THE POTATO—ITS BOTANY, USE AND CULTURE.

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The following notes of a lecture before the Santa Cruz Farmers' Association, March 6, 1880, are prepared especially for the *Pacific Rural Press:*

The potato belongs to a useful family of plants, and for good or evil, powerful as useful. It is the Nightshade Family *(Solanaceæ)*, and includes the tomato with all its varieties, the egg plant, the capsicum, the tobacco, atropa (belladonna or deadly nightshade), the ground cherry, the stramonium, and a multitude of other plants too tedious to mention. Many of these are cultivated in California, and some members of the family are natives. Some are valuable only for food, others furnish the most powerful and useful medicines, and others again are cultivated chiefly for the beauty and fragrance of their flowers. Of this latter class I may mention the petunia, the datura and some climbing solanums. We have all seen the tall, tropical-looking brugmansia with its large trumpet-shaped flowers in our gardens, sending its fragrance out to the sidewalks and streets—a distant cousin of the less-showy solanum tuberosum, the subject of our discourse, and the potato of our gardens and fields.

The potato is found native on the uplands of Mexico, Chile, Peru and perhaps other parts of the American continent. In its wild state it was first found in the elevated regions of the tropics. But it adapts itself to almost any climate, and is cultivated from northern Alaska and Labrador to Patagonia, and from Lapland to the Cape of Good Hope. It has become wild in New Mexico and California, and even in the cold climate of northern Minnesota, on the shore of Lake Superior, it has been known to run wild for years.

Wildness, however, with the potato does not mean improvement. It soon degenerates and becomes worthless. Cultivation is almost everything with this plant; and when left to itself, or badly cultivated, it soon relapses into its original condition. The tubers decrease in size and nearly disappear, affording a striking example of *involution*, as its cultivation does that of *evolution*.

Whilst cultivation of this plant in different soils and climates may cause a wide variation in the form, character and color of the tuber, the plant as a whole preserves, except in the color of the flowers, its characteristics. In some highly cultivated varieties flowering and maturing of seed-balls ceases almost entirely.

Early in the 16th century, or some 350 years ago, the potato found its way into Europe, supposed to have been introduced by the Spaniards. It was carried into Great Britain from the colony in Virginia, by Sir Walter Raleigh in the year 1584. He first planted it on his estate in Ireland near Cork. In 1597 it was first figured and described by the noted English botanist, John Gerard. He named it *Batata Virginiana*, and recommended it as an article of food. The price at first was so high that it could only be afforded by kings. It was used in Ireland as an article of food long before the people of England were induced to esteem it of value. It was nearly 100 years after its introduction by Sir Walter, and its description by Gerard, before the people of England began to use it as an article of food extensively.

MANNER OF GROWTH.

What we call the potato is the tuberous root-stock of the *Solanum tuberosum*. It is the only part of the plant that we have discovered of any use. It is not botanically correct to call the potato a *root*, for that is quite another thing. It is really a thickened underground branch or stem. It has axillary buds (eyes), around which are the thickened imperfect leaves (scales). These buds are similar to buds on branches of other plants. Each one contains the embryo of the new plant—the stem, the roots, the leaves. The scale or imperfect leaf serves as a protection to the bud until it has fairly commenced growing.

This bud is but another form of seed in which all the organs are folded up ready to be expanded at the proper season into stem, root and leaves. The root descends into the earth and imbibes the water with whatever of nutriment that fluid contains, and the leaves open out in the air with mouths and lungs to breathe the gases that surround them, and by this process to assimilate materials for the plant.

We are taught by some vegetable physiologists that the tuber is necessary to nourish the young plant after the bud has expanded into stem, root and leaf. This is incorrect, after the rootlets have started into the soil and the leaves have reached the air, the remaining portion of the tuber is of little consequence to the new plant. We often see the old tuber remaining after the new tubers have matured.

The potato plant is perennial. The top stem grows and dies each season, but the underground stem, which is the tuber, remains ready to start with favoring conditions, and thus continue the growth.

The buds are sometimes compound, *i. e.*, two or more may be contained in one eye. In fact some tubers are so prolific that buds start out from places showing to external observations no sign of a bud.

The seed end of a tuber may be recognized by having a greater number of buds. The stem end is the end attached to the parent vine. A fragment of the stem end usually remains attached to the tuber. The buds for planting may be cut out by commencing at the stem and holding the seed end upwards, and proceeding upwards and to the left, turning the potato as we go. It will be noticed that the eyes are arranged spirally, so that one bud is obliquely above another, and thus in going around the tuber we remove all the buds without material injury to either; for it is not well to cut across a bud. The seed end may be cut so as to divide the clusters of buds equally. In cutting, endeavor to carry the lower point of each piece towards the center of the stem end, for the reason that the vascular system radiates from that point towards the buds.

The stem grows by elongation of the terminal bud, which as it goes forward develops lateral buds. These form side stems. In case of injury or destruction of the terminal bud by frost or otherwise, the next axillary or side bud becomes terminal and continues the growth.

When an eye contains more than one bud, usually the extra buds perish. Sometimes they all grow at the same time, or if the tuber does not decay they may remain dormant for a long time waiting for favoring conditions to commence growing.

ANATOMY OF THE POTATO.

The structure of a potato tuber is composed principally of *sacs* and *ducts*. The sac is a little receptacle for holding the material brought to it by the duct, and in it are formed the starch grains. It has a membraneous wall on all sides, and when fully matured is filled with starch. The duct is of a fibrous or thread-like structure and conveys the nutriment to the little bags. The process of starch manufacture is through the lining membranes of the sacs out of material brought by the ducts. The law of action called *osmosis* by physiologists—exchange of material through a membrane—is exercised in all probability in this case.

An examination of the tuber with a microscope reveals the sacs and ducts as a fine network, the interlacing fibers holding the sacs, large and small (for they vary considerably), in place. The grains of starch in these sacs have a peculiar structure. They are egg or kidney-shaped somewhat and made up of layers around a point or eye, which is situated at one end of the granule.

Plants that produce starch may often be distinguished by the size and structure of these starch grains, somewhat as animals are distinguished by the size and shape of their blood cells. Hence in adulterations the microscope serves a valuable purpose in testing these grains as to their source.

The starch grains in the potato tuber are *larger* than in almost any other plant used as food, and to this fact much of its value is due. And that potato that has the largest and best developed starch sacs and grains is the best variety. The best cultivation leads to this end. A maximum development of the starch grains and a minimum of the fibrous or vascular bundles seem to produce the most satisfactory quality of tuber. "Watery" and "waxy" tubers indicate an excessive vascular growth or a degeneration of the starch grains.

CHEMISTRY OF THE POTATO.

The chemical composition of the potato varies greatly with soil, climate and season. According to the most numerous and careful analyses of the potato we find an average to be about as follows:

	Percentage.
Water	70.00
Nitrogenous matter	1.70
Fatty matter	0.16
Sugar	1.10
Starch	23.00
Mineral matter and skin	4.00

The ash of the tuber yields on an average about 60% of potash salts and 17% of phosphoric acid, and smaller, and nearly equal amounts of lime, soda, magnesia, silica, chlorine and sulphuric acid.

A soil then containing a large amount of potash and phosphates would be indicated; and the successful fertilization with these materials has frequently been demonstrated. These constituents in a loose, deep sandy loam, in which there is a large percentage of vegetable mold and good drainage, will give the best crops—other things being equal. The food part of the *dried* tuber is about 28%, 24 of which is starch.

Although the analysis of the potato does not show a large proportion of nutritious matter, the easy transformation and assimilation of the starch and mineral constituents, owing to their peculiar properties, into animal tissue, places it among the most valuable and important of food material. It is estimated, perhaps correctly, that a bushel (or 60 pounds) of tubers will produce 3 pounds of beef or 5 pounds of mutton, or the same of pork, or 30 pounds of milk, or 3 pounds of butter, and so on in like proportion throughout all the animal products. But their value depends on combining with other food and by being fed judiciously to animals of good breed. Thus 20 pounds of potatoes and 20 pounds of good hay with either 1 pound of bean meal or 2 or 3 pounds of shorts or bran, will give the best results. It is in such combinations that the potato becomes most valuable as a food for domestic animals. And its value as a food for man is no less important.

As an illustration of what the potato will do, let us look at the inhabitants of the northern coast of Ireland, strong and healthy, yet having only for food potatoes and sour milk, with an occasional scrap of fish or sea weed.

It is said that Parmentier, who did so much in the last century to promote the cultivation of the potato in France, once invited a number of guests to a grand entertainment in Paris, among whom were Lavoisier, one of the fathers of modern chemistry, and Benjamin Franklin. Every dish consisted of potatoes prepared in various ways, wonderfully differing from each other, and even the wines and brandy were the product of these tubers.

The starch of commerce has for a long time been largely manufactured from the potato, both in Europe and the United States. Lately attention has been called to the manufacture of potato flour. The ease and simplicity of the process commends itself to the people of California, where the potato can be raised so abundantly and cheaply that even the harvesting of the crop at times will not pay.

As flesh formers they are estimated to be superior to carrots, mangolds, rutabagas, turnips, or sugar beets. According to results at German experimental stations, when dried they are more than half as valuable as wheat or oats, and two-thirds equal to corn.

There is a popular idea that potatoes will *mix* if different varieties are planted together. This is an error. They will no more mix than