Since the number of plants tested was relatively small it will be possible to record a number of intermediate responses which under normal circumstances would probably be omitted for the sake of brevity. The overall results of this study then can be summarized as follows: (1) Plants giving a general increase in growth at all light intensities over non-lighted plants — *Caragana arborescens, Euonymus nana, Kolkwitzia amabilis, Ligustrum lucidum compactum,* (2) high light intensities generally increase growth over low or no light — *Forsythia suspensa, Lonicera claveyi nana, Lonicera "purpurea," Prunus besseyi,* (3) plants stunted by high and low light intensities: normal or increased growth at intermediate intensities — *Elaeagnus angustifoldia, Fraxinus pennsylvanica, Philadelphus virginalis,* (4) medium and low light intensities generally increase growth over no light -- *Spiraea frobeli, Weigela vanicek,* (5) plants stunted by high light intensities; normal or increased growth at intermediate and low intensities — *Berberis thunbergi, Caryopteris* Blue Mist, (6) plants generally stunted by light period — *Abelia grandiflora, Cornus "nana," Chaenomeles lagenaria, Cotinus coggygria, Ilex cornuta burfordi, Syringa 'President Grevy,'* (7) plants not responding to light period — *Deutzia lemoinei, Gardenia fortunei* (observed to be better branched under lights) *Rosa* (Red and White varieties), and *Syringa vulgaris varieties.*

PART II. RESPONSES OF SEVERAL VIBURNUM SPECIES TO DAYLENGTHS

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During 1956 plants of five Viburnum species were grown on various daylengths to determine their effects on growth The growth measurements reported represent net increases during the treatment period in length of the shoots of main and lateral branches whether due to increased number of nodes, increased internode length, or both of these.

Uniform cuttings, rooted the previous summer and overwintered in the field, were provided by H. M Templeton[1]. The species were *V. burkwoodii, V. juddii, V. chenaultii,* and *V. plicatum forma tomentosum* (*V. tomentosum-plicatum*). Three replicates of five plants each of the five species were subjected to photoperiods of 8, 12, 14 and 16 hours.

The study was begun March 5, 1956. Plants on all daylength treatments were maintained in the natural light of the greenhouse for a basic 8-hour period, from 8 a.m. to 4 p.m., after which they were moved into ventilated light-controlled chambers, where they received the necessary supplemental light to complete the given photoperiod. The source of the supplemental light was 100-watt incandescent-filament lamps, which proved approximately 30 foot-candles of illumination at plant level. The greenhouse experiments were terminated August 20, when final growth data were collected. Plants were maintained on their respec-

[1]Winchester, Tennessee

tive photoperiods after this date until moved at 4-week intervals to the field for additional study.

During the greenhouse experiments all species showed marked response to daylength. The main axis and lateral branches in each species made relatively little growth on 8-hour days Leaves of plants on this shortday treatment were darker green than those of plants on the longer photoperiods Growth of both the main axis and the lateral branches was greater on the longer daylengths, but the number of laterals, except on *V. juddii,* was not greater. During 24 weeks of treatment the total growth increase, that is the sum of growth made by both main axis and lateral branches, was more than twice as great on 16-hour days as on 8-hour days for *V burkwoodii* and *V. chenaultii* Similarly, on the longer daylength, plants of *V. carlesii* produced three times as much growth, *V. juddii* about five times as much growth, and *V. plicatum f. tomentosum* more than four times as much growth as plants of the same species on 8-hour days (table 1.) In general, this is in agreement with the results that Sidney Waxman reported to this Society last year. He indicated increased vegetative growth of plants of *V. carlessi* and *V. opulus* on long days. *Viburnum prunifolium* reportedly did not respond to photoperiod.

Table 1.—Mean increase in length of the growth[1] of Vbirnum Plants in the greenhouse during 24 weeks on various photoperiods.

Species	Increase on indicated photoperiod 8-hour	12-hour	14-hour	16-hour
V. burkwoodii	49	60	81	113
V carlesii	34	45	85	117
V chenaultii	47	57	77	108
V juddii	10	15	25	47
V plicatum f tomentosum	15	19	26	69

[1]Mean of 15 plants Growth was measured as total extension of both the main axis and the laterals L S D for means between photoperiods for a given species 43 at 5% level, 61 at 1% level.

On plants of three species grown under our greenhouse conditions and treatments, flowers buds were apparent in June regardless of the photoperiod. Thus, photoperiods did not seem to control floral initiation However, marked differences in the extent of flower-bud formation did occur among the species. *Viburnum burkwoodii* and *V. chenaultii* formed at least one flower bud per plant, *V. carlesii* formed flower buds on only one-fourth of the plants, and *V. juddii* and *V. plicatum f tomentosum* had not formed any visible flower burs by August 20. At this time, the flower buds that did form appeared to be single ones tightly subtended by bracts. Actually, in the axils of these bracts were minute flower buds which remained compressed and inconspicuous throughout the photoperiod experiment.

For the field phase of the experiment, a complete replicate consisting of five plants of each species, except *V. plicatum f. tomentosum,*

from each photoperiod was transplanted to the field on August 20, September 17, and October 15. The small flower buds that were already visible expanded and appeared as enlarged clusters of buds on plants of each group 6 weeks after it was moved to the fall field conditions. Certain of these buds on *V. carlesii* that had been on 8- or 12-hour days developed until the corolla tube was expanded and colored; often erratic opening of individual corollas followed. By December 11, 1956, marked differences in total flower-bud formation were noted. *Viburnum carlesii* and *V. juddii* formed no additional buds after they were moved to the field However, the numbers of flower buds on plants of *V burkwoodii* and *V chenaultii* nearly doubled. Some of these seemingly new buds might have been initiated in the greenhouse, but since the plants on longer daylengths were producing leaves at that time, the majority of the new buds probably were initiated after the plants were moved to the field.

It was also noted that leaves of plants of all species, regardless of the previous photoperiod treatment, turned the typical wine red or bronze color expected during the fall. Plants of *Viburnum chenaultii* retained their foliage in the field better than those of the other species tested.

The field experiment is being continued to study the effect of previous daylength treatments on winter injury and subsequent growth of the plants in the Washington, D.C., area.

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PRESIDENT SCANLON: We now have time for a few questions.

DR. CHADWICK: How many days after your lights were turned off did Caryopteris Blue Mist flower?

DR MAHLSTEDE: The plants, regardless of position in the row, flowered almost immediately after the lights were permanently turned off.

MR KEN FISHER. Was *Viburnum opulus nanum* used in the studies?

DR. NITSCH: We have just now started to propagate this plant. For this reason we do not have any results that we can report at this time.

MR. BUCKLEY: Dr. Nitsch, I would like to know whether you noticed any difference in the growth habit of plants when using, say, 1000 foot-candles as against using 25 foot-candles of light?

DR NITSCH: I should first state that we didn't work with different light intensities. We used the same light intensity throughout our studies We were using incandescent light, which, if I remember correctly was about 50 foot-candles. I should say I was quite interested in the results showing that the intensity of the light has quite a lot to do with the response . I think it is quite a new angle

MR BUCKLEY: We have noticed a definite response of plant materials to varying light intensities. Recently I went over to see the experiment we carried out using 1000 foot-candles supplementing normal sunlight on birch and caragana and also those given 25 foot-candles of light for an 18-hour day. With the 25 foot-candle light supplement we obtained very long, weak growth which measured about six foot on White Birch, and which had to be supported. The plants given normal sunlight supplemented with 1000 foot-candles of incandescent light made stronger, bushier growth. There seemed to be quite a difference in the branching habit and the ability of the plant to stand up without support under the higher light.

DR. NITSCH: I see Under the high intensity light then you get photosynthesis entering the picture. We endeavored to use low intensity because we didn't want to study this effect In addition to this you observed a stunting effect at the higher light intensity?

MR. BUCKLEY: Yes, that is true The seed of these plants was sown about the last of May. We did notice an inhibiting effect of supplemental light on the growth of germinating white pine seedlings, but this was almost immediately overcome and the seedling grew normally

DR. NITSCH: If you remember, Downs and Borthwick say with Scotch pine a better result is obtained with 14 hours than with 16 hours of light Of course, I haven't given you all the possible types of responses, but it looks like certain plants actually do much better under short days. For example, apple grows better under 12 hours of light than under 18 hours.

MR. HOOGENDOORN: I don't like to make this more confusing than it is already, but would you say that most plants will grow better with a longer light period?

DR. NITSCH: Well, we haven't explored all the plant kingdom, so I can't say definitely. However, a good number of them, at least those that we have tried will do better with a longer light period.

MR. HOOGENDOORN: Well, the 21st of June is your longest day. After that, the days become shorter I was wondering then, how you would explain why we get our best growth, in general, on shrubs from the first of August until the middle of September.

DR. NITSCH: What plants are those?

MR. HOOGENDOORN: Evergreens and shrubs.

DR. NITSCH: Did you observe this on dogwood?

MR. HOOGENDOORN: No. Take for example, Cotoneaster Up to the first of August they don't do much but they put on a terrific growth from the first of August until the middle of September.

DR. NITSCH: Well, I don't know how Cotoneaster responds. Maybe it grows better under intermediate light or temperature, or there even may be other factors operating.

MR. BRUCE VANDERBROOK: We have observed the same thing. I wonder how much of that response is due to when you fertilize, and how much rain and fog you get.

MR. HOOGENDOORN: Whether you get rain or no rain, that is the time a lot of these plants make up. Of course, if you get rain they will get that much bigger.

MR. JIM WELLS: Case, are these plants to which you refer transplanted in the spring?

MR. HOOGENDOORN: Yes.

MR. WELLS: Isn't it perhaps due to the fact that the plant requires a certain amount of time to reestablish its root system? This occurs during the early summer and then by fall you get that flush of growth

MR. HOOGENDOORN: All right, you take established plants and you cut them back. They do the very same thing, that is they put on most of the growth late in the summer.

MR. WELLS: I concede defeat. I wanted to ask Dr. Nitsch if any work had been done or whether he thought it would be advantageous to apply supplementary light to young cuttings of such plants as deciduous azaleas, Japanese maples, or Viburnums which have proved difficult to over-winter. It seems that if a cutting can be induced to make vigorous growth after rooting, it can probably be over-wintered more successfully. Would supplementary light after rooting be of value?

DR NITSCH: Well, it depends first of all on how much time you have left until the first frost. This will depend on the location of your nursery, that is if it is in the North, or the South. If you use supplementary light you will get soft growth which will take time to harden off and become dormant. I am sure that in the South you could probably do it In the North, you may have to shorten the days artificially. I should say we don't yet know how to get plants hardened off enough to stand the winter. This is one of the next things to be studied.

MR. McDANIEL: I have one question to ask. You didn't mention anything about the prevalence of insects under your lights, particularly leaf hoppers Did you notice them?

DR. MAHLSTEDE: No, since I was never at the Horticulture farm at 12:30 A.M. when the lights went on.

MR. McDANIEL: That possibly might be one of your influence affecting slower growth of plants directly under the lights. Take Sophora that Mr. Flemmer talked about the other day Reduced growth might be traced back to toxins which the plant receives from the leaf hoppers.

DR MAHLSTEDE: As far as insect damage on the plants in concerned, I am certain that none existed. As for large populations of insects cutting down the amount of light reaching the plant, I am inclined to think that this was not the case.

PRESIDENT SCANLON: We are indebted to Dr. Nitsch for this excellent discussion and to Dr. Mahlstede for his concise report of the photoperiod trails sponsored by the Field Trials Committee.

We will now preceed to our Annual Business Meeting. (See page 9).

SIXTH ANNUAL BANQUET

The newly elected president, Mr. Louis Vanderbrook, presided at the Sixth Annual Banquet.

A gavel was presented to each of the former Presidents of the Society Each gavel was inscribed with the individual's name and the year of office. Those honored included:

James S. Wells, President, 1951 and 1952
L C. Chadwick, President, 1953
Richard H. Fillmore, President, 1954
Edward H. Scanlon, President, 1955

Following a period of entertainment, Professor Frank A. Pearson, Agricultural Economist, Cornell University, Ithaca, New York, addressed the group on the subject. "That and That."

The Sixth Annual Meeting of the Plant Propagators Society adjourned *sine die* at 10:00 p.m.