physiological and morphological studies on potato plants
part 10. on the physiological behavior of ascorbic acid in the formation of potato tubers

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Figure 1. The variations of total ascorbic acid, reducing sugar and starch contents in the tips of potato stolon and tubers.

Résumé
This investigation is one of a series of experiments carried out under the title of physiological studies on potato plants. It has long been known that potato tubers are an important source for the supply of ascorbic acid (Vitamin C) as a dietary essential for human nutrition. Although a great number of studies on the ascorbic acid contents in potato tubers...
Figure 2. Variations of the reduced form, oxidized form and the reduced form/oxidized form of ascorbic acid in the tips of potato stolon and tubers.

have recently been reported by many investigators, few data concerning the influence of ascorbic acid on the tuberization and maturity of the potato tubers, especially on the accumulation of starch in the new tubers, are available. In the present investigation, in extending the work on the carbohydrate metabolism of potato tubers, particular attention was given to a study on the physiological interrelationship between the accumulation of starch and the variation of ascorbic acid content in the potato tuber during the time of its development. The analysis was carried out on the following fractions, namely, total ascorbic acid, reduced ascorbic acid, oxidized ascorbic acid, reducing sugar, non-reducing sugar, and starch during the period from late May to the beginning of August. The experimental results obtained may be summarized as follows:

1. The ascorbic acid metabolism during the stolon elongation stage.

The stolon arises in the axils of underground main stem soon after the germination. The total ascorbic acid and the reducing sugar contents in the stolon increase with the development of the stolon. At this stage, however, the amount of ascorbic acid, especially in the reduced form, in the stolon tips was less than that of the following stage: the decline of the ratio of reduced form/oxidized form of ascorbic acid may be pointed out as a characteristic feature at this stage.

2. The ascorbic acid metabolism during the tuberization stage.

The duration of this stage is very short, from the middle of June to late in June. The tips of the stolons began to swell into a spindle shape as soon as the elongation ceased and then gradually became tuberous through the deposition of starch in them. As a characteristic feature at this stage a conspicuous increase of ascorbic acid content and a decrease of reducing sugar content in the stolon tips were recognized. When reviewing the works of Purr (1934), Hanes (1935) and Nishida (1951) which state that the ascorbic acid is very effective for inhibiting amyrase activity, it is very interesting to assume that the ascorbic acid in the potato tubers may act as an activator in the formation of starch in the stolon tips. In the previous paper, the authors have reported the fact that the amyrase activity declined rapidly with the development of new tuber. This experimental evidence reported by the author added confirmatory support to the previous assumption of inhibitory effect of the ascorbic acid upon the amyrase activity. At any rate, a close relationship between the accumulation of starch and the increase of the ascorbic acid content in the new tubers is supposed to exist.

3. The ascorbic acid metabolism during the tuber maturing stage.

When the tubers attained maturity the leaves gradually died, and the onset of ripening of the new tubers roughly coincided with the yellowing and drying up of the vines. With the increasing maturity of the tuber the rate of increase of the ascorbic acid content in the new tuber slackened gradually. With respect to the detailed ratio of the constituents of ascorbic acid, an increase of the reduced form and a decrease of the oxidized form were recognized. Accordingly the ratio of reduced form/oxidized form of ascorbic acid also rose. Concomitant with these changes of the ascorbic acid content according to the tuber maturity, the starch content in the new tuber increased steeply.