thesis, is speaking before chapters and clubs of the Society of the Sigma Xi, the Scientific Research Society of America.

Modern plants, with their green chlorophyll, utilize the energy of the light from the sun to break down molecules of water. They build the hydrogen thus obtained, along with the carbon dioxide they take from the air, into their plant structures. The oxygen they discard in this process maintains the balance of nature and the constitution of the air.

The earliest plants, Dr. van Niel is telling his scientific audiences, could not have made use of this complicated process which combines two radically different mechanisms: First, the photochemical reaction; second, the liberation of molecular oxygen.

Evidence has been found, Dr. van Niel reports, that certain purple bacteria make use of a simpler kind of photosynthesis. This method may have preceded that which takes place in the green chlorophyll. It is accomplished by a photochemical decomposition of water as in green plants. In both types of photosynthesis the hydrogen is transferred to carbon dioxide. But only in green-plant photosynthesis is oxygen evolved. In bacterial photosynthesis an oxidation product other than oxygen takes its place, and this must be continuously reduced. That requires the simultaneous oxidation of a reducing substance, for example a secondary alcohol. All these reactions take place under the influence of various enzymes.

It is reasonable, Dr. van Niel found, to regard the evolution of photosynthesis as proceeding from organisms with highly developed synthetic mechanisms but not yet endowed with photochemically functional pigment systems.

The pathway of development would then lead in the direction shown by the mechanisms in use by the purple bacteria. Their pigment systems were present in their colorless ancestors, but they were not yet independent of extraneous reducing chemicals.

"The next step in the evolutionary sequence," Dr. van Niel reports, "would then be concerned with changes whereby the 'oxidation product' of the photochemical reaction becomes capable of self-regeneration through the elimination of molecular oxygen. This is the mechanism operative in green plants."

"Interpreted in this manner, green plant photosynthesis appears as the ultimate result of that line of physiological evolution which represents the gradual development of synthetic mechanisms, and in which the organisms become progressively more independent of an external supply of reducing substances. Only with green plant photosynthesis has complete independence been acquired."

Science News Letter, November 6, 1948

Letters To The Editor

Autumn's Colors

If many readers of the SCIENCE NEWS LETTER are like myself they are curious to know what are the causes and contributing factors resulting in "Golden, crimson, purple, russet, scarlet—autumn's brave banners . . ."—J. Edward Johns, Columbus, Ohio.

The yellows and orange-reds in autumn leaves are due to the presence of a group of pigments known collectively as the xanthenes. Carotene, which gives carrots, rutabagas, squashes, etc., their characteristic color, is one of the xanthenes. The purples and deep crimsons are due to another group of pigments, the anthocyanins, which are also responsible for the colors of such things as purple cabbage, beets, and red-foliaged ornamental plants.

The xanthenes are present all the time, but are covered up by the more abundant green pigment, chlorophyll. As autumn advances, the chlorophyll dies and loses its color, while the xanthenes remain. Formation of the anthocyanins is promoted by the clear, sunny weather of the "Indian summer" type, cool but not frosty. Frost, if it comes too early in autumn, actually prevents the development of good autumn coloration.

The outside influences that set the leaves on the way towards their autumnal glory are complex, hence not well understood. They are not unlike the complex of causes that produce the ripening of fruit; indeed, an autumn-colored leaf might well be regarded as a RIPE *leaf rather than as a dead one.*

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