

CHAPTER I

The Definition of a Potato Variety

A POTATO variety may arise in various ways, as described in the section dealing with the production of new varieties, but no matter how it may have been produced the fact must never be overlooked that a variety is in reality an individual and not a race.

A tuber is but a modified leaf-formation on the stolon, or more correctly, the rhizome, which in its turn is but an underground stem. A new plant arising from the tuber is thus but the equivalent of a cutting and it reproduces the plant from which it grew with the same certainty as does the cutting from a willow reproduce the parent tree. So long as the potato is propagated by means of such vegetative buds or "eyes," so long does the entire succession of plants which emanate each year from the tubers of the preceding one represent but one individual. It matters not how many millions of such plants have been grown, nor for how many years this type of reproduction has continued. The "Magnum Bonum" grown today will be essentially the same individual plant as that produced from the seed by Clark fifty years ago. Excepting the rare occurrence of mutations, which will be discussed later, every morphological feature which was exhibited in the first year's seedling should be, and indeed is, present in the last. Such a successive series of presentations of the same individual is spoken of as a "clone," and such a clone is only in the rarest of circumstances subject to variations due to its hereditary composition, no matter how hybrid it may in fact be. Equally uncommon is the occurrence of any segregation of the hybrid characters within it (somatic segregation).

Differences in the environment may affect the growth and development of a variety, but except it be by pathological infection the result of such environment is a purely temporary one, and on returning to the normal environment, the plant responds by a reversion to its normal behaviour.

It will be gathered that this constancy in vegetative reproduction is essentially different from that of sexual propagation in "pure lines." This latter phenomenon is also possible in the potato; the writer has produced pure lines of white long-tubered potatoes as well as those of

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red round potatoes by breeding on genetic lines, but such “pure lines” are at present of no practical value, at least not in climates such as ours.

A potato variety may be defined as a group of identical plants, sharing the distinctive characters of an original individual from whom they are derived by vegetative reproduction.

A potato variety is considered *distinct* when it differs from all other known varieties by one or more recognizable characters whether they be of a morphological or of a physiological nature.

CHAPTER II

*Historical Sketch of the Development
 of Present-day Varieties*

THE potato was brought to Europe as a domesticated plant which already in its native home of Peru and Chili had been cultivated possibly for over a thousand years. With its history before the days of the discovery of America we are not here concerned further than to note that there is today evidence that the native Peruvians had raised a large if not an indiscriminate collection of varieties already before the arrival of Pizarro.

The potato reached Europe in the latter half of the sixteenth century, the first recorded mention being in 1587 when Clusius in Vienna received some tubers by an indirect source from Spain. A year later Gerarde in London likewise received some tubers which, however, he states he obtained from Virginia; whether they came from or, as is much more likely, only *via* Virginia must be left for consideration in another place. The fact which is of importance is that from two different sources the tuber reached Central and Western Europe and the British Isles respectively, and to these two importations all the varieties existent today outside of South America owe their origin.

It is of no little interest to learn what were the characters of the two varieties which came to Europe at the close of the sixteenth century. Fortunately, both Clusius⁽²⁹⁾ and Gerarde⁽⁴⁷⁾ have bequeathed to us a wealth of detail accompanied by drawings which, though rather schematic, are evidence of no small value in arriving at a correct view of the types described. Clusius, however, has in addition left us a beautiful aquarelle drawing now in the Musée Plantin¹ at Antwerp of the plant which he grew from his tubers. An excellent reproduction of this drawing forms the frontispiece of Roze's⁽¹²³⁾ classic work on the potato.

In all essentials these varieties are similar to those in use today and differ from the wild tuber-bearing solanums in precisely the same respects. Thus these two original varieties possess in common with all our domestic varieties the following characters: long spear-like calyces in contrast to the short ones of nearly every wild type, the coronate

¹ The Musée Plantin Ref. No. is Exp. Salle III, No. 107.

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or wheel-like petals as opposed to the stellate type of *S. commersonii* and others, and the spherical berry as opposed to the elongated one common to the great majority of the wild species. On the other hand, there are certain varietal differences which distinguish these two early sorts from the majority of present-day productions; these will be apparent from the descriptions given below, which are derived from the original accounts, diagrams and pictures relating to these two types.

CLUSIUS' POTATO

Haulm	Upright, spreading, very vigorous.
Stem	Stout, winged.
Colour of stem	Bronzed.
Leaf	Open, flat, stiff.
Leaflet	? Smooth and fairly broad.
Folioles	Small, numerous.
Colour of foliage	Grey-green, light.
Inflorescence	Simple, flower stalks very long and strong (much like "Up-to-date").
Flower	Abundant, very persistent.
Colour	Dark heliotrope, on upper surface.
Anthers	Broad, orange, regular.
Pollen	Abundant.
Style	Medium.
Stigma	Simple.
Berry	Round.
Stolons	Long, numerous, thick.
Tubers, skin	Beetroot-red, smooth; small and very numerous.
Shape	Cylindrical irregular, very prone to outgrowth.
Eyes	Very deep.
Flesh	White (not coloured with red).
Maturity	Very late.

GERARDE'S POTATO

Haulm	Spreading, vigorous.
Stem	Stout, winged.
Colour of stem	Red in midrib.
Leaf	Open, flat, ? drooping.
Leaflet	Smooth, long, narrow.
Folioles	Medium size, few.
Colour of foliage	Dark green.
Inflorescence	Simple, flower stalks slender and drooping.
Flower	Abundant, persistent.
Colour	Pale heliotrope.
Anthers	Narrow, gold, regular.
Pollen	? Abundant.
Style	Long.
Stigma	Simple.
Berry	Round.

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Stolons	Very long, thick.
Tubers, skin	White, smooth.
Shape	Round to oval, very irregular.
Eyes	Deep.
Flesh	? Pale yellow.
Maturity	Maincrop.

The distinctions between the two varieties are that Clusius' Potato is a very deeply coloured red and of the latest maturity, whilst Gerarde's is a white-skinned tuber of Maincrop or even earlier maturity. The similarity that is peculiar to the two, and differentiates them most from our present-day varieties, is the very irregular shape of the tubers disfigured by outgrowths, and the extremely deep eyes. We now know that these latter features were characteristic of the early Peruvian varieties¹ and that both in England and on the Continent these very clumsy deep-eyed varieties were the rule till the earlier part of the nineteenth century. The variety with deep blood-red tubers of the Clusius' type was likewise a favourite one with the ancient Peruvians, with whom the colour had an especial sacrificial significance.

Neither of the two varieties we have been discussing were pure or homozygous in all their characters, a fortunate fact in respect to the subsequent development of the potato in Europe, for no new blood seems to have been introduced till the middle of the nineteenth century. Fortunately we know Clusius' Potato to have been hybrid as regards its flower colour and the genetic experience of the writer with the potato would suggest with the utmost confidence that it was equally hybrid or heterozygous in respect to its tuber colour. "Beetroot-reds" are peculiar in that they very readily throw "Blacks" when mated to other sorts, including white-tubered ones. Now black-tubered varieties are common today and are used for salad purposes; we do not know when they were introduced, but we have mention of them as established varieties in 1795. It may be not unfairly assumed that at some time after their introduction, the two varieties of Clusius and Gerarde must have been mated and, as a result, amongst other seedlings, black ones produced. The ordinary dark and pale reds would arise naturally from the selfed berries of Clusius' Potato.

As is well known the spread of the potato was, except in Ireland, a very slow one. When, however, the tuber had found favour in the sight of the people and its virtues had been lauded by their Governments as a certain remedy against famine, there soon arose a demand for more

¹ It is hoped to publish later the evidence for this statement together with some fresh material respecting the early history of the potato.

varieties and better ones. The great prevalence of Curl throughout the eighteenth century, and the ease with which seedlings could be raised, conduced to the same end. There appears to have been no scientific or even reasonably careful breeding of varieties for a long time; in 1785 Marshall⁽⁹²⁾ complains of the indiscriminate raising of seedlings and describes the varieties extant as “endless.” Cartwright⁽²⁶⁾, reporting to the Board of Agriculture in 1806, alludes to the raising of new varieties as a very usual practice and a valuable corrective to the constant deterioration of existing varieties. He himself attacked the problem on very sound lines. He refrains from giving a list of varieties because he says they are so numerous and such a list could have, moreover, only “a local interest.” In what order and in what stages occurred the improvements that now overtook the original potato we do not know. By the year 1795, however, there were varieties in existence presenting many new features. We find white, pale red, dark red and black, as well as parti-coloured tubered varieties, potatoes with white flesh and potatoes with yellow flesh. One meets with varieties bearing round, oval, kidney or pure long finger-shaped tubers. Potatoes with deep eyes, with medium or with fleet eyes, with colourless eyes or with “picked” eyes. Early and late varieties, dwarf and tall stocks abound. Specialization had already produced potatoes for men, and potatoes such as the “Ox noble” and the “Yam” for horse and beast.

It seems indeed not short of marvellous that all these types, to say nothing of the scores of intergrades between them, should have arisen from but two and on the whole two such very similar initial types. Yet there is no reason, historic or scientific, to doubt this. The lessons derived from the author’s genetic studies render it quite easy to follow. Given white and beetroot-red parents respectively, the other coloured varieties would appear in the first or, at latest, the second generation of breeding by true seed. As regards parti-coloured tubers, the condition may arise either as a genetic mutation of the factor inducing self-colouring, in which case it is closely linked with one of the factors for red coloration, or it may occur as a somatic mutation in the germinal cells of the bud in the eye of a seed tuber, in which case a “mosaic” of colour arises: such has been described both by McKelvie and the writer^(86, 140). “Picked eyes” is likewise a character which would appear to have arisen as a germinal mutation and is linked in a similar manner to a gene for colour.

The varieties in shape which supervened on the original “rounds” and “cylindricals” are readily explained on genetic lines. The prevalence

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of the long "fluke" potatoes may be due to the fact that this is a pure dominant form and, once obtained, can be bred true.

Yellow-fleshed varieties such as the "Yam" can readily be bred from varieties with pale yellow or almost white flesh, for the pale type is the hybrid form from the mating of white and deep yellow flesh and the latter can be bred true.

Early varieties are recessive to Maincrop and Late ones, hence their extraction from these varieties offers no difficulty apart from their much greater constitutional delicacy.

A few of the varieties from this epoch still exist in remote corners of the British Isles, some of them were collected by the Ministry of Agriculture and grown by the N.I.A.B.¹ at Ormskirk in 1921. They included the "Yam," "Brown Rocks" and its synonym "Yellows," "Leather Coats," "Silver Skins" and "White Rocks"; "Gawkies" and its synonym "Red Kemps"; "Grigor Cup" and its synonym "Red Cup" and "Cups"; "Irish Whites" and "Brown Blacks." All of these varieties possess round tubers with very deep eyes. The oldest variety now in general use is "Myatt's Ashleaf" which may possibly be over a hundred and fifty years old.

In the beginning of the nineteenth century an effort to introduce more scientific principles in the raising of varieties is apparent, and such men as Andrew Knight⁽⁶⁹⁾ bred seedlings and tested them carefully against existing sorts.

The most momentous change, however, in the evolution of our domestic varieties took place after 1845. In that and in the succeeding year the most devastating outbreaks of Blight (*Phytophthora infestans*) took place which not only ruined the potato crop but produced such dire economic events in Ireland that their repercussion is being felt to this day. The collapse of practically all the most used varieties in face of the epidemic onslaught of *Phytophthora infestans* led many to seek for new and resistant varieties, and it was at this juncture and for this reason that a new strain of blood entered into our cultures. In 1851 Goodrich in America obtained a new cultivated potato from Chili; this he named "Rough Purple Chili" and from it in successive generations were produced "Garnet Chili," "Early Rose" and "Beauty of Hebron." The blood of these two latter sorts soon found its way into our English breeds.

Perhaps to no one man does the world owe more than it does to William Paterson of Dundee (born 1810, died 1870), for the existence of the many splendid varieties of the potato which have been grown

¹ National Institute of Agricultural Botany, Cambridge.

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during the last seventy-five years. Paterson^(114, 115) in 1853 began to work on the potato with the definite purpose of raising new stocks which would be better able to cope with the Blight to which the older sorts had so readily succumbed. Neither his methods nor his views would today pass as either very sound or indeed as scientific; he was convinced that no variety had a life of much more than thirty years and that the Blight was “caused by atmospheric action on the plants, it having the seeds of disease within itself” and hence regeneration was possible only by raising new varieties. To attain this end Paterson literally ransacked both the hemispheres for varieties, gathered them together and collected the berries which had formed naturally on them (he does not appear to have crossed them artificially) and from this resultant seed he raised a large series of potatoes. The most famous of his varieties was “Paterson’s Victoria,” introduced in 1856. Indeed, it may be said that practically no potato today of any outstanding merit is without the blood—though far removed—of this variety. Unfortunately, he has left no information as to the actual seed parents employed, but it seems probable that the Irish “White Rock” was one of the chief stock parents.

“Magnum Bonum,” introduced by Messrs Sutton in 1876 and raised by Clark of Christchurch from a cross with “Early Rose,” together with the famous “Champion” raised in 1863 by Nichol of Arbroath, gave strength to the new era in the potato industry. For many years these varieties displayed a very striking resistance to Blight and together they did a great deal to ameliorate the damage which the Blight again produced in Great Britain in 1879, and to which every other variety fell a hopeless victim.

The resistance which these varieties and others which have followed in their train have displayed proved, however, not to be permanent, and today both have practically ceased to be cultivated. Following, however, on the stimulus occasioned by the fulminating attacks of Blight and the recognition of the impermanence of many good varieties, the quest for new and improved ones reached its climax by the beginning of this century. “Scottish Triumph,” better known as “Up-to-date,” the name under which it was introduced by the late A. Findlay, and Sutton’s “Abundance” perhaps mark the high-water mark for yield and quality. It would not be just to pass on to the new era in potato breeding which marks the last decade and a half without making some mention of the excellent varieties which were produced in the last quarter of the nineteenth century, and some of the raisers to whose efforts we owe them. Foremost is the name of J. Clark of Christchurch

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to whom we owe "Magnum Bonum," "Abundance," "Epicure," "Early Market" and "Ninetyfold"; to Robert Fenn of Sulhampstead are due "Reading Regent," "Early Regent," "Woodstock Kidney" and "Rector of Woodstock" and to A. Findlay, "British Queen," "Evergood" and "Majestic."

In the beginning of this century there took place a financial gamble centring around two varieties, "Eldorado," which was but "Evergood" renamed, and a worthless seedling called "Northern Star." The public entered wholeheartedly into the boom and paid for tubers more than their weight in gold. Both varieties multiplied vegetatively and, forced to the last degree, proved utter failures in the coming season, and financial ruin followed closely on the *dénouement*. This unsavoury episode would willingly have been left to the oblivion it deserves were it not that out of it arose a new spirit in respect to the whole question of new varieties. The public had been severely bitten and had become critical, the trade in its turn had become cautious, and raisers were induced to apply the methods of science rather than those of the Bourse to their work of raising new varieties.

Scientific men began to interest themselves in potato breeding, and Universities to consider its possibilities. Amongst the new and more successful breeders were the late Rev. Aikman Paton who raised the "Castle" group of potatoes for Messrs Sutton and Sons, and the late Dr Wilson who produced the "Bishop," "Crusader" and "Templar."

To this latter period belongs the attempt to introduce the blood of genuine wild varieties such as *S. commersonii*, *S. maglia* and *S. edinense* into the existing domestic strains. In this work the writer has also taken part and is obliged to confess that his efforts have been no more, perhaps less, successful than those of others. This failure to improve our domesticated varieties by means of such distinct and unrelated species as those used¹ is due to the fact that it takes so many generations of crossing and inbreeding to get rid of the objectionable characters of the wild species such as low cropping, long stolons and extreme lateness, that in the process, the desirable qualities such as resistance to Blight and Mosaic have hitherto been lost. These difficulties are greatly enhanced by the existence of "linkages" between many of the factors influencing just those characters with which the breeder most wishes to work. Thus the writer has good reason for believing that resistance to Mosaic and what amounts practically to an immunity from Leaf Roll are firmly

¹ *S. edinense* might in this sense be excluded, for some measure of success has been achieved with it, but no new variety has been attained thereby superior to existing sorts.

linked to the character of "no crop," "wild stolons," "late maturity" and other less desirable features common to *S. utile*, a variety which crosses readily with the domestic *S. tuberosum*. Breeders following more prosaic lines but exercising the utmost care and displaying their gift of "spotting" at sight a hopeful seedling, have done better; it is to such men as Butler who gave us "King Edward VII," Mair who raised "Great Scot" and McKelvie with his "Arran" group of productions to whom we are today indebted for most of our best sorts.

The pioneer work of Goodrich in America has already been mentioned. He was followed by Bresee, who introduced "Early Rose"—a natural seedling of "Garnet Chili" in 1867. This variety proved to be invaluable as a parent, and from it arose in succession "King of the Earlies," "Prolific" and "Peerless" all of which have played an important part in American potato culture. Luther Burbank produced in 1876 the well-known seedling which takes its name from him; it was a natural seedling of "Early Rose." Carman introduced the "Rural New Yorker" and O. Alexander the "Green Mountain."

An outstanding fact is that it is two stocks, the one that of "Rough Purple Chili" through its immediate child "Garnet Chili" and grandchild "Early Rose"; the other Paterson's "Victoria," which have thrown pre-eminently good material. It is their blood today which is circulating in all our best varieties.

The last fifteen years, however, have marked a new era in potato culture. The recognition and the alarming spread of Wart Disease have forced to the front the question of "immune varieties." Fortunately, immunity and susceptibility to Wart Disease are phenomena which are controlled by inherent forces in the potato, the working of which, though complicated, follows the laws of Mendel (see Chapter v, p. 34).

Many good immune plants have been bred in recent years and many old ones such as "Edzell Blue" and "Snowdrop" have been rediscovered, and still more have been refurbished with new names. Nevertheless, we have no immune plants which can compare in yield with "Up-to-date" nor in quality with "King Edward," nor in earliness and cropping capacity with "Duke of York," "May Queen," "Ninetyfold" or "Epicure." It is particularly in respect to Earlies that we are without any first-class immune variety.

The firm of Sutton and Sons of Reading hold rightly a special niche in the annals of the history of the potato. For over fifty years this firm has introduced varieties, many of which, such as "May Queen," "Ninetyfold," "Epicure," "Abundance" and "Flourball," are holding