XIX. THE ANTISCORBUTIC POTENCY OF APPLES. III.

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IN comparing the potency of a number of varieties of apples, a particularly striking disparity between the antiscorbutic activity of the Bramley's Seedling and the King Edward was observed [Bracewell, Hoyle and Zilva, 1930, 1, 2] in spite of the fact that these two apples resemble each other in so many respects. A few chemical analyses disclosed also a difference in their nitrogen content. Thus, three nitrogen determinations yielded the following percentages: Bramley's Seedling 0.027, 0.035 and 0.038, King Edward 0.061, 0.070 and 0.072. In view of these indications it became necessary to establish definitely whether a relationship existed between the nitrogen content and the antiscorbutic activity of the apple. In the experiment here described an attempt was made to throw some light on this subject. The aim was to investigate Bramley's Seedling and King Edward apples grown under conditions which would conduce to the production of fruits of high and low nitrogen content similar to the above in both varieties. The following are the cultural details of the experimental material.

King Edward VII.

High nitrogen sample. The fruits were grown at Long Ashton Research Station. The soil, derived from the Keuper Marl formation, is a medium loam containing high proportions of fine sand and silt. The trees were planted in 1920, are under clean cultivation and have received annual dressings of fertiliser as under:

Nitrate of soda	at 2 cwt. per acre
Superphosphate	„ 3 „
Sulphate of potash	„ 1 „

The trees are of the bush type, are extremely vigorous and growth is very strong. They are just beginning to come to the age of bearing crops.

The 1929 crop was very light and all the fruits were large and of the vigorous type. The fruits were picked on October 8th, 1929.

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Low nitrogen sample. These were grown at Bratton, Wilts. The soil is derived from the Chalk formation and is a typical, thin, chalky soil. The trees were planted in 1922 and are of the bush type. They have only made medium growth. Since 1927 they have been grown under a sward of clover which has reduced vigour and resulted in typical "low nitrogen" trees. Potash manuring has been the manurial treatment given.

In 1929 vigour of growth was low, the leaves were yellowish green, the fruits small, with pale yellow ground colour and usually a fair reddish flush denoting low nitrogen conditions. The crop was heavy and the fruits were picked on October 8th, 1929.

Bramley's Seedling.

High nitrogen sample. These fruits were grown at Faversham, Kent. The soil is of mixed origin, being derived from surface deposits overlying chalk, probably largely Brick Earth and Thanet Sands material. It has the texture of a medium loam, containing high amounts of fine sand and silt fractions. The trees are about 20 years old, large and of the bush type, and are extremely vigorous in growth. Cultivation has been on a high level ever since planting. Fertilisers containing nitrogen and phosphorus have been freely applied but potash manures have only been applied to any extent during the last few seasons.

In 1929, vigour of growth was strong and the fruits were large, green specimens, being typically those of high nitrogen trees. The crop was heavy. The fruits were picked on October 9th, 1929.

Low nitrogen sample. These were also grown at Faversham, Kent, in an orchard situated near that on which the high nitrogen sample fruits were grown. The soil is of similar origin to that of the high nitrogen sample but is heavier and the site is rather drier. The trees are of similar age and type to those from which the high nitrogen fruits were taken but have always been less vigorous, and the vigour has been greatly checked by substituting grass culture for arable conditions.

In 1929, the trees were showing all the symptoms of severe nitrogen starvation, *i.e.* lack of shoot growth, very sparse, small and yellow leaves and small fruits of extremely high colour. The crop was heavy. The fruits were picked on October 9th, 1929.

On analysis the following percentages of nitrogen were found: *King Edward*. High nitrogen 0.0390 and 0.0387; low nitrogen 0.0305 and 0.0309. *Bramley's Seedling*. High nitrogen 0.0404 and 0.0372; low nitrogen 0.0166 and 0.0172. The high and low nitrogen figures of both varieties did not, unfortunately, coincide with the corresponding high nitrogen figures of *King Edward* and the low nitrogen figures of the *Bramley's Seedling* previously tested. In fact, the high nitrogen *King Edward* in this experiment contains about 30 % or 40 % less nitrogen than the apples of this variety used in the first experiment, whilst the nitrogen content of the high nitrogen *Bramley's Seedling* is

of the same low order shown by these apples in that investigation. There is, however, a definite difference in the nitrogen content in both cases.

The difference in the antiscorbutic activity between the high and low nitrogen Bramley's Seedling (Table I) falls within the limits of the experimental error of the method of the determination of vitamin C. The low nitrogen King Edwards are, on the other hand, definitely (about 1.5 times) more potent than the high nitrogen apples.

Table I.

These tests began on October 27th, 1929.

Dose g. daily	Bramley's Seedling 1929 Low nitrogen	Bramley's Seedling 1929 High nitrogen	King Edward 1929 Low nitrogen	King Edward 1929 High nitrogen
3	++++	+++	+	No protection
5	++++	++++	++	+
10	++++	++++	++++	+++
20	Test not finished but fully pro- tected for 55-60 days	Test not finished but fully pro- tected for 55-60 days	++++	++++

These results, however, offer no clear-cut information for or against the theory that the nitrogen content of the apple has a bearing on its vitamin C content and consequently further attempts are being made in the hope of ascertaining whether such a relationship exists.

SUMMARY.

King Edwards containing about 0.0307 % of nitrogen were about 1.5 times as potent antiscorbutically as apples of this variety containing about 0.0387 % of nitrogen. No significant disparity in the vitamin C content was found between Bramley's Seedlings containing high and low quantities of nitrogen.

REFERENCES.

- Bracewell, Hoyle and Zilva (1930, 1). *Biochem. J.* **24**, 82.
 ——— (1930, 2). *Med. Res. Council. Special Report Series*, No. 146.