MOUNTING WORLDWIDE CRISIS in AGRICULTURE

by Dale L. Schurter

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Government leaders worldwide have come face-to-face with a *dangerous*—yet *little understood*—CRISIS IN AGRICULTURE!

Today's farmlands are tired, overworked and being depleted. In man's husbandry of the soil, his impulse is to take the simple, fast, cheap, easy way—either ignoring or not recognizing the real causes of the problem. Too often, agriculturists see only the *effects*, while the actual *causes* of the crisis grow worse and more complicated.

If we are to preserve the well-being of the soil for our sake, and for the sake of our children, and children's children, a major reform in modern agriculture is a MUST. We must *recognize* our agricultural problems—their *causes*—and CORRECT THEM.

WHY are we IN an agricultural CRISIS? Where is it leading—and what is the solution?

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About the Author and Ambassador Center

December 4, 2008, marked the start of Ambassador Center in the city of Wadsworth, Ohio. This rigorous, two-year educational program, founded by Chancellor David C. Pack and supported by The Restored Church of God, has one overarching purpose: the development of the whole person.

While The Center began in the first decade of the 21st century, the tradition for the institution began more than 60 years earlier in Pasadena, California, with Ambassador College. Founded by Herbert W. Armstrong and funded by the Worldwide Church of God, the college eventually branched into three separate campuses in Pasadena, California; Bricket Wood, England; and Big Sandy, Texas. The two North American campuses routinely won awards for their beauty and quality, and all three were renowned for their immaculately landscaped grounds.

The college operated under the motto, "Recapture True Values." It taught students that, "The Word of God is the foundation of knowledge."

Today, Ambassador Center holds to the same high standards of excellence.

For example, the original Ambassador College had an extensive, cutting-edge agriculture program, which continues today as the Agriculture Education and Research Institute (AERI).

Sharing experience: The author delivers a lecture on husbandry techniques in Destin, Florida. Mr. Schurter oversees the Agriculture Education and Research Institute, which is a division of Ambassador Center, the modern continuation of the original Ambassador College.

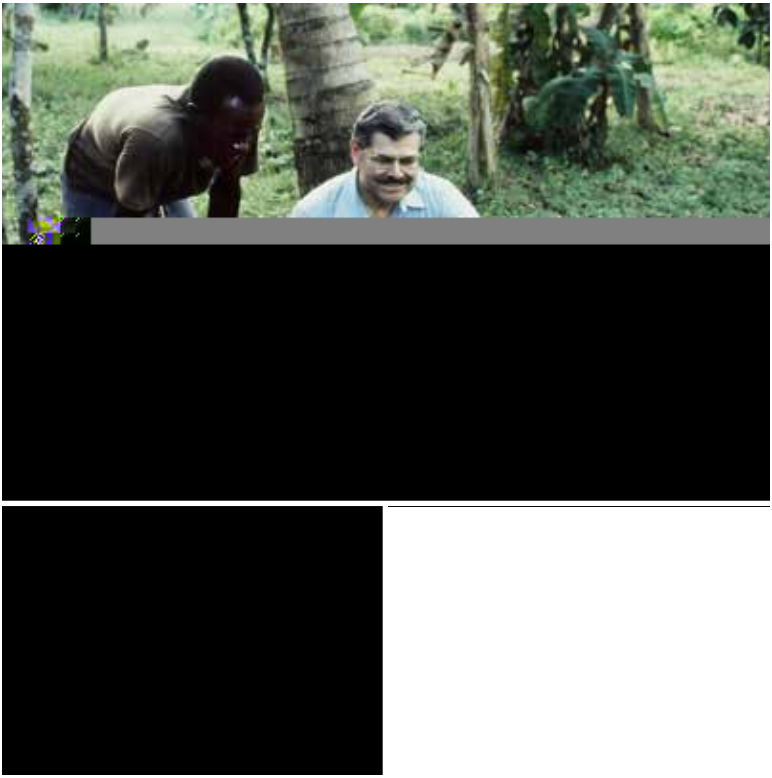
The vision for the AERI began in the mid-1960s: "When Dale Schurter graduated from Big Sandy in 1965, Herbert W. Armstrong asked him to teach a course in agriculture and submit a proposal for an ag curriculum," Ambassador College's student newspaper *The Portfolio* recorded in 1977. "In the spring of 1966 Mr. Schurter headed up the [educational, research, production and extension] program…and continued as Ag Department head until 1975…The four areas of effort during the first seven years were research, with a view to recapturing true values in agriculture, student education, extension services (including some soil testing and fertilizer sales) and production."

Mr. Armstrong's vision was for Ambassador College to pioneer the use of agricultural principles found in the Bible, coupled with natural cycles, scientific and practical research, and common sense, to find the most effective and sustainable ways to raise healthy animals and produce quality feed crops and food (such as

Continuing tradition: Ambassador Auditorium (above) is one of the many elements of the former Worldwide Church of God headquarters that created an environment of quality to cultivate well-rounded personalities. These same standards are evident in The Restored Church of God's Headquarters Hall of Administration building and campus (pictured in the artistic rendering below).

meat, milk, eggs, cheese, vegetables, fruits and honey). The ultimate purpose was to bring happy, healthy and abundant living to those who implemented these practices.

AC students were presented the opportunity to apply what they learned on the college's 1,600-acre (and additional rented 2,600-



Outstanding results: Above, Mr. Schurter is pictured in a buckwheat field during a visit to Guyana, South America, where he worked with government leaders and local officials to increase the level of food production in the nation. Left, a pepper plant produces fruit as a result of these efforts. Right, black-eyed peas are grown using sustainable farming practices taught by Mr. Schurter.

acre) farm and ranch. Over a five-year period, a 27-course agribusiness major became an important component of the Big Sandy Ambassador College curriculum and in serving the college students, employees and community.

Mr. Schurter and colleagues also organized outreach programs and informational workshops designed to educate the public about

Accelerating World Crisis in Agriculture

Today's agriculture is in *deep trouble*. It faces a crisis that even now affects the cost and quality of the food eaten in every corner of the world.

Famine and disease have become a reality for the poor, "have not" areas of the world. But few are aware that an agricultural crisis of *equal*—and *greater*—magnitude looms on the horizon for the third of the world we call the "have" nations.

The United States, Canada, Western Europe, Australia, South Africa, and the other "have" regions have been dazzled by the storybook pronouncements of "scientific agriculture." We who live in such areas have become accustomed to talk of "burdensome surpluses," and, while others were going hungry, came to believe *we* were immune to a food crisis.

More than 40 years ago, this organization's predecessor published a booklet with a similar title to this one predicting that the growing crisis in agriculture then, if not seriously addressed on a large scale, could and would begin to adversely affect more affluent countries. At the time, we stated, "In the very near future, the growing crisis in agriculture could easily cause YOU to be numbered

among the seriously sick and diseased—or among those hapless millions who go to bed at night with empty, aching stomachs."

True to what we said, this is coming to pass, with increasing numbers of people now suffering illness as a result. Also, disease and death rates in livestock, poultry and crop industries are increasing, with many elements of production becoming critical. A genuine crisis *has* developed in agriculture worldwide, including in the United States. World food shortage is no longer a prophecy but a reality, and one that will greatly worsen unless wholesale changes occur in our approach and attitude toward agriculture and *its* approach to food production.

And this does not even take into account the shocking fact that arable land is disappearing by millions of acres per year!

Diminishing Land Resources

The United States is an alarming example of vanishing rural land. According to American Farmland Trust, more than one acre of farmland was lost per minute, with more than four million acres of agricultural land—an area the size of Massachusetts—disappearing from 2002 to 2007 as a result of homes and urban sprawl. During a 25-year period, the population grew 30 percent while land converted

PHOTO: THINKSTOCK

for urban use increased 57 percent. And this is only in the United States!

According to the *CIA World Factbook*, "The planet's population continues to explode: from 1 billion in 1820, to 2 billion in 1930, 3 billion in 1960, 4 billion in 1974, 5 billion in 1987, 6 billion in 1999." In October 2011, the world's population passed the *seven billion mark!* At last calculation, the world's arable land is a little over 10 percent.

While cultivable land areas are "shrinking," *BBC* reported that the United Nations expects that at present, "Food production will have to increase by 70% over the next 40 years to feed the world's growing population…"

Even simply *maintaining* current food production is unpromising. The world depends heavily on United States exports, along with products from Eastern European countries and those situated on the Black Sea. *IRIN*, the United Nations news service, reported that in the beginning of 2012, the U.S. "planted more than 39 million hectares of maize [corn], 5 percent more than in 2011, making it the highest acreage under maize in the last 75 years."

It also stated that the "third largest soybean crop ever was put in."

But this made no difference, as "record high temperatures and poor rainfall—less than 50 percent of normal precipitation in the corn-belt, a group of Midwestern US states where maize is traditionally grown—wilted most of the standing maize. In the past few weeks [of June], just when the plants needed moisture in the crucial pollination phase, there was little or none. 'Irrigating this scale of farms is out of question—we would need to empty an ocean,' said [Abdolreza] Abbassian [secretary of the Intergovernmental Group on Grains for the UN's Food and Agriculture Organization].

"The USDA announced [in July 2012] that only 48 percent of crops were in a 'good to excellent' condition, down from 72 percent at the beginning of June. This is the worst good to excellent rating since 1988, said the department, when 23 percent of crops were given a good to excellent rating…The projections for soybeans have also been reduced by eight percent—the lowest level since 2003" (ibid.).

As a result, *The Associated Press* reported that "a number of farmers in the hardest hit areas of the Midwest have cut down their crops just midway through the growing season."

On top of this, *Reuters* showed that grain exports for 2012 from Russia, Ukraine and Kazakhstan "could be at least 35 million tonnes less than in 2011," and in 2012 Morocco's "cereals crop fell from 8.4 million tonnes in 2011 to 5.1 million tonnes."

For the first time ever, there is no new, rich agricultural land that man can use. The deforestation of the Amazon Basin and rainforest areas of many other countries of the world continues, but good crop production on these soils is usually short-lived, followed by a reduction of rain.

PHOTO: THINKSTOCK

According to the film "Food or Famine," in 1850, Earth's land area, if equally distributed, was about 33 acres per person; in 1900, it was 24 acres; by 1950, it had dropped to 15 acres; in 1974, it was 10 acres. Given today's most recent statistics, it is NOW only *five acres*.

But that is not all! Of these five acres, approximately one and a half are desert—and too dry for production. Another one acre represents the arctic and polar regions—meaning it is too cold. Yet another acre is jungle and tropical forest, which is too wet for production. The additional one acre is mountainous—too high and steep. *This leaves only a half-acre of land per person suitable for cultivation*. And—you guessed it—half of this remaining half acre has already been depleted by previous generations—wasted by

erosion because of improper tillage, monoculture and other poor management practices.

What about the remaining one-fourth of an acre?

Seven Inches from Starvation!

No matter who you are or where you live, you must eat food to continue your physical existence.

Ultimately ALL your food comes directly or indirectly from the soil and, more specifically, from the top few inches known as topsoil.

Author Karl B. Mickey wrote in *Man and the Soil* that this life-sustaining topsoil "lies in a thin layer of an average depth of seven or eight inches over the face of the land." In some few areas, it may be as deep as two feet or more, but in many others it is considerably *less* than seven inches.

"If that layer of topsoil could be represented on a 24-inch globe it would be as a film three-millionths of one inch thick," Mr. Mickey wrote. "That thin film is all that stands between man and extinction."

This thin layer of earth sustains ALL PLANT, ANIMAL AND HUMAN LIFE upon it!

Previous civilizations have already destroyed much of the topsoil, and today we are depleting what remains more rapidly than at any other time in history.

PHOTO: THINKSTOCK

Record of History

The story of mankind's interaction with the land is long, complicated and brimming with lessons—most instructive in what *not* to do.

In the journal *BioScience*, Dr. Lamont C. Cole compares the leading aforetime civilizations to their modern counterparts.

"The valley of the Nile was [a great] cradle of civilization. Every year, the river overflowed its banks at a predictable time, bringing water to the land and depositing a layer of silt rich in mineral nutrients for plants.

"Crops could be grown for 7 months each year. Extensive irrigation systems were established before 2000 BC. This land was the granary of the Roman Empire, and this type of agriculture flourished for another 2,000 years.

"But the population has continued to grow and economic considerations have diverted land from growing food to growing cash crops such as cotton."

In 1902, in an effort to promote year-round irrigation, the Aswan Low Dam was constructed in the southern part of the country. But it proved to have an inadequate reservoir area. After almost overflow-

ing in 1946, the Aswan High Dam was constructed in 1970 to further contain the water.

While the dam has irrigated hundreds of thousands of acres, the soil has been deteriorating through salinization, a process that increases soil's salt content. In addition, the productivity of its riverside lands has decreased—proving to be a disaster for Egypt. Any plusses accorded the dam have been far outweighed by the creation of serious problems. Aside from salinization, "population growth has virtually destroyed any possibility that…agricultural land can significantly raise the average level of nutrition."

The Sahara Desert was once forested and inhabited. "The glories of ancient Mali and Ghana in west Africa were legends in medieval Europe. Ancient Greece had forested hills, ample water, and productive soils" (ibid.).

Today, less than 10 percent of land in modern Iraq—site of the Tigris and Euphrates valleys—is cultivated. Dr. Cole wrote, "The landscape is dotted with mounds representing forgotten towns, the ancient irrigation works are filled with silt, the end product of soil erosion [the oldest and biggest polluter in history], and the ancient seaport of Ur is now *150 miles from the sea* with its old buildings buried under [several] feet of silt…Similar conditions prevail in Iran which was once the seat of the…Persian Empire…" (emphasis added).

Yet the valleys of the Tigris and Euphrates had at one time supported some of the greatest civilizations. With a complex irrigation system built using its flood plain, these rivers produced the fertile soil that nourished the Sumerian and Babylonian empires.

"Herodotus tells us that this country was one of the greatest for the production of grain, yielding returns as high as two hundred fold or even three hundred fold in exceptional years," Milton Whitney wrote in *Soil and Civilization*.

Citing *Conquest of the Land Through Seven Thousand Years*, Dr. Cole stated in *BioScience* that "old Roman roads [in Lebanon] which have prevented erosion of the soil beneath them now stand several feet above the rock desert. But in a churchyard that had been protected from goats for 300 years, the cedars were found [in] about 1940 to be flourishing as in ancient times."

Farther east, a similar pattern is seen. China was one of the first to build an agricultural structure conducive to supporting a society.

However, as with other ancient civilizations, population growth led to terrible abuse of the land. Today, the nation endures recurring, catastrophic floods due to silt-clogged rivers, some colored yellow by eroded soil.

In addition, the ancient irrigation systems of India and China "stand abandoned and filled with silt. When the British assumed the rule of India two centuries ago, the population was about 60 million. Today it is about [1.2 *billion*] and most of its land problems have been created in the past century through deforestation and plowing and the resulting erosion and siltation, all stemming from efforts to support this fantastic population growth" (ibid.).

Speaking of Central and South America, Dr. Cole said, "Archaeologists have long wondered how the Mayas managed to support what was obviously a high civilization on the now unproductive soils of Guatemala and Yucatan. Evidently, they exploited their land as intensively as possible until both its fertility and their civilization collapsed. In parts of Mexico the water table has fallen so that towns originally located to take advantage of superior springs now must carry in water from distant sites."

Aerial reconnaissance "has revealed ancient ridged fields on flood plains, the remnants of 'a specialized system of agriculture that physically reshaped large parts of the South American continent'" (ibid.).

According to Dr. Cole, today we call these areas of the world underdeveloped. Yet we ought to call them *overdeveloped*!

Lesson of Rome

A closer look at Rome is worthwhile, as the empire's territory is considered a classic case study in manmade erosion.

From Rome's Golden Age to the Western empire's collapse, *all* soils in the farmed areas (with the possible exception of Egypt) had been deprived of the nutrients necessary for the production of healthy crops.

"In England evidences of Roman cultivation have been found five feet below the present surface," Mr. Mickey wrote in *Man and the Soil*. "Largely as a result of Roman exploitation, there are [almost] no forests on the Mediterranean coast from Spain to Palestine. Typical of this region is the North Dalmatian coast…[where the] hills of this region

once were magnificently clothed with primeval forests. The Romans and the Illyrians, the earliest inhabitants, began the destruction of the forests. The first Slav settlers were prodigal, too. The denudation of the hills was completed by the Venetians, from about 1400 to 1700, who cut the trees for timber for their ships and piles for their palaces. The Yugoslav government was unable to reforest the hills because the young trees not uprooted by the savage north winds of winter were eaten by the goats of the peasants" (ibid.).

Many of these regions saw greatly reduced populations before the empire's fall in AD 476, chiefly due to the deficient soils that could no longer sustain the region's inhabitants.

Until modern times, Rome represented perhaps the worst example of long-term, widespread agricultural mismanagement. As a consequence, "the results of [Rome's] avarice are visible yet today, in the eroded hills of Greece and the Mediterranean coast, in the sands of north Africa and western Asia."

Yet in the 1940s, some soils in Italy had "completely recovered and…were producing more than they ever did." Also, *some* soils in Western Europe and England had been "farmed for centuries not only without injury but…with yields steadily increasing for the past [217] years" (*Man and the Soil*).

WHY? How did this recovery come about? And why is it that some soils of Western Europe and England did not suffer erosion comparable to that of so many other areas?

"Golden Age"

Following Rome's self-destruction, Europe's inability to keep fertile soil in the Middle Ages continually pushed them to the brink of starvation.

During the 18th century, central Europe's soils showed severe deterioration. In his 1947 book *Food or Famine: the Challenge of Erosion*, Ward Shepard wrote, "Since the end of the Napoleonic Wars, the world has had a larger food supply than it ever had before. The nineteenth century was the golden age of abundance. Except for this relatively brief period, though, food has been man's chief preoccupation through his long, precarious history and prehistory."

But this age of abundance is *rapidly* drawing to a close. In 2010, almost one in seven people in the world—925 million—were

underfed and undernourished, according to the Food and Agriculture Organization of the United Nations. And the first six months of 2012 showed that an additional 50 million worldwide are without food.

In the 19th century, two notable factors helped make Europe's food supply plentiful—parallel revolutions in industry and agriculture.

This was mostly due to the new conservation efforts put forth that transformed crop growth. The most significant practices are still in use today, such as contour farming and the process of rotating crops with bare fallow.

In addition to these, Mr. Shepard wrote in *Food or Famine*, the institution of effective crop rotations also helped accelerate the improvement in agriculture, along with the shift "from a soil-depleting grain economy to a soil-building livestock economy.

"The agricultural revolution not only greatly increased Europe's food production, but gave an unparalleled stability to her soils by devoting a high proportion of them to permanent improved pasturage. This inherent stability and balance have been maintained despite two world wars and the immense growth of [the] European population."

This was aided by the fact that central European soil is not as easily erodible as others. Also, rainfall there "is regular, frequent, and gentle, as contrasted with the heavier and more irregular rains that prevail in most parts of the United States" and the rest of the agricultural world (*Man and the Soil*).

But there is also a most important fact that must be considered: "soil stability in Europe was purchased at the expense of the *ruthless exploitation* of the soils in the new continents" (*Food or Famine*, emphasis added).

The dramatic agricultural revolution that fed the European "masses fathered by the machine age" was important. But even more so was "the European colonization of the rich new fertile lands—the Americas, Africa, and Australia—and the opening up of the black lands of Russia, coincidentally with perfecting machine exploitation of the soil and rail and ocean transport of food crops to the ends of the earth.

"With machine tillage and rapid transport, the vast new lands became the granary of the world. Their produce could be quickly moved to feed the swiftly growing industrial populations of the capitalist countries or to alleviate famine in India or China" (ibid.).

The soils and resources of the new frontiers—especially in North America—seemed inexhaustible. But not for long!

Last Frontier

The New World was shamefully exploited and abused. By 1685, streams were muddy with silt, and floods increased due to deforestation. But the destruction of field and forest continued unabated.

George Washington and Thomas Jefferson—among a host of other early American leaders—were alarmed by what they saw taking place around them. They crusaded against destructive farming practices in word and deed, but to no avail, according to Mr. Mickey. The rape of the New World continued—and accelerated. When one tract of land wore out, undeveloped land was always available a little to the west.

"Every social and economic force seemed to encourage the spread of American agriculture. The invention of McCormick's reaper, in 1831, and the other inventions of farm machinery that followed it made possible the cultivation of more and more acres… When the iron plow proved inefficient in the sticky prairie soil, the self-scouring steel plow appeared in 1837 to accelerate the westward march of agriculture" (*Man and the Soil*).

Throughout the millennia, when man has worn out land in one area, he has moved to another. The close of the 19th century saw farming territory expanded to Oklahoma, marking the last free land area that could be occupied. After that, there was no rich, new agricultural land to which he could go.

The last significant U.S. frontier had been reached!

Decades of Destruction

The consequences of misuse of the land became more fully apparent around 1914, at the beginning of the first world war.

"During World War I, 50 million acres of agricultural lands in Europe, exclusive of Russia, went out of cultivation. Consequently, 40 million acres of grass lands in the United States were thrown *into* cultivation for the first time. This land—most of it in the area of western Texas and Oklahoma, extending into bordering parts of

Colorado, Kansas, and Nebraska—never was fitted for intensive cultivation."

"In the madness of the 'wheat rush' these lands were ripped open by the plow and wheat was cultivated on them by a process which is better described as 'mining' than agriculture."

"On many of these huge farms there were no human inhabitants. Men came in the fall or the spring, plowed and seeded the soil, and went away. They returned in the summer, gathered the crop and went away again. After the harvest, the bare soil lay unprotected in that arid, windswept region, while the fierce sun baked it and robbed it of moisture and fertility" (*Man and the Soil*).

The original condition of the soil was so rich that the effects of poor husbandry took a number of years to become apparent. Then, over the 20-year span of 1914 to 1934, erosion took a greater amount of soil than in any previous period, which created an environment ripe for the coming great dust storms.

In portions of the U.S. Plains states, as well as Arizona and California, there are now deserts where approximately 90 to 140 years ago lush grasses reached up to horses' bellies or higher, and bumper wheat crops were a yearly occurrence.

America Not Alone

Much of the world followed the U.S. in these short-sighted practices. In the 19th century, economic expansion, with attendant soil mismanagement, took place around the globe. The population explosion pushed for more intensive farming practices that would rob the planet of its capability to support its occupants.

Africa ranks equally or perhaps even ahead of North America in the extent and severity of depletion.

Data has shown that most nations in Central and South America suffer these problems to some extent, Mr. Shepard wrote in *Food or Famine: the Challenge of Erosion*. In many areas, such as the wheatlands of Chile and the vast plains of the Argentine Pampas, they are severe. Overgrazing and tilling up grasslands to cultivate wheat have taken a heavy toll in destroying the choicest agricultural lands on the continent. The Amazon Basin and other tropical areas—though of less value agriculturally—also reveal excessive erosion.

The story of topsoil depletion in the Australian wheatlands and grazing lands on the border of the central desert sounds like a replay of what happened in the American West of the 1930s. Deforestation of mountains has also led to flooding and siltation issues (ibid.).

And the same picture emerged in New Zealand, where acres of forest converted into pastureland were overgrazed. Many steep slopes that should have been left to permanent forest were cleared to accommodate more sheep and cattle.

Yet it is not just the aforementioned countries that are devastating their soil. Erosion swept with unexpected force through the population-strained country of India as well as the wheatlands of Russia and grasslands of Eurasia.

"Looking at the world's soils and natural resources in the large, they are in general and with few exceptions characterized by similar degenerative processes, which may be classified as follows:

"1) In humid regions, water erosion is destroying sloping lands by virtue of poor methods of tillage and by overgrazing of pastures.

"2) The cultivable grass-lands—the prairie soils of the Americas, Australia, Africa, and Russia—are being depleted by one-crop farming, notably wheat, and by wind and water erosion.

"3) Semi-arid grass-lands in the Americas, Eurasia, Africa, and Australia have been severely devegetated by overgrazing, with intense wind and water erosion that in many regions is producing, or threatening to produce, true desert conditions.

"4) The bulk of the world's forests are being destructively exploited, not over 12 or 15 percent of the total forest area being under scientific management.

"5) In all these countries, poor tillage, overgrazing, and deforestation are wasting vast quantities of surface water by permitting it to rush into stream channels and out to sea instead of being absorbed into the soil by well-kept vegetative cover. This wastage causes desiccation of the land, the disruption of rivers and valleys, and an increasing menace to immense potential sources of hydroelectric energy" (*Food or Famine*).

Earth's total forest and grassland cover has already been depleted well below the safety margin for maintaining a healthy climate.

Assessing the Erosion Problem

"Erosion has modified the surface of the earth more than the combined activities of all the earthquakes, volcanoes, tornadoes and tidal waves since the beginning of history, yet its processes are so gradual that we…have been prone to ignore it," Austin Burges wrote in *Soil Erosion Control*.

And ignore it most have!

PHOTO: THINKSTOCK

In 1935, the United States Congress began to take notice. It established the Soil Conservation Service to address the widening scope of manmade erosion. The seriousness of the situation was driven home by a series of "calamities in the form of searing droughts, stupendous floods, and continent-darkening dust storms that impressed on men's minds, to the four corners of the earth, the fury of the swiftly spreading revolt of nature against man's crude efforts of mastery" (*Food or Famine*).

What did the Soil Conservation Service find when they made their first survey? They discovered that manmade erosion was "in progress on more than half our land surface—on more than a billion acres of the less than two billion acres in the continental United States.

"They found that already over 100 million acres of our best cropland had been irremediably ruined for further cultivation" (ibid.).

In addition, Mr. Shepard wrote: "An even more destructive and critically dangerous erosion has swept over the western grass-lands of the Great Plains and intermountain plateaus after fifty or seventy-five years of overgrazing by livestock and futile and mistaken efforts to subdue these lands to the plow…Nowhere in America and almost nowhere in the world is the stupendous breakdown of great land masses and river systems more advanced, and in few parts of the world has man been more decisively defeated by nature than in the grass-lands.

"On our third great category of land—forest-land—America has met the same decisive defeat at the hands of nature."

Despite conservation efforts over the past 75 years, government estimates from the Soil Conservation Service, which became the Natural Resources Conservation Service in 1994, indicate that nearly two-thirds of the 1.35 billion acres of privately owned rural land in the U.S. (about three-fifths of the total land area) need additional conservation treatment!

Estimated Annual Loss

In his book *Soil Erosion Control*, Mr. Burges recorded that erosion by wind and water in the 1940s annually removed "21 times as much fertility from the fields of the United States as do the crops harvested from them."

In accordance with the same calculations, Mr. Mickey wrote in *Man and the Soil*, "This loss in plant nutrients…represents 60 times the quantity used each year in commercial fertilizer."

Food or Famine also stated, "From our farms and grass-lands alone, man-made erosion [was] moving over *three billion tons* of soil every year down into our rivers and reservoirs and out to sea" (emphasis added).

To put this into perspective, Mr. Burges described that hauling this vast amount of earth "would require a train of freight cars long enough to encircle the globe at the equator *37 times*!" (emphasis added).

That is a loss of about one-half ton of topsoil for every man, woman and child on Earth.

This is the same topsoil that holds the vital nutrients needed to produce the sustenance we depend on and serves as a thin line that separates man and famine.

"On the basis of 1,000 tons of topsoil to cover one acre seven inches deep, that meant the equivalent…of 7,000 one-hundred-acre farms" was lost in the U.S. to water erosion down the Mississippi River every year (*Man and the Soil*). That equates to about two million tons per day!

"All of the rivers of the earth probably [carried] to the sea about forty times as much sediment as that carried by the Mississippi," *The Illustrated Library of the Natural Sciences* stated.

Recent years have seen little improvement, with estimates from 2007 showing that *87 percent* of cropland continues to "erode excessively"—meaning that soil erosion rates are beyond the maximum annual "loss that will permit crop productivity to be sustained economically and indefinitely on a given soil" (U.S. Department of Agriculture).

Former USDA International Agricultural Analyst Lester Brown wrote in his book *World on the Edge: How to Prevent Environmental and Economic Collapse*, "As long as soil erosion on cropland does not exceed new soil formation, all is well."

In the past two centuries, however, erosion has *far exceeded* the natural rate of replacement.

Dr. Brown stated, "Today, roughly A THIRD of the world's cropland is losing topsoil at an excessive rate, thereby reducing the land's inherent productivity. An analysis of several studies on soil erosion's effect on U.S. crop yields concluded that for each inch of topsoil lost, wheat and corn yields declined by close to 6 percent" (emphasis added).

Following a series of high-intensity deluges in 2011, Richard Cruse, an agronomy professor at Iowa State University, told *The New York Times*, "In a variety of locations, we're losing topsoil considerably faster—10 to as much as 50 times faster—than it's forming" (emphasis added).

But what has been the source of such dramatic losses?

"In some situations, the threat to topsoil comes *primarily from overplowing*, as in the U.S. Dust Bowl, but in other situations, such as in northern China, the cause is primarily overgrazing. In either case, permanent vegetation is destroyed and soils become vulnerable to both wind and water erosion…*Giant dust bowls are historically new, confined to the last century or so*. During the late nineteenth century, millions of Americans pushed westward, homesteading

on the Great Plains, plowing vast areas of grassland to produce wheat. Much of this land—highly erodible when plowed—should have remained in grass. Exacerbated by a prolonged drought, this overexpansion culminated in the 1930s Dust Bowl…" (*World on the Edge*, emphasis added).

What wind erosion can do was demonstrated by an unprecedented dust storm, or "duster," on May 11, 1934. Mr. Mickey recorded that it "carried away an estimated *300 million tons* of the topsoil of western Kansas and Oklahoma and the bordering parts of Texas, Colorado, and Nebraska" (emphasis added). On the same basis as mentioned above, this one duster, "meant the equivalent of 3,000 one hundred-acre farms taken out of crop production" (*Man and the Soil*).

But the lessons from the Dust Bowl have not been fully learned. Soaring corn and soybean prices in 2011 drove farmers to once again till more land for crops—from steep hillsides to grassy pastures.

"'There's a lot of land being converted into row crop in this area that never has been farmed before,' said [a farmer in western Iowa], explaining that the bulldozed land was too steep and costly to farm to be profitable in years of ordinary prices. 'It brings more highly erodible land into production because they're out to make more money on every acre'" (*The New York Times*). Such shortsighted practices mine cash for the moment instead of building renewable assets for the next year—and generations to come!

Yet even after cultivating more land, crop yields still fell short of those recorded in 2010.

Then in 2012, after a planting season surpassing that of the past 75 years, *Bloomberg* reported that record drought struck the U.S. and drove 29 states into natural-disaster status. The corn market forecasted a loss of 60 million metric tons, which skyrocketed prices up 55 percent within five weeks!

In an effort to aid livestock producers, protected land was opened in July.

"Additional acres in the Conservation Reserve Program will be made available to farmers and ranchers for haying or grazing, as the most widespread drought in seven decades has substantially reduced forage for livestock, the USDA said.

"The lands made available are classified as 'abnormally dry' and do not include sensitive lands such as wetlands and rare habitats," *Agence France-Presse* reported.

The combination of overplowing, overgrazing, deluges and droughts leaves the land even more susceptible to erosion than previous years. One wonders how much longer it will be until history repeats itself.

All these figures, of course, must be taken only as estimates. Erosion takes away the prime materials of the soil. Therefore, some experts believe the loss "is *far greater* than is apparent from a mere consideration of its actual weight or total quantity" (*Conservation of the Soil,* emphasis added).

PHOTO: THINKSTOCK

Loss of Water

The effects of man's mismanagement of the land continue to spread like ripples in a pond. As rainwater carries away vital nutrients contained within the soil, the surface water it drains into becomes unusable due to sheer mass of debris. So man has been sowing the seeds of his own destruction by fouling the two primary sources of nourishment: the soil and the water upon which all life depends.

Evidence of this manifests itself in our rivers and streams. During the 1970s, the USDA reported more than 8,000 of the 12,711 small watersheds identified in the U.S. mainland—or 65 percent—as having conservation problems needing solutions. Today, ALL watersheds are in need of treatment, with only those of "high need" up for consideration, according to the USDA.

Yet "engineers, still bemused by the fallacy that man can conquer nature, dream of restoring our broken-down river systems by the simple expedient of erecting gigantic flood-detention and silt-detention dams. This is a naive oversimplification of the problem."

"For the engineers ignore the most significant aspect of their problem, namely, *that nature herself*, violently reconstructing entire watersheds in an effort to cope with the surplus runoff, *has carved over 200 million gullies in the United States*," Mr. Shepard wrote in *Food or Famine* (emphasis added).

Testifying to the unconquerable force of nature, "an estimated 2000 irrigation dams in the United States are now useless impoundments of silt, sand, and gravel" (*BioScience*).

Improper use of land has not only affected surface water quality, but it has also spread into the seas where our rivers lead, as reported by *The New York Times*: "Fertilizer runoff is responsible

PHOTO: THINKSTOCK

for a vast ‘dead zone,’ an oxygen-depleted region where little or no sea life can exist, in the Gulf of Mexico.”

Whether simply overlooked or willingly ignored, proper soil fertility management and land use has been proven to vastly reduce both water loss *and* erosion. Unless there is a return to these true values, these losses will lead to catastrophe!

PHOTO: THINKSTOCK

Declining Quality of Today's Soil

Robust human health demands wholesome food, but wholesome food can only come from fertile and productive soil.

Just what is this miracle we call soil? How does it work? What is its function in the cycle of life? This is basic knowledge we all should possess.

Soil is a complex ecosystem composed of six parts: (1) air, (2) water, (3) rock mineral particles, (4) dissolved minerals, (5) organic matter—dead remains of plants and animals (and animal wastes)—and (6) a vast community of living organisms. These all work together to perform important functions.

One major function is to provide a place in which plants can live and grow to give us food. Another is to act as a "garbage processing plant" that not only rids the landscape of plant, animal and human waste and refuse, but also decomposes the unusable refuse and gives it back to us in a form that is usable and beneficial to producing food.

Realize this towering fact: fertile topsoil is BY FAR man's most valuable and indispensable natural resource.

Agronomically, the *dust* is the best, most mineral-rich part of the soil. The smallest soil particle is called a colloid, and the dust

is made up of both humus and clay colloid particles. These tiny particles hold/carry the vast majority of the minerals that form the structure of the soil—and thus the "structure" of plants, animals and humans.

Unknown to most, agricultural principles found within the Bible's pages align with scientific laws of nature. The first book of the Bible, Genesis, states that mankind was formed "of the *dust* of the ground" (2:7).

Consider: what is removed by erosion is the *best* part of the rich topsoil—the dust—the surface portion, which also contains health-producing microbes, humus and finished plant food. Each half ton of topsoil lost every year contains enough plant food to provide one person's sustenance for years. This all means, of course, that soil conservation and proper agricultural methods could make the whole earth fabulously wealthy.

Rich, well-kept farmland equals life! When man degrades topsoil, however, he is destroying his ability to live healthfully.

Restoring the land: When Ambassador College's agriculture department began working with the farmland at its campus in Big Sandy, Texas, the topsoil was only two inches deep. After five years of its soil fertility balancing program, the topsoil had increased to seven inches—one inch per year.

This is just one example where science aligns with agricultural principles found in the Bible. *Much more* will be mentioned later.

Amazing Processes

Again, topsoil lies at "an average depth of seven or eight inches over the face of the land" (*Man and the Soil*). In some few areas, it may be several feet deep, in many other areas, considerably less than seven inches.

In 1994, I was invited to introduce biblical agriculture in Ukraine, and had the opportunity to visit and walk over native pastureland in their National Land Reserve, preserved untilled for over 2,300 years. An elongated excavation had been made, beginning at ground level, sloping downward to more than 12-feet deep. This excavation fully exposed the soil's profile, and enabled good access for inspection of the depth of topsoil, and the first two feet of subsoil. The rich topsoil measured an amazing *11.38-feet deep*.

Incredible!

"The soil is not, as many suppose, a dead, inert substance," Jerome Rodale wrote in his book *Pay Dirt: Farming & Gardening with Composts*. "It is very much alive and dynamic. It teems with bacteria…fungi, molds, yeasts, protozoa, algae and other minute organisms. All are microscopic plants except the protozoa which represent animal life. As a group, these lower plants and animals are referred to as the biologic life of the soil…This microbial population of the soil is concentrated mainly in the upper four or five inches where the bulk of the organic matter, their food, is to be found."

"This hive of living things in the soil, the eaters and the eaten, adds up to incredible numbers. The bacteria alone may range from a comparative few [to] up to three or four billion in a single gram of dry soil…in good soil the bacterial matter, living and dead, may weigh as much as 5,600 pounds per acre…The fungi may add up to a million [hyphae, microscopic strands of cells in which fungi grow] in a gram of dry soil, weighing over 1,000 pounds to the acre" (*The Web of Life*).

In his book *The Forest*, Peter Farb estimated that "about 95 per cent of the nearly one million insect species" spend part of their lives in the soil.

And then there are the humble earthworms. They are nature's plow, chemist and cultivator, maker and distributor of plant food. According to Mr. Farb, rich soil may support millions of earthworms per acre. They are the soil specialists responsible for building and maintaining an ideal fertile environment for good plant growth from inert rock particles and organic debris.

The larger earthworms, night crawlers, are a miracle of engineering in and of themselves. They burrow sometimes many inches downward into the soil, sometimes *many feet* into the subsoil searching for and gathering small bits of soil and/or rock particles to ingest and move through their series of "stomachs." As this species of worm tunnels down and around, it instinctively searches out minerals missing in the topsoil above. The earth it ingests and "composts" does not just travel through it. This type of earthworm also serves as a "dump

Homemade compost: Two piles of compost made from organic materials—banana peels, coffee grounds, leafy greens, etc.—are used for mulch, fertilizer and humus building. The decomposed organic matter helps provide minerals and nutrients needed for healthy soil.

truck," and carries a processed load to the soil's surface and deposits it there, where most needed. In addition to minerals, enzymes, bacteria and hormones are also deposited, all adding to the soil's fertility.

The "red wiggler" earthworm species does much of the digestion and composting in the top few inches of the soil and in compost piles or bins.

All this teeming life plays a vital role in keeping the soil healthy and building it up.

Soil is not solid. It is actually composed of billions of grains, or colloidal particles. These "particles of the soil are classified according to size into three principal groups [known as soil separates], which are called sand, silt, and clay. The particle sizes in each of the groups range between certain limits, which have been arbitrarily fixed at diameters of 2 to 0.05 mm for sand, 0.05 to 0.002 mm for silt, and less than 0.002 mm for clay" (*Soils and Men*). Each tiny soil particle is covered with a tight-fitting film of oxides, water and bits of organic matter, which provides a supportive environment for the soil life.

The surface area of these particles is staggering. According to A. F. Gustafson in his book *Using and Managing Soils*, "The combined surface area of the colloidal particles in a cubic foot of soil is from 150 to 200 acres."

Organic cementing agents hold these particles together to form small structural units called aggregates or peds. They give soil the ideal crumbly granular structure necessary for proper tilling—and prevent compaction. Prime aggregation provides an optimum of large and small pore spaces needed for the soil to "breathe."

A favorable soil structure is just as important to growing healthy plants as is soil fertility. The organic bonding compounds in soils are continually decomposing and must be replaced to maintain aggregate stability and good soil structure.

The organic matter is obtained from living and dead plants and animals, plant roots, green manure crops, animal manure, crop residues, fungi, bacteria, worms, insects, etc. This organic matter is broken down and decayed through the action of the complex mass of soil microorganisms and earthworms. As soil organisms decompose organic matter, nutrients are released. This digestive action produces organic acids that dissolve insoluble rock minerals and makes them available for plant use.

The most important product of organic matter decomposition is humus.

Humus Is Vital

The importance of humus cannot be overemphasized. Humus is the portion of organic matter that accumulates in soil to give it its most

valuable characteristics. Here are a few reasons: humus improves the physical condition of the soil, supports its organisms, increases permeability, improves aeration, stabilizes temperature, and serves as a storehouse of plant nutrients. Essentially, all of a soil's nitrogen reserves are stored in humus.

When it rains, soil with humus soaks up water. Because it is so porous, it can hold at least its own volume in water. A four-inch rain on humus-rich soil causes little or no runoff, whereas a half-inch rain on humus-poor land can cause erosion.

Originally, the rich virgin soils of the U.S. Midwest contained from 5 percent to more than 10 percent humus in the top 12 inches. Now, worldwide our tillable land (and its soils that feed us) continues to send millions on a "death march by installment plan." Malnutrition and starvation will result from our increasing neglect—indeed, poisoning—of this vital resource.

This flies in the face of husbandry guidelines found early in the Bible, which were given to bring health and abundance to mankind. Notice: "And the LORD God took the man, and put him into the garden of Eden [personally prepared for him, see verse 8] to *dress* it and to *keep* it" (Genesis 2:15).

Digging deeper, we find the Hebrew words translated "dress" and "keep" in *Strong's Exhaustive Concordance of the Bible* include quite an expanded meaning:

- **Dress:** (Hebrew *abad*) "to work," "serve," "till." In the *King James Version*, it is also translated to be a "husbandman."
- **Keep:** (Hebrew *shamar*) "to hedge about," "guard," "keep," "to protect," and "attend to." In the *King James Version*, it is also translated "observe," "preserve," "reserve," and "save."

What specific guidelines! With soil being man's most precious resource, he MUST guard, keep, protect, preserve and SAVE IT!

Underlying the idea of dressing and keeping the earth is that we must be in line with God's natural laws. Breaking these has *dire* consequences—the record of history vividly and *repeatedly* proves this statement true.

Why Soil "Wears Out"

When minerals, organic matter, and soil organisms are present and *in balance* for a particular type of soil, the soil is fertile and healthy. But

all too often this balance is upset. How? By the serious depletion of organic matter and humus due to improper cultivation and fertilization practices, unchecked erosion, continued monoculture (growing a single variety of plant in large tracts of uniform crops)—and *failure to rest the land* and restore what the preceding harvests have taken from it.

Biblical principles established millennia ago help guard against such depletion, but today are being ignored. The most basic of these laws states that all land should *rest* one year in seven. This provides a "sabbatical"—a rest for the land in which natural cycles are allowed to restore balance to the soil. This guards against topsoil depletion and erosion.

Essentially, a land sabbath is a way the earth "puts itself in check." It allows the restoration of minerals and other plant nutrients used and not returned during the previous six years. During this time, organisms that naturally replenish the land can more quickly build up the soil.

This practice is outlined in the book of Leviticus: "Six years you shall sow your field, and six years you shall prune your vineyard, and gather in the fruit thereof; but in the seventh year shall be a sabbath of rest unto the land, a sabbath for the LORD: you shall neither sow your field, nor prune your vineyard" (25:3-4).

Healthy soil: High-humus soil should hold together yet still be friable (crumbly) so that it is better able to retain moisture, air and nutrients, as pictured by a soil sample taken from the Big Sandy Ambassador College Farm.

The next verses detail what should be done during the rest year and how food will be provided. Read carefully: "That which grows of its own accord of your harvest you shall not reap, neither gather the grapes of your vine undressed: for it is a year of rest unto the land. And the sabbath of the land shall be meat [food] for you; for you, and for your servant, and for your maid, and for your hired servant, and for your stranger that sojourns with you, and for your cattle, and for the beast that are in your land, shall all the increase thereof be meat" (vs. 5-7).

Simply put, this means that during the year that a field rests, a farmer can still pick fruits and vegetables (that grew on their own) to sustain his family, workers and animals. This fresh produce is *in addition* to foods that would have been stored during previous years, such as grains.

This sabbatical maintains the health and life of the soil, and *ensures* a continued abundance of food for all. If we followed this and other biblical practices today in the United States and worldwide, we would not be facing the soil depletion and erosion crisis we do.

In an attempt to get around the necessity of land sabbaths, modern agriculture practices the substitution of synthetic fertilizers for humus that is not allowed to be replenished in the soil. The "replacing" of humus by artificial means does stimulate plant growth, but what happens to soil humus, organic matter, and soil life as a result?

Philosophies of Fertilization

There are essentially two basic philosophies regarding fertilization. One began with the humus theory, and is based on the concept that fertilizer should be used to feed the soil to maintain its balance and vital functions—thus allowing the soil to feed the plants. The other philosophy, largely promoted by the chemical fertilizer industry, is that fertilizer is a plant food and should be used to feed a plant directly. Such thinking often ignores and bypasses the biological and physical properties and functions of the soil (*The Scientific Monthly*).

This "fertilizer as plant food" philosophy had its beginnings in the 1840s. It was at that time when Justus von Liebig in Germany noticed the regular presence of certain mineral elements—especially nitrogen, phosphorus and potassium—in the ashes of burned plants. Since these

elements had to be drawn from the soil, he concluded that soil fertility depended primarily upon the presence of these elements in the soil.

He further suggested that fertility could be maintained or improved by adding these elements in "suitable forms" to the soil. About the same time an Englishman, Sir John Bennet Lawes, was experimenting along similar lines (*Soil and Civilization*).

These men found that when nitrogen, phosphorus and potash—or potassium carbonate—were added to depleted soil, in the form of water-soluble chemicals, production increased like "magic"!

Soon farmers the world over were adopting this method as a shortcut to soil fertility.

It should be noted that early proponents of chemical fertilizers did not believe that such substances should be used to replace organic matter. But with additional demands on food from the war economy of the 1940s, farming methods dramatically changed.

In his book *An Agricultural Testament*, English botanist Sir Albert Howard addressed the loss in soil fertility at that time. He said, "A wide gap between the humus used up in crop production and the humus added as manure has naturally developed. This has been filled by chemical manures. The principle followed, based on the Liebig tradition, is that any deficiencies in the soil solution can be made up by the addition of suitable chemicals. This is based on a *complete misconception* of plant nutrition. It is superficial and fundamentally unsound. It takes no account of the life of the soil, including the mycorrhizal association—the living fungous bridge which connects soil and sap" (emphasis added).

He continued, "The ease with which crops can be grown with chemicals has made the correct utilization of wastes much more difficult. If a cheap substitute for humus exists why not use it? The answer is twofold. In the first place, *chemicals can never be a substitute for humus* because…the soil must live and the mycorrhizal association must be [one of the essential links] in plant nutrition. In the second place, the use of such a substitute cannot be cheap because soil fertility—one of the most important assets of any country—is lost; because artificial plants, artificial animals, and artificial men are unhealthy and can only be protected from the parasites, whose duty it is to remove them, by means of poison sprays, vaccines and serums and an expensive system of patent medicines, panel doctors, hospitals, and so forth" (ibid., emphasis added).

An increased demand for agricultural products fostered by World War I and government price supports caused intensive and specialized farming methods to become more popular. Also, by this time, the internal combustion engine was gradually replacing the horse. Mass migration to the cities was causing labor problems. The size of farms had to increase to cope with economic pressures against farmers.

And then there was industry. Following World War I and II, nitrate and phosphate factories producing munitions for war no longer had a market. Sensing huge potential profits, industry began developing a new market in agriculture. Through research grants to agricultural colleges and extensive advertising campaigns, it urged and "educated" farmers into believing that with artificial fertilizers they could produce greater yields and make bigger profits (*Journal of the Soil Association*).

Under these conditions, the use of chemical fertilizers skyrocketed!

Between 1949 and 1968, "agricultural production increased by about 45 per cent"—and this was on 16 percent *less* land. "In that period, the annual use of fertilizer nitrogen increased 648 per cent… Clearly, more crop was being produced on less land (the yield per acre increased by 77 per cent)," Barry Commoner wrote in his book *The Closing Circle.*

Mr. Commoner also stated that "the cost of fertilizer, relative to the resultant gain in crop sales, [was] lower than that of any other economic input" for the farmer.

"In 1949, an average of about 11,000 tons of fertilizer nitrogen were used *per USDA unit of crop production*, while in 1968 about 57,000 tons of nitrogen were used for the *same* crop yield. This means that the efficiency with which nitrogen contributes to the growth of the crop declined fivefold. Obviously, a good deal of the fertilizer nitrogen did not enter the crop and must have ended up elsewhere in the ecosystem." *Unbelievable!*

"The organic content of the U.S. soil, according to data from Missouri University, has gone down 50% since 1940 [by the early 1970s]" (*Land Bulletin Number 133*).

Even after these reports warned of the damages that fertilizers were costing soil fertility, little has been done over the decades to quell its use, and the situation continues to grow dire. (It is also worsening in many other heavily farmed regions of the world.)

A 2011 report released by the USDA found that, over a period of 20 years, cropland lost 27 percent of soil organic matter. This means that even after over four decades the same pattern of decline is prevalent—virtually *nothing* has changed!

In nature, plants and animals live together, and their litter—such as fallen leaves, shed fur, manures, etc.—accumulates on the surface along with plant residues. These then decay and are broken down by microorganisms to become incorporated into the layers underneath, thus making a life-sustaining, humus-rich soil. This then repeats, creating a "whole life cycle in the soil [that] becomes a self-regulating system—an organized community, adjusting its numbers to the food supply so long as it is undisturbed by [humanly designed] outside forces," John H. Storer wrote in his book *The Web of Life*.

History proves that when man enters the picture, these soil systems are changed. In ignorance or in greed, he plows up virgin land to grow cash crops. Increased aeration caused by plowing stimulates the microorganisms into breaking down the organic matter more rapidly. Then man removes his crops from the soil, thus taking further nutrients from its reserves. When he has mined the soil until it can no longer produce profitably, he moves on—or at least he did. Now there are no new lands to exploit. But man must till and use the soil to survive, and the *way* it is used has a direct relationship to soil, plant, animal and human health.

With a little more effort and a lot less greed, man could return enough organic matter to the soil to build up humus levels. But he seems to be hopelessly greedy from economic pressure and shortsightedness. He would rather borrow from the soil's capital and ignore repaying this debt until necessity demands it. Well, necessity is now banging on the door!

Average farmers, ranchers, landscapers, horticulturists, lawn keepers, and home flower and vegetable gardeners continue to desperately look to chemical fertilizers, pesticides and herbicides—rather than to good husbandry practices that rebuild, restore and sustain true soil fertility, and crop, animal and human health. The Fertilizer Institute estimates that more than 50 million tons of chemical pesticides are being applied *every year* on food-producing land just in the United States of America, plus over 180 million are used on a combined much greater acreage in the rest of the world. It should be a "no brainer" that

230 million TONS of *poison* (toxic chemicals) are incredibly harmful! (While these figures are lower than in previous years, this is due to a simultaneous rise in the planting of genetically modified crops. More about this later.) This practice truly does support and promote other practices that kill and destroy. The costs are *much* higher than paying more for health-supporting, mineral-rich *non*toxic foods.

We would do well to remember the message of the book *Silent Spring* by Rachel Carson, who was one of the first authors to write about the destruction of the environment as a result of pesticides and other chemicals. Unless we as individuals, communities and nations change our ways, are we not headed for the "*Last* Silent Spring"—by choice?

Fertilizer and You

Much research on soil and plant nutrition has been done to the tune of millions of dollars annually, and continues to expand. At the same time, plant disease and insect infestation has increased by leaps and bounds.

More and stronger pesticides are being used to combat old and new "mutant" insects, more chemical fertilizers are being applied per acre in an attempt to produce similar yields as previous years, and new resistant plant strains are being developed to combat "mutant" strains of plant diseases. Yet the problem of disease and insect invasion is escalating.

Why? There *is* a CAUSE!

Research facilities such as the Sanborn Field Agricultural Experiment Station study the results yielded from the various agricultural practices as well as their effects on soil composition. When the results of a 50-year study were published by the University of Missouri in 1942, it showed that large quantities of nitrogen maintained good crop yields. Even after such heavy amounts of fertilizer were applied, however, "it was too small to have an appreciable effect…"—and actually *degraded* the soil.

But the report also showed dramatic changes. "The organic matter content and the physical properties of the soil on the chemically treated plots [had] declined rapidly. These altered conditions prevented sufficient water from percolating into the soil and being stored for drought periods. Apparently a condition [had] developed

in the soil whereby the nutrients applied [were] not delivered to the plant when needed for optimum growth."

"Evidently most of the nitrogen not used by the immediate crop [was] removed from the soil by leaching or denitrification" (ibid.).

The Sanborn Field study and others elsewhere "were a warning that in humus-depleted soil, nitrate fertilizer tends to break the natural self-containment of the soil system," Mr. Commoner wrote in an article published by *Scientist and Citizen*. But this warning was ignored. Today, it can be ignored no longer!

Overall nitrogen fertilizer production and use over a 25-year period from 1946 to 1971 showed a 1,050 percent increase (*The Closing Circle*). Roughly half of this fertilizer leaves the soil in some way. Much is leached out and drains into water supplies, as demonstrated today by the dead zone in the Gulf of Mexico.

The United States Geological Survey (USGS) released a study in 2010 illustrating the ineffectiveness of nationwide efforts to prevent fertilizer from running or leaching off the land, with nutrient pollution remaining "one of the top three causes of degradation in U.S. streams and rivers…" The levels of nitrate in drinking water are above U.S. Environmental Protection Agency standards, continuing to be a health concern for over 40 million people.

Two other studies by the USGS followed nutrient trends in the Mississippi River and Chesapeake Bay. From the late 1970s to 2008, nitrate concentrations showed dramatic elevations, with a 75 percent increase in two sites along the Mississippi River and a 53 percent increase on the eastern shore of the Chesapeake Bay.

Good fertilization is the addition of materials to the soil that provide minerals (in balance) and increase soil life, organic matter, and humus.

A much-misunderstood aspect of soil fertilization lies in recognizing the detrimental effect that improper fertilization and overfertilization has on the soil, its life, and ours. Just as we humans are different and have different nutritional needs, so does soil.

Soils have been classified into several types. Each of these has a different capacity for holding fertilizer. This is determined by several factors, one of the greatest being the specific composition of the soil's colloidal particles. Two major classes of colloids are clay and humus. Soluble minerals (fertilizers) attach to these particles until they are needed and used by a plant.

The fertilizer molecules are held there by a type of electronic bond. When fertilizers are applied, they should be applied in proper balance and not exceed the capacity of the soil's colloidal system. Humus in soil is of vital importance in that it has *10 times* the capacity of an equal amount of clay. Once the colloids are "full," any excess soluble fertilizer may accumulate in toxic amounts in the soil or may leach downward into the groundwater (especially in sandy soils) or runoff in surface water when it rains or when land is irrigated. In fact, this is the cause of a major portion of agriculture's contribution to nitrate and phosphate pollution in our streams, rivers and groundwater.

Plants also can be malnourished when soil has been overfed with water-soluble fertilizers. Again, just as humans need nutritionally balanced diets, so do plants, and the only way they can get them is by feeding on nutritionally balanced soil.

Roots of plants take up nutrients by exuding carbon dioxide and hydrogen in exchange for minerals attached to the soil colloids. They also solubilize mineral particles that are taken up in water solution. When one (or more) water-soluble fertilizers are found in excess in the soil, as the plant takes up water into its circulatory system, it can be choked by an abnormal amount of those minerals. When this happens, the plant is not able to use the excess in its tissue-building process and the normal balance of plant nutrients (minerals) is upset. This extra amount of minerals remains within the plant, sometimes in toxic form. For example, this is how excess applications of water-soluble nitrogenous fertilizers can cause excess nitrate accumulation in crops and in foods.

Manufactured fertilizers alone cannot supply what the soil needs to produce abundant, healthy crops. Plants need much more than NPK (nitrogen, phosphorus, potassium). They need many other secondary and trace elements—all in proper balance. And they need the teeming microbial life that helps them absorb minerals.

The margin between too much and too little is often very slight. Mineral excesses in plants—now common—are often more dangerous than deficiencies. If given too much nitrogen, a plant grows weak and watery. The content and quality of its proteins and minerals suffer, which makes the plant more susceptible to disease.

There is no artificial fertilizer on Earth that can supply a completely balanced diet for plants in the way that humus-rich soil can. Chemical fertilizer companies blend and formulate mixtures to the best of their

abilities, but they simply cannot mechanically formulate humus. And plants were not designed to get nutrients by being force-fed.

Decline in Food Value

Crops grown in humus-deprived soil through use of ever-increasing quantities of chemical fertilizers become deficient in proteins, vitamins and minerals. This has been proven repeatedly by comparative analyses of grains, vegetables and other products produced on humus-rich soil and on chemically fertilized soil.

A study by researchers at Washington State University comparing wheat yields from 1842 to 2003 "found declines in mineral concentration for all eight minerals studied, with an 11 percent decline for iron, 16 percent decline for copper, 25 percent decline for zinc, and 50 percent decline for selenium. Put another way, the researchers found that, to get their recommended daily allowance of nutrients, people would have to eat many more slices of bread today than people had to eat in the past" (The Organic Center).

Nutritional content in corn and other feed crops have dropped even more remarkably than in wheat. This is one reason farmers today give larger quantities of feed to livestock than they did in times past to accomplish the same gain.

Plants must depend upon the available supply of minerals in the soil for elements essential to their growth. Man and the animals he eats depend in turn upon the plants for these nutrients.

Remember, we are sustained by the *dust* of the ground. In other words, we are what we eat! Human beings are what they think and eat—what we eat does affect the way we think and the way we think *does* affect what we eat.

If we consume foods that lack nutritional value, our bodies pay the penalty. Plants and animals raised on eroded and depleted soil are inferior producers of foods. And such foods can result in sick, degenerate and disease-prone human beings.

"The most serious loss resulting from…soil exhaustion," warned *Man and the Soil*, "is not *quantitative*, *but qualitative*. It has to do with the quality of life the soil supports…Soil lacking in calcium and phosphorus lacks the elements of proper bone growth of both animals and humans…Soils lacking in nitrates and other chemicals produce

vegetation lacking in the proteins essential to the building and repair of body tissues. It has long been known that animals raised on soils like those around Lexington, Ky., have stronger bones, sounder flesh, greater endurance, and longer lives than animals raised on soils less rich in minerals. That is why breeders of race horses have practically taken over the Kentucky bluegrass region" (emphasis added). This area is also great garden country.

Mr. Mickey continued, "The same thing applies equally to humans…The baby won't have good bones if its formula is made of milk from a cow whose feed came from a soil deficient in calcium and phosphorus. And the adult won't build muscle and good red blood [cells] from a steak from a steer fed on grasses and grain from leached and eroded soils devoid of protein-building minerals and iron.

"Much remains to be done in the study of the relationship of the soil to the mineral and vitamin requirements of human diet, but much has been done. And what is known points unequivocally to the fact that deficient soils produce deficient men."

Can we now better see and understand why the growing problem of soil depletion is so important to you, me and *all* fellow human beings with whom we share this planet—which had its life systems up and running when we arrived?

What Can Be Done

First of all, we need to acknowledge what actually works *within the laws of nature*. We must stop employing practices that have caused problems and begin replacing them with conscientious methods of cure and prevention. We must have open minds—minds willing to be re-educated, willing to admit error, willing to *change*.

A sad truth I have witnessed in my short 75-year sojourn on this planet, thus far visiting and teaching in 40 different countries around this "jewel in the sky" we call Earth, is that many—and I mean most—do not yet *do*, *practice* and *live* the good practices they already know. *Do you?*

Man needs to change his *attitude* toward the soil. Instead of only taking from it, we need to GIVE BACK to it by replacing and building up the supply of humus.

Basically, this can be done through good management of cropping, tillage, fertilization and resting the land. Growing cover

crops and returning other organic material such as crop residues, animal manures, etc., to the soil should be included—and we must STOP *poisoning* it!

We need to put technology to work to help us fertilize soil in a scientific, balanced way. Soil balancing through proper fertilization should be a major goal. Fertilization should not exceed the soil's capacity to hold added nutrients on its colloidal system. To fertilize beyond this, remember, causes pollution problems, and wastes one's hard-earned money.

Based on the most recent estimates, every year, 1.37 billion tons of solid animal waste is produced, which "is 130 times greater than the amount of human waste—a total of [3.75] tons for every human being in the country" (Pew Commission on Industrial Farm Animal Production). "Waste," however, is not the right word, for these byproducts of the life process should not be wasted but carefully used in maintaining soil fertility. Manure used to be carefully collected, composted and put on land. Today its disposal is one of the livestock industry's biggest headaches. Instead of being a pollutant, as it has become in many instances, it should be considered an asset and returned to the soil.

We need to make efficient use of all organic refuse. Why pollute our rivers and lakes with organic wastes when such material could be used to enrich the land?

Careful attention also needs to be given to soil ecology.

Tillage practices that invert and totally bury organic residues help destroy soil structure, soil life, and should be ceased. Manures, fertilizers and other organic material should be added to the soil's surface or mixed into only the top few inches. They should be incorporated into the soil so that mixing, but *not* covering, the material takes place. The depth of mixing will be determined by the amount of residue to be incorporated.

To follow practices that "mine" soil humus decreases soil quality and its productive capacity. On the other hand, following management programs based on revealed understanding and confirmed by scientific knowledge and demonstration *will* maintain and build soil humus and overall soil fertility to benefit both present and future generations.

PHOTO: THINKSTOCK

How Man Can Restore the Balance of Nature

Chemical warfare has long been a reality on planet Earth. Today it has become the last weapon in man's arsenal against crop-destroying insects and weeds.

These chemicals affect not only insects, but also man himself—*us*! No matter who you are or where you live, the food you consume contains pesticides originally meant for insects. And now, you carry these toxic chemicals in your body.

More than a trillion pounds of pesticides have probably already accumulated and remain in Earth's air, water, soil, living plants, and animals, and the amount *grows daily*. Remember, we saw earlier that *50 million tons* of toxins are applied annually to soil and crops in America alone.

What these poisons are doing to the entire web of life—and to personal health—began to be known some 40 to 50 years ago. We warned at that time that unless mankind drastically changed its ways, we were headed for disaster.

And now, *today*, as you read these words, we are *in the middle* of that forecasted disaster—and are *witnesses* of an ever-expanding crisis!

Life Chain Threatened

The most common pesticides 40 years ago were DDT and other chlorinated hydrocarbons. In 1972, after Ms. Carson's book *Silent Spring* brought the world's attention to DDT's adverse environmental effects, the United States and many other nations worldwide banned the application of this compound. Because of its effectiveness in fighting diseases such as malaria, however, use of DDT persists in some countries, including China.

Today, toxins from DDT and similar compounds that have replaced it are manifold, found virtually everywhere in the soil, on the soil, and in food and feed crops—from mega-farms to community landscapes, even including home lawns and flower and vegetable gardens. And this does not count those "seeded" into the clouds, which eventually find their way into the air we breathe, trees, plants, water and soil. They have become "silent" direct and indirect killers—alive and well today.

In 1996, another *major* instrument was added to the arsenal of destructive devices. Enter the onslaught of genetically modified organisms (GMOs), which are also called "genetically engineered" (GE) crops.

Genetics is the study of the way plants, animals and humans pass on unique characteristics to their offspring. A gene is any of the units "programmed" with these inherited features that make up a section of a chromosome. And chromosomes are tiny particles in the nucleus of cells, the basic building blocks of which are deoxyribonucleic acid (DNA). DNA stores the genetic code and passes on said characteristics.

Consider what the possible outcomes, and consequences, would be from manipulating gene code sequencing. Here are just a few brief but sobering examples (emphasis added):

- A Baylor College of Medicine study linked exposure to a component of GMO corn to infertility in rats as well as to the growth of human breast and prostate cancer cells (*Environmental Health Perspectives*).
- Mice fed GMO corn had lower birth rates and their offspring had lower average birth weights than a control group sustained by non-GMO corn, according to an investigation conducted by the

University of Veterinary Medicine in Vienna, Austria, and the Research Institute of Organic Agriculture (sponsored by the German Federal Ministry of Education and Research).

• An Italian study found that mice exposed to feed with a 14 percent GMO content developed testicular changes, some irreversible, and were associated with diminished DNA function and cell damage (*European Journal of Histochemistry*).

• "Russian biologist Alexey V. Surov…and his colleagues set out to discover if Monsanto's genetically modified (GM) soy, grown on 91% of US soybean fields, leads to problems in growth or reproduction…After feeding hamsters for two years over three generations, those on the GM diet, and especially the group on the maximum GM soy diet, showed devastating results. By the third generation, most GM soy-fed hamsters *lost the ability to have babies*. They also suffered *slower growth*, and a *high mortality rate* among the pups.

"And if this isn't shocking enough, some in the third generation even had hair growing *inside their mouths*…" (Institute for Responsible Technology).

• In 2012, scientists from Norway reported that rats fed GM corn over a 90-day period were fatter than those fed non-GM corn. They found similar changes in fish as well, "'These were not major changes; all were within a normal range and the fish appeared healthy,' says [Ashild Krogdahl, a professor at the Norwegian School of Veterinary Science].

"'But the ones who had fed on GM corn were slightly larger, they ate slightly more, their intestines had a different microstructure, they were less able to digest proteins, and there were some changes to their immune system. Blood samples also showed some change in the blood'" (*ScienceNordic*).

Additionally, the researchers found that genetically modified foods have much greater consequences than previously believed: "'A frequent claim has been that new genes introduced in GM food are harmless since all genes are broken up in the intestines. But our findings show that genes can be transferred through the intestinal wall into the blood; they have been found in blood, muscle tissue and liver in sufficiently large segments to be identified,' Krogdahl explains.

"'The biological impact of this gene transfer is unknown.'"

And this could be called the tip of the iceberg! Are we to think that we will fare any better when exposed to the same chemicals?

A number of countries have already banned the use of GMO seeds.

In the very beginning, our Creator gave guidelines—if we have eyes to *see* and ears to *hear*—to plant seed that reproduces like-kind, "whose seed is in itself" (Genesis 1:11-12). These are sustainable and renewable. Consider. Where in this statement is license to enter the plant world—which God designed—and genetically modify them in ways that human beings think to be better?

Toxic Environment

The major pesticides in use today are vicious pollutants. Many are very stable compounds, meaning they are not easily broken down. And because of this persistence, they build up in dangerous biological concentrations in the food chain. They ultimately end up in the human body. Here is what happens:

Ocean water, for example, contains phytoplankton—the producer of over half the world's oxygen supply and the first link in the sea's chain of life. Not only does DDT (and similar compounds) decrease oxygen-producing photosynthesis, but it also has a tendency to accumulate in biological organisms and be passed up the food chain—from phytoplankton to zooplankton, shrimp, small fish, larger fish, and then fish-eating birds. In birds, the concentration accumulated to an astounding 10 million times the original amount present in the ocean water (*Time*).

Even 40 years after banning DDT, "Fish consumption advisories are in effect for DDT in many waterways including the Great Lakes ecosystem" (EPA).

Likewise on land, these poisons are extremely harmful to microorganisms and other minute forms of life and life processes in the soil.

Pesticides have virtually wiped out certain bird species by upsetting an intricate hormone-enzyme relationship, leading to thin-shelled eggs that crack and fall apart easily. They have produced fatal effects in wildlife by interrupting the communication network in animals' nervous systems. (Keep in mind the disappearance of honey bees and so many other pollinating insects—beneficial creatures

destroyed by continually expanding the application of these and other toxins.)

In Canada, marked levels of DDE—a derivative of DDT—were found in the droppings of chimney swifts (birds that often nest in chimneys) dating from 1944 to 1992, which provides clues as to why "the number of chimney swifts dropped 95% between 1968 and 2005," *Science* reported.

Research indicates DDT and other chlorinated hydrocarbons cause a marked alteration in the sexual mechanisms of rats and a proneness to cancer in animals from mice to cattle. Do we dare assume humans are *not* affected in the same way?

Chlorinated hydrocarbons expert Dr. Charles Wurster plainly stated the dangers of these chemicals: "All are nerve poisons. They cause instability or spontaneous 'firing' of nerve cells, and increased doses result in tremors or convulsions—typical symptoms of acute poisoning that can occur in organisms ranging from houseflies to man. In general, if an organism has nerves, the chlorinated hydrocarbons can kill it" (*Weeds, Trees, and Turf*).

Shocking!

Dr. Joseph J. Hickey, professor of wildlife ecology at the University of Wisconsin, was even more direct in his book *Farm Chemicals*: "DDT is a chemical of extinction." This has been public knowledge for decades—but who is listening? Are you?

In 1971, *Gainsborough News* published an article about a river of death in Britain: "Children and adults, attracted by tens of thousands of fish slaughtered in the River Till at Sturton-by-Stow, dice with danger if they touch them…It is one of the strongest forms of organic chemical pollution we have come across and rats and birds which have been feeding on the dead fish are being found dead along the banks… Dogs which have been drinking the water will soon follow suit and farmers have been warned to clear their livestock from the riverside. The pollution, apparently from the Ingham area, is a killer and River Authority workmen have been strongly advised not to allow either the contaminated water or the fish to come into contact with their skin.

"The sluggish black waters of the River Till have become a glistening graveyard as shoals of bream, prime roach and eels float grimly to the surface. Not a single item of river life has escaped the horror, as flies, beetles and even hedgehogs are carried motionless along the killer stretch."

As the realization of these harmful truths expands, many around the world have already taken action against the use of DDT and chlorinated hydrocarbons in their countries. Regardless of DDT's ban in the U.S. years ago, residual toxicity remains. This is in part because several countries from which we import food continue to use it and the chemicals wind up in our diets.

Thankfully, more nations are pursuing the elimination of DDT, including China. But what about the other substances that have taken its place?

Nerve Gases Used as Pesticide

In many areas, organic phosphorus compounds—or organophosphates—have replaced DDT and chlorinated hydrocarbons. These were originally developed in World War II as German nerve gases. Chemically, they are cousins to the nerve agents GD and VX, which are involved in the current chemical and biological warfare controversy.

Over 30 million pounds of organophosphates are being spread unchecked as pesticides on America's farms and gardens annually (EPA).

Because these pesticides break down much more quickly than chlorinated hydrocarbons, many assume they are safer. In reality, these odorless and colorless chemicals are potentially *more* dangerous.

Dr. Alice Ottoboni, former California State Public Health Department toxicologist, wrote of organophosphates in the book *The Dose Makes the Poison: A Plain-Language Guide to Toxicology*, "A great deal of data indicate that some degradation products of nonpersistent pesticides have at least as much potential for nontarget damage as DDT."

Small amounts can cause harm almost instantly, either by contact or ingestion.

"When DDT was banned, the use of organophosphate insecticides increased greatly. A large increase in poisoning of farm workers accompanied this increase; some poisonings were so severe as to be lethal" (ibid.).

Realize: a nonpersistent pesticide does not just "disappear" when it is broken down. "On the contrary," Dr. Ottoboni continued, "*All nonpersistent pesticides merely degrade to other chemicals!*

The only difference is that most of these new chemicals do not have the same pesticidal action as their parent chemicals. These new chemicals may not kill pests, but what is their toxicity to other organisms? What is their fate in the environment? Do they persist? Do they accumulate?" (emphasis added).

There is growing knowledge, however, surrounding the most common pesticide in use throughout the U.S. today—atrazine. Since its introduction in 1958, atrazine has grown to have an "estimated production of 76 [million] to 85 million pounds annually. Approximately 76.5 million pounds of active ingredient are applied domestically per year" (EPA).

This is over twice the amount of total organophosphates used!

Even more shocking is just *how much* is known about this pesticide and its effects. Consider this 2010 report from the Natural Resources Defense Council (NRDC): "Banned in the European Union and clearly linked to harm to wildlife and potentially to humans, the pesticide atrazine provides little benefit to offset its risks. In 2009, NRDC analyzed results of surface water and drinking water monitoring data for atrazine and found pervasive contamination of watersheds and drinking water systems across the Midwest and Southern United States."

"Approximately 75 percent of stream water and about 40 percent of all groundwater samples from agricultural areas tested in an extensive U.S. Geological Survey study contained atrazine. NRDC found that the U.S. EPA's inadequate monitoring systems and weak regulations have compounded the problem, allowing levels of atrazine in watersheds and drinking water to peak at extremely high concentrations.

"The most recent data confirms that atrazine continues to contaminate watersheds and drinking water. Atrazine was found in 80 percent of drinking water samples taken in 153 public water systems. All twenty watersheds sampled in 2007 and 2008 had detectable levels of atrazine, and sixteen had average concentrations above the level that has been shown to harm plants and wildlife" (ibid.).

But with so great an amount of this pesticide applied today, could the effects be as harmful as some believe?

A study released in 2010 by the University of California, Berkeley, yielded disturbing results: "Atrazine, one of the world's most widely used pesticides, wreaks havoc with the sex lives of adult

male frogs, emasculating three-quarters of them and turning one in 10 into females…"

"The 75 percent that are chemically castrated are essentially 'dead' because of their inability to reproduce in the wild, reports UC Berkeley's Tyrone B. Hayes, professor of integrative biology.

"'These male frogs are missing testosterone and all the things that testosterone controls, including sperm. So their fertility is as low as 10 percent in some cases, and that is only if we isolate those animals and pair them with females,' he said. 'In an environment where they are competing with unexposed animals, they have zero chance of reproducing.'"

Environmental chemicals that enter into our bodies, whether by air, food or water, *will* affect us. An article published by *rodale.com* recorded some of these effects: "Researchers from the Baylor College of Medicine compared rates of a rare birth defect called choanal atresia—which happens when the cavity between a baby's nose and mouth becomes fully or partially closed and causes breathing problems that can be fatal—to application rates of the herbicide atrazine in Texas farm fields.

"The results: Birth defect rates and atrazine application levels went hand-in-hand, says lead study author Philip Lupo, PhD, assistant professor in the department of pediatrics. Women living in counties with the lowest rates of pesticide application had relatively no risk of having babies with this specific birth defect, he says. 'But as you go up to the next group—areas with medium levels of atrazine application—there was almost a 40% increase in risk. Moms in counties with the highest levels saw an 80% risk,' he says.

"That should raise red flags, even if you're not planning to have children any time soon. Lupo says that the only known risk factor for choanal atresia is thyroid-medication use during pregnancy. But, according to the birth records he used in his analysis, very few of the mothers had been diagnosed with thyroid problems or were taking thyroid medications, which means your body could be reacting to the herbicide the same way it would to a thyroid medication or thyroid abnormality.

"If atrazine is messing with thyroid hormones, the herbicide could play a bigger role in other health problems, according to research done by the Endocrine Society. Chemicals that interfere with thyroid hormones have been linked to metabolic disorders, and

thus could be playing a role in diabetes and obesity, as well as in autoimmune disorders and cardiovascular disease."

To curb the effects of pesticides on crops, farmers in the U.S. came to broadly endorse the genetic engineering of agriculture. So much so that "herbicide-tolerant crops accounted for 93 percent of U.S. soybean acreage, 78 percent of cotton acreage, and *70 percent* of corn acreage in 2010" (USDA, emphasis added).

In addition to herbicide-tolerance, plant genetics are also manipulated to be resistant to insects. One popular crop contains "the gene from the soil bacterium Bt (*Bacillus thuringiensis*)… [producing] a protein that is toxic to specific insects. Plantings of Bt crops accounted for *73 percent* of U.S. cotton acreage and *63 percent* of corn acreage in 2010" (ibid., emphasis added).

Although the use of Bt crops has reduced the application of insecticides, Dr. Ottoboni wrote in her book *The Dose Makes the Poison* that "BT's usefulness is limited to certain classes of insects, and it is harmful to *all* butterflies and moths. Additionally, some chemically sensitive people believe that they respond just as severely to BT as to other pesticides" (emphasis added).

Adding to the concern, a study released in 2011 found that the toxin produced by the Bt bacterium was present in the blood of 93 percent of pregnant mothers and 80 percent of their babies as well as 69 percent of women who were not pregnant (*Reproductive Toxicology*).

The distressing fact, outside of the ecological effects, is that pesticides *have not* eliminated insect infestation and crop loss—and are actually creating new problems.

Charles Benbrook, a research professor at the Center for Sustaining Agriculture and Natural Resources at Washington State University, told *Reuters*, "…the introduction of 'Bt' corn and cotton crops engineered to be toxic to certain insects is triggering the rise of insects resistant to the crop toxin."

"Insecticide use did drop substantially—28 percent from 1996 to 2011—but is now on the rise, he said.

"'The relatively recent emergence and spread of insect populations resistant to the Bt toxins expressed in Bt corn and cotton has started to increase insecticide use, and will continue to do so,' he said.

"Herbicide-tolerant and Bt-transgenic crops now dominate U.S. agriculture, accounting for about one in every two acres of harvested

cropland, and around 95 percent of soybean and cotton acres, and over 85 percent of corn acres.

"'Things are getting worse, fast,' said Benbrook in an interview. 'In order to deal with rapidly spreading resistant weeds, farmers are being forced to expand use of older, higher-risk herbicides. To stop corn and cotton insects from developing resistance to Bt, farmers planting Bt crops are being asked to spray the insecticides that Bt corn and cotton were designed to displace.'"

Devastation and loss of agriculture is not exclusive to the United States—or to this century.

In 1973, "Annual loss…in Latin America alone [reached] the staggering level of 40 per cent of the total crop, while in the middle of Africa half of the sorghum [was] eaten away by insects during a single year's storage. Similarly, an enormous amount of rice [was] lost every season in Asia because farmers [did not] find it worth their while to dry the rice—losses [were] estimated by the FAO [UN's Food and Agriculture Organization] at three million tons each year. Mishandling of food in storage and transit also [caused] grievous waste. For instance, birds pecking holes into grain bags…ruined up to three-fourths of the contents; other local predators, such as rats and locusts, have taken their toll" (*The Saturday Review*).

Another source from that era stated, "In India insects annually consume more food than the entire nine million population of Michigan eats. Such losses can doubtless be reduced, but there is good reason to tone down generous promises about what can be achieved along these lines when similar conditions can be recorded also in countries where man has created powerful chemical barriers around his lush fields and even resorted to war gases in his fight for victory and survival. Nevertheless, the U.S. Department of Agriculture estimates that merely the insects cause losses to our nation in the range of four to five billion dollars annually. Our total agricultural production is valued at only six times that amount" (*Too Many: A Study of Earth's Biological Limitations*).

Though we have increased pesticides and genetically modified crops enormously since then, the rate of agricultural loss due to insects remains about the same.

A sobering example of just one crop was reported in *Cotton Farming*: "No matter how much progress is made in the ongoing fight against cotton insect pests, the damage incurred each year remains

significant, according to the 2010 Cotton Insect Loss report compiled by Michael Williams, Mississippi State University entomologist emeritus.

"Of all the detailed statistics contained in this report, the most revealing may be the fact that 8.1 million cotton acres across the Belt were infested by the bollworm/budworm insect complex, resulting in 263,902 bales lost."

"When translated into economic losses for cotton production…the total yield loss due to insects across the Belt adds up to $376,673,521, or an average of $35.33 per acre."

Another major problem with using pesticides is that predators of the pest are often killed along with the target. Since these natural enemies have been partially successful in controlling the pest population, wiping them out temporarily leaves the primary offender free of important natural restraints.

Under these circumstances, the pest will develop a resistance through mutation and multiply before natural enemies can multiply to control them.

Thus insects' resistance to pesticides is a mounting worldwide problem. Between 1908 and 1945, only 13 species of insects had developed resistance. Now, according to the FAO, the figure stands at over 700!

The current practice employed to control these hardy new pests is to develop more potent pesticides. But instead of controlling or killing an insect, a vicious cycle is created—stronger insects, more toxic pesticides, and an increasing threat to all life forms on this planet. And the vast majority *still* refuse to address the fundamental *cause*! They seem bound and determined to continue and expand more of the same husbandry practices that caused the problem in the first place.

And their use is once again on the rise: "Genetically engineered crops have led to an increase in overall pesticide use, by 404 million pounds from the time they were introduced in 1996 through 2011, according to the report by Charles Benbrook…" (*Reuters*).

This is due in part to the rise of herbicide-resistant weed species, referred to as "superweeds." Mr. Benbrook also stated in the article, "Resistant weeds have become a major problem for many farmers reliant on GE [genetically engineered] crops, and are now driving up the volume of herbicide needed each year by about 25 percent."

The proposed answer? "Scientists say the solution to the widespread resistance problem is a new type of GM that uses a powerful weedkiller that was once part of Agent Orange, the defoliant widely used during the Vietnam war" (*BBC*). Again, *shocking*! Should we not be addressing the *cause* of insects?—trying a little *prevention*?

No Way Out?

Here then is where scientists and farmers see a problem: we are told that "crop and livestock production in the United States would drop by 25 to 30 percent"—that commercial production of apples, peaches, cherries, grapes, cranberries, raspberries, strawberries, citrus and a host of other products would come to a halt—"and prices of agricultural products would increase by 50 to 75 percent, if pesticides were completely withdrawn from use" (The World Bank Development Research Group). According to these numbers, millions would have their diets drastically altered or reduced.

Yet this data *flies in the face* of numerous documented cases of farmers who have stopped using insecticides and have fared better than their neighbors who continued to use these poisons.

As I wrote some 40 years ago, "If we continue to use non-biodegradable pesticides we will be in deep trouble." And now, we *are* in DEEP TROUBLE!

Not only is pollution reaching critical proportions, but as insects continue to develop resistance faster than new pesticides are produced, it is just a matter of time until these creatures begin to destroy food crops wholesale. And mankind will be *utterly unable* to stop them!

Some look to biological control—natural pesticides taken from animals, plants, bacteria and certain minerals—to provide an out. But so little money and effort is being spent on research in this area—and progress comes so slowly, if this ever even materializes—that it appears to be a false hope. In addition, there are whole categories of pest problems with *no remote prospect* of biological control.

Have we painted ourselves into a corner? Is there no way out? Is there no way that insect plagues can be stopped without using pesticides?

Role of Insects

Let's continue by asking some basic questions—and finding some simple, yet profound, answers. Do insects have a purpose? What causes insects to attack plants and become "pests"? Few seem to know.

Insects constitute 70 to 80 percent of all animal species. They are so numerous that no one knows how many species there really are. More than 800,000 have already been classified and about 10,000 more are classified annually. While there are seven billion humans on Earth, there are on average three billion insects on *every square mile* of the planet!

Insects multiply rapidly. A single pair of flies is potentially capable of producing 191,000,000,000,000,000,000 (191 quintillion) offspring in just six months! If they all survived, the earth would be covered to a depth of 47 feet!

This cannot happen, though, because natural laws never permit a single species, plant or animal, to completely dominate any environment. Weather factors—such as temperature and rainfall—limit the distribution of an insect species. Toads, lizards, frogs, moles, snakes, birds, bats, shrews and other creatures feed largely on insects. Some birds eat their own weight in insects every day. Predatory insects prey on other insects. Larvae of parasitic insects develop in the eggs, young or adults of other insects. Viruses, fungi and bacterial diseases also help control the insect population.

In fact, if insects were not kept in check by these natural (that is, *created*) forces, it is doubtful whether any conceivable volume of chemicals could possibly keep their populations down. Yet we are seldom aware of these created controls that protect and serve us.

All these *natural* checks do their work without threatening man. *Insecticides*, which contribute only a very small part of the total controlling force over harmful insects, *are threatening to* ALL *life*. Does it not make sense for man to encourage the inherent balance, rather than devastate the natural controls?

It is not generally realized that *less than 0.5 percent* of insect species are considered pests to man. But crop loss due to these pests accounts for one-fifth of the world's annual crop production (FAO). The positive benefits of insects are often overlooked because they are more difficult to estimate.

Fields of green: Above, an aerial shot of farmland south of Dallas, Texas, shows the difference between two cotton fields, which were planted the same day with the same seed stock, on a farmer's property who was consulting with Ambassador College agriculture personnel. Below, close-up photos show the two cotton fields side by side. The one on the left used conventional fertility growing methods. The one on the right used Ambassador College's biological and mineral balancing program. Notice that the plants on the right are much fuller. It was a very dry growing season and much of the difference is due to better moisture retention and deeper root growth.

It is easy to forget that bees, wasps, flies, butterflies and other insects pollinate plants that provide us with fruits and vegetables. Among the top likely factors for Colony Collapse Disorder, which causes sudden and complete destruction of beehives, are pesticides such as miticides and fungicides, as well as genetically modified crops.

In addition, some insects are vital links in the food chains of fish, birds and land animals—others act as scavengers of animal and vegetable debris and others as aerators of soil—still others are parasites or predators of damaging insects.

Instead of studying the habits of insects and implementing natural control methods, however, many now simply mow them down with spray guns.

For the most part, the function of "harmful" insects is all too little understood. Now, thankfully, some few scientists are beginning to realize the *relationship* between soil fertility, crop production, and pests.

Why Insect "Pests"?

In his landmark book, *An Agricultural Testament*, the famous British agriculturist Sir Albert Howard related how in five years' time at a research station in India he "had learnt how to grow healthy crops, practically free from disease, without the slightest help from mycologists, entomologists, bacteriologists, agricultural chemists, statisticians, clearing-houses of information, artificial manures, spraying machines, insecticides, fungicides, germicides, and all the other expensive paraphernalia of the modern Experiment Station."

Sir Albert worked with the principles any small farmer could use economically. From his experience, he observed that: "Insects and fungi are not the real cause of plant diseases but only attack unsuitable varieties or crops imperfectly grown. Their true role is that of censors for pointing out the crops that are improperly nourished and so keeping our agriculture up to the mark. In other words, the pests must be looked upon as Nature's professors of agriculture: as an integral portion of any rational system of farming.

"The policy of protecting crops from pests by means of sprays, powders, and so forth is unscientific and unsound as, even when

successful, such procedure merely preserves the unfit and obscures the real problem—how to grow healthy crops."

These conclusions are not dreams of a man who failed. Sir Albert was knighted for this very agricultural research—for effectively proving the usefulness of the system.

Many who have worked with the soil have noticed the tendency of insects to prefer plants that are weak, sickly, unhealthy, unbalanced or just a little "under the weather."

This deficiency or imbalance may be so subtle or slight that it cannot be measured or analyzed by present scientific methods. But it does exist. And the bugs know it!

Now take the cause-effect relationship one step further. What is it that causes plants to be weak and inferior—prone to insect attack?

Substandard Plants

A number of factors may cause weak and inferior plants—poor seed, moisture levels (too much or too little), temperature, climate, etc. But one of the most important factors is plant malnutrition caused by *unbalanced soil*.

In 1974, professional soil consultant for Brookside Laboratories of New Knoxville, Ohio, Martin H. Augustin stated in a personal letter: "We are proving today that sick soils produce sick plants and sick plants produce sick animals and humans. There are about one hundred of us who work with about 10,000 farmers at the present time. The overwhelming majority of them have already discovered that in a *truly healthy soil* our crops are not attacked by insects because God created these pests to destroy sick plants so that they cannot reproduce themselves."

Insects serve a vital purpose as guardians and supporters of our health and well-being. Many pollinate vast numbers of food crops, flowers, trees, shrubs, provide honey, etc., while others consume and destroy sick, unhealthy plants and trees so that humans, birds and animals do *not* eat them and themselves get sick. But we go to war with the insects by using pesticides, destroying both the "good" with the perceived "bad."

In times past, this interrelationship of soil, plants and insects was recognized. In 1870, American journalist Horace Greeley reported:

"I hold that [insect] multiplication and their devastations are largely incited by the degeneracy of our plants caused by the badness of our culture." Later he stated, "I heard little of insect ravages in the wheat-fields of Western New-York throughout the first thirty years of this century; but, when crop after crop of Wheat had been taken from the same fields until they had been well nigh exhausted of their Wheat-forming elements, we began to hear of the desolation wrought by insects…" (*What I Know of Farming*).

Mr. Greeley had understanding that most seem to lack today. In this day and age, so few see any relationship between our depleted soils, the use of incomplete synthetic fertilizers, and the alarming increase in insect pests. Unsustainable tillage and cropping methods continue to contribute to this growing problem of soil infertility and bug invasions. Our good stewardship, or lack thereof, is witnessed by its fruits—good or bad.

It is to our shame that most agricultural institutions of the "modern" era have been preoccupied with research dealing with effect-driven palliatives such as pesticides—which make the problem appear less severe or painful, but do not effect a cure. Should we not rather be performing judicious research into how to correct the cause of insect pests?

"Various studies have shown that if the soil fertility is good, then the resistance to insects is high," Dr. Stig Erlander demonstrated in his article published by the German scientific journal *Starch/Starke* in 1970. "Thus [Dr. William Albrecht] has shown that spinach grown in fertile soil resisted the attack of thrips [winged insects], whereas that grown on poor soil was destroyed by these insects. A deficiency of phosphorus or magnesium produced tomatoes which were susceptible to the greenhouse white fly, whereas those grown on good soil were not. Moreover, corn can be destroyed by chinch bugs when a deficiency of nitrogen occurs. But if the amount of nitrogen is too plentiful, then the grass becomes deficient and is subjected to damage by bugs.

"It can be concluded from the above that a change in the composition of the soil may lead to genetic changes which could alter the structure of the cell wall or other constituents such as the starch granule. Moreover, good soil fertility will produce plants which are resistant to insects, viruses or detrimental worms. Genetic variations produced by radiation only eliminate specific enzymes or protein

Compare and contrast: Two sample crops of hay grazer in eastern Texas (the left was grown using Ambassador College's soil treatment program and the right was conventionally grown), were planted on the same day using the same seed to demonstrate a vast difference in results. Due to extended drought after planting and lack of the soil's friability, the soil's hardness prohibited the roots on the right from penetrating deeply into the soil. In contrast, the roots on the left grew in healthy soil, which meant the plant's roots could grow much deeper to extract the needed water and nutrients for proper growth. A penetrometer (below), which measures the permeability of the soil, rests in between uprooted samples from both fields that demonstrate the effectiveness of the AC treatment.

structures and hence weaken the plant. Unlike natural mutations, they may not allow the plant to return to its original state when soil conditions change. The best method for producing insect-resistant crops is thus soil fertility and not induced mutations which no doubt will eventually be [disastrous]."

In January 2012, scientists from Arizona State University and the Chinese Academy of Sciences published a report directly linking land management practices with modern-day locust swarms. Like chinch bugs, locusts also thrive and multiply on plants low in nitrogen, such as those from heavily grazed plots, and can "populate over 20 percent of the Earth's land surface, negatively affecting more than 60 countries" during an outbreak year (*ASU News*).

Work done at the University of Florida shows that both the rate and the source of nitrogen have a pronounced effect on the susceptibility of grass to chinch bug damage. Grass receiving high rates of inorganic nitrogen was severely damaged by the bugs, in contrast with the grass receiving nitrogen from an organic source (*Florida Turf Grass Association Bulletin*).

Haughley Research Farms in England, established in 1939 and now under the world-renowned Soil Association, found in actual practice that crops grown on soil built up by natural manures were much more resistant to pest-inviting weaknesses than crops grown with the aid of chemicals.

In the article "Pesticides Poison Us," "Dr. William Albrecht, [former] chairman of the Department of Soils at Missouri University College of Agriculture, and other investigators have shown that unhealthy plants are more subject to insect attack than are healthy plants. This is nature's way of eliminating sick plants which should be returned to the earth instead of being eaten by humans."

We observed the same result in our Ambassador College Agricultural Research Program. Even under the best conditions, insects destroyed a small percentage of the crop. But is this in itself bad? The loss of the weakest part of the crop ensures the food value of the remaining part and that the best seed is saved for the next crop.

You would think that the prospect of growing quality products that resist insects and render pesticides unnecessary would cause great excitement. But not so! This *solution*—the only real solution—runs

counter to the greed of human nature and the vested interests of our social and economic systems. And it appears that man would rather perish than change *that*!

Before and after: After applying soil-building principles taught at Ambassador College, a struggling 70-acre pasture (above) is transformed into a flourishing meadow able to support one cow-calf unit of black Angus cattle on less than one acre (below). Green pastures were then able to be maintained throughout the year.

Monoculture Upsets Natural Balance

Without interference by man, Earth's soil always produces varied, diverse crops. Yet in some areas of our modern world, it is a rare sight to see mixed crops growing together.

Monoculture reduces soil quality and will attract abnormal amounts of insects. The greater the area under one crop, and the extent to which that crop is grown exclusively year after year, the greater the potential insect problem. This practice of husbandry extracts the same variety of a host of minerals from the soil year after year, without replenishing them. Thus the mineral-deficient plants invite the insects.

The Colorado beetle is an example of what happens when man begins to simplify agriculture and farm one crop exclusively. This beetle used to be harmless and fed principally on smartweed, which it hunted out from among many other plants. When huge fields of potatoes were newly introduced to Colorado, however, this insect suddenly found itself in the midst of mile after mile of green potato fields—a beetle's "paradise." As a result, the beetle multiplied so rapidly that within little over a decade it literally ate its way over 1,600 miles to the East Coast!

Many similar examples could be cited, and from all parts of the planet. Regrettably, our entire modern farming method is geared toward extensive monoculture. To many it would be unthinkable to even suggest that this practice be changed! There are those, however, who have *successfully* changed of their own free will, and with positive results.

Other sound principles of agriculture that farmers often neglect include rotating crops to minimize insect reproduction, and observing the correct time for planting and growing trees and hedges, which encourage insect-eating birds to visit a farm.

Weeds and Herbicides

According to some estimates, U.S. crop losses from weeds have been equal to the combined losses from insects and diseases, and run second only to those caused by soil erosion.

Alfred H. Krebs recorded in 1964 in his book *Agriculture in Our Lives*, "Some persons who have studied the matter estimate that weeds cause an annual loss of about five billion dollars to farmers

in the United States. The average loss per farm is probably over a thousand dollars, most of which is in the form of crop damage. Some experts have placed the losses from weeds at a minimum of ten dollars per acre. The losses caused by weeds are considerably more than the losses from either crop diseases or insects." These dollar figures would be multiplied more than seven times by 2012!

As weeds become stronger, heartier and resistant to current herbicides, more toxic compounds are being produced by the giant chemical industry. It is devising ever more powerful methods to kill weeds and beneficial soil life, and never coming to (or perhaps willingly ignoring) the true knowledge of the *cause* of weeds. So we see here the same vicious cycle as with all forms of pesticides.

Purpose of Weeds

As with insect pests, few seem to realize that weeds have a purpose. In the publisher's preface to Joseph Cocannouer's book *Weeds, Guardians of the Soil*, the publisher summarizes some of the purposes of weeds:

"1. They bring minerals, especially those which have been depleted, up from the subsoil to the topsoil and make them available to crops. This is particularly important with regard to trace elements.

"2. When used in crop rotation they break up hardpans and allow subsequent crop roots to feed deeply.

"3. They fiberize and condition the soil and provide a good environment for the minute but important animal and plant life that make any soil productive.

"4. They are good indicators of soil condition, both as to variety of weed present and to condition of the individual plant. Certain weeds appear when certain deficiencies occur.

"5. Weeds are deep divers and feeders and through soil capillarity they enable the less hardy, surface feeding crops to withstand drought better than the crop alone could.

"6. As companion crops they enable our domesticated plants to get their roots to otherwise unavailable food.

"7. Weeds store up minerals and nutrients that would be washed, blown or leached away from bare ground and keep them readily available."

Obviously, these purposes and benefits are listed only as general guidelines and do not apply to all weeds under all conditions.

F.C. King, in his book *The Weed Problem: A New Approach*, also revealed that weeds build up and protect the soil and, coexisting with domestic crops, help make soil nutrients more available. The author stated that "we are hopelessly wrong in believing weeds to be useless plants and in devoting our energy to their suppression, instead of studying to employ them."

In England, it has been reported that when lawns become deficient in lime, daisies appear. The daisies are found to be rich in lime, which they manufacture in their tissues. The lime goes into the soil when the daisies die and decay. When the soil becomes sufficiently enriched with lime, the daisy "problem" disappears.

When weeds become so abundant that they interfere with crop production, it ought to be recognized that the cause of the problem is not the weeds, but the *depleted soil* that the weeds were created and designed to protect and build up! Instead of destroying such weeds wholesale with herbicides while our soil continues to be degraded, we need to get busy building up the soil so weeds will naturally reduce themselves.

Solving the Problem

Here, then, is where we stand in regard to the pollution problem caused by pesticides such as herbicides and related chemicals.

Is it possible to survive if we continue to use ever-stronger chemicals in ever-greater quantities? *No!*

Is it possible to survive if we quit using pesticides? *Yes!* Many farms—large and small—are successfully doing it!

Will this be easy? For many, *no*! This is because the solution to the problem is to restore balanced fertility to the soil. And as Professor Cocannouer well stated in *Farming with Nature*, "The trouble is that most people refuse to learn just what farming [within the guidelines of nature] really is. Anything or any operation which *enhances* the activities in the soil's workshop is farming with Nature. But merely speeding up those activities is not necessarily enhancing them."

"Bringing a piece of land back to permanent fertility is probably the most difficult of all farm operations. Too often the farmer fails to

make a go of his soil building because he doesn't acquaint himself thoroughly, before starting, with all the adverse factors he is going to have to fight. He gets discouraged because he does not see the size of the job of remaking land that has been weakened for fifty or a hundred years. He has more than likely been schooled to expect the quick response that land makes to stimulants. He forgets that now he is *building* for permanency, not merely *stimulating*" (*Weeds, Guardians of the Soil*, emphasis added).

But it *can* be done and is being accomplished on an expanding number of farms, orchards and vineyards. This includes through Ambassador Center's Agriculture Education and Research Institute (AERI) and its extension programs.

Obviously the biggest hurdle will be changing our attitudes and accepting that the way to success is to *work with* natural laws rather than defying them.

A crash program in research and education on restoration methods—dealing with *cause*, not effect—needs to be carried out

Bountiful harvest: This thriving backyard vegetable garden for a family of four in Big Sandy, Texas, demonstrates that anyone who employs correct methods of gardening can reap high yields.

on a grand scale immediately, and administered by the highest-level governmental agencies, in order to make a significant and successful

Winter vegetables: Collard greens and kale grow in a raised bed in Wadsworth, Ohio. The organic garden is a local extension of the Agriculture Education and Research Institute.

transition on a national level. (The reader should ask: is this likely to happen?) Again, however, *each* of us *individually* is responsible for the choices we make and actions we take.

Through years of eye-opening education, research and production in the Agriculture Division of Ambassador College, Big Sandy, Texas—without using *any* toxic chemical herbicides, GMOs, etc.—we proved beyond the shadow of a doubt it *can* be done, and with rewarding success. And we continue to do so through the AERI. Healthier soil, healthier plants, and healthier animals equal healthier people!

I, my co-workers, and many of the program's graduates have personally taught and continue to teach these methods. All have their underpinnings in the principles of the Bible and are backed up by the laws of biogenesis, physics and chemistry. These programs focus on *carefully following the instructions and guidelines* of Scripture, and then practicing them.

In doing so, we have proven the Bible's way works and is best… *every* time.

PHOTO: THINKSTOCK

A Preview of Agriculture in Tomorrow's World

What about the future? What about tomorrow? Will man's achievements in agricultural science and technology really be able to bail out humanity—to genuinely solve our growing agricultural problems? Let's see what he has planned for the future of agriculture, *despite* the negative side effects we are experiencing today—and then see how it compares with future events detailed in the Bible.

Agriculture in the Future

Sugarbeet Update Magazine highlighted a dazzling report titled "Agriculture 2000" that was written by the Ford Motor Company in the late 1960s and later reprinted in *Holly Agricultural News*. The report predicted what some experts thought agricultural conditions would be like at the turn of the millennium.

"'The efficient farmer of the year 2000 is a super breed of farmer with super skills and super tools,' [said] the report. 'The heart of his operation will be a control center equipped with a wide array of electronic wizardry to help him produce crops two to five times as abundant as today.'

The magazine continued, "The unmanned tractors would be controlled by computer tape, buried wires, or sensing devices, and courses would be plotted on headquarter units similar to radar sets which follow today's airplane flights.

"Cows, which will have quadrupled their own milk production, will be backed up by the manufacture of identical milk from carrot tops and pea pods. Fertile eggs will be transplanted from superior cows into common incubator cows, allowing a superior cow to mother as many as 1,000 calves in her lifetime, compared with today's average of only ten.

"To completely control environment and growing conditions, huge plastic or glass domes, covering ten acres or more, will be erected. Plant growth will be automatically recorded so the farmer can provide proper light, water and nutrients simply by turning a dial.

"Today's tall corn fields will give way to new, squatty plants shaped like pine trees to lap up extra energy from the sun and the ears will be attached to the top for easier harvesting. Corn yields will zoom to 500 or more bushels per acre, compared with today's national average of about 75 bushels."

"Staggering production figures will be achieved, states the report. It projects yields of 300 bushels of wheat per acre, compared with today's 27; 175 bushels of soybeans, compared with today's 25; 30 tons of forage compared with three; 30,000 pounds of milk per cow, compared with 8,000, and 1,000 pounds of beef at 10 months of age, compared with 750 today."

And how would these staggering production figures be achieved? By the three magic wonders of modern agriculture: greater mechanization and automation, greater use of chemistry, and man-manipulated genetics!

All of the above "improvements" were predicted in 1967 to be in place by the year 2000. *Many* have not materialized, but some of what *has* been employed is far worse!

"Cradle to Grave"

Today, many farmers feel they could not survive without chemical pesticides and fertilizers. And what is worse is that scientists feel the intensive use of chemicals and genetic modification in agriculture is *still in its early stages*, compared to what it will become.

These researchers envision a time when chemical pesticides will not only be used with greater efficiency and precision in eliminating pests, but also in which these artificial fertilizers will become more refined and powerful in a "cradle-to-grave" chemical regulation of plant growth, development, yield and quality! It may surprise you to learn that the following systems of control over plant development are either presently in use or in experimental stages: synthetic hormones and solar radiation (to speed up or slow down plant growth and germination, whichever is desirable), and engineered mutations (to produce a "higher breed" of crop).

All these methods demand genetic and chemical manipulation, and move further from any form of natural processes.

Other manmade control measures involve regulating the branching and leaf orientation, the time of flowering and fruit set, the color and enlargement of the fruit, and fruit ripening. It also includes "abscission control," which prevents the premature dropping of fruit yet loosens it to make mechanical harvesting easy.

More manipulation of nature.

Artificial lighting and automatic feeding have long been widespread in livestock and poultry operations. Experiments with controlled environments show that all animals have a "comfort zone" and that temperature and humidity exert a marked influence on performance. Man hopes to raise livestock of the future in controlled environments (some even predict in high-rise, apartment-like dwellings!) and feeding is planned to be computer-programmed to meet specific needs. Estrus (sexual excitement) will be synchronized and ovulatory rates regulated with the ova being fertilized artificially with sperm of known genetic material.

More manipulation.

With chickens, researchers are working to break through the egg-a-day barrier. It is reasoned that a hen should not have to act as a packaging machine and be required to produce a limestone container for each egg. If the shell could be discarded and only the "membrane envelope" produced, much of the time and energy now used in egg production could be eliminated ("Progress of Research and Technology on the Food Supply in the United States").

Still more manipulation!

Hogs marketed 100 days after birth and beef animals marketed in six months were other predictions. The goal, then as now—get

as much gain as possible from every pound of feed consumed. One experiment in the same article showed that *caged* piglets would produce close to one pound of gain for one pound of feed.

Unsanitary living conditions: Cattle confined by the hundreds often stand ankle-deep in their own manure in feedlots, which provides a breeding ground for disease.

PHOTO: THINKSTOCK

As of 1969, *plastic* roughage (which is added to livestock feed in an attempt to promote digestion) went on the market for cattle! This product stays in the rumen and provides a "scratch factor" needed for digestion of grain and supplement. Proponents claim that it eliminates the need for natural roughage and in some instances has even increased feed conversion by 10 percent (*Western Livestock Journal*). Later developments included adding substances such as cement and wood pulp to increase the bulk of cattle feed!

Ask: if you would NEVER eat plastic, cement or wood pulp—*why* is it suitable for cattle?

The recycling of animal wastes as reconstituted foods for livestock and poultry is another destructive trend. This is intended to accomplish two purposes: getting rid of waste and providing cheap feed.

Again, ask: Would *you* eat animal feces? Or knowingly eat an animal fed with it?

Most American cattle are now given GMO corn, a practice so widely accepted that the term "corn-fed" is used by marketing

campaigns to sell steaks. Yet, ask: when was the last time you saw cows instinctively grazing in a cornfield? These ruminants are designed to consume grasses, and the beef that results from this natural feeding has been shown to be significantly more healthful than the artificial feedlot.

"We have come to think of 'cornfed' as some kind of old-fashioned virtue; we shouldn't," Michael Pollan wrote in *The New York Times*. "Granted, a cornfed cow develops well-marbled flesh, giving it a taste and texture American consumers have learned to like. Yet this meat is demonstrably less healthy to eat, since it contains more saturated fat. [A] study in The European Journal of Clinical Nutrition found that the meat of grass-fed livestock not only had substantially less fat than grain-fed meat but that the type of fats found in grass-fed meat were much healthier. (Grass-fed meat has more omega 3 fatty acids and fewer omega 6, which is believed to promote heart disease; it also contains betacarotine and CLA, another 'good' fat.) A growing body of research suggests that many of the health problems associated with eating beef are really problems with cornfed beef. In the same way ruminants [were not made] to eat grain, humans may not be well adapted to eating grain-fed animals. Yet the U.S.D.A.'s grading system continues to reward marbling—that is, intermuscular fat—and thus the feeding of corn to cows.

"The economic logic behind corn is unassailable, and on a factory farm, there is no other kind. Calories are calories, and corn is the cheapest, most convenient source of calories. Of course the identical industrial logic—protein is protein—led to the feeding of rendered cow parts back to cows, a practice the F.D.A. [U.S. Food and Drug Administration] banned in 1997 after scientists realized it was spreading mad-cow disease."

However, he continued, "F.D.A. rules still permit feedlots to feed nonruminant animal protein to cows. (Feather meal is an accepted cattle feed, as are pig and fish protein and chicken manure.) Some public-health advocates worry that since the bovine meat [beef] and bone meal that cows used to eat is now being fed to chickens, pigs and fish, infectious prions [a virus-like particle] could find their way back into cattle when they eat the protein of the animals that have been eating them."

As if this unnatural diet were not enough, to further speed the process of beef development, "American regulators permit

hormone implants on the grounds that no risk to human health has been proved, even though measurable hormone residues do turn up in the meat we eat. These contribute to the buildup of estrogenic compounds in the environment, which some scientists believe may explain falling sperm counts [in men] and premature maturation in girls…studies have also found elevated levels of synthetic growth hormones in feedlot wastes; these persistent chemicals eventually wind up in the waterways downstream of feedlots, where scientists have found fish exhibiting abnormal sex characteristics" (ibid.).

More recently, 66 percent of commercial chicken feed was found to contain substances such as "acetaminophen, the active ingredient in Tylenol, Benadryl, an antihistamine, even Prozac, an antidepressant. Farms feed chickens these mood-altering drugs to reduce their anxiety. Chickens are anxious because they are bred on overcrowded and filthy factory farms. Stressed-out birds develop meat that is tough and unpalatable, so they need to be sedated. Yet, chickens on tranquilizers sleep all the time and do not eat enough. So they are given high doses of caffeine (which was also found in the feather meal) to keep them awake at night to feed and fatten up" (*Guardian*).

Obviously, something is terribly wrong with this picture!

Modern Agriculture *Is* Failing!

The biggest problem with the glowing predictions we read is that nothing can *quickly*, *practically*, *cheaply* and *effectively* be put to work in solving our race against worldwide famine!

Projections may sound good. Some few may even come to pass in carefully controlled experiments or on *some* acreage in rich countries such as the U.S. But this is a far cry from having the capital and skilled manpower to make them useful on a large scale.

Besides, too often these glamorous-sounding projects deal with relatively minor factors as far as food production is concerned. The really big problems of shrinking available arable land (due to erosion, salt destruction, and urban development), a sinking water table, and the continuing general worldwide decline in soil fertility are almost totally ignored. Little or nothing is being done to solve these major problems. In fact, modern practices are all too often *hastening* the destruction of these priceless resources.

Look at the end result of many "successful" practices of modern farming, such as chemical pesticides and fertilizers, drugs, antibiotics in feeds, hybrids and GMOs. Every one of these is largely at odds with natural laws.

Some of these unnatural practices may *appear* to be successful—until we begin reaping the penalties. Already we are seeing the social and economic consequences of modern agriculture. New and deadlier diseases are increasingly being traced to what we eat and ultimately to poor farming practices.

The cost-price squeeze is one of many factors driving small farmers off the land and into already overcrowded cities, where they try to eke out an existence. While big farmers force all they can out of the land, the cost-price squeeze is also slowly but surely closing in on them.

And what about developing, hungry countries? There, limited agricultural resources (and almost all fertilizers) are used to grow cash crops such as coffee, peanuts or even plants used in illegal drug trade. These products are then often exported in exchange for foreign currency. Meanwhile, local people suffer from malnutrition and hunger.

Just look at the food crisis in the nation of Yemen. The problem continues to grow worse "because Yemenis use 40 percent of their available water to grow qat, a mildly narcotic plant that's the country's largest cash crop…That's far more than they allocate to grow food," *United Press International* reported.

Five million people are in need of emergency aid and it was estimated that 500,000 children could die in 2012 as a result of malnutrition or famine. Approximately 750,000 children under 5 years old suffered from malnourishment during the same year.

All the while, agribusiness debts pile higher and higher across Western nations. Farmers are forced to take out ever-bigger loans until they owe the bank or other lending agencies the majority of their total assets.

In utter incongruity, some governments have paid for taking cropland *out of production* to relieve a perceived surplus, while in other parts of the world fellow humans are starving, often due to *their* governments' policies. In the meantime, a farmer tries as hard as he can to produce more by forcing as much as possible from his remaining or total land so he can make a living! We are living *right*

now today the dichotomy of "surplus" alongside famine, malnutrition and starvation.

Positive Picture

If the vast majority of man's attempted solutions result in unintended negative consequences, where can we turn for real answers?

Time and again, biblical agriculture guidelines have been proven true. During my over 50-year career, I have seen the astounding results! Using the Bible and working within the guidelines of nature—not attempting to manipulate Creation—is *the only way* to produce abundance and health for the masses.

In fact, the promotion of correct farming practices is a major theme throughout this Book's pages. Imagine a world where the following is reality:

• "…and they shall beat their swords into plowshares, and their spears into pruninghooks: nation shall not lift up sword against nation, neither shall they learn war any more" (Isaiah 2:4).

• "And the desolate land shall be tilled, whereas it lay desolate in the sight of all that passed by. And they shall say, This land that was desolate is become like the garden of Eden…" (Ezekiel 36:34-35).

• "Behold, the days come…that the plowman shall overtake the reaper, and the treader of grapes him that sows seed…they shall plant vineyards, and drink the wine thereof; they shall also make gardens, and eat the fruit of them" (Amos 9:13-14).

Swords beaten into plowshares—desolate land becoming like the Garden of Eden—the plowman overtaking the reaper—an era of abundance and peace!

Sounds impossible, right? Yet unlike the utopian pronouncements of man, the Bible provides a *concrete* game plan of HOW to achieve this picture-perfect future.

Currently, however, something stands in the way.

The Basic Problem

Throughout history, man has cut down forests, overgrazed grasslands, and mined Earth's croplands—with hardly a thought given to

replacing, rebuilding and restoring. With very few exceptions, land *use* has been synonymous with land *abuse*.

And what has been at the root of this abuse? Human nature! A mindset of avarice, materialism, greed and a love of self—rather than of *outflowing concern* for the air, soil, plants, animals and fellowman. An attitude of *getting* and *taking*—rather than GIVING! Man's character of vanity, jealousy, lust and greed manifests itself in every one of his endeavors—and agriculture is no exception.

The obvious problems of agriculture today cannot be solved unless and until *self*-serving human nature in man can be replaced by a character and attitude focused on giving. As long as man's nature, with its tendencies to tear down, exploit and destroy, is allowed to dominate, there is no lasting hope for agriculture—or to feed the malnourished, hungry and starving masses of our world.

Yet there is another side to the agricultural crisis that many refuse to acknowledge. That the natural laws of science are really laws put in place by a Creator. If the world lived *His way*, then the era of abundance and peace mentioned in the Bible could come into glorious reality.

This God, however, *does not* require blind faith that He exists. In the Old Testament book of Malachi, He declares: "Prove Me now herewith…" (3:10).

A major part of God's Way includes agricultural laws and blessings. He calls on all peoples to prove for themselves that obedience to His statutes and commands brings unparalleled prosperity.

Notice Deuteronomy 28: "And it shall come to pass, if you shall hearken diligently unto the voice of the LORD your God, to observe and to do all His commandments…that the LORD your God will set you on high above all nations of the earth" (vs. 1).

God boldly states that obedience *will* bring spectacular agricultural prominence. In a sense, He is saying, "Because I exist, these blessings will occur!"

These conditional blessings are detailed in Leviticus 26: "If you walk in My statutes, and keep My commandments, and do them; then I will give you rain in due season, and the land shall yield her increase, and the trees of the field shall yield their fruit. And your threshing shall reach unto the vintage, and the vintage shall reach unto the sowing time: and *you shall eat your bread to the full*, *and dwell in your land safely*" (vs. 3-5).

This is the SOLUTION that would immediately start turning the present agriculture disaster around!

To do so we must make it a way of life to emulate and *do* what *God* says is good, and immediately *reject* what any man or corporation says is "better."

You MUST ask yourself whom you believe when the counsel and instruction from these two sources—God or man—differ, as they nearly always do!

Realize that your Creator states He is on *your* side: "I [God] call heaven and earth to record this day against you, that I have set before you life and death, blessing and cursing: therefore *choose life*, that both you and your seed *may live*" (Deuteronomy 30:19).

What a loving and merciful God! What a difference! While man's way—without immediate and drastic change—*delivers death*, God's Way promotes and *promises life!*

Two Ways

Man has the choice between two ways of life summarized as "life and blessing" *or* "death and cursing." This is the same decision he has faced since the beginning.

Summer's bounty: A peach tree produces a record harvest after being treated with good plant nutrition by way of foliar minerals and natural soil bacteria and enzymes.

In the Garden of Eden, God placed two trees symbolizing two opposing ways of life: "the tree of life" and "the tree of knowledge of good and evil" (Genesis 2:9).

Man has been living the way of "the tree of knowledge of good and evil" for millennia. Simplified, this means he decides *for himself* what is good and evil, what is right and wrong.

The results have been drastically mixed. The genius of the human mind has brought incredible advancement and progress coupled with dastardly evil acts.

God warned man to not eat from this tree, saying, "But of the tree of the knowledge of good and evil, you shall *not* eat of it [do not eat the fruit representing a mix of true knowledge with false]: for in the day you eat of it you will surely die [relying on humanly devised knowledge leads to sickness, disease and death]" (vs. 17).

Man deciding what is right and wrong is the core problem of the agricultural crisis. Trying to change nature through genetic and chemical manipulation is a futile effort.

Notice: "God saw *everything* that He had made, and, behold, it was *very* good" (Genesis 1:31). For example, God created insects for our good. But in man's eyes, insects are a *mix* of good and evil.

The laws of nature implemented by the Creator are GOOD. They do not need "perfecting" by a meddling mankind!

Left on his own, man can—*at best*—produce results that are both good and evil. History proves this true. Due to this, there is a dire need to educate humankind in proper farming practices. And the solution must be implemented on a *global* scale.

World leaders have often echoed the need for a close-knit worldwide government. Sir Winston Churchill once said: "The creation of an authoritative all-powerful world order is the ultimate aim towards which we must strive. Unless some effective World Super-Government can be set up and brought quickly into action, the prospects for peace and human progress are dark and doubtful" (*Never Give In!: The Best of Winston Churchill's Speeches*).

And a SUPERGOVERNMENT is exactly what God has in mind.

Yet the Creator's solution will *not* come in the way men seem to think, and *not* through any so-called "united" coalition of nations or any other "world order" of *man's* design. Yet it *is guaranteed* to happen.

Notice Daniel 2: "But there is a God in heaven that reveals secrets, and makes known…what shall be in the latter days…And in [those days] shall the God of heaven set up a kingdom, which shall NEVER be destroyed: and the kingdom shall not be left to other people…and it SHALL STAND FOREVER" (vs. 28, 44).

Under this kingdom, the whole world is going to learn the right way to farm—the right way to live—the way to abundance and happiness. *All* destructive and toxic agricultural, social and religious practices *will* come to an *end*! They will be replaced by the life-giving and life-sustaining laws and blessings of God's government. They will produce far-reaching breakthroughs in food production and prosperity that will stagger the imagination. It will deeply and directly affect the life of every person in every country on Earth.

Agriculture's Fantastic Future

The Bible paints an exciting picture about some of the tremendous and wonderful changes that will occur in coming years.

At that time, society will be agriculturally oriented. Farming and gardening, orchards and vineyards, livestock and poultry husbandries will be so popular that even city dwellers will want to take part. But not in the way so many do today, "playing at" farming just to gain tax benefits.

Rather, people in tomorrow's cities will want to have their own gardens and small orchards just for the pleasure of working with the soil, of being close to God's Creation, and of growing part of their own food.

Because of changes in tomorrow's urban areas, many people in towns and cities will have room for small-scale agricultural activities. Some may even keep a few chickens, cows, sheep or goats!

Vast new acreages of fertile, well-watered land will become available for growing crops and raising livestock. Perfect weather and bumper crops will become the rule—not the exception.

Remember the Great Educator's promised blessings in Leviticus 26: "…rain in due season, and the land shall yield her increase, and the trees of the field shall yield their fruit" (vs. 3-4).

Hunger and malnutrition will become a thing of the past. Everyone in every land will be able to enjoy fresh, clean, wholesome, tasty, nutritious food—grains and nuts, meat and dairy products, and

God's Coming Solution

In his book *Tomorrow's Wonderful World – An Inside View!*, Ambassador Center Chancellor David C. Pack outlines the dramatic changes that will occur with the establishment of the kingdom of God:

"At the end of Christ's 1,000-year rule...vast billions will be resurrected to physical life and given an opportunity to receive salvation. The Earth must be ready to receive them. God has a plan to prepare and reclaim potentially available land, in such vast expanses, that this problem will be solved for all time.

"Catastrophic prophesies, to be fulfilled just prior to Christ's Return, will bring unparalleled devastation and destruction to the earth's surface. God is most specific about what will happen. Weapons of mass destruction will be unleashed before, and possibly during, Christ's Coming. The 'waste places' spoken of previously may include nuclear 'dead zones' in multiple places. Biological and nerve weapon releases may leave vast areas uninhabitable.

"God will have to literally *rehabilitate* the surface of the earth in order to make it fit, once again, for human habitation. Bear in mind that 77 percent of the earth's surface is already uninhabitable oceans and seas. (Indications are that this percentage could actually temporarily *increase* for a short time due to climate change.) Enormous deserts and great mountain ranges occupy a large percentage of Earth's landmasses, including islands. Some regions of land (the two Poles) are too cold to inhabit. Only about 10 percent of the earth's surface is suitable for agriculture, with no more than 15 percent inhabitable.

"God has a Master Plan! No man could ever think of it, or bring it to pass if he did. Yet it will solve *every* problem related to overpopulation, pollution, and production, procurement and distribution of food and water. It will involve a complete change in entire weather patterns around the earth, including ocean currents, jet streams, and flow of Arctic air. Beautiful, clear water will be available—and in abundance—in all parts of the world. The nature of mountain ranges, islands, and even placement of continents will allow a repopulation of Earth simply inconceivable to modern planners of cities and nations.

"Let's take a look.

Deserts Disappear—Water Plentiful

"The world is now running out of fresh drinking water—but that will soon change dramatically. Here is one of the most incredible prophecies in the entire Bible: 'Then shall the lame man leap...and the...dumb sing: for in the wilderness shall waters break out, and streams in the desert. And the parched ground shall become a pool, and the thirsty land

springs of water: in the habitation of dragons, where each lay, shall be grass with reeds and rushes' (Isa. 35:6-7).

"Verses 1-2 add more to what this will mean for all the deserts of the world: 'The wilderness and the solitary place shall be glad for them; and the desert shall rejoice, and blossom as the rose. It shall blossom abundantly, and rejoice even with joy and singing: the glory of Lebanon shall be given unto it, the excellency of Carmel and Sharon, they shall see the glory of the LORD, and the excellency of our God' (Isa. 35:1-2). Take time to read the entire inspiring 35th chapter of Isaiah.

"The following is a phenomenal prophecy about a river that does not yet exist. It will flow from Jerusalem—in what will no doubt be the largest natural spring in the world, even bigger than Mammoth Springs, Arkansas—eventually reaching around the world: 'And it shall be in that day, that living waters shall go out from Jerusalem; half of them toward the former sea, and half of them toward the hinder sea: in summer and in winter shall it be' (Zech. 14:8).

"Wastelands of sand and cactus will break forth into a scenic beauty of lush greenery that is hard to imagine. Pasturelands, trees, shrubs, brooks, streams, rivers, and gardens will replace all the deserts of the world.

"But it is not just the deserts that will radically change in tomorrow's world.

Mountains Altered

"Take a moment to savor the meaning pictured in this related prophecy, also in Isaiah. Notice what will happen to the mountains:

"'Fear not...you men of Israel; I will help you, says the LORD, and your Redeemer, the Holy One of Israel. Behold, I will make you a new sharp threshing instrument having teeth: you shall thresh the mountains, and beat them small, and shall make the hills as chaff. You shall fan them, and the wind shall carry them away, and the whirlwind shall scatter them: and you shall rejoice in the LORD, and shall glory in the Holy One of Israel. When the poor and needy seek water, and there is none, and their tongue fails for thirst, I the LORD will hear them, I the God of Israel will not forsake them. I will open rivers in high places, and fountains in the midst of the valleys: I will make the wilderness a pool of water, and the dry land springs of water. I will plant in the wilderness the cedar, the shittah tree, and the myrtle, and the oil tree; I will set in the desert the fir tree, and the pine, and the box tree together: that they may see, and know, and consider, and understand together, that the hand of the LORD has done this, and the Holy One of Israel has created it' (Isa. 41:14-20).

"Can you imagine this happening around the world? Mountains and hills being shred like mulch, bubbling springs and new rivers appearing suddenly, and wilderness areas disappearing and being

replaced by great forests of diverse trees. God says to 'see,' 'know,' 'consider,' and 'understand' the scope of what He promises.

"How awesome are the ways of God!

"This amazing prophecy depicts a world with plenty of room for people—and cities, parks, forests, recreation areas, crops, lakes, and rivers. The biggest challenge might be where to store the gargantuan food reserves that could soon appear. This would be a much better 'problem' than the food wars that numerous experts predict will come, if something does not happen soon. (Incidentally, do not forget that millions of pounds of beef on the hoof will be available in places such as India, once superstition and ignorance is replaced by cooperation and *true* knowledge. So will the perhaps half of India's crops that are lost annually during the typhoon-monsoon season.)

"And why should Isaiah's prophecy seem strange? God's purpose has always been that people be happy and peaceful, contented and joyful. While this is strange and unusual in *this* world, it is neither strange nor unusual to God. This is what He always intended for His creation. He wanted Adam and Eve to enjoy the garden from which they eventually had to be expelled.

"Since God formed the mountains (Ps. 90:2; Amos 4:13), He can also *re*-form them in any way that He wishes. He apparently will use great earthquakes to do much of the work (Zech. 14:4; Rev. 16:18), because He states, 'The mountains quake at Him, and the hills melt' (Nah. 1:5).

"Isaiah 40:4 states, 'Every valley shall be exalted, and every mountain and hill shall be made low: and the crooked shall be made straight, and the rough places plain.'

"There are many great mountain ranges on Earth. Imagine the desolate, snow-covered, windswept stretches of the Himalayas, Alps, Rockies, Andes, Hindu Kush, Sierras, Pyrenees, and other great mountain ranges lowered or leveled and made fertile and inhabitable. Then picture the vast icepacks and mountain ranges of Antarctica, Greenland, and Siberia, including immense areas of tundra and permafrost, becoming available. Countless millions of acres will be made available to a mankind that could never do this for itself. (Could all the nuclear weapons on Earth blast away even a few of the world's great mountains? And what would remain if they could?)

"Now imagine how *many* great deserts would disappear. Start with much of the Middle East and almost all of Northern Africa. Picture the Sahara in Africa and nearly all of Saudi Arabia becoming lush and verdant. Then picture the Gobi desert in Asia and the Kalahari and Lake Chad basin, also in Africa, suddenly turning green, along with much of the American West and Southwest. More countless millions of acres of virtually useless land will become available for multiple purposes.

"Astonishing, but true—and in your lifetime!"

fruits and vegetables in unbelievable variety and abundance. No, it will not happen overnight, but it *will* happen!

A large percentage of the world's populace will live on prosperous family-sized farms. Millions of these well-kept country areas with spacious, beautiful homes on them will dot the landscape. Families will enjoy stable economic prosperity, radiant health, and a sense of satisfaction, accomplishment and fulfillment from their work.

They will strive to work in harmony with the laws of God in every aspect of their husbandry operations. Farming will be a respected

Abundance: A local organic garden in Wadsworth, Ohio, which is an extension of the AERI program, shows the fruit of applying God's principles of agriculture.

occupation and farmers will take pride in what they produce. Their goal will be to produce food that is high in *true quality*—tasty and nutritious—not just a lot of "bulk."

This means that careful attention will be paid to building up the land. Management practices will be used that produce healthy soil rich in humus and biological life—with vegetation practically impervious to insect infestation and disease. This fertile soil will be protected and further built up by proper tillage methods, diversification, crop rotation, and other conservation practices. Such carefully managed soil will make maximum use of available moisture. It will not be plagued with erosion and a troublesome amount of weeds.

Diversification will replace monoculture. Farmers in the world to come will raise a large variety of crops, planted at the right time on the right soil.

Pesticides and other harmful chemicals will be totally unnecessary! Forcing and mining soil, which produces yields of inferior quality, simply will not be practiced.

A land sabbath will be observed every seventh year, during which the land will rest—yet with an abundance of food for all. Recall from earlier: "Six years you shall sow your field, and six years you shall prune your vineyard, and gather in the fruit thereof: but the seventh year there shall be a sabbath of rest unto the land, a sabbath for the LORD: you shall neither sow your field, nor prune your vineyard. That which grows of its own accord of your harvest you shall not reap [for market or storage], neither gather the grapes of your vine undressed [for market or storage]: for it is a year of rest unto the land.

"And the sabbath of the land shall be meat [food] for you; for you, and for your servant, and for your maid, and for your hired servant, and for your stranger that sojourns with you, and for your cattle, and for the beast that are in your land, shall all the increase thereof be meat [food]."

"Wherefore you shall do My statutes, and keep My judgments, and do them; and you shall dwell in the land in safety. And the land shall yield her fruit, and *you shall eat your fill*, and dwell therein in safety" (Leviticus 25:3-7, 18-19).

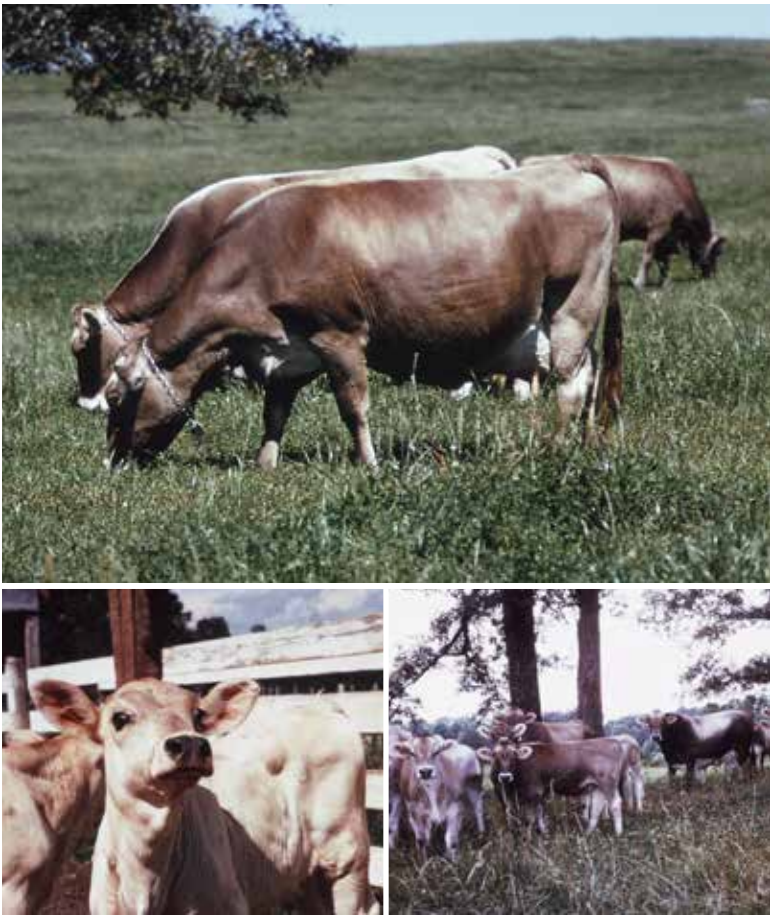
The government of God will be in place ensuring proper care of the soil, plants, animals and people. *The give way of life*—the way of the KINGDOM OF GOD—will be in place *everywhere*! Gone will be the way that leads to death, which we see all around us today!

Healthy Livestock and Poultry

Since animals play an important part in the ecology of the life cycle, tomorrow's farms will have a variety of poultry and livestock. Animal wastes will be properly used to make an important contribution to soil fertility.

Though livestock may be temporarily penned for fattening purposes, they will not spend most of their lives confined in crowded feedlots. Neither will chickens stay cooped up in cages so small they can barely turn around.

These farm animals will not be given a host of drugs and shots, and feeds of unnatural, unbalanced, highly concentrated mixtures that cannot possibly produce high-quality meat. Rather, poultry and livestock will be given healthful feed and forage that is clean, balanced and high in nutritional value. This wholesome feed will produce strong and healthy stock that will result in robust offspring of the same high caliber.



Healthy herd: Registered Brown Swiss cattle on the Ambassador College campus in Big Sandy, Texas, demonstrate the effectiveness of the principles used in the school's agricultural program. Their bright eyes and moist noses indicate they are in vibrant health. No chemical fertilizers, pesticides or animal vaccinations were needed or used. The blessings of God were abundant!

Selective breeding of both plants and animals will be practiced to build up factors of, again, true quality—*not* genetically engineered by man. Development and use of inferior hybrid strains and GMOs will be neither permitted nor desired. Neither will there be such practices as artificial insemination.

It is actually a violation of God's laws to interbreed different kinds of animals. "You shall keep My statutes. You shall not let your cattle gender with a different kind: you shall not sow your field with mingled [blended, hybrid] seed…" (Leviticus 19:19).

This scripture speaks of gendering cattle with diverse kinds. But the Hebrew has only one word that means both "kind" and "variety" or "breed," in the sense used here. It would be better translated "variety" or "breed," not kind. It would normally be impossible to gender cattle with any other kind—such as horses, sheep or dogs, buffalo, elk or deer. "In the wild," none of these animals interbreed, and we are not to "force" it. (Read the example of Jacob in Genesis 30:29-43 for more about correct selective breeding for herd improvement.) From time to time throughout history, a new breed (or variety) has occurred, but this is only through a natural mutation process that reproduces *like kind*.

When God, for a purpose beneficial to mankind, blesses us with different varieties derived from parent stock, He wants those varieties kept pure. He does not want what He has wisely done to be undone by man (through methods such as hybridization of plants and animals).

Varieties in both animals and plants are a blessing!

Abundant Living for the Farmer

The high quality evident in farm produce will also be reflected in the personal life of a husbandman and his family. There will be work, of course, but it will be enjoyable, challenging and rewarding. Remember, Adam and Eve were given a very large garden and the responsibility to "dress [work, serve, till] it and to keep [save, hedge about, guard, protect, preserve] it" (Genesis 2:15). Work is good when work is *for* good. And farm life will not be a humdrum existence of toil and sweat from dawn to dusk with no time out for culture, relaxation and enjoyment of a rewarding life.

In this world to come, all farmers will be educated, cultured individuals—in a profession looked up to by the rest of society, not "looked down on" as it is in many regions today.

Nearby cities will offer additional rich varieties of cultural, recreational, educational and social opportunities for rural families. And scenic areas and parks of natural beauty will be available for hiking, boating, camping, fishing and more.

Entire Society Agriculturally Oriented

As mentioned earlier, in this new world, nations "shall beat their swords into *plowshares*, and their spears into *pruninghooks*: nation shall not lift up sword against nation, neither shall they learn war any more" (Micah 4:3).

Instead of making instruments of destruction for a war-oriented society, men will make instruments of peace, and society will become agriculturally oriented, productive and service-oriented—excited about serving our Creator, family and neighbors. Agriculture will be a respected profession, and many, many people will be engaged in it: "But they shall sit every man under his vine and under his fig tree; and none shall make them afraid: for the mouth of the LORD of hosts has spoken it" (vs. 4).

Can you imagine what it will be like when man wholeheartedly works in harmony with all of God's physical and spiritual laws? The results will be breathtaking.

The Bible describes it in these terms: "Therefore they shall come and sing in the height of Zion, and shall flow together to the goodness of the LORD, for wheat, and for wine, and for oil, and for the young of the flock and of the herd: and their soul shall be as a watered garden; and they shall not sorrow any more at all" (Jeremiah 31:12).

And again, "Behold, the days come, says the LORD, that the plowman shall overtake the reaper, and the treader of grapes him that sows seed; and the mountains shall drop sweet wine, and all the hills shall melt…and they shall plant vineyards, and drink the wine thereof; they shall also make gardens, and eat the fruit of them" (Amos 9:13-14).

Yes, there is fantastic hope for the future! There is wonderful *good news* that lies ahead. With the establishment of the government of God throughout the earth, there will be no famine, no malnutrition or hunger, and no war any more—in the world to come for ALL who respond to His benevolent rule.

You can begin to live a foretaste of this way now—if you choose to live by the guidelines found in the Bible!

Once again, read God's solemn but inspiring words: "I call heaven and earth to record this day against you, that I have set before you life and death, blessing and cursing: therefore *choose life*, THAT BOTH YOU AND YOUR SEED MAY LIVE."

Peaceful setting: Horses, used for stable management and physical education by way of horseback riding classes, graze in a pasture and hay meadow at the Ambassador College campus in Big Sandy, Texas.

The Following Literature Expands on Topics Covered in This Book

- Tomorrow's Wonderful World – An Inside View!
- God's Principles of Healthful Living
- The Truth About Healing
- Are *All* Animals Good Food?

Books by Ambassador Center Chancellor David C. Pack

- The Awesome Potential of Man
- Tomorrow's Wonderful World – An Inside View!
- The Bible's Greatest Prophecies Unlocked! – A Voice Cries Out
- Saturday or Sunday – Which Is the Sabbath?
- The True Jesus Christ – Unknown to Christianity
- Sex – Its Unknown Dimension
- Where Is the True Church? – and Its Incredible History!
- Dating and Courtship – God's Way
- Train Your Children God's Way
- The Trinity – Is God Three-In-One?
- The Bible's Difficult Scriptures Explained!
- The Ten Commandments – "Nailed to the Cross" *or* Required for Salvation?
- Herbert W. Armstrong – His Life in Proper Perspective

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