a transverse partition across a palisade cell (Fig. 4). In every case the lines of stratification are beautifully marked. That this deposit is cellulose was determined by the ordinary tests for that substance. During these changes the chlorophyll bodies are seen both to disintegrate and to blend together in larger masses. In the case of the red leaf, these larger masses often become invested by a pellicle which appears to be cellulose.

In the leaf which has become brown (Fig. 2) a greater amount of cell contents remain than in the red, the chlorophyll bodies do not mass together so much, and the cell sap is a dirty brown.

In the red leaf (Fig. 3) the cell contents are even more reduced, some cells being almost empty. The

FIG. 3.

remaining contents are mostly collected in masses of considerable size and often surrounded by the pellicle referred to, and the cell sap is colored by the characteristic red coloring matter, erythrophyl.

In the yellow leaf the cell contents are much like those of the red leaf, but the cell sap is colorless and the chlorophyll masses are stained yellow by xanthophyl.

What has been said of red and yellow and brown leaves is applicable as well to groups of cells in the case of mottled leaves.

The existence of erythrophyl and xanthophyl in these positions, the former in the cell sap, the latter in the solid cell contents, is of course well known in a general way. But we wish to add an additional fact or two in the explanation of these phenomena. Chlorophyl, manufactured constantly under the influence of light, is as constantly undergoing decomposition by the metabolism of the cell. Under ordinary conditions the manufacture of chlorophyl is sufficient to cover up its decomposition and the leaf retains its green color. Under certain changed conditions, however, such as intense light or diminished vitality, the decomposition of chlorophyl exceeds its manufacture, and xanthophyl (probably one of the products of its decomposition*) appears. In other words, xanthophyl is being formed all the time, but only becomes apparent when the manufacture of chlorophyl is checked. The condition of intense sunlight gives us the occasional summer yellowness, while to lowered vitality must be attributed the failure of chlorophyl manufacture in the autumn. This lower vitality is brought about by diminution of light, lowering of temperature, and probably causes in the plant itself. The common notion that frost is the cause of autumnal coloration is true only so far as it is one of the causes which tends to diminish the vitality of the plant and so the manufacture of chlorophyl. Autumnal coloration may take place before any frost. Xanthophyl then stains the chlorophyll masses yellow, which were before stained green by chlorophyl.

The red coloration is brought about in a very different way, as chlorophyl is manufactured in the leaf and stains the cell sap, leaving the chlorophyll masses untouched. This red coloring matter cannot be discovered in any of the crude materials brought into the plant, or in any other part than the leaves, except sometimes in the phloem regions of the petioles. When the leaf falls and the cell sap evaporates, and the chlorophyll bodies die, the erythrophyl lays hold

FIG. 4.

of the cell wall and solid contents and stains them. In this way dried leaves retain their red color. As erythrophyl is soluble in water, however, contact with moisture will soon cause the most of it to disappear. In the case of many cells containing erythrophyl we found the chlorophyll masses retaining their green color. In fact, the green was so slow in disappearing that it was only in the most advanced stages that it had given place to the yellow of xanthophyl. In some cases where chlorophyll masses were in contact with external cell walls they had become yellow, while in the same cell those masses completely surrounded with erythrophyl remained green. The explanation of this seems to lie in the fact that in the red rays the decomposition of chlorophyl goes on less actively than in the rays of low refrangibility.† The erythrophyl thus acts as a check upon the decomposition of chloro-

phyl, and so on the appearance of xanthophyl. It thus seems that all the leaves would become yellow but for the presence of erythrophyl. The brown coloration seems to be a modification of the red, the erythrophyl color of the cell sap being replaced by a dirty brown. Whether this is a resultant from the action of erythrophyl upon certain cell contents, or an entirely different coloring matter, was not ascertained.

RELATIONS OF MERCURY TO OTHER METALS.

By A. C. COUSINS.

SINCE my first paper on mercury, I have noticed other relations between that metal, gold, and thallium, which are interesting, and if not accidental, may possibly lead to the discovery of an important law.

The atomic weights and specific gravities are those previously given, and are the most recent determinations I have been able to obtain:

	Sp. Gr.	Atomic Weight.	Atomic Volume.
Gold.....	19 263	196.2	10.181
Thallium.....	11.86	203.6	17.167
Mercury, liquid.....	13.598	200.0	14.708
“ solid.....	14.39		

It will be seen that not only is the atomic weight of mercury the mean of that of gold and thallium, but its specific gravity in the liquid state is very nearly the mean of their atomic volumes; and its own atomic volume is almost exactly the theoretical specific gravity of an alloy formed of equal weights of gold and thallium, the calculated specific gravity being 14.68, which is only 0.29 in excess of the specific gravity of solid mercury.—*Oil, Paint, and Drug Reporter.*

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* Vines' Physiology of Plants, p. 241.
† Vines' Physiology of Plants, p. 266.