The Nature of Vitamin C
The Position of the Vitamin C Foundation on Natural Vitamin C and So-Called Vitamin C-Complex
by Owen Fonorow

"The 'powers that be' did a good job of influencing me to ignore Linus Pauling, describing him as a failing old man with a 'mental' problem who had once been a great scientist. They said he was wrong about vitamin C. I believed them."

"Richard"
Vitamin C Foundation online forum

There are a surprising number of well-intentioned people among the alternative medical community who now believe that ascorbic acid isn't the real vitamin C. The dietary substance that causes scurvy when missing and cures scurvy when present is by definition vitamin C. Linus Pauling was unequivocal in his belief that the ascorbate fraction of ascorbic acid (called the ascorbate ion) is vitamin C. Referring to scurvy in his landmark Vitamin C and the Common Cold (1970), Pauling stated, "Ascorbic acid, which has been vitamin C since at least 1937, has only a supporting role, according to Cowan and Fallon, who write that ascorbic acid is only present in plants "as a preservative for this complex, serving to keep it together in the plant tissue, preserving its integrity, freshness and color" (Cowan et al. 2004:21).

Cowan and Fallon even go so far as to say in this book that "ascorbic acid is not a food for us; that which it preserves is our food" (Cowan et al. 2004:21). Too much "synthetic" ascorbic acid is harmful, the naturalists assert, especially when not accompanied by the "vitamin C-complex."

If the naturalists are right about the C-complex being the real vitamin C, then Linus Pauling was wrong in his reviews and analyses of more than 60 years of vitamin C science. There is massive scientific support for the assertion that ascorbic acid is vitamin C. No scientific basis has been found for the existence of the C-complex or for the implication that such a complex can cure scurvy without ascorbic acid present. This assertion is proven every day in hospitals around the world. Comatose patients are kept alive using ascorbic acid only. No patients on a feeding tube are kept alive with a "vitamin C-complex."

The following treatise represents the position of The Vitamin C Foundation on the true nature of vitamin C. The ascorbate ion, the fraction commonly found in ascorbic acid, or one of the salts, e.g., sodium ascorbate or calcium ascorbate, is vitamin C. This is the substance that when missing in the diet causes death by scurvy. There is no scientific debate about this fact. The scientific literature is so voluminous that few would be capable of digesting it. Part of the problem is that today's dietitians and orthodox nutritionists are taught to ignore much of the early research, and medical doctors are not well versed in vitamin C either. Apparently, this knowledge vacuum has opened the door to the emotionally appealing idea of a "natural" vitamin C-complex.

The Perfect Food Theory Vs. the Orthomolecular Theory
The basis for Cowan's, Fallon's, and other naturalists' arguments is that plant-derived "natural" vitamins and vitamin complexes obtained from foods are more wholesome and generally better for us than individual synthetic vitamins. The naturalists argue that food complexes are preferable, because groups of these substances usually appear together in healthful foods and because individual...
vitamins do not work alone in the body to sustain health.

There are at least two theoretical reasons why plant food may provide perfect nutrition for humans and other animals: either perfect foods evolved from a mutual dependency between the plants and the animals that eat them, or these perfect plant foods were created by divine intervention. Either way, plants and their contents are the model to which naturalists look for the best guidance as to what constitutes proper human nutrition. This theory might be called the Theory of Divine Food Creation in Plants or the Perfect Food Theory.

The naturalists are not wrong that animals evolved to eat particular foods. It seems likely that animals and plants evolved together and in such a way that any plants that the surviving animals generally ingest do provide some guidance as to the nutrition that the animal requires. To obtain information about the foods that are best for humans, this theory requires the study of our ancestor's diets — what they ate, not necessarily why they ate it.

On the other side, in the Pauling camp, orthomolecular nutritionists, or orthomolecularists, might argue that during the course of evolution, immovable plants had different survival issues from the evolving animals that ate the plants. Orthomolecularists view foods from the perspective of what they contain — e.g., which molecules are required to sustain life and which ones must be obtained in food.

Linus Pauling and other biochemists explain that there is no difference between a so-called “synthetic” and a “natural” vitamin molecule. Biologically identical, or bio-identical, molecules are indistinguishable from those synthesized by plants or animals. In the blood serum, the origin of bio-identical molecules is thought to be of little significance. Receptors on the surface of animal cells control the uptake of individual molecules, regardless of how or why these molecules appear in the bloodstream. Any complexes of molecules present in food generally disassociate during digestion. The theory that animal biochemistry and DNA, perhaps more than plant biology, provides the better guide for optimal nutrition might be called The Molecular Theory of Vitamin Evolution in Animals, or simply, The Orthomolecular Theory.

The Myth of the Vitamin C-Complex

"This was the first proof that ascorbic acid was identical with vitamin C and that the substance's activity was not due to an impurity." — Albert Szent-Gyorgyi, Nobel Lecture, Oxidation, Energy Transfer, and Vitamins, December 11, 1937.

Mainly because of the appeal of words such as “natural” and “vitamin complex,” adherents to the naturalist view have gained many followers, and their views are often repeated by respected nutritional authorities. It is understandable why naturalists distrust modern medical science with its orientation towards potentially dangerous prescription drugs, but this is no reason to ignore science altogether.

There is no scientific debate about whether there is such a thing as a vitamin C-complex. Such a thing as a matter of human nutrition does not exist. The argument for ascorbic acid as vitamin C carries as much weight as any argument in any field of science. Its sugar-like molecular structure was first isolated by Albert Szent-Gyorgyi, and the chemical shorthand is C6H8O6. Dr. Szent-Gyorgyi received the Nobel prize for this discovery. No one who is engaged in conventional medical research believes there is a C-complex, nor are there any peer-reviewed papers accessible in the Medline medical database that support the idea that there is a C-complex, much less that it is the real vitamin C.

It is known that animals generally do not require vitamin C in their diets. Almost all mammals, and virtually all animals, synthesize ascorbic acid in the liver or kidney. While most animals synthesize ascorbic acid, there is no scientific evidence that any animal synthesizes the ill-defined C-complex within its body. There is some debate whether vitamin C travels in the bloodstream as ascorbic acid or as one of the salts, such as sodium ascorbate.

The previously mentioned book, Fourfold Path to Healing (2004), by Thomas Cowan, MD, with Sally Fallon and Jaime McMillan, is remarkable for the number of false or unsupported assertions these authors make concerning vitamin C. Every sentence in the vitamin C section on pages 20 and 21 is either unsupported or contains misleading or false information that they present as fact. The message these authors are trying to convey is that the natural vitamin C-Complex not only exists but also is required, lest consumers risk clogged arteries and DNA damage.

Cowan et al. begin their vitamin C section with the intriguing sentence, “Several recent studies have shown that taking synthetic vitamins can actually be harmful, thus challenging a practice suggested in virtually all other books written about health and nutrition over the past 40 years” (p. 20). Unfortunately, one reason for their different advice is that they are wrong. The two studies cited made headlines, but both “studies” have been debunked scientifically by the Vitamin C Foundation. (See the Vitamin C Foundation's online forum for our rebuttal to these two media reports and for the complete description of the errors about vitamin C published on pages 20 and 21 of The Fourfold Path to Healing.)

The Real Vitamin C Is the Ascorbate Ion (Commonly Ascorbic Acid)

Any review of the scientific literature, which spans 80 years and includes more than 100,000 published studies and reports, concludes that what is commonly called vitamin C, the ascorbate ion, or simply ascorbic acid is the real vitamin C. Humanity is fortunate that Linus Pauling became interested, for such a review of the literature requires reading the equivalent of 400 bound books just to hold the abstracts. The genius Linus Pauling was probably the only person who could possibly digest and assimilate and then disseminate
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this much scientific research over the course of his 30-year study.

Linus Pauling made the vitamin C science understandable to the rest of us with his books for the layman. His 1986 book *How To Live Longer and Feel Better* is an updated and expanded version of his earlier landmark *Vitamin C and the Common Cold* (1970) and is still one of the best references on the nature of vitamin C. In the early 1900s, the existence of a dietary factor that cured scurvy was named vitamin C before the substance had been isolated or its molecular structure had been identified.

The late science writer Isaac Asimov wrote the following in 1972:

In 1913, two American biochemists, Elmer Vernon McCollum and Marguerite Davis, discovered another trace factor vital to health in butter and egg yolk. This one was soluble in fatty substances instead of water. McCollum called it “fat-soluble A,” to contrast it with “water-soluble B,” which was the name he applied to the anti-beriberi factor. In the absence of chemical information as to the nature of the factors, this seemed fair enough, and it started the custom of naming them by letters. In 1920, the British biochemist Jack Cecil Drummond changed the names to “vitamin A” and “vitamin B,” dropping the final e of “vitamine” as a gesture toward taking “amine” out of the name. He also suggested that the anti-scurvy factor was still a third such substance, which he named “vitamin C” (Asimov 1972).

Isolating and identifying the nature of vitamin C turned out to be a more difficult task for biochemists than most of the other vitamins that were being identified at the beginning of the twentieth century. Here is more from Asimov on isolating vitamin C:

Vitamin C was a different sort of problem. Citrus fruits furnish a comparatively rich source of this material, but one difficulty was finding an experimental animal that did not make its own vitamin C. Most mammals, aside from man and the other primates, have retained the capacity to form this vitamin. Without a cheap and simple experimental animal that would develop scurvy, it was difficult to follow the location of vitamin C among the various fractions into which the fruit juice was broken down chemically.

In 1918, the American biochemists B. Cohen and Lafayette Benedict Mendel solved this problem by discovering that guinea pigs could not form the vitamin. In fact, guinea pigs developed scurvy much more easily than men did. But another difficulty remained. Vitamin C was found to be very unstable (it is the most unstable of the vitamins), so it was easily lost in chemical procedures to isolate it. A number of research workers ardently pursued the vitamin without success.

As it happened, vitamin C was finally isolated by someone who was not particularly looking for it. In 1928, the Hungarian-born biochemist Albert Szent-Györgi, then working in London in Hopkins’ laboratory and interested mainly in finding out how tissues made use of oxygen, isolated from cabbages a substance which helped transfer hydrogen atoms from one compound to another. Shortly afterward, Charles Glen King and his co-workers at the University of Pittsburgh, who were looking for vitamin C, prepared some of the substance from cabbages and found that it was strongly protective against scurvy. Furthermore, they found it identical with crystals they had obtained from lemon juice. King determined its structure in 1933, and it turned out to be a sugar molecule of six carbons, belonging to the L-series instead of the D-series. It was named “ascorbic acid” (from Greek words meaning “no scurvy”) (Asimov 1972; p. 690-700).

Ascorbic acid was easily synthesized after this discovery, and the deadly scurvy became rare. As little as ten milligrams per day of ascorbic acid, or one of its salts, is all that is required to cure frank scurvy. Scurvy-like symptoms can rarely be caused by a lack of other factors in the diet, such as a lack of vitamin B6 or copper, but vitamin C is by far the most important and the most likely essential substance to be missing in the diets of humans (Williams 1971).

Vitamin C is now one of the most studied substances in the history of science. We know what vitamin C is, we know a great deal about what it does, and we know how it is naturally synthesized within plants and animals. We know that ascorbate, and it alone, prevents scurvy in the few animals that do not produce it. This has been exhaustively studied in the guinea pig by Ginter and others (Ginter 1982).

Ascorbate, and it alone, has been shown to have a strong effect of preventing and shortening the duration of the common cold. Early experiments found that bioflavonoids provide no additional benefits in this regard, either alone or added to ascorbate (Pauling 1986).

Ascorbate, in the form of the salt sodium-ascorbate, can be injected intravenously to control and inactivate viral infections. This is well-documented in Thomas Levy’s *Vitamin C Infectious Diseases and Toxins: Curing the Incurable* (2002).

Intravenous sodium ascorbate recently made news based upon reports from Mark Levine at the National Institutes of Health and others that it can kill cancer cells at high blood concentrations (Padayatt 2006). Ascorbate by itself can detoxify the body of heavy metals, including the toxic metal mercury (Levy 2002). Vitamin C, as ascorbic acid, and vitamin E cut intensive care unit deaths in half in a randomized, placebo-controlled trial (Nathans 2002).

Recently, medical research at John Hopkins University discovered that ascorbate supplements, in conjunction with vitamin E, significantly reduce the risk of Alzheimer’s by 78% and provides an 88% reduction in cognitive dementia (Zandi et al. 2004).

Other recent findings, of which the Vitamin C Foundation is aware, include the ability of vitamin C as ascorbic acid to reduce the risks of...
stroke and cataract and to extend life. The risk of stroke was 70% higher among those in the lowest quartile for serum vitamin C than among those in the highest (Yokoyama 2000). Women who took vitamin C supplements for at least ten years proved only 23% as likely to develop cataracts as women who received the vitamin only in their diet (Jacques 1997, Mares-Perlman).

Low blood vitamin C concentrations (ascorbic acid) in the older British population strongly predict mortality. Other vitamins had no effect on mortality. In fully adjusted models, there was no evidence for an influence of alpha-tocopherol (vitamin E), beta-carotene, or retinol (vitamin A) on total mortality (Fletcher et al. 2003). Researchers in Japan artificially decreased age-dependent telomere shortening by 52-62% over untreated control with an enrichment of intracellular vitamin C (Furumoto 1998).

Ascorbic acid, and not a complex, has been shown to inhibit the HMG CoA Reductase enzyme, which controls the production of cholesterol (Harwood 1986).

Arguably, the most important result from a chronic deficiency of ascorbate, as is commonly present in most human beings, is the condition medically referred to as heart disease, or Cardiovascular Disease (CVD). As first proposed by the Canadian medical doctor and researcher G.C. Willis in the 1950s, and later verified by Linus Pauling and Matthias Rath in 1989 and, most recently, by a literature review by Thomas Levy, this condition is primarily attributable to low vitamin C (Willis 1952, 1953, 1954, 1957; Pauling 1992; Levy 2006).

Among its many metabolic functions, vitamin C as ascorbate is required in the manufacture of the protein collagen (Pauling 1986). Collagen provides strength and structural integrity to animal tissues. The repair and maintenance of tissue induces a daily need for new collagen. In the human scurvy, the body disintegrates from a lack of collagen, and the disease only appears in the few animal species that do not synthesize vitamin C.

Humans compensate for their chronic scorbutic condition by creating plaster-like casts in the arteries. Atherosclerosis – and the resulting high incidence of cardiovascular and heart disease now common in human populations, according to Pauling and his associates – is caused by the lack of vitamin C (Pauling 1992). CVD in those on western diets is reversible only by taking high amounts of ascorbate, amounts that are impossible to achieve using natural vitamin C, or any plant derived complex. Incidentally, cellulose, not collagen, provides structural integrity for plants.

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A 15-year study of 85,000 nurses at Harvard found that a daily vitamin C pill as ascorbic acid reduces heart disease almost 30%. Interestingly, dietary intake of vitamin C seemed to have little effect on coronary heart disease risk. But if women used vitamin C supplements, their risk was reduced by 27%. According to the numbers in the Harvard study, a 360 mg vitamin C pill daily would save more than 300,000 lives per year (Osganian 2003).

The biochemist Sherry Lewin writes in his book Vitamin C: Its Biology and Medical Potential (1976) about the exact biochemical nature of vitamin C. Lewin, perhaps the greatest authority on vitamin C other than Pauling, explains that vitamin C travels in the blood as ascorbic acid and through the lymph as sodium ascorbate. Lewin never mentions even the possibility of a vitamin C-complex.


This is not to say that plant complexes, containing bioflavonoids, are devoid of health benefits. Linus Pauling himself advised eating a wide variety of foods, because there is a chance that not every molecule a healthy body requires have been discovered. The most common health benefit of the bioflavonoids, such as the quercetin and rutin commonly found with vitamin C, that are mentioned in the literature is that they strengthen walls of tiny capillaries. However, there is no evidence that any molecule other than ascorbate, the same molecule that is produced by most animals in their livers, can replace vitamin C to prevent scurvy or provide equivalent metabolic properties.

Fortunately for humanity, synthetic vitamin C is inexpensive, offering the hope of better health to everyone. Vitamin C researcher Ralph Lotz points out that the 100 mg of the "natural vitamin C complex" sold by one company is 1,315 times more costly than synthetic vitamin C.

The Problem with Natural Vitamins

If the naturalists are wrong about vitamin C, perhaps their arguments favoring other "natural" vitamins are spurious also. Human beings require more than 50 essential substances from the diet. The necessary inorganic substances are called minerals; organic substances that cells require and that contain nitrogen are called amino acids. Other organic trace substances are generally called vitamins. Most of these substances can be found in plants; however, plants generally depend on not being eaten for their survival, and not all natural plants make good foods.

Poison Ivy is a plant that does not provide any known nutritional value and that is, in fact, harmful to the animals that happen to touch it. If natural plants can be poisonous, what methods do the naturalists use to determine "good foods?" Why make the assumption that components in food complexes always act to preserve the best health of the animal eating it?

The story of the development of the statin prescription cholesterol-lowering drugs is a story of how a "natural" plant-derived substance that is poisonous to its predators was isolated and engineered into a prescription drug. Author and former pharmaceutical chemist Shane Ellison explains in Hidden Truth About Cholesterol Lowering Drugs:

In a natural response to the threat of a predator, red yeast produces the drug known as lovastatin (as well as other chemicals). Utilizing fundamental laboratory research, the discovery and isolation of lovastatin from red yeast rice was paid for by the US government in the 1970s. Commercially, lovastatin is known as Mevacor. It was the first statin drug, released in 1987 by the US government-influenced company named Merck. Using a technique known as combinatorial chemistry, other drug companies have since unleashed their own versions. These versions include Zocor, Lipitor, Pravachol, and Crestor.

As a toxic agent, the consumption of lovastatin via red yeast rice by its predators leads to sickness and, in some cases, death. This is true for humans as well. Lovastatin's (and all other statin drugs') toxicity is attributed to its ability to block cholesterol and CoQ10 production (Ellison 2006).

Statins have become the number-one-selling class of prescription drug after decades of marketing and scare tactics about the supposed dangers of high cholesterol.

Orthomolecular Nutrition

At the cellular level, DNA controls the metabolic machinery in both plants and animals. The question reduces to whether plant or animal DNA holds the key to the food that produce the best health in humans? According to Linus Pauling, the study of evolution and the single-celled organisms provides an important clue. Primitive cells, bacteria, and even plants are examples of organisms that must be able to synthesize more of the chemicals that they require for existence than the organisms capable of movement require.

We are accustomed to thinking of human beings as the highest of all species of living organisms. In one sense they are: they have achieved effective control over a large part of the earth and have even begun to extend their realm as far as the moon and Mars. But in their biochemical capabilities, they are inferior to many other organisms, including even unicellular organisms, such as bacteria, yeasts, and molds. The red bread mold (Neurospora), for example, is able to carry out in its cells a great many chemical reactions that human beings are unable to carry out. The
red bread mold can live on a very
simple medium, consisting of water,
inorganic salts, an inorganic source
of nitrogen, such as ammonium
nitrate, a suitable source of carbon,
such as sucrose, and a single
vitamin, biotin. All other substances
required by the red bread mold are
synthesized by it, using its internal
biochemical mechanisms. The red
bread mold does not need to have
any amino acids in its diet, because
it is able to synthesize all of them
and also to synthesize all of the
vitamins except biotin. The red
bread mold owes its survival, over
hundreds of millions of years, to
its great biochemical capabilities.
If, like humans, it were unable to
synthesize the various amino acids
and vitamins, it would not have
survived. because it could not have
solved the problem of obtaining
an adequate diet (Pauling 1986,
2006).

The forces helping to continue the
existence of plants work in opposition
to the evolutionary interests of the
animals. As Pauling explains, the
animals evolved to eat the immovable
plants that must make many of the
molecules required for life. The
animals began to delegate important
biological functions to the DNA of
plants, making animals dependent on
plants for their very existence. Plants
have had to evolve protections from
being eaten into oblivion. Nature
is the balance between these two
diametrically opposing evolutionary
forces.

Generally, the type of molecules
that animals delegated to plant DNA
require many steps to synthesize
(introducing greater opportunities
for mutation), and several of the
vitamins have lipid as well as protein
components. These molecules are
required in small amounts by the
animal but are found in relatively
large amounts in plants. Many of the
essential vitamins are coenzymes, as
coenzymes survive the many chemical
reactions they help facilitate.

Vitamin C as ascorbic acid is unique
among the vitamins. Ascorbic acid is
produced by most animals in large
amounts. Rather than a complicated
coenzyme, ascorbic acid is a rather
simple sugar-like molecule, and the
animals synthesize it using a four-step
process. Few species have survived
after losing the ability to synthesize
ascorbate. This has created a valid
argument as to whether vitamin C is
really a "vitamin" (the term vitamin
implies a trace factor), or whether
humans require this substance in
much higher amounts. There are high
concentrations of ascorbate in the
adrenal glands, and animals produce
more when they are under stress.
Irwin Stone suggested that a more
descriptive term for ascorbic acid is
the "missing stress hormone."

Patrick Holford expands on this
version of the vitamin C-isn't-really-
a-vitamin argument and explains how
the animals make their ascorbate:

Vitamin C isn't a vitamin at all.
It isn't a necessary component
of diet, at least for all mammals
with the exception of guinea pigs,
fruit-eating bats, the red-vented
bulbul bird and primates - which
includes us. All other species
make their own. This they do by
converting glucuronic acid derived
from glucose into ascorbic acid
(C6H8O6). Three enzymes are
required to make this conversion.
One of these enzymes, or part of
the enzyme system, is missing in
primates. Irwin Stone proposed,
in 1965, that a negative mutation
may have occurred in these
species so as to lose the ability
to produce vitamin C. In primates,
this is thought to have occurred in
the region of 25 million years ago
(Holford 1994).

Holford's argument is not whether
ascorbic acid is required. Holford,
Stone, and others argue that humans
suffer a genetic defect and that they
require more than mere vitamin-like
amounts for the best of health (Stone
1972). According to the Pauling/Rath
unified theory of cardiovascular
disease, humans have adapted for
their loss of the ability to make vitamin
C by producing the Lp(a) cholesterol
molecule as the vitamin's surrogate
(Pauling 1992).

The plants are not necessarily
producing any more organic molecules
than the minimum levels required
to ensure the continued existence of
the animals. A better indicator
of optimal animal nutrition may be
the production and serum levels of
a needed substance in animals that
still retain the capacity to make it.
For example, Coenzyme Q10, or CoQ10,
is the complicated, vitamin-like
molecule that is required by all cells
for the production of energy.

The DNA in humans encodes for
the 17-step sequence to synthesize
CoQ10, requiring at least seven
vitamins (vitamin B2 - riboflavin,
vitamin B3 - niacinamide, vitamin
B6, folic acid, vitamin B12, vitamin
C, and pantothenic acid) and several
trace elements. According to John
Ely, the amount of CoQ10 humans
endogenously produce is about 500
mg per day, while humans might
obtain less than 5 mg from the
ordinary diet (Ely 2006).

Although the complex CoQ10
molecule is similar to other vitamins,
especially vitamin K, over the course
of evolution, no vegetarian animal
has delegated its needed CoQ10
to plant DNA. This is probably
because more CoQ10 is required
in animals than in plants to support
their motion. Therefore, the DNA of
immobile plants provides little help
in determining the proper amount of
CoQ10 to supplement.

The DNA of most animals encodes
for both CoQ10 and ascorbate. The
amount of CoQ10 synthesized by
animals can be compared with the
amount of ascorbic acid synthesized
to estimate the human requirement
for vitamin C. The amount of ascorbic
acid that animals make is roughly ten times
more than the CoQ10 they make by
weight. Using this ratio, after adjusting
for body weight, an orthomolecularist
might predict the need for 5000 mg
of ascorbate daily in human blood and
tissue. To obtain this level, we might
have to ingest more than 10,000 mg
of ascorbic acid by mouth. (Pauling
and Lewin determined that about
one-half the ascorbate taken orally is

from FDA interference or regulation as a prescription drug on the basis that ascorbic acid is vitamin C; that which prevents the vitamin C-deficiency disease scurvy. However, should the notion that the “real” vitamin C is the ill defined C-complex found in plants prevail, then it, the C-complex, not ascorbate, would enjoy the protection afforded vitamins and foods by DSHEA.

Natural Vitamin E

We will concede natural vitamin E to the naturalists. There are cases of molecules apparently required in the diet, but manufactured solely by plants. Animal DNA may never have encoded for these molecules, and even single cell organisms may not encode for them. It is probable that these molecules evolved entirely in plants, and we humans and other animals have evolved to be healthier by eating the plant versions of such molecules, perhaps even containing a complex.

Suggested Reading

Of course case is vitamin E, or the d-alpha-tocopherol form. No animals are known to synthesize vitamin E; there is no readily identifiable deficiency disease; and its molecular structure is therefore unknown. The naturalists concern about the synthetic form of vitamin E (the dl-alpha tocopherol form) is probably legitimate. We speculate that, rather than a vitamin, vitamin E is better classified as a vitamin-like substance, only required in humans to spare the low amount of vitamin C normally present in the tissues on a typical low-ascorbate diet. Higher amounts of natural vitamin E have been shown to provide many health benefits. The vitamin C Foundation recommends 400 to 3200 IU of naturally derived forms of vitamin E, as recommended by the Shute brothers.

Summation

It is a serious error for an alternative practitioner to identify orthomolecular substances, such as ascorbic acid,
as dangerous. Orthomolecular, or bio-identical molecules, are by definition indistinguishable from their naturally created counterparts. These molecules are transported to the cells, regardless of whether they are eaten or endogenously manufactured by other animal cells. There is no experimental evidence that such molecules behave differently in the bloodstream or within cells. There may be, in fact, fewer impurities than what appears in our plant foods.

The naturalist arguments have a broad appeal, especially to those concerned about the unnatural and toxic nature of prescription drugs. Naturalists and orthomolecularists share a common concern with pharmaceuticals. Drug companies often change natural or orthomolecular molecules so that they may be patented and become more profitable. Such molecular changes make drugs toxicimolecular (not orthomolecular) and potentially dangerous.

Much of what we know about the molecules required for life comes from the study of the simple organisms, such as some microbes and yeasts. These simple organisms manufacture most of the vitamins they require within their single cell. Fixed plants must also retain the genetics to manufacture more of the chemicals needed to reproduce than animals require. Higher-order organisms, including plants, have evolved into colonies of cells, each colony with a specific function, but many, if not all, the molecules required for the organism are made by some colony within the plant.

A vitamin is a substance among a group of trace substances, including vitamins, minerals, and amino acids that an animal cell doesn't make but that is a requirement for life. As life progressed, animals emerged that began eating plants. This food contained some of the same molecules animals cells were then making. Over time, species lost their genetic instructions necessary to create these essential molecules. The essential substances are what cells require, less what all the colonies in the organism manufactures and distributes to other cells.

Plant evolution is the model for naturalists, yet plants have evolved to protect themselves from being eaten. As animals ate and became dependent upon plants, a risky relationship developed. Plant DNA has literally become an extension of animal DNA, and animals that don't get a minimal amount of any one of the vitamins they require will die of the deficiency.

Comatose patients can be kept alive indefinitely on man-made products containing all the synthetic vitamins, plus the trace minerals and necessary protein, fats, and carbohydrates. One such complete nutrition product is the Ross Laboratories Ensure™. When the product was originally developed, biotin was not known to be a vitamin. Patients on the early Ensure became ill and died until biotin was added to the formula. All complete nutrition products, including Ensure, provide vitamin C as ascorbic acid. Not one product offers a vitamin C complex.

The naturalist assertion that vitamin C isn't vitamin C - that, instead, it consists of a complex of nutrients - raises many questions. Is ascorbic acid the substance whose deficiency leads to scurvy or are thousands of experimental studies wrong? Why is scientific information about the vitamin C-complex hidden? What experiments have been conducted, and where is science about the C-complex published, and how could Linus Pauling, Sherry Lewin, Steve Hickey, Hillary Roberts, Irwin Stone, Thomas Levy, and others have missed this important information? What exactly is the complex? (Is the C-complex from the orange the same as the C-complex in the tomato? If not, which C-complex is better?) Why do almost all animals except humans produce ascorbic acid, yet not one animal has been found that produces the C-complex? Why would the ascorbic acid synthesized by plant DNA be better than the ascorbic acid that all animals synthesize? On what theory are the animals wrong and the plants right? And how do hospitals keep patients alive with complete nutrition products that contain only ascorbic acid? The naturalists are unable to satisfactorily answer any of these questions.

Today, through the science of chemistry, human beings may now dispense with the need for plant DNA. We encode the process of vitamin synthesis into large chemical manufacturing processes, making these pure molecules reliably, plentifully, and at low cost. Such manufacturing makes it possible for many more people to experience their benefits. Orthomolecular vitamin molecules, however, are biologically identical to the molecules synthesized by living organisms.

I discovered, or rediscovered what Linus Pauling had to say about heart disease. I have already five heart operations, including a quad bypass and various stent operations. I suffered the last heart attack (my fourth) and went through another heart operation (my fifth) in December of 2003. Last October of 2005, I did intensive research (on the Internet) to discover what I could do to stay alive. I was having more chest pain, and I realized I was over due for another heart attack and operation (based on my previous ten years experience).

I read all of Linus Pauling's books. I was very impressed, and I finally understood my situation. This led me to search for more information about vitamin C. [By following Pauling's recommendations], my chest pain is gone. I have not felt this good in over twelve years! I now consider Linus Pauling to be the greatest most significant scientist of this era.

“Richard”

[Read Richard's entire story at the Vitamin C Foundation's online forum at www.vitamincfoundation.org/forum.]

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