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For United Horticulture . . .

The particular objects and business of the American Horticultural Society are to promote and encourage national interest in scientific research and education in horticulture in all of its branches.

THE AMERICAN HORTICULTURAL MAGAZINE is the official publication of The American Horticultural Society and is issued during the Winter, Spring, Summer, and Fall quarters. The magazine is included as a benefit of membership in The American Horticultural Society, individual membership dues being $15.00 a year.

THE AMERICAN HORTICULTURAL MAGAZINE is devoted to the dissemination of knowledge in the science and art of growing ornamental plants, fruits, vegetables, and related subjects. Original papers which increase knowledge of plant materials of economic and aesthetic importance are invited. For manuscript specifications, please address the chairman of the Editorial Committee.

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1970-71 EDITORIAL COMMITTEE

In This Issue

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Featuring ENVIRONMENTAL HORTICULTURE:

Editor, FREDERICK G. MEYER
Managing Editor, O. KEISTER EVANS

COVER ILLUSTRATION
Spacecraft Earth

Earth-rise from Apollo 8. Surface of drab, naked, and lifeless moon 780 kilometers from spacecraft. In stark contrast, the view of Earth shows our planet in living color—blue waters of the Atlantic and Pacific oceans and grayish land areas of parts of the Western Hemisphere and West Africa. Earth features are largely obscured by clouds. Man in the twentieth century has come to realize the value of his environment. Our astronauts have helped us to appreciate our earth environment with life-giving water, brown deserts, great green forests, and grasslands and the need to preserve them. (NASA photo)

Guest Editorial

A Report on Pollution

Air pollution is one of the most urgent problems facing mankind today. In most large cities of the United States it is reaching levels hazardous to human health and is particularly dangerous for those who suffer from emphysema, bronchitis and other respiratory ailments. Polluted air is also linked to higher mortality rates from other causes, including lung cancer and arteriosclerotic heart disease.

The threat to plants is even more serious because all life on earth is absolutely dependent on green plants. By the process of photosynthesis, they provide the oxygen we breathe and raw materials for the food we eat.

About 70 per cent of the oxygen and 90 percent of the food are produced by plankton in the oceans. Studies indicate that DDT may be reducing the ability of plankton to carry on photosynthesis. Scientists can only guess as to the effect on them of other types of pollution.

Dr. Howard E. Haggestad, USDA Beltsville Plant Air Pollution Laboratory, estimates that nearly a billion dollars is being lost annually to the agricultural economy in the United States because of air pollution.

Dr. Russell J. Seibert, director of Longwood Gardens, says if air pollution build-up continues unchecked, it will effectively prevent Longwood and similar gardens throughout the United States from carrying out their objectives after 1970.

In a report to the American Horticultural Congress last November, Dr. Seibert called on gardeners to plant plants everywhere a place can be found for them. "They are smog eaters," he said, "and the more plants we plant, the better our chances of breathing fresh, clean air."

Dr. Seibert was chairman of an ad hoc committee appointed by Fred C. Galle, then president of the American Horticultural Society, to make a study and prepare recommendations as to the role AHS should play in dealing with environmental problems.

"It is our mission to work toward a healthier world by doing what comes most naturally," said Dr. Seibert, "namely planting and caring for our plants. It is the thing we can do best in dealing with the environmental crisis."

Without water there could be no life on earth and water pollution is a problem throughout the country, but is most acute in densely settled or industrial sections. Organic wastes from municipalities and industries enter rivers, where they are attacked and broken down by organisms in the water. But in the process, oxygen in the river is used up. Nutrients from cities, industries and farms nourish algae, which also use up oxygen when they die or decompose. And when oxygen is gone, the game fish disappear, plant growth rots, and the stench of decay reaches for miles.

In its first annual report to Congress last August, President Nixon's Council on Environmental Quality said that in some areas of the country remedial programs have succeeded in raising the levels of water quality.

"However, population and industrial growth, higher water quality demanded by the public and the increasing severity of certain types of pollution—for example, oil spills and increased algal blooms in lakes, all mean that we have only begun to tackle the problem," the Council's report said.

A copy of this remarkably fine 326 page report can be purchased from Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402, for $1.75.

More than 200 million tons of pollutants are being pumped into the air over the United States per year, the report said. By weight, 47 per cent is carbon monoxide, 15 per cent sulfur oxides, 15 per cent hydrocarbons, 13 per cent particulates, and 10 per cent nitrogen oxides.

Transportation, particularly the automobile, is responsible for 42 per cent of the pollutants, fuel combustion in stationary sources for 21 per cent, industrial processes for 14 per cent, forest fires for 8 per cent, solid waste disposal for 5 per cent, and miscellaneous for 10 per cent.

Looking toward the future, the report said, the President's proposals for a $10 billion financing program and tighter enforcement will reverse the worst water pollution, but other water pollution problems will become even more apparent.

"In the short run," said the report, "there is no easy solution to this highly complex problem. In the long run, control of water pollution will require institutional and management changes, possibly some changes in the products that people consume. It will require large amounts of public funds, and it will lead to higher prices for some products."

The costs and institutional barriers to higher air quality are not as massive as in water pollution control, the report said. "Abatement technology can be installed rapidly when available. Clearly the technological gaps in air pollution must be overcome, but once breakthroughs are made, rapid progress will be possible."

Even though man doesn't know all the answers to a solution of pollution problems, a lot can be done to improve conditions, says William D. Ruckelshaus, head of the new Environmental Protection Agency, which came into existence Dec. 2 1970 to enforce control of air, water and solid waste pollution.

"That we don't know all we should like to know should not obscure the vital fact that there are important steps we can take right now to dramatically improve our environment," he declared.

Mr. Ruckelshaus said he would use all the authority he has, and all the persuasion at his command, to see that every means of controlling pollution will be used in every city and town "starting right now."

We say, more power to you, William Ruckelshaus. We pledge you all the support we can possibly provide.

Tom Stevenson

TOM STEVENSON
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Report of American Horticultural Society ad hoc Study Committee on the Environmental Crisis

AHS Congress-Hotel Deauville, Miami Beach, Florida, Nov. 1-4, 1970

Mr. Fred Galle, President, American Horticultural Society, appointed an ad hoc committee to develop an American Horticultural Society policy position concerning this country's current environmental problems as they relate to our field of interest.

This committee has attempted to approach a position by which every member of AHS might "roll up his sleeves" and individually contribute toward the betterment of our eroding quality of life.

In approaching this positive means of individual action on the part of every AHS member and his family, there are several points which we might keep in mind and which might help in placing our current environmental threats in better perspective for the average American who is interested in gardens and in the field of Horticulture.

1. Only through the grace of God has man been placed on earth.
2. Only through the photosynthetic action of the green plant has man been permitted to evolve and remain on earth.

NOW it seems even our green plants are threatened—by pollution. If we can accept these points, perhaps we can also relate our present predicament to the oldest guide book and manual for human conduct, about which most of us have some familiarity, namely, the Bible, from which two quotes do definitely touch on a tender note.

1. From Deuteronomy 21, Verse 23: "You shall not defile your land which the Lord your God gives you for an inheritance."
2. From Numbers 35, Verse 34 :"You shall not defile the land in which you live."

The world "defile" means to make unholy that which is holy, or—to make impure that which is pure.

What then, can the individual member of AHS do to help improve his land, his breathable air, his living environment?

The attached statement of our position entitled, "A Livable Environment-A Horticulturist's Manual for Preserving it," represents the thoughts and efforts of many of us who are deeply concerned by what we observe and what we read in the results of the research conducted by our nation's scientists. We hope that you, too, will become concerned and will do what you can to help reduce pollution in its many forms, all of which together is eroding our quality of life through the deterioration of our environment.

Respectfully submitted,

Mr. Vincent K. Bailey
Mr. P. H. Brydon
Dr. John Carew
Dr. Edward J. Conklin
Mrs. Erastus Corning, II
Mr. O. Keister Evans
Mr. Kenneth W. Fisher
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Mr. Tom Stevenson
Dr. Tom Throckmorton
Mrs. Helen Van Zele
Dr. Russell J. Seibert, Chairman

ad hoc Study Committee on the
Environmental Crisis
American Horticultural Society

PHOTO MISSOURI DEPARTMENT OF CONSERVATION—BY DON WOOLDRIDGE.

Field of purple cone flowers (*Echinacea purpurea*) mixed with prairie grasses, a sight that has all but disappeared over much of the plains states. Only strong conservation measures can preserve what misguided farming practices and urban sprawl have all but destroyed.

A Livable Environment—
A Horticulturist's Manual for Preserving It

RUSSELL J. SEIBERT

The American Horticultural Society, as a society, is made up of members—individual, organizational, institutional, commercial and student. Its survival depends solely on the combined effort and resources of its membership. Some members contribute more than others but there is an irreducible minimum demanded of all members—the annual membership fee!

In a way, our livable environment hangs on a similar thin thread. It all goes back to us as members—as individuals. If we wish to continue enjoying a livable environment, then we, as members of the human species, must preserve it. The government can legislate against pollution until it's blue in the face, but unless we, as pollutors, decide to do something about it, we end up blue in the face—from lack of breathable air; with sterile soil and with poisoned water.

What is the price, then, the minimum membership fee, that each of us must pay to help restore and maintain our environment? Let us look to some of the complex modern pollution problems individually and the dues we must pay to solve them.

First, consider the air. Man induced air poisons are increasingly cited as the causal factor of death in warrants signed by medical authorities during air pollution alerts. The cumulative and chronic effect of repeated incidence of air pollution causes readily recognized symptoms of damage on hundreds of species of plants. Distinct symptoms are now identifiable for the different types of major air pollutants. Air pollution injury on plants retards growth and kills chloro-

Chairman—American Horticultural Society ad hoc Study Committee on the Environmental Crisis.

phyll, thus interfering with the process of photosynthesis.

What of combustion, so essential to production for modern man? The CO_2 content of the world's atmosphere is reported to have gone from slightly less than 300 ppm in 1900 to 320 ppm in 1970. At the rate we are going, it is estimated to reach 380 ppm by 2000. One wonders about the effects of the oxygen each human uses and the carbon dioxide he throws back into the atmosphere? How can we visualize our relationship to the plants about us? The oxygen they give us? The carbon dioxide we give them? Calculations indicate that under primitive Amazonian jungle conditions at least one large tree actively photosynthesizing for 12 hours a day is needed to convert to breathable oxygen the CO_2 contributions for each tribal resident living off the forest. But we also are tampering with the atmospheric balance in more unconscionable, if unconscious, ways.

Comparative calculation indicates to what extent each average North American is responsible for upsetting the CO_2 ratio in our breathable atmosphere as expressed in the daily photosynthetic efforts of actively growing trees:

1 man's breathing	1 tree
Auto & truck driving (5 gal/day)	20 trees
Oil for heating home	20 trees
Household electricity	5 trees
Garbage	2 trees
Industrial goods-fossil fuel	30 trees
Total estimated number trees required per person per day in modern civilization necessary just to maintain the CO_2 ratio in atmospheric balance.	78 trees*

Because of the deciduous nature of many temperate trees, the need for world-wide vegetation including algae and green plankton is emphasized for the support of life.

The above estimates do not even consider the devastating effects of mass public transportation, forest fires and countless other natural contributors to the atmosphere's CO_2. One commercial jet aircraft traveling round trip between New York and Los Angeles utilizes 10,000 gallons of fuel-creating CO_2 pollution that takes the combined effort of more than 100,000 trees—photosynthesizing one day—to overcome. Who knows how many trees are involved in cleaning up the resultant photochemical pollutants?

One obvious solution to man-made pollutors is to curb them. We must curtail pollutants at their source and we must curtail the number of sources. We need also the research to develop technology for improving ways of dealing with pollutors. And this must be the cooperative effort of government and industry—and the individual.

Our field as amateur and professional gardeners and horticulturists gives us the specialized knowledge to deal effectively with part of the environmental crisis. It is our mission to work toward a healthier world by doing what comes most naturally—planting and caring for our plants. We deal with plants. We can select, propagate, plant and care for the increasingly required cultivated plants of the world and help prevent the destruction of vegetation in its natural habitat.

It is the green plants, through their remarkable process of photosynthesis, that reward us for our efforts by returning life-giving oxygen to the atmosphere. This symbolic relationship between animal and plant life is so basic that it is difficult to understand those who abuse the green around them. Only through the process of photosynthesis has man been permitted to evolve and remain on earth.

It is plants that are able to clean up our many kinds of air pollution—provided the concentrations of the man-made air poisons do not reach the toxic limits of the plants' resistance and provided there are sufficient plants available to neutralize, filter, absorb and precipitate out the pollutants.

The second dilemma confronting horticulturists is that as the world's popula-

* Correspondence with Dr. Karl Wolfgang Böer, Department of Physics, University of Delaware, Newark, Delaware.

tion increases rapidly, our forests, open spaces, green pastures, natural resources and, indeed, our best soils are being sacrificed for more houses, more industrial sites, highways, products of our urbanized life.

The cement world we are creating is also polluted visually and with noise. It is squeezing out what remains of our natural environment. New York City, a shocking example of urban pollution, now boasts less than ¼ of a tree per resident. We must plant, plant, plant—urban mini-parks, along highways, in street triangles, on roof tops in recreation areas, in public—our own backyards—to clean up the atmosphere and to keep the beauty of living plants alive in our cities. We must make intelligent use of pollution-tolerant plants and "smog eaters," which can help eliminate the ingredients of man-made pollution in the air. Plants can soften the harshness of stark walls and often the reverberations of the unnatural noises. We must work with public officials to hang on to what we've got—our often threatened botanic gardens, arboreta, parks and forests.

Israel has in recent years reforested mountains which have been barren for more than 2,000 years, stripped by a powerful civilization which has long since disappeared. She has so far planted over 100,000,000 trees or about 25 trees per inhabitant of that small country. Who else in this day and age can boast such a record?

The Lebanese, too, have started to reforest parts of their mountains with "Cedars of Lebanon" which were desecrated by the first of a long line of forestland rapers—King Solomon. The Lebanese have learned the value of the land and its vegetative cover.

Europe, despite repeated ravages by selfish, greedy men, has made great strides in the art of land and forest restoration, as well as city planning and green resources management. In Scotland, for example, there are family managed forests which have been commercially timbered continuously and successively restored since the 1400's. We have many examples to follow and to inspire us if only we will stop "developing" every piece of open green space.

A third aspect of environmental pollution for which we, as horticulturists, must share the responsibility is the misuse of chemical fertilizers and dangerously toxic pesticides and herbicides. These types of chemicals alter the natural composition of our soils if used incorrectly. They flood our waters with dangerous by-products, and in quantity, threaten basic food chains.

Our responsibility, our duty, is to use these biological poisons with care and knowledge. Pesticides and fungicides are essential to the prevention and cure of plagues and many diseases, but their misuse is a threat to life on earth.

Every member of AHS can participate as a contributing horticultural member to American society. Our aims shall be:

1. *Recognize Pollution:*	Learn to recognize its symptoms on plants; recognize the fact that we all contribute to it—curb pollution.
2. *Set an Example:*	Use public transportation when possible. Return to using the hand mower—push it for exercise—abandon the power mower! The power saw and the multitude of power equipment for home use. Quit smoking!
3. *Encourage Pollution Education:*	People, films and literature are readily available to disseminate reliable information on pollution, its effects and its control.
4. *Select Plants for Natural Resistance to Air Pollution:*	Scarcely a plant species exists that does not somewhere have individuals which successfully resist pollution diseases and other ecological stresses. These are the individual plants that we all need to seek out and grow in our cities. This is the great hope for horticulturists.
5. *Plant! Plant! Plant!*	*Green* survival is prerequisite to *our* survival.

Environmental Problems

TOM STEVENSON

Climate and Pollution

Is man inadvertently changing the climate by polluting the atmosphere? This is possible, says Pres. Nixon's Council on Environmental Quality. The chemical composition of the earth's atmosphere has been altered in a measurable way by pollution, and the changes are enough to affect the earth's surface temperature.

During the past 30 years, the average annual temperature at the earth's surface fell about 0.5 degree Fahrenheit. That doesn't sound like much, but actually a few degrees downward could bring on a disastrous ice age, or a few degrees upward result in melting of polar ice caps and catastrophic flooding of coastal regions.

The lowering of the temperature has been accompanied by the shifting of frost and ice boundaries to the south and marked increases in rainfall in parts of previously arid continental regions. In the last two winters, ice coverage of the North Atlantic has been the most extensive in over 60 years. Because of it, Icelandic fishermen suffered great losses, and the colder temperature substantially diminished Ireland's agricultural output. In contrast, the rains in central continental regions, particularly in India and East Africa, contributed to high wheat yields.

Beginning in about 1890, the average annual temperature began an irregular climb. By 1940 it was 1.1 degree F. higher than it had been during the decade from 1880 to 1890. Simultaneously, pronounced aridity gripped the south central parts of Eurasia and North America which led to dust-bowl conditions in some areas and a northward displacement of the polar fronts.

Between 1940 and 1970 one-half of the warming that had occurred was erased. Such alternating periods of warming and cooling have been going on during the past 10,000 years.

Carbon dioxide in the atmosphere is virtually opaque to some long wave radiation that is emitted by the earth's surface. Thus, when carbon dioxide concentrations increase, heat loss through radiation from the surface is reduced—the greenhouse effect. Observations by Scripps Institution of Oceanography and Environmental Science Services Administration (ESSA) show that from 1958 to 1970 the carbon dioxide concentration in the atmosphere increased from 312 to 320 parts per million, an average annual jump of 0.7 ppm. Yet during this period the earth's surface temperature was falling rather than rising.

Thus, the heating effects of carbon dioxide apparently were counteracted by natural fluctuations or by other man-made activities, according to the Council on Environmental Quality.

Recent findings of scientists from Sweden and ESSA indicate that as increased fossil fuel consumption raises carbon dioxide output, a larger portion is absorbed by the oceans and a lesser percentage is retained by the atmosphere. During the last five years, they say, less than 40 per cent of man-made carbon dioxide has stayed in the atmosphere.

Particle pollution could be the cause of temperature drops during the past three decades. Certain kinds of industrial processes emit cloud condensation nuclei which increases the frequency of fog and low cloud layers. These in turn reduce the radiation that reaches the earth from the sun. Forest fires, even the burning of leaves and trash by gardeners, also produce cloud condensation nuclei from dust and ashes.

Some investigators estimate that a de-

Washington *Post*-Los Angeles *Times* News Service, Garden Columnist, 6900 Mornington Road, Baltimore, Maryland 21222.

crease of atmospheric transparency of only three or four per cent could lead to a temperature reduction of 0.7 degrees. Another study shows that the addition of 1 per cent in the world's average low cloud cover lowers the temperature by 1.4 degrees. This is almost three times the increase which occurred in the last 20 years.

On the average about 31 per cent of the earth's surface is blanketed by low clouds. If this figure were to reach 36 per cent (there is no evidence at present that it will), the temperature could drop about seven degrees. It would bring the earth's temperature very close to that required for return of an ice age.

Increases of fog and low clouds are known to occur when open country is turned into urban areas. But it is not known whether there has been any increase of global cloud cover. With satellites, data are now obtainable fairly routinely of clouds above oceans. But data are often incomplete because high clouds prevent satellite observation of lower clouds.

One study concludes that a major part of the variation is due to fine-grained particles introduced into the stratosphere (upper atmosphere) by volcanic eruptions. If true, it would appear that dust from volcanoes overshadows that from urban and agricultural pollution.

If pollution were significantly responsible, then the world would face an important problem of man-made global climate modification, said the Council, because atmospheric pollution has increased markedly, and at the present time there still are no acceptable means of impeding its growth on a global scale.

It is still unknown if oil pollution contributes significantly to climatic change, the Council said. Effects of oil films on the ocean surface are poorly understood. With their vast stores of thermal energy, the oceans act as balance wheels to climate. The atmosphere exchanges energy with the ocean through radiation and mechanical processes. The strength of the mechanical interaction associated with moving over a wave-roughened surface depends on the surface roughness of the water and the velocity and regularity of the wind. Very thin oil films can alter this interchange by reducing turbulence, evaporation, and the radiation emission of the surface.

Pesticides and People

There is a great deal of opposition in the United States today to the use of any pesticide for any purpose and the opposition probably is increasing. It is based on a lot of truth, some untruth and a lot of half-truth.

The stark fact is that without pesticides at this time in history there would be a heavy loss of food crops, food would be scarce and much more expensive and millions of lives would be lost because of starvation.

A number of nonchemical alternatives to pesticides are talked about. These include the development of disease and insect resistant varieties, light traps for control of insects, attractants, radiation, sterilization, biological controls, and improved cultural practices. The question is often asked, Why aren't they used more extensively instead of pesticides? The truth is that in all too many cases they simply will not do the job.

"During the past quarter of a century, nations in all parts of the world have benefited from increasing use of the synthetic pesticidal chemicals," according to the Committee on Persistent Pesticides appointed by the National Research Council to examine the subject. "Through use of these chemicals, spectacular control of diseases caused by insect-borne pathogens has been achieved, and agricultural productivity has been increased to an unprecedented level. No adequate alternative for the use of pesticides for either of these purposes is expected in the foreseeable future."

The President's Science Advisory Committee has pointed out that in the developed countries, most of the increase in the use of pesticides has been in agriculture, whereas, in the developing countries, most of the increase has been due to efforts to control insect vectors of disease. Moreover, as a result of the greatly reduced incidence of diseases in some developing countries, more food is needed—to feed those saved from disease. These countries must turn to more intensive agriculture, and use of pesticides, to support their growing populations.

Farmers sometimes apply more pesticide than the amount needed for controlling insects with the aim of raising the level of control from good to the level of almost perfect in order to increase market acceptability.

"In some instances," said the Committee, "it may be desirable to reexamine the basis of market quality in the interest of reducing pesticide residues in the environment."

The primary objective in regulating pesticide use has been to keep residues in food supplies at minimal and safe levels, because food is the principal route by which pesticides normally reach man. Increasing effort has been devoted to inspecting food supplies, and supplies in which residue levels were found to exceed legal tolerances have been condemned.

"As a result," said the Committee, "residues in the food supplies of the United States have been maintained at remarkably low levels during a time of great increase in pesticide use. The committee believes that, at present, pesticidal chemical residues in food are being maintained at safe levels."

In home gardening and household uses, pesticides may be applied at excessive rates because the user does not know the proper type of pesticide for best results and because he applies them improperly, said the Committee. "In doubt as to proper quantity, he may reason that if some is good, more is better and thus may apply too much."

The persistent pesticides are the ones that are causing the greatest concern. They include most of the chlorinated hydrocarbons. DDT, aldrin, dieldrin, endrin, heptachlor, and toxaphene belong to this family. Present information indicates that DDT can remain toxic for at least 20 years (pesticides based on toxic, inorganic elements such as mercury, lead, and arsenic are virtually permanent).

According to the Council on Environmental Quality, there is still relatively little information on the impact of the persistent chlorinated hydrocarbon insecticides on humans.

"Consequently, it is not yet known with certainty what are the long-range effects on humans of accumulation of these substances, although some investigators consider that the results from test animals show that a significant threat exists for humans," the Council said.

"Such materials accumulate in the body, especially in fat. Investigations show that Americans carry an average of about 8 parts per million of DDT and its metabolites in their body fat. Workmen who handle large quantities of DDT may have several hundred parts per million and still show no harmful effects. The milk of nursing mothers contains DDT. It is also metabolized and excreted in the urine. If exposure decreases, the body concentration diminishes. Therefore, current reductions in DDT use will bring gradual reduction in body burden, but how fast this may take place is not known."

Even pesticides that degrade rapidly are not without serious drawbacks, the Council said. Many organophosphate insecticides are extremely toxic and nonselective. Places where they are applied are left nearly devoid of insects, including the natural enemies of the intended targets. Since the chemicals then disappear rapidly, fields are extremely vulnerable to new attacks by insects from adjacent areas. Pests always multiply more rapidly than their predators. In addition, insects resistant to the pesticides emerge rapidly. The typical response is to apply heavier doses of the same pesticide at shorter intervals.

The Council recommended greater

Photo U.S. Forest Service

This ponderosa pine tree *(Pinus ponderosa)* is nearly dead from the effects of smog in the San Bernardino National Forest, southern California.

effort toward development of nonchemical methods of pest control.

"Federal outlays for such methods have increased to $45 million annually, but with little success," the Council said. "The list of nonchemical controls remains small and almost all have disadvantages. Industry has invested little in this area, so public agencies are left with the leading role in research and development."

Incentives to industry should be explored to stimulate research and development on substitutes for persistent pesticides and on nonchemical control, the Council added, and studies of the effects of pesticides on man and the environment should be increased.

Pollution Control

What Is Being Done About It

A common complaint has been that despite an alarming increase of pollution, very little is being done about it. Lots of talk and no action was the frequent protest.

As a matter of fact, a great deal has been and is being done. At least the ground work is being laid for an organized high-powered assault on the sources of pollution.

On Jan. 1, 1970, President Nixon signed into law the "National Environmental Policy Act of 1969," Public Law 91-190. It was a declaration of national policies and goals. ". . . It is the continuing responsibility of the Federal Government," says the Law, "to use all practicable means (including financial and technical assistance) to . . . fulfill the responsibilities of each generation as trustee of the environment for succeeding generations; assure for all Americans safe, healthful, productive, and esthetically and culturally pleasing surroundings; attain the widest range of beneficial uses of the environment without degradation, risk to health or safety, or undesirable and unintended consequences; preserve important historic, cultural and natural aspects of our national heritage, and maintain, wherever possible, an environment which supports diversity and variety of individual choice; achieve a balance between population and resource use which will permit high standards of living and a wide sharing of life's amenities. . . ."

Public Law 91-190 also established the Council on Environmental Quality ". . . to gather timely and authoritative information concerning the conditions and trends in the quality of the environment . . . to analyze and interpret such information . . . to review and appraise the various programs and activities of the Federal Government (relating to pollution) . . . to develop and recommend to the President national policies to foster and promote the improvement of the environmental quality . . . to conduct investigations, studies, surveys, research, and analyses relating to ecological systems and environmental quality. . . ."

On July 9, 1970, President Nixon sent to Congress two "Reorganization Plans," one to establish an Environmental Protection Agency, and one to establish, within the Department of Commerce, a National Oceanic and Atmospheric Administration.

"Our national government today is not structured to make a coordinated attack on the pollutants which debase the air we breathe, the water we drink, and the land that grows our food," said President Nixon in his message accompanying the Reorganization Plans. "Indeed, the present governmental structure for dealing with environmental pollution often defies effective and concerted action. Despite its complexity, for pollution control purposes the environment must be perceived as a single, interrelated system. Present assignments of departmental responsibilities do not reflect this interrelatedness."

The reorganization plans went into effect on Dec. 3, 1970. The Environmental Protection Agency brings together in one unit some 5,700 employees from 15 other government departments, dealing with water quality, air pollution, pesticides, radiation, and solid wastes. William Doyle Ruckelshaus was appointed administrator and his appointment was confirmed by Congress.

Mr. Ruckelshaus was born July 24, 1932, at Indianapolis, Indiana. He received his A.B. from Princeton University in 1957 and his LL.B. from Harvard Law School in 1960. He served in the U.S. Army 1953-1955 and was discharged as drill sergeant. He served as Deputy Attorney General of Indiana 1960-1965, and drafted the Indiana Air Pollution Control Act which was adopted in 1963. In 1967 he was elected to the Indiana House of Representatives, in 1968 was nominated by the Republican Party of Indiana as its nominee for the U.S. Senate (he was defeated in the general election), and in 1969 was appointed Assistant Attorney General of the United States, Civil Division.

In a press conference briefing on Dec. 16, 1970, Mr. Ruckelshaus outlined the functions of the Environmental Protection Agency.

"EPA is an independent agency," said he. "It has no obligation to promote agriculture or commerce; only the critical obligation to protect and enchance the environment. It does not have a narrow charter to deal with only one aspect of a deteriorating environment; rather, it has a broad responsibility for research, standard-setting, monitoring and *enforcement* with regard to five environmental hazards; air and water pollution, solid waste disposal, radiation, and pesticides. EPA represents a coordinated approach to each of these problems, guaranteeing that as we deal with one difficulty we do not aggravate others."

EPA is responsible for establishment of tolerance levels for pesticide residues which occur in or on food; the registration of pesticides; review of pesticide formulations; regulation of sale or use of pesticides; and research on effects of pesticides on human health, fish, and other wildlife and their environments.

While EPA has the authority to set pesticide standards and to monitor compliance with them, the Food and Drug Administration retains authority to remove from the market food with excess pesticide residues.

The Department of Agriculture will continue to conduct research on the effectiveness of pesticides and furnish its information to EPA, which has the responsibility for actually licensing pesticides for use after considering environmental and health effects.

The National Oceanic and Atmospheric Administration brings together under one head the various Federal departments and agencies dealing with the scientific, technological, and administrative problems of the oceans and atmosphere.

"What Can One Man Do My Friend?"

ROBERT F. LEDERER

Creation of micro-environments, replete with plant material which beautifies land, purifies air, insulates against noise, and stabilizes soil, is a viable answer to the question "What can one man do about pollution?"

Green Survival, a national action program sponsored by the American Association of Nurserymen, literally brings anti-pollution warfare down to grass-roots level. It makes conservation activists of us all.

If pollution is our most serious environmental problem, air is our most vital resource. Concentration of population in already densely populated urban areas overloads the air with a variety of pollutants, noxious and otherwise. It doesn't stretch the imagination too far to envision a nation in gas masks, groping about a concrete jungle of dying cities, unless something is done—and soon!

Ambient air in America's metropolitan areas is saturated with thousands of tons of pollutants. Since air pollution injury to plants generally becomes evident before visible effects can be noted on animals or materials, green growing things literally are air pollution detectives.

Vines, trees, shrubs and other vegetation and plankton in the sea supply the oxygen that man requires to live. Through intake of carbon dioxide, at the proper levels of light, temperature, and water, plants release oxygen to the atmosphere. This process is called photosynthesis.

Belts of greenery are part of the solution to smog build-up along the nation's highways. Green vegetation helps remove pollutants and muffles sounds, even as it improves the appearance of the highway right-of-way and increases highway safety.

Executive Vice President, American Association of Nurserymen, Washington, D. C.

Trees, shrubs, vines, and flowers act as natural traps for airborne matter. Hairy leaf surfaces clutch falling particles, and accumulate vast quantities of particulate matter which would otherwise end up in the lungs of human beings.

Soil erosion causes a billion dollar loss of top soil each year in America. Plants and the top soil they form—and stabilize—provide a type of counter attack needed to minimize the loss of a vitally important natural resource.

Shrubs and vines, planted on steeply sloping land, prevent erosion also. And carefully calculated plantings along roadways help greatly in halting the drift of soils and the clouds of loose dirt which dust storms raise.

Planted vegetation assists in reducing erosion of the nation's 300,000 miles of streambanks by an estimated 75 percent.

A water quality crisis has been building for decades in this country. It is now at a dangerous peak in many cities and towns. As the pollution problem grows, the population increases—and vice versa. Result? There is a steadily increasing demand for clean water, and a critically-short supply, over all. Impoundment of water is one of the major solutions to water-shortage problems. Since most water comes from forest land, trees play an important role in helping to increase water supply.

Modern man lives in an environment polluted by excessive noise. Over the years, man-made sounds have increased to the point where they are producing both psychological and physiological problems. Plant material is increasingly used to deflect, absorb, break up, and tone down many of the sounds which make community life miserable.

Property owners are increasingly conscious of the need for heavy plantings to provide a barrier against the traffic noise on adjacent highways. Planting not only decreases noise, it also screens moving vehicles from sight, giving a sense of privacy which makes traffic sounds less objectionable.

Today's cities are all too often concrete and asphalt jungles, cheerless canyons intertwined with cliff-like high-rise offices and apartments. Man, who appears to be genetically programmed to require natural surroundings—fresh clean air, and a green landscape—is plainly out of place in the metropolis.

Steady progress is being made toward more abundant and graceful use of plant material, and toward providing more open spaces in the "Center Cities" of America.

Green Survival involves the entire environment, and the awakening interest in conservation is greening-up the land.

The fact is, people don't like ugliness in their surroundings, and pride makes them want to do something about it. Trees, grass, shrubs, and flowers lift our spirits and brighten our outlook. We plant and tend green things to satisfy a primordial desire—and to express our individuality.

The time is here to pay our debt to the past and provide a legacy for the future by halting the degradation of our national environment. City dwelling is almost totally devoid of the qualities which make for the good life. And degradation of the environment is a major cause of the growing discontent which plagues urban society.

At last man, the great polluter, is starting to change the drab and ugly scene. The horticulturist, who has fought this battle for many years is helping even more intensely to bring millions the changed outlook which an abundance of green growing things can produce.

And, this is the great strength of "Green Survival." There is little question that our environmental dilemma is as great as it is depressing. But Green Survival provides to the individual a positive and enthusiastic alternative. Green Survival tells each of us in this great land that in the struggle to save man from himself, the nursery industry can provide leadership and technical assistance to purify our air, abate noise, stabilize soil, and purify water. Through it all, the landscape industry will apply its art to balance function with beauty of form. The landscape industries are pledged to help create the kind of world in which human life will be enriched as never before.

The Green Survival philosophy has a clear and unmistakable message for the individual. It says one person . . . by himself . . . can have a great effect on making the environment better if he will choose to take action. The American Association of Nurserymen, with its Green Survival Program, is dedicated to guiding the individual in constructive use of plant material to make our communities and our nation a land of beauty and majesty from "Sea to Shining Sea."

Green Survival truly answers the question, "What can one man do my friend, what can one man do?"

Plants in the Living Environment

HENRY M. CATHEY

We have a new view of the spacecraft "Earth" and a new way of looking at ourselves as the crew of that spacecraft.

Our Earth is a spacecraft tied to a supply ship, a dying star, both hurtling through space on elegant, precise, gravitationally controlled orbits. There is no source of fresh supplies, no untapped frontier to provide us with more consumables.

On board with the crew are the life support systems — micro-organisms, plants, and animals. All together we direct and maintain the environmental conditions suitable for life. We literally make the crust of our spacecraft Earth alive—each and all of us are involved together.

Our supplies are with us and must last for the duration of the mission. We assume that our resources are unlimited and expect that man will somehow keep ahead of problems through new technology.

The Societies of the Seventies, the young and old who participated in the environmental teach-in last spring, are saying that there is a limit to what we can expect from technology. We already have much information that we are not using. We need to fragment the environmental crisis into many small goals which are within the grasp of a part of society. We, the horticulturists, must apply our expertise in solving these problems through the use of plants, living plants—green plants. Our goal should be a legacy of green plants for tomorrow's landscape.

Carbon Recycling

Plants have a unique function on spacecraft Earth. They are responsible for the recycling of carbon dioxide and oxygen. They complement the cycling of the animals' metabolism. Plants are contributors to the recycling system only when they are in active growth, with all of their green leaves carrying on photosynthesis. They take up large volumes of carbon dioxide in sunlight, in the correct range of temperatures, at the proper levels of light, with the proper levels of moisture and mineral nutrients. For many hours, parts of each day, or even weeks, plants do not add oxygen to our environment but actually generate carbon dioxide as a by-product of their respiration.

Plants are found in most parts of our spacecraft Earth. Areas and types of plants contribute to the recycling in varying degrees:

Habitat	*Carbon Fixed Percent*
Oceans	89.2
Forests	7.4
Cultivated Land	2.6
Steppes	0.7
Deserts, Polar Regions	0.1

We are very dependent on our marine and fresh water algae. Almost 90 per cent of photosynthesis occurs in water. Our forests and grasslands, the major contributors on land, fix 8.1 per cent of the carbon. The plants cultivated by man contribute only 2.6 per cent of the photosynthesis that occurs on spacecraft Earth, but these green plants live where the crew lives. These green plants surround man, and help man and his habitat create the landscapes of Earth.

Spacecraft Earth contains only a limited number of consumables. The major limiting consumable may be readily available carbon diovide. Each year 2×10^{11} tons of carbon are fixed in photosynthesis in carbohydrates. This represents about 0.4 per cent of the readily available carbon dioxide. To maintain the present level of photosynthesis on earth, we must recycle all of the carbon dioxide every 250 years. We are burning and releasing more carbon dioxide than

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in previous generations, and thus we are slowly changing the balance of life on spacecraft Earth. The long-term effects of increased carbon dioxide levels, increased growth rates of plants, and changes in temperatures of our urban areas and the shift in the balance of nature are not fully comprehended on a global scale.

Let us examine some of the polluters of our environment and the foreign agents which may change our spacecraft.

Deficient carbon dioxide

Plants function only in the presence of carefully controlled levels of carbon dioxide. Our environment on an average day contains 0.03 per cent carbon dioxide. There are many times during the daylight hours when the level of carbon dioxide falls much below this value. Plants vary greatly in their ability to take up carbon dioxide from the air. Plants are uniquely designed to complete this function. Plants vary in the maximum and minimum light levels which will support growth.

Plant	*Light (foot candles)* *Min.*	*Max.*
Bean (*Phaseolus*)	100	2,200
Oak (*Quercus*)	300	1,500
Pine (*Pinus*)	300	9,000
Philodendron	25	500

The recycling of carbon dioxide and oxygen is retarded due to the scattered remains of rubbish floating in our air.

We are told that plants in our urban environment are receiving 16 per cent less light than they did a generation ago. This means that the efficiency of the plants is reduced since the plants are growing at or less than minimum conditions.

Green plants help purify the air and provide life sustaining elements.

Air

Our air is filled with chemicals which attack the life support systems of plants. They may be by-products of man's machines and wastes or may be created in space by photochemistry. During the daylight hours our plants have their mouths, the stomates, wide open, and they take up ozone, sulfur dioxide, peroxyacetyl nitrate (PAN), carbon monoxide, ethylene, and many other substances.

Plants do not rid the environment of these foreign agents but they trap many substances and unintentionally remove them.

Water

The water crisis has been building in America for decades. The amount of potable water required to maintain the liquid balance increases each year for every factory, man, and plant. Man rejects water that is not palatable. Plants are as demanding of water quality as man. The materials dissolved and dispersed in water also lower the availability of water to plants and thus in turn limit growth.

Plants lose water to the atmosphere as

Green plants recycle contaminated water which becomes aerated rain water.

part of the recycling of the earth's consumables. The amount of water required to grow even an annual plant is enormous.

Plant	*Water Lost—Gallons (In one growing season)*
Tomato (*Lycopersicon*)	34
Corn (*Zea*)	54
Sunflower (*Helianthus*)	130

Less than 5 per cent of this water is essential to maintain the life processes of plants. The remaining water cools the surrounding areas and sets up the recycling from contaminated to aerated rain water.

Many of our recent advances in the culture of plants have been based on the indiscriminate use of large volumes of water. The excess water evaporates into air or leaches our agricultural chemicals and sediment into streams, lakes, and finally oceans. We never seem to have the correct amount of water, at the proper times to grow vigorous plants.

Green plants screen out, deflect, absorb and muffle the unpleasant sounds in a community.

Noise

Man and his machines generate a steadily rising din measured as decibels. Over the years, noise levels have increased to the point where they are producing both psychological and physiological problems for man. Strips, buffers, and screens of green plants can be used to deflect, absorb, break up, and muffle many of the sounds that make community living unpleasant and uncomfortable.

Light

Man's need to see other men and machines moving around on spacecraft Earth has brought constant moonlight over most of our urban environment. Ordinary mercury vapor lamps have been the standard for urban lighting for many years. Although they have only slight effects on the growth and development of our green plants, the blue light emitted from them attracts night-flying insects from the surrounding areas. The insects consume our decorative plants, lay eggs on the branches for future generations, and disfigure the landscape. Color-improved lamps are now being substituted for the blue ones, the so-called "color improved" lamps emit sufficient levels of red light to retain green leaves and to delay the onset of dormancy of many kinds of plants. Night lighting with the wrong kind of lamps in our urban environment greatly decreases the survival of some of our most desired trees and shrubs.

Green plants respond to light—sometimes in unpredictable ways.

Man will continue to find ways to adapt himself and his plants. This is an optimistic view. Man may be able to do some things to adapt himself, his plants, and his environment, to survive. But there are many plants that are extinct today because they were not able to survive. Others, such as the magnolia, dogwood, and the ginkgo, have survived many environmental changes, and are still beautiful and widely used.

In this adaptation process man can call upon all of his resources. But he must still look to the horticulturist to propagate, to grow, and to protect our plants.

The horticulturist will be pressed to select tolerant plants for even a scrubbed environment. The pressures will be so great that he will be impatient to wait for years to find out whether a seedling possesses desired color, form, resistance, sound baffling, and fragrance, as well as tolerance of polluted air, soil and water. He will have to learn more about relating the early stages of plant growth to the desired performance of mature plants. He will have to develop plants that use inherent resources and characteristics to ward off pests and diseases. He must continue to look for plants for the consumer to plant EVERYWHERE.

Green is the color of hope. In the green of our plants is the hope of survival. It begins in the hands of the skilled horticulturist but ultimately it moves through the hands of horticulturists to the hands of all people who grow plants—fruit, vegetables, ornamentals.

The decisions are in our hands, in our propagation beds, in our fields. In the seeds that we planted last week or the cuttings we shall make next week lies our hope for survival.

Man First? Man Last?

HUGH H. ILTIS

The ubiquitous conservation speeches and environmental panels of today are dealing mainly with urgent problems of population, pollution, and crowding. That the priorities are given to these big city, strictly human, homocentric syndromes is obvious and understandable. People die of pollution, people go crazy with crowding, people starve and lay waste the lands through overpopulation.

Hopefully, we may yet solve the *pollution crisis;* we could, I think, clean up our polluted nests—an obvious and necessary achievement. But, if in cleaning up the cities, we forsake the rest of life; if we, in our human preoccupation, let all but corn and cow slide into the abysmal finality of irreversible extinction, then our species indeed will have committed ecological suicide.

Clearly, there is no cause for optimism in the broader *environmental crisis,* for the spectres of ecosystem collapse, of catastrophic extinctions of most living animals species, and a vast number of plant species, are on the horizon.

According to Talbot (*BioScience,* March 15, 1970), 3% of the world's mammals, not counting such pre-historic wonders as the Irish elk or the mammoth, became extinct in historic times, and most of them during the past 50 years! Today, 10% to 12% can be considered endangered, extrapolating from the conservative 8% of species and subspecies listed as imperiled in the *Red Data Book for Mammals* of the International Union for the Conservation of Nature. Perhaps 130 of the 400 United States mammal taxa are believed to be threatened with extinction. Birds are fairing no better! Dillon Ripley, of the Smithsonian Institution, recently estimated that a majority of animal species will be extinct by the year 2000! And Kenneth Boulding suggests that, with the present rate of human reproduction, in another generation it may be economically impossible to maintain any animals, except domesticated ones, outside of zoos. Those are the grim prospects that economic, political, or evolutionary optimists should be confronted with.

Butterfly and wild flower, mountain lion and caribou, blue whale and peli-

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PHOTO W. H. HODGE

The Venus fly-trap (*Dionaea muscipula*) occupies a special habitat in sandy grassy areas near Wilmington, North Carolina and adjacent South Carolina. It is one of America's most interesting plants. Burning of the tall grass in areas where it grows encourages the plant and helps to keep it from disappearing. It is highly essential to preserve the habitat of the Venus fly-trap and to keep the bull-dozer and developer away from areas where it grows, otherwise the plant could easily become extinct. Many other native plants, even the common ones, are endangered when the habitat is disturbed or eliminated.

can, coral reef and prairie land—who shall speak for you? My grandchild may need to know you, to see and smell you, to hear and feel you, to be alive,—bright and happy!

Yet, among all the many programs of the recent "Teach-ins" at the University of Michigan and at Northwestern University and 1000 other campuses, there were few to speak for the wild environment, for nature, for a *Morpho* butterfly in a Peruvian valley, for a timber wolf chasing caribou in Alaska.

This lack of concern is understandable, because man now occupies every bit of the earth and, like a dictator, controls or could control, if he wished, every living thing. As some see it, except for a few primitive tribes—"Man has . . . broken contact almost entirely with the ecological universe that existed before his culture developed. He no longer occupies ecological niches; he makes them."*

But have our genes ceased to need the environment that shaped them? If we destroy ecosystems and species with abandon,—ecosystems to which we are adapted, species whose values we do not yet know, and cannot predict—we surely do it at our own peril.

Thus, the lack of focus on the natural environment, on the wild animals and plants, on the woods and streams, is frightening.

Who defends wilderness, the natural unspoiled environment? Who defends the environment in which we evolved, and which we still may need in all its purity? Except for a vociferous but ineffective minority, hardly anyone!

How can we rationalize preservation of wild lands in a man-centered world?

The ultimate question one has to ask is this: Shall man come first, always first, at the expense of other life? And is this really first? In the short run, this may be expedient; in the long run, impossible.

Not until man places man second, or, to be more precise, not until man accepts his dependency upon, and puts himself in place as part of nature, not until then does man put man first! This is the great paradox of human ecology. Not until man sees the light and submits gracefully, not until he moderates the homocentric part of himself; not until man accepts the primacy of the beauty, diversity, and integrity of nature, not until he limits his domination and his numbers, and places equally great value on the preservation of the environment and on his own life, is there hope that man will survive.

If we are to usher in an Age of Ecologic Reason, we must accept the certainty of a radical economic and political restructuring as well as ethical and cultural restructuring of society. No more expanding economics. No more expanding agricultures. No more expanding populations. No new unnecessary dams. No new superfluous industries. No new destructive subdivisions. We must stop and limit ourselves now.

Let the archaic power structures of the technologically intoxicated cultures of the USA, USSR, Japan, and others, listen and listen well to the winds of change:

The earth and the web of life come first,

man comes second;

profits and "progress" come last.

Man now is responsible for evey wolf, as well as for every child, for prairie and ocean as well as for every field.

Henceforth the laws to govern man must be the laws of ecology, not the laws of a self-destructive *laissez-faire* economics. And what the laws of ecology say is that we, we fancy apes, are forever related to, forever responsible for this clean air, for this green, flower-decked, and fragile earth.

Indeed, what ecology teaches us, what it implores us to learn, is that all things, living or dead, including man, are interrelated within the web of life. This must be the foundation of our new ethics.

If you love your children, if you wish them to be happy, love your earth with tender care and pass it on to them diverse and beautiful, so that they, 10,000 years hence, may live in a universe still diverse and beautiful, and still find joy and wonder in being alive.

If we survive, that is . . . if we survive.

* G. L. Stebbins, SATURDAY REVIEW, *March 1970.*

Air Pollution and the Home Gardener

JOHN PHILIP BAUMGARDT

How should the home gardener react to the present furor over air pollution? What does it mean to John Doe in his backyard? It all depends on how polluted the air is in the Doe neighborhood, and whether or not the pollutants are of a sort that damage plants. We all have been conditioned to turn the other cheek when big business or big government makes living a little more intolerable. Probably John Doe will practice *laissez faire* once more unless his plants get into trouble. The worm will turn when the Doe garden shows signs of pollution injury.

How do you know air pollution injury when you see it? Most of us first encountered it when the neighbor applied a hormone-type weed killing agent to his lawn when the breeze was in our direction. With dismay we saw new growth on the trees and shrubs twist, elongate, and produce abnormal leaves. Later we noticed that the grape leaves were thickened, misshapen and grotesque. That fall no nice clusters formed, but the grapes ripened irregularly and some still were green when frost came. Because of incorrect use of the hormone-type broadleaf weed control chemicals, it is next to impossible to grow grapes in any city these days. Most plants are distorted when subjected to weed killer fumes.

Horticultural Consultant, 3431 East 60th Street, Kansas City, Missouri 64130.

The city of Chattanooga, Tennessee learned of this sort of pollution in a big way. A major manufacturer of a weed killer allowed fumes to escape from his stacks. Downwind, for miles, plants were distorted; some were killed outright. Even evergreens showed damage, and the forested slopes of Lookout Mountain took on a strange, diseased appearance. Vigorous litigation was required to achieve some limitation to the toxic emissions.

In eastern Missouri plants downwind from a smelter were stunted, internodes scarcely elongated, foliage was dwarf and off color—the problem was zinc fumes from a smelting system that failed to control chemicals belching from the stacks. Finally, the plant had to be shut down.

Poisons such as these are more or less local problems arising from a manufacturing process. Gardeners living downwind from the plants suffer if toxic products are thrown out in the flue systems.

If you are the gardener whose plants

PHOTO CRAIG R. HIBBEN

Lilac (*Syringa vulgaris*) specimen at the Brooklyn Botanic Garden showing air pollution injury to the leaves. The photo shows the leaf curl, necrosis, and premature defoliation that are typical of this problem. Photo taken in August or September. Lilacs are good indicators of air pollution damage on plants.

are damaged (and your property is unsaleable) you come to feel strongly about air pollution.

Flue emissions may be heavy metals—copper, lead, zinc, mercury and so on. They may be some sort of solvent that is toxic to protoplasm. The burning of plastics containing chlorine will release phytotoxic chemicals such as hydrogen chloride.

The pollutant may be a hormone-type chemical such as ethylene, or a poisonous gas such as sulfur dioxide. Some emissions from industry are extremely subtle in their physiology; it takes a real expert to identify the damage and its causal agent.

Sulfur dioxide fumes are among the commonest, often originating from coal with high sulfur content. SO_2 damage is nothing new; alfalfa damage was reported in the 1930's.

The internal combustion engine—your auto's motor—is the biggest villain. Exhaust and motor fumes rise in the atmosphere and, in the presence of sunlight, a reaction takes place producing something called photochemical smog. This is the brownish, opalescent haze that blankets so many cities.

Two of the most injurious chemicals in photochemical smog are ozone and peroxyacetyl nitrate (PAN). Ozone injury frequently appears as small lesions on the upper surface of leaves. Lesions may be light or dark depending upon species and leaf position. If the injury is severe it penetrates right through the leaf blade. Leaves are most sensitive about the time they are fully expanded. Hand lens scrutiny reveals no hair-like webbing or tiny dark bodies that would suggest leafspot fungi. PAN injury is more subtle. It affects younger leaves than does ozone so the entire plant looks unthrifty, and the undersides of leaves may exhibit a silvery sheen.

Some general plant reactions to air pollution include unthrifty appearance, off-color foliage, premature aging of leaves and stunted growth. Photo chemical oxidants such as ozone, PAN, and nitrogen dioxide are known to cause considerable growth retardation even in the absence of visual injury on citrus and, no doubt, on other crops.

Leaf roll, leaf scorch (marginal burning), browning of the undersides of leaves and early abscission may indicate pollution damage. Symptoms of various forms of air pollution vary. For specific information, review the references following the papers on air pollution recorded in the Proceedings of the 24th American Horticultural Congress.

The homeowner can combat air pollution damage to plants somewhat. Though succulent growth usually is more susceptible to damage than hardened tissues, it pays to keep plants as thrifty as possible. Proper cultivation, pruning, fertilization and other cultural practices make a difference. Where particulate pollution is a problem, frequent syringing of the plants helps. And loud and long protests over the polluted condition of the air, hitting the polluting source, is most effective of all.

Must we give up growing redbud, maples, pines, sycamores, rhododendrons, ajuga, petunias and other desirable ornamentals because of impure air? Some of the more resistant species, boxwood, cotoneaster, pyracantha, juniper, holly, pomegranate, oak and viburnum, to name a few, are quite nice plants.

But the point is, why should the home gardener allow the atmospheric conditions to dictate limitations to his plantings? Every gardener needs to inform himself about the local air pollution.

Power plants, industrial plants, excessive motor vehicle traffic—these are things that can be brought to task if they affect the public good. And what about John Doe; will he take care when applying herbicides and other toxic garden chemicals? A hot spot of local air pollution is just as critical as broad damage.

Air pollution episodes are usually related to stagnating air conditions which allow pollutants to accumulate near the earth's surface. These may be sunny days with temperature inversions, i.e., a layer of warm air existing over cooler air near the ground.

John Doe needs to keep a garden

diary. He ought to record everything he does to his plants; when they are sprayed, when cultivated, watered, fertilized, and otherwise manipulated. He should record all responses. When a pattern of abnormality shows up, he should make a note of it. From these records he can tell when an injury began, what form it took, and what plants were involved. This will help experts trace down the air pollutant villain (if one was involved), and next year Mr. Doe can concentrate on new and different problems in his garden.

The Environmental Protection Agency

List of Regional Offices

The Environmental Protection Agency was created as an independent federal organization on December 2, 1970 to help protect and enhance the quality of the nation's environment. William D. Ruckelshaus was named administrator of the Agency by President Nixon.

Shortly after his appointment, Mr. Ruckelshaus announced that ten regional offices covering the entire nation would be established to implement the Agency's efforts to prevent further deterioration of the nation's resources and improve the quality of the environment.

Headquarters for the ten regions have been announced and they are listed here for those AHS members who will be taking an active role in environmental horticulture, or in other anti-pollution efforts in their own community and state.

Region I: Headquarters, Boston, Massachusetts at—Room 2303, John F. Kennedy Federal Building, 02203. Phone No. 617 223-7210. For states of Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont.

Region II: Headquarters, New York, New York at—Room 847, 26 Federal Plaza, 10007, Phone No. 212 264-2525. For states of New Jersey, New York, Puerto Rico, Virgin Islands.

Region III: Headquarters, Philadelphia, Pennsylvania at—P.O. Box 12900, 19108, Phone No. 215 597-4506. For states of Delaware, Maryland, Pennsylvania, Virginia, West Virginia, District of Columbia.

Region IV: Headquarters, Atlanta, Georgia at—Suite 300, 1421 Peachtree Street, N.E., 30309. Phone No. 404 526-5727. For states of Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina and Tennessee.

Region V: Headquarters, Chicago, Illinois at—33 East Congress Parkway, 60605. Phone No. 312 353-5250. For states of Illinois, Indiana, Michigan, Minnesota, Ohio and Wisconsin.

Region VI: Headquarters, Dallas, Texas at—1114 Commerce Street, 75202. Phone No. 214 749-2827. For states of Arkansas, Louisiana, New Mexico, Texas, Oklahoma.

Region VII: Headquarters, Kansas City, Missouri at Room 702, 911 Walnut Street, 64106. Phone No. 816 374-5493. For states of Iowa, Kansas, Missouri, Nebraska.

Region VIII: Headquarters, Denver, Colorado at—Room 9041, Federal Office Building, 19th & Stout Streets, 80202. Phone No. 303 837-3283. For states of Colorado, Montana, North Dakota, South Dakota, Utah, Wyoming.

Region IX: Headquarters, San Francisco, California at—760 Market Street, 94102. Phone No. 415 556-4303. For states of Arizona, California, Hawaii, Nevada, American Samoa, Guam, Trust Territories of Pacific Islands, Wake Island.

Region X: Headquarters, Seattle, Washington at—Room 501 Pittock Block, 921 S.W. Washington Street, 97205. Phone No. 503 226-3914. For states of Alaska, Idaho, Oregon, Washington.

Embryo Culture of Ornamental Plants

O. M. NEAL

To be useful, the new and superior plants whether they are natives or a product of the breeders art, must be available through propagation in a reasonable length of time. This has been a well-nigh impossible hurdle in all too many instances.

In this brief sketch Dr. Neal reveals some of the reasons, and even more importantly, some of the solutions, for seed dormancy and delayed growth of some of our choice native plants.

The surgeons knife and the physiologists culture techniques are combined to speed the growth of excised embryos to the cotyledon stage.—Neil W. Stuart, Editor

In the course of investigations to improve native ornamental plants of the Appalachian area by selection and breeding, it became evident that progress was limited by the time required for dormant seeds of native species to germinate. This is not surprising as a majority of the classical examples of species with complicated seed dormancies are native ornamental plants of this area. Embryo culture on nutrient media was initiated both to study the mechanisms of seed dormancy and to reduce the breeding cycle time.

Although orchids have been propagated on nutrient media for almost 50 years and plant breeders and physiologists have used embryo culture as long, seeds with complicated dormancies, especially those caused in part by immature embryos, have seldom been cultured. A majority of the approximately fifty genera that have been cultured in this study, like the seven species illustrated, have dormancies of this type. The seedlings shown grew from embryos excised from freshly harvested seeds under sterile conditions (Fig. 1) and were cultured on a modified White's medium in tightly sealed screw top vials, one inch in diameter. They were photographed after growing approximately two years under continuous fluorescent light in an air conditioned laboratory. For best continued growth, cultured seedlings would be potted at the cotyledon stage.

Horticulturist, West Virginia Agricultural Experiment Station, Morgantown 26505.

AUTHOR PHOTOS

Fig. 1. Excising embryos. To prevent contamination of the culture by bacteria or fungi, the fruit or seed are surface sterilized with alcohol or Clorox and excised in a cabinet which has been sterilized by an ultraviolet lamp.

Comparative times to reach the cotyledon stage by normal seed germination and by embryo culture respectively for the examples shown are as follows: false spikenard 9 months, 2 months (Fig. 2); black chokeberry 100 days, 20 days (Fig. 3); American holly 2-3 years, 2-3 months (Fig. 4); fringe-tree 2-14 months, 2 weeks (Fig. 5); witherod 6 months, 1 month (Fig. 6); highbush-cranberry, 2-5 months, 1-2 months (Fig. 7); arrow-wood 6-17 months-unsuccessful (Fig. 8).

Cultured embryos reached the cotyledon stage faster only because the time consuming treatments needed to eliminate mechanisms causing seed dormancy were not required. Rate of growth of intact embryos and excised embryos was similar. Mechanisms causing delayed germination which are removed by embryo excision and culture are germination inhibitors, impermeable coverings and an inactive enzyme system.

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Fig. 2. Seedlings from an untreated excised embryo of false spikenard, *Smilacina racemosa*, photographed 2 years after excising. When embryo excision is not used, seeds require four stratification periods: cold to break root dormancy; warm for necessary root growth; cold for epicotyl dormancy; and warm for epicotyl growth.

Fig. 3. Plant from untreated excised embryo of black chokeberry, *Aronia melanocarpa*. A single cold stratification period normally is required for seed germination when embryo excision is not used.

Fig. 4. Growth of fringe-tree, *Chionanthus virginicus*, from an excised embryo. Continuing root growth and rapid development of the cotyledons on nutrient media indicate epicotyl dormancy.

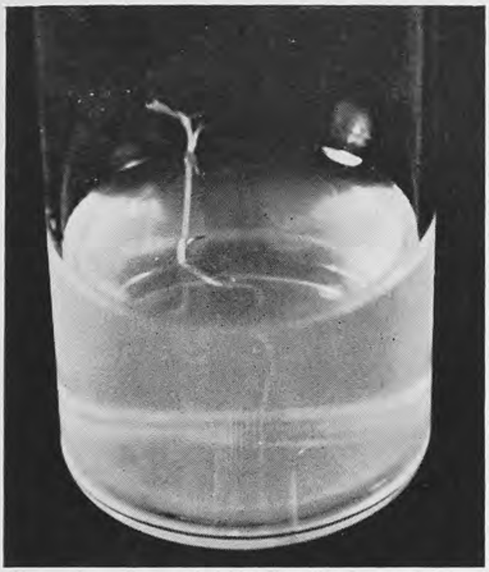

Fig. 5. Growth of American holly, *Ilex opaca*, from an excised embryo. In nature germination requires 2 or more years. Excised embryos which are only 0.3 mm in diameter germinate and reach the cotyledon stage in 2-3 months and grow continuously.

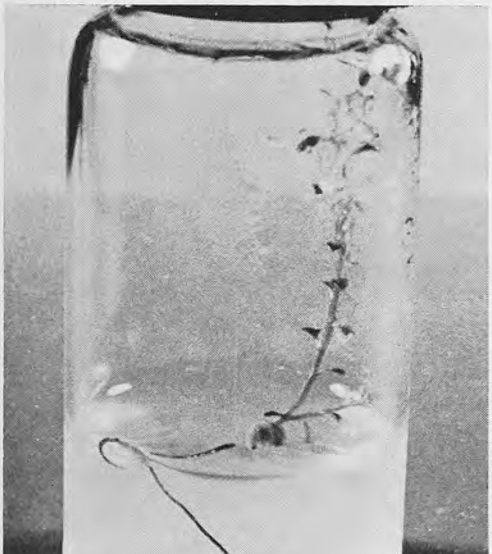

Fig. 6. Witherod, *Viburnum cassinoides* (above) grew continuously for two years after excision without treatment. The single cold stratification requirement was replaced. Seeds of *Viburnum* species require 1, 2, or 3 stratification periods for normal growth.

Fig. 7. Plant from excised embryo of highbush cranberry, *Viburnum trilobum*. When untreated embryos are excised, this plant goes into dormancy soon after germination.

Fig. 8. Arrow-wood, *Viburnum acerifolium*, which has a long stratification requirement, makes only dwarfed root and top growth in two years from excised embryos as shown above.

Controlling Weeds in Plantings of Herbaceous Perennials

I had the pleasure of participating in the 22nd Williamsburg Garden Symposium in Williamsburg, Virginia, in 1968. Dr. Tom D. Throckmorton of Des Moines, Iowa gave an interesting lecture on the use of a computer for sorting and retrieving genetic information on daffodils. He grows many kinds of daffodils and has a severe problem in controlling weeds in the plantings. I suggested that he try dimethyl tetrachloroterephthalate [DCPA, trade name Dacthal] herbicide as an early spring treatment on the soil. This treatment controls many germinating weed grasses and broadleaf weeds. It does not effectively control weeds that are up at the time of treatment.

I received a letter from Dr. Throckmorton saying that he had used DCPA with excellent results.

DCPA also may be used in plantings of lilies, iris, gladiolus, and many other herbaceous ornamentals, including chrysanthemums, columbine, coral bells, larkspur, peonies, and others, when hand-weeding is impractical. The granule formulation of DCPA should be used when available.

Another herbicide, α,α,α-trifluoro-2,-6-dinitro-*N,N*-dipropyl-*p*-toluidine [trifluralin, trade name Treflan] is effective on many germinating weed seeds in plantings of certain of these perennials listed on the manufacturer's label.

Crabgrass

Large crabgrass, *Digitaria sanguinalis*, is one of the most prevalent annual weed grasses in plantings of herbaceous perennial ornamentals throughout most of the United States. Seeds germinate in warm soil from late April to October. Plants are prostrate with only the flowering stalk being upright. Overall height of plants including flowering stalk may reach 4 feet in undisturbed locations. As culms lengthen, the lower joints contact

DRAWING BY REGINA O. HUGHES

Large crabgrass, *Digitaria sanguinalis*. A. Growth habit. B. Front and back views of florets. C. Seed.

the soil and roots are formed at the points of contact. The hairy leaf blades are 2 to 6 inches long and approximately 1/4 to 1/2 inch wide. Flowers are formed in multiple spikes 2 to 6 inches long. Spikes form a whorl of 3 to 13 fingerlike segments at the upper end of the stalk. The seed is a caryopsis or dry indehiscent fruit approximately 1/10 inch long. DCPA and trifluralin applied to the soil prevent emergence of crabgrass seedlings.

Mention of a trademark or proprietary product does not constitute a guarantee of warranty of the product by the U.S. Department of Agriculture, and does not imply its approval to the exclusion of other products that may also be suitable.

All agricultural chemicals recommended for use in this report have been registered by the U.S. Department of Agriculture. They should be applied in accordance with the direction on the manufacturer's label as registered under the Federal Insecticide, Fungicide, and Rodenticide Act.

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A New Fragrant Gladiolus Hybrid— X *Gladanthera* 'Lucky Star'

JOAN WRIGHT

Joan Wright is a devotee of steeple chasing. In 1952 while participating in her favorite sport, she was thrown from her horse and seriously injured. As a result of the accident she was unable to ride for several years and to occupy her time turned to horticulture.

She became especially interested in gladiolus. When she discovered that certain plants used in the hybridization of gladiolus were fragrant, she was determined to breed that quality into the plant she was producing.

This is Mrs. Wright's story of the experiments that produced fragrance as a significant breakthrough in gladiolus breeding. Editor.

Breeders of gladiolus have tried for many years to produce a strongly scented race of this popular summer flower but without significant success. The new fragrant bigeneric hybrid × *Gladanthera,* which combines the characters of *Gladiolus* and *Acidanthera,* has renewed interest in this goal.

Gladiolus, as we know them, were produced by the intercrossing or hybridizing over a lengthy period of time, of some twelve or more different *Gladiolus* species, none of which were fragrant. There are, however, a number of fragrant species of *Gladiolus,* and one might expect it would be simple enough to transfer this desirable attribute from the dainty winter-flowering "wildings" to their more robust summer-flowering cultivated counterparts. From all reports of such crosses, nothing of lasting worth has ever been obtained, though crosses between some of these scented species were quite successful.

Professor Barnard in England has produced several such hybrids, popular with people who require small fragrant flowers for dining table decoration and similar uses during winter and early spring. Glasshouse cultivation is required in the northern hemisphere for these frost tender hybrids.

Hopes of producing the desired summer flowering type arose in the early 1930's, when a few faintly fragrant gladiolus suddenly appeared in the U.S.A., among widely separated plantings of ordinary non-fragrant gladiolus seedlings. A few enthusiasts collected these forms and concentrated on crossing them together in the hope of increasing the fragrance, which is of a kind that most people have difficulty in detecting. Rev. Buells' *Gladiolus* 'Acacia' is the best known of this type and is one many people recognize as scented.

When the distantly related, summer-flowering, strongly scented *Acidanthera bicolor* Hochst. 'Murielae' from Abyssinia became available to hybridizers, it was hoped that this plant might be the answer to the problem, but this approach was so unsuccessful that the *Acidanthera* was declared to be incompatible with *Gladiolus.* The cultivar 'Murielae' is a garden selection described originally as *Acidanthera bicolor* var. *murielae* by Perry, an English nurseryman, in 1930.

However, I was unaware of this when I started my plant breeding venture and as *Acidanthera* was the only fragrant species available in New Zealand, I decided to use it. Similar to a *Gladiolus* in growth but with pendulously attached starry white flowers with a dark mark on the petals, it was, I felt, unusual and elegant, and it certainly had a beautiful scent.

I was not particularly worried because the flower spike curved at the tip, or

Matakana, North Auckland, New Zealand.

that there were only eight or nine buds, with only two flowers open at a time—characteristics frowned upon by gladiolus enthusiasts. At that time, I could not be classed as one of these, as I then preferred the so-called orchid-flowered gladiolus with their small-narrow-petalled flowers with only three or four blooms open at once. My original intention was to produce a scented race of these charming "arrangement" gladiolus for my own pleasure, as I felt that fragrance was the only thing they lacked.

I made several crosses between *Acidanthera* and various orchid-flowered *Gladiolus* in January of 1955. Perhaps it was fortunate that a cross with *Gladiolus* 'Filigree' as the female parent ($4n = 60$) and *Acidanthera bicolor* 'Murielae' as the male parent ($2n = 30$) produced the only successful hybrids as 'Filigree' was the best gladiolus in my collection. It was 36 inches to 40 inches in height and similar to *Acidanthera* in this respect; its pretty buff pink and cream flowers were tightly attached to the slim but strong straight flower spike, and up to six flowers would open at once out of around 18 buds on the spike. The leaves were straight and erect and of a good color, while the *Acidanthera* foliage was softer and inclined to bend over, and the color was more nearly a light olive green.

Twenty-three plants flowered from this cross. The first twenty-one plants to bloom did not resemble the *Acidanthera* in any respect, although there were some rather curious plants among them. Most of these were discarded because they had no fragrance. By the time I had sought assistance from the botany department at our local high school and had been introduced to Dr. J. A. Rattenbury, then Senior Lecturer in genetics (botany), University of Auckland, the only specimens available for chromosome counts among these non-fragrant types were a few normal looking gladiolus, too pretty to destroy. They have since been lost. Their chromosome count was $4n = 60$, as in cultivated gladiolus. What the

PHOTO F. G. MEYER

× *Gladanthera* 'Lucky Star' in a Maryland garden.

more freakish ones were will never be known, and I have always regretted my impetuous destructiveness! If the last two plants to bloom from this cross had flowered sooner, I would have regarded their seemingly worthless sisters with more interest.

Two years after I made the original cross, the first fragrant hybrid plant bloomed. This plant, destined to become the seed parent of 'Lucky Star', was a truly intermediate form. The flower, having rather long tepals and a distinct hood, and actually a little larger than either parent, was deep creamy yellow, gradually fading to white, with lighter and longer darts on the tepals than in *Acidanthera*. The extremely long tube of the *Acidanthera* had been modified by the *Gladiolus* influence to become intermediate in length in the hybrid. The flower tube of the hybrid plant was distinct but without any weakness. The fragrance was very mild but definite. In due course it was found that the number of buds produced from a large corm averaged 18 and four or five flowers would remain open at once. The average performance from medium corms was 16 buds, with 3 open at once in good condition. The tip of the flower spike curved somewhat, but straightened up as the flowers opened. The foliage was again more or less intermediate. Below ground, the corms and cormlets were more like the *Gladiolus* than the *Acidanthera* parent and were much easier to store. The cormlets were large and rough skinned and grew readily.

The last corm flowered in the third year. It was a much prettier flower with slightly shorter, broader tepals, darker marks, better scent than its sister, and a clean pink in color. It looked very promising but was almost sterile. It was duly lost, although I have a few descendents of it still.

However, the white flowered hybrid, eventually named 'White Triploid' when its chromosome count was determined, was a slightly better parent even though far from prolific. Using gladiolus cultivars with good color and neatly ruffled well attached flowers, I raised quite a lot of seedlings from this hybrid. Using the hybrid as the pollen parent, only gladiolus-like non-fragrant seedlings were obtained. Using the hybrid as the seed parent, the progeny were variable, but several quite handsome fragrant forms were obtained. The fragrance, however, was rather faint and all efforts to increase this were to no avail.

I had by then recovered from the riding accident which had forced me to take up a less active hobby for a while, and seriously considered, at this stage, abandoning the project to produce a pretty and fragrant arrangement gladiolus. At least I had the 'White Triploid' which if not actually beautiful, had a certain charm, and as I had now learned, was something of a horticultural achievement even if it had come about more by beginner's luck than anything else. But both my commercial and my scientific colleagues advised me to continue. I had by this time acquired a fair knowledge of genetics and found a paper of great interest by Robert E. Jones and Ronald Bamford (*American Journal of Botany*, vol. 29 no. 10, 1942) on the behavior of triploid gladiolus. Dr. Rattenbury, who did a lot of work on my experiment, considered that my triploid would behave in a similar manner and felt it would be possible to produce a tetraploid by using a diploid pollen parent (haploid gametes) on 'White Triploid', and *Acidanthera* was still the only fragrant diploid available. After pollinating about a hundred flowers of 'White Triploid' with *Acidanera*, I obtained a few fertile seed as a result of this cross which I planted as soon as they were ripe. Half of the seed grew. Two years later the four survivors bloomed. Practically identical, they all had a stronger fragrance than the 'White Triploid' and broader, more *Acidanthera*-like leaves, but otherwise were very similar to the 'White Triploid' seed parent. Fears that these second generation hybrids would show too much of the *Acidanthera* parentage were not realized.

Chromosome counts showed them to be tetraploids as hoped. Progeny tests proved these new plants to be better parents than the triploid with better fertility and a greater proportion of fragrant seedlings, most of which were distinctly gladiolus-type with satisfactory flower attachment and opening ability. The fragrance varied in different crosses. It appeared that the non-fragrant gladiolus parent influenced this. The key to success appeared to be the choice of a gladiolus which would enhance rather than inhibit the fragrance the hybrid contributed to all its progeny.

Plans were made to produce a wide range of crosses with gladiolus said to have some fragrance, when domestic and financial considerations forced me to take a full time job. Such a program became impossible to develop adequately and rather than lose the precious hybrid material (and there was a strong chance of this) some stock of the best tetraploid, named 'Lucky Star', was offered to hybridizers in New Zealand and the U.S.A.

Since 1966 'Lucky Star' has been widely distributed in many districts of New Zealand, in the United States and Canada, and also in England and Australia. Some people compared it unfavorably with gladiolus in appearance, because they did not appreciate its *Acidanthera* content. Fortunately, quite a number of progressive and far sighted hybridizers obtained corms. Regarding it as a bridge between the two genera, they commenced long term projects to transfer the fragrance via this bridge to the popular types of gladiolus.

By the end of 1969 (it takes two and one-half to three years to flower plants from seed) reports from the U.S.A. confirmed the findings of my small scale tests. These experienced hybridizers who would not be satisfied with anything but really promising seedlings, are obtaining good types with the physical form of the exhibition quality *Gladiolus* parent, and a perceptible fragrance from the *Gladanthera* parent.

I can appreciate the fears of some gladiolus enthusiasts who felt that 'Lucky Star' would re-introduce the loosely attached plain-hooded flowers with poor opening ability, all traits that had taken many years to eliminate, but there is no need to worry on this score. Seedlings with these faults will undoubtedly appear, due to the fact that some gladiolus regardless of their trimly-tailored appearance are still carrying these factors. The solution is to destroy these seedlings and to use a different *Gladiolus* parent with dominant desirable characteristics. The hybridizers who "know" their breeding stock will have an advantage here, although luck will undoubtedly play a part. An amateur who knows as little about gladiolus breeding as I did when I started, could well be the one to make the cross that produces the first high quality summer flowering gladiolus with a pleasing perfume that most people can detect.

CULTURE

One interesting aspect is that many hybridizers are finding that 'Lucky Star' appears to be contributing a much needed factor for health to its progeny. 'Lucky Star' itself is surprisingly hardy considering the delicacy of *Acidanthera bicolor* 'Murielae' and grows in a wide range of soils and climatic conditions. Following the advice given me many years ago by one of New Zealand's best known gradiolus growers, I vary the treatment according to my requirements.

Planting stocks, to produce clean vigorous corms, receive very little nitrogen and minimum watering. My garden has a rather hard clay soil and with sand under and over the corms, no lush growth of foliage is obtained. Aphids avoid the plants grown this way and while the general appearance of the bed can be most unattractive with hard brown-flecked foliage and a few scraggy looking flowers, better things are to come when those young corms are pampered a little next season. Grown in a sheltered spot in well-drained, rich, gritty compost, or better still, container grown on a sheltered patio with shade from the hottest sun, an elegant plant with clean green leaves and a graceful flower spike is one's reward. For best results: the corm, while growing, likes cool moist root conditions; while it is resting, dry and warm conditions are required.

Many people have asked me if there are colored forms of 'Lucky Star'. I am trying to produce these, but as yet only one has pleased me, colorwise. And it has not proved itself reliable, so far. Others to flower this year (1970-71) may be better.

Although I now have three young horses to educate, it does not seem possible to put my gladiolus project aside completely. No doubt I will devise some means of handling both the horses and the gladiolus hybrids, until my original aim has been achieved and extended to include most forms of small flowered gladiolus.

PARENTAGE

The bigeneric hybrid × *Gladanthera* Wright ex F. G. Meyer was derived from the following cross:

Gladiolus 'Filigree' (tetraploid female, $4n = 60$)

×

Acidanthera bicolor 'Murielae' (diploid male, $2n = 30$)

The initial F_1 cross yielded × *Gladanthera* 'White Triploid' (triploid, $3n = 45$).

A backcross of × *Gladanthera* 'White Triploid' (female)

×

Acidanthera bicolor 'Murielae' (male)

The latter F_2 cross yielded × *Gladanthera* 'Lucky Star' (tetraploid, $4n=80$).

DESCRIPTION

× *Gladanthera* Wright ex F. G. Meyer hyb. gen. nov. 'Lucky Star' n. cv.

Flowers irregular, triangular in shape, with six tepalsegs in two whorls, the three inner segments largest, ascending, the upper segment of the inner whorl the largest, hoodlike and curved down slightly, slightly wider than the outer segments, the two lower segments two-thirds the length of the upper segments and the two smaller ones slightly yellowish just above the eye-spot, opening creamy yellow from deep cream-colored buds, gradually turning white when fully open on the second day (in hot weather flowers may be mauve-flecked), 3¾ to 4 inches in diameter; tepalsegs all with spade-shaped lilac-purple markings in the throat (70A and 70B, red-purple group, Royal Horticultural Society Colour Chart, 1966), extending along the midrib of each segment about half-way to the tip; filaments red-purple (70A), about 1¼ inch long; anthers light yellow, about ¾ inch long; stigmas white. *Fragrance* of the flowers delicate and pleasant but definite, resembling *Lilium candidum*, rarely apparent until the afternoon of the second day. (Sunlight assists in the development and intensity of the fragrance.) *Flower buds* average 14 to 15 up to 18 per scape, 3 to 4 flowers open at the same time. *Corms* pale yellow, smooth with thin husks, much broader than thick, up to 2 inches in diameter. *Plants* average 36 to 40 inches, sometimes to 48 inches in height. *Leaves* are 1-1½ inches wide and in length extend barely beyond the lowermost flowers.

Origin

Hybridization Jan. 1959 by Mrs. Joan Wright, Matakana, North Auckland, New Zealand. Flowered, May 1961. Introduced in May 1966. It has been grown in many districts of New Zealand, the United States and Canada, England, Australia, the USSR, and France.

The bigeneric hybrid × *Gladanthera* 'Lucky Star' was registered in *North American Gladiolus Council Bulletin*, No. 90, Summer 1967 without a description. This new bigeneric hybrid cultivar is now validly described for the first time in accordance with the International Code of Nomenclature of Cultivated Plants—1969.

The description is based on notes sent by Mrs. Joan Wright and on plants grown by F. G. Meyer in the summer of 1970 in Takoma Park, Maryland.

The clonotype specimen (Meyer 12456) is on deposit in the U.S. National Arboretum (NA) herbarium, Washington, D.C.

Garden Notes

A Fall-blooming *Stewartia malachodendron*

The silky camellia, *Stewartia malachodendron,* is one of the rarest and most beautiful flowering shrubs of the Southeast. It grows naturally in the north-central Alabama area on heavily wooded slopes along stream banks. I have read that it is difficult to grow outside of its natural range. Here, within its range, it is certainly no more difficult to grow than some other natives, such as *Rhododendron canescens* or *Kalmia latifolia,* if you can find a plant.

I strongly suspect that the real reason *S. malachodendron* has been neglected by gardeners is its undistinguished appearance for over eleven months of the year. It is not unattractive it just has no distinctive growth habit, is deciduous, and doesn't even have brightly colored foliage in the fall. The general appearance is that of a tree sapling except in mid-May, when its ethereal blooms open. Since wild plants often bloom sparsely in their deeply shaded ravines and these ravines are visited by only a few, the *S. malachodendron* exists as a botanist's delight that has not yet caught the gardener's fancy.

This would all be changed if a *Stewartia malachodendron* like the one in the yard of Mr. and Mrs. Joseph F. Johnston of Birmingham were available. This particular plant blooms twice each year and consequently is an ornamental of extreme beauty throughout the gardening season. In the spring, usually about the second and third week in May, it is absolutely covered with large white

PHOTOS PERRY C. COVINGTON

Fig. 1. *Stewartia malachodendron* blooming in late summer in garden of Mr. & Mrs. Joseph F. Johnston, Birmingham, Alabama.

Fig. 2. Flowers of fall-blooming *S. malachodendron* three to three and a half inches across, and somewhat smaller than in spring.

blossoms accented with rich purple filaments. Then, in early August, the tree begins blooming again. This second blooming period is not spectacular like the spring one. The flowers are smaller, only three to three and a half inches across, as would be expected with our summer heat. They are still quite beautiful, though, as can be seen in the photographs which were taken on September 1, 1970. These fall flowers open over a long period of time, with only a dozen or two open each day. This goes on, however, until freezing weather. Another fascinating characteristic of the Johnston's *Stewartia* is the large seed pods that develop from the spring flowers. Seeds also develop from the late blooms but the pods are smaller as is usual for *S. malachodendron.*

Over thirty years ago, this shrub and two others were brought from nearby woods to the Johnstons by Mr. Jim McDaniel. The other two were planted in more shade on the adjoining grounds of Mr. Johnston's parents. One of these shrubs died and the other has never exhibited the fall-blooming characteristic. Mr. and Mrs. Johnston's *Stewartia* was planted several feet from the driveway circle on a slight down-ward slope. It is in a fairly open situation in grass and gets filtered sunlight in the morning with more direct sunlight in the afternoon. It has not received any unusual care. The little tree is about twelve feet high and considerably wider than tall. For at least the last twenty-five years, it has charmed its owners with its extra blooming season.

A local nurseryman has been unsuccessful in attempts to propagate this particular tree by seeds or cuttings. Of course, there is no way of knowing whether the fall-blooming characteristic is genetic or environmental. The regular occurrence of this phenomenon over so many years would seem to suggest that it might be transmitted in vegetative propagation.

LOUISE G. SMITH
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Flowering of Japanese Weeping Cherries

One weeping cherry tree in flower will provide beauty and enjoyment for a limited period. Due to seedling, species and variety differences, several different forms of weeping cherries will flower in succession during the blooming season. A group of such individuals would then provide color and pleasure for an extended period. The following information was collected to demonstrate this fact and to show how effectively individual trees of a similar form contribute to an extended period of bloom succession.

This study is concerned with several outstanding, weeping trees in the collection of ornamental cherries at the U.S. Plant Introduction Station, Glenn Dale, Maryland. The group includes ten trees of *Prunus subhirtella* 'Shidare-Higan' and two specimens of *Prunus* × *yedoensis* 'Shidare-Yoshino (1, pp. 22). The subhirtellas are recognized as outstanding ornamentals because of their ability to live for many years (1, pp. 12-18) and, at the same time, add exceptional beauty to the early spring landscape. In the best selections, the buds are pink but open to a paler hue. In poorer forms the flowers may fade to a watery-white that is not quite so attractive.

Within the weeping forms of *P. subhirtella* at Glenn Dale, seedling variation is responsible for a bloom succession that covers an average period of 30 days. This offers the possibility of a four to five week show with a minimum of only three trees. The show of color can be extended by the addition of a specimen of the Yoshino cherry, the common form of which is not weeping. The pendulous form of the Yoshino 'Shidare-Yoshino', is useful because of its smaller stature and weeping habit that is more pronounced than that of the more upright 'Shidare-Higan'.

Over a six-year period I noticed that an early spring will add several days to the bloom period. Also, it is possible for a large part of the overall show to be lost due to frost occurring as the buds break. Frost occurring after flowering is well underway appears to have a less severe effect. The term "nipped in the bud" could well be applied to these trees since the flowers are susceptible to frost damage in the spring season while still in the early bud stage.

For four of the six years of observation, the entire bloom sequence occurred mostly in April (Fig. 1). During the other two years, early spring seasons permitted longer bloom periods that were distributed between the middle of March and the latter part of April.

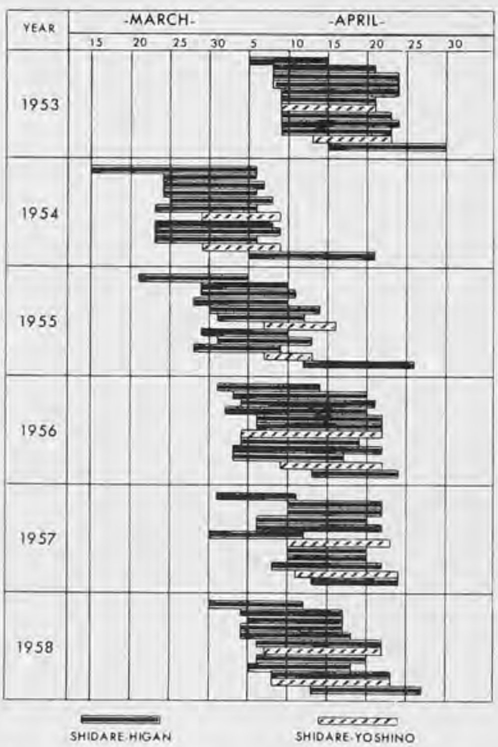

Fig. 1. Bloom sequence for weeping cherries.

PHOTO U. S. DEPARTMENT OF AGRICULTURE

Fig. 2. *Prunus subhirtella* 'Shidare-Higan', at the U. S. Plant Introduction Station, Glenn Dale, Maryland.

'Shidare-Higan' is usually seen in two forms; the more or less pyramidal type (Fig. 2) which assumes an upright habit with long, sweeping branches; and the more formal spreading form produced by grafting high on a standard rootstock. The former seems to be more vigorous and makes a perfect "lawn house" for children. A crop of fruit is usually set so that one may start seedlings if desired.

To insure the reproduction of a desirable form, scion wood should be grafted onto the seedling *P. subhirtella* understocks. To obtain a strong and upright basic scaffolding, it is advisable to stake the young growth for several years until the trunk members have become strong enough to retain a vertical habit.

Recently, a pendulous form of *P. subhirtella* with small double pink flowers has appeared in nurseries, but trees I have seen are not as prolific bloomers as the single form. Here, too, should be mentioned the fall flowering cultivar *P. subhirtella* 'Jugatsu-Zakura.' This bears double flowers both in autumn and spring and the tree tends to grow in a rather bushy habit with a flattened crown. It scarcely compares with the majestic and graceful habit of the tall pendulous 'Shidare-Higan'.

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The Two Tuliptrees

There are two species of tuliptrees: *Liriodendron tulipifera* L., a native of eastern United States, and a Chinese species (*L. chinense* (Hemsl.) Sarg. From the time of the original collection of the Chinese species by Shearer in 1873 at Lushan (Moore, 1875) to the present day, few western botanists or horticulturists have observed flowers of this tree either in the wild or in cultivation. The accompanying photograph of *L. chinense* comes from the only known source of flowering specimens in this country.

The chain of events leading to this photograph and to subsequent work with this species may be of interest. In 1948, Albert G. Johnson, then of the Maria Moors Cabot Foundation and The Arnold Arboretum, received a shipment of *L. chinense* seed from the Lushan Botanic Garden in China. Some of this seed was sent to Jonathan W. Wright, then employed by the U.S. Forest Service and stationed at the Morris Arboretum of the University of Pennsylvania. Dr. Wright assigned the seedlot number NEG-462 to this seed (NEG = North East Genetics). Some seedlings were grown at the Morris Arboretum and subsequently outplanted in Philadelphia, Pennsylvania; Williamstown, Massachusetts; and Beltsville, Maryland (Li and Wright, 1954). While working

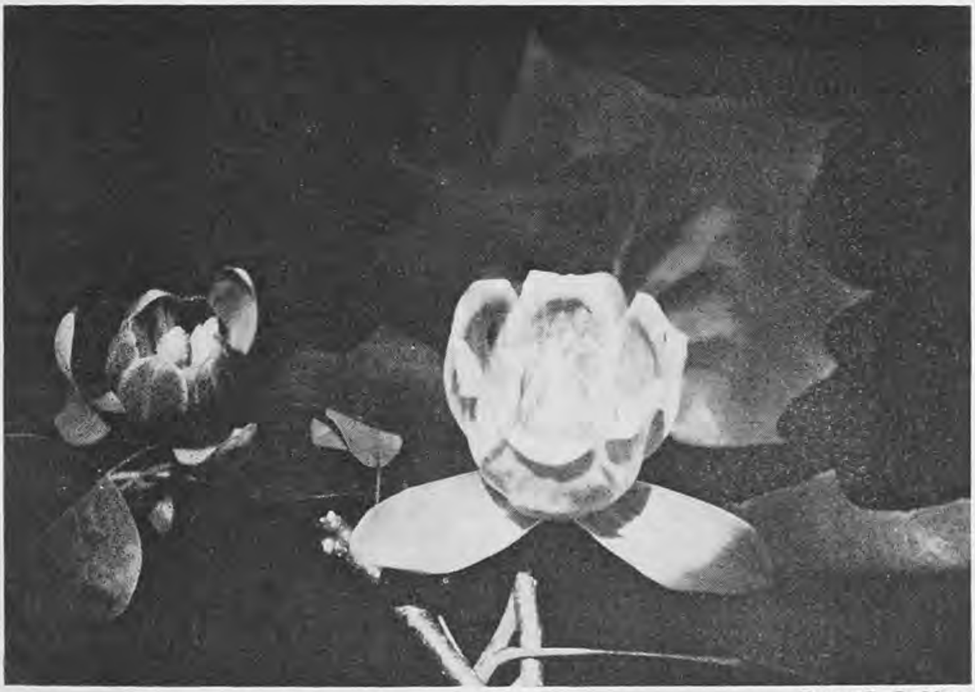

PHOTO F. G. MEYER

Fig. 1. Chinese tuliptree (*Liriodendron chinense*), on left, with flowers 2-2¼ in. in diameter and greenish throughout with yellow veins. On right, American tuliptree (*L. tulipifera*) with larger flowers, 2-3½ in. in diameter and with a prominent orange blotch (which is lacking in *L. chinense*) at the base of the inner tepals.

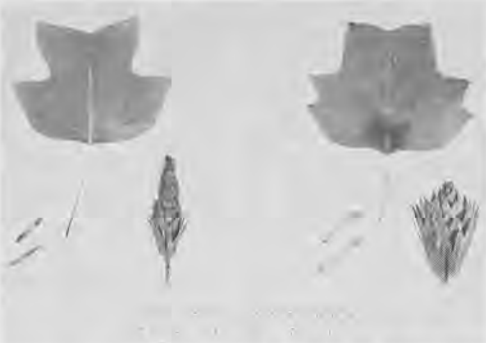

PHOTO U. S. DEPARTMENT OF AGRICULTURE

Fig. 2. Typical leaves, fruits, and samaras of *Liriodendron chinense* (left), *L. tulipifera* (right).

for both the U.S. Forest Service and the Morris Arboretum (1963 and 1966), Frank S. Santamour, Jr. attempted to locate these trees, but concluded that all had died.

Meanwhile, there was new interest in the genetic improvement of *Liriodendron* by both the U.S. Forest Service and several State universities. Eyvind Thor and Robert D. MacDonald of the University of Tennessee surveyed many horticultural and botanical institutions for specimens of *L. chinense*. Mr. MacDonald located six trees of the Chinese tuliptree in the Orland E. White Research Arboretum of the Blandy Experimental Farm, University of Virginia, Boyce, Virginia. He collected scion wood for grafting onto *L. tulipifera* rootstocks in Tennessee. Following Mr. MacDonald's move to the John J. Tyler (Painter) Arboretum in Lima, Pennsylvania, he visited the U.S. National Arboretum and informed Frederick G. Meyer about the existence of these trees. This was in 1968, shortly after Dr. Santamour had joined the National Arboretum staff to establish a breeding program with shade and ornamental trees.

Drs. Meyer and Santamour contacted Russell L. Edwards at Blandy Experimental Farm and were assured that the trees were alive and well. However, Mr. Edwards had not looked for any flowers. During the spring of 1969, Mr. Edwards was not able to keep a continual watch on these trees but reported that, if any flowers were present, they must have been quite inconspicuous. Our first trip to Blandy Farm was in September 1969, when herbarium specimens and fruit "cones" were collected. The trees had, indeed, produced flowers! An examination of the records disclosed that the accession number at Blandy was S 12479-49 and that the seed had been received from the Morris Arbotretum in 1949 as seedlot NEG-462. The Lushan seeds introduced from China in 1948 were now sexually mature trees.

Flowering of the Chinese tuliptree in 1970 was limited, as in 1969, to only two of the six trees, and the flower crop was poorer than in 1969. We were, however, able to reach enough flowers in the tops of the trees for both herbarium specimens and for the production of pollen to be used in breeding. On the following day, Santamour crossed *L. tulipifera* with *L. chinense*. Seed was harvested in October and both hybrid and open-pollinated seedlings of both species are now growing at the National Arboretum.

As far as we can determine, the trees at Blandy Farm are the only sexually mature specimens of Chinese tuliptree in the United States. Li and Wright (1954) stated that there was a flowering 30-foot Chinese tuliptree from Wilson's 1902 introduction growing at the Brooklyn Botanic Garden. The Brooklyn Botanic Garden (E. O. Moulin, personal communication) reported that they have had two trees of this species. The first, obtained in 1919 from a French nursery, died sometime prior to 1934. The second tree, received from the Veitch Nursery in 1934, proved to be *L. tulipifera* and died in 1966. The New York Botanical Garden reported (D. A. Brown, personal communication, 1971) that they had a tree from Lushan seed, accessioned in 1937, that has not yet produced flowers.

The growth of the trees at Blandy Experimental Farm indicates the accuracy of earlier reports of Chinese tuliptree as a small tree or "shrubby." At 20 years from seed, the trees averaged only 20 feet in height. All but one of the trees are multiple-stemmed, with an average trunk diameter (at breast height) of 3.4 inches. However, trees up to 60 feet in height have been reported from China (Lee, 1935).

Flower size and color are, by far, the most important distinguishing characters for the identification of the two species of tuliptree. Flowers of *L. chinense* are 2 to 2¼ in. in diameter at anthesis and goblet-shaped; the outer tepal segments 3, oblong-obovate, *ca.* 1 in. long, *ca.* ⅜ in. wide, rather strongly glaucous beneath, the 6 inner tepal segments obovate, narrowed at the base, *ca.* 1¼ in. long, greenish throughout with yellowish veins; stamens *ca.* 40.

L. chinense differs from *L. tulipifera* in the smaller flowers, 2-2¼ in. in diameter as compared with 2-3½ in. in diameter for *L. tulipifera*. Flowers in *L. chinense* are greenish throughout with yellow veins giving a reticulate aspect to the tepal segments; the orange blotch found at the base of the inner tepals in *L. tulipifera* is lacking in *L. chinense*. The tepals in *chinense* are more strongly curved and cup-shaped and not reflexed at the tip as in *L. tulipfera*.

Typical leaves of the two species are illustrated in Figure 2. *Liriodendron* leaves are commonly described as being 4-lobed, but the wide range of leaf variation in *L. tulipifera* encompasses unlobed as well as 2-, 4-, 5-, 6-, 7-, and 8-lobed leaves. Based on specimens we have seen, the leaves of Chinese tuliptree are always 4-lobed. Bean (1919) described the leaves of *L. chinense* with "lobes reaching, as a rule ⅔ of the way to the midrib, giving the leaf a distinct 'waist.'" The illustrations in Bean (1908, 1919) show this type of leaf, and the clone currently distributed by Hillier and Sons, Winchester, England, is very deeply lobed. The leaves of the Chinese species pictured in Lee (1935) agree with our specimen in general morphology. Leaves are not a good criterion for distinguishing the two species since the variation in *L. tulipfera*, especially in juvenile or shaded specimens, may even include the "narrow-waisted," deeply lobed type grown in Great Britain.

Fruits of the two species are somewhat distinct and are pictured in Figure 2. Elwes and Henry (1906) state that in *L. chinense* fruits "the carpels are consolidated so as to appear like a solid column, and are obtuse at the apex when ripe." Certainly the degree of "opening" of the mature fruit, when allowed to dry in the laboratory, is diffrent for the two species. The samaras are, however, not obtuse at the apex, but those of *L. chinense* are narrower in relation to length, and more numerous than those of *L. tulipifera*. There are also some specific differences in winter twig color: those of *L. chinense* being gray while those of our native species are brown. However, the most reliable distinguishing morphological character is the flower.

With only the few Blandy Farm specimens as a guide, it is impossible to determine the future usefulness of the Chinese tuliptree in American horticulture. Certainly, we can expect some new flower types in the hybrids of *L. tulipifera* × *L. chinense*. However, further work with the Chinese species (and the hybrids) is needed before we can assess its potential contribution to ornamental improvement in the tuliptrees.

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PHOTOS JOHN L. CREECH

"Demekarpiga" the Iron Gate through which the Vardar River flows to the Aegean Sea. Junipers colonize on the cliff walls.

Plants of the Vardar River Valley, Jugoslavia

In 1934, The Arnold Aboretum sent Edgar Anderson* to the Balkans on a plant collecting expedition. He later wrote that he had chosen this region, in particular, because he believed that the climatic data suggested it might be a source of hardy plants for trial in the midwestern United States.

One of the plants that Anderson collected was a common privet (*Ligustrum vulgare*). The seed was sent to the U.S. Department of Agriculture and the subsequent plants were distributed rather widely in 1937. After only two trial years, observers in areas with rather rigorous climates, including Wyoming and South Dakota, began to report on the superiority of this introduction over others, including the privet noted for hardiness, Amur River North (*Ligustrum amurense*). The Anderson collection proved to be so useful in the colder parts of the country that it was named *L. vulgare* 'Cheyenne' at the Cheyenne, Wyoming U.S.D.A. Plant Introduction Station, and is now a standard nursery item.

Another plant that Anderson collected was a boxwood (*Buxus sempervirens*) from the Treska Gorge of the Vardar River, not far from the city of Skopje, Yugoslavia. It, too, proved exceptionally hardy and appears in many nursery catalogs, as 'Vardar Valley'.

These two successful introductions confirmed the soundness of Anderson's concept used in selecting the Balkans for his exploration. A review of the plants of the Vardar Valley shows it to be an ideal place in which to collect hardy ornamental plants for northern areas of the United States. In addition, the generous hospitality of the Yugoslavians and the freedom to travel about the country are advantageous.

I had long wondered about the kind of habitat that would produce so hardy a boxwood, in spite of the Mediterrane-

*A well-known botanist-geneticist and teacher, formerly Professor and Director of the Missouri Botanical Garden, St. Louis, Missouri.

an climate. Furthermore, I had been intrigued by the name "Vardar Valley."

In the spring of 1970, I was fortunately able to visit Yugoslavia to review some of the horticultural research in that country. I was determined to include a trip along the Vardar River to visit some of the mountain sites of wild fruit tree species and at the same time, to look for habitats of boxwood. Because this is a remarkable region and one we seldom hear about from a plantsman's point of view, I am sharing my observations so that others traveling in Europe may include Yugoslavia in their plans.

Yugoslavian Macedonia, which does not include the Bulgarian and Greek parts of the region, covers an area of about 10,000 square miles. It is ringed with mountains some of which are 7,500 feet high. Skopje, the capital of Macedonia, is an hour's plane trip from Belgrade. It is from Skopje that the traveler begins its journey down the Vardar River. If circumstances permit, he will end at the Aegean Sea, near Thessalonika, Greece. The Vardar winds through deep gorges and the prevailing climate is dry and hot in summer. Except where the cliffs are forbiddingly steep, goats have destroyed most of the edible vegetation. It is in this semi-arid environment that the wild boxwood grows. In short pockets formed by valley terminals where oak groves once stood, clusters of dense evergreen vegetation flourish.

The plants include box, *Buxus sempervirens, Phillyrea latifolia* var. *media, Quercus coccifera,* and butcher's broom, *Ruscus aculeatus.* On the hill tops, the number of plants that can survive the barren, hot, dry winds is reduced to the shrubby evergreen oak, *Quercus coccifera* and *Juniperus excelsa.* The oriental plane, *Platanus orientalis* reaches its northern-most distribution here and one might expect to find some useful types for testing.

In all, there are some three hundred species and varieties of trees and shrubs in Macedonia, covering 52 plant families. Undoubtedly, the combined influence of the Mediterranean climate, the encirclement by mountains, and the

Stands of *Buxus sempervirens* in damp cuts along the Javorica River, Macedonia.

range of soils (from limestone of a neutral or slightly alkaline nature to acid silicate soils in subalpine meadows) accounts for the interesting range of useful plants in this region.

Plants of the rose family are frequently encountered, such as *Cotoneaster*, hawthorn (*Crataegus*), and mountain ash (*Sorbus*). Several ancestral species of our cultivated pears, apples, and various stone fruits, all indigenous of the area, are taking on new importance because they are unusually late flowering and therefore escape late spring frosts.

It is surprising, after one has climbed the barren slopes through pastures grazed to stubble, to find clumps of species which escape destruction by goats because of their armament. Many of the young fruit species are mixed with spiny barberries (*Berberis*), pistachio (*Pistacia*), *Cotoneaster*, and roses (*Rosa*) and thus find protection.

There is an excellent highway running from Western Europe into Yugoslavia and down along the Vardar River which makes it a popular journey for Europeans. In late April the limestone cliffs on both sides of the Vardar River are brightened with the purple blooms of the wild common lilac (*Syringa vulgaris*). These contrast with the showy golden blooms of the dense upright shrub, *Coronilla emerus*. The latter is a half-hardy species sometimes cultivated in northern areas of the United States, but it is fully hardy in the South and in California.

As for the boxwood, it occurs occasionally along the roadside. To reach extensive stands, we left the main highway and traveled several miles over unpaved trails along a small tributary, of the Vardar River, the Javorica, about 5 miles from the famous landmark, the "Iron Gate." At this point the Vardar River cuts through a narrow gorge between two massive rock walls and forms an impregnable pass known for centuries as a defense against invaders.

The boxwood was simply in small clusters along the streambed, sometimes in rock ledges, more or less rampant, and again as small single shrubs on the upper terraces of the stream. Short of time, I could only gather cuttings from a few individuals. By use of plastic bags and careful attention to them throughout the remainder of my stay in Yugoslavia, the material survived the long journey home without difficulty.

I visited the walled city of Dubrovnik on the Adriatic Sea where there is a small botanic garden on the island of Lokrum, former vacation villa of Maximilian. Dubrovnik deserves the attention of any tourist. The gardener will be particularly surprised by the array of Japanese plants. But this is, perhaps a story in itself.

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Bloodroot
Sanguinaria canadensis

Bloodroots are ideal early spring subjects for the shaded wild flower garden or for "naturalizing" among flowering shrubs like azaleas. The species is streamlined for its short period of activity. The simple white flower and single leaf appear together quickly after being stimulated by the first warming rays of the returning sun. Their rapid growth is made possible by food manufactured and stored the preceding season in the thick underground stem, or rhizome. The latter is colored by a characteristic red acrid juice which has given both the common name and the generic name *Sanguinaria*, (from the Latin, *sanguinarius* = bleeding) to the species. Quick growth enables bloodroots and other so called tropophytes to complete their short life cycle rapidly in the sun before the dominant forest trees leaf out and shade the woodland floor.

During woodland wanderings as a boy in Massachusetts, I recall the annual pleasure of coming across the first bloodroots of spring blossoming in the rocky woodlands, sometimes in late February, but usually in March or early April along with hepaticas, yellow vio-

PHOTO W. H. HODGE

Bloodroot *(Sanguinaria canadensis)* is one of the common woodland plants of early spring in many parts of eastern United States.

lets, and the like. Because of their early flowering I've often thought of bloodroots as taking the place of snowdrops (*Galanthus*) in the American scheme of spring. Bloodroots, however, are members of the poppy family and so are not even distant relatives of monocotyledonous snowdrops. I also found bloodroots—because of the thick rhizomes—transplanted easily, to the tiny shaded wild flower garden I maintained. There they increased gradually through the years, as they will in most gardens.

A pink-flowered form of the bloodroot is known (forma *colbyorum*) as well as a pure white double-flowered form (forma *multiplex*), the latter sometimes seen in cultivation.* I personally have a distinct preference for the simple loveliness of the common single-flowered form.

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*See *Am. Hort. Mag.* 47 (4): 361. 1968 and 48 (3): 139. 1969 for additional information on the double-flowered bloodroot.

From *The National Horticultural Magazine,* Volume 1, Number 1, August, 1922:

HOME IS BASIC AMERICAN INSTITUTION—HOME AND GARDEN SYNONYMOUS

The home is the basic American institution, and the role of horticulture in the building of the home is fundamental. A home without a garden is an anomaly. Correct landscaping of the home grounds is the chief means of creating a restful environment in both the city and country, and a proper understanding of the art of horticulture will enable all to possess beautiful home surroundings thus bringing contentment into their lives through the hourly or daily contact with the reposeful influence of the harmonious home.

Recognition of Air Pollution Injury to Vegetation: A Pictorial Atlas

Edited by: Jay S. Jacobson and A. Clyde Hill—1970. Air Pollution Control Association, 4400 Fifth Ave., Pittsburgh, Pa. 15213 Single copies: $15.00

This remarkable volume was prepared under the joint auspices of the Air Pollution Control Association of Pittsburgh, Pa., and the National Air Pollution Control Administration, Raleigh, N.C.

One of the serious problems throughout our relatively recent and rapid build-up of plant injuring air pollutants in this country, has been the lack of widespread, authentic, color illustrated, readily understandable literature available for the use of the gardener, the practical horticulturist and the amateur plantsman.

One of the first definitive volumes, including this subject was "Air Pollution," World Health Organization, Monograph Series No. 46, Columbia University Press, N.Y., 1961. This excellent volume reached only the more technical libraries and scarcely ever was seen by others than research workers or high government officials.

More recently, in 1969, the "Handbook of Effects, Assessment-Vegetation Damage" by Norman L. Lacasse and William Moroz, was published by the Center for Air Environment Studies, the Pennsylvania State University. This very fine treatment of the subject was published as a handbook guide for the use of Penn State Extension Agents in reporting the effects of air pollution suspect injury on plants and crops within the state of Pennsylvania.

Each of these volumes has had a definite place in extending the knowledge of the effects of air pollution on plants.

We are now indebted to the Air Pollution Control Association for its excellent pictorial atlas which should be, for some time to come, the practical guide or manual recognizing air pollution injury on vegetation by those interested, and especially for those who deal with and grow plants.

The Association also has available a proof set of 8 sheets with 15 illustrations, a total of 120 color reproductions, showing the symptomology of the different pollutants on a wide variety of plants. These sets are helpful for training, display and general educational use and sell for $6.50 per set.

The Atlas includes concise descriptive information on the relative susceptibility and symptomology of a wide range of plant materials for the primary pollutants.

Of great supplemental help are the symptoms which resemble or mimic the symptoms of all the major pollutants including ozone, sulfur dioxide, fluoride, nitrogen oxides and the peroxyacyl nitrates. The colored illustrations are superb and quite accurately reproduced.

Minor or other than the primary phytotoxic pollutants are also concisely covered with symptomology and lists of plants which are sensitive, intermediate and resistant to each pollutant.

A very helpful index alphabetically lists all of the plants and the section (s) under which they are discussed in reference to the specific pollutant.

Each section is authored by research authorities who have specialized on each of the different pollutants. Each section, too, furnishes an extensive bibliography of the applicable literature.

We now have an effective, easily usable piece of literature which illustrates air pollution injury to a relatively wide range of vegetation. It now is very feasible for anyone interested in growing plants to learn how to recognize specific types of air pollution injury on his favorite plants. When more of America's plantsmen are aware of and can recognize the serious injury air pollution causes to our plants, it will be that much easier to convince our population as a whole, the urgent need we face to control pollutants at all of their sources. This need must start at home and with the individual.

RUSSELL J. SEIBERT

Fairchild Tropical Garden—Catalog of plants 1970

William T. Gillis, Fairchild Tropical Garden, 10901 Old Cutler Road, Miami, Florida 33136. 1970. 102 pages. $2.12. (Library)

The catalog of the Fairchild Tropical Garden in Miami, Florida, is a highly useful guide to the plants growing in the only tropical botanical garden in continental United States. Founded in 1938, the garden was named in honor of David Fairchild, for over three decades a well-known world traveler and plant explorer of the U.S. Department of Agriculture.

At the end of 1968, the total collection in the Fairchild garden, including palms and all other groups, consisted of plants in about 144 families, 896 genera, and 2,500 species, varieties, and cultivars—indeed, an impressive assortment of warm climate plants, all assembled since 1938.

The Fairchild garden provides a splendid opportunity for a bird's-eye view of vegetation from the humid tropics that may be grown outdoors in southern Florida. Plants in the Fairchild garden are planted in an attractive setting and are fully available to the public as well as research workers and students. The garden has thus become an extremely valuable educational facility.

The palm collection at Fairchild is the world's largest and consists of nearly 400 species in 155 genera, including 38 species of *Chamaedorea*. Plants in other families are also well represented and include 10 species of *Acacia*, 14 of *Agave*, 34 of *Aloe*, 18 of *Bauhinia*, and 29 of *Ficus*. The collection of cycads is perhaps the largest in this country and contains eight, except *Bowenia*, of 9 living genera of Cycadaceae.

Each plant in the catalog is provided with a latin name, common name, and native area. A map is also included for locating plants in the garden. There is a separate index of common names for the general user of the catalog unfamiliar with the latin name.

The catalog of 102 pages is 6 in. x 9 in. in size and small enough to be carried in the average coat pocket. The typography is clear and the text is easy to read. Relatively few technical errors seem to have crept into the text. Undoubtedly, questions will arise as to the nomenclature and identification of some of the plants, but these are technical matters that need bother only the specialist and not the average user.

The Fairchild Garden is to be congratulated for the considerable effort that went into the production of the catalog, which is one of the few of its kind to be produced in recent years for a public garden in this county. Perhaps other botanical gardens and arboretums will follow with similar catalogs, which basically are important in recording the cultivated plant resources in this country.

Frederick G. Meyer

In Praise of Roses

Harry Wheatcroft. Published by The Henry Regnery Company, 114 West Illinois Street, Chicago, Illinois 60610. 1970. 192 pages. $12.50. (Library)

One of the great joys of being a rose enthusiast, as I rediscovered when I was sent a copy of Harry Wheatcroft's new book, *In Praise of Roses* for review, is being able to absorb the personable characteristics of the author when reading facts and information about the world's most popular and favorite flower.

This is the kind of book all of us have wished for time and again. Reading this book was like listening to this friendly man talk, or reminisce if you will, letting the stimulus of his vast knowledge and experiences increase the desire to enjoy the pleasures and excitement of ministering, as he describes it, "to the flower which was once the rich man's treasure but is now everyone's darling."

He takes the reader over the bridge of years from the earliest records of roses to the present, and on to what is anticipated. It is a readable and understandable book for the library of every home gardener. It is a handbook of information and practical reminders free from technical jargon, yet wide in scope, to be read and re-read by those wishing moments of relaxation, plus answers to important questions for bigger and better and more fragrant roses.

Charles C. Montgomery

Garden, Plants and Man

Carlton B. Lees, Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 1970. 251 pages, price $19.95 (Library)

This book is perhaps as timely as it is ageless. The poetry and pictures spanning much of man's civilization are combined with prose to bring focus on the needs of modern man. The author states "City environments are artificial, they deny our origin. . . . Since man's very existence depends upon plants, it is essential that he have contact with them in order to recognize himself in the total scheme of things." With this as his working premise, Lees explores the relationship of gardens, plants and man.

In the five sections of his book, he takes the reader on a journey, to a city slum to visit Jane Brown and see her geranium. Then on to other parts of this country and to other countries. From early man's first few plants around his crude shelters, Lee travels through the gardens of the Middle Ages and into the splendid gardens of the Renaissance—Villa Lante, Versailles, Villa d'Este.

He visits the gardens of England and then on to a new beginning in the gardens of America. With his skilled photography and use of words, he makes the gardens and the plants in them an experience to be felt as well as seen. He introduces the reader to the men who through the ages have had strong influence on this relationship between plants and men: the great landscape architects, the scientists, explorers, writers and illustrators who have made the union of gardens, plants and man into an art and a science.

Then he brings the reader, with his wealth of information, back to the city; to the "hardness of asphalt, concrete and steel." Here he confronts him—"If the landscape is bad it is because man has made it so. He can preserve a place, he can make a place—or he can destroy a place." The reader is left aware.

PAULA DIANE HEFLEY

The Flowering World of "Chinese" Wilson

Daniel J. Foley. Published by The Macmillan Company, 866 Third Avenue, New York, N.Y. 10012. 1969. 334 pages. $8.95. (Library)

One of the most fascinating aspects of horticultural plants is the story of their origin and introduction into cultivation. We take for granted many of our finest ornamentals without realizing that they have not always grown in the U.S. or in the western world, and that many were first introduced under conditions of great difficulty and danger.

Perhaps as many as half of our commonly cultivated woody landscape materials are natives of the Orient, and no individual was responsible for introducing a greater number than Ernest Henry Wilson. Indeed, the number of well-known plants for which he can claim credit is astounding; for example the beauty-bush, butterfly-bush, Chinese dogwood, dove-tree, Korean boxwood, the Kurume azaleas, paperbark maple, shore juniper, tea viburnum, and the tea crabapple. The regal lily is probably the best-known of his herbaceous plant introductions.

Wilson was a prolific and entertaining garden writer until his untimely death in 1930. Unfortunately, his books have long been out of print. Thus, Mr. Foley has done a great service in bringing together a representative selection of Wilson's writings, along with a brief biography, so that another generation of gardeners can enjoy Wilson's enthusiasm for plants and plant hunting.

There are chapters on plants of special interest for the four seasons; plants adapted for distinctive landscape uses; major groups, such as crabapples, cotoneasters, orchids, wild roses, and clematis; and the ornamental woody plants of China, Japan, Korea, Taiwan and the tropics. Of particular interest are his personal experiences in collecting and introducing plants in each of the categories listed above. He paints vivid pictures of their native habitats and frequently notes the conditions under which they grow best in the wild and under cultivation.

Those of us who will never have the opportunity to travel in the remote regions which Wilson explores are indebted to him for his descriptions of lands which in many cases have changed drastically in recent years. Perhaps this volume will stimulate readers to explore Wilson's other books, particularly his fascinating two-volume *Plant Hunting* (1928).

ROBERT L. BAKER

African Violet Book

Helen Van Pelt Wilson. Hawthorn Books Inc., 70 Fifth Ave., New York, N.Y. 10011. 1970, 238 pages, Illustrated, $7.95. (Library)

This third edition of a book on an important house plant is up to date and covers all phases in the culture of this plant. It is written in an informal manner, covering first the cultural phases such as soil, fertilizers, light and containers. For the more involved gardener there are the chapters on the species of the *Saintpaulia* and on its hybridization. For the organizer, there is a chapter on the starting of a club and the organizing and staging of a show. An interesting chapter deals with the genera that are closely related to the *Saintpaulia,* such as *Achimenes, Episcia, Streptocarpus,* and *Sinningia.* The culture of these plants is generally similar to the *Saintpaulia.* A final chapter deals with pests.

CONRAD B. LINK

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National Aeronautics and Space Administration