as establishing herbaceous flowering plants in plots among collections of trees and shrubs, which would divert attention from the main installation, or the introducing of exotic species into natural woodlands and thickets, which would give the public erratic ecological conceptions. Flower gardens, as such, are generally located separately from the botanically grouped plantations, for in them esthetic considerations are predominant.

The popularity of botanical gardens causes them at times to be over-crowded and problems relative to the control and circulation of large numbers of people arise which have to be met as well as possible. A comprehensive system of paths is essential; the majority of visitors instinctively keep to the paths, but it is undesirable in large gardens, at least, to actually restrict visitors to paths, for they could then come close to only a relatively small number of the plants installed, unless the path system was unduly elaborated and landscape considerations wholly neglected. A very small proportion of the public is intuitively destructive, and it is this small number of people that entail high expense for guards and keepers; legal punishment of offenders as a warning to others of mischievous proclivities is the only treatment available. In large gardens a driveway system and provision for conveyances for hire are also desirable, for many visitors are unable or unwilling to walk considerable distances.

The indirect relation of botanical gardens to the public lies in their function of adding to the knowledge of plants and plant products and the diffusion of this knowledge by publication and otherwise. Laboratories, herbaria and a library are essential adjuncts to the garden itself, and through investigations carried on in them and in the garden, additions to knowledge are constantly made. Of these additions to botanical information those of an e nomic character are the most immediat available for the public good, but the m theoretical additions to information m prove the more important in the long r

From what I have said it will be cle that the function of botanical gardens their relation to the public is somewhat d ferent from their relations to college a university students, although, after a this difference is one of degree rather tha of kind.

N. L. Britton

THE PLACE OF BOTANICAL GARDENS IN COLLEGIATE INSTRUCTION

The splendid gardens under the direc tion of my predecessors in this discussio are well known to everybody, but this ca not be true of the modest one of which I have charge. It will therefore be fairer to my comments on the subject if I say that it has been my duty, during the past fifteen years, to develop at Smith College, with due regard to reasonable financial restrictions, a garden which should be as well adapted as possible to collegiate instruction. It now includes these parts. First, there is an arboretum and fruticetum, of some 500 species, distributed, with regard partly to scientific arrangement and partly to pleasing landscape effects, over a campus of some thirty acres. Second, there is an herbaceous garden of some 700 species, arranged on the Engler and Prantl system. Third, there are three natural gardens, a rock garden, water garden and wild garden, the last as yet too young to be effective. Fourth, there is a range of well-built and suitably stocked greenhouses, nine in number with two attached laboratories. Upon the development of this garden rests my qualification for the part I have in this discussion. Naturally, it approximates to my idea of what a college botanical garden

should be. I wish to ask you to bear in mind that I speak upon gardens in collegiate instruction, and I shall keep strictly to that subject. Many of my conclusions do not apply at all to gardens of a different type—public, university or other.

Colleges differ much from one another in many features, but from our present point of view have these in common: First, they have only an undergraduate constituency, with practically no graduate work. Second, they have extensive grounds, usually of a rural character, which it is desirable to make as beautiful as possible. Third, they have a long summer vacation, with no summer schools or other instruction in that time. Of these conditions, to which collegiate botanical gardens must be adjusted, I shall speak in reverse order.

The long summer vacation is even longer, from the present point of view, than its number of weeks implies, for most of our students do not know enough to make profitable use of the garden at the opening of college, while the great number of social and other distractions at the end of the college year, not to mention the attractions of the native flora, seriously shorten its period of usefulness in the spring. Consequently the part of a botanical garden of most use in a college is that in which plants are alive and at work during the winter months, viz., the greenhouses. There is no question that, so far as scientific instruction in a college is concerned, suitable greenhouses are far more valuable than any outdoor garden.

Yet the long summer vacation does not by any means empty a college garden of its utility or desirability. The part which the vacation renders least useful is the herbaceous garden, arranged on the systematic plan, and I am not sure but that, if I were starting all over again, I would omit this part, closely identified though it is with the very idea of a botanical garden. Another kind which the long vacation would render of slight use is an ecological garden, that consisting of beds designed to illustrate types of structure, of dissemination methods, of cross-pollination mechanisms, and the like, for these would be well-nigh useless in early spring and late fall. Indeed, such observation and limited experimenting as I have been able to make on such beds leads me to disbelieve in their value aside from this limitation. It is impossible to have many of the forms illustrative of a certain idea in good condition at the same time; many of the forms best illustrating an idea are otherwise very unattractive and often difficult to grow; and even when such beds are developed, there are few people who can understand them unless they already know the subject with some thoroughness. I think it is usually true that gardens prepared to illustrate any artificial plan or idea, whether ecological, historical (*e. g.*, plants mentioned by Shakespeare) or other, are very unattractive in appearance and difficult to maintain effectively. These objections do not apply to natural gardens, viz., rock gardens, water gardens, wild gardens, in which plants are grown in natural surroundings; for these plants and places can be made so attractive as to draw appreciation and notice from all, and when suitably labeled, as of course all parts of the garden must be, they are decidedly instructive. We have at Smith College a very attractive rock garden, with a variety of exposures, containing many kinds of plants, from cliff dwellers to shade-loving ferns, and it amply repays its cost in the pleasure and the instruction it gives to its many visitors.

Another part of the outdoor garden that is well worth while despite the long vacation is the collection of trees and shrubs, especially as these are needed for the beau-

tifying of the grounds, which must receive attention whether a true botanical garden is developed or not. And this brings me to the second of the three conditions which must be met in collegiate gardens. All colleges desire to have their grounds as beautiful as possible, in order to create attractive surroundings for undergraduates, pleasing memories for graduates and favorable impressions for parents and benefactors. Now, to this end, the extensive use of trees and shrubs is indispensable. It would seem at first sight possible to combine a good landscape use of these with a systematic arrangement to illustrate relationships, but I have found, as no doubt have many others before me, that this is only partially possible. Thus, some families contain far more plants of attractive form than others. Imagine confining Coniferæ strictly to one section! Again, the proportion of trees to shrubs is so different in the various families that if these were confined to special areas some sections would have few or no trees and others no shrubs. Thus Leguminosæ have several ornamental trees, but hardly any ornamental shrubs, while this case is reversed in Rosaceæ, reaching an extreme in Caprifoliaceæ, which has no ornamental trees at all. Hence a strictly systematic arrangement can not be combined with good landscape results, and the best that can be done is to make sure that representatives of a given family are present in the appropriate area, even though not confined thereto. But on this plan, a very good collection of trees and shrubs, both pleasing to the eye and useful for study, can be assembled on a college campus. Moreover, trees and shrubs are in condition for study earlier in spring and later in autumn than herbaceous plants, and besides can be studied to considerable advantage all through the winter when herbaceous plants are not visible at all. Hence my experience has shown that of the outdoor garden, the trees and shrubs are far and away the most valuable part; next come natural gardens, and last of all the systematic garden. There is one other matter worth mention in this connection. The absolute necessity which colleges are under to keep their grounds attractive in any case, makes it possible to develop them as a botanical garden with comparatively little additional expense, for the extra cost of the other features is not relatively great. This applies in part also to the greenhouses, because where these are developed it is possible to give profitable and congenial employment to a good gardener during the winter, and consequently a more competent type of man can be kept, to the great advantage of all the interests involved.

Another matter which I am finding important in connection with the outdoor garden, but which applies equally to the greenhouses, is this. It is far better to concentrate upon good effects with a few things rather than upon the collection of many. In my own garden, we are reducing the number of species, but are giving better massing and surroundings to those we retain, which include especially the kinds the observer is likely to meet with again. Primarily this is in order to conform to an educational principle of which the importance steadily grows upon me, viz., that the scientific merits of a garden, or of anything else, are not of themselves sufficient to attract persons to their study, but attention must be paid to the peculiarities of human nature which demand that things shall be made attractive also. I therefore consider it important to so arrange plants that they will evoke attention and admiration first, on which basis instruction is far more easily given. And as the human capacity for attention and absorption is strictly limited, it is no use to

try to produce many such pleasing effects. A few very pleasing trees appeal more to human nature than do many only moderately pleasing. This principle fits perfectly, also, with my first condition of college instruction above mentioned, that only undergraduates make use of the garden, and the number of kinds they can utilize is not very great. In all scientific institutions, whether gardens, museums, or courses of instruction, we seem to pass first through an accumulation stage, in which completeness is the ideal and we try to collect all the kinds we can. Later we pass to a selection and individualization stage, in which we pick out the most essential objects and give each an ample and distinctive setting. We have passed into the second stage in our museums and to some extent in our instruction, but hardly yet in our botanical gardens.

I pass finally to the greenhouses, the importance of which I can not too strongly emphasize. These should be arranged, for convenience of both use and management, upon a climatic basis, including cool temperate, warm temperate, desert, stove and palm houses at least, furnished with a selection of well-labeled plants of the chief scientific interest, and with room for the growing of class material and for horticultural and physiological experiment, while the closer the attachment of the greenhouses to laboratories the better. I am here, as you may suspect, outlining the arrangement of the range developed under my charge, the practical working of which is extremely satisfactory.

The educational advantages of good greenhouses are too well known to all to need comment, but I may add another advantage not so obvious, viz., that they provide an extremely attractive and instructive place for visit in winter, not only by students but by their friends and visitors; and this is something of marked advantage in rural communities. Indeed, the instruction and enjoyment derived by the public from outdoor gardens as well as greenhouses constitute no small reason for their development. For not only do they attract attention and sympathy to a college, but they are also a wholly appropriate and serviceable form of college extension.

There are two warnings I would sound in connection with the greenhouses. First, they should be kept free from all entanglements in connection with the supply of ornamental plants for college functions. Such a use is bad for the plants, subversive of a scientific interest in them by the gardeners, and derogatory to the reputation of the greenhouses. The respect of the college community is far greater for a collection of plants kept exclusively for educational purposes, and for the scientific interests involved therein, than for any collection at their beck and call for social purposes. Second, they should be kept free from any attempt to make them help pay their own cost. The florist business is a highly specialized one, conducted, as a rule, on a narrow margin of profit, and no range of college greenhouses can earn any considerable amount without devoting thereto an amount of space and gardener's time wholly incompatible with any considerable attention to educational objects. Moreover, the feeling of local florists is quite sure to be aroused against an institution conducting a competition which they are sure to regard as unfair. These objections do not apply to the greenhouses of agricultural colleges; where the problems are different, and where it is essential that the students learn to raise plants for profit.

So, I may summarize my ideal botanical garden for a college by saying that it consists first of a good range of greenhouses, second of a collection of trees and shrubs,

primarily grouped artistically and secondarily on a systematic plan, third of natural gardens, and fourth of a limited systematic herbaceous garden. In all, selection and attractiveness of setting should be controlling principles.

W. F. Ganong

A UNIVERSITY BOTANICAL GARDEN

It requires some presumption for a mere novice to talk on this theme, after the fathers of our great botanical gardens have spoken from their ripe experience. One who neither grew up in a botanical garden already established, nor has had time to grow far with one established but a short two years ago, can hardly be expected to speak with authority. My only justification for complying with the request of your secretary to participate in this discussion is the fact that, in planning the botanical garden for the Johns Hopkins University, I have discovered what a goodly number of problems confront the beginner in this kind of work and how little detailed information is to be found in print that will aid him to overcome them.

I may therefore, perhaps, be permitted to say something of the purpose of our garden, of some of the difficulties encountered, and of such solutions of these, or part of them, as have either been worked out at Homewood or gathered from the experience of other gardens. These things are said not only in the hope of being of service to others who may be planning gardens, but also of evoking from others helpful criticism, that may be of aid to us in the work at Homewood.

That a botanical garden can be of great value to university students does not stand in need of proof to you of this audience. I desire, however, to suggest some of the particular ways in which I believe it may be most useful. If university students are what they should be, in aim and industry, it seems evident that access to a well-arranged botanical garden may advantageously replace class-room courses on certain aspects of gross morphology, floral biology and floristic geography, besides greatly enhancing the value of many of the formal courses on other subjects, given in lecture room and laboratory.

A botanical garden which is to be of use in the ways mentioned must suggest clearly what it is intended to illustrate. It must leave no suspicion of the aimlessness of a "cabinet of curiosities," but must show the purposefulness of a skilfully arranged museum—a museum in which (as an able museum director has said) the carefully selected specimens illustrate a well-devised series of labels, rather than one in which the labels are mere name-tags for more or less accidentally acquired specimens.

Such a definitely planned garden can well serve to extend the laboratory work and to concentrate the field work. For in the laboratory a student can not study enough plants minutely to comprehend them broadly; in the field he can not study any plant so thoroughly as to understand it deeply. The garden renders a larger variety of plants accessible, brings plants of different regions together for ready comparison, taxonomically, morphologically and physiologically, makes it possible to observe their activity and development more continuously and, finally, gives the most satisfactory opportunity of preserving them at critical stages for future study and comparison. The garden then does not replace either field or laboratory, but it does effectively link them.

If now we consider more specifically the functions a garden may serve we may summarize them thus:

1. It can illustrate certain phenomena of plant life which may be observed directly,