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MEDICINAL PLANT GARDENS.

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It is not my intention in this paper to present a descriptive account of Medicinal Plant Gardens in general, or even to discuss the more important ones of this country, except in so far as reference to them may be necessary by way of illustration. I shall endeavor, however, to point out what to me appear to be some popular misconceptions concerning the scope and function of such gardens, and to suggest how they may be made to increase their usefulness to Materia Medica and Pharmacognosy.

For the purpose of this discussion Medicinal Plant Gardens may be regarded as falling under one of two general classes, the first being pedagogic, the second industrial. The pedagogic garden is naturally an adjunct of a School of Pharmacy, or of a Botanic Garden. Its scope includes all medicinal plants that are adapted to existing soil and climatic conditions, supplemented by greenhouse facilities. Its function is to familiarize students with the habit and appearance of the entire living plant, some part of which is used as a plant drug, to supply the need for authentic specimens for observation and demonstration in the classroom, and to furnish materials for research work on the morphology and chemical constituents of drug plants. Necessarily it will be found desirable to grow a large number of species in this type of garden, but, owing to the cost of maintenance, the space which can be devoted to any one species will be very small.

The industrial garden, on the other hand, is an adjunct of public or private enterprises, the object of which is to give additional information concerning our agricultural resources. Its scope is the same as that of the pedagogic garden, but it differs very materially in function which is to serve for the determination of the adaptability of medicinal plants, not only to soil and climatic conditions, but to economic conditions as well. In the industrial garden, a large number of species will be tested on a small scale to determine whether the soil and climate are suitable for their growth, then the few promising ones must be tried out on an area large enough to yield reliable data on the actual conditions of commercial production. A considerable acreage of land is indispensable for this type of garden, if the results secured therein are expected to have much economic significance.

There is no lack of evidence that the general public often, if not as a rule, fails to differentiate the functions of the pedagogic and industrial gardens, since advice

is freely sought from both regarding the production of medicinal plants for the sole purpose of deriving profit therefrom. It is also an open question whether this distinction in function is in every case clearly understood by those responsible for the management of medicinal plant gardens. Statements sometimes unguarded, or not properly qualified, and sometimes based upon inconclusive and insufficient data, have on several occasions inspired the imagination of writers for the popular magazines or daily press, and, as a result visions of large and easy profits have been portrayed under various alluring titles, as, for example, "Big Profit from Drug Weeds," "The Herb Grower Has a Chance at an $18,000,000 Business," "A Profit of One Hundred Dollars Per Acre from Growing Medicinal Weeds." Moreover, the wide-spread interest in the possibility of growing medicinal plants for profit, which has been developed in this country during the past decade has been capitalized by a number of crafty promoters, who use the mails and the columns of journals and magazines to disseminate flamboyant advertisements of the enormous profits which may be made by growing certain medicinal plants. Frequently, the name of the plant is withheld until the victim has remitted from one to five dollars, for which he receives practically valueless instructions for the cultivation of some plant poorly adapted to our economic conditions. A typical get-rich-quick scheme, of this class, is explained thus: has to do with a certain plant which grows like a weed; it is cut and cured like hay and sells for 45 cents per pound, which is at the rate of $900 per ton." The investment of one dollar brings the name of the herb with the further information that the product of one acre will sell for $1800!" As a matter of fact the commercial cultivation of this plant is almost unknown in the United States, and there is yet no established market for the American product.

These illustrations will account for the doubt which has arisen in my mind as to the propriety of purely pedagogic gardens being used as a basis for generalizing on the question of drug growing for profit. In agricultural experimentation, it is well recognized that the results from small trial plots must be interpreted with due regard for the large factor of error, which is always present. With proper care and attention, it is relatively easy to grow a luxuriant crop of any one of a number of drug plants on a square rod of good garden soil but what can be done under ordinary agricultural conditions on one or more acres can not be calculated therefrom by "a simple sum in arithmetic," as one writer has naively said.

There are numerous well authenticated instances in which the production of some medicinal plant has resulted in a fair profit, but there is yet no evidence at hand to justify the belief that satisfactory results can be secured without some practical experience in gardening, some knowledge of the requirements of crude drugs and due regard for economic conditions.

Every pharmacist and physician is or should be interested in obtaining crude drugs of highest quality and standard efficiency, but material progress toward the attainment of this end will not be favored by encouraging a large number of persons to become small producers. The result of small individual collections varying widely as to time, place and method of gathering is seen in the miscellaneous aggregates all too frequently found in our crude drug markets, and unless a perpetuation of this condition is desirable, little encouragement should be given

to the suggestion that whoever has a small back yard available may become a producer of plant drugs.

The educational opportunity open to the pedagogic gardens is almost limitless. The dissemination of knowledge to countless individuals not having access to the garden itself regarding the history, geographic distribution, methods of preparation and uses of crude drugs may be accomplished through illustrated lectures and carefully prepared articles written for the less technical periodicals. Such misconceptions as, for example, that the production of ipecac in New England and vanilla beans in Iowa is a commercial possibility, or that stramonium is produced by a "melon weed" are all too prevalent, and should be corrected. But educational work along this line deserves little tolerance unless inspired by some motive more commendable than that of merely arousing interest in growing drug plants, otherwise the whole movement will sooner or later be discredited. Recently a reputable pharmaceutical journal published an article in which the writer set forth at some length the possibilities for the commercial production of a certain drug plant in the southwest. A request for further information brought forth from this writer the astounding statement that he had no personal knowledge of conditions in the southwest, but, *having grown this plant in one of the northern States,* he saw no reason why it should not be profitably grown in the southwest "on rocky and otherwise unprofitable land, on hillsides or arid desert soil." In this case, the motive was evidently merely the arousing of interest, and the writer mentioned displayed a fine disregard for the practical difficulties atending the growing of the plant in question which sharply localize the areas on which it may be economically produced.

The time is certainly ripe for injecting into discussions and recommendations regarding the cultivation of medicinal plants some of the sanity and discrimination which characterize conservative business operations. Such a course is necessary if the interest already aroused is to be retained and directed along lines productive of beneficial results. It should be remembered that the expense of agricultural operation varies widely according to location. In some localities, the outlay for farm labor will be three and one-half times as much as in others. Sometimes we find a low expense for labor associated with a heavy outlay for fertilizers, sometimes heavy expense for both labor and fertilizers, and, again, low expense for both. The complications introduced by these factors alone render it practically impossible to make any safe general statement as to the profitableness of drug growing. Furthermore, two localities separated by a distance of less than fifty miles may present a totality of conditions so different that a drug-growing enterprise which could probably be conducted at a profit in the one would with equal probability fail absolutely in the other.

I do not wish to be understood as taking the position that there is no opportunity in the cultivation of medicinal plants, for I have abundant evidence that given the *necessary favorable conditions* a fair return may be expected from several drug crops. On the other hand, I also have abundant evidence that hundreds of persons have received the impression that drug crops can be grown by anybody anywhere at a profit far in excess of that to be obtained from ordinary cultivated crops. I am convinced that in some cases optimism and enthusiasm have

been allowed to outrun common sense, but if in the future due consideration is given to the fundamental principles of agricultural economics, I believe that a rational attitude toward commercial drug plant cultivation may be developed.

The founders of the several excellent pedagogic gardens which are now maintained in connection with certain Schools of Pharmacy have inaugurated a movement which promises much for the future of Materia Medica and Pharmacognosy. It is sincerely to be hoped that their example will lead to the establishment of such gardens in connection with each of the 75 or more Schools of Pharmacy in the United States, and to an extension of the scientific study of medicinal plants. The problems demanding attention are very numerous, but some of the lines of study and investigation which need to be emphasized are those concerning the adaptation and acclimatization of medicinal plants, the conditions under which the active principles of plants are formed, and the behavior of the plants themselves under varying conditions of climate and culture. Moreover, the selection and breeding of medicinal plants not only promises to yield results of great practical importance, but also affords a field for the widest scientific activity.

It is to be regretted that at present there is no satisfactory way in which the investigations being made upon medicinal plants in different sections of this country can be properly correlated and reduced to form for definite comparison. Especially desirable is a practicable basis of correlation for studies of the variation in plant constituents due in part, at least, to differences in geographical location. When two more or less widely separated workers attempt to compare the results of their studies, it frequently happens that they experience the greatest difficulty in harmonizing their results. This is due in part to differences in the response which plants make when under different environmental conditions, in part, probably, to variations in the method of procedure followed in the cultivation, curing and analysis of the plant, and in part, no doubt, to differences in the genetic relationship of the plants studied by the respective investigators.

There seems to be an opportunity for some arrangement or mutual agreement between the representatives of our various medicinal plant gardens, under the terms of which, multiplicate samples of seeds or plants of common parentage could be distributed for the production of plants to be used experimentally. If under such an agreement, uniformity of treatment, throughout the processes of culture, curing and analysis could be secured, comparison of results would be much more profitable than at present, and the tabulation and summarizing of the results of experimental work conducted along the lines indicated in a number of localities would permit the drawing of conclusions having a significance far greater than those that can be reached by a single isolated worker. The suggestions here offered, contemplate nothing like a general coöperative investigation, but rather the adoption of what might be regarded as a standard method of procedure analogous to official methods of analysis, etc. The tabulation and summarizing of results might well follow individual publication, as no other course is likely to give satisfaction.

In conclusion, I wish to say that the resources of the experimental drug gardens of the Office of Drug-Plant Investigations, Bureau of Plant Industry, are open to any School of Pharmacy desirous of starting a medicinal plant garden, as are

also the facilities of that Office for effecting the distribution of material for experimental purposes, and for furthering the collection and compilation of data on the cultivation of medicinal plants under great diversity in conditions of growth.

DISCUSSION.

MR. FRED T. GORDON: May I ask Dr. Stockberger, have you ever noticed any difference in the attacks of insect pests on plants? For instance, we had the army worm in Philadelphia not long ago, and they ate every blade of grass as they moved forward, but they would not touch clover, and in the same way certain insects eat certain vegetables and leave certain weeds alone, like milkweed. Do insects attack such plants as belladonna?

DR. STOCKBERGER: Yes.

MR. GORDON: I know that insects do not seem to attack stramonium very much, although there is an insect, the tobacco worm, which eats tobacco. I was questioning whether there were any special differences in plants in this respect.

PROF. KREMERS: I should like to see the question brought up and discussed. I may say, although I am not a very close observer of animal life, that I have had occasion in recent years to have my attention drawn to things of this sort. Indeed I should enjoy an opportunity for study along this line, and to observe more.

With regard to stramonium, for instance, this plant is attacked by insects. When you pick up a stramonium leaf you will find it perforated with hundreds and hundreds of small holes. If you approach a field of stramonium, from a distance of several rods you will hear a peculiar noise. It is a very faint noise, in a way, and yet the noise reminds one of the distant roar of the ocean waves. This noise is made by countless small beetles, which upon your approach rise and then settle down again. The noise thus produced reminds one of the surf.

We have experimented with something like fifteen or twenty species and varieties of stramonium, and we have found that practically all of them, except one, I have forgotten which, is attacked by this particular beetle. If we could effect a hybridization of the other species of *Datura* with this one, which would give us the alkaloid-content desired, and also the necessary resistance, and thereby eliminate these beetles, we could produce a much finer looking drug than we can at present.

I have also observed the Colorado beetle or common potato bug on hyoscyamus. Both instances clearly demonstrate that alkaloids do not necessarily render plants beetle-proof.

In connection with the remarks made by Dr. Stockberger, I should like to call attention to a somewhat discouraging feature in drug standardization. For some years past, we have had occasion to make a special study of stramonium. In connection with this work, we have made a compilation of all the stramonium-assays we could find in the world's literature, and not a single generalization could be drawn from all of them. We begun work of our own, and compared the results of two consecutive years from materials obtained from the Northern Station for the Cultivation of Medicinal Plants. In writing up the results, we naturally drew conclusions. We did not, however, publish our data immediately. Because of the results obtained, during the third year of the investigation, we were obliged to strike out our generalization upon each and every variety that we had studied.

This is not very encouraging. We are now starting work along the line of plant breeding, and if we can continue this for five or ten years we may secure some results. That is the character of the work that has to be done.

One feature that possibly needs emphasis in connection with drug cultivation should be mentioned. As a simple illustration, let me again use stramonium, will suffice. When the Pharmacopœia of 1900 or 1904 went into effect, it called for 0.35 percent of alkaloidal content, if I am not mistaken. Soon complaints were received from drug jobbers and pharmaceutical manufacturers that stramonium of that strength was not obtainable in quantity. Stramonium was then put down to 0.25 percent alkaloidal content. Any ignorant drug-collector can get stramonium that will come up to this requirement.

What we should have done was to have established a proper standard and have adhered to it, but we should also have given the market sufficient time to adjust itself to the new requirement.

Again, I suppose, it is too late now. After ten years nothing has been done. If we revised the Pharmacopœia as it ought to be revised, we would insist on the right standard after having given people an opportunity to raise stramonium. We can raise, without trouble, stramonium on good garden soil, and we can raise it on poor agricultural soil with 0:35 percent alkaloidal content. But, as long as the Pharmacopœia calls for 0.25 percent, there is no use trying to raise stramonium with 0.35 percent.

The people down south can go and collect a handful of stramonium and take it to the corner-grocery and get their pipe of tobacco, or bottle of whiskey for it. That is the way drugs are frequently collected. As Dr. Stockberger has remarked, our "crude drugs" are frequently exceedingly crude.

I do not want to take up too much of your time, but I might say a word about the present war-situation. I am not a believer in war, and I do not know that there is any justification for the war. But if we had had warning that this war was coming, and known the result, we might have produced sufficient thymol for the United States in northwestern Wisconsin. However, it is too late now.

Monarda punctata grows freely in the sandy areas along the lower course of the Wisconsin river. This plant yields from one-half to one percent of volatile oil, fifty percent of which is thymol. Whereas the related species, *Monarda fistulosa,* grows abundantly on heavier soil, it seems difficult to propagate the former species in the heavier soils of our gardens or farms. Nevertheless *M. punctata* may be improved by cultivation on poor sandy soils. Thus it has been shown that a straggling wild plant, when transplanted and cultivated, is greatly improved. The former may be a foot or two high, with a few straggling branches six inches long. After cultivation in the same soil, this same plant could not be covered by a bushel basket.

In connection with this plant, a few observations have been made that throw some light on the attitude of animals toward plants. Both *Monarda fistulosa* and *M. punctata* grow wild in the meadows, but neither is touched by grazing cattle. However, if the oil, which, as already stated, contains fifty percent of phenols, is removed by distillation, cattle and sheep will feed on the exhausted material. During a summer that produced a scarcity of hay, such exhausted *Monarda* was sold for the price of hay.

Man's relation to the genus *Monarda* is very similar. Thus *Monarda didyma* has long been used as a substitute for tea but not the botanically related *punctata* or *fistulosa.* Whereas the latter contain a fair amount of volatile oil, fifty percent of which consists of phenols, the former contains but a trace of oil, none of which is phenolic in character.

The behavior of cattle toward wormwood is quite parallel. In some of the wormwood fields, cattle are used, up to a certain stage in the development of the plant, for weeding. They will keep down the grass without eating the wormwood. However, after the oil has been removed by distillation, the exhausted herb is eaten by the animals. Hence, wormwood culture and cattle raising have developed hand in hand.

No doubt, there are a number of medicinal plants that might be cultivated advantageously. However, we must not play with the standards, as we have done in the case of stramonium. Moreover, we must learn much more about the cultural conditions, as illustrated by the monardas, plants so well known in the wild condition, but which we have not yet mastered for economical purposes in garden and field.

ACTION OF PEPSIN AND TRYPSIN ON ONE ANOTHER.

Excess of trypsin inhibits the digestive action of pepsin in acid solutions, and excess of pepsin hinders the digestive action of trypsin in alkaline media. In both cases the inhibition is directly proportional to the amounts of the enzymes present.—E. S. Edie (Biochem. J., Chem. Abstr. Amer. Chem. Soc., 1914, 8, 2399).