

Scientific Section

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THE FIELD FOR DRUG-PLANT BREEDING.

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In the decade which has just passed great advances have been made in the knowledge of breeding, and during the same period the practical service which breeding has rendered in the field of plant production has come to be very generally recognized and appreciated. The art of the plant breeder has now been exercised upon a large number of the plants from which materials for food or clothing are obtained or which serve for ornamental and decorative purposes, and as a result the number of new or improved varieties and strains of useful plants has been enormously increased.

In the face of all this progress the fact that, with a few notable exceptions, our medicinal plants have been almost entirely neglected by plant breeders seems to deserve an explanation. A brief statement, therefore, of the probable causes of delay in the inclusion of medicinal plants among the subjects of the plant breeder's art, and of the possibilities which the exploitation of this field seems to offer may be of more than passing interest to pharmacists generally.

Although the term breeding has become very familiar in recent years, a brief statement of the sense in which it is used in this discussion may contribute somewhat to clearness. The improvement of a plant, the object of which is to render it more serviceable to the purposes of man, may be effected by continually selecting for propagation such plants as conform most closely to the ideal sought, by the selection of spontaneous variations or sports, by the isolation and live breeding of forms presenting morphological variations, by the breeding of the so-called ever-sporting varieties, and by hybridization. Other methods of procedure might be mentioned but those just named will serve to indicate some of the various avenues through which the problem of plant improvement may be approached, and to gage the wide sense in which breeding is used in this paper in contrast to a narrow usage occasionally encountered which restricts the term to changes produced in plants as a result of sexual reproduction.

It was long since recognized that the medicinal qualities of plants are easily affected by culture, but practical breeders have been very slow to avail themselves of this knowledge. There can be little doubt that this failure to grasp the opportunity presented was largely due to the fact that the criteria of progress in medicinal plant breeding are of an order almost entirely unlike that which

includes the standards of fitness commonly employed by plant breeders. Such standards are usually based upon characteristics which are readily perceived by the senses, e. g., form, size, color, odor, agreeableness to the taste; or by those which are readily estimated by simple physical means, e. g., weight of yield, strength of fiber, hardness of grain; or again by those characteristics estimated by comparison, e. g., hardness, resistance to disease, drought, etc. On the other hand, the characteristics which the breeder of medicinal plants must use as his main guide can be determined only through the use of the technique and methods of the pharmaceutical chemist or of the pharmacologist. Probably few, if any, of the practical breeders have either the inclination or necessary skill for the estimation of the active principles which condition the value of medicinal plants, and the natural result is that their activities are directed along other lines.

A second cause for the small consideration given to medicinal plant breeding may be found in the disparity which exists between cultivated drug plants and many other economic plants with respect to their importance as marketable products. It is but natural that plants which have long been widely cultivated or which possess great commercial possibilities should be among the first to attract attention to the desirability of their improvement.

A third but by no means unimportant consideration is the relatively imperfect state of our knowledge with respect to the essential facts concerning the cultural requirements of many drug plants and the prevailing uncertainty as to the possible modifications in the nature or quantity of the active constituents of these plants which may be induced by variations in soil, climate or other environmental factors.

It may be well at this point to disavow any intent in the foregoing paragraphs to disparage in any way the very creditable work that has been done in recent years along the line of drug plant breeding, or to disregard the fact that the cultivation of a small number of drug plants has been successfully carried on in several localities in this country. On the contrary the object has been to show that as a whole medicinal plant breeding is as yet largely an untried field.

In this as in other new fields of endeavor it is advisable to heed the homely proverb, "make haste slowly," and misguided enthusiasm must not be mistaken for ability to produce practical results. The practical breeder will hesitate long before undertaking a line of work which may require years of time and the outlay of thousands of dollars to bring it to completion. First of all he will seek to establish an *ideal*, a clear cut mental picture of the end to be attained. This ideal will be a composite built up from a definite understanding of what is required, and from a thorough knowledge of the relationships and the morphological and physiological characteristics of the species which he is seeking to improve. The formation of these ideals must be preceded by a period of experimentation and study in order that the breeder may become familiar with the nature, requirements, adaptability and behavior of the plants in question. This preliminary course is all the more necessary since many of the medicinal plants upon which the breeder must work have been brought to this country from foreign lands, and many more which are indigenous here must be brought under cultivation in the course of which they may be expected to undergo certain modifications.

In the opinion of the writer the constructive work of the immediate future in the field of drug plant breeding will consist largely in extending our knowledge of the chemical constituents of these plants, in determining the relative value and relationship of their various characteristics and in fixing standards of breeding which will lead to definite economic results. Then as pharmaceutical chemistry leads the way and gives us further information concerning the nature of the active principles, there is every reason to believe that the selection of different pure lines of superior potency and their subsequent hybridization will result in the attainment of standards of production far in advance of those to which we are accustomed.

The work of the Bureau of Plant Industry on medicinal plant breeding was inaugurated by Dr. R. H. True, formerly Physiologist in Charge of Drug Plant Investigations. That he early recognized the necessity for a thorough preliminary study of the materials later to be used in breeding is evident from a paper prepared by him in 1906, in which with reference to breeding drug plants he says, "The pioneer work of finding out the necessary preliminary facts concerning culture methods and the demands made on soil and climate is only now being done. As soon as these fundamental conditions are fairly well understood, the cultivator will be in a position to refine and increase his product by the application of new methods." In harmony with the principle here expressed, the work has since been consistently carried on and in the Office of Drug Plant Investigations two correlated lines of work are now in progress, one a series of laboratory studies on the quantitative variation of the active constituents in a number of plants, and the other a series of comparative cultural tests conducted in widely separated localities.

The character of the laboratory investigations is well illustrated by the paper by Mr. A. F. Sievers, entitled, "Individual Variation in Belladonna Plants as a Basis for Improvement by Selection," and by that of Mr. Frank Rabak entitled, "The Effect of Geographical Source on the Volatile Oil of Hops," both of which have just been presented for your consideration. The cultural tests carried on at the several field stations have for a common object the determination of the fitness of a large number of drug plants for the conditions offered by each locality, a study of the possibility of bringing under cultivation various wild plants yielding important drugs, the selection of strains or individuals which promise to serve as valuable material for the further purposes of breeding, and the acquiring of data relative to the localities of situations offering the most favorable economic conditions for the commercial production of certain medicinal plants.

At Madison, Wisconsin, where the Office of Drug Plant Investigations is conducting its investigations in co-operation with the University of Wisconsin, there are now under observation approximately forty-five species of which belladonna, henbane, stramonium, a number of the mints, cannabis and grindelia may be mentioned. At the two stations located near Washington the number of species being studied is much larger. Here some solanaceous species and others yielding valuable essential oils are receiving special attention. A study of the perfume roses is also in progress, the purpose of which is to select and improve the varieties best suited for the production of oil of rose in this country.

At Timmons ville, S. C., the work is largely concerned with cannabis, species of capsicum and a few oil bearing plants. In Florida, where the station is at present located at Orange City, we find one of the most interesting parts of our field. Here the opportunity for the selection and improvement of plants yielding essential oils is very promising and the data so far secured with respect to camphor, monarda, rose geranium, lemon grass, citronella grass, and a number of other species clearly show that further important results will be obtained by continuing the present line of investigations. For example, strains of *Monarda punctata* have been developed by selection which give an unusually high yield of an oil containing the valuable constituent thymol. We are now seeking to increase the percentage of thymol in the oil through suitable modifications in the conditions of growth of this plant.

To extend this discussion further would perhaps be a presumption upon privilege but if the remarks just made on the work of the Office of Drug Plant Investigations have suggested something of the scope of the field of Drug Plant Breeding, the purpose of this paper is fulfilled. It may be permitted to say in closing that the breeding of medicinal plants not only offers much in a very practical way but also affords a field for the greatest scientific activity.

THE PAPAIN OF COMMERCE.

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Much has been said and written about papain, yet much more needs to be said and written about it before its adulteration can be stopped, and before it will be possible for it to occupy the place in our materia medica that it should.

Papaw—*carica papaya*—is a tree cultivated in southern Florida, tropical America, and in all tropical countries. It is supposed that the parent trees from which the present cultivated forms were derived originally grew wild in the West Indies. In proof of this, it is definitely known that the papaw tree was not known in India and other tropical countries before the discovery of America. Under favorable conditions a tree grows to a height of twenty feet. The unbranched trunk is light green and smooth, except for the leaf scars. The leaves are light green above, paler beneath, five to seven lobed, the lobes again divided into smaller lobes; the petioles of the leaves are frequently 1.5 dm. long. The leaves occur in greatest numbers at the top of the stem where they stand nearly erect. The older, larger leaves droop and finally fall away as the trunk increases in length. There are three types of flowers borne on as many different trees. The fragrant staminate flowers are in slender panicles, one to three dm. long; the calyx 1.5 mm. long; the corolla is saucer shaped, 3 cm. long; the slender tube is dilated at or near the top. The lanceolate lobes of the corolla are shorter than the tube. The ovary, if present, is rudimentary and no stigma is developed. The pistillate flowers occur singly or in groups of two or three. The calyx is about 5 mm. long and does not fall off after fertilization. The lanceolate petals stand erect to a height of 2.5 cm. The egg-shaped ovary is bluntly five-angled. The perfect flowers are bell-shaped, the lobes standing erect.