gains water, especially during the period of yellowing. The average of a number of analyses showed that the percentage of water in the pulp increased from 72.29 to 75.50, and further that the whole, or certainly nearly the whole, was drawn from the peel. It is unlikely that the greatly increased amount of sugar in the pulp, which will be mentioned below, attracts the water from the peel. Under the best conditions the pulp will be juicy as well as properly flavoured and nutritious, while if more or less dried out, the pulp becomes more or less pasty.

At full ripeness, the peel is considerably shrunken. In Fig. 2, showing transverse slices, one may note the change in form of the fruit due to this fact. From a more rounded shape (G) it becomes more angular (R), and if evaporation continues, it becomes much reduced in size (VR).

Aside from the changes in water content, other, properly called textural, changes occur. To understand these it is necessary to form a picture of the structure of the interior of the fruit. Imagine a vast number of irregularly oval, closed sacs of cellulose fastened together side by side and end to end, each sac containing as much as it will hold to distension of sap and starch grains (Fig. 3). Such, as a matter of fact, is the structure, aside from details which need no mention here. In the green fruit, these sacs or "cells" are quite firmly held together by a sort of cement called pectose. During ripening, this cement is changed by a process chemically similar to that of changing the starch into sugar, to form pectin, which is soluble in water. The cells are thus freed from each other, rendering the pulp of the consistency of paste, and the peel readily removable. If the cells die and collapse, as they do in time, the pulp then becomes watery and discoloured, but from the point of view of nature, this is the natural and inevitable end of the process.

It is well known that the ripening of bananas will not proceed normally unless they are properly ventilated. It is therefore of interest in this connection to note that in the absence of oxygen, the fruit remains firm. That is to say, the process of changing pectose to pectin is arrested if oxygen is withdrawn. It was Pasteur, I believe, who in 1872, during his studies in fermentation, was the first to discover this fact. He wrote that plums exposed to air became "soft and watery and sweet while those enclosed in a jar remained very firm and hard, the flesh was by no means watery, but they had lost much sugar" and yielded 1 per cent of the total weight of alcohol.[1]

Geerligs [2] found the same to be true of bananas, by keeping them in nitrogen, itself inert, but thus excluding oxygen. In such the firmness of flesh was retained, and the starch remained unaltered, showing that the presence of oxygen is necessary not only for the change in texture, but also for other ripening processes. I found the same to be true of bananas kept in an atmosphere of carbon dioxide, which is normally generated during respiration by fruits as they ripen, while at the same time oxygen from the air is taken up. It is evident from the foregoing that proper ventilation is necessary to ripening. At the same time it must be noted that a reduction of oxygen or an increase in carbon dioxide to some controlled extent might be of use in holding back the changes involved, if so desired.

Changes in Food Content

The food material present in the banana when in the unripe state consists chiefly of starch, occurring as in-

[1] Studies on Fermentation—The Diseases of Beer. Transl. from "Etudes sur la Biere." London, 1879.

[2] Prinzen, Geerligs, H. C. Intern. Sugar Journ. 10 : 378. 1908.