SINGLE-CHARACTER VS. TOUT-ENSEMBLE BREEDING IN GRAPES.

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INTRODUCTION.

In my work in breeding grapes and other fruits, the prime object was not to discover fundamental laws of inheritance *first* and then to practice those laws to get results, but, acting on the great universally accepted truth which is impressed upon us everywhere in organic nature—that each individual, each variety, each species, reproduces closely after its own kind, and yet is ever varying one way or another from the parent form—to proceed at once by selecting and combining parents embodying to the largest extent the characters desired, to attempt the production of offspring coming nearer to my ideals than either parent. As I proceeded, I kept close observation on results of uniting different mates with the mother, so that I soon found myself unconsciously searching for “laws” or methods of action under different circumstances. After all, that is all we mean by the term law in nature—*method of action under certain circumstances*. As the circumstances are infinitely variable so the “laws” are infinitely numerous, past fully finding out.

It would be just as reasonable to instruct a chess player to make every move according to laws of chess as for a breeder to require every new individual plant or animal to be bred according to the laws of heredity. The best move in a game of chess is the one that at that particular stage of the game goes farthest toward mating the opposing king and at the same time preventing the mating of the player’s king. This, it is true, is in itself a “law”—a very vague and general law—that every chess player, good or poor, observes to his best ability, but that which makes him win most games is skill to penetrate more deeply into the possible combinations within the next few moves ahead, and to pick out that move each time most favorable to his side of the game. The skill is mostly the product of two chief factors—first and most important, natural acuteness in observation and thinking; second, much experience in the play. So it is with the breeder.

Breeding, like chess-playing, is an art. Yet there is a science of chess, and a science of breeding—classified facts with reference thereto—the knowledge of which greatly aids anyone who engages

in it to become expert. This science comes from those who have gone before. Hence each expert owes it to the race to give his accumulated clearly demonstrated facts in classified order. The study of these facts sharpens the wits and aids much in developing the expert. The best and the proper time to study them is when we are putting them into practice.

The science of breeding with all its complexities is new and only partially developed, and there yet remain to be worked out many more or less general truths and a vast multitude of details before any complete work can be compiled on breeding.

In breeding, only specialists can accomplish the greatest good. The universal breeder is even less likely to accomplish permanent beneficial results than is the "Jack of all trades" to make great success in business.

The following statements are based on the writer's experience in the breeding of grapes.

To get form, or size, or flavor; to get persistence to pedicel, non-cracking skin, even ripening, or certain season of ripening; to get resistance to parasitic enemies, especially fungus and bacterial parasites; to get drought resistance, heat resistance, cold resistance, or resistance to excessive wet; to get productiveness and long life; in fact to get any desirable character in the seedling, it was quickly seen that such character must be found in the parentage somewhere. This is simply the first universal law of inheritance in different applications, and can be practiced by any "lunkhead" if dealing with only *one* characteristic, but in general-character breeding, the keenest wit is required to get desirable results.

SINGLE-CHARACTER BREEDING.

If a person should seek only to produce grapes with the largest possible berries, he would neglect all other characters and choose at first such parents as Black Hamburg, Union Village, Eaton, Red Giant, etc., and cross any two of them. Then from this progeny he would select the two largest and cross again, and so continue. But the breed would soon be so weakened by in-and-in breeding that it would require "new blood" to revive it, so he would be compelled to start with four or eight parents, uniting into four pairs, and then uniting the largest product of any one pair with the largest of any other pair, and the largest product of the other two pairs united with

these, and then select seeds, and plant from the self-pollenized largest variety produced for several generations from this conglomerate parentage, until the vines would no longer endure in-and-in breeding without becoming too weak in vitality. Then the product would in all probability be valueless. So it would be had any other one character been used. Although in this kind of breeding only one character was kept in view, yet the final product is worthless in every character but size. Fortunately there are few who tend to single-character breeding, and those few should learn better ways.

GENERAL-CHARACTER BREEDING.

Every breeder worthy of the name seeks a product containing as many of the desirable points as possible. It is in attempting this that the real fine art of breeding begins. It requires the combining, certainly, of parents containing as many good and as few of the undesirable points as can possibly be found. This calls for wide and accurate knowledge, not only of existing varieties but also of all their characteristics and adaptabilities.

The breeder soon learns that some pairs selected, for some reason which he cannot perceive, are uncongenial, as is the case between human beings sometimes, so that no desirable progeny results, while other pairs are extra good breeders. No "law" can help him here. He has to learn by actual test. This is expensive, but it cannot be avoided.

It is quite probable that no two parents can be found to contain all the points sought. This requires the second, third, fourth, or later generations to be produced, and then only a very few of the plants of each generation approach the ideal. Bad qualities perhaps, at first concealed as "recessives" (according to the Mendelian writings), crop out and must be eliminated. So the successful breeder must not only be a careful selector but a rigid rejector, and a perpetual keen-eyed, quick-witted student.

I do not mean to say that the breeder of grapes need not know and observe the general laws of breeding already discovered; on the contrary he must observe these consciously or unconsciously to obtain success above the ordinary method of planting indiscriminately gathered seed. Happily the general laws are so few and simple that almost every person of fair observing powers and ordinary information understands them.

The great general laws may be stated thus: Like purebred parents produce like, with slight modifications produced by environments; unlike combined produce, in the first generation, all degrees of variation between the two parents; the progeny of the unlike combination, if self-pollinated, produce three classes of progeny—one-fourth like one parent, one-fourth like the other, and one-half variable between the two unlike parents of the first generation. This is known as the Mendelian Law of Heredity. In grape breeding, little is gained by combining like purebreds, but combinations of the best unlikes may be continued until a decidedly more desirable form than before existed for the purpose is secured.

It is the conceiving of ideal varieties for different seasons, climates, soils, and purposes, and the finding of those already in existence which come nearest to the ideal, and of these the ones most congenial in crossing and hybridizing and that go farthest in combination toward reaching the ideal, that makes a progressive and successful breeder. Such a breeder, taking up a single class of fruits such as grapes, if he seeks to cover all the seasons of ripening, all soils and climates capable of yielding profitable results, and all uses of the fruit, undertakes a lifetime service in experimentation which largely curtails his ability to make money.

Fortunately such work is fascinating, and, if good business methods are used in marketing the products originated, it should yield a comfortable living. Such a life yields one satisfaction that a life devoted to money getting generally lacks—the knowledge that it leaves a great beneficial legacy to coming generations.

The planters of vineyards, especially, reap profit from such work; the consumers are regaled with finer colors and richer flavors than could be enjoyed without the originator's varieties, and the breeders that follow are greatly aided by his recorded experience, if this has been duly classified and published, hence he should be paid good prices for the best products of his breeding.

As we cannot hope to excel the best examples in nature as regards ability to survive the destructive influences of climate, disease, etc., we take these best examples as a basis on which to ingraft, by crossing and hybridizing, the desirable individual characters of color, size, quality, etc., found in other individuals. But it is a general rule that the varieties of fine quality—especially the property of sweetness—are more affected by climatic extremes and more subject

to fungus and insect attacks than the hardy stock selected for resistance, and thus we find ourselves ingrafting weakness, reducing the hardiness of constitution, to gain quality. The usual result is a product reduced in quality from the high-quality parent and lower in hardiness than the extra hardy foundation. But we find that some of the hybrid individuals have retained much more hardiness than others, and some much better quality than others, and a very few possess largely both hardiness and improved quality. We seize these as the prizes vouchsafed us for our labor, and cross and recross these better combinations among themselves, and with still other fresh blood, until we have arrived at a greater perfection than is possessed by the varieties in general cultivation; when we can truly say the originator has a product worthy to be placed on the market. To ascertain adaptability to season, soil, and climate is as much the work of the prospective planter as of the originator; for, if the originator attempts to test in all regions before selling, it costs more than ever returns to him. Experiment station tests, under restrictions, should do this work; but experience proves this usually a losing game to the originator. Probably the best the originator can do is to give several years' test in different soils and situations, entirely subject to his control in propagation, before naming or introducing. Then he must charge what seems a high price per plant and advertise extensively to get a meager return for what has cost him years of most skillful work. It is in the first three or four years after introducing only that the originator derives mentionable returns. None of the bad products must be put on sale, or the reputation of the breeder suffers at once, and it is doubly difficult to regain what is lost.

The greater the number of desirable characters sought to be embodied in a variety (and a single individual is equivalent to a variety in fruits to be propagated by cuttings, budding, layering, or grafting), the longer and more difficult becomes the work. The process may be continued interminably with gradual improvement, as we are entitled to infer by comparing the poorest with the best in nature and art, and finding there is room to add to the best; and this encourages us to forever aspire with confidence to a still better future in special breeding.

SOME SPECIAL OBSERVATIONS.

Some breeders of grapes have assumed that it is a "law" that the female parent transmits vine characteristics, while the male transmits fruit characteristics, in the vines produced by crossing or hybridizing. This, I find, is not a law of reproduction among grapes. For example, in a lot of hand-made hybrids between Rommel as mother, having a peculiarly flavored white grape and distinct vine and foliage, and Brilliant as pollen parent, having a red grape of distinct flavor and a vine different from that of Rommel, the resulting hybrids all had vines very closely resembling Brilliant, while all had berries much resembling Rommel in flavor, and in color they were very nearly the same—all white. The size and shape of clusters, however, were in all like Brilliant. In hybrids of America (black) with Delaware (as male), the vine is an even combination of the two parents, but the berries and clusters are much more like Delaware, being translucent red. The flavor is a fair combination of those of both parents. Many other examples I could mention prove that there is no such law among grapes.

It seems in many cases there is no telling beforehand which characters in the parents will be dominant and which recessive or evenly blended in the progeny. In some combinations, all the characters of one parent are dominant and, of course, all others recessive. This is true of *Vitis rotundifolia* (as female) when united with varieties of true bunch grapes, the Rotundifolia characters being dominant. A similar result generally follows when a species of a very uniform fixed set of characters is united with a species that is quite variable, and I think may be set down as a law among grapes, and may be stated thus: *Species of grapes very uniform in character when hybridized with species of very variable character give progeny with the characteristics of the uniform species dominant.* This I have determined with several pairs of species to the second generation.

[Presented by Committee on Breeding Tree and Vine Fruits]