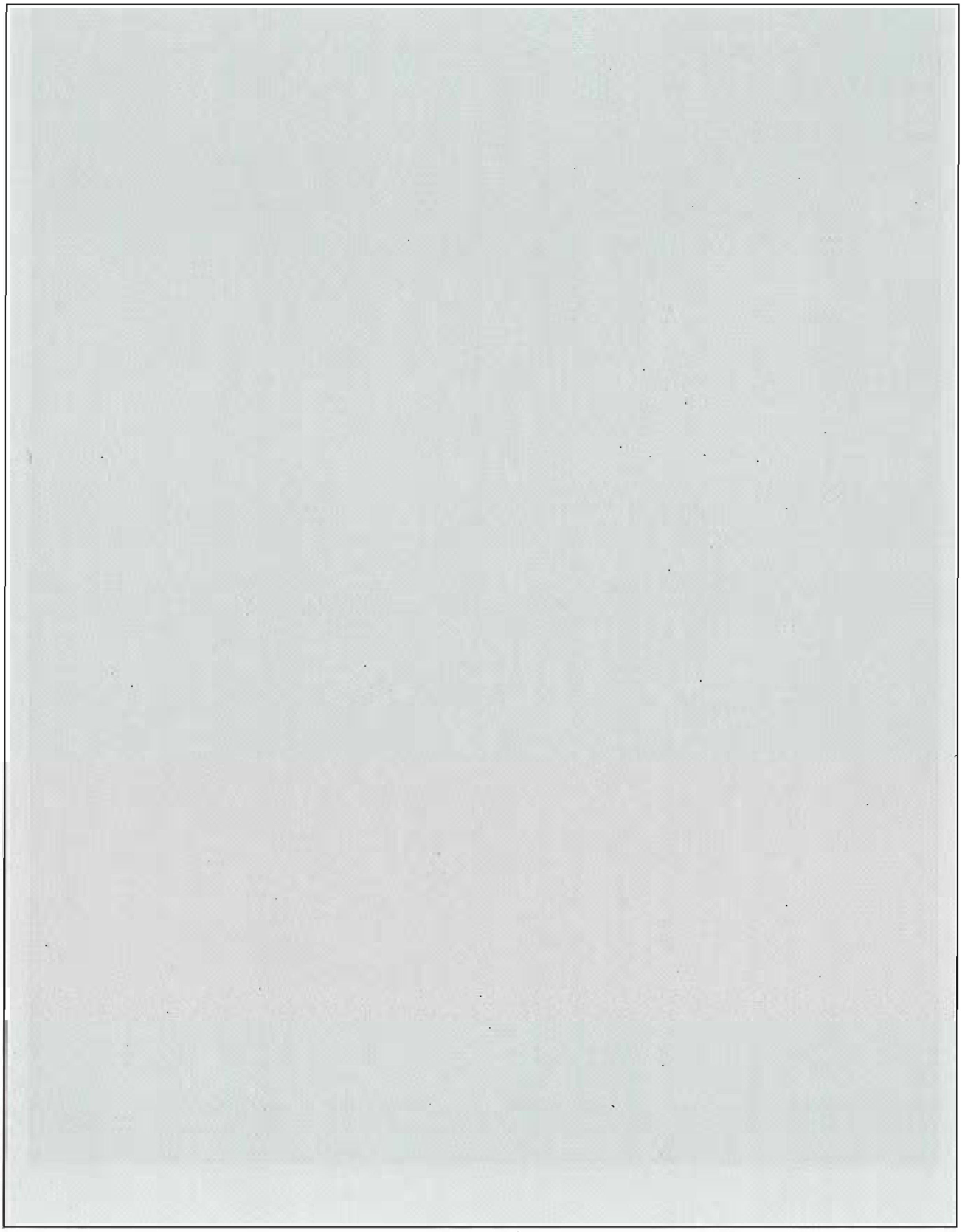

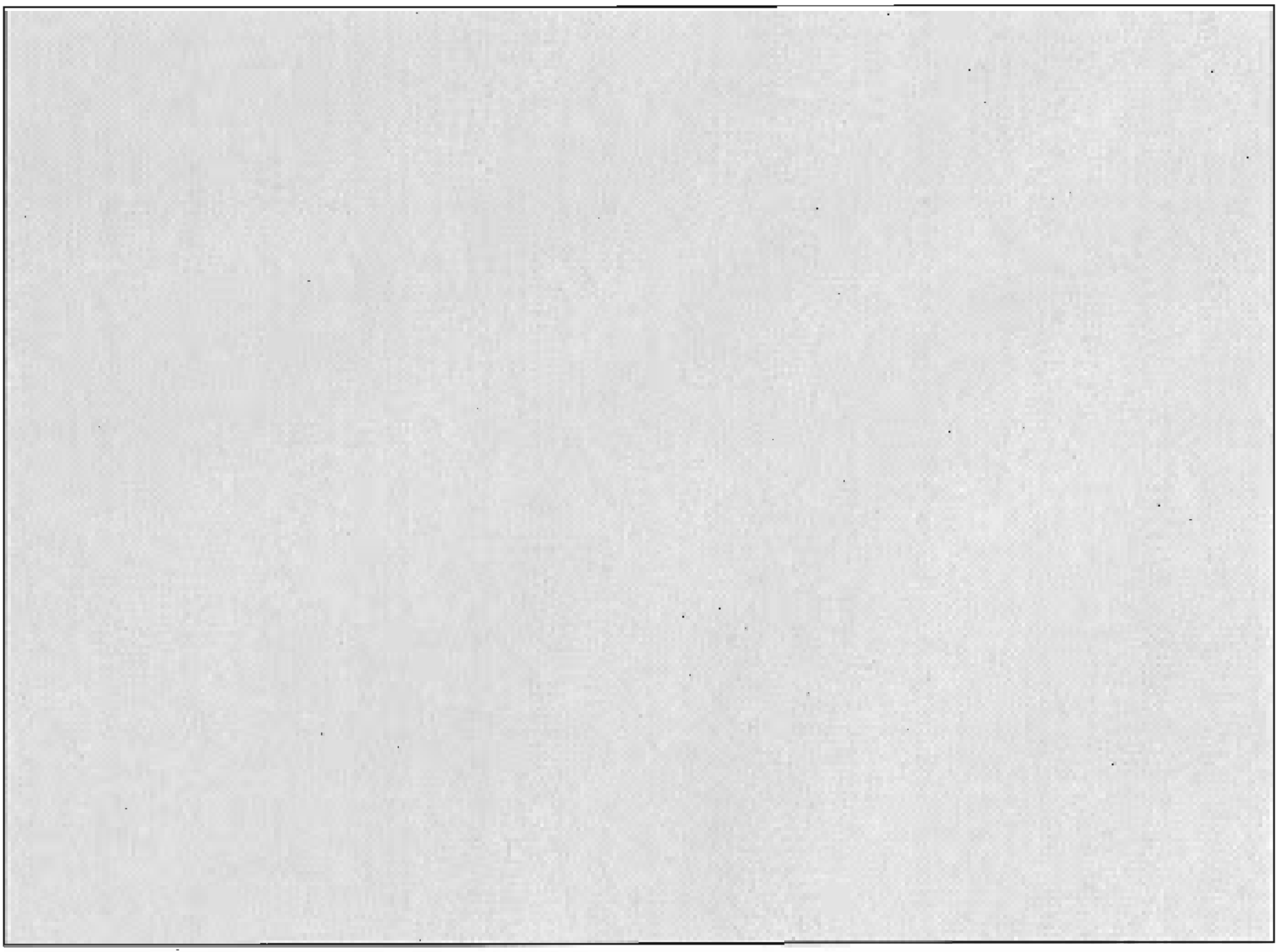

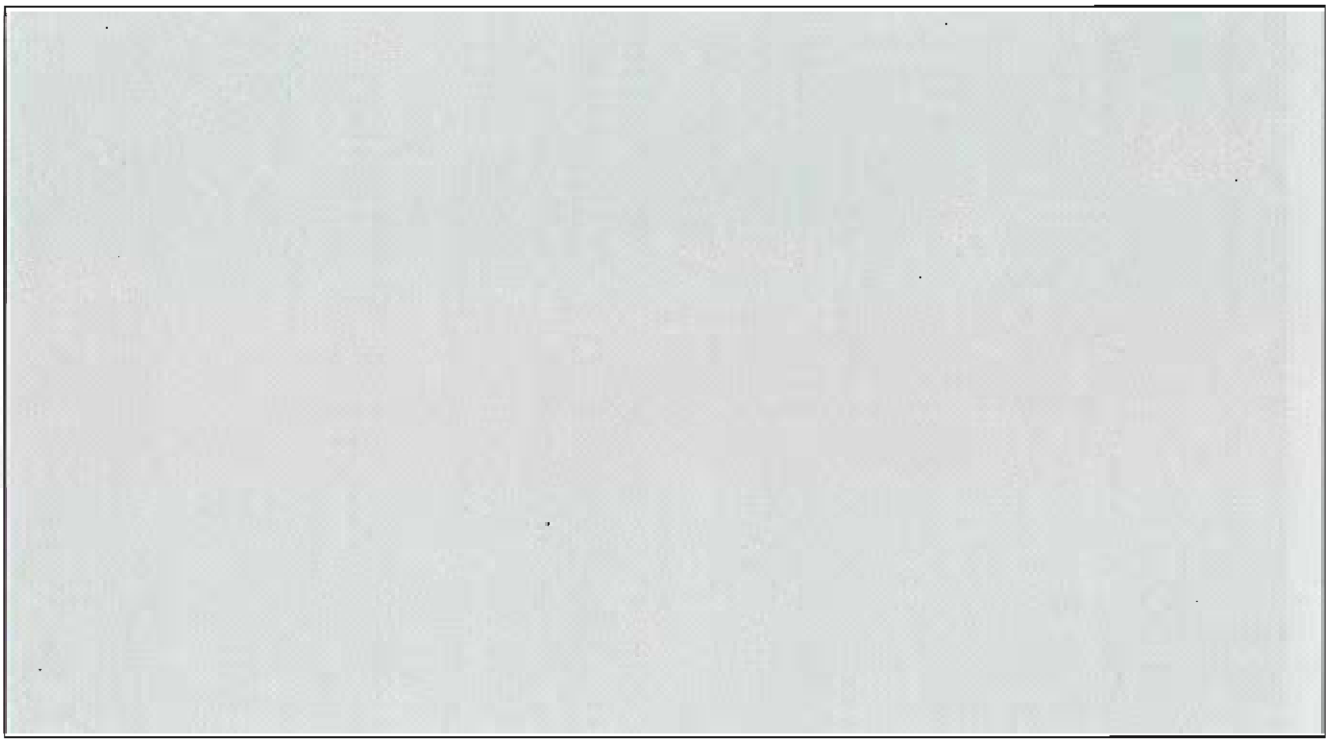

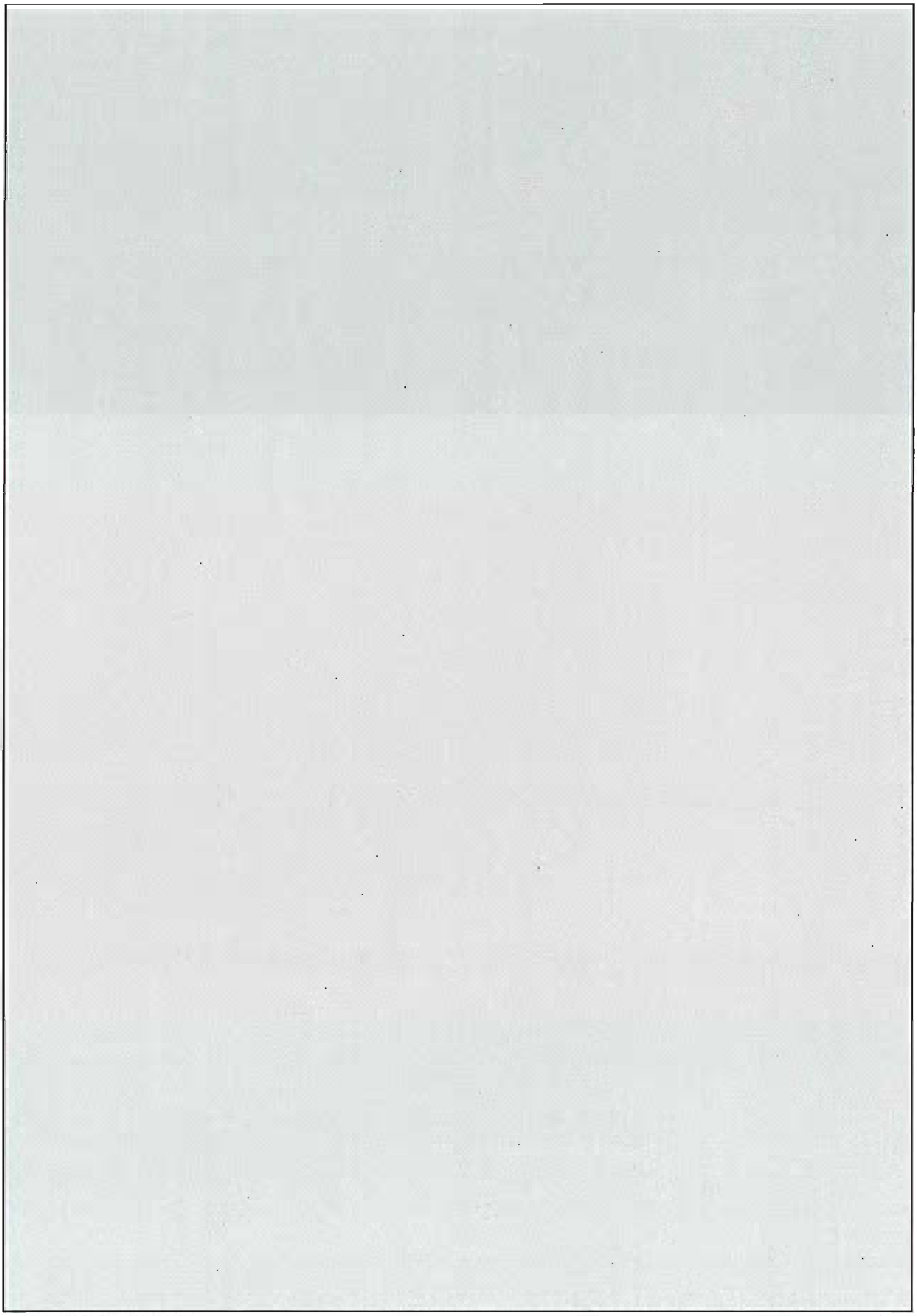

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