

Ruellia, but further mention of them is unnecessary since good descriptions of the anatomy of all three plants are readily available in the literature.¹

An effort was made to trace the source which supplied this new substitute, but aside from the mere statement that a large shipment from Kentucky had reached the crude drug markets of the East, nothing was learned. It is probable, however, that more of this root will be collected and marketed and it may be possible eventually to determine the exact locality in which it is being collected.

It is an open question whether the wholesale adulteration of pinkroot which has been so much in evidence during recent years is due to carelessness, ignorance or cupidity on the part of the collectors. Manufacturers using this drug certainly can not afford to jeopardize the purity of their preparations by using the false or adulterated pinkroot, and a concerted effort to drive the spurious drug out of the markets is highly desirable.

Some definite results might follow if the large dealers in pinkroot were to furnish to local buyers for distribution among collectors, a leaflet containing a good picture of the spigelia plant and a warning against the unsatisfactory methods of collection so frequently pursued.

THE COMMERCIAL POSSIBILITIES IN GROWING MEDICINAL PLANTS.

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The commercial possibilities in growing medicinal plants are now recognized by the governments of England, Austria and the United States. The International Congress of Applied Chemistry, a society whose able efforts toward industrial development are now universally recognized, is taking active steps in the investigation of drug plant cultivation through an international committee. Universities, private institutions, and individuals have been induced to broaden their field of investigations to include medicinal plants.

From scattered, disconnected and poorly planned investigations of a minor character this work is gradually being organized with a determination that insures success. The dignity with which this movement is now being advanced removes all chances for doubt as to the practical value of drug growing. The success of such an undertaking will of necessity depend upon the commercial possibilities presented. The work in the United States has now reached a stage where these possibilities must be carefully considered.

The early history and evolution of the cultivation of medicinal plants within the U. S. and other countries has been treated elsewhere in an able manner by several authorities and need not be repeated here. It might be well to add, however, that most of the early work on drug growing was not exhaustive. It gave

¹Holm, Th., Medicinal Plants of North America, No. 5. *Cunila Mariana* L. Merck's Report, vol. 16, pp. 188-189, 1907.

Stockberger, W. W., Pinkroot and Its Substitutes, *Pharmaceutical Review*, vol. 25, pp. 2-21, 33-47, 66-84, 97-107, 1907.

Mansfield, W. M. *Ruellia* as a *Spigelia* Substitute. *Druggists Circular*, vol. 53, pp. 110-114. 1909.

us little in the way of methods and in the behavior of medicinal plants under varied conditions. With the exception of a few forms such as cinchona, coca, and opium, little was accomplished upon commercial productions and improvement. Of greater value to the progress of this work would be a careful interpretation of the progressive stages through which some of the valuable economic plants have passed in being brought to their present high state of development. Some of them are as old in cultivation as history itself. Still they are subject to improvement and, rich as some of them are in established varieties, other more valuable ones are being discovered and isolated which surpass their parents in many characteristics. Instead of attempting to solve the more practical phases of the question of drug growing as has been done in modern agriculture we have been busy suggesting long cumbersome lists of probable forms for cultivation and repeating antiquated methods of collecting, curing and packing which are of little practical value and have been handed down from early generations rather than evolved from actual investigations. The methods used have been in opposition to the principles of agriculture. No improved varieties of known cultural requirements were at hand and little effort has been made to produce them. The behavior of active principles under varied soil and climate conditions are imperfectly understood. Supplies of authentic seeds and plants of the more valuable forms are either unknown or extremely rare. And finally the greater number of requests for information upon the commercial possibilities of drug cultivation are from people not versed in the requirements of crude drugs. Not only are they deficient in this respect but they usually have a false impression as to the profits to be derived from such an undertaking. It is in this respect that the greatest care must be exercised in order that the interest now aroused may not be lost through an exaggeration of commercial possibilities. This has already been done to a certain extent and a portion of the recent literature dealing with this phase of drug growing invites discussion and some friendly criticism. The time is now current for the accumulation of practical data and its circulation under the most conservative and carefully guarded statements. There is a demand for information bearing directly upon immediate possibilities in drug growing. This demand should be met by information based upon actual practice and not upon theory and supposition. If this is impossible then a clear confession of our ignorance upon the subject should be in order.

The unfortunate error of one investigator in calculating the productivity of digitalis should serve as a caution to all those engaged in experimental drug growing. The estimated return of 4,606 dollars per acre was sufficiently attractive to engage the immediate attention of the daily press and of prominent trade journals. It created no little feeling and enthusiasm among florists by appearing in one of their most popular journals. This publication is noted for its practical information upon plant culture and is read almost exclusively by commercial growers. In view of the difficulties to be overcome in establishing drug growing it is unfortunate that information of this kind should find its way to practical men. The yield of 100 pounds produced upon 1,120 square feet as given by Prof. Newcomb does not differ greatly from that obtained by myself which was 101 pounds upon 1,089 square feet for *Digitalis gloxinoides*. This form is probably one of the heaviest producers of the purpurea strains and would not be repre-

sentative for the official purpurea. The yield of 101 pounds was also obtained from 80 percent of the maximum number of plants which could be accommodated upon this size plot. This is probably a more nearly perfect stand than could be obtained upon a large scale where an acre or more was involved. That it would not be safe to calculate even the yield alone upon a basis of the above figures is indicated by the fact that only 288 pounds were obtained from one-fourth acre planted with a mixture of several varieties of the purpurea strains.

Kraemer in his fourth edition of *Botany and Pharmacognosy* includes a brief chapter of thirteen pages upon the cultivation of medicinal plants. However brief this chapter may appear there are over seven pages of the thirteen which are devoted strictly to plant names, both common and technical and including probably three hundred different species. The practical value of the publication of such a list in a general chapter upon drug cultivation is in doubt when we consider the very questionable virtue of many of the drugs mentioned. The great majority of these lesser important and questionable drugs are not only still abundant in the wild state but are marketed at extremely low prices and are used by pharmaceutical manufacturers in very small amounts. These conditions together with the growing tendency of the medical profession to reduce the number of drugs used would seem to justify the elimination of many of them from publications supposed to serve a practical purpose. It is said that the average practitioner will use less than twenty vegetable drugs. A few who may be called exceptions and those not of the modern school of medicine may use as many as thirty or forty. Even this liberal figure, however, would not seem to demand a list of three hundred or more as a matter of choice. In number alone such lists as those of Kraemer and of Schneider in "*Pharmaceutical Plants and Their Culture*" might serve to suppress, rather than arouse interest in drug growing. They not only seem discouraging in this respect but are also confusing and impractical. In "*Pharmaceutical Plants and Their Culture*," page 10, the author states that there is no plausible reason why such common but nevertheless very desirable drugs as taraxacum, chicory, mallow, burdock, horehound, milk weed, sambucus, stramonium, rosemary, and many others, should not be very profitably cultivated on a large scale. If cultivated upon a large scale and at the same time profitably these drugs must be held in considerable demand by pharmaceutical manufacturers. This condition certainly does not exist for more than two or three and probably not for more than one of the forms mentioned. Little difficulty has been experienced during the past years in obtaining sufficient quantities of such drugs at very moderate prices. The same is true for a large number of plants mentioned in the latter part of the same publication. This is given up to brief notes upon eight hundred and sixty-nine forms, classified as medicinal and poisonous. It is believed that for all practical purposes at least eight hundred of these forms might well be omitted.

Turning to another phase of the situation it has been found that doubtful comparisons have been made of American grown and foreign drugs. Some of these comparisons have been decidedly too liberal in certain important instances. The production of *Cannabis Indica* in the United States furnishes an example. The advancing price of the foreign drug has made it desirable that the United States produce its own supply. This appeared to be one of the easiest problems in drug

growing, especially in view of the statements of several authorities. These statements are to the effect that American grown cannabis is equally as active physiologically as the imported drug. These broad statements together with requests for the home grown drug have undoubtedly had a stimulating effect upon its production. Few cultural difficulties were encountered and consequently many samples of the drug soon found their way from one part of the country to another. An examination of many of these samples has failed to substantiate the statements of the above authorities. In many instances the samples were also very inferior from a physical standpoint. Samples of this drug produced by the United States Department of Agriculture in South Carolina which so far seem to represent the best American grown product, have tested 75 percent as active as good imported drug. Drug produced in Indiana from foreign seed does not test over 65 percent when compared with the drug from which the seeds were taken and some test as low as 40 percent. In view of this situation it does not seem fair to commercial interests to recommend at this time the raising of this drug upon a large scale. It has also been found that belladonna varies greatly in percentage of alkaloids when grown in this country, and it is very probable that many sections of the country will not be suitable for its commercial production. The possibility of using the entire herb instead of the leaves in an effort to simplify its commercial production may be questionable in view of the great difference in the alkaloidal content of these parts. Samples taken from the same plot assayed as follows: leaves 0.445 percent, leaves and stems 0.300 percent, stems 0.065 percent.

Information in the form of cultural directions may also be made too general. As late as May 10th a request was received for information upon the planting of one acre of digitalis. The impression had been gained that this drug could be started by open field sowing on or about this date. Such cultural directions for digitalis have been published from reliable sources upon two occasions and may or may not have been responsible for this impression. However, it should be generally recognized among investigators that digitalis is not a plant that can be propagated upon a large scale by this method. The same may be said of henbane a drug that is probably in greater need of cultivation and improvement than any other. Immediate results would be very desirable at this time when the quality of the imported supply is extremely poor and the botanical source of the drug is questionable. Repeated failures with the commercial production of this drug have been experienced in England and still the technical difficulties of its cultivation have not been overcome. Such instructions as those of Turner, *Pharmaceutical Journal*, 86, 390, to the effect that henbane is not difficult to grow where the grower has a knowledge of general agriculture and Farwell, *Bulletin of Pharmacy*, 19, 258, that belladonna, henbane, digitalis and aconite can be grown as easily as a field of potatoes are somewhat too general for application. The cultivation of henbane in this country upon an experimental scale has resulted in such complete failure that efforts to continue its investigation have been almost abandoned. I do not agree with Schneider that from a cultural standpoint it can be associated with stramonium, cannabis, tobacco, and belladonna or that to make the culture profitable, only the flowering herb must be used. In the first place the culture of stramonium, cannabis and tobacco are ex-

tremely simple and the propagation of belladonna now fairly well developed. Much difficulty has been experienced, however, in the seeding and transplanting of henbane and in the elimination of insects from the growing plants. In the second place it is extremely doubtful whether any biennial forms can be grown profitably in this country if the second year product is demanded. In my estimation such a demand cannot be based upon strictly economic and scientific principles. The henbane situation for the past three years has demonstrated that conditions may arise which will make it not only advisable but probably necessary to pursue a vigorous search for pharmacopœial substitutes. I have demonstrated repeatedly that much of the commercial henbane is not from *Hyoscyamus niger* of the second year's growth and further-more first year leaves of biennial henbane have been tested which yielded 0.089 percent of alkaloids. This figure is only suggestive but should be an incentive to further investigations upon the production of an annual crop of this drug. As yet however, the uncertainty of the plant under cultivation does not warrant an attempt at commercial productions. The experimental stage has not been passed, and so long as this condition exists little can be said for prospective growers in the nature of direct and specific recommendations.

The foregoing conditions apply not only to henbane but in my estimation to most of the important drug plants now under investigation within the United States. The mere fact that a form is grown experimentally or for garden or decorative purposes does not signify that it can be produced successfully upon a commercial scale. The production of a few specimen plants does not involve field conditions and is no indication of the ease and rapidity with which the same form may be grown commercially. Commercial possibilities have been suggested upon these grounds and the much talked of "profit in weeds" has resulted in more talk than profit. It is now time to reduce the work on drug cultivation to an exact science, and to determine the commercial possibilities of the most promising forms in the same manner as has been done for agricultural and other economic forms. When this has been accomplished there will be ample time for recommendations to practical growers. Until then all inquiries should be met with a clear statement of the uncertainty of immediate commercial possibilities together with an idea of the exacting nature of the requirements for the various classes of medicinal plants.

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A BIBLIOGRAPHY OF THE DETERIORATION OF DRUGS AND PHARMACEUTICAL PRODUCTS.

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The term deterioration is here restricted to the decrease of therapeutic value by decomposition or loss of active constituents. It is only in recent years that the matter of the deterioration of drugs and their preparations has received any considerable attention. At least practically all of the systematic work on the subject is of comparatively recent date. The older results were mostly inci-