ORCHIDS AND PHOTOGRAPHY

H.B. Riblet

My hobby of growing orchids started about twelve years ago. When I moved to Kensington, Maryland, seventeen years ago, my interest in gardening was revived because of the need for some landscaping and the acquisition of several new shrubs. Included were several gardenias which required warm winter quarters. The den, which had many windows, soon became overcrowded and stimulated thoughts of a greenhouse. A neighbor who was associated with Kensington Orchids lent his assistance in the planning stage and helped in the procurement of used greenhouse materials. After over a year of excavating and construction, the lean-to greenhouse was finished in 1955. My neighbor said "Now you need something to put in it besides gardenias and azalea cuttings; how about an orchid or two?" This seemed a little more than I had bargained for, but I decided to try it. Now, after several years, the greenhouse is almost completely filled with orchid plants.

Mrs. Riblet and I have continued to be inspired by these beautiful flowers. We are gradually organizing our plants so that we will have plants in bloom each month of the year. We have a handy source, since the Kensington Orchids' greenhouse is just across from our house. Kensington Orchids, started as a hobby, is now an expanding commercial enterprise furnishing a large percentage of the wholesale orchids in this area.

Our greenhouse is modest in size, about 10 by 16 ft. Our home heating plant is a hot-water system and it was simple to extend this to the greenhouse area by the addition of another circulation pump and thermostat. By excavating under the den, a small room was made adjacent to the greenhouse to serve as a potting and storage room. In addition to automatic heat, I installed a ventilating window which operates if the temperature rises above 75°F. I do not have an automatic humidity control, however. The humidity is presently kept at a relatively high level by frequent watering and spraying the ground and benches with a fine mist on sunny mornings.

The Orchid Plant

More than 24,000 different kinds of orchids grow in all parts of the world. It is often thought that orchids grow only in the tropical areas or in dense rain forests. However, orchids are found in almost all countries, even a few in Alaska and the snow-covered summits of the Himalayas. Maryland has a very beautiful native orchid, the Showy Ladyslipper, a *Cypripedium*. It is true that most orchids like a damp humid spot, but this environment is found in many areas.

Orchid flowers display all the colors of the rainbow. The most frequently seen are the greens and browns, even though most people ordinarily think of the orchid as a lavender or magenta *Cattleya*, the usual "corsage" flower. Through hybridization many fine colors have been produced, including pure white flowers as well as many variegated colors. Orchid blooms come in all sizes, some measuring less than 1/32-inch in diameter and at least one species has a flower almost a foot in diameter.

Most orchids are found in the warm regions of the earth, and they are mainly air-plants or epiphytes. The epiphyte grows lodged on a tree, bush, or a rock but derives no nourishment from the host; therefore, it is not a parasite. Some orchids, particularly those that grow in the temperate zones, are terrestrials, that is they grow in the ground like other plants. It is often difficult to classify an orchid either as an epiphyte or a terrestrial since some will grow equally well in either environment. An epiphyte may be forced to take up life as a terrestrial when the tree branch it has used for support is broken and falls to the ground.

Orchids are classified into two main types of vegetative structures. The monopodials are those that grow in one direction only, and the sympodials are those in which the growth of the main axis, stem, or pseudo-bulb ceases, usually at the end of a season's growth, and a lateral growth is produced the following season. This type of growth is actually a rhizome, a primary stem, from which arise the secondary stems. The roots of most orchids are heavy sponge-like tissue that absorb the air and moisture with great rapidity and can contain the moisture for long periods. The roots cling to their supporting structure, whether it be a tree or a pot, with tenacity.

H.B. Riblet graduated from Friends University (Kansas) with majors in chemistry and physics. Prior to joining the staff of the Applied Physics Laboratory, he was involved in radio broadcasting and the design of directional antennas. Soon after coming to APL in 1949 he was appointed Supervisor of the Bumblebee Telemetering Group. In 1958 this Group became directly involved in space development and designed antennas and telemetering systems for the early Transit and navigation satellites. Since 1964 Mr. Riblet has been Supervisor of the Data and Control Branch of the Space Development Department.

The flowers or inflorescence are of almost every conceivable type. Some are solitary while others are on long spikes with hundreds of flowers. Some of the flowers are produced from the leaf axials and some from the base of the pseudobulb.

The Culture

The orchid, contrary to popular belief, is easy to grow if the correct environment is provided. This means adequate fresh air, proper light, correct temperature condition, and sufficient humidity. The orchid is relatively immune to most diseases and pests, although some are susceptible to virus ailment and fungi, if not cared for properly.

Fresh air is one of the prime requisites of a successful orchid collection. Frequent ventilation and good air circulation is a must. We keep a fan running continuously in the greenhouse so that the air does not become stagnant. An automatically controlled ventilator window provides fresh, cool outside air when needed.

The correct amount of light is more difficult to control, since different orchids require differing amounts of light. Diffused sunlight is best and, at this latitude, direct sunlight should seldom be allowed except during the winter months. The greatest danger of direct sunlight is the possibility of leaf burn, that is, the temperature of the leaf becomes too great unless cooling moisture is present. The light required by the orchid ranges from 200 to 400 foot-candles for the *Phalaenopsis* to a few thousand foot-candles for the sun-loving varieties. The light condition provided in a fixed installation such as a greenhouse cannot be altered, except by correct shading during the summer months.

Closely tied in with the proper light is the correct temperature. Orchids can be divided into three main groups with respect to temperature environment. Since night temperature is the most critical, the classification is usually given in this parameter: Cool varieties: 45° to 55°F; Intermediate: 55° to 65°F; and Hot or Warm: above 65°F. In a small greenhouse such as ours we try to collect orchids that fall into one temperature grouping. Occasionally one can find a cool corner or a warmer area for one or two plants. The thermostat in our greenhouse is set at 58°. Since a temperature differential between night and day is important, we depend on the sun to heat the greenhouse to 75° or over in the daytime.

The most time-consuming factor, and the one most prone to neglect, is that of proper moisture. A correct watering routine is difficult to schedule. Although the orchid plant is tolerant to a lack of moisture in the potting medium for short periods, it is very intolerant to over-watering. A once-a-week watering routine is usually adequate except in the summer when, because of a higher temperature, watering twice a week is usually necessary. Some plants require more moisture than others and plants in the resting period should be carried on the dry side. I use a garden hose to fill each pot until completely saturated. The humidity is easily maintained in a closed greenhouse. The evaporation of the excess water during the routine watering, and an occasional spraying of the benches and the ground area, provide for this element. Automatic humidifiers are available and would be useful.

Although the orchid will grow and bloom reasonably well without a great deal of fertilizer, strong growth and better color can be obtained with regular application. I have established a monthly feeding routine for most plants, although some require fertilizer more often, especially during the growing period before flower production. I use a commercial soluble fertilizer which is applied with a siphon-type proportioner. The proportioner is attached to the watering hose, and each pot receives several ounces of the diluted chemical. A color tracer is usually added to insure, by inspection, that the fertilizer is being applied.

Most orchids need repotting about every two years, not because they get root bound as an ordinary plant, but because they literally grow out of their pots. The sympodial, which grows laterally, will actually grow over the edge of the pot and the roots will attach themselves to anything with which they come in contact. At this point the plant should be divided and repotted so that the roots are all in the potting medium. The best time to repot is soon after the blooming period, just after the new growth starts and new roots are forming. The plant is divided into sections, each having four or five leads. The back bulbs or old growth can also be potted and will establish new growth in time. The monopodials such as the *Vanda* and *Phalaenopsis* do not need to be repotted as often, since they grow only in a vertical direction. These types need to be repotted when the medium has decomposed and no longer provides the correct drainage and aeration.

Several types of potting medium can be used. The epiphyte orchid is never potted in a loam soil, but in a very coarse material such as osmunda, or fir

Mr. Riblet is shown in his greenhouse, applying fertilizer to the orchid plants.

bark. Osmunda is the fibrous root of a particular fern. Shredded fir and redwood bark are natural materials since epiphyte orchids grow on the trees. Since it is more difficult to obtain and use osmunda, I prefer shredded fir and redwood bark. It is essential to pack the potting medium with some firmness, not only to hold the plant in the pot but to provide a solid mass for the roots. Pot shards are used at the bottom of the pot to insure good drainage. The water must run freely through the pot and not cause any sogginess. Either clay or plastic pots may be used. I prefer the clay pot because it allows the medium to dry faster. Some like the plastic pots because less frequent watering is needed. The terrestrial orchid, such as the *Cymbidium,* needs a little leaf mold, peat moss, some coarse material such as bark, and a little cow manure. Good drainage is also very important, but the medium should be damp at all times.

Orchids are less susceptible to insects and other pests than many other plants. This does not mean that occasional spraying is not needed. I have to watch for the mealy bugs and scale, as they seem to cause the most difficulty. Orchid scale is most troublesome and can spread quite rapidly, especially in the summer. Spraying with DDT will usually control it. However, if, as occasionally happens, the scale spreads beyond control, only a good scrubbing with soapy water can eradicate it.

It is essential to be on the lookout for various types of disease, some of which are caused by bacteria, viruses, and fungi. These are best controlled by good air circulation, preventing overcrowding, and never watering at night when quick drying cannot take place. Viruses can be transmitted from one plant to another by using an unsterilized knife or scissors. All diseased parts of a plant should be destroyed.

Propagation

Propagation of orchid plants is accomplished by two main methods, vegetative division and by seed. For the amateur the vegetative process is the best. Divisions will produce a number of additional blooming plants in a few years, while the seedling requires from five to seven years to mature. In addition to this time, a seed pod requires about ten months to ripen. However, if one is interested in creating new hybrids, experimenting with pollination can be very rewarding. I tried a cross pollination experiment about a year ago and succeeded in obtaining a ripened seed pod. However, the seeds were sterile because the two parent plants had incompatible chromosomes. I was not aware of this requirement and have not tried the experiment since. The back bulbs of the *Cymbidium* provide a good source of new plants. These will sprout new plants if kept damp, and in a year or two a mature plant will provide new flowers. I have a number of *Cymbidium* back bulbs in a flat of peat moss and sand which are about ready to be placed in pots. I have difficulty convincing myself to throw away any piece of a plant which has a possibility of growing.

In my small greenhouse, I have about a dozen different types of orchids:

Cattleya	*Cypripedium*
Phalaenopsis	*Calanthe*
Vanda	*Epidendrum*
Oncidium	*Aerides*
Dendrobium	*Odontoglossum*
Cymbidium	*Phaius*

There are several plants of each variety. I haven't counted them, but there are almost a hundred plants. I try to keep the plants which are about to bloom in an attractive arrangement. Each plant will bloom once each year if it is growing well. A good sized *Cattleya* may have two or three blooming leads with two to four flowers on each lead. Varieties like the *Cymbidium* and the *Epidendrum* produce flowers on long spikes with a dozen or more flowers to a spike. A well-grown plant will sometimes have three or more spikes. It is not unusual to have a large plant with three to four dozen flowers. Each plant will bloom once each year and at the same time each year, plus or minus a few weeks. It is possible to collect enough varieties and types to provide continuous blooms the year around. This is difficult in a small greenhouse but it can be done. Most of my plants bloom from late fall through the winter and into late spring. I hope to obtain additional plants which will bloom during the summer and early fall.

It is important to keep good records of your plants. I maintain a log book in which I record the blooming time, number and quality of flowers, when it was last repotted, and how many divisions were made. A numbering code together with the name is used to keep track of each plant. Of course each plant must be labeled and care must be taken not to lose this bit of information. An amusing incident (at least now it is amusing) happened a year or so ago. I had placed about 20 *Cymbidium* plants on a bench for the summer. One evening a neighbor's little girl, a three-year old, was visiting our yard and decided all the plastic labels in the pots were nice playthings so she took them all home to her Daddy! That evening when I came home from work, my wife showed me the bundle of plant labels on the kitchen counter. We won't go into my reaction, but I soon recovered and, fortunately, could remember some of the proper label-to-pot combinations. Others will not get relabeled until they bloom. So there are always moments of surprise in any hobby.

Photography

I have been interested in photography for as long as I can remember. My interest developed in a natural way because my mother had made contact prints from her old 3-1/4 x 4-1/4 Eastman camera even before I was born. She taught me the basics of the black and white developing and printing processes. I used to help her make dozens of family pictures for our relatives. Thus I have always owned a camera of some sort.

About four years ago I finally acquired a precision 35-mm camera, a Bessler TOPCON RE Super. This camera is a single lens reflex with interchangeable lenses. It has a built-in behind-the-lens light meter and several other features that make its operation flexible and precise. When I obtained the camera I had no idea of reviving my interest in darkroom work. At that time my wife, Idabelle, was the Executive Director of the Montgomery County Association for Retarded Children and she suggested that I try to document some of the activities of the nursery and day center operated by the association.

At this point interest in printing of pictures increased rapidly. Enlargements were needed and soon I was set up, in the basement, with an enlarger and other essentials for making black and white enlargements. Incidentally, the candid shots and other pictures of the children in the schools were a great success and the teachers, particularly, were very pleased with the results.

After doing several weddings in black and white, I began to wonder about the difficulties of color printing. I started to read all the books I could find including Eastman Kodak's technical data. I studied for about eight or ten months before I got enough courage to invest in

Lc. Helen Mizuta × Bc. Estelle

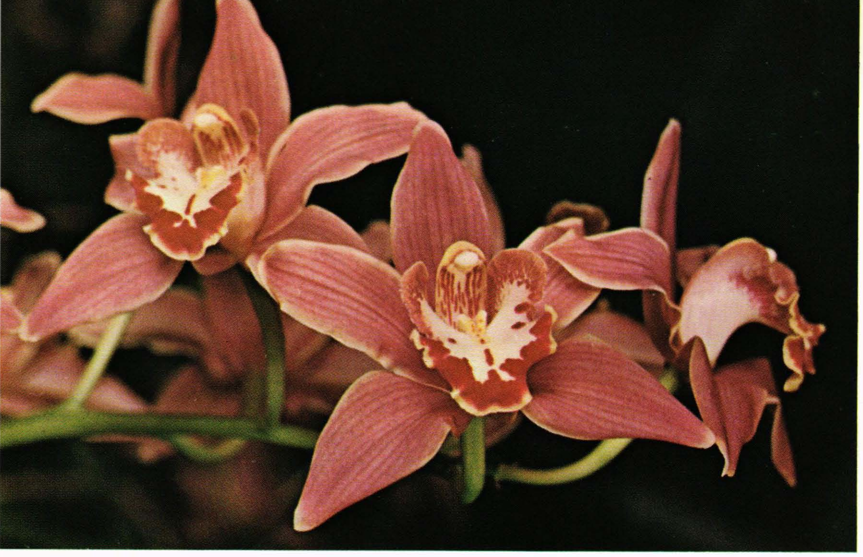
Dendrobium Nobile

Cattleya Dorothy Miller

Phalaenopsis Schilleriana

Sophrolaeliocattleya Dawcon

Vanda Tricolor



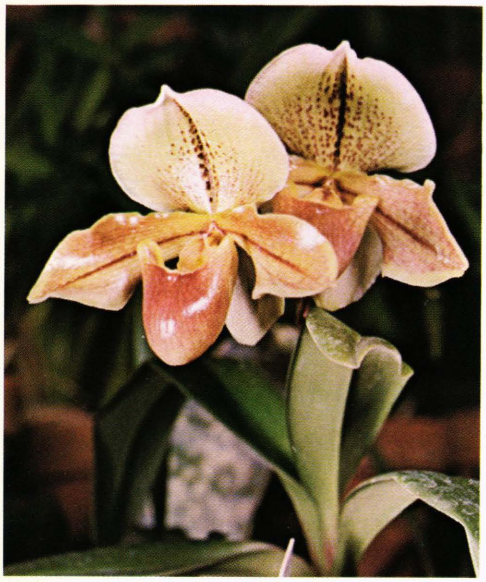
Carisona × Edzell

Cymbidium Pauwelsii

Epidendrum Atropurpureum
Lionetianum Lumsden

Cattleya White Belle × Swan

Cypripedium Maryland



Cattleya Skinnerii

the necessary color chemicals and paper. The chemicals and paper deteriorate rather rapidly and I wanted to have a high probability of success before I started. Fortunately, I have a friend and neighbor who is in charge of the color printing laboratory at *National Geographic Magazine* and he gladly assisted when I needed help and advice.

After achieving success with color processing, I decided it would be interesting to document the orchids as they came into bloom and make color prints for an exhibit; so I started photographing the orchid blooms on color negative film. These were awarded a blue ribbon at the National Capital Orchid Show, October, 1967, and later were exhibited in the Library foyer at the Applied Physics Laboratory. The flowers shown in the color plate are representative of a few of the many blooms which develop during the year. In preparing the pictures for this article, I made positive color transparencies from the color negatives. The standard photoengraving process utilizing color separation negatives was used to make the printing plates.

Equipment

As I mentioned previously, my camera is a single lens reflex, Bessler TOPCON RE Super. This is a Japanese-manufactured instrument, imported by the Bessler Optical Company. In quality and precision, it is comparable to the NIKON. I am very pleased with the operational characteristics and the results that this camera produces.

I have three lenses for my camera, a standard 58-mm f/1.8 lens; a 135-mm f/3.5 telephoto; and a 35-mm f/2.8 wide-angle lens. Although additional lenses would be useful, these three take care of most situations. The lenses are of excellent quality, as verified by a measurement of the resolution on an optical bench. The built-in light meter uses a cadmium sulfide element deposited on the back of the reflex mirror. This meter measures the light over the whole scene and is coupled with the aperture and time controls to provide easy setting of the correct exposure. A removable pentaprism view finder and the use of a magnifier for ground glass focus makes the camera adaptable for copy work.

During the past year and a half I have completed a darkroom which measures 7x 12 ft. There is a sink and drain board the full length of one side, which serves as the wet area for all chemicals and trays. The opposite side is furnished with work and storage areas for film and paper. The enlarger, a Durst 606, is installed on the dry side, and is equipped with a filter drawer, above the negative holder, for color correction filters. I have designed and built a number of electronic aids to help me in photography, including a photometer or light meter for use with the enlarger. The photometer was especially designed for simple operation. It is calibrated in Kodak printing speed numbers as given in their data sheets. With this instrument I can measure the light intensity on the easel and determine the printing time for any magnification.

Figure 1 shows a simplified diagram of the photometer-timer. The heart of the device is the cadmium sulfide photoresistor, R_1. Its resistance varies with incident light intensity, from a few hundred ohms in daylight to several megohms in darkness. It acts as the variable arm of a voltage divider circuit consisting of R_1 and R_2. The voltage output of the divider is registered by the voltmeter circuit. The output voltage is given by the simple relationship, $V_o = V_{in} R_2/(R_1+R_2)$. As the resistance of the

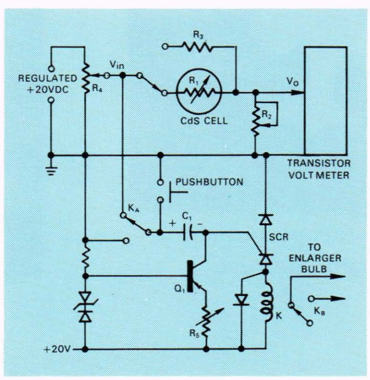


Fig. 1—Simplified diagram of photometer-timer.

photoresistor R_1 changes with light intensity, the output may be restored to a reference mark on the voltmeter by either adjusting the input voltage with R_4 or the shunt arm resistance R_2. The calibrating resistor R_3 is sized to match the resistance of R_1 at a particular light value. During the calibration procedure, the controls R_2 and R_4 are set to particular calibrating values and the sensitivity of the voltmeter is then adjusted to provide a "red-line" reference reading. R_4 is calibrated to read the printing time in seconds directly, and R_2 is calibrated in printing speed number P_I. The printing speed number given in the Kodak paper data sheets is based on the formula $P_I = 10{,}000/M_c t$, where M_c is the light value in meter candles and t is the printing time in seconds. Figure 2 gives a typical calibration curve of a photoresistor. From this information the range of values of R_2 for specific printing speed numbers and printing times can be calculated for a specific fixed output voltage. In the actual circuit two ranges are provided which give printing times from 1 to 50 seconds and printing speed numbers from 100 to 5000.

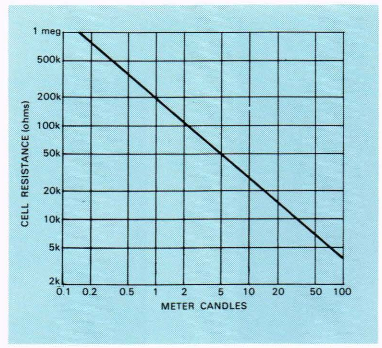


Fig. 2—Calibration of cadmium sulfide cell.

The timer circuit provides a timed relay contact K_B to control the enlarger bulb current. The input voltage to the divider network, which is proportional to the printing time, is stored on the R_4 potentiometer arm. Capacitor C_1 is charged to this voltage. Relay K is held in the energized state by the constant current source Q_1 and the zener diode. When the push button is depressed, the emitter of the SCR is made negative by the condenser voltage which turns the SCR off and transfers the relay contacts. Contact K_A latches the relay in this condition. The condenser C_1 discharges through Q_1 linearly for a time which is proportional to the stored voltage. R_5 is used to calibrate the time constant. When the condenser has discharged to a level equal to the diode drop of the SCR, it will again turn on, energizing the relay coil. The circuit is now ready for another operation.

Other electronic equipment includes thermistor circuits for temperature control of the water bath for the developer and a voltage or light intensity regulator for the enlarger bulb. This device senses the enlarger bulb brightness by a cadmium sulfide cell and controls the average current in the lamp to keep the light intensity constant. This feature is very important in color printing because, as the power in the bulb changes, the color temperature of the illuminating source will change, altering the color balance of the finished print.

Principle of Color Photography

I thought it would be interesting to give a very brief summary of the basic color printing principle even though this information is readily available in technical books. Most color photography uses three sensitive emulsion layers on the film and printing paper. These three emulsions are individually sensitive to the red, green, and blue wavelengths. In the color negative material, either film or paper, the original color produces dyes of the complementary color in the respective emulsion. Thus red light produces cyan dyes in the emulsion, green light produces magenta, and blue light produces yellow. When printing a color positive from a color negative, the same action occurs with respect to the emulsion dyes, except now instead of red, blue, and green basic colors we have cyan, yellow, and magenta, their complements. Let's assume that the original color photographed was green; the color in the negative will be magenta. Assuming for the moment that the spectral content of the enlarger bulb is white light, or in other words contains red, blue, and green wavelengths of equal intensity, the magenta dyes in the color negative will absorb the green wavelengths and will transmit the red and blue. Thus the spectral content of the light through the negative and the enlarger lens onto the printing paper contains higher intensities in the blue and red wavelengths. The red light will print cyan dyes in the paper, and the blue light will print yellow dyes in the paper. The addition of cyan and yellow dyes produces a combined green color. In this way the original green color is produced in the final positive print.

The method of obtaining a proper color balance on the final print is one of spectrum equalization. In other words, for a given spectral distribution of the enlarger bulb, the attenuation in the red, blue, and green wavelengths, due to the negative dyes, is altered appropriately by placing in the light beam variable-density filters of magenta, cyan, and yellow combinations. In this way the correct combination of dyes in the paper emulsion, which most nearly matches the original scene, is produced. All three filters are never used, since this would result in a neutral density combination and only change the light level and not the color balance; which two filters are used depends on the color temperature of the original scene.

Red, blue, and green additive filters or magenta, cyan, and yellow subtractive filters can be used to alter the color spectrum of the light source. Either type of filter can be used to make a color print. When using the additive filters, red, blue, and green, one must actually combine light in the red, blue, and green wavelengths sequentially with three exposures, adjusting the exposure time for each to give the proper balance. When using the magneta, cyan, or yellow subtractive filters, white light is being used to print all three emulsion layers simultaneously by selectively attenuating the red, blue, and green wavelengths, making one exposure for the correct color balance. Of course the total density of the print is controlled by the exposure time. Thus in color printing two parameters must be adjusted, the color balance and the density.

Processing

Standard chemical kits for color printing are available and I rely on these. The only unique technique I use relates to the temperature control for the color developer. The developer temperature must be held constant to $\pm 1/2$°F so that consistency can be obtained from one print to another. This is done in my darkroom by using a large plastic pan full of water which is heated to a temperature of 100°F by an aquarium heater. The temperature is controlled to the $\pm 1/2$° tolerance by the use of a thermistor sensor immersed in the water bath some distance from the heater. This sensor controls, through special transistor circuits, the average current in the heater such that the heat applied is just equal to the heat loss. This is much better than a "bang-bang" type thermostat since no large differential exists. Its sensitivity is such that the error temperature which is needed for control is a small fraction of a degree. A stainless steel tray is floated on the surface of the heated water, transferring the controlled heat to the 3 or 4 ounces of developer which is used for each print.

Conclusion

Many people have asked me what happens to all the orchids. First of all, it is rewarding to observe nature in the fulfillment of a growing and flowering plant particularly when one has a hand in their culture. Also it is enjoyable to have the flowers available for home decoration. In addition, Idabelle has mastered the art of making beautiful corsages. She enjoys this creative part of the hobby and is delighted to be able to give corsages to our friends.

We are members of the National Capital Orchid Society and the American Orchid Society and enjoy the programs and orchid shows sponsored by these organizations. We learn from association with others who are orchid hobbyists. I am presently serving as Chairman of the Photography Committee for the Society. At monthly meetings members exhibit their orchid plants that are in bloom; this provides an excellent opportunity to see the many varieties and possibly acquire a few new plants. I am looking forward to continuing these hobbies with even more enjoyment after retirement.