



Keys Which Unlock One Door May Also Fit Another

CHARLES GLEN KING, *Scientific Director of The Nutrition Foundation
and Professor of Chemistry, Columbia University*

REVERENCE FOR LIFE is an expression describing a keystone formulated in Albert Schweitzer's philosophy. Around this concept, he built a pattern of ideas that impinge upon the thinking of our present civilization, perhaps as strongly as the philosophic contributions of any individual in this generation. From a background of disciplined living and high attainments in science, history, music and human service, his thoughts summarized in the above three words were in large part crystallized as he traveled by boat through the tangled plant world of tropical Africa. Under the skins of men and animals all about him, and of whatever color, he knew that a red pigment, hemoglobin, was as characteristic of their bodies as the endless green was of the surrounding forest.

Only a few atoms make the difference between red particles in all animals and the green chlorophyll, characteristic of plants. But more subtly within the cells of practically all *plants and animals*, there is a further series of very similar pigments, the cytochromes, almost identical in structure and equally essential to life . . . reaching all the way from single yeast cells to the complex structure of human brain. Each cell as it grows makes its own pigment from simpler food materials. Despite the similarity in structure, and advertisements notwithstanding, animals do not use chlorophyll to make their red pigments, but instead use very simple nutrients such as glycine, iron, and 4-carbon acids.

As research proceeds and knowledge of nature grows, increasingly we see relationships among the vital processes in living bodies, whether those bodies be animal or plant, simple or complex.

If one turns to the greenish-yellow color in milk whey, liver and other animal products, one finds there riboflavin, or vitamin B₂, exactly the same compound that is present in plants, from green leaves down to bacteria. An interesting contrast appears with the fat-soluble yellow coloring in carrots and green leaves, masked normally by chlorophyll—there, in a series of "carotenes," are compounds that animals almost never synthesize but instead obtain from plant foods and convert to vitamin A, thence to eye pigments essential to vision. If animals do

not have adequate supplies of the yellow plant pigments, directly or indirectly, death is the only alternative, as certainly as when animals do not have supplies of essential amino acids and minerals. Fortunately nature has given us, in the forms of chickens and cows, a pleasant series of intermediate converters for many of the essential nutrients, to spare man's otherwise embarrassing prospect of eating grass.

Another highly colored vitamin that was discovered in green leaves and accordingly named folic acid—then promptly found in liver and kidney cells—furnished a close link between plants and animals. Its most obvious contribution to animal nutrition is the prevention of anemia, but it also prevents and cures a related common tropical disease, sprue. However, its role is much more fundamental in that it appears to be essential to life functions in all cells. Plants manufacture it freely, but animals depend upon abundant stores in their livers, kidneys and other tissues. Early work on its chemical structure, long before it was identified as a vitamin, resulted from the trail-hiking chemist's curiosity about the delicate coloring in the wings of butterflies.

That same vitamin has led to research frontiers breaking into new channels which emphasize ever more strongly the similarities of all life processes—the metabolism of carbon dioxide and related one-carbon compounds: formaldehyde, wood alcohol, and formic acid. Two decades ago, none of these compounds, known to be toxic in high concentrations, would have been considered as a normal metabolite in animals. Today they are among the most actively studied nutrients in relation to the functions of vitamins and the normal utilization of sugars, fats, and proteins.

As we advance beyond the earlier horizons, we are finding that regions we thought distinct and even far apart now merge. Paths which seemed once to diverge have turned and already some have come together. And keys which unlock one important door may also fit another. In forging our keys we can look forward to better understanding of our physical world and make progress toward a better civilization for all mankind.