The Open Court

A MONTHLY MAGAZINE

Devoted to the Science of Religion, the Religion of Science, and the Extension of the Religious Parliament Idea

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THE HOME OF THE CAVE MAN.

BY W. KRANZ.

Frontispiece to The Open Court.

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BURBANK'S PRODUCTION OF HORTICULTURAL NOVELTIES.

BY HUGO DE VRIES.

THE commercial catalogues of the horticulturists contain, yearly, a certain number of novelties. Some of these are introduced from foreign countries, others are due to accidental sports, but many are the results of artificial improvements. They are produced either by nurserymen or by private persons who charge the seedsmen with their sale. As a rule, this production of novelties is a subordinate matter. It is very rare to find a man who devotes his whole life and all his energies to the introduction and production of new, beautiful or useful, horticultural plants.

Such a man is Luther Burbank of Santa Rosa in California. He is a nurseryman, but has no nursery in the ordinary sense of the word. He is a tradesman, but sells nothing besides his novelties, and these only to other dealers who will multiply them and offer them to the general public. His aim is not the accumulation of wealth, but to contribute to the welfare of other men by giving them better food, better fruits and more beautiful flowers. He is especially interested in the production of cheap ornamental plants for private gardens, in order to disperse their enjoyment as widely as possible. He is not engaged in pure scientific research, but of late he has consented to have his methods and cultures published, that they may become a guide for other men in their work along the same line. The Carnegie Institution of Washington has accorded him an annual grant of $10,000 for ten years, thus enabling him to extend his cultures on as large a scale as is possible for the work of one man. Moreover, the Institution will take in hand the recording of the history of his experiments and thus create a source

of practical and scientific information of the highest importance upon many questions of plant-breeding.

Such a standard work is the more needed, since the methods and results of European horticulturists are, as a rule, accessible to American breeders only with difficulty. Burbank has had to rediscover many of the rules and practices which in Europe were more or less universally known. His science and methods are his own work, although in comparison with those of other horticulturists they do not contain essentially different procedures. It is a most

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interesting study to go into the details of such a comparison, especially since, by the same principles, he has obtained such striking new results. If his work does not enlarge our knowledge of the general rules, as it is not intended to do, it at least provides us with such numerous illustrations that a description of his experiments, even if but brief and incomplete, may be considered as a review of almost the whole field of horticultural plant-breeding.

From this point of view I shall now give a survey of Burbank's

* Dr. Geo. H. Shull is one of the two men appointed by the Carnegie Institution to watch Burbank's work and record the results.

work. In doing so it is not my aim to recommend his fruits or his flowers. They recommend themselves, and their world-wide appreciation gives the best proof of their high value. I am concerned only with the methodological side of the work and my aim is to describe such details as will best contribute to the establishment of the full agreement of Burbank's experience with the agricultural methods of Nilsson on the one side, and with the latest results of biological investigation on the other.

Luther Burbank was born March 7, 1849, in Lancaster, Mass. His father was of English and his mother of Scotch ancestry. He was reared on a New England farm and indulged in the breeding of American grapes and of new potatoes, which was quite a common pursuit in Massachusetts about the year 1873. He succeeded in raising some new varieties of potatoes in that year, multiplied them during the two succeeding summers and offered them for sale to the well-known seedsmen Messrs. J. J. H. Gregory & Son at Marblehead, Mass. They selected one variety among the three he had offered and paid him $125 for it. This happened in the summer of 1875, and in September of the same year Burbank left Massachusetts and settled at Santa Rosa, California, partly on account of his health, partly on account of the bright prospects which the climate of that part of California offered him for his most beloved occupation, the improvement of plants. For at Santa Rosa almost all the garden plants which require greenhouses in the Eastern States, can be cultivated in the open, and therefore on a much larger, or even on an almost unlimited scale. As an instance I mention the Amaryllis.

In the beginning, Burbank rented a small nursery near Santa Rosa and cultivated market flowers and small fruits, but had to look for work on other farms also, in order to gain money enough for maintenance. It was only after thirteen years, in 1888, that he had saved enough to buy his present farm. Here he organized a large nursery and soon accumulated a small capital which enabled him to sell out his business, in the year 1890, and devote his whole life to the introduction and production of novelties. Three years afterward (1893) he published his first catalogue on *New Creations in Fruits and Flowers,* which gained for him a world-wide reputation and brought him into connection with almost all the larger horticultural firms of the whole world.

In 1905 he accepted the Carnegie grant and was appointed an honorary lecturer on plant-breeding at the Leland Stanford Junior University. Here he delivered two lectures a year before a score

of advanced students and professors, illustrating his new creations by means of specimens and photographs and explaining the experiments by which they were won.

In the meantime, the potato which he sold to Messrs. Gregory had proved to be a great success. It had rapidly increased in importance and supplanted many of the older cultures. According to an official statement of the United States Department of Agriculture at Washington made a few years ago, this Burbank potato is adding to the agricultural productivity of the country an annual amount of $17,000,000. In the Eastern States it is cultivated alongside with other varieties and is often indicated by local names instead of Burbank's name. But along the Pacific coast, from Alaska to Mexico, it is now the standard of excellence among potatoes. In fact, it is almost the only variety cultivated in California, where the culture of potatoes for cattle-feeding or for factories is of hardly any importance. Its tubers are of a large and (what is more important) almost uniform size.

The evidence which is set forth in this discussion I gathered mainly during my visits to the Santa Rosa and Sebastopol farms of Burbank, where he was so kind as to explain his cultures to me and to answer all my questions about them. I visited him twice during the summer of 1904 and had the privilege of a four-days' intercourse with him in July 1906. Of course, I had prepared myself for these visits by studying the magazine articles on his work published during the last few years, among which those of E. J. Wickson in *Sunset Magazine* may be cited as the most complete and the most reliable. Wherever possible, however, I submitted the statements once more to my host, asking him such questions about them as would meet the doubts which might offer themselves from the standpoint of a biologist. As a rule, the answers covered my wishes and led to the conclusion that notwithstanding the widely divergent, and on some points quite opposite methods, the main results of practice and science are the same.

In order to understand the kind of evidence which will be discussed here, it is necessary to have a clear idea of what a visitor can see on the farms. As soon as Mr. Burbank has originated a new kind of useful or ornamental tree, flower, fruit or vegetable, he sells it to one of the great seedsmen, florists and nurserymen with whom he is in constant relationship. They take the whole stock, multiply it and offer it to the trade. They buy the exclusive right of selling the new variety, and nothing of it is left on the farms of Burbank. Hence it follows that a visitor cannot expect to have

a survey of the achievements that have already been made. There is no collection of these in living condition. One may study the commercial catalogues of Burbank or inspect his numerous photographs but the perfected varieties themselves are no longer there.

On the other hand, the visitor to the experiment-farms will become acquainted with the novelties destined for the immediate future. Burbank will explain to him his aim and his hopes as well as the methods by which he expects to fulfil them. The future, however, is uncertain, and the real value of a novelty can be judged only after some years have elapsed after its introduction into general culture. The spineless cactus opens the brightest prospects for the cultivation of the arid deserts, but the trial to determine whether it will succeed under those unfavorable conditions and will reward the expenses of its cultivation must still be made. So it is in many other cases too. Burbank himself is the most exacting judge of his productions and insists that they shall stand all tests of culture and trade and shall survive exacting trials or perish.

From this discussion it may easily be seen that my evidence relies, for a large part, on experiments which are not yet finished and the ultimate result of which cannot yet be estimated. For the description of the methods used this is of no importance, and in many cases the older experiments with their practical results will have to be alluded to.

Burbank's first catalogue was published in 1893. It is now thirteen years old. The varieties described therein are, of course, older, but they are only a small number in comparison with his present stock. The larger part of his experiments are younger, and only a few of his pedigrees cover more than ten years, as, for instance, those of the plums.

A special feature of Burbank's work is the large scale on which his selections are made. It is evident that in a variety of mixed condition or in the offspring of a hybrid and even in ordinary fluctuating variability the chance of finding some widely divergent individual increases with the number of the plants. In some hundred specimens a valuable sport can hardly be expected, but among many thousands it may well occur. The result depends largely upon these great numbers. In one year he burned up sixty-five thousand two- and three-year old hybrid seedling berry bushes in one great bonfire and had fourteen others of similar size. He grafts his hybrid plums by the hundreds on the same old tree, and has hundreds of such trees, each covered with the most astonishing variety of foliage and fruit. Smaller species he sows in seed-boxes and selects

them before they are planted out, saving, perhaps, only one in thousands or ten thousands of seedlings. Thornless brambles, spineless cactus, improved sweet grasses (*Anthoxanthum odoratum*) and many others I saw in their wooden seed-boxes being selected in this way.

The same principle prevails in the selection of the species which are submitted to his treatment. Here, also, the result depends chiefly upon the numbers. He tries all kinds of berries and numerous species of flowering plants. Some of them soon prove to be promising and are chosen, others offer no prospects and are rejected. The total number of the species he has taken into his cultures, amounts to 2500. The list of the introductions of last year shows 500 species, mostly from South America and Australia. Formerly he often made excursions in order to collect the most beautiful wild flowers or the best berries of Northern California, but for several years he has had no time to spare for this work. He has two collectors who collect only for him, and many relatives who send valuable bulbs and seeds, from time to time. One of his collectors travels in Chile, the other in Australia, preferring the regions in which the climate corresponds best with that of Santa Rosa. The Australian plants are usually sent to him under their botanical names, the South American often without any names at all, only the date and locality of collection being indicated. This insufficiency of denomination is of no importance at all for the practical work, but often diminishes the scientific value of the experiment, as for example, in the case of the spineless cactus. The thornless species with which he crossed the edible varieties have been sent to him from Mexico and elsewhere without names and they have been eliminated from the cultures as soon as the required crosses had been made. Hence it is evident that a scientific pedigree of his now renowned spineless and edible cactus will always remain surrounded with doubt as to the initial ancestry.

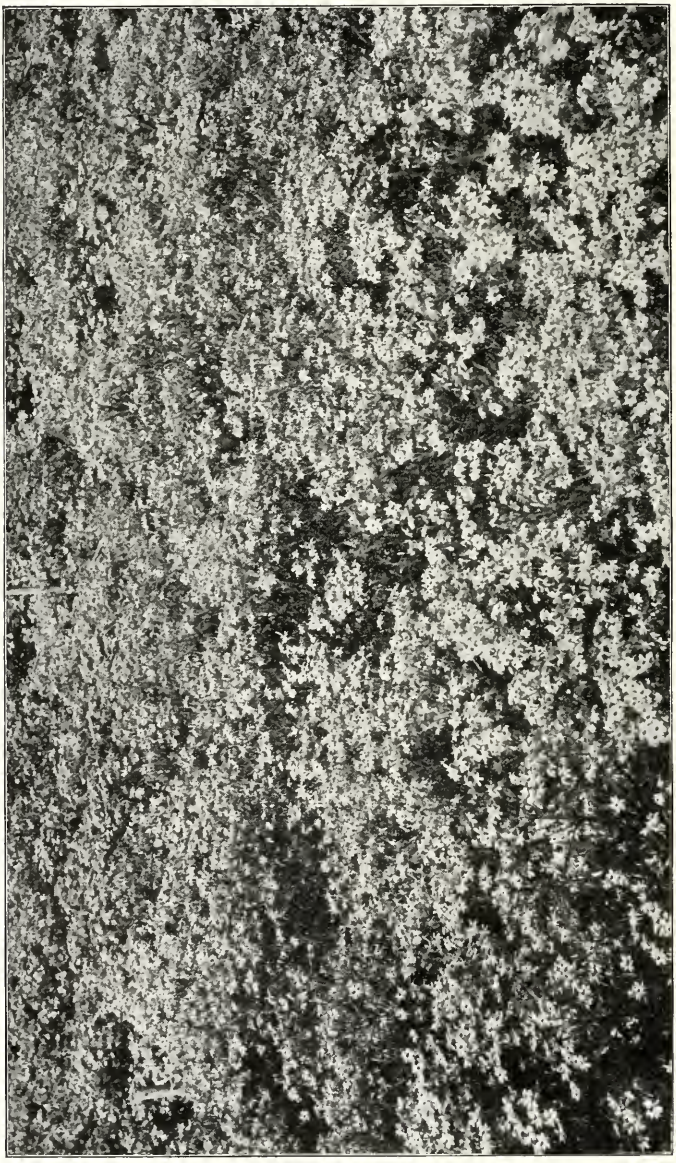
Besides his collectors in other countries and his correspondents widely scattered through the United States, he is constantly on the look-out for odd sorts of fruits or flowers, in order to combine them with the existing varieties. He procures seeds from the nurseries of all countries, from Europe and Japan as well as from America. He brings together, in each genus, as many species as possible before starting his crosses. Of Asclepias I noted about twenty species on a plot, of Brodiæa four, of Rhodanthe, Schizanthus and the fragrant Tobacco all the best and newest European varieties and hybrids. Many other instances will be given in the special descriptions. Among grasses he is now trying species of

Lolium, Stipa, Agrostis and Anthoxanthum, partly for forage and partly for lawns. Of evening primroses he had received a large flowered form of the creeping white *Oenothera albicaulis,* which he has now selected along with other small- and large-flowered yellow primroses. Many wild species afford deviations, which are ordinarily considered as monstrosities, but which in his hand may be improved to yield valuable ornamental plants. He showed me a beautiful yellow papaveraceous plant, the *Hunnemannia fumariæfolia* from Mexico, which in some specimens doubled its flowers on the outside instead of within, in the same way as some Gloxinias. Many other introduced deviations and hundreds of beautiful species I saw, but there is no reason for mentioning their names here. Very often a wild strain supplies some valuable quality or perhaps only the vigor of growth which fails in its cultivated allies. Many a weak race was made strong by this means.

Among the species and varieties introduced from foreign countries some proved to surpass the corresponding American forms without needing any improvement. In this way very valuable contributions to American fruit-culture have been secured. In the beginning of his work, a Japanese agent one day sent him some plum-pits. From these he grew two varieties which he has since introduced under the names of Burbank and Satsuma plums. The first of them was named for him by the United States pomologist at Washington. It was exceptionally suitable to American conditions and has justified its selection by its present wide distribution and economic value. The Satsuma plum is now commonly cultivated in California and is a most delicious preserve on account of its sweet flesh and small pits. The Burbank plum, on the other hand, is one of the best and most popular Japanese plums throughout all the United States; it is early and heavy bearing, free from insects and diseases, and a market fruit of large size and attractive color.

Other species needed only sowing on a large scale and a selection of the best individuals, and could then be introduced without artificial improvement. The common French prune, of which California has produced one hundred and fifty millions of dried produce in a year, is a small fruit and late in ripening, although it is rich in sugar. In order to enlarge the size and to change the time of ripening, Burbank sowed large numbers of seeds of this French prune d'Agen, grafted the seedlings on older trees in order to force them to yield their fruits soon and finally chose among the thousands of grafts, the type which is now known as the sugar prunes, a

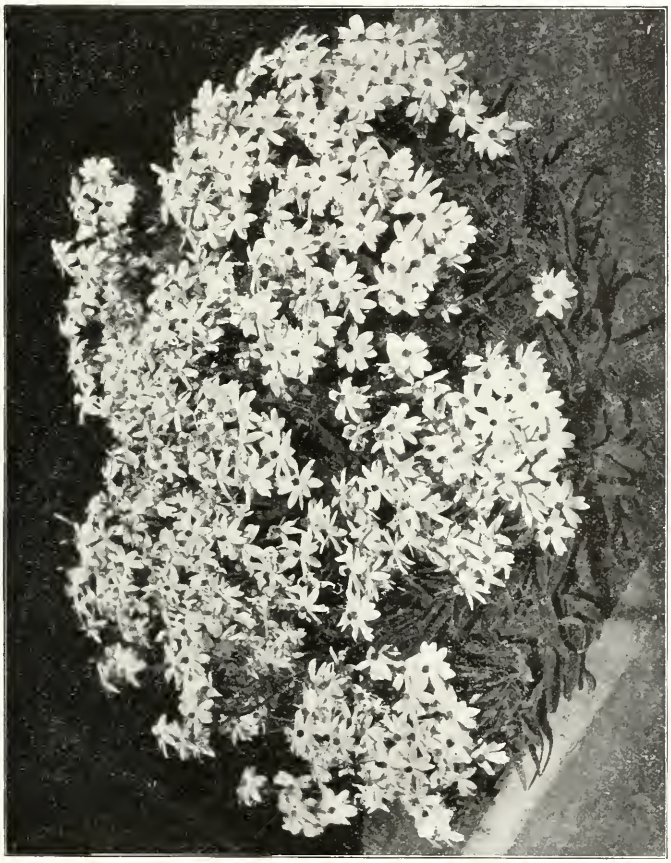
large fruit ripening a month earlier and prolific in bearing. In the same way, the crimson rhubarb, or Mammoth pie plant, was secured



4952 FIELD OF IMPROVED AUSTRALIAN STAR FLOWERS.

which is now grown on a large scale all around Los Angeles, whence it is shipped, during the winter months, to the markets of New

York. It is a continuous bearer throughout a large part of the year and has a peculiarly delicate flavor. It was sent to Santa Rosa by Messrs. D. Hay & Son, Nurserymen in Auckland, New Zealand, about 14 years ago. Burbank sowed the seeds on a large scale, and selected the best type for introduction as soon as he perceived its excellent qualities.



THE IMPROVED AUSTRALIAN EVERLASTING STAR FLOWER. 4951

Among flowers, the Australian star flower or Everlasting (*Cephalipterum Drummondii*) is now being introduced after only a few years of multiplication and selection. It is a composite, and its apparent flowers are in reality flower-heads, the bright red color of which is due to the bracts of their involucres as in other species of everlastings. It is recommended for millinery purposes and may supplant a large part of the trade in artificial flowers. I admired,

on each of my three visits, the large beds full of the shiny red flowers, and saw the selection of the largest and brightest specimens going on.

The main work of Burbank, however, consists in producing

AN ENORMOUS HYBRID FROM CALIFORNIAN AND NEW ENGLAND BLACK WALNUTS. 4954

new varieties by crossing. The aim of crossing is the combination of the desirable qualities of two or more species and varieties into one strain, and the elimination of the undesirable characters. In

the most simple cases this can be produced by one cross and without selection; but, ordinarily, many crosses and the production of a more or less chaotic progeny are required, and selection has to decide what is to live and what is to be rejected. It is a well-known fact, discovered by Koelreuter and Gärtner, and confirmed by numerous other scientific hybridologists, that hybrids often surpass both their parents in the vigor of their growth and the profuseness of their flowering. Taking advantage of this rule, in more than one instance, Burbank has produced hybrids of extreme capacities. The most astonishing instances are afforded by his hybrid walnuts. In the year 1891 he crossed the English walnut and the Californian black walnut and afterwards planted a row of them along the road before his residence. At the time of my first visit, six gigantic trees were seen growing. They had reached twice the height and size of ordinary walnut trees. Three of them he has since been compelled to cut down, because they increased too rapidly. This summer (1906) I saw the three remaining specimens, eighty feet in height and two feet in diameter. He showed me sections of the cut stems. Their wood was of a fine grain, very compact and of silky appearance. The annual layers measured 5 centimeters, a most extraordinary thickness. Fast growing trees are usually of soft grain, but these hybrid walnuts have a wood as hard as that of the ordinary species.

HYBRID FROM ENGLISH WALNUT AND CALIFORNIAN BLACK WALNUT.

By recrossing them the qualities of the wood have been still further improved, and selection in this direction produces a broad variety

of hard and soft, coarse and fine, plain and beautifully marked, straight and wavy grain. In driving me to his Sebastopol farm, he pointed out an enormous walnut tree in one of the gardens along the road. It far surpassed all the surrounding trees, though many of them were older. It is a hybrid between the native Californian black walnut and the New England black walnut. It is, next to the redwood and big trees, perhaps, the largest tree and fastest grower I ever saw.

Another tree which displays the vigor of hybrids is the Wickson plum. It is a little more than ten years since Burbank distributed the first grafts of this variety, and it was the first of his plums to make a deep impression on California fruit growers. It was produced by crossing the above-named Burbank plum with the Kelsey, both parents being varieties of the Japanese *Prunus triflora*. The flesh of the Burbank is red, that of the Kelsey being dull pink and green. The special merit of the breeder lies in the choice of the parents from which to produce his hybrid. The Wickson plum is, at present, most largely grown in California for shipping purposes on account of its high durability. It has the unique heart shape of the Kelsey but the flesh of the Burbank, a rich garnet and yellow color, a large size and a perfect shape. It is very juicy and delicious but its firm skin insures good shipping and keeping qualities. Its first sales in Chicago made the record for plum prices in the United States. It is widely distributed over the world, though somewhat less hardy than other varieties. It has the best qualities of both parents and in many respects surpasses both of them. It is one of the best illustrations of what can be obtained in a single crossing by a man who thoroughly knows all the qualities and characteristics of his trees and how to combine them, and who is guided by this knowledge in the choice of the parents for his cross.

It is exceedingly difficult to gain a correct idea of the influence which the introduction of such novelties can have over the horticulture of some definite country or state. The Burbank, Satsuma, sugar and Wickson plums are now largely cultivated in California as well as elsewhere. They have partially supplanted old varieties and have, also, been the means of increasing the acreage devoted to plum culture. But it is manifest that the change of varieties requires the regrafting of the orchards and cannot be performed at once. It often requires ten years or more to revolutionize an established and profitable industry on any large scale. It takes some years to prove the trustworthiness of the new sorts and to convince the fruit-growers of the desirability of the change. The

production of a new variety is one great step, but its introduction and distribution is another equally important one. The whole fruit-growing industry of California amounts to an aggregate value of about sixty millions of dollars annually, and of this sum hardly one per cent. is represented by the varieties imported or created by Burbank.

If we compare these figures with those given for the importance of the Burbank potato, we find a great difference. But for a fair appreciation we must realize that the Wickson plum is scarcely older than the ten years required for its first wide distribution and that most of the other hybrids created by Burbank are much younger. We must leave it to the future to decide what will be the real significance of the improvements in fruits and flowers, of which this one man has produced such an astonishing number of excellencies.