

**APPENDIX: FIGURES, CHARTS, PHOTOGRAPHS**

**AIR POLLUTION GREENHOUSE  
FIGURES, CHARTS AND  
PHOTOGRAPHS**

LOS ANGELES STATE AND COUNTY ARBORETUM, ARCADIA 1990-91

# THE AIR POLLUTION GREENHOUSE

The Los Angeles State and County Arboretum, the California Air Resources Board [and in 1990, the South Coast Air Pollution Management District] are co-operating in establishing, maintaining, and improving the Air Pollution Greenhouse Display on the grounds of the Arboretum, in Arcadia, California. The exhibit, which runs from April thru October, was first opened in 1987. Visitors can see, touch and smell plants grown in air from which all pollution has been removed. They can then compare the appearance of these commonly grown plants with those grown in a matching greenhouse which has no filtered air. Environmental conditions in the greenhouses match each other and those in the outside [ambient] air in Arcadia as closely as possible. Therefore, the reason for the difference in the plants is the air pollution.

Over 100 kinds of kinds of plants have been on display, with many showing dramatic responses to air pollution. Very little is known about the impact of air pollution on ornamentals. The photographic record of the response of the plants to air pollution is the first of its kind. The display combining a working greenhouse with living plants and museum quality educational materials is the only one of its kind.

During the time it has been open, the display has undergone improvements and modifications which are pictured in the pages which follow. More than 100 thousand visitors have viewed the exhibit and many more have learned about it through coverage on TV, newspapers, and in popular magazines. Most people have never seen plants growing in clean air, and go away from the exhibit planning to take action to help reduce pollution.

The pages which follow identify the location, layout, and contents of the display; identify the improvements to the facilities and the display materials in the greenhouses and information center; and document the responses of both the plants and of the visitors to the display.

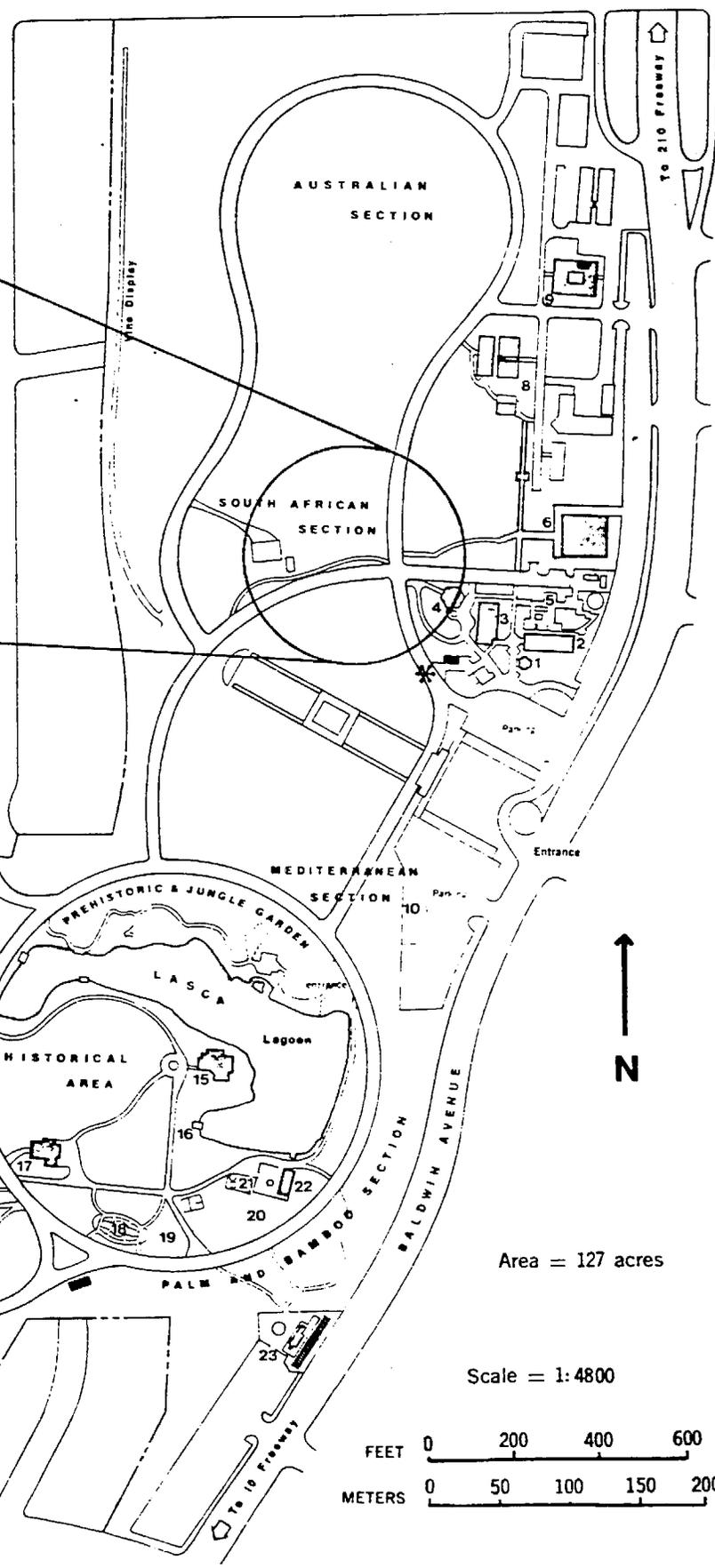
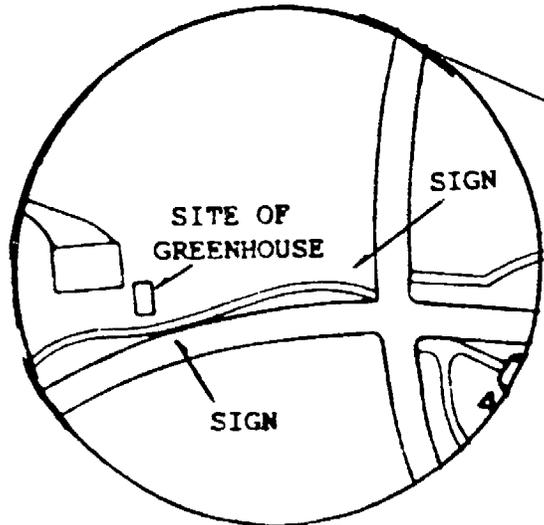
**PHOTOGRAPHS, CHARTS, AND FIGURES FOLLOW**

# AIR POLLUTION GREENHOUSE INTRODUCTION

LOS ANGELES STATE AND COUNTY ARBORETUM, ARCADIA 1990-91

16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1

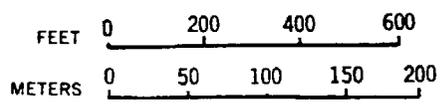
Map of  
Los Angeles State & County Arboretum



- Restrooms
- \* Tram Boarding Area

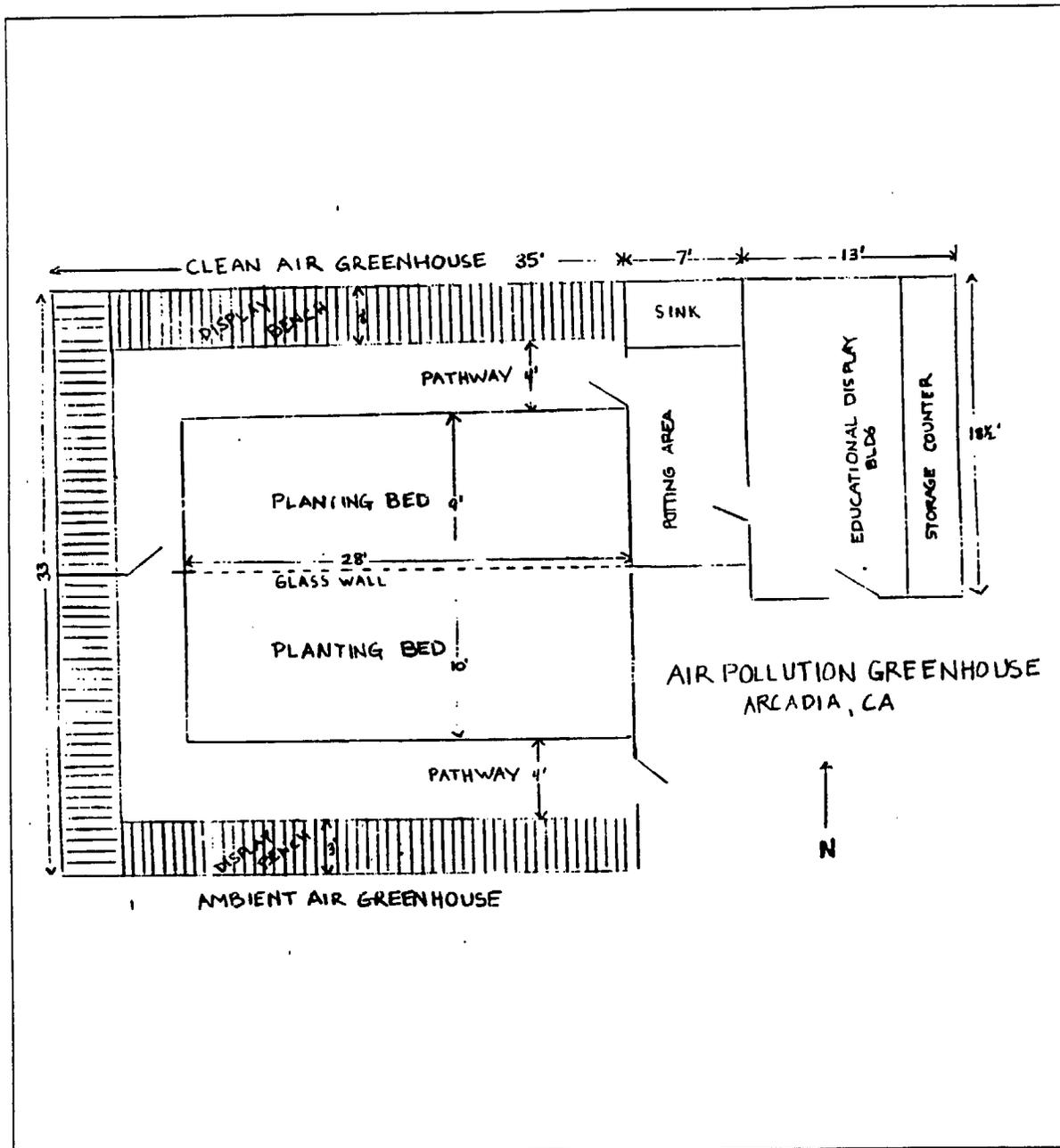
Area = 127 acres

Scale = 1:4800



16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1

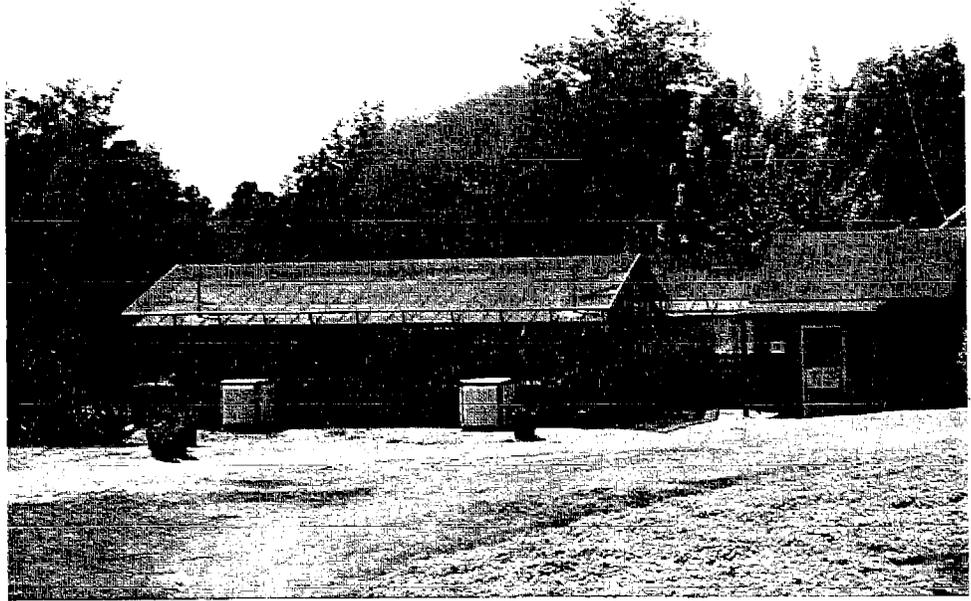
# FLOOR PLAN OF FACILITIES AIR POLLUTION GREENHOUSE DISPLAY



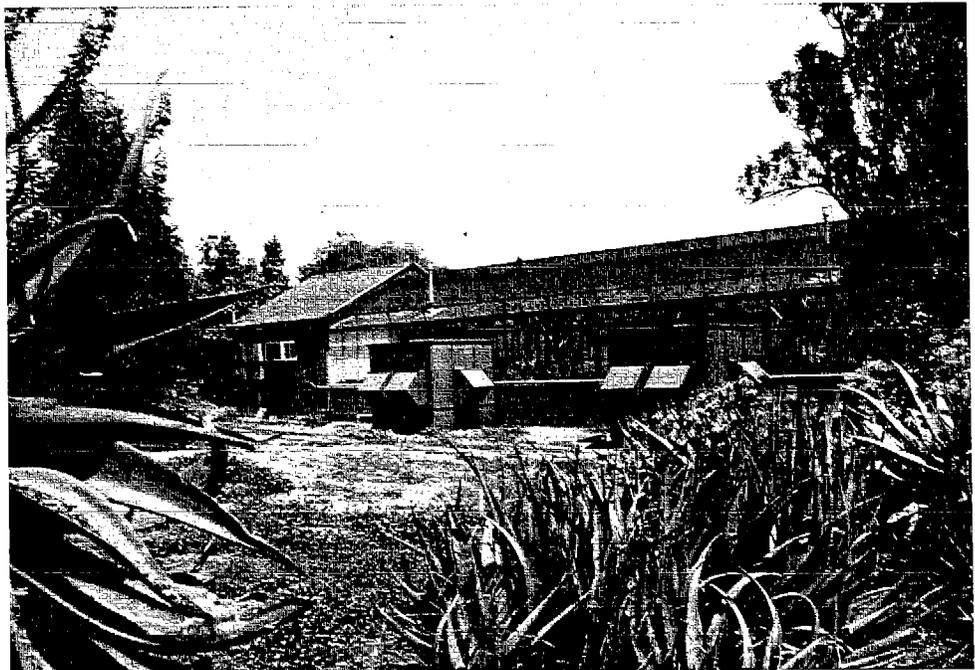
L.A. STATE AND COUNTY ARBORETUM, ARCADIA CA

# THE AIR POLLUTION GREENHOUSE DISPLAY AND INFORMATION CENTER

"SMOGGY"  
GREENHOUSE  
AND  
"CLEAN AIR"  
GREENHOUSE  
PORTION  
OF THE DISPLAY  
ON THE LEFT;  
INFORMATION  
CENTER WITH  
AIR QUALITY  
MONITORS AND  
EDUCATIONAL  
MATERIALS ON  
THE RIGHT



THE AIR  
POLLUTION  
GREENHOUSE  
EXHIBIT AS  
SEEN FROM  
THE WALKWAY

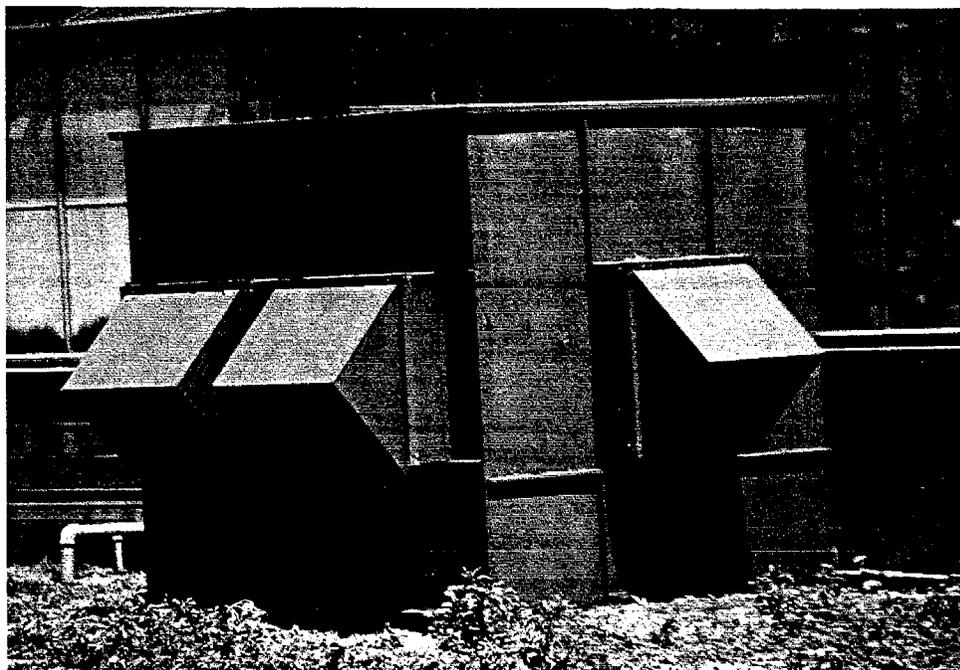


# THE AIR POLLUTION GREENHOUSE DISPLAY AND INFORMATION CENTER

DUST FILTERS  
AND COOLERS  
FOR "SMOGGY  
AIR" SIDE  
RECEIVED  
REGULAR  
SERVICE,  
AND KEPT THE  
AIR TEMPERATURES  
MATCHED TO THAT  
OF THE OUTSIDE  
AIR IN ARCADIA.

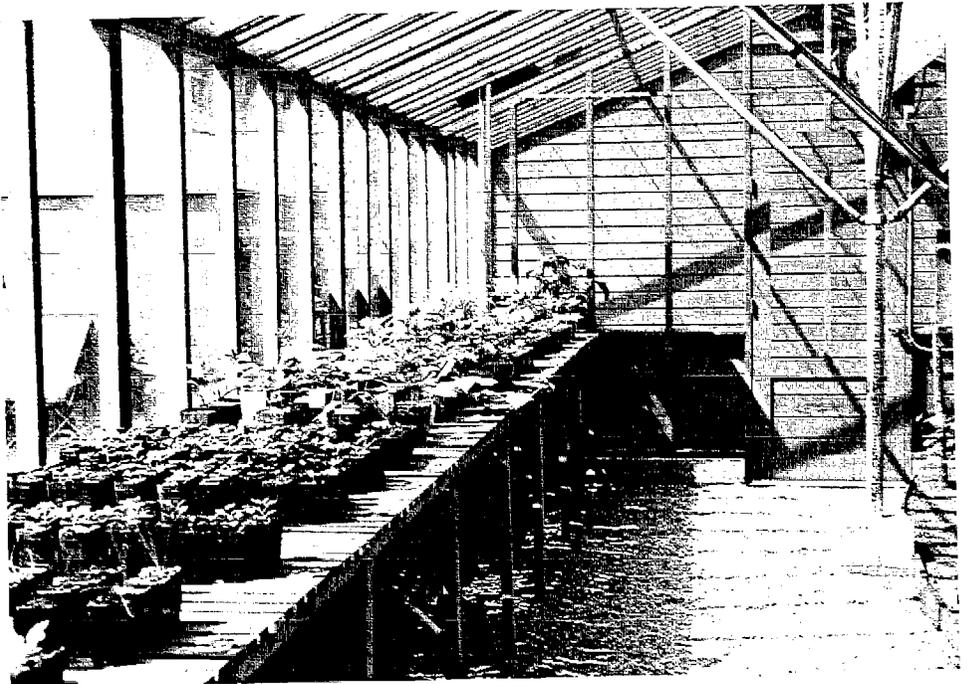


CHARCOAL  
FILTERS  
AND COOLERS  
FOR "CLEAN  
AIR" SIDE  
RECEIVED  
REGULAR  
SERVICE  
AND KEPT THE  
GREENHOUSE FREE  
OF AIR POLLUTION,  
BUT AT THE SAME  
TEMPERATURE AS THE  
OUTSIDE AIR.



# THE AIR POLLUTION GREENHOUSE DISPLAY AND INFORMATION CENTER

BENCHES FOR  
SMALLER POTS  
WERE INSTALLED  
WITH TRADITIONAL  
SIZED SIGNS  
WHEN THE  
GREENHOUSE  
WAS OPENED IN  
1987

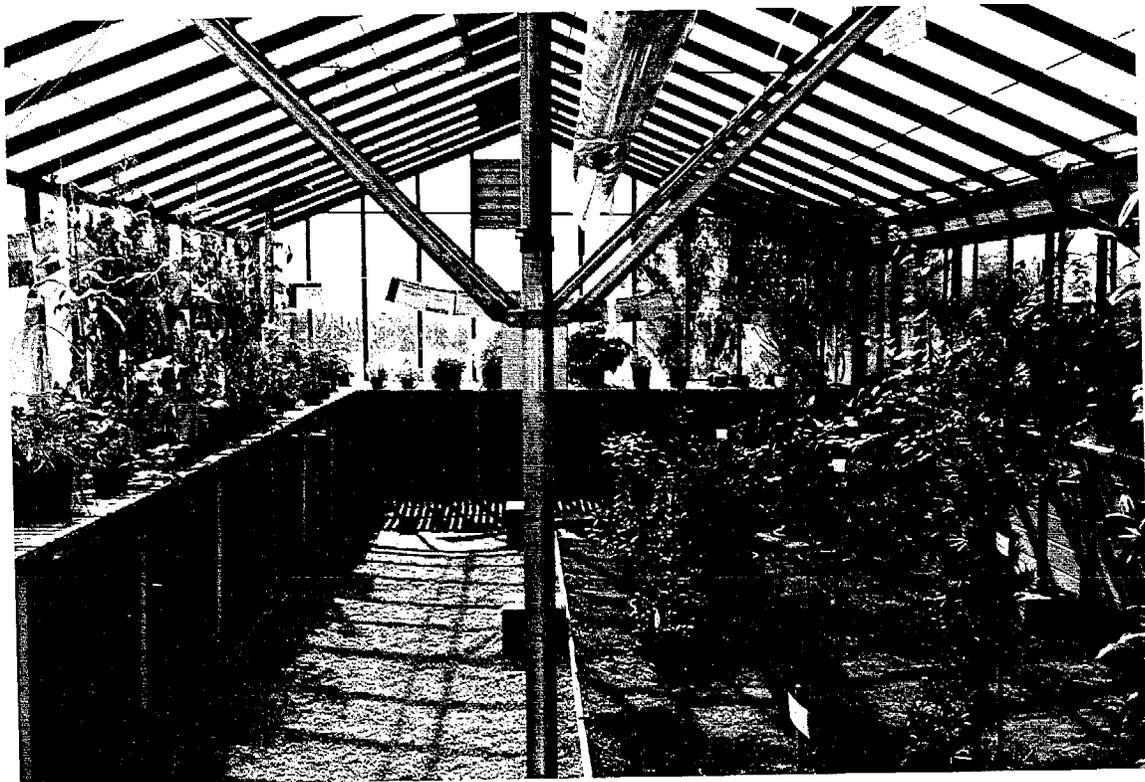


LARGER  
PLANTS  
IN FIVE  
GALLON  
CONTAINERS  
WERE SET  
IN LARGER  
POTS IN  
THE GROUND  
FOR DISPLAY  
IN 1987, BUT  
SIGNS WERE  
NOT INCLUDED.

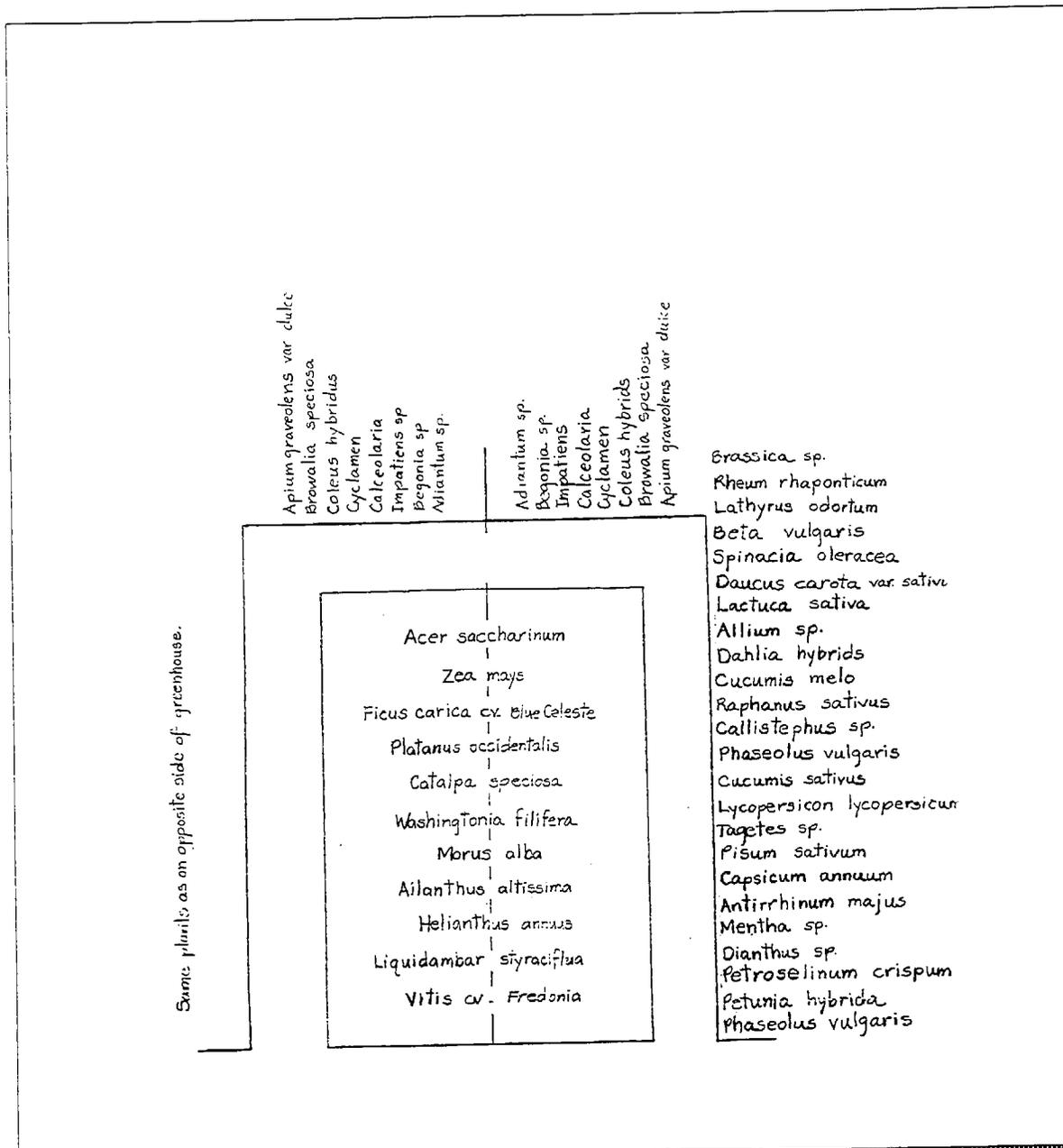


# THE AIR POLLUTION GREENHOUSE DISPLAY AND INFORMATION CENTER

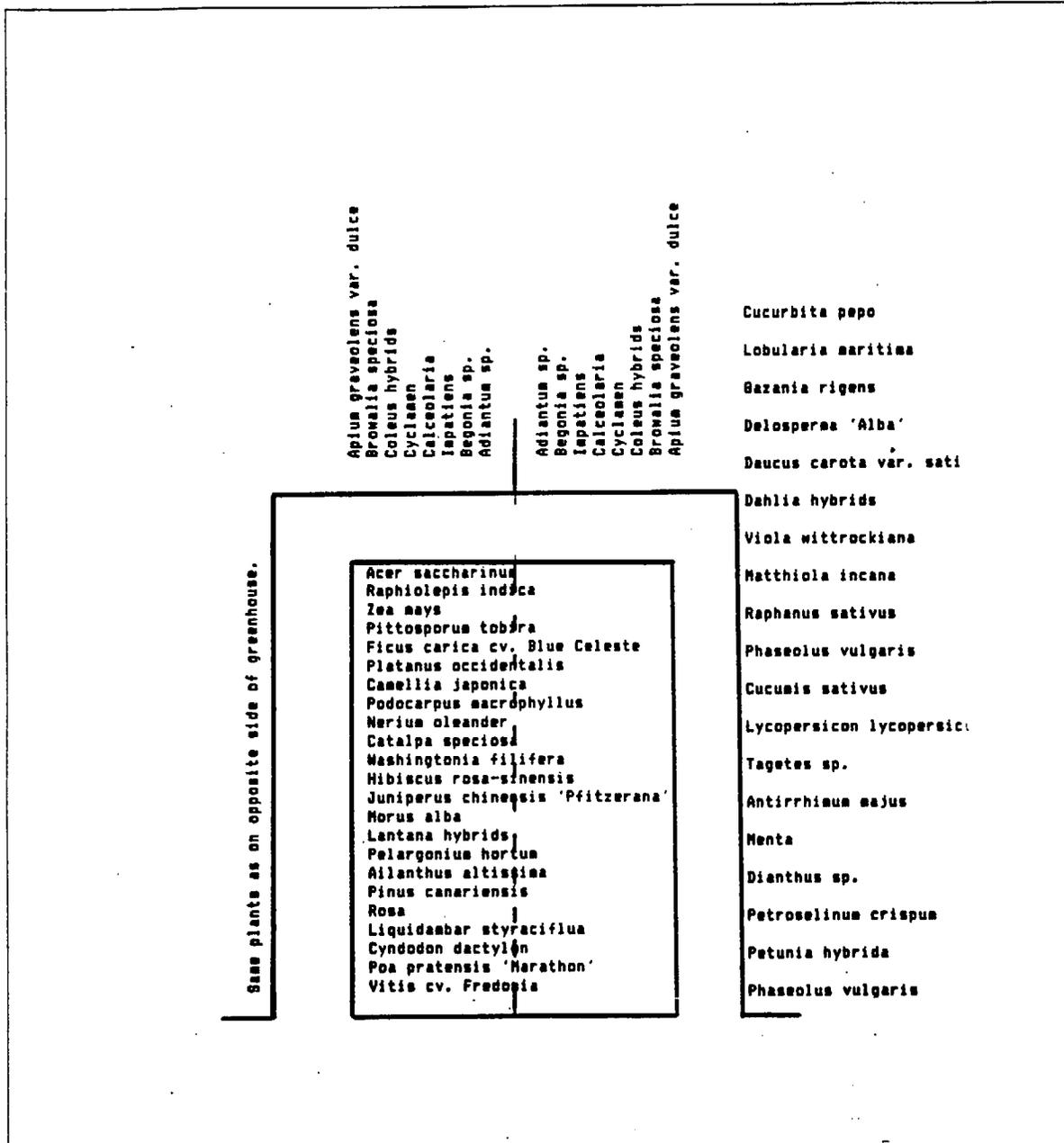
THE LAYOUT OF THE PLANTS IN THE FILTERED SIDE OF THE GREENHOUSE (TOP) IS A MIRROR IMAGE OF THE PLANTING ARRANGEMENT ON THE UNFILTERED SIDE (BOTTOM.)



# LAYOUT OF GREENHOUSE DISPLAY AIR POLLUTION GREENHOUSE, 1987

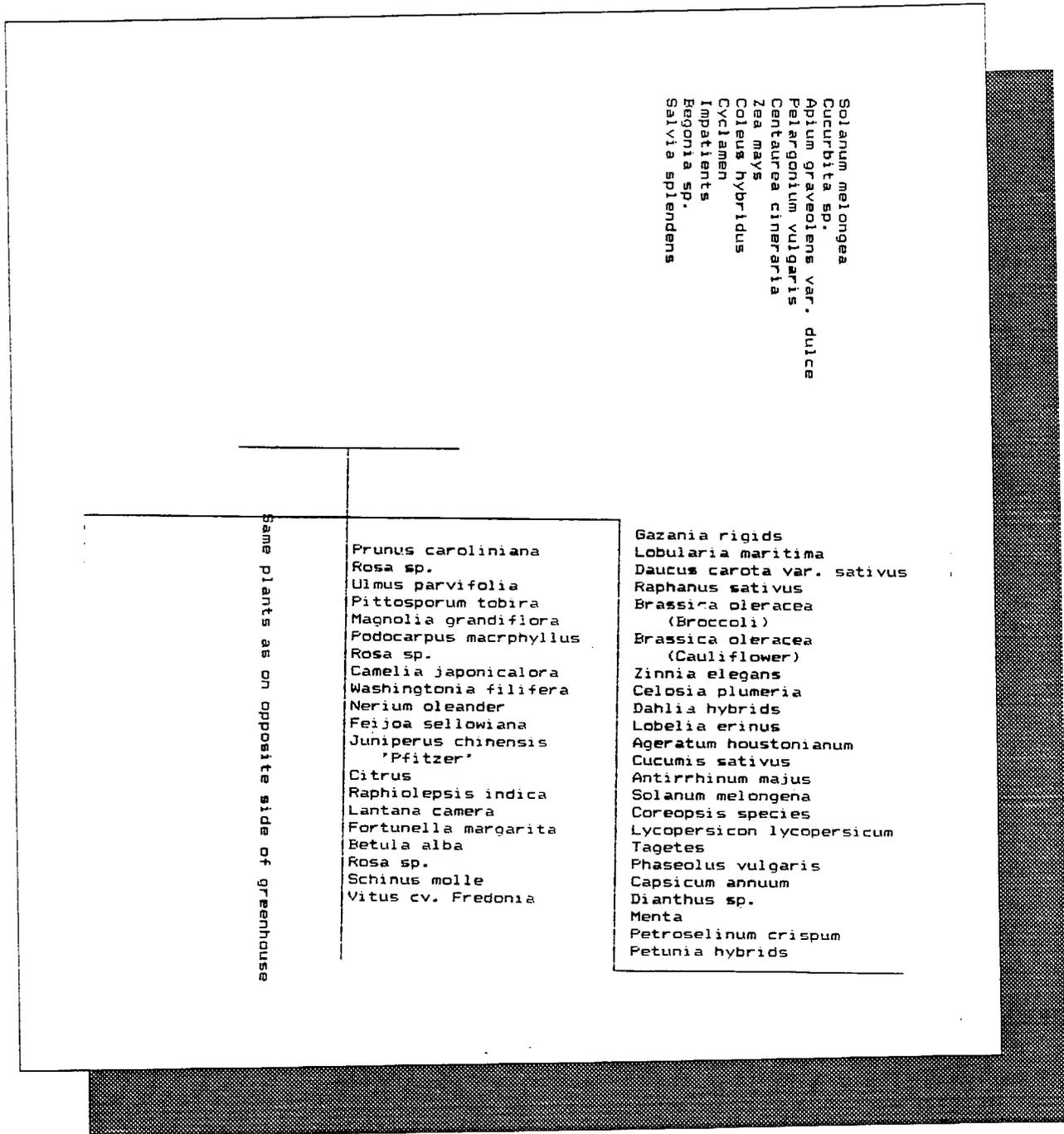


# LAYOUT OF GREENHOUSE DISPLAY AIR POLLUTION GREENHOUSE, 1988

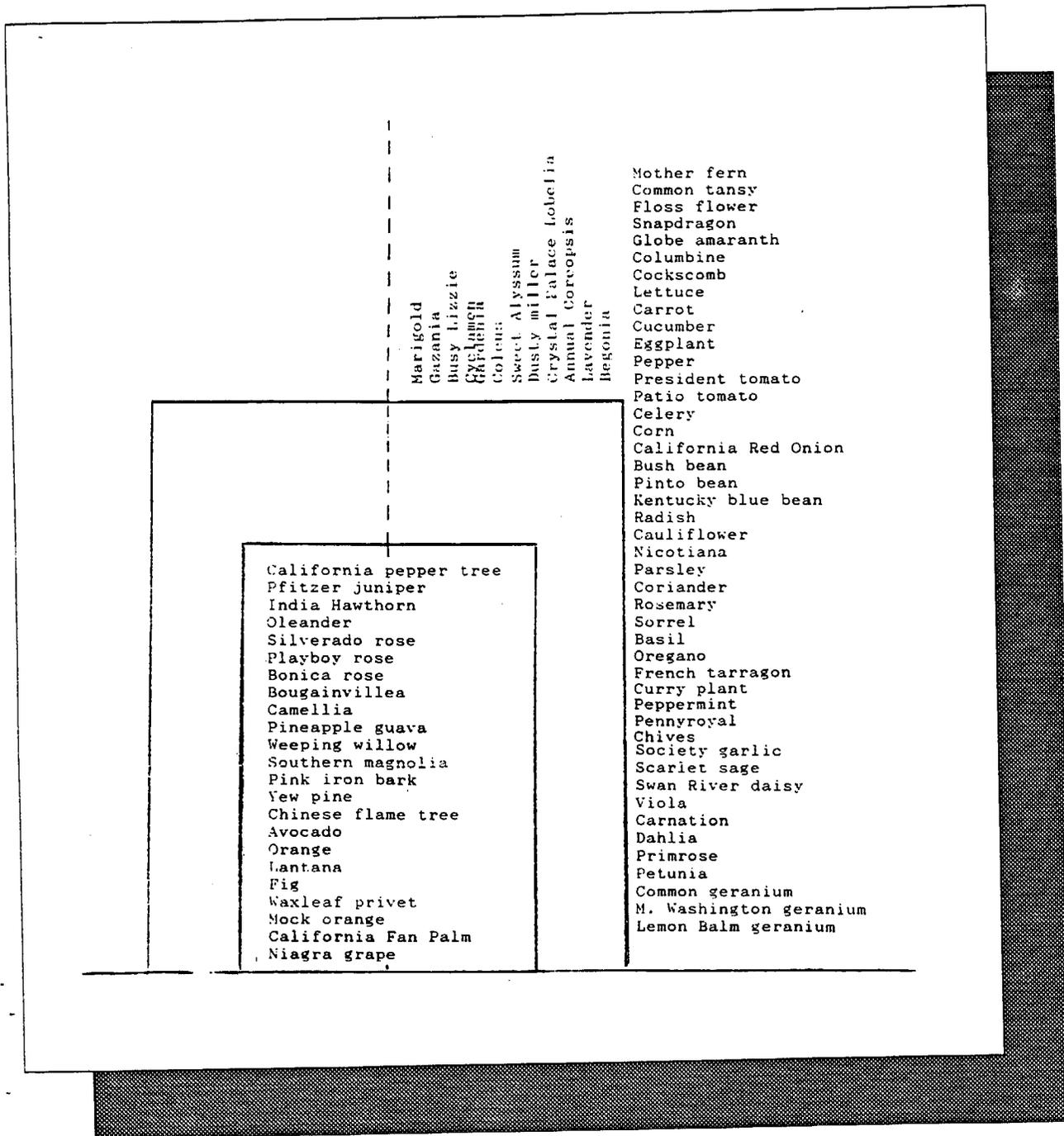


L.A. STATE AND COUNTY ARBORETUM, ARCADIA CA

# LAYOUT OF GREENHOUSE DISPLAY AIR POLLUTION GREENHOUSE, 1989

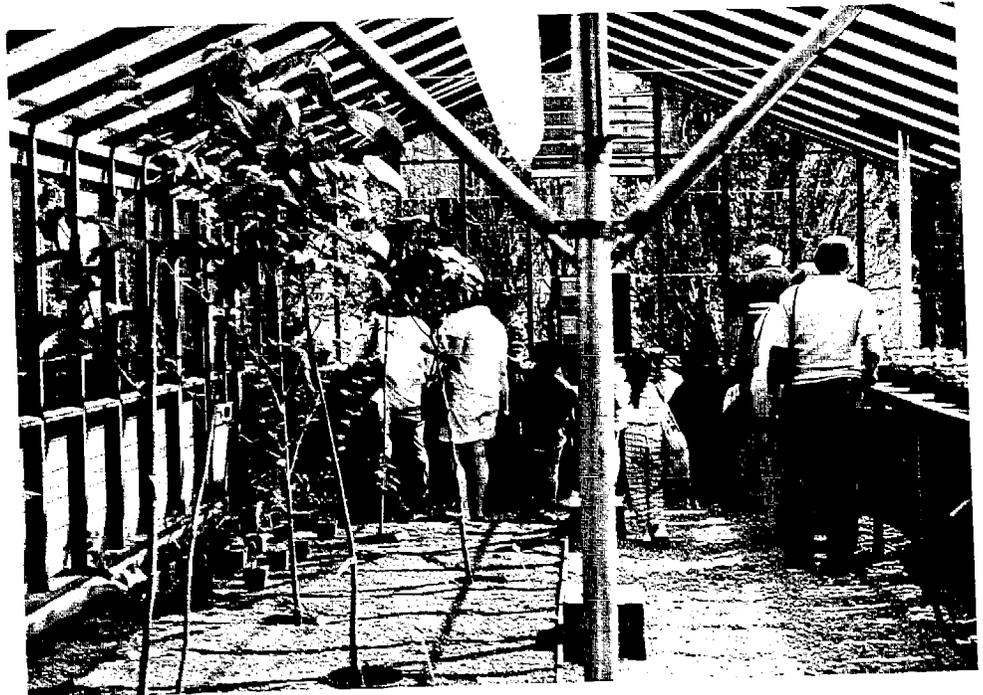


# LAYOUT OF GREENHOUSE DISPLAY AIR POLLUTION GREENHOUSE, 1990

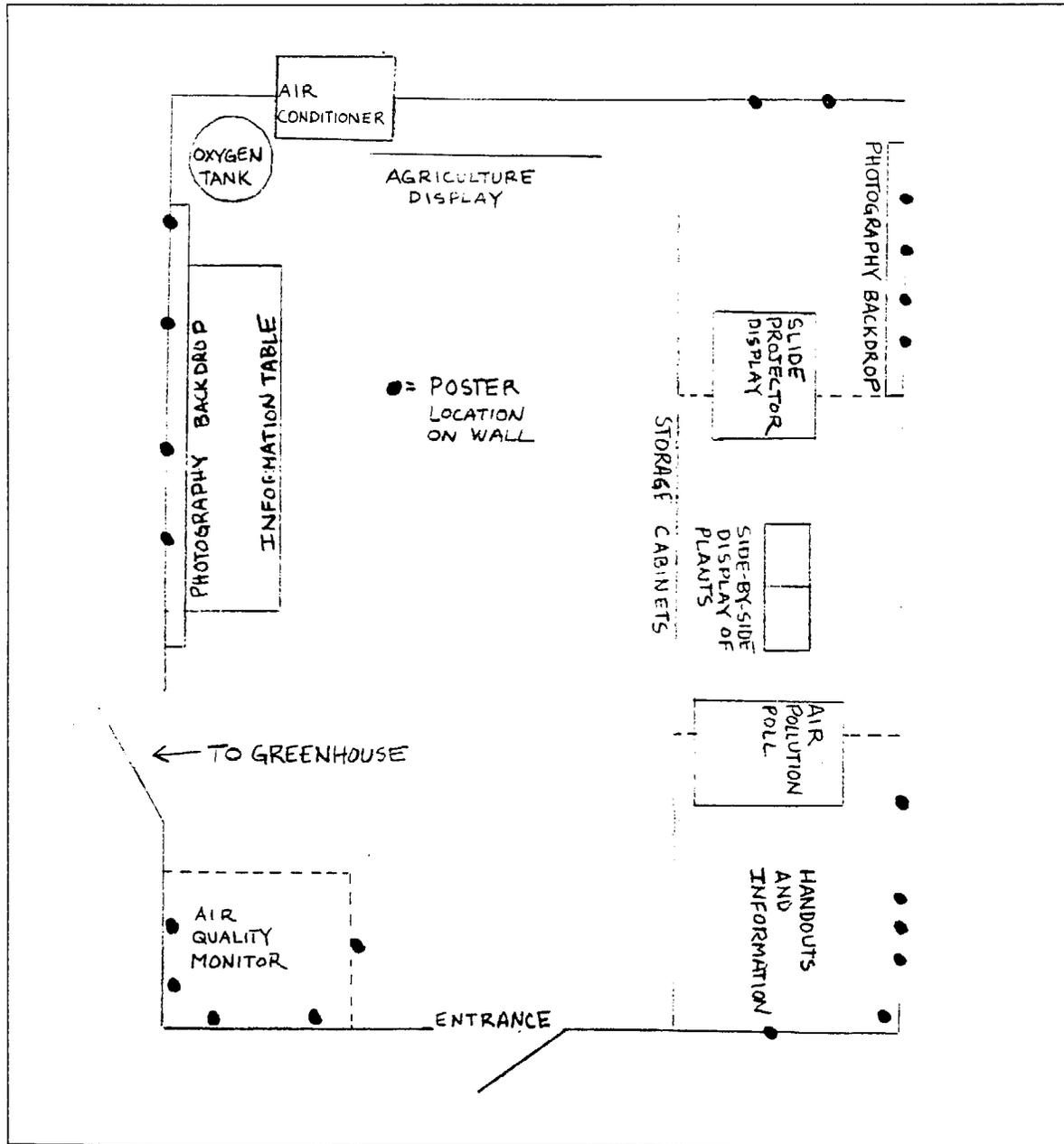


# THE AIR POLLUTION GREENHOUSE DISPLAY AND INFORMATION CENTER

VISITORS OF ALL AGES COME TO THE GREENHOUSE. BENCHES ON THE RIGHT HOLD SMALLER CONTAINERS. LARGER PLANTS ARE PLACED IN FIVE GALLON CONTAINERS AND BURIED IN THE PLANTING BED, SHOWN HERE ON THE LEFT HALF OF THE PICTURE. WHEN THE PLANTS IN THE SMALL POTS SHOWN HERE ON THE GROUND ARE LARGER, THEY WILL BE PLACED ON THE BENCHES. SOME WILL GO IN "SMOGGY AIR" SIDE, SOME TO THE "CLEAN AIR" SIDE. THE GLASS WALL ON THE LEFT EDGE OF THE PICTURE SEPARATES THE TWO SIDES OF THE GREENHOUSE. THE DOOR BETWEEN THE TWO SIDES IS NOT OPEN IN THIS PICTURE.

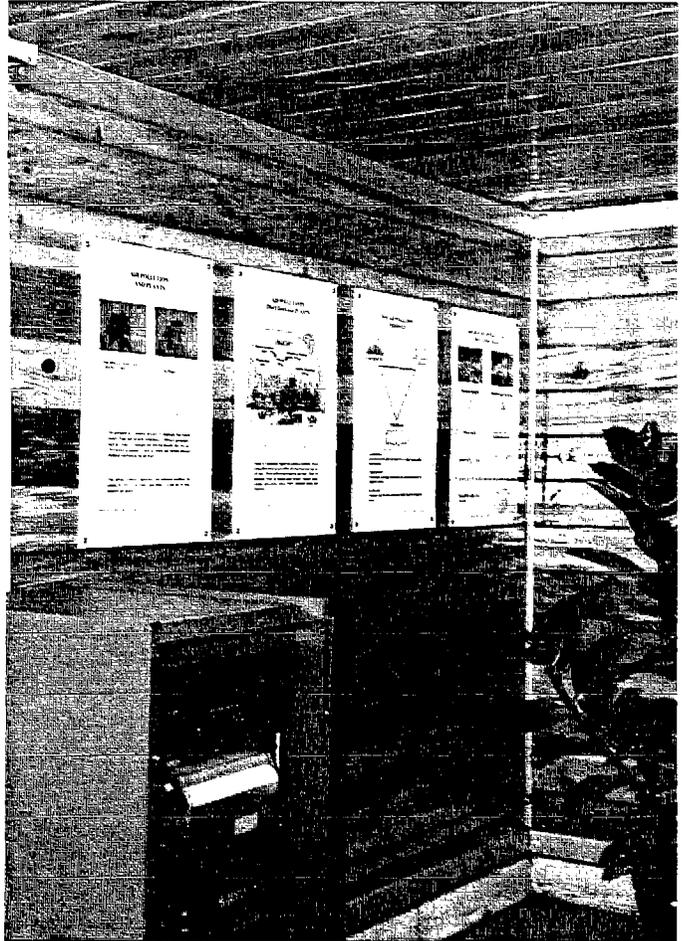


# FLOOR PLAN OF INFORMATION CENTER AIR POLLUTION GREENHOUSE DISPLAY



# THE AIR POLLUTION GREENHOUSE DISPLAY AND INFORMATION CENTER

IN 1987, VISITORS TO THE INFORMATION CENTER COULD SEE AN AIR QUALITY MONITOR AT WORK AND WALL CHARTS DESCRIBING THE SOURCES OF AIR POLLUTION, THE TYPES OF AIR POLLUTANTS, AND HOW POLLUTION IMPACTED PLANTS.



THE HOUSE PLANTS IN THESE PICTURES HAD NO SYMPTOMS OF AIR POLLUTION AND WERE LATER REPLACED WITH LIVING PLANTS WITH AIR POLLUTION SYMPTOMS. THE AIR CONDITIONER IS NEEDED TO KEEP THE AIR QUALITY MONITOR IN OPERATION.



POSTERS ON DISPLAY  
INFORMATION CENTER, 1987-1989

What Air Pollution Numbers [PSI] Mean

Ozone Alert Levels

Parts of the Air Quality Monitor

Air Pollution and Plants

Air Pollutants that Damage Plants

The Air Pollution Triangle

Sources of Air Pollution that Form Ozone

Smog Costs Agriculture Millions

Geography and Air Pollution

Climate and Air Pollution

Air Pollution Damage to Plants

What You Can Do About Air Pollution

Growth Reduction in Dusty Miller

AIR POLLUTION GREENHOUSE, LASCA

POSTERS ON DISPLAY  
NEW POSTERS in INFORMATION CENTER

This Season's Smoggiest Day  
Example of the Air Quality Monitor's Strip Chart  
The Greenhouse: How We Filter the Air  
Air Pollution Can Have the Same Effect on Different  
Plants: Yellow Leaves

Air Pollution Can Have the Same Effect on Different  
Plants: Reduced Growth

Air Pollution Can Have Different Effects on the Same  
Plant: Petunia and Cockscomb

Confused about "Ozone?" An Air Pollutant and the  
Greenhouse Effect

Structure of the Earth's Atmosphere  
Smog Damage to Leaf Cuttings  
What We Do at the Air Pollution Greenhouse  
What is Smog?  
The Air Pollution Poll: What I did to reduce pollution !

# AIR POLLUTION GREENHOUSE IMPROVEMENTS TO THE FACILITIES

LOS ANGELES STATE AND COUNTY ARBORETUM, ARCADIA 1990-91

# THE AIR POLLUTION GREENHOUSE

## PHOTOGRAPHS OF THE IMPROVEMENTS TO THE FACILITY

IMPROVEMENTS WERE MADE TO THE ORIGINAL FACILITIES TO MAKE THE EXHIBIT EASIER TO FIND AND TO UNDERSTAND

New, large direction signs were installed to help the visitors locate the greenhouse.

A new door and welcome sign were added to the entrance of the information center.

A new air conditioner was installed to permit the operation of the pollution monitoring equipment.

The information center was rearranged to permit the construction of a photography studio.

Equipment was added to the potting area and to the information area to fumigate sample plants with ozone so that symptoms were always on display in the greenhouse and information center until the ambient smog levels were high enough to produce symptoms in the smoggy side of the greenhouse.

PHOTOGRAPHS ILLUSTRATING THE IMPROVEMENTS FOLLOW

# THE AIR POLLUTION GREENHOUSE UPGRADE DIRECTION SIGNS TO DISPLAY

NEW SIGN FOR  
WALKWAY TO  
FRONT OF THE  
GREENHOUSE WAS  
ADDED 1989-90.



NEW SIGN FOR  
WALKWAY TO  
SIDE OF THE  
GREENHOUSE WAS  
ADDED 1989-90.



# THE AIR POLLUTION GREENHOUSE IMPROVEMENTS TO INFORMATION CENTER FACILITIES

ENTRANCE TO  
INFORMATION CENTER  
1987

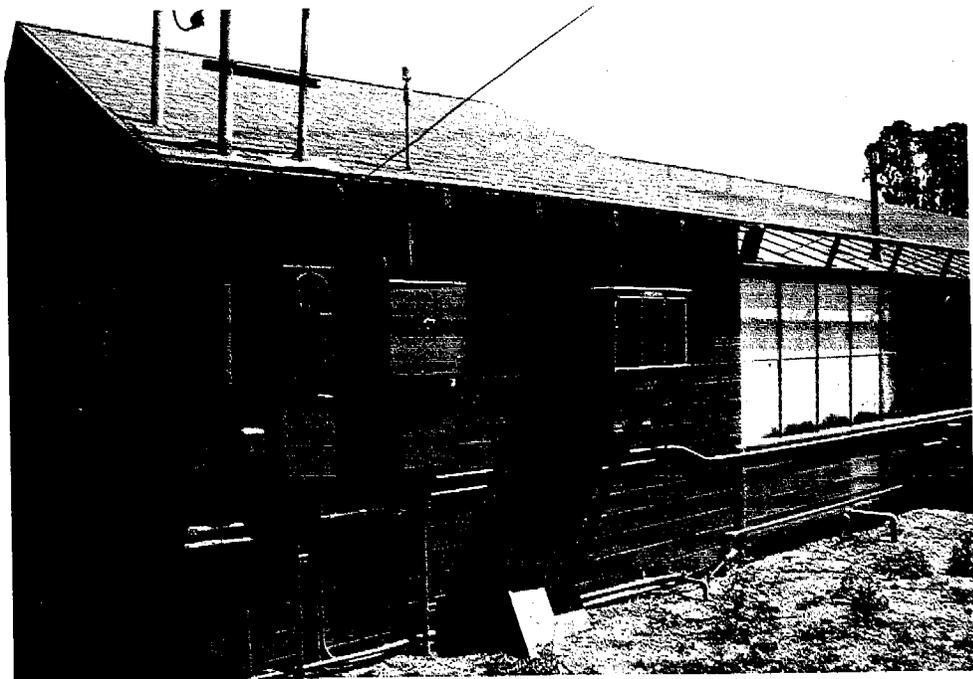


A NEW SIGN AND  
DOOR TO  
INFORMATION  
CENTER WERE  
ADDED 1989-90.



# THE AIR POLLUTION GREENHOUSE IMPROVEMENTS TO INFORMATION CENTER FACILITIES

IN 1989, A NEW AIR  
CONDITIONER WAS  
INSTALLED TO KEEP  
THE AIR QUALITY  
MONITOR OPERATING  
AND THE ELECTRICAL  
CIRCUITS WERE  
UPGRADED

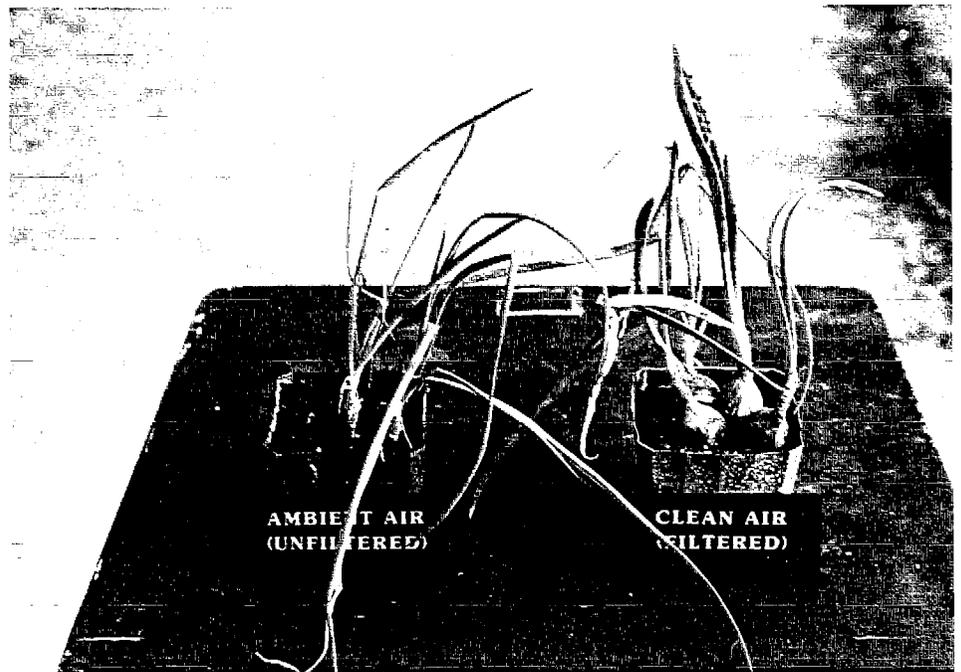


THE AIR QUALITY MONITOR  
WAS RELOCATED TO MAKE  
ROOM FOR A PHOTOGRAPHY  
STUDIO. A LED DISPLAY  
TO INCREASE THE SIZE OF THE  
AIR QUALITY READOUT  
NUMBERS ECHOED THE  
RECORDED OZONE LEVELS



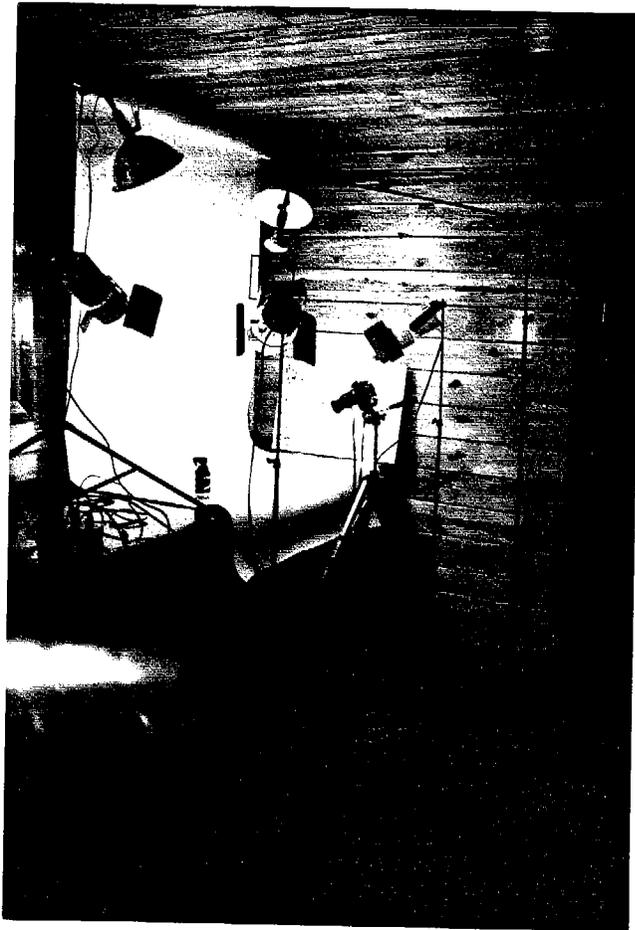
# THE AIR POLLUTION GREENHOUSE IMPROVEMENTS TO INFORMATION CENTER FACILITIES

The first set up to take photographs was to "borrow" the table used to house the questionnaire and move it outside. These photographs show onions produced smaller bulbs in the ambient air side of the greenhouse and that *Browallia speciosa* was almost impossible to grow in the ambient air side of the greenhouse.



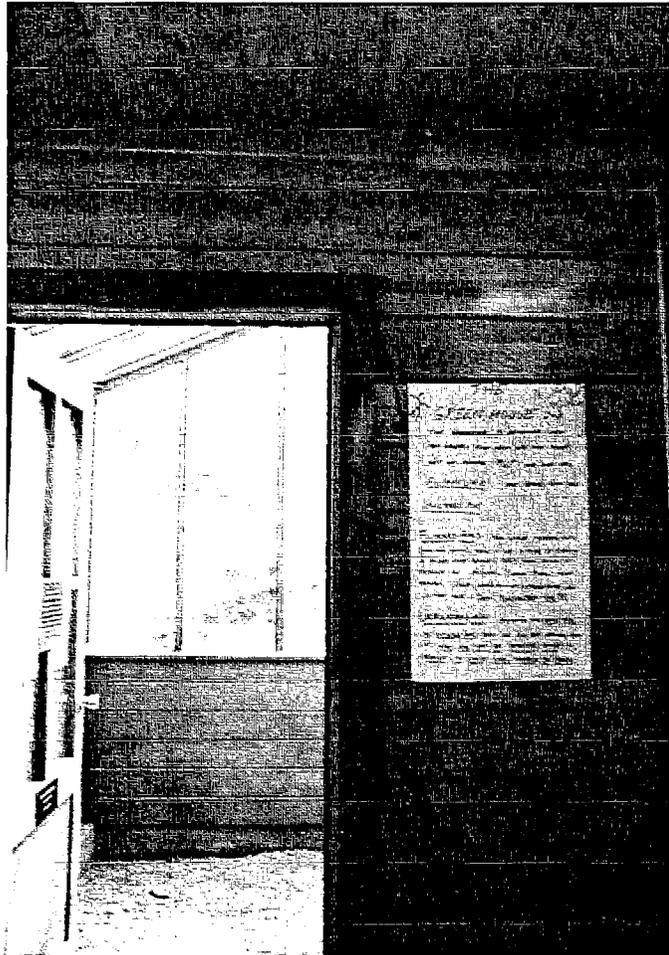
# THE AIR POLLUTION GREENHOUSE IMPROVEMENTS TO INFORMATION CENTER FACILITIES

In 1988 a photography studio was set up in the information center to photograph the smaller plants. At first a plain white backdrop was tried. Because of the location of the power outlets, the studio was near the entrance. The information center had to be closed to the public while photographs were being taken.

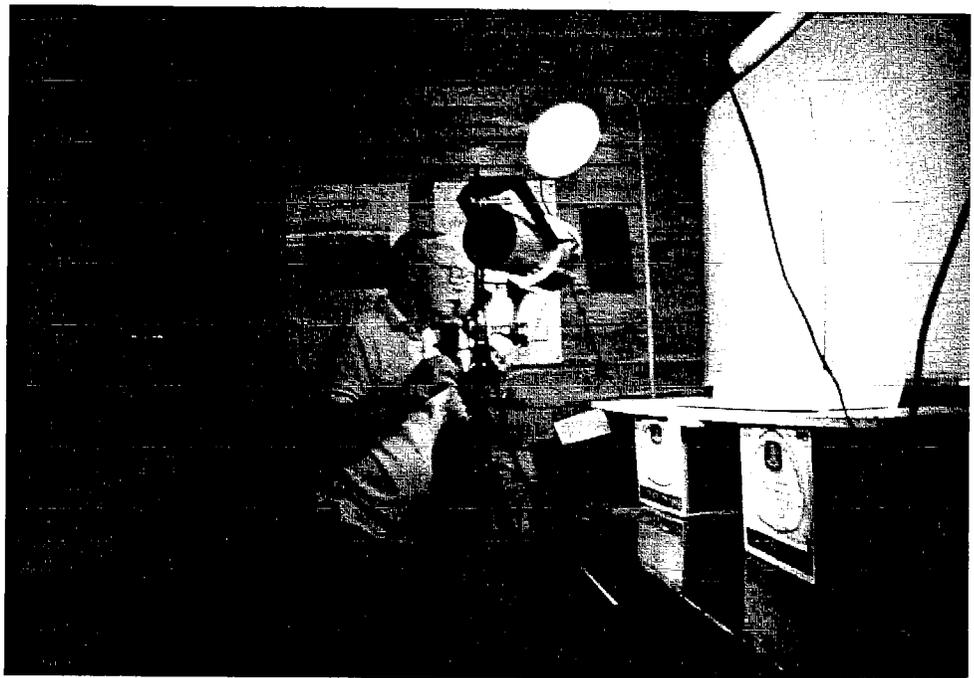


# THE AIR POLLUTION GREENHOUSE IMPROVEMENTS TO INFORMATION CENTER FACILITIES

In 1990 the photography studio was moved to the rear of the information center. The air quality monitor was re-located to permit photography of larger plants. A large pull down backrop was installed near the ceiling. A new poster describing how the air was filtered was displayed when the photography studio was not in use.

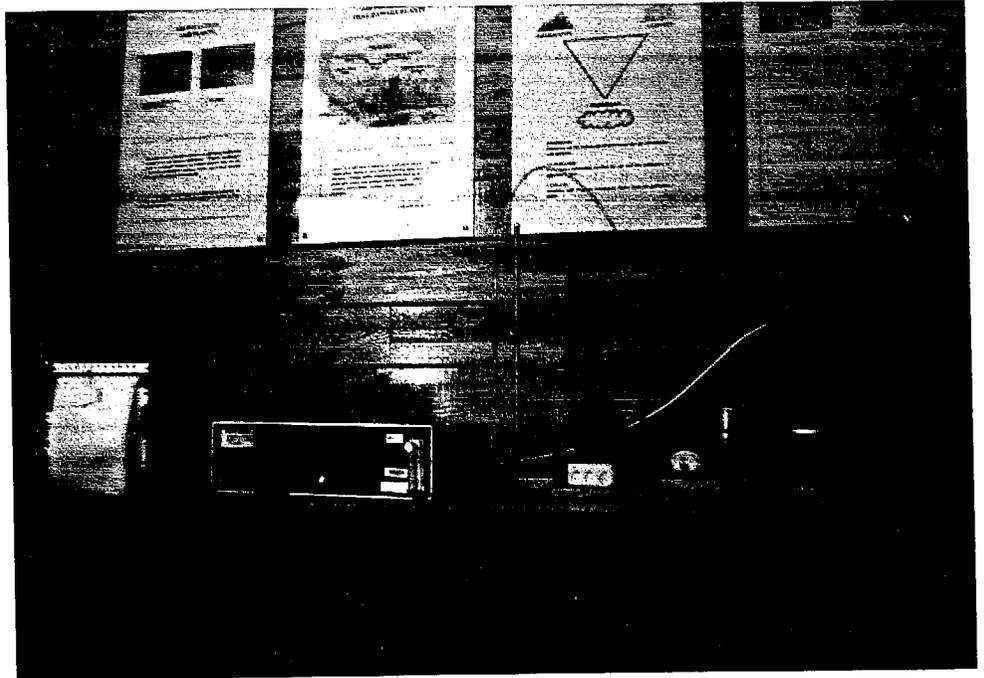


The new photography studio in use by the photographer, Ken Quigley.

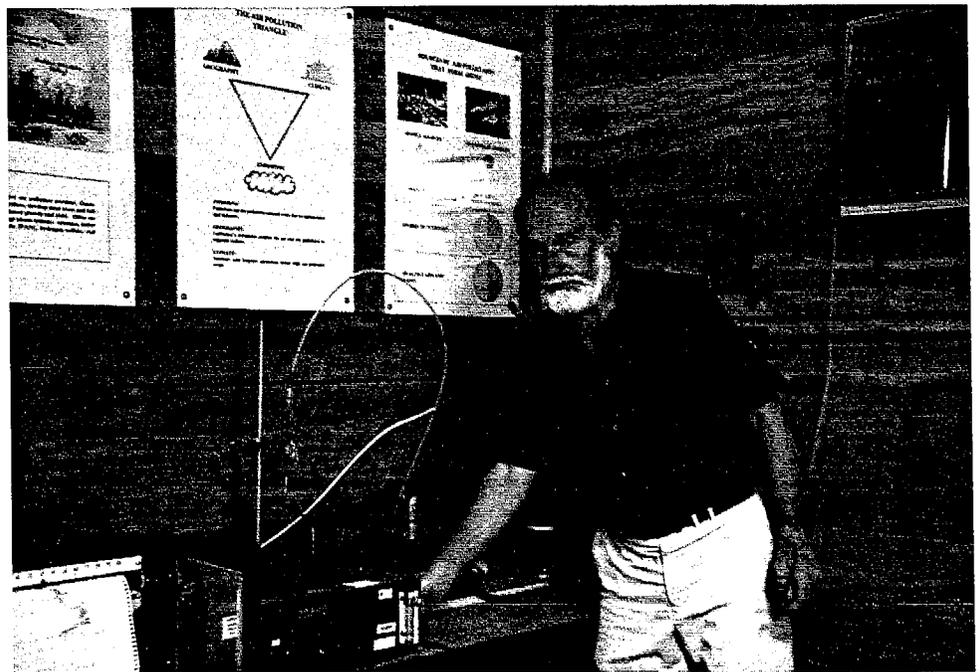


# THE AIR POLLUTION GREENHOUSE IMPROVEMENTS TO INFORMATION CENTER FACILITIES

Equipment was installed to generate ozone, including (LEFT TO RIGHT) a strip chart, ozone monitor, tubes connecting the ozone chamber to the monitor, the generator itself, and an oxygen tank. The potting area was used as the chamber, and the greenhouse was closed to the public during fumigations.



The new ozone generating equipment in use by the air pollution consultant from UC Riverside, Gerrit Kats. Three treatments were required to provide examples of air pollution injury before the ambient side contained high enough levels of "smog" to produce symptoms in the display plants



# THE AIR POLLUTION GREENHOUSE PHOTOGRAPHS OF IMPROVEMENTS TO THE DISPLAYS

IMPROVEMENTS WERE MADE TO THE DISPLAYS IN THE INFORMATION AREA AND THE GREENHOUSES TO HELP THE VISITORS IDENTIFY THE PLANTS AND THE AIR POLLUTION SYMPTOMS

Improvements were made to the signs and posters in the Information Center and new posters and a slide show were added.

A Free-standing floor display was added.

Pairs of plants, one from each side of the Greenhouse, were moved to the Information Center to give visitors a preview and aid in identification of air pollution symptoms.

Visitors were polled about measures they preferred to use in reducing air pollution, and the questionnaire about the Display continued to give feedback about the display.

Vegetation was replaced for the opening of the exhibit season in April and replanted as necessary to maintain examples of pollution symptoms until the exhibit closed in October.

Tour Guides were added to answer questions and to improve the maintenance of the display plants, and increase security.

Photographs were taken of the plants and used in new signs to help the visitors identify the plant species and the pollution symptoms. Photographs of the 77 plants showing the most striking symptoms were used in the signs. An example of the sign is included.

Changes were made to the photography set up to provide a standard background for each picture.

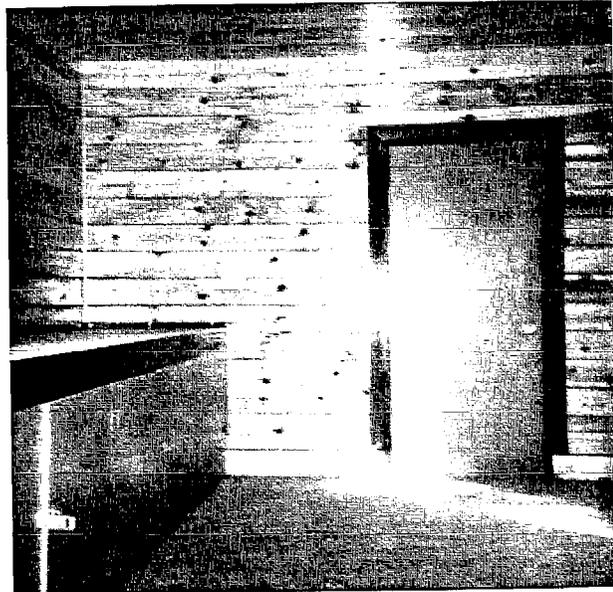
PHOTOGRAPHS ILLUSTRATING THE IMPROVEMENTS FOLLOW

# AIR POLLUTION GREENHOUSE IMPROVEMENTS TO THE INFORMATION CENTER

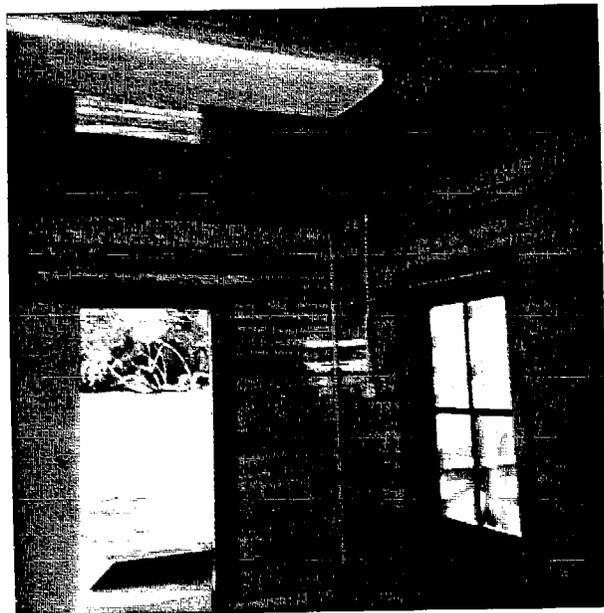
LOS ANGELES STATE AND COUNTY ARBORETUM, ARCADIA 1990-91

# THE AIR POLLUTION GREENHOUSE EXPAND AND IMPROVE INFORMATION DISPLAY

INFORMATION CENTER  
MAIN ENTRANCE, 1987  
BEFORE GRAPHICS  
AND DISPLAYS WERE  
ADDED



THE CLOSED DOOR LEADS TO  
THE POTTING SHED AND  
GREENHOUSE



# THE AIR POLLUTION GREENHOUSE EXPAND AND IMPROVE INFORMATION DISPLAY

## AIR POLLUTION AND PLANTS



AIR POLLUTION CAN CHANGE THIS.....

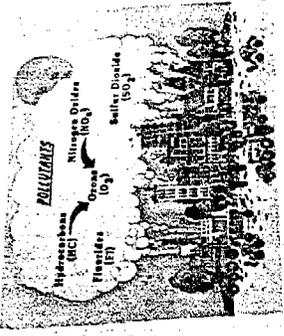
.....TO THIS

Air pollution is a complex mixture of chemicals that results mainly from our modern technology. "Primary pollutants" such as oxides of nitrogen are emitted directly into the air. "Secondary pollutants", such as ozone, are formed through chemical reactions in the air itself.

This exhibit explains California's air pollution problem, its causes, its effects on plants, and what you can do to help improve air quality.

1

## AIR POLLUTANTS THAT DAMAGE PLANTS



**POLLUTANTS**

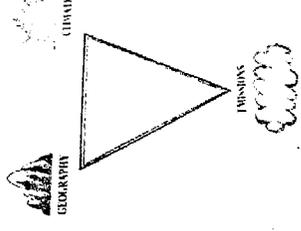
Hydrocarbons (HC)  
Ozone (O<sub>3</sub>)  
Nitrogen Oxides (NO<sub>x</sub>)  
Sulfur Dioxide (SO<sub>2</sub>)

These pollutants damage plants by blocking sunlight, interfering with photosynthesis, and causing leaf injury.

Ozone is California's biggest air pollution problem. Ozone causes plant leaves to turn yellow, develop leaf scars and fall off early. It also can damage plants inside: ethylene, sulfur dioxide, peroxyacetyl nitrate (PAN), hydrogen sulfide, and freonides.

2

## THE AIR POLLUTION TRIANGLE



**GEORGIVIN** (top vertex)  
**CLIMATE** (bottom-left vertex)  
**POLLUTION** (bottom-right vertex)

Interactions between these three factors create the air pollution problem.

**LEGEND:**  
 - Pollution is the pollution released from the automobile and industry.  
 - Climate: weather conditions that affect the pollution.  
 - Geogivins: natural conditions that affect the pollution.  
 - Climate: weather and topography that affect the pollution.

3

## SHIELDING AIR POLLUTIONS THAT HARM PLANTS

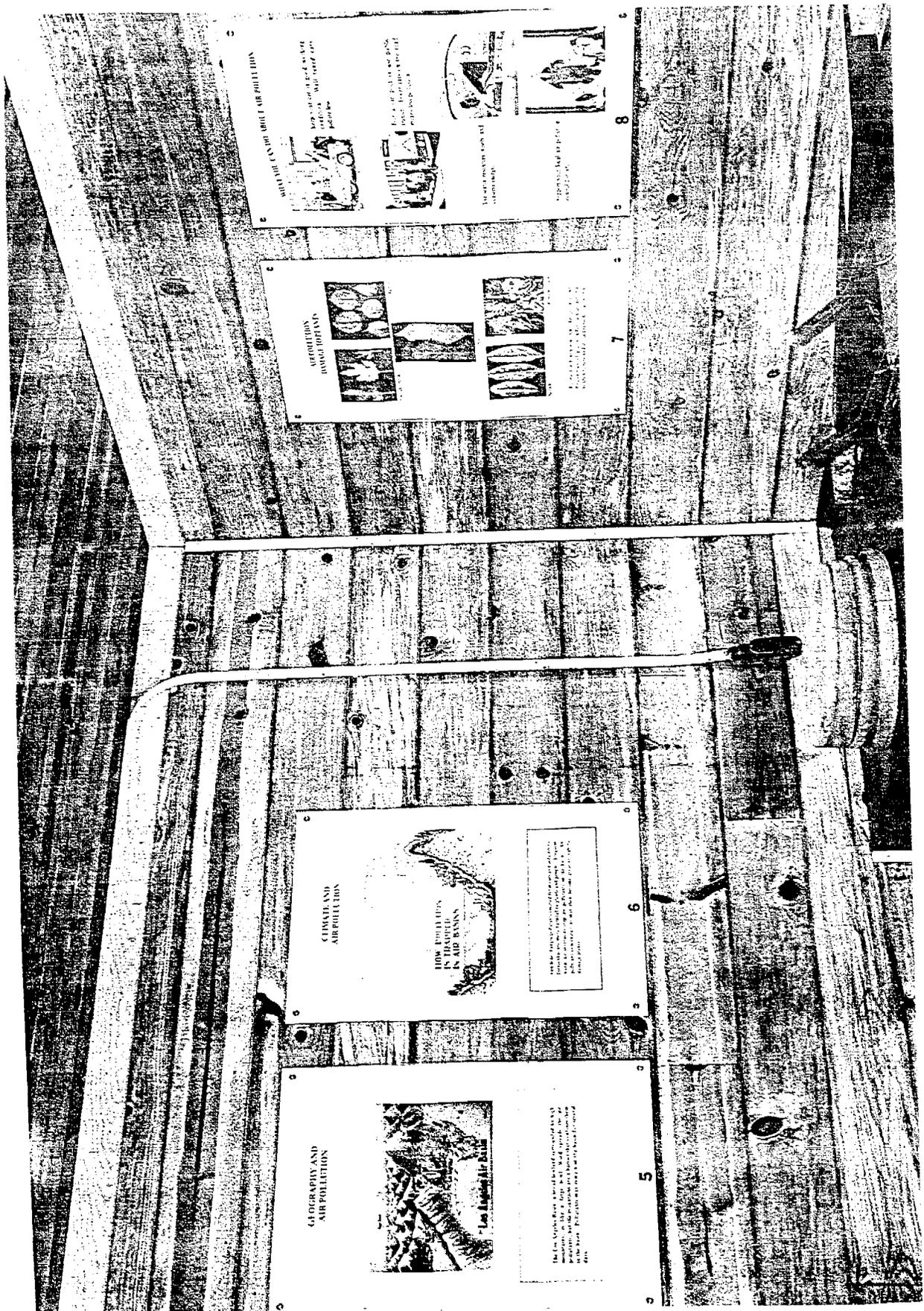


**WIND BREAKERS**  
**WIND TUNNELS**  
**WIND TUNNELS**  
**WIND TUNNELS**

**PLANTING**  
**WIND TUNNELS**  
**WIND TUNNELS**

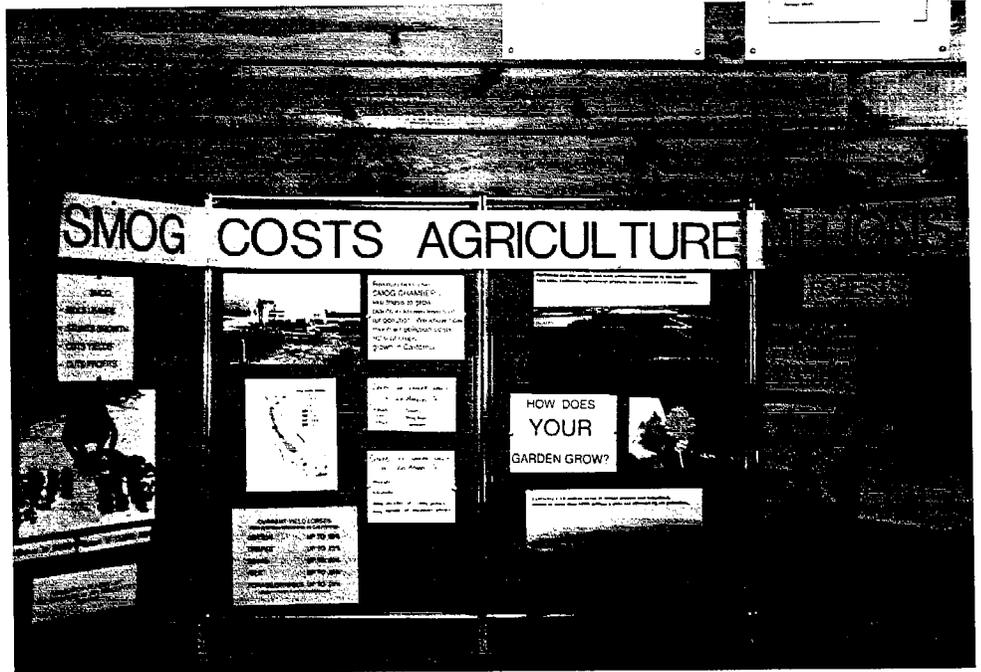
4

# THE AIR POLLUTION GREENHOUSE EXPAND AND IMPROVE INFORMATION DISPLAY

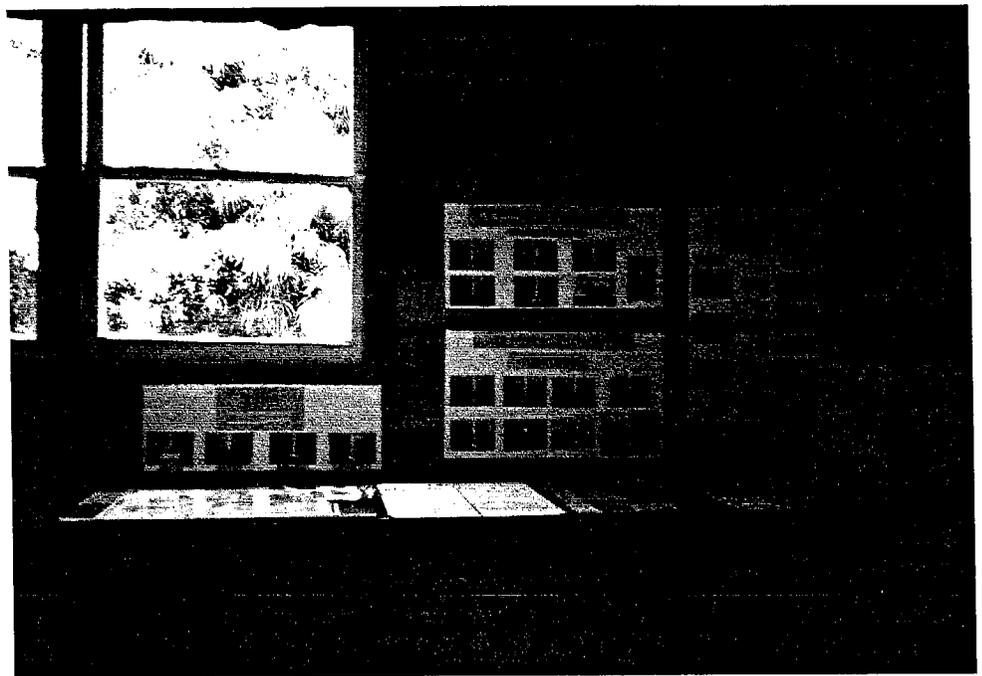


# THE AIR POLLUTION GREENHOUSE EXPAND AND IMPROVE INFORMATION DISPLAY

FREE STANDING  
DISPLAY:  
"SMOG COSTS  
AGRICULTURE  
MILLIONS"  
ADDED, 1989-90

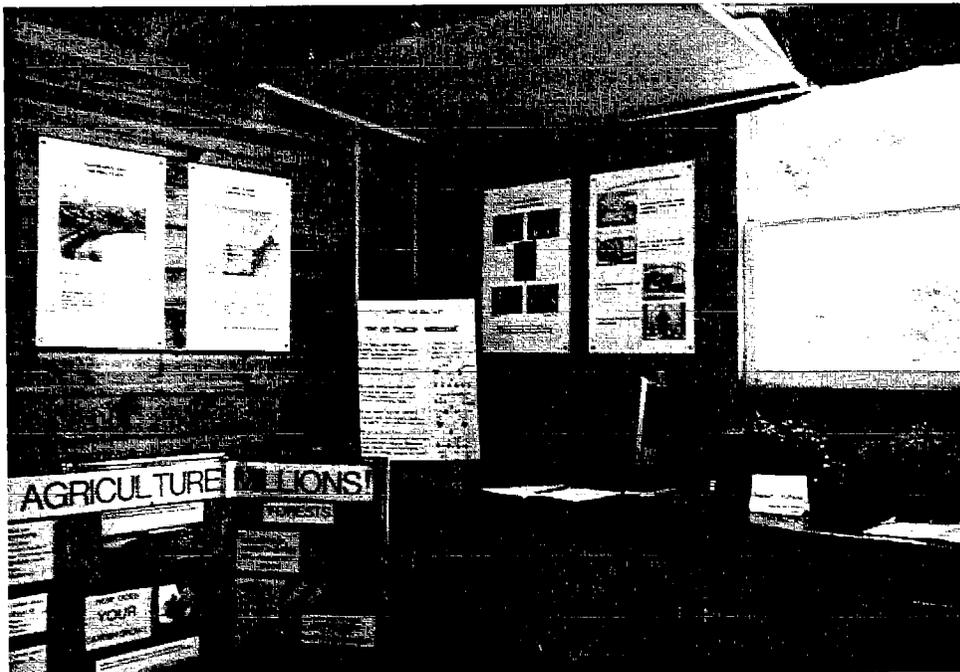


SYMPTOM  
IDENTIFICATION  
POSTERS,  
ACTIVITY POLL,  
AND NEW HANDOUTS  
ADDED, 1990-91



# THE AIR POLLUTION GREENHOUSE EXPAND AND IMPROVE INFORMATION DISPLAY

VIEW OF THE GRAPHICS ON THE WALLS AND DISPLAY ITEMS ON THE WORK BENCH IN THE DISPLAY AREA OF THE INFORMATION CENTER. AN AUTOMATIC SLIDE PROJECTOR WITH A BUILT IN SCREEN SHOWED PHOTOGRAPHS OF SYMPTOMS AND SELECTED PLANTS GAVE VISITORS A PREVIEW OF THE "SYMPTOM OF THE DAY" TO AID THEM IN IDENTIFYING SYMPTOMS IN THE GREENHOUSE. NEW POSTERS WERE ADDED, SHOWN HERE NEXT TO THE WINDOW AND AS A FREE STANDING DISPLAY ON THE FLOOR. THE NEW POSTERS EXPLAINED HOW THE GREEN HOUSE WAS OPERATED AND SHOWED VISITORS HOW AIR POLLUTION SYMPTOMS SHOW UP ON LEAVES. A PULL DOWN BACKDROP WAS CONSTRUCTED TO COVER THE WINDOW WHEN THE PHOTOGRAPHS WERE BEING TAKEN. IT PROVIDED A STANDARDIZED GRIDDED BACKGROUND FOR ALL THE PHOTOGRAPHS TO AID THE VIEWER IN IDENTIFYING THE PLANT'S NAME, TYPE OF EXPOSURE, SIZE, DATE AND LOCATION.



# AIR POLLUTION GREENHOUSE IMPROVEMENTS TO THE GREENHOUSE DISPLAY

LOS ANGELES STATE AND COUNTY ARBORETUM, ARCADIA 1990-91

# THE AIR POLLUTION GREENHOUSE EXPAND AND IMPROVE GREENHOUSE DISPLAY

GREENHOUSE  
IN 1987 BEFORE  
PLANTS WERE  
ADDED, SHOWING  
SHOWING BENCH  
AND FLOOR  
AREAS. THE  
GLASS WALL  
BETWEEN THE  
FILTERED SIDE  
AND THE NON  
FILTERED SIDE  
IS ON THE LEFT  
OF THE PICTURE.



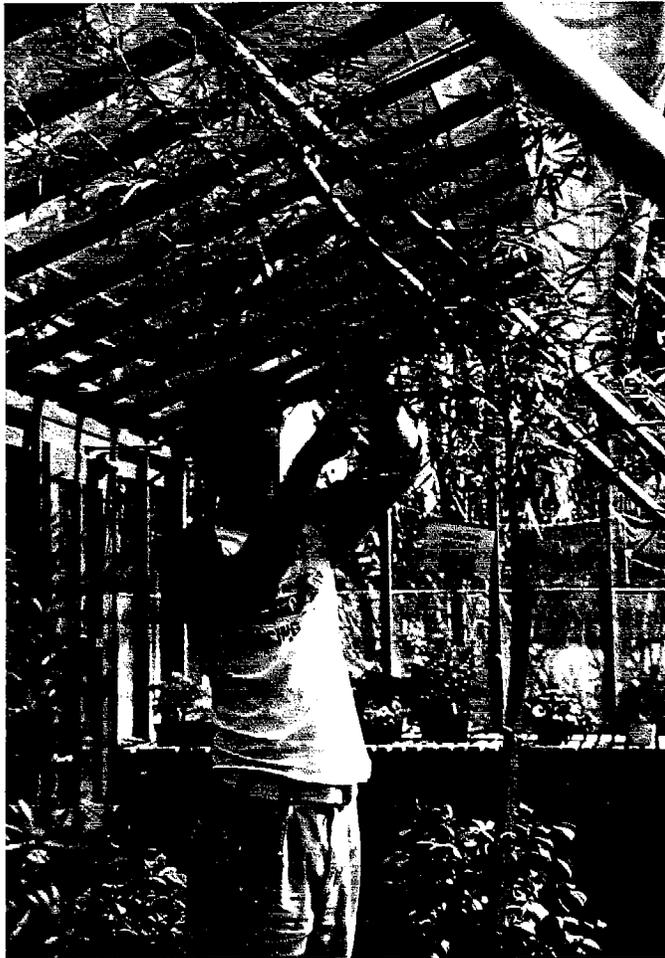
NEW DISPLAY  
PLANTS ARE  
ADDED IN APRIL  
WHEN THE EXHIBIT  
OPENS. THIS 1987  
PHOTOGRAPH OF THE  
CLEAN AIR SIDE  
INDICATES HOW  
VIGOROUSLY THE  
PLANTS GROW IN  
CLEAN AIR. PLANTS  
IN THIS LAYOUT  
ARE DIFFICULT TO  
IDENTIFY AND THE  
VIEWER CANNOT  
EASILY COMPARE  
PLANTS FROM  
ONE SIDE WITH  
PLANTS FROM  
ANOTHER.



# THE AIR POLLUTION GREENHOUSE EXPAND AND IMPROVE GREENHOUSE DISPLAY

AFTER THE FIRST DISPLAY SEASON, PLANTS WERE DISCARDED WHEN THEY NO LONGER DISPLAYED AIR POLLUTION SYMPTOMS, SO THE EXHIBIT DID NOT APPEAR SO CLUTTERED. HERE, JOE WILLIAMS IS PROVIDING THE NECESSARY CARE TO MAINTAIN THE PLANTS AT THE QUALITY REQUIRED FOR A DISPLAY OF AIR POLLUTION SYMPTOMS.

NEW PLANTS IN POTS ARE REPLACED AS NEEDED TO KEEP THE SYMPTOMS CLEARLY VISIBLE. PLASTIC DUCTS NEAR THE ROOF MOVE THE AIR FROM THE AIR CONDITIONING AND FILTERING EQUIPMENT THROUGH THE GREENHOUSE.



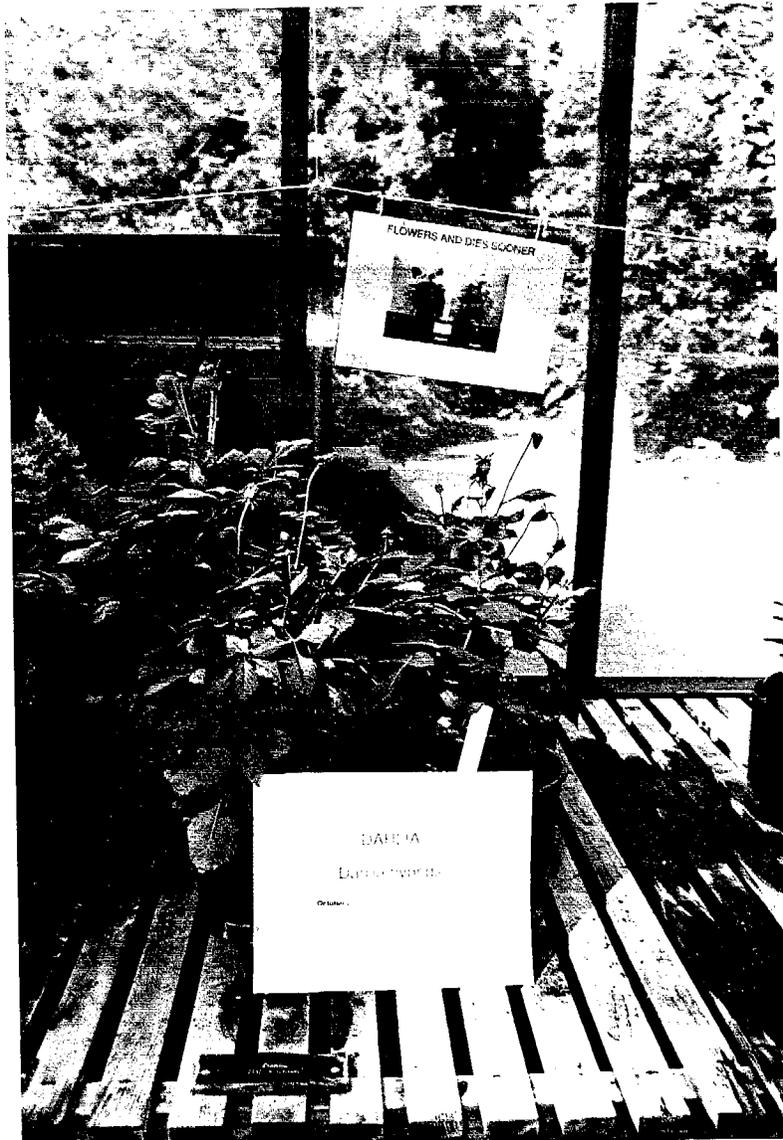
# THE AIR POLLUTION GREENHOUSE EXPAND AND IMPROVE GREENHOUSE DISPLAY

In 1989, tour guides were added to the display. Here, in 1990, Gloria Mao gives a tour designed for the age of the audience. These junior high school students enjoy smelling the air in the filtered side. The glass wall in the background separates the potting area/ fumigation chamber from the rest of the plant display area and the information center. Staffing the greenhouse with guides all the hours it was open improved security.



# THE AIR POLLUTION GREENHOUSE EXPAND AND IMPROVE GREENHOUSE DISPLAY

Visitors commented that differences in size, shape, or color of leaves and flowers were difficult to see from one side of the greenhouse to the other. The signs on the plants were improved in 1989-1990. The sign nailed to a bench in front of the Dahlia is traditional, but expensive and too small to see easily. The sign in front of the plant is too big to leave in the display and too small to use in a photograph. The sign above the plant helps the visitor identify the type of smog injury.



# THE AIR POLLUTION GREENHOUSE EXPAND AND IMPROVE GREENHOUSE DISPLAY

New, large laminated signs show the plant's scientific and common names. These signs are cheap, easy to make, read and relocate. Photos were taken in the filtered side.



# THE AIR POLLUTION GREENHOUSE EXPAND AND IMPROVE GREENHOUSE DISPLAY

Plume cockscomb makes a good display plant because the flowers fade dramatically in the smoggy side of the greenhouse (top photograph). The bottom photograph was taken in the clean air side.



PLUME COCKSCOMB  
*Celosia plumeria*

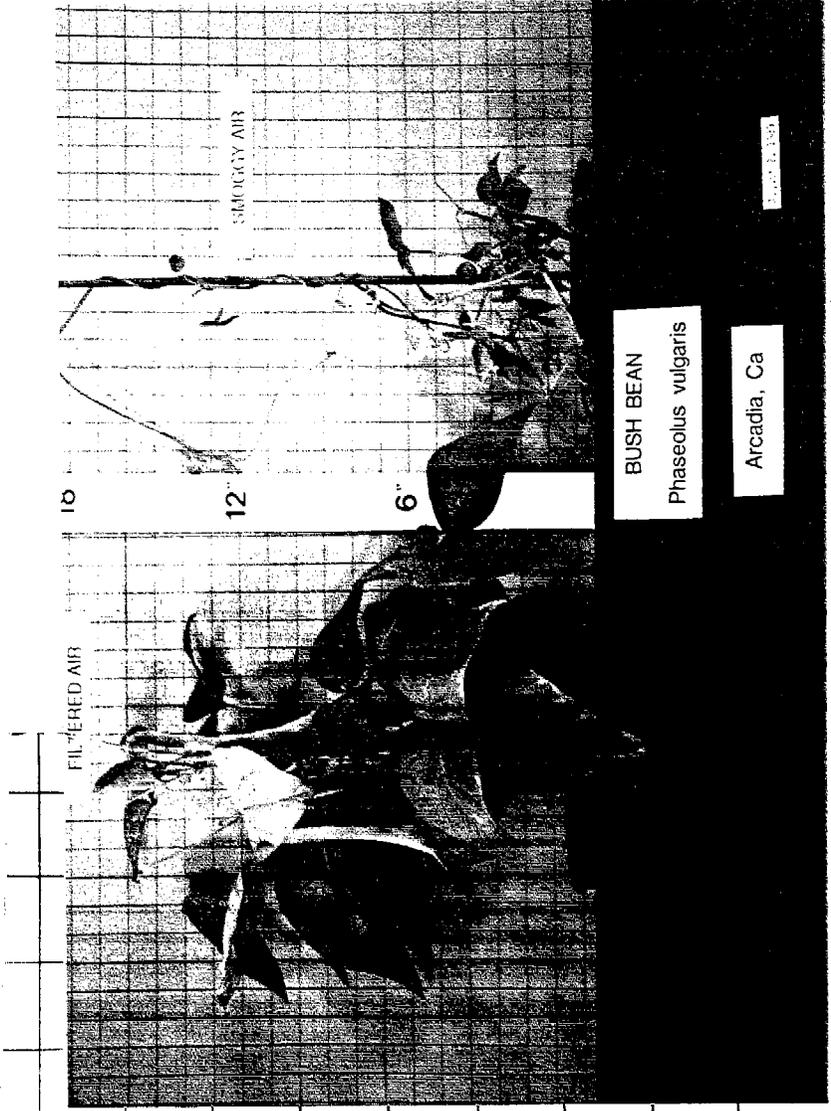
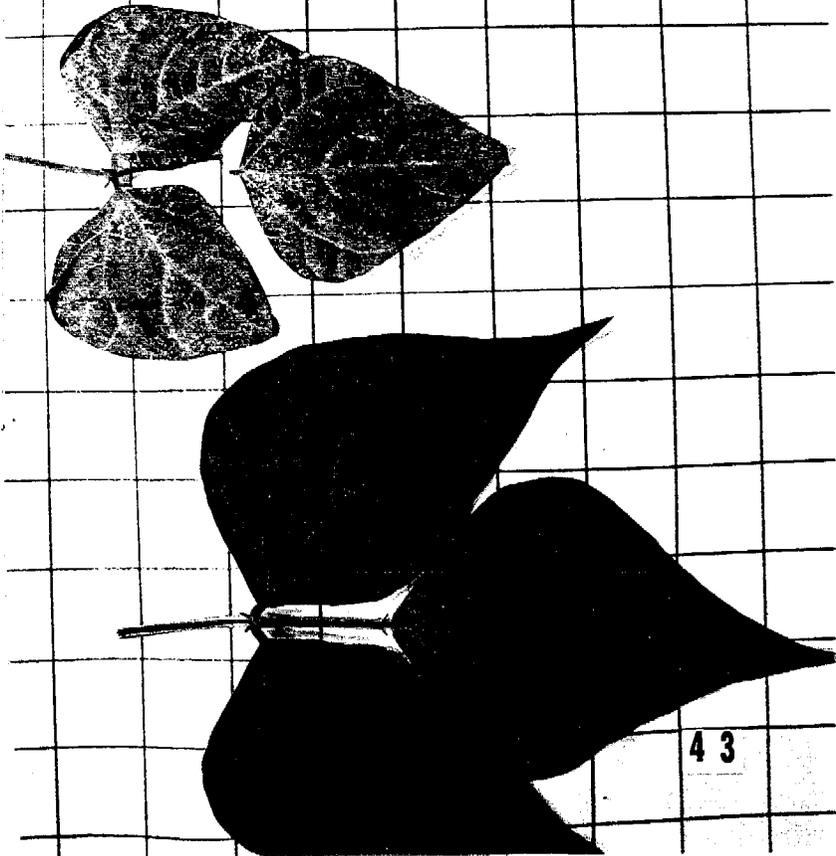
# THE AIR POLLUTION GREENHOUSE EXPAND AND IMPROVE GREENHOUSE DISPLAY

The group of coleus plants on the left are grown in the clean air side of the greenhouse, and are brighter and bigger than the photograph below. However, this difference is not obvious all season long. In 1990, signs were hung behind each type of plant, showing the visitor what symptom is most obvious. Photographs taken in 1989 were used to make the improved signs. Coleus is a good plant to put in the display because the growth reduction is obvious even when viewed from the pathway in the greenhouse. A photocopy of a sign is on the next page.



# LEAF SPOTS

# SMALLER LEAVES



BUSH BEAN  
*Phaseolus vulgaris*

Arcadia, Ca

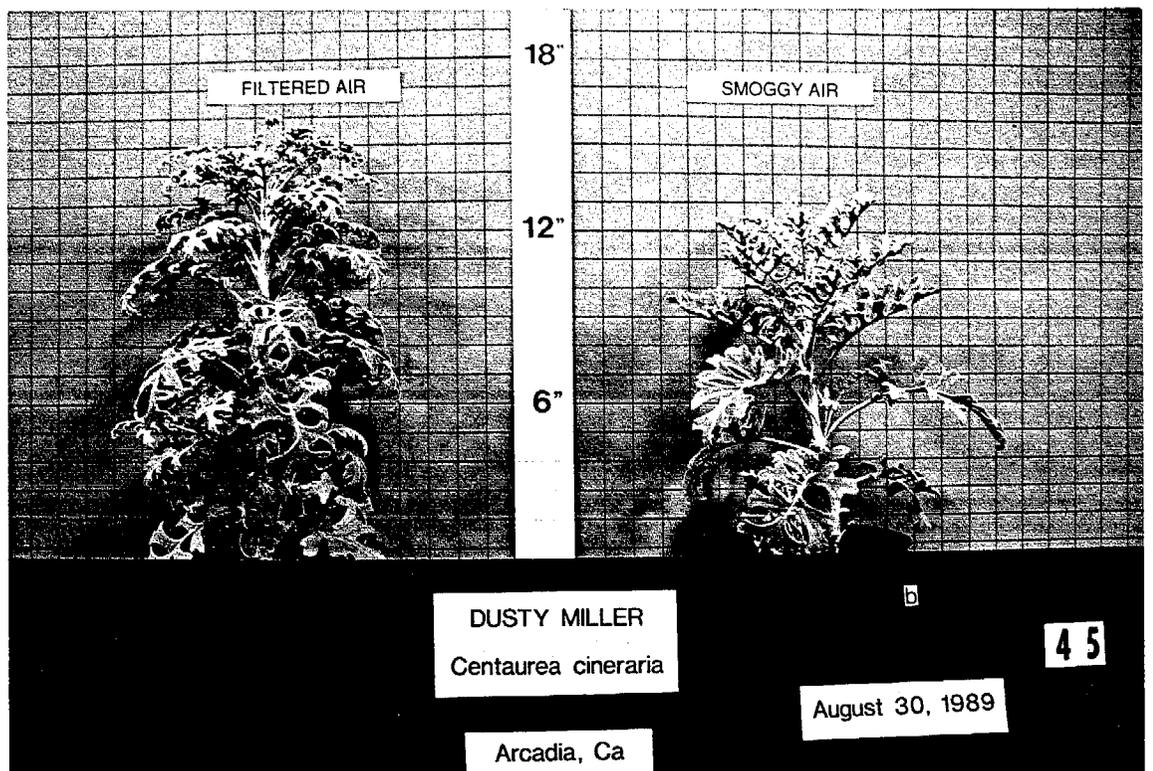
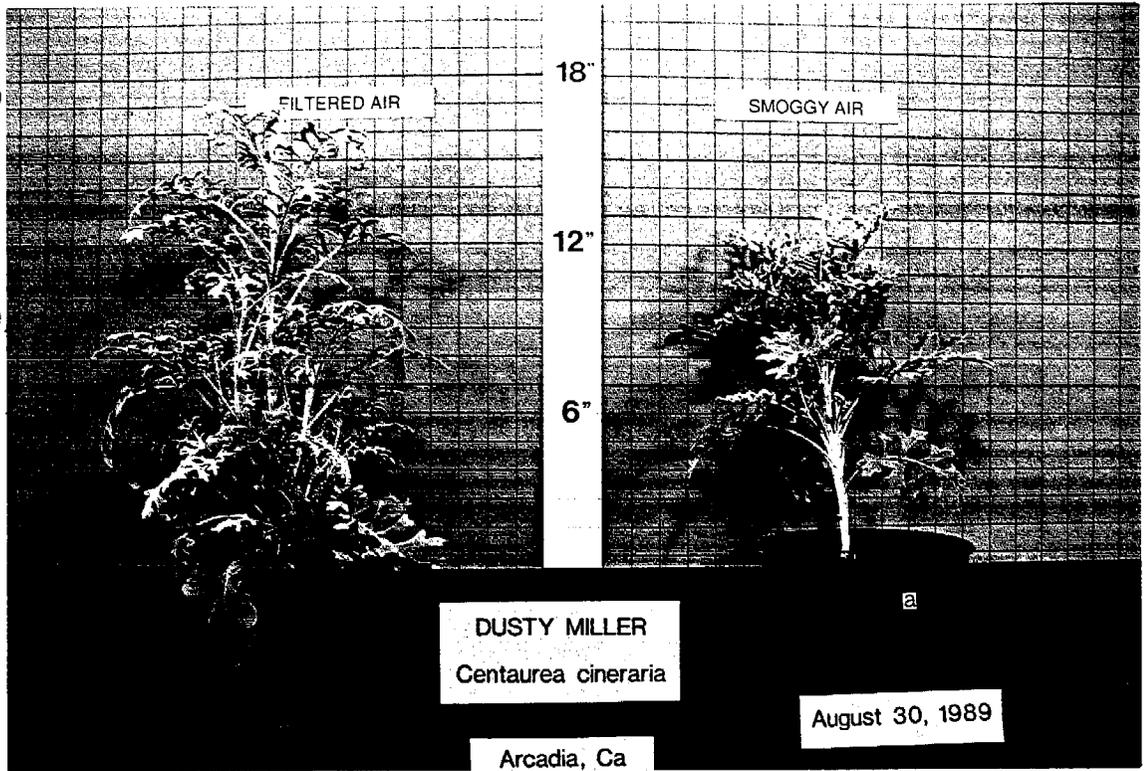
# THE AIR POLLUTION GREENHOUSE EXPAND AND IMPROVE GREENHOUSE DISPLAY

Reductions in growth due to air pollution were documented using groups of plants kept in each side of the greenhouse and photographed every two weeks against a standard background. The photograph below is the group of Dusty Miller plants in the unfiltered side. Although available space limited the size of the group, these plants all appear to be of a similar size and without symptoms. Unless compared with the matched set from the unfiltered side, it is difficult to see any growth reductions.



# THE AIR POLLUTION GREENHOUSE EXPAND AND IMPROVE GREENHOUSE DISPLAY

All these Dusty Miller plants were grown from seed in the filtered side, and then half were transferred to the unfiltered side. both the "A" plants and the "B" plants showed growth reductions in the smoggy side of the greenhouse. The growth reduction photographs were made possible by the addition of the photography studio in 1989-90.



# THE AIR POLLUTION GREENHOUSE EXPAND AND IMPROVE GREENHOUSE DISPLAY

These 1987 photographs of *Washingtonia filifera* show that California Fan palm is a good tree to put in the exhibit because differences in the leaves were striking. Additional improvements are needed to the photography set up to photograph air pollution symptoms on plants which live longer than one season or are too large have more than one plant in each side of the greenhouse.



# THE AIR POLLUTION GREENHOUSE EXPAND AND IMPROVE GREENHOUSE DISPLAY

This 1989 photograph of the California Fan Palm was taken at a time in which the leaf injury symptoms were not as striking as they were in the previous photographs, which were taken in 1987. The time of the visit and the timing of the photography can be critical in seeing the symptoms and the order in which they appear. The tree on the right is from the smoggy side of the greenhouse, and is smaller and has lost some of its fronds.



## PROBLEMS WITH DISPLAY PLANTS IN GREENHOUSE, 1990

TYPE OF PROBLEM	PLANT WITH PROBLEM
SNAILS	CAULIFLOWER, CUCUMBER RADISH, GRAPE
ANTS	CORIANDER, IMPATIENS, PEPPER
APHIDS AND ANTS	CAULIFLOWER, PEPPER CORIANDER, CARROT CARNATION, PARSLEY AVOCADO
SPIDER MITES	FLOSSFLOWER, CELERY, PEPPER CORIANDER, DAHLIA, CARROT, CARNATION, GARDENIA, IMPATIENS MINT, BASIL, PARSELY, RADISH, ROSES, SORREL, MARIGOLD, CORN COREOPSIS, BEANS
WHITEFLIES	ORANGE, TOMATO, AVOCADO, MOCK ORANGE
POWDERY MILDEW	BEGONIA, EGGPLANT, PRIMROSE VIOLA
SOOTY MOLD	ORANGE, AVOCADO, TOMATO, LANTANA, NICOTIANA, GERANIUM
HEAT STRESS	SNAPDRAGON, COLUMBINE, SWAN RIVER DAISY, CAULIFLOWER, COREOPSIS, CUCUMBER, LAVENDER, LETTUCE, PRIMROSE, EGGPLANT, VIOLA, GRAPE, BEGONIA
POOR ADAPTATION, CAUSE UNKNOWN	FRENCH TARRAGON, CHINESE FLAME TREE, YEW PINE WEeping WILLOW

LOS ANGELES STATE AND COUNTY ARBORETUM, ARCADIA CA

PESTICIDES USED IN GREENHOUSE, 1990  
GREENHOUSE CLOSED DURING CHEMICAL APPLICATIONS

CHEMICAL, DATE APPLIED	EFFECTIVENESS
METALDEHYDE 4/11/90	1 application eradicated snails for entire season
SAFER SOAP 6/15, 6/30, 7/15 and repeated as needed	Mildly effective on aphids for 3 days to one week. Severe damage to scarlet sage cockscomb, nicotiana
DIAZINON 5/8, 6/15, 8/13	1 application very effective on ants for up to 2 months
MAVRIK 6/18 [24 hr shutdown]	1 application very effective on aphids, whiteflies, or spider mites for up to 3 week
PENTAK 6/18 [24 hr shutdown]	1 application effective on spider mites for up to 3 week
RESMETHRIN 7/9, 8/13 [16 hr shutdown]	1 application moderately effective for aphid and whitefly for up to 2 weeks
ORTHENE 7/16 [16 hr shutdown]	1 application gave moderate control for spider mites & whitefly for up to 2 weeks
EXCLUDE 8/18, 9/7	Spot treatments moderately effective for aphids, spider mites and whiteflies for 2-3 weeks
CHIPCO 6/18	Fungicide to control powdery mildew; 1 application eliminated fungus for 3 months

LOS ANGELES STATE AND COUNTY ARBORETUM, ARCADIA CA

PHOTOGRAPHS OF ORNAMENTALS

EQUIPMENT USED AND  
CHANGES IN THE  
SET-UP

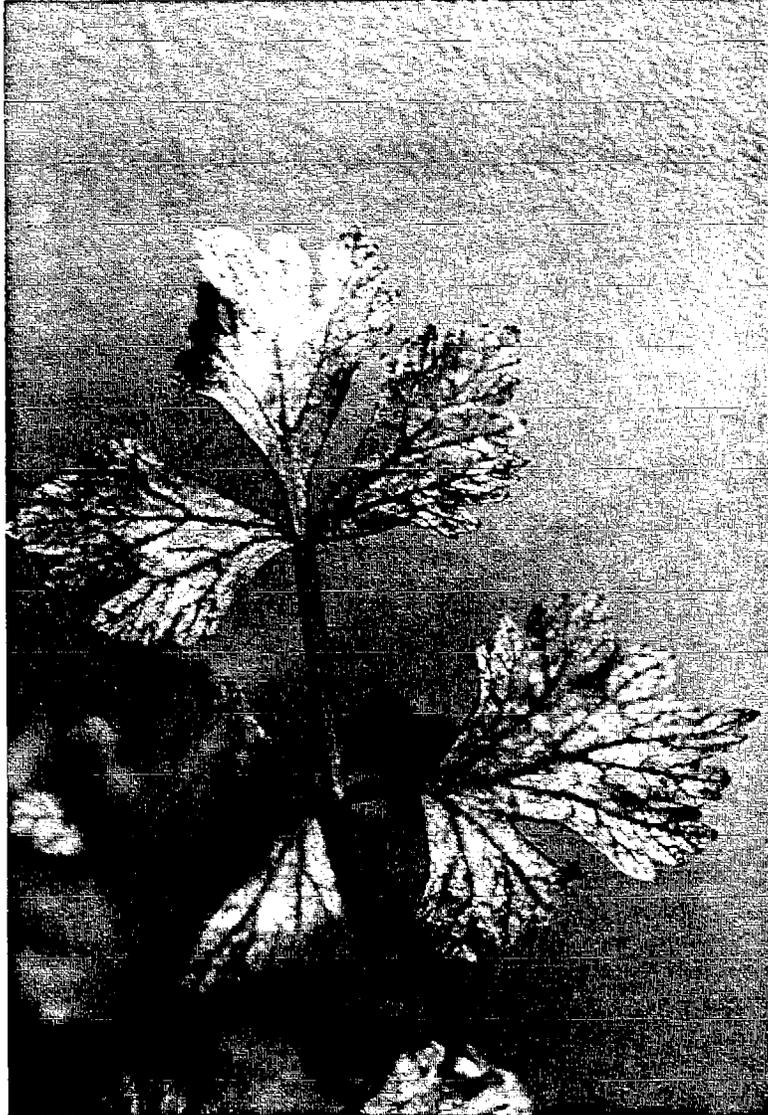
LOS ANGELES STATE AND COUNTY ARBORETUM, ARCADIA 1990-91

## EQUIPMENT USED IN PHOTOGRAPHY STUDIO AIR POLLUTION GREENHOUSE DISPLAY DOCUMENTATION

2 Cannon AE-1 Cameras  
Minolta X700 CAMERA  
Minolta 50MM MACRO LENS  
Dot Line Corp. 24" Cable Release  
Craig DT 6000 Tripod with support for two cameras  
3 Smith Victor K62 steel light stands  
Smith Victor 85 Mini Boom  
3 Smith Victor Q60 video lighting units  
4 Smith Victor A12UL clip lights  
HOYA 87MM Filter 80B  
HOYA 55MM Skylight Filter 1B  
Falcon Dust off II  
4 Extension cords with 2 or 4 way sockets  
KODACOLOR Color Print Film, 100 ASA  
EKTACHROME Color Slide Film, 200 ASA  
STANDARD BACKGROUND MATERIALS  
Grey backdrop paper and roller  
Grey grid-board backdrop  
Grey cloth backdrop  
Ruler made for backdrop  
Grey frontboard  
Grey signs with plant names, date, location  
Prop boxes and boards  
Photographer  
Photographer helper to move plants in and out

LOS ANGELES STATE AND COUNTY ARBORETUM, ARCADIA CA

## PHOTOGRAPHY SET UP CHANGES, 1989-1990 HELPING VISITORS IDENTIFY AIR POLLUTION SYMPTOMS



Celery grown in unfiltered half of Greenhouse.  
Photo does not identify species, size, date,  
type of exposure, or location. Visitor cannot  
compare this leaf to one grown in filtered air.

Los Angeles State and County Arboretum, Arcadia

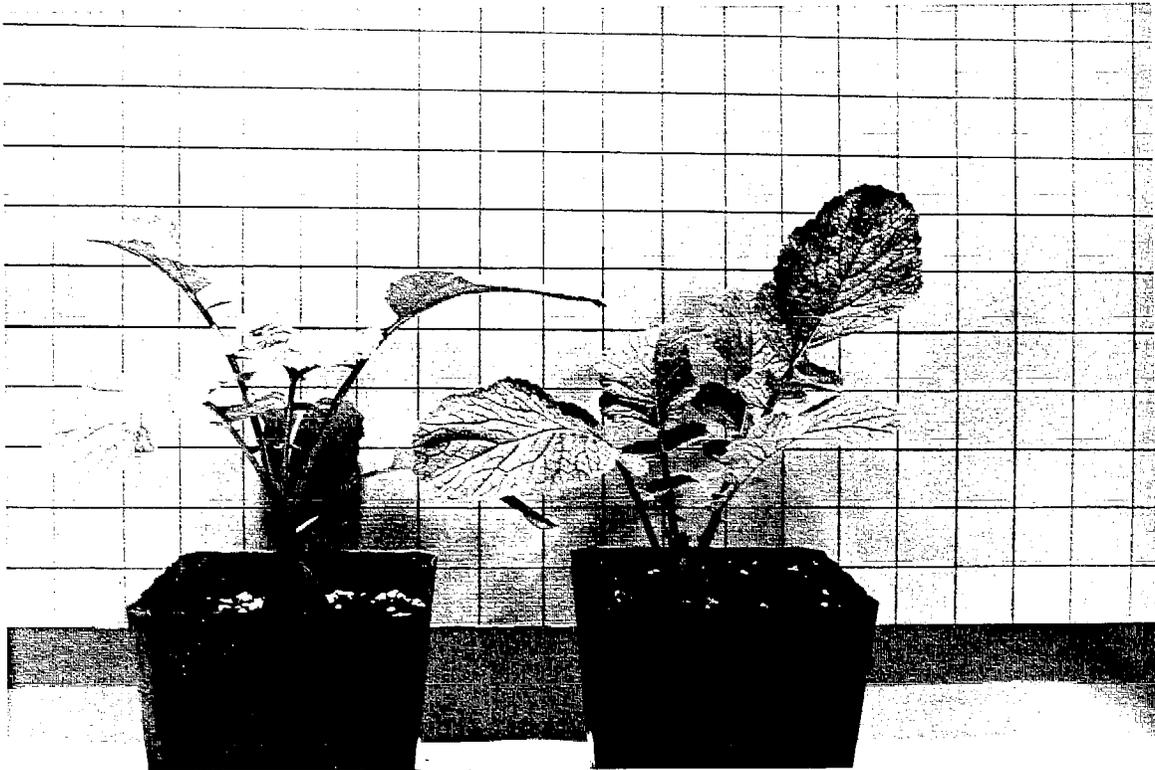
# PHOTOGRAPHY SET UP CHANGES, 1988-1990 HELPING VISITORS IDENTIFY AIR POLLUTION SYMPTOMS



Dahlia grown in filtered half (LEFT) and unfiltered half (RIGHT) of the greenhouse. Photo pairs permit a comparison of leaves of similar age and position on plant, but do not identify species, size, date, type of exposure, or location.

Los Angeles State and County Arboretum, Arcadia

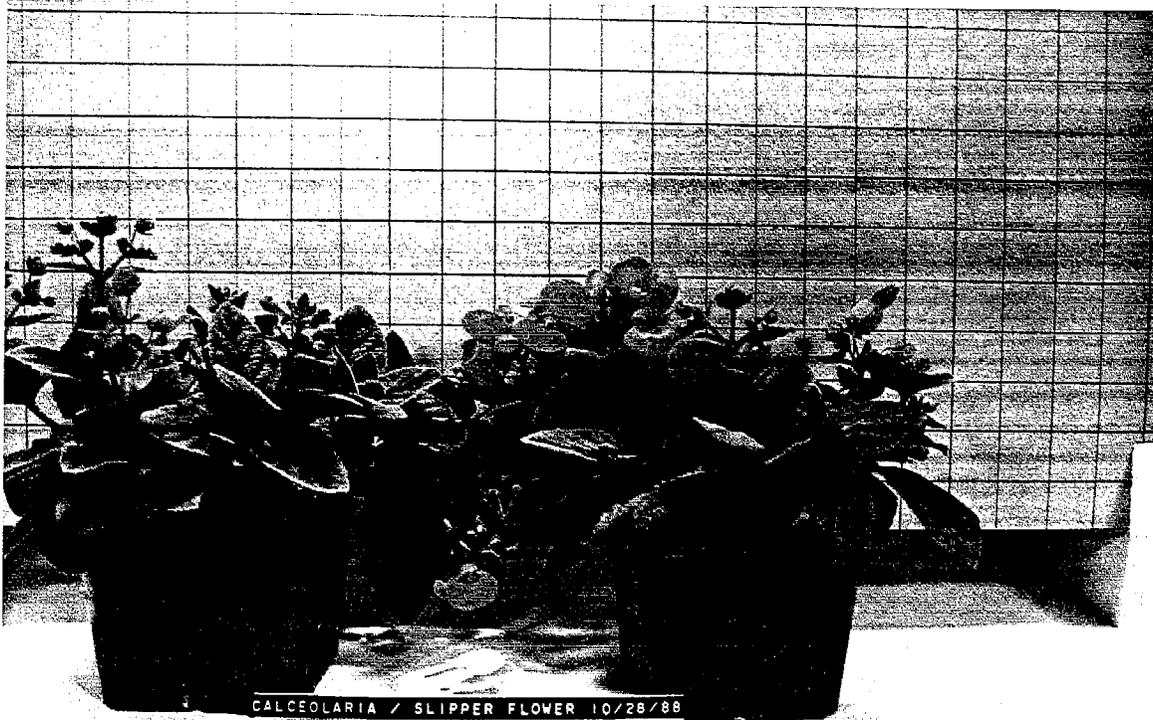
# PHOTOGRAPHY SET UP CHANGES, 1989-1990 HELPING VISITORS IDENTIFY AIR POLLUTION SYMPTOMS



Radish grown in the Air Pollution Greenhouse.  
Photo does not identify species, size, date,  
type of exposure, or location. Photo shows  
yield reduction and leaf stipple symptoms.

Los Angeles State and County Arboretum, Arcadia

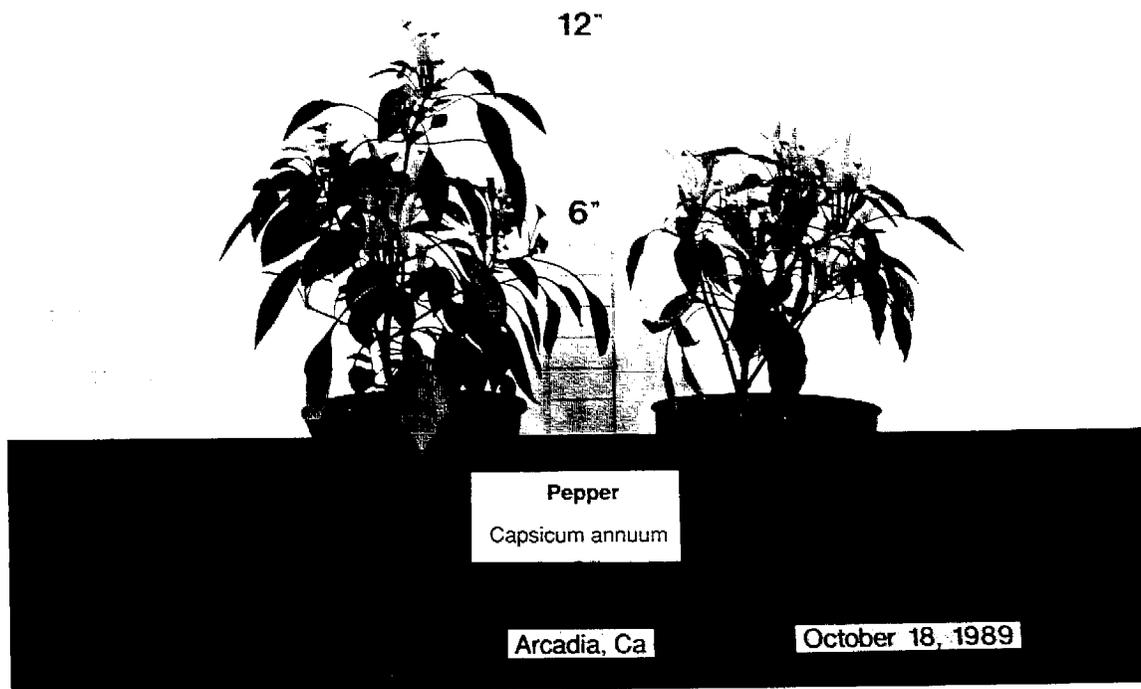
# PHOTOGRAPHY SET UP CHANGES, 1989-1990 HELPING VISITORS IDENTIFY AIR POLLUTION SYMPTOMS



Slipper flower grown in the Air Pollution Greenhouse. Photo identifies species, common name, and date; but not the type of exposure, or location. Photo shows annuals bloom earlier and die sooner in air pollution.

Los Angeles State and County Arboretum, Arcadia

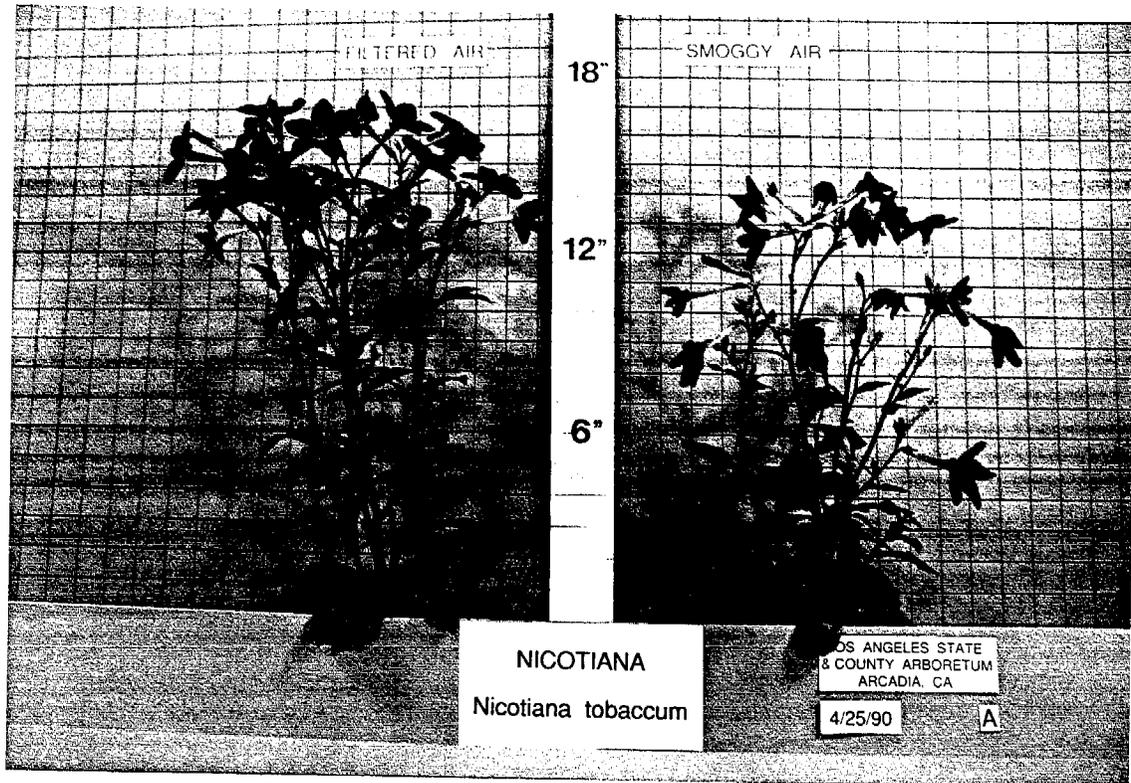
# PHOTOGRAPHY SET UP CHANGES, 1989-1990 HELPING VISITORS IDENTIFY AIR POLLUTION SYMPTOMS



In 1989 a display board was added to hide the pots and provide space to display the name of the plant, the location and the date. A ruler was added to the white background. Too much contrast resulted from the black and white background.

Los Angeles State and County Arboretum, Arcadia

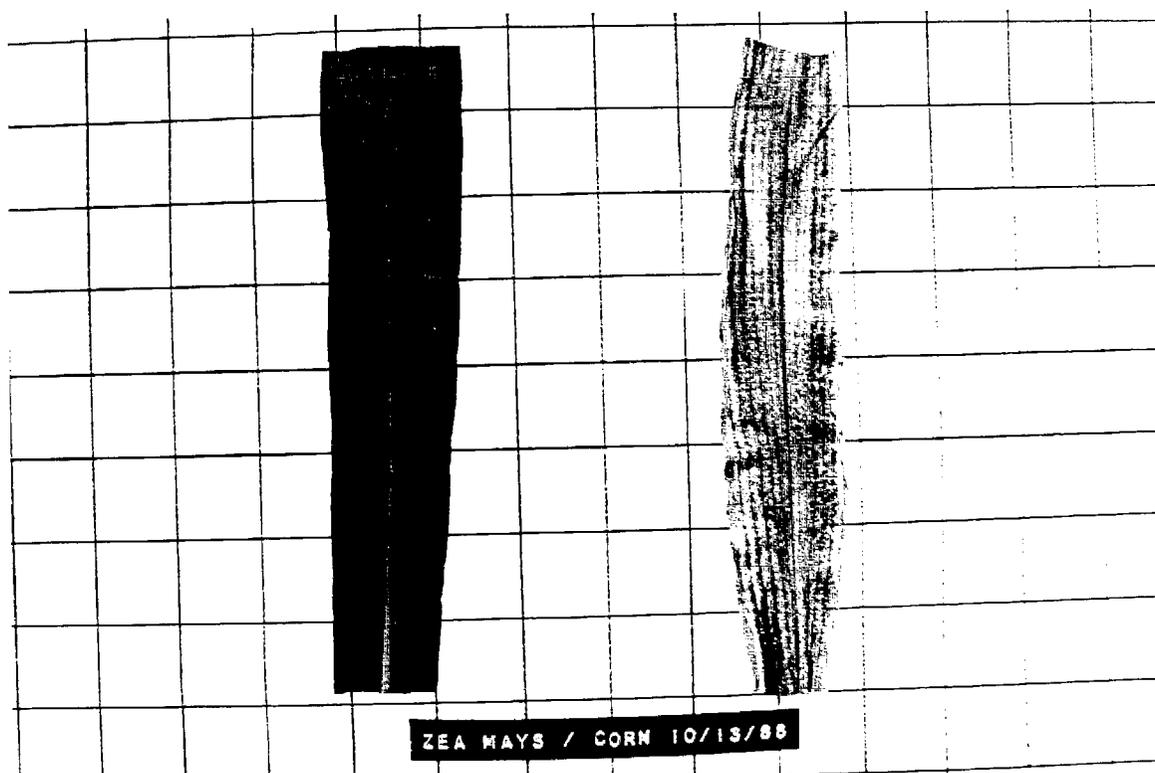
# PHOTOGRAPHY SET UP CHANGES, 1989-1990 HELPING VISITORS IDENTIFY AIR POLLUTION SYMPTOMS



Nicotiana grown in the Air Pollution Greenhouse. Photo identifies species, common name, date, the type of exposure, size, and location, with an all grey background. Photo shows air pollution reduces the value of ornamentals.

Los Angeles State and County Arboretum, Arcadia

# PHOTOGRAPHY SET UP CHANGES, 1989-1990 HELPING VISITORS IDENTIFY AIR POLLUTION SYMPTOMS



Displays of leaf injury symptoms were made. Visitors to the information center saw photographs like these and could touch leaf tissues taken from display plants.

Los Angeles State and County Arboretum, Arcadia

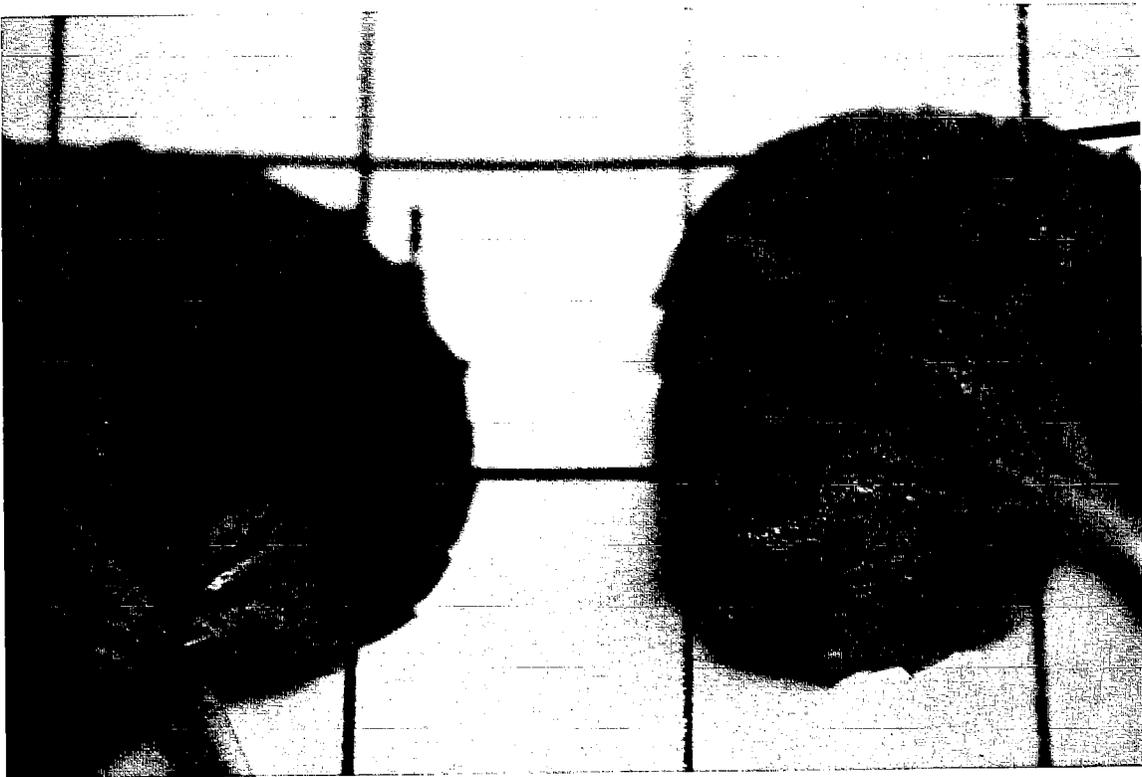
# PHOTOGRAPHY SET UP CHANGES, 1989-1990 HELPING VISITORS IDENTIFY AIR POLLUTION SYMPTOMS



Improvements were made in displays of leaf injury. Visitors to the information center saw photographs like these and could touch leaf tissues taken from display plants.

Los Angeles State and County Arboretum, Arcadia

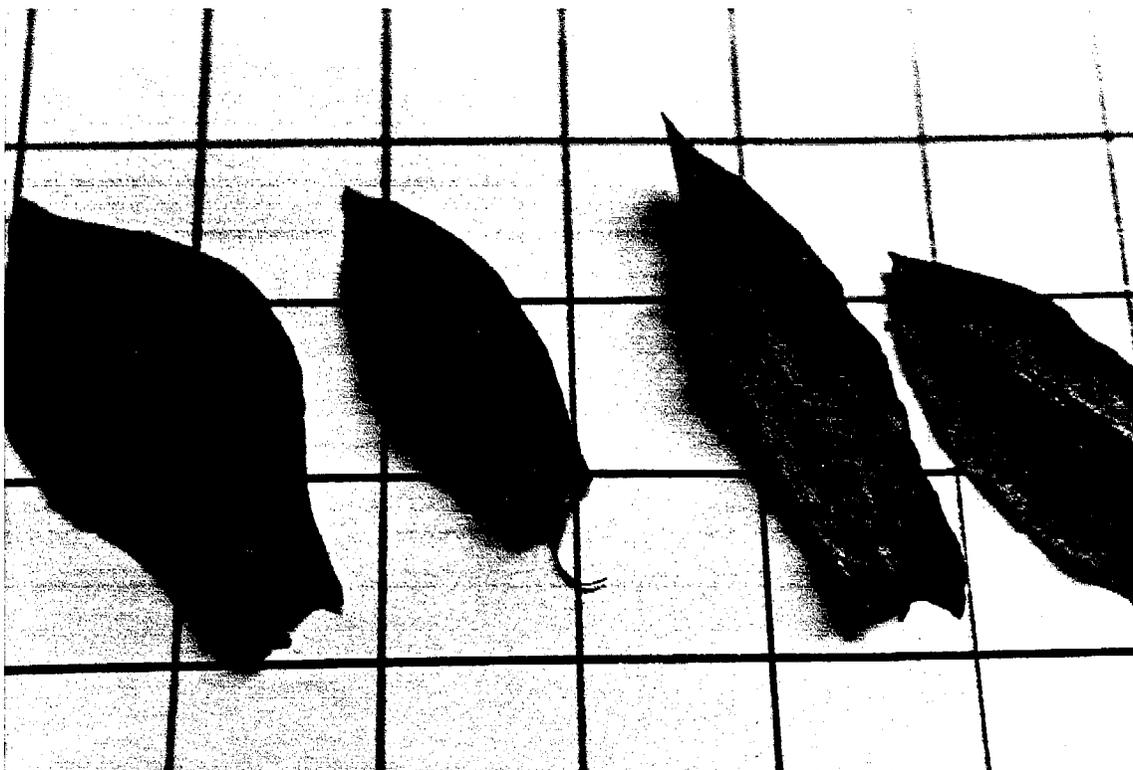
## PHOTOGRAPHY SET UP CHANGES, 1989-1990 HELPING VISITORS IDENTIFY AIR POLLUTION SYMPTOMS



Selected plants were fumigated with ozone so visitors who arrived before the high-level smog days could see symptoms of air pollution. Photos of fumigated Begonia leaves (RIGHT) and non-fumigated Begonia leaves (LEFT) were part of displays of leaf symptoms in the information center.

Los Angeles State and County Arboretum, Arcadia

## PHOTOGRAPHY SET UP CHANGES, 1989-1990 HELPING VISITORS IDENTIFY AIR POLLUTION SYMPTOMS



Selected plants were fumigated with ozone so visitors who arrived before the high-level smog days could see symptoms of air pollution. Photos of fumigated *Nicotiana* leaves (RIGHT) and non-fumigated *Nicotiana* leaves (LEFT) were part of displays of leaf symptoms in the information center.

Los Angeles State and County Arboretum, Arcadia

RESPONSES  
OF VEGETATION TO

AMBIENT LEVELS OF AIR POLLUTION  
AFTER GROWING FROM  
APRIL TO OCTOBER, 1990

IN THE AIR POLLUTION GREENHOUSE EXHIBIT  
LOS ANGELES STATE AND COUNTY ARBORETUM, ARCADIA CA

# THE AIR POLLUTION GREENHOUSE

## DOCUMENTING THE IMPACTS OF AMBIENT POLLUTION

PICTURES WERE TAKEN TO DOCUMENT THE EFFECTS OF AIR POLLUTION ON COMMON ORNAMENTAL PLANTS.

Most of the plants were photographed every two weeks. Care was taken to photograph each plant under standard conditions of light, background, and camera. The same plant was photographed repeatedly to assess the impact of air pollution on growth and development.

Photographs of the plants on display were grouped according to the most striking symptoms of air pollution impacts and are presented in the pages which follow.

A special series of pictures traces the growth and development of three species of plants.

PHOTOGRAPHS ILLUSTRATING THE RESULTS FOLLOW

# RESPONSE TO AMBIENT AIR POLLUTION: TYPE OF SYMPTOMS SEEN, APRIL-OCTOBER, 1990

DESCRIPTION OF EFFECT

SCIENTIFIC TERM USUALLY USED

LEAF INJURY

FOLIAR INJURY

PALE LEAVES  
PALE SPOTS ON LEAVES  
BRONZE SPOTS

CHLOROSIS  
CHLOROTIC MOTTLE  
OZONE BRONZING OR  
OZONE STIPPLE

FEWER LEAVES  
LOSS OF OLDER LEAVES

PREMATURE LEAF DROP

GROWTH DISTURBANCES

REDUCED GROWTH  
SMALLER LEAVES  
FEWER FLOWERS  
SMALLER FLOWERS  
FEWER FRUITS  
SMALLER FRUITS  
CHANGES IN LENGTH OF STEM  
CHANGES IN OVERALL FORM

STUNTING  
YIELD LOSS  
YIELD LOSS  
YIELD LOSS  
YIELD LOSS  
YIELD LOSS

SHORTENED LIFE SPAN

PREMATURE SENESCENCE

LOS ANGELES STATE AND COUNTY ARBORETUM, ARCADIA CA

1987 DISPLAY SUITABILITY TRIALS  
DISPLAY OF PLANTS WITH UNKNOWN SENSITIVITY

PLANT NEW TO DISPLAY	DEGREE OF INJURY
CALIFORNIA FAN PALM	SEVERE
CORN	SEVERE
ONION	re-evaluate for bulb growth
CELERY	SEVERE
BEGONIA	SEVERE
SWISS CHARD	
MUSTARD	
BROWELLIA	SEVERE
ASTER	
CANTALOUPE	
DAHLIA	SEVERE
CARROT	SEVERE
CARNATION	SEVERE
ICEBERG LETTUCE	TOO HOT
SWEET PEA	
PETUNIA	SEVERE

LOS ANGELES STATE AND COUNTY ARBORETUM, ARCADIA CA

## 1987 GREENHOUSE DISPLAY PLANTS SHOWING AIR POLLUTION DAMAGE

Acer saccharinum	Silver Maple
Adiantum	Maiden Hair Fern
Antirrhinum majus	Snapdragon
Apium graveolens var. dulce	Celery
Begonia sp.	Begonia
Browallia speciosa	Browallia
Calceolaria	Slipper Flower
Catalpa speciosa	Western catalpa
Coleus hybridus	Coleus
Dahlia hybrids	Dahlia
Daucus carota var. sativus	Carrot
Ficus carica var. Blue Celeste	Celeste Fig
Impatiens	Busy Lizzie
Lycopersicon lycopersicum	Tomato
Mentha	Mint
Morus alba	White Mulberry
Petroselinum crispum	Parsley
Petunia hybrida	Petunia
Phaseolus vulgaris	Bush bean
Phaseolus vulgaris	Pinto Bean
Platanus occidentalis	American Sycamore
Raphanus sativus	Radish
Tagetes	Marigold
Vitis cv. Fredonia	Fredonia Grape
Washingtonia filiera	California Fan Palm
Zea mays	Sweet Corn

LOS ANGELES STATE AND COUNTY ARBORETUM, ARCADIA CA

1987 GREENHOUSE DISPLAY  
PLANTS SHOWING NO SIGNIFICANT FOLIAR DAMAGE

Ailanthus altissima	Tree of Heaven
Allium sp.	Onion
Beta vulgaris	Swiss Chard
Brassica sp.	Mustard
Calistephus sp.	Aster
Capsicum annum	Pepper
Cucumis melo	Cantaloupe
Cucumis sativus	Cucumber
Cyclamen	Florist's Cyclamen
Dianthus	Carnation
Helianthus annus	Sunflower
Lectua sativa	Iceberg lettuce
Lathyrus odoratus	Sweet Pea
Liquidambar styraciflua	American Sweetgum
Rheum raphonticum	Rhubarb
Spinacia oleracea	Spinach

LOS ANGELES STATE AND COUNTY ARBORETUM, ARCADIA CA

# 1988 DISPLAY SUITABILITY TRIALS

## DISPLAY OF PLANTS WITH UNKNOWN SENSITIVITY

PLANT NEW TO DISPLAY	DEGREE OF INJURY
SWEET ALYSSUM	SEVERE
ROSE	SOME PALE LEAVES
ROSE	SOME PALE LEAVES
CAMELLIA	RETEST
SQUASH	SEVERE INSECT PROBLEMS
GAZANIA	SEVERE
CHINESE HIBISCUS	SEVERE
JUNIPER	RETEST
LANTANA	PROBLEMS WITH INSECTS
STOCK	RETEST
GERANIUM	RETEST
CANARY ISLAND PINE	RETEST
PITTOSPORUM	RETEST
BLUEGRASS	COLOR CHANGE
BERMUDA GRASS	COLOR CHANGE
INDIA HAWTHORN	RETEST
PANSY	SEVERE
OLEANDER	LEAF SPOT
YEW PINE	RETEST
ZINNIA	RETEST
OKRA	LEAF SPOTS
AMERICAN SYCAMORE	RETEST
PEPPER	SEVERE

LOS ANGELES STATE AND COUNTY ARBORETUM, ARCADIA CA

## 1988 GREENHOUSE DISPLAY PLANTS SHOWING AIR POLLUTION DAMAGE

Abelmoscus esculentus	Okra
Acer saccharinum	Silver Maple
Adiantum	Maiden Hair Fern
Antirrhinum majus	Snapdragon
Apium graveolens var. dulce	Celery
Begonia sp.	Begonia
Browallia speciosa	Browallia
Calceolaria	Slipper Flower
Catalpa speciosa	Western catalpa
Coleus hybridus	Coleus
Cucumis sativus	Cucumber
Dahlia hybrids	Dahlia
Daucus carota var. sativus	Carrot
Ficus carica var. Blue Celeste	Celeste Fig
Hibiscus rosa-sinensis	Chinese hibiscus
Impatiens	Busy Lizzie
Lycopersicon lycopersicum	Tomato
Lobularia matitima	Sweet alyssum
Lantana camera	Lantana
Mentha	Mint
Morus alba	White Mulberry
Nerium oleander	Oleander
Petroselinum crispum	Parsley
Petunia hybrida	Petunia
Phaseolus vulgaris	Bush bean
Phaseolus vulgaris	Pinto Bean
Platanus occidentalis	American Sycamore
Raphanum sativus	Radish
Rosa sp.	Prima Donna Rose
Tagetes	Marigold
Vitis cv. Fredonia	Fredonia Grape
Washingtonia filiera	California Fan Palm
Zea mays	Sweet Corn

LOS ANGELES STATE AND COUNTY ARBORETUM, ARCADIA CA

**1988 GREENHOUSE DISPLAY  
PLANTS SHOWING NO SIGNIFICANT FOLIAR DAMAGE**

Ailanthus altissima	Tree of Heaven
Allium sp.	Onion
Beta vulgaris	Swiss Chard
Brassica sp.	Mustard
Calistephus sp.	Aster
Camellia japonica	Camellia
Capsicum annum	Pepper
Cucumis melo	Cantaloupe
Cucurbita pepo	Squash
Cyclamen	Florist's Cyclamen
Cyndodon dactylon	Common burmuda
Delosperma 'Alba'	White trailing ice plant
Dianthus	Carnation
Gazania rigens	Gazania
Juniperus chinensis 'Pfitzerana'	Pfitzer juniper
Lathyrus odoratus	Sweet Pea
Liquidambar styaciflua	American Sweetgum
Matthiola incana	Stock
Pelargonium hortorum	Common geranium
Pinus canariensis	Canary Island Pine
Pittosporum tobira	Tobira
Poa pratensis 'Marathon'	Marathon bluegrass
Podocarpus macrophyllum	Yew Pine
Raphiolepis indica	India Hawthorn
Rosa	Cecile Brunner
Rosa	Honest Abe cv. Aron
Rosa	Beverly Hills cv. Delmatore
Viola wittrockiana	Pansy
Zinnia elegans	Zinnea

LOS ANGELES STATE AND COUNTY ARBORETUM, ARCADIA CA

1989 DISPLAY SUITABILITY TRIALS  
DISPLAY OF PLANTS WITH UNKNOWN SENSITIVITY

PLANT NEW TO DISPLAY

DEGREE OF INJURY

BROCCOLI	TOO HOT, BOLTED
CAULIFLOWER	TOO HOT, BOLTED
EGGPLANT	SEVERE
FLOSSFLOWER	SEVERE
WHITE BIRCH	SEVERE
COCKSCOMB	SEVERE
DUSTY MILLER	SEVERE
ANNUAL COREOPSIS	SEVERE
PINEAPPLE GUAVA	RETEST
LOBELIA	SEVERE
SOUTHERN MAGNOLIA	SEVERE
CAROLINA LAUREL	SEVERE
CALIFORNIA PEPPER TREE	SEVERE
SCARLET SAGE	SEVERE
CHINESE EVERGREEN ELM	RETEST
KUMQUAT	SEVERE
ORANGE	SEVERE
PRIMROSE	SEVERE

LOS ANGELES STATE AND COUNTY ARBORETUM, ARCADIA CA

## 1989 GREENHOUSE DISPLAY PLANTS SHOWING AIR POLLUTION DAMAGE

Ageratum houstonianum	Floss Flower
Antirrhinum majus	Snapdragon
Begonia sp.	Begonia
Betula alba	European White Birch
Brassica oleracea	Broccoli
Brassica oleracea	Cauliflower
Capsicum annuum	Pepper
Camelia japonica	Camillia
Celosia plumeria	Cockscomb
Centaurea cineraria	Dusty Miller
Coereopsis sp.	Coreopsis
Cucumis sativus	Cucumber
Cyclamen	Florists's Cyclamen
Dahlia hybrids	Dahlia
Daucus carota var. sativus	Carrpt
Gazania rigids	Gazania
Impatiens	Busy Lizzie
Lantana camera	Lantana
Lobelia erinus 'Crystal Palace'	Lobelia
Lobulaira maritima	Sweet Alyssum
Lycopersicon lycopersicum	Tomato
Mentha	Mint
Nerium oleander	Oleander
Petroselinum crispus	Parsely
Petunia hybrida	Petunia
Phaseolus vulgaris	Bush Bean
Primula polyantha	Primrose
Raphanus sativus	Radish
Rosa sp.	Rose
Salvia splendens	Scarlet Sage
Schinus molle	California Pepper Tree
Solanum melongena	Eggplant
Tagetes	Marigold
Ulmus parvifolia	Chinese Evergreen Elm
Vitus cv. Fredonia	Fredonia Grape
Washingtonia filifera	California Fan Palm
Zea mays	Corn
Zinnia elegans	Zinnia

1989 GREENHOUSE DISPLAY  
PLANTS SHOWING NO SIGNIFICANT FOLIAR DAMAGE

Camellia japonica	Camellia
Citrus	Orange
Cucurbita sp.	Squash
Dianthus sp.	Carnation
Feijoa sellowiana	Pineapple Guava
Juniperus chinensis 'Pfitzer'	Pfitzer Juniper
Magnolia grandiflora	Southern Magnolia
Pelargonium vulgaris	Common Geranium
Pittosporum tobira	Mock Orange
Podocarpus macrophyllus	Yew Pine
Raphiolepis indica	India Hawthorn

L.A. State and County Arboretum, Arcadia CA

# 1990 DISPLAY SUITABILITY TRIALS

## DISPLAY OF PLANTS WITH UNKNOWN SENSITIVITY

PLANT NEW TO DISPLAY	DEGREE OF INJURY
CALIFORNIA RED ONION	SEVERE
CHIVES	SEVERE
FRENCH TARRAGON	DIED
MOTHER FERN	SEVERE
COREIANDER	SEVERE
CURRY PLANT	SEVERE
PATIO TOMATO	SEVERE
PEPPERMINT	SEVERE
PENNYROYAL	SEVERE
BASIL	SEVERE
MARTHA WASHINGTON GERANIUM	RETEST
LEMON BALM GERANIUM	REDUCED GROWTH
AVOCADO	DIED
SORREL	SEVERE
COMMON TANSY FERN	REDUCED GROWTH
SOCIETY GARLIC	RETEST
NIAGRA GRAPE	REDUCED GROWTH

LOS ANGELES STATE AND COUNTY ARBORETUM, ARCADIA CA

## AIR POLLUTION DAMAGED PLANTS, 1990 DISPLAY

Ageratum houstonianum	Floss Flower
Allium cepa	California Red Onion
Allium schoenoprasum	Chives
Antirrhinum majus	Snapdragon
Apium graveolens var. dulce	Celery
Aquilegia sp.	Columbine
Asplenium bulbiferum	Mother Fern
Begonia sp.	Begonia
Bougainvillea sp.	Bourgainvillea
Brachycome iberidifolia	Swan River Daisy
Brassica oleracea	Cauliflower
Capsicum annuum	Pepper
Celosia plumeria	Cockscomb
Centaurea cineraria	Dusty Miller
Citrus sinensis	Orange
Coleus hybridus	Coleus
Coreopsis sp.	Coreopsis
Coriandrum sativum	Coriander
Cucumis sativus	Cucumber
Cyclamen sp.	Florists' Cyclamen
Dahlia hybrids	Dahlia
Daucus carota var. sativus	Carrot
Dianthus sp.	Carnation
Ficus carica	Fig
Gardenia sp.	Gardenia
Gazania rigids	Gazania
Gomphrena globosa	Globe Amaranth
Helichrysum congestifolium	Curry Plant
Impatiens	Busy Lizzie
Lantana camera	Lantana
Lavandula sp.	Lavender
Lectua sativa	Lettuce
Lobelia erinus 'Crystal Palace'	Lobelia
Phaseolus vulgaris	Mock Orange
Phaseolus vulgaris	Kentucky Blue Bean
Primula sp.	Primrose
Raphanus sativus	Radish
Rosa sp.	Bonica Rose
Rosa sp.	Playboy Rose
Rosa sp.	Silverado Rose
Rosmarinus officinalis	Rosemary
Rumex scutatus	Sorrel
Salvia splendens	Scarlet Sage
Schinus molle	California Pepper Tree
Solanum melongena var. esculentum	Eggplant
Viola sp.	Viola
Washingtonia filifera	California Fan Palm
Zea mays	Corn
Zinnia elegans	Zinnia

1990 GREENHOUSE DISPLAY  
PLANTS SHOWING NO SIGNIFICANT FOLIAR DAMAGE

Camellia japonica  
Eucalyptus sideroxylon rosea  
Feijoa sellowiana  
Juniperus chinensis  
Magnolia grandiflora  
Nerium oleander  
Pelargonium vulgare  
    'Martha Washington'  
  
Podocarpus macrophyllus  
Raphiolepis indica  
Tulbaghia violacea

Camellia  
Pink Iron Bark  
Pineapple Guava  
Pfitzer Juniper  
Southern magnolia  
Oleander  
  
Martha Washington  
  
Yew Pine  
Indian Hawthorn  
Society Garlic

L.A. State and County Arboretum, Arcadia CA

# RESPONSES OF VEGETATION TO

## AMBIENT LEVELS OF AIR POLLUTION AFTER GROWING FROM APRIL TO OCTOBER, 1990

IN THE AIR POLLUTION GREENHOUSE EXHIBIT  
LOS ANGELES STATE AND COUNTY ARBORETUM, ARCADIA CA

### RESPONSE TO AMBIENT AIR POLLUTION: TYPE OF SYMPTOMS SEEN, APRIL-OCTOBER, 1990

DESCRIPTION OF EFFECT	SCIENTIFIC TERM USUALLY USED
LEAF INJURY	FOLIAR INJURY
PALE LEAVES	CHLOROSIS
PALE SPOTS ON LEAVES	CHLOROTIC MOTTLE
BRONZE SPOTS	OZONE BRONZING OR OZONE STIPPLE
FEWER LEAVES	PREMATURE LEAF DROP
LOSS OF OLDER LEAVES	
GROWTH DISTURBANCES	
REDUCED GROWTH	STUNTING
SMALLER LEAVES	YIELD LOSS
FEWER FLOWERS	YIELD LOSS
SMALLER FLOWERS	YIELD LOSS
FEWER FRUITS	YIELD LOSS
SMALLER FRUITS	YIELD LOSS
CHANGES IN LENGTH OF STEM	
CHANGES IN OVERALL FORM	
SHORTENED LIFE SPAN	PREMATURE SENESCENCE

LOS ANGELES STATE AND COUNTY ARBORETUM, ARCADIA CA

**RESPONSE TO AMBIENT AIR POLLUTION:  
REDUCED GROWTH**

SCIENTIFIC NAME	COMMON NAME
<i>Allium cepa</i>	CALIFORNIA RED ONION
<i>Allium schoenoprasum</i>	CHIVES
<i>Centaurea cineraria</i>	DUSTY MILLER
<i>Citrus sinensis</i>	ORANGE
<i>Coleus hybridus</i>	COLEUS
<i>Coreopsis</i> sp.	COREOPSIS
<i>Gazania</i> sp.	GAZANIA
<i>Helichrysum congestifolium</i>	CURRY PLANT
<i>Lavendula</i> sp.	LAVENDER
<i>Ligustrum japonicum</i>	WAX LEAF PRIVET
<i>Origanum vulgare</i>	OREGANO
<i>Pelargonium</i>	LEMON BALM
<i>Pittosporum tobria</i>	MOCK ORANGE
<i>Rosa</i> sp.	BONICA ROSE
<i>Rosa</i> sp.	PLAYBOY ROSE
<i>Rosa</i> sp.	SILVERADO ROSE
<i>Rosmarinus officinalis</i>	ROSEMARY
<i>Washingtonia filifera</i>	CALIFORNIA FAN PALM
<i>Zinnea elegans</i>	ZINNEA

LOS ANGELES STATE AND COUNTY ARBORETUM, ARCADIA 90-91

**RESPONSE TO AMBIENT AIR POLLUTION:  
LEAF INJURY**

SCIENTIFIC NAME	COMMON NAME
<i>Brassica oleracea</i>	CAULIFLOWER
<i>Dianthus</i> sp.	CARNATION
<i>Gomphrena globosa</i>	GLOBE AMARANTH
<i>Mentha pulegium</i>	PENNYROYAL
<i>Rumex scutatus</i>	SORREL
<i>Schinus molle</i>	CALIFORNIA PEPPER TREE

LOS ANGELES STATE AND COUNTY ARBORETUM, ARCADIA 90-91

RESPONSE TO AMBIENT AIR POLLUTION:  
SHORTER LIFE SPAN

SCIENTIFIC NAME	COMMON NAME
<i>Lactuca sativa</i>	LETTUCE

LOS ANGELES STATE AND COUNTY ARBORETUM, ARCADIA 90-91

RESPONSE TO AMBIENT AIR POLLUTION:  
PALE LEAVES AND REDUCED GROWTH

SCIENTIFIC NAME	COMMON NAME
<i>Ageratum houstonianum</i>	FLOSS FLOWER
<i>Capsicum annum</i>	PEPPER
<i>Celosia plumeria</i>	COCKSCOMB
<i>Cucumis sativus</i>	CUCUMBER
<i>Dahlia hybridus</i>	DAHLIA
<i>Gardenia sp.</i>	GARDENIA
<i>Lycopersicon lycopersicum</i>	PATIO TOMATO
<i>Lycopersicon lycopersicum</i>	PRESIDENT TOMATO
<i>Mentha piperita</i>	PEPPERMINT
<i>Ocimum basilicum</i>	BASIL
<i>Salvia splendens</i>	SCARLET SAGE
<i>Solanum melongena</i>	EGGPLANT
<i>Tanacetum vulgare</i>	COMMON TANSY

LOS ANGELES STATE AND COUNTY ARBORETUM, ARCADIA 90-91

RESPONSE TO AMBIENT AIR POLLUTION:  
SPOTTED LEAVES AND REDUCED GROWTH

SCIENTIFIC NAME      COMMON NAME

Begonia sp.	BEGONIA
Phaseolis vulgaris	BUSH BEAN
Phaseolis vulgaris	KENTUCKY BLUE BEAN
Phaseolis vulgaris	PINTO BEAN
Raphanus sativus	RADISH
Vitus sp.	NIAGRA GRAPE
Zea mays	CORN

LOS ANGELES STATE AND COUNTY ARBORETUM, ARCADIA 90-91

RESPONSE TO AMBIENT AIR POLLUTION:  
FEWER LEAVES AND REDUCED GROWTH

SCIENTIFIC NAME      COMMON NAME

Bougainvillea sp.	BOUGAINVILLEA
Cyclamen sp.	FLOREST'S CYCLAMEN
Impatiens sp.	BUSY LIZZIE

LOS ANGELES STATE AND COUNTY ARBORETUM, ARCADIA 90-91

RESPONSE TO AMBIENT AIR POLLUTION:  
FEWER FRUITS AND REDUCED GROWTH

SCIENTIFIC NAME      COMMON NAME

*Ficus carica*

FIG

LOS ANGELES STATE AND COUNTY ARBORETUM, ARCADIA 90-91

RESPONSE TO AMBIENT AIR POLLUTION:  
FEWER FLOWERS AND REDUCED LIFE SPAN

SCIENTIFIC NAME      COMMON NAME

*Antirrhinum majus*

SNAPDRAGON

LOS ANGELES STATE AND COUNTY ARBORETUM, ARCADIA 90-91

RESPONSE TO AMBIENT AIR POLLUTION:  
REDUCED GROWTH AND REDUCED LIFE SPAN

SCIENTIFIC NAME      COMMON NAME

*Lobelia erinus*

CRYSTAL PALACE LOBELIA

LOS ANGELES STATE AND COUNTY ARBORETUM, ARCADIA 90-91

RESPONSE TO AMBIENT AIR POLLUTION:  
LEAF SPOTS AND REDUCED LIFE SPAN

SCIENTIFIC NAME      COMMON NAME

*Tagetes* sp.

MARIGOLD

LOS ANGELES STATE AND COUNTY ARBORETUM, ARCADIA 90-91