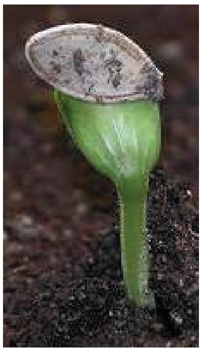

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**Earthworms are the intestine of the soil.**
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# The $B_{12}$-Cobalt Connection

by **Mark Mead** & **John Mann**

reprinted from **SOLSTICE** magazine #34, Feb. '90

Vitamin $B_{12}$ is the only vitamin synthesized solely by a certain small, specialized family of micro-organisms—many of which are abundant in soil. And the only vitamin containing a trace element: cobalt. Vitamin $B_{12}$ owes its chemical name—**cobalamin**—to the cobalt at the center of its molecular structure. Humans and all vertebrates require cobalt, though it's assimilated only in the form of $B_{12}$.

Cobalt is important in the plant world. Bacteria on root nodules of legumes (beans, alfalfa, clover) require cobalt (and other trace elements) to synthesize $B_{12}$ and fix nitrogen from air. Soybeans grown without cobalt are severely retarded in growth and exhibit severe nitrogen deficiency, leading to death in about one of four plants. Adding only a few ounces of cobalt per acre can resolve deficiency symptoms in ten to 21 days.

**$B_{12}$ or not to $B_{12}$**
**vanishing vitamin or magnetic hormone?**
the role of a micronutrient and a trace element in human survival

Cobalt deficiency is far more dramatic in animals, particularly ruminants (cattle, deer, camels, and sheep) grazing on deficient pasture. These animals obtain all their $B_{12}$ from their gut bacteria, but only if bacteria are provided cobalt salts from pasture. Legumes with less than 80 parts per billion (ppb) cobalt can't meet ruminant $B_{12}$ needs. Under deficient conditions, calves and lambs thrive and grow normally for a few months as they draw on $B_{12}$ reserves in liver and other tissue, but soon exhibit gradual loss of appetite and failure to grow, followed by anemia, rapid weight loss and finally death. Marginally deficient pastures cause birth of weak lambs and calves that don't survive long. These symptoms mirror $B_{12}$ deficiency in human infants.

To prevent or alleviate cobalt-$B_{12}$ deficiency, farmers routinely add cobalt to animal feeds or salt licks. Some fertilize pastures with cobalt-enriched fertilizers; others opt for periodic quick-fix $B_{12}$ injections. With any of these measures, all symptoms are reversed and $B_{12}$ in milk and colostrum dramatically increases.

The implication for humans subsisting on vegetarian diets are profound. $B_{12}$ synthesis by indigenous bacteria is known to occur naturally in the human small intestine, primary site of $B_{12}$ absorption. As long as gut bacteria have cobalt and certain other nutrients, they produce $B_{12}$. In principle then, internal $B_{12}$ synthesis could fulfill our needs without any $B_{12}$ provided by diet.

But if cobalt in our diet is on the wane, perhaps the problem isn't so much lack of $B_{12}$-synthesizing intestinal flora as lack of cobalt, the element with which bacteria weave their magic. The burning question then is: how cobalt deficient is our soil?

## Stalking the Wild Cobalt

Investigating soil-cobalt links, we sought perspectives of two researchers: an expert in agricultural chemistry, another in nutrition. Dan Reeter, chief researcher at Bio-Systems Labs in Salida, Colorado, is creating one of the world's most comprehensive computer facilities for soil biology testing. Reeter, whose lab has served agricultural industry for over 40 years, told us: "I can say with certainty there's a decline of soil cobalt. Confirm this for yourself. Simply to pick any Ag magazine—they all push cobalt supplements, spurred by $B_{12}$-poor condition of crops."

**Fire in the Water**
how mineral becomes biology
Dr. Gorge Earp-Thomas
inventor of Tracelyte™

Reeter said soil bacteria, comprising 20 percent of soil biomass, is destroyed or inactivated by ag chemicals, inhibiting uptake and metabolism of cobalt and other trace elements. Reeter directly traces this problem to increasing presence and proportion of $B_{12}$ analogues ("false" $B_{12}$). Reeter reports his extensive tests at Bio-Systems demonstrate plants grown in organically managed soil make significantly higher levels of usable $B_{12}$.

Robert Kay, PhD candidate in nutrition at the Univ. of Connecticut, emphasized

Indonesian farmer
Muhammad Yacob
harvests his record rice crop
after the Tsunami

## Elements
in the Human Body

| element | symbol | % atoms | % weight |
|---|---|---|---|
| ORGANIC | | | |
| Hydrogen | H | 62.0 | 9.7 |
| Oxygen | O | 26.0 | 65.0 |
| Carbon | C | 10.0 | 18.6 |
| Nitrogen | N | 1.5 | 3.2 |
| MAJOR | | | |
| Calcium | Ca | .2 | 1.8 |
| Phosphorus | P | .2 | 1.0 |
| Potassium | K | .06 | .4 |
| Sodium | Na | .06 | .2 |
| Sulfur | S | .05 | .04 |
| Chlorine | Cl | .04 | .2 |
| Magnesium | Mg | .03 | .06 |
| TRACE | | | |
| Iron | Fe | .007 | .0002 |
| Iodine | I | .0005 | [na] |
| Silicon | Si | .0000003 | [na] |
| Flourine | F | [na] | [na] |
| Copper | Cu | [na] | [na] |
| Manganese | Mn | [na] | [na] |
| Zinc | Zn | [na] | [na] |
| Selenium | Se | [na] | [na] |
| Cobalt | Co | [na] | [na] |
| Molybdenum | Mo | [na] | [na] |
| Chromium | Cr | [na] | [na] |
| Tin | Sn | [na] | [na] |
| Boron | B | [na] | [na] |
| Nickel | Ni | [na] | [na] |
| Vanadium | Va | [na] | [na] |

uncertainties in $B_{12}$ research, especially in light of new methods to measure $B_{12}$ and new insights these methods made available. He also cautioned categorization of "true" vs. "false" $B_{12}$ may be too absolute. "We no longer talk about simply $B_{12}$, since we now know there's many varieties of cobalamins with varied biological action (i.e., availability). There is no 'gold standard' in this area."

Asked if current research suggests an across-the-board decline in $B_{12}$ due to soil demineralization, Kay responded, "It's complex to study, and probably premature to make hard conclusions. But subjectively—yes, I have a sneaking suspicion that speculation is valid."

## $B_{12}$—A Glacial Legacy?

According to "Trace Elements in Agriculture," the cobalt range for U.S. soils in 1969 was 30 and 50 ppb—well below the ruminant requirement and "possibly enough to slow legume growth and turn leaves yellow prematurely," says Maurice Cook, PhD, professor of Soil Science at North Carolina State Univ. In **Micronutrients in Agriculture**, Drs. Kubota and Allaway state, "Forage grasses and cereal grains frequently lack required concentrations of cobalt, and ruminant diets based on grasses or grains require cobalt supplements in most areas of the U.S.

Glaciated regions in the Northeast and Great Lake states contain more total cobalt than sandy Coastal Plain soils."The significance of "glaciated regions" can't be overstated. In the 100,000-year glacial cycle, soil mineral content is thought to fluctuate, reaching an ebb at the end of an interglacial—the precise geological point where we now stand. Explains Dr. Cook, "Glaciers act as a giant bulldozer to pulverize rocks and create new parent material for soil formation. One primary effect of glaciers is to distribute fresh rock material over land."

Dr. Cook suggests intensive dehydrating and acidifying effects of farm chemicals on conventionally farmed soils will tend to accelerate cobalt losses, though this may be countered by alkalizing agents such as calcium or ionized potassium salts. Also, plants with deep root systems, such as clover and alfalfa, are able to pull cobalt from deep subsoils and redistribute it in topsoil. This underscores the wisdom of crop rotation alternating legumes with non-legumes.

## Soil Remineralization

Research we've reported in past articles [see "Salts of the Earth", "Whither the Trees?", "Perspectives on the Climate Crisis", "Stone Age Agriculture"—Ed.] corroborates the observation that soil minerals, including cobalt, are in precipitous decline. As cobalt declines, $B_{12}$ content in food necessarily follows.

The emerging nutritional crisis of $B_{12}$ deficiency calls for remedial action in the macro- as well as micro-environment. Broad-spectrum remineralization of topsoils using crushed rock or dried seaweed from ocean areas known to contain sufficient cobalt can reestablish mineral balances necessary for healthy food supply able to fulfill our requirement, both direct and indirect, for $B_{12}$. The cobalt connection is especially relevant to us growing our own food, since cobalt-deficient areas likely are well-established. Beyond promoting remineralization to the farm community, we can adopt the practice in our gardens.

Special acknowledgments to **Maurice Cook**, PhD in Dept. of Soil Science, No. Carolina St. Univ.; and **Forrest Nielsen**, PhD of the USDA/ARS Human Nutrition Research Center in Grand Forks, ND.

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