PERELANDRA MICROBIAL BALANCING PROGRAM MANUAL

REVISED AND USER-FRIENDLY

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Perelandra Microbial Balancing Program Manual
Revised and User-Friendly
Machaelle Wright

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Chapter 1

The World of Microbes

I LOVE MICROBES. I love microbes because they make an honest person out of me. Their sheer strength and numbers require that I operate with the highest level of integrity that I can muster. In fact, this is one thing I love about nature. We can play games and fool ourselves about some things. And we can play games and fool others. We can even get away with this, if we're good enough. But we can't pull the wool over nature's "eyes." Nature automatically knows what is in balance and what is out of balance within any action or state of mind that we may project. It doesn't judge us. Our lack of integrity is not nature's concern. It simply knows balance, it knows its survival depends on balance—and it won't adjust to support something that is out of balance.

The strength and numbers of microbes not only require that I be honest, they require that I function with them as partners. They provide me with a challenge. I know that in the end microbes will *always* win every war we wage with them. It's in their nature not only to win but to come out of the war stronger than they were prior to it. So not only have we lost the war, we've further strengthened microbes in the process. This is not a smart battle plan on our part.

And this is something else I love about microbes. They highlight our ignorance, arrogance, stubbornness and down-and-out stupidity in clear and undeniable ways. They force all of us to be honest. They force us to conduct ourselves with integrity and true cooperation. They force us to come up to very high personal standards, if we are all to survive.

The bottom line: We either work in a mutually beneficial partnership with them or we will destroy ourselves as a result. They *will* survive. That's their goal and they are very good at accomplishing this goal. They've proven it over 3.5 billion years of evolution. We will annihilate ourselves long before we destroy even a small fraction

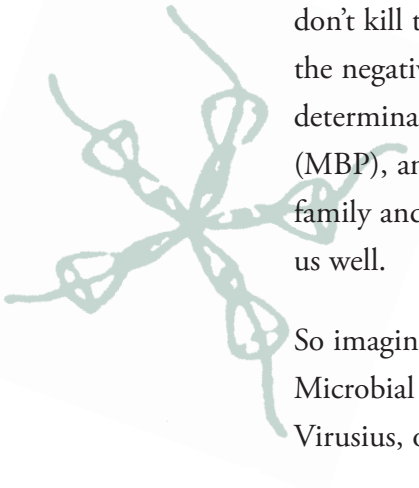
* Pronounced: my-crow'-be-al

of microbes. Sure, we can kill off individual microbial* colonies, but this is hardly a ripple in the microbial waters and it is temporary. The few that survive the attack will mutate in ways that will allow them to survive any similar attack in the future, and those "improved" microbes will rapidly reproduce.

I also love the world of microbes because they so clearly reflect the state of the world—the global environment—that *we* have created. They are an accurate mirror for us. We like to think that our present microbial woes are caused by the microbes themselves. But we need to remember that, on their own, they do not create and sustain an imbalanced environment.

I love this world because it operates on two basic and simple concepts: balance and survival. Microbes already know that to survive they must adjust to a balance that supports that survival—hence, their outstanding ability to mutate. What they know and how they demonstrate it is what we still have before us to learn. The microbial population that is within, on and around our body and is a natural part of our system automatically interacts with us in mutually supportive ways. However, more and more we are confronting them with an attitude of control and battle. We assume they will do what we wish—or else.

In order to appreciate what the Perelandra Microbial Balancing Program can give us, it is important that we know a little something about microbes and the problems we have created for ourselves as a result of our attitudes and lifestyle. Generally, as a lay population, we know very little about microbes except that they can kill us if we don't kill them first. I feel that if we understand the present microbial picture better, the negative as well as the positive, we will make smarter lifestyle decisions, have the determination to learn a self-help program such as the Microbial Balancing Program (MBP), and use this program more responsibly and in better ways for ourselves, our family and our friends. In short, I think a little knowledge about microbes can serve us well.



So imagine, if you will, that we have arrived at the mythical University of Advanced Microbial Studies and that we are being given a tour of the facility by Professor Virusius, one of the university's most esteemed senior faculty members. As we move

through the hallways, we will hear various lectures on microbes being given. Whenever the Professor appears, we are standing at the door of a new classroom listening to a different lecture. I think what you will "hear" will amaze, trouble, shock, stun, scare, and sometimes even take your breath away. We begin with the Infectious Disease class as they listen to a comprehensive list of facts illustrating the rising impact of disease globally.

Professor Virusius: The professor will also be pointing out important information throughout the book that you'll need to pay special attention to.

THE INFECTIOUS DISEASE CRISIS

According to Daniel Epstein from the Pan American Health Organization, "Health is today more than ever a global concern. Worldwide, every week, more than 1 million people travel between industrialized and developing countries, and every year, over 17 million people die from infectious diseases. [That's 1.417 million *every month* and 750,000 are small children.] Rapid air travel and international commerce in foods and other goods can easily bring in infectious agents . . . of disease from anywhere in the world. Population growth combined with rapid urbanization causes overcrowded and unhygienic conditions that are breeding grounds for infectious diseases. Wars, civil turmoil and natural disasters mean that millions of migrants and refugees are on the move in conditions that are also fertile for infectious diseases. Expanding areas of human habitation place additional millions of people at risk from pathogens previously rare or unknown as causes of human disease.

"Social changes, including the clustering of young children in day-care centers and growing numbers of the elderly in nursing homes, place these more vulnerable age groups at higher risk of infections. Diseases formerly under control are re-emerging because of complacency towards them—TB is one example. . . ." ("Infectious Diseases")

- "Infectious diseases are the third leading cause of death in the U.S. and the leading cause of death worldwide," according to Dr. James Hughes, director of the National Center for Infectious Diseases at the Center for Disease Control.
- "The microbes that cause infectious diseases are well-suited to outwit us and our tools. A brand-new generation of bacteria can appear in just twenty minutes. Microbes have evolution on their side.

- "In the last two decades, more than thirty new, often virulent diseases have been discovered: like Lyme Disease, Legionnaire's Disease, Ebola, AIDS [and SARS]. Diseases like malaria and tuberculosis are on the rise.

- "What tops [Dr.] Hughes' list of public-health concerns are 'antibiotic-resistant organisms,' often called 'killer bacteria.' Diseases once easily cured with antibiotics—such as pneumonia and meningitis, even children's ear infections—can now outsmart common drugs. [Dr. Hughes has said:] 'Today we have only one drug to treat some infections. Once they become resistant to this drug, then we will basically be back in the pre-antibiotic era.'

- "The vast majority of organisms that we focus on now, like the E. coli 0157:H7 bacteria, we did not even know about twenty-five years ago. Since E. coli was identified in 1981, it has been blamed for hundreds of deaths and sickened thousands in food-borne outbreaks.

- "Ebola scares people, but it has only killed a few hundred. Pneumonia, AIDS and urinary-tract infections are three of the four leading infectious-disease killers in the U.S." (Winik)

Dr. John Bartlett, chief of the infectious diseases unit at Johns Hopkins Medical School warns: "Most of all, we have to be prepared to deal with the unpredictable. We never know when one of these new viruses or bacteria will hit. We have to be ready to respond." (Winik)

The World Health Report 1996 shows that "we stand on the brink of a global crisis in infectious diseases. No country is safe from them. No country can any longer afford to ignore their threat."

- "Most of the lives lost are in the vital age groups that societies rely on to alleviate poverty—school-age children and working-age adults—the potential workforces of tomorrow, and the actual workforces of today.

- "Infectious diseases remain the world's leading cause of death, accounting for at least 17 million (about 33%) of the 52 million people who die each year. Apart from those 17 million—about 9 million of whom are young children—

up to half the world's population of 5.72 billion people are at risk of many endemic diseases.

- "Until recently, antibiotics were regarded as the solution to many infectious diseases. Today they are becoming less and less effective as resistance to them spreads. Meanwhile, evidence gathers on the role of viruses, bacteria and parasites in the genesis of deadly cancers of the stomach, cervix and liver.

- "Today's crisis is likely to get worse before it gets better. Internal and international movement of populations including refugees and migrants, haphazard and uncontrolled urbanization, economic development and changes in patterns of land use as well as in ecology and climate are creating new opportunities for the spread of infections. Because of rapidly increasing international air travel, there is also a growing risk that diseases will spread within days or even hours from one continent to another. The expanding world trade and marketing of foods carries with it the threat of food borne diseases.

- "Changes in lifestyle and behavior are an additional factor in the emergence of some infectious diseases, particularly those that are sexually transmitted.

- "Diseases that used to be restricted geographically, such as cholera, are now striking in regions once thought safe. While some diseases have been almost completely subdued, others such as malaria and tuberculosis that have always been among our greatest enemies are fighting back with renewed ferocity.

- "The role of infectious agents in the development of many types of cancer is becoming more evident.

- "Antibiotic resistance in hospitals worldwide threatens to leave medical and public health workers virtually helpless in the prevention or treatment of many infections. Many of the most powerful antibiotics have been rendered impotent. Disastrously, this is happening at a time when too few new drugs are being developed to replace those that have lost their effectiveness. In the contest for supremacy, the microbes are sprinting ahead. The gap between their ability to mutate into drug-resistant strains and man's ability to counter them is widening fast.

- "Infectious diseases range from those occurring in tropical areas (such as malaria and dengue haemorrhagic fever, which are most common in developing countries) to diseases found worldwide (such as hepatitis and sexually transmitted diseases, including HIV/AIDS) and food borne illnesses that affect large numbers of people in both the richer and the poorer nations.

M "Transmission can happen by direct person-to-person contact, through insects and other vectors, by way of contaminated vehicles such as water or food, and in other more complex ways. The reality today is that there are ominous trends on all fronts. . . ." (WHO)

Tuberculosis: "Tuberculosis remains the most deadly infectious disease in China accounting for more than 250,000 deaths each year.

"Tuberculosis, the Godzilla of bacterial diseases, infects up to a third of the world's population and currently kills more people per year than any other single infectious agent.

"Ninety-five percent of TB cases occur in developing countries, so it's easy for Americans to ignore this affliction. But we may no longer be able to afford to do so, health experts warned at a press conference sponsored by the World Health Organization. . . .

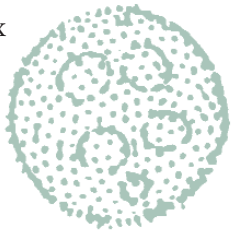
"The reason? Deadly drug-resistant TB strains are springing up around the world.

"'In today's global society, increasing drug resistance [to tuberculosis] anywhere becomes a threat everywhere,' Dr. Ken Castro, director of the CDC's TB Elimination Division, said at the briefing. 'Tuberculosis has the power to adapt, to grow stronger, and to travel as easily as we do from one nation to another.'

"Just last October, a Ukrainian emigre traveling on a Paris–New York flight may have infected a number of passengers with a strain of multi-drug-resistant TB. Luckily, the man visited a Pennsylvania health clinic two days later and state health investigators immediately called the airline and contacted the passengers who had sat near him.

"Thirteen of the passengers tested positive for TB, and were treated immediately with preventive medication (although it's not clear that the man actually infected the passengers: some may have already had the bug).

"This case is the latest in a small but growing number of incidents where travelers have spread active TB on airplanes.



"From 1992 to 1994, the CDC reported seven such cases, including two that involved multi-drug-resistant tuberculosis. These seven people, including six passengers and one flight attendant, potentially exposed more than 2,600 passengers on a total of 191 flights to TB . . .

"Most of the exposed passengers were tracked down by the airline, tested, and treated. In many cases, the people who tested positive may have already been infected with TB, and no person has actually developed active TB symptoms from an airline flight . . .

"However, as air travel increases, and the number of drug-resistant TB cases careens out of control in Russia and other nations, the likelihood that planes will become incubators for dangerous TB infections is increasing . . .

"While screening for TB is usually mandatory for immigrants and refugees, the overwhelming majority of passengers flying on commercial aircraft are not screened for TB . . .

"In 1994 alone, 'there were almost 97 million passengers on international flights between the U.S. and the rest of the world,' the report said. 'Clearly, medical examination of millions of people traveling by air worldwide would not be possible.'

"If new strains of TB are spread to the U.S., they could prove highly expensive to treat. Ordinary TB can be effectively treated with a six to eight month course of four very cheap medications. But the medications which work against drug-resistant TB can cost up to $10,000 per patient. In the late 1980s and early 1990s, the U.S. spent over $1 billion to treat a mini-epidemic which involved less than 2,000 cases of multi-drug-resistant tuberculosis, [Dr. Ken] Castro said.

"Do refugees and immigrants pose a health danger? The U.S. requires both refugees and immigrants to be medically screened for TB and a host of other infectious diseases within a year before leaving their home country, and also provides free medical screening and treatment to refugees within 90 days of their arrival in the U.S., according to Dr. David Smith of the U.S. Government Office of International and Refugee Health.

"Under these requirements, a person can theoretically become infected with TB within a year before entering the U.S., then become infectious once he or she has entered the country." (Wong)

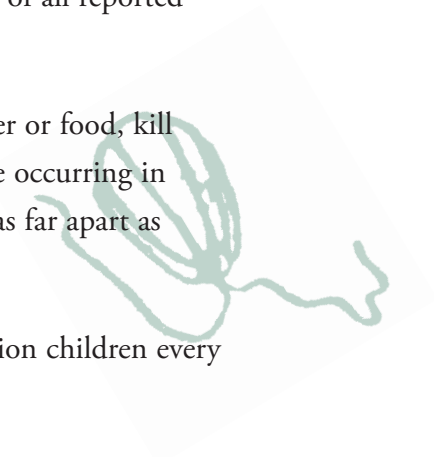
"Malaria is the worst of the insect-borne diseases. It still strikes up to 500 million people a year, killing at least 2 million." (WHO)

"Malaria, the most deadly of all tropical parasitic diseases, has been undergoing a dramatic resurgence. WHO estimates that between 300 and 500 million new cases occur each year. In 1997, approximately 1800 cases in the U.S. were reported to the CDC. It is estimated, however, that reported cases represent only 25 to 50% of actual cases. Although most of these cases were among persons who had been infected while traveling abroad, local transmission has been documented in recent years in California, Florida, New Jersey, New York, Texas, Michigan and Georgia.

"Increasing resistance of the malaria parasite to inexpensive and effective drugs presents problems for the treatment of active infections. At the same time, increasing resistance of mosquitoes to standard insecticides makes control of transmission difficult to achieve. (NIAID)

Influenza: "In the U.S., around 25% of the population has an influenza-associated illness annually, leading to an average of 20,000 to 40,000 deaths per year." (NIAID)

Other emerging viral diseases: "In 1993, an outbreak of a mysterious, often fatal illness occurred in the southwestern United States. Scientists quickly determined that the illness, characterized by fever, chills and muscle pain followed by acute respiratory distress, was caused by a previously unrecognized strain of hantavirus, a family of disease-causing viruses that occurs naturally in mice and other rodents. Now known as hantavirus pulmonary syndrome (HPS), the disease has been diagnosed in 211 people as of March 1999. Almost half of all reported cases have resulted in death." (NIAID)



"Diarrhoeal diseases, spread chiefly by contaminated water or food, kill nearly 3 million young children every year. Cholera epidemics are occurring in countries ranging from South-East Asia to the Middle East, and as far apart as western Africa and South America." (WHO)

"Acute lower respiratory infections kill almost 4 million children every year." (WHO)

"HIV, the virus that causes AIDS, is predominantly transmitted sexually, and has already infected over 24 million adults, of whom at least 4 million have died.

"More than 330 million new cases of other sexually transmitted diseases occurred in 1995." (WHO)

"[In 1998], close to 2 million people worldwide died from AIDS. The number of AIDS orphans is horrifying: 8.3 million children, according to UNICEF.

"Less reported is the growing economic impact. In Zimbabwe, companies report training seven workers for each job, as the death toll is so great. In Zambia, colleges graduated 300 new teachers last year; but AIDS took the lives of 600 [teachers]." (Lyman)

"Viral hepatitis is another major problem worldwide. This term is used to describe a group of several distinct infections which are similar in many ways, but which nevertheless differ in some of their characteristics, and in the prevention and control. At least 350 million people are chronic carriers of the hepatitis B virus, and

another 100 million are chronic carriers of the hepatitis C virus. At least a quarter of them will die of related liver disease." (WHO)

Cancer: "Some of the 10 million new cases of cancer diagnosed in 1995 [alone] were caused by viruses (hepatitis B and hepatitis C among them), bacteria and parasites. WHO estimates that 15% of all new cancer cases could be avoided by preventing the infectious diseases associated with them. . . ." (WHO)

"Recent studies undertaken by the International Agency for Research on Cancer have shown that cancer is the second most common cause of death in many parts of the world. An estimated 6.6 million people died of cancer in 1995 and 10 million new cases were diagnosed. It is generally believed that environmental and lifestyle factors as well as common practices such as diagnostic radiographic procedures are largely responsible for this disease. In addition, the link between infectious diseases and cancer is becoming increasingly clear. Viruses, bacteria and parasites may be the 'secret agents' of cancer.

"Up to 84% of cases of some cancers are attributable to viruses, parasites or bacteria." (WHO)

"Many diseases not thought to be infectious, like ulcers, are in fact caused by microbes. It may turn out that hardening of the arteries, rheumatoid arthritis, heart valve disease and other health problems could be caused by bacteria." (Blakeslee, "From Birth")

Hospital infections: "At any one time, many millions of people in the world suffer from infectious complications acquired in hospitals. About 2 million such cases occur every year in the U.S. alone, including about 70,000 related deaths. The spread of these infections is a growing threat to both patients and health care workers. It imposes huge economic costs—up to $10 billion a year in the U.S.

"Infections are most common in intensive care units and acute surgical and orthopaedic wards. The most frequent are surgical wound infections, which represent 25% of all hospital infections.

"The problem is getting ever more serious, largely because of increasing microbial resistance to drugs used to treat even the most common infections. Antibiotic-resistant bacteria are responsible for up to 60% of hospital-acquired infections in the U.S. Some organisms are resistant to at least one drug and often as many as ten.

"Patients receiving treatment in hospital are likely to have lowered natural resistance to infection. In industrialized countries with modern, well-equipped hospitals, other reasons for the rise of infections include the growing number of surgical and medical procedures and invasive techniques which create many routes of infection. In poorer countries, hospitals may lack the equipment or the trained staff to reduce infections. . . ." (WHO)

"The first signs of bacterial resistance appeared more than fifty years ago. In 1940, scientists had already identified the presence of an enzyme that inactivated the effects of penicillin in E. coli. Then, just four years later, a similar type of enzyme was found by epidemiologists in S. aureus.

"Even before penicillin came into widespread use, resistance was already beginning to crop up.

"Then in the 1970s, there were reports of organisms resistant not only to penicillin-type drugs, but other classes of antimicrobial agents.

"It has only been in the last few years that a handful of organisms have become resistant to all known antimicrobial agents." ("1990s")

A couple of years ago CNN reported about bacterial resistance to penicillin: "The bacteria that cause pneumonia, meningitis and other serious illnesses are becoming increasingly resistant to penicillin. . . . The CDC in Atlanta said that in 1997, 25% of the illnesses caused by streptococcus pneumoniae organisms were resistant to the antibiotic. The rate was 14% in 1993–94. The data came from a CDC study of hospitals in seven states with a total population of 16 million. The prevalence of drug-resistant pneumonia varied from 15.3% in Maryland to 38.3% in Tennessee." ("Drug-resistant")

Global warming: "Global warming problems are ultimately public health problems.

"People are more likely to support policies that really reduce the threat of global warming once they have understood the risks to themselves and children."

Effects include: "increased outbreaks and spread of some infectious diseases carried by mosquitoes, including dengue fever and malaria; and increased outbreaks of water-born diseases such as childhood diarrhea disease and cholera."

Paul Epstein of Harvard Medical School wrote: "Human beings are conducting a gigantic experiment on this planet with ourselves as experimental subjects. No human subjects committee at any medical school or hospital in any country of the world has ever approved such an experiment. As a scientist, I can say there are uncertainties about the future, but as a public health physician, I am very certain we are in deep trouble today. Although a lot of focus is now placed on the cost of reducing global warming, the damages by outbreaks of disease and epidemics would be much more serious." (Oshima)

Update: Since this first extensive report on infectious disease, the WHO has issued a follow-up report on the current state of infectious disease. It concludes that the global situation since 1996 has worsened considerably and the numbers have increased significantly since the 1996 report.

AN EXAMPLE OF HOW LITTLE WE HUMANS KNOW ABOUT BALANCE

I want to illustrate to you as clearly as possible how unknowledgeable we are when it comes to understanding the concept of balance and what is required to sustain a biosphere's health. Our lack of understanding in this area has created many of the microbial problems we face. Consider that nature has been doing this very thing on a global level successfully for about 3.5 billion years.

To illustrate our best stab at this balance business, I chose the Biosphere 2 project in Arizona. It was set up by top-notch scientists who had all the money they wanted to do what they wanted to do, how they wanted to do it. They controlled all the variables that they wanted to control. In other words, they "did the job right"—from their point of view. The result is appropriately described as a scientific nightmare.

"Biosphere 2, originally designed to study self-contained ecologies like those that might be created on Mars, ended in failure and impending biological collapse. Under its new management, the project is being converted to a controlled habitat for exploring how the earth's ecology would respond to global warming.

"Work on Bio 2 began around 1984. [It was] financed by Edward P. Bass, a Texas billionaire and oil heir. The aim was to have human inhabitants thrive in a miniature world made of a sea, savanna, mangrove swamp, rain forest, desert and farm—the areas and atmospheres interacting to form a totally independent life-support system. . . ." They brought in the best scientific minds to achieve their goals.

"It was a bold test of the Gaia hypothesis, proposed in 1972 by an Englishman, James Lovelock. The theory holds that the earth and its living creatures evolved together in a self-regulating system that maintains conditions that are optimum for life. [Biosphere 2 is an attempt] to mimic the earth's natural harmonies.

"The first crew entered in September, 1991, and left two years later, thin and tight-lipped. Columbia University scientists and advisors [have since put together] the grim tale. [The project] was torn asunder by 'unexpected problems and surprises.'

- "Oxygen levels plummeted from 21% to 14%, barely sufficient to keep [humans] alive.
- "Carbon dioxide skyrocketed along with nitrous oxide (laughing gas). Its strength may have been sufficient to reduce vitamin B_{12} synthesis to a level that can impair or damage the brain.
- "Morning glory vines, introduced to soak up carbon dioxide, exploded in number and overran other plants, including food crops.
- "Nineteen of 25 vertebrate species went extinct, as did all pollinators, dooming most plants to seedlessness.
- "Large trees became brittle and prone to catastrophic collapse.
- "Most insects died off, except for katydids, cockroaches and crazy ants.
- "Air temperatures soared higher than expected.
- "Light filtering through glass panes was surprisingly dim.
- "Too much rain turned desert areas into chaparal or grasslands.
- "The crew lost weight [one Biospherian dropped from 260 to 150 pounds], got sick and began to grow paranoid about food theft. . . ." (Broad, "Paradise Lost")

THE BEAUTY AND MAJESTY OF MICROBES

What's the up side about microbes? What do they actually do for us? I think you're going to be quite surprised.

"A love affair between humans and microbes begins at birth. Before birth, the fetus is germ-free. The skin, mouth and gut are all sterile. As a newborn passes through the birth canal, or the second it is touched by the doctor or midwife during Caesarean delivery, its adjustment to a world with microbes begins.

"[Microbes] are in the air, on the hands of [all] who touch the baby, [on] the mother's nipples, and on the rubber nipple of every milk bottle [it's given]. The

infant is colonized by successive invasions of microbes. Four hundred species begin to set up housekeeping in the baby's gut. Many more reside on the skin, mouth and elsewhere.

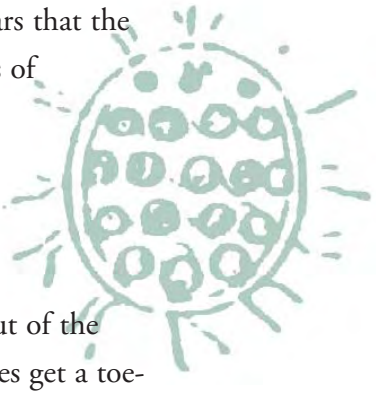
"Only a few bacteria out of thousands of known species in the world are virulent threats to human health and welfare. [Those] that colonize the human body are, for most part, working on the hosts' behalf.

"The body's bacterial colonies are among the most dense in nature. Half the contents of the colon is bacterial. Every year each person excretes his weight in bacteria. There are very few places in nature where one can find populations as diverse and numerous as ones found in the human body. It is estimated that the number of microbes that colonize the body *exceeds* the number of cells in the body by tenfold to one-hundredfold.

"Once inside the baby, microbes establish niches in particular regions of the gut. [Once settled,] they begin a conversation with other microbes, with epithelial cells lining the gut and with immune cells that also reside in the gut and talk to the brain.

"Microbes perform two major functions for their human hosts:

1. "They feed their host. Some help synthesize vitamins. Others produce sugars. The colon almost looks like it evolved for the purpose of harboring bacteria. The flow is sluggish. Many nutrients that people do not use or need appear to be eaten by bacteria. In turn, the bacteria produce sugars that the body wants and needs. This exchange may be important in times of famine or poor food quality. Bacteria may help a starving person extract more nutrients from paltry rations. People eating a high-fiber diet extract an estimated 10% of their energy from colonic fermentation.



2. "Friendly gut microbes work hard to keep disease microbes out of the body. By filling every available niche, they do not let harmful ones get a toe-hold. Antibiotic drugs may help cure a bacterial infection elsewhere in the body,

> [but] they often wipe out segments of friendly gut bacteria. People may feel nauseated or suffer from diarrhea until normal micro flora return, but others can experience a secondhand destruction of their gut bacteria, fall seriously ill and may even die as a result.

"When working normally, gut microbes engage in a conversation that is just now beginning to be understood. The system is very stable yet dynamic—new foods are constantly coming into the gut and the epithelial cells lining the gut walls are being shed every three to five days. The body discards these cells to protect itself from mutagenic chemicals found in natural plant foods. Plants evolve toxins to ward off insects, but those same poisons could harm the gut, so it changes its skin often.

"New research has shown how the bacteria that live in and on humans communicate with their host body and provide comfort, protection and nourishment. Researchers picked up the biochemical conversation between an organism that lives in the gut and the cells that line the colon.

"[Here's an example of] one discussion between one type of bacterium and epithelial cells in the small intestine: The bacteria send a signal to epithelial cells, telling them to make a sugar called fucose. The cells comply and the bacteria use the fucose to make more of the signal, setting up a reciprocal relationship. The microbes get fed. In return, the microbes establish a dense colony that keeps the intestines occupied by friends. If a pathogenic foe were to slide by, also looking for fucose, it would not be able to dig in—the niche is full.

"[This] suggests that an obsession with handwashing does not always make sense. People who handle food for others should definitely wash up. If a person is infected with a pathogen, it can easily spread to others. But for most people, the bacteria on their hands and bodies are usually friendly. If they get into the mouth, no harm is done.

"Of the 400 identified bacterial species in the gut, many have yet to be characterized. But there are indications that one may produce a calming effect on the body by synthesizing a tranquilizer. When people suffer total liver failure, they

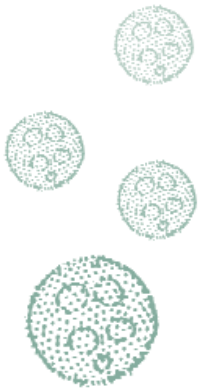
fall into a deep coma. This coma can be reversed by giving a drug that blocks benzodiazepine—otherwise known as Valium. This suggests that the gut produces its own Valium, which is normally broken down by the liver. When the liver is failing, the 'Valium' goes straight to the brain and knocks the person unconscious.

"The human mouth is no less bizarre when it comes to harboring microbes. The number of individual bacteria in one human mouth could easily exceed the number of people living on earth. Only half the roughly 600 species that live in the mouth have been identified. They, too, take up special niches. Some are inside of cheeks and others are on top of the palate. Some are along the back of the tongue. As in the gut, the filling of niches helps keep pathogenic microbes at bay.

"Populations of good ecosystems and bad ecosystems appear to switch back and forth. We don't understand what drives such changes—possibly diet and stress. Most of the time, the mouth is stable.

"Some bugs produce hydrogen peroxide and others acids that help prevent pathogens from getting a toehold. When pathogens get an upper hand, people suffer periodontal (gum) disease." (Blakeslee, "From Birth")

The kinds of microbes found in the mouth is a big surprise. "Microbes have been evolving for billions of years and they are always seeking new niches. We don't have to go to hot springs to find exotic bugs. Common scum on human teeth (plaque) contains relatives of a bacterium first identified in the intestines of African sheep. These sheep could eat a toxic legume with impunity. But when sheep elsewhere in the world ate the legume, they died. When researchers fed African sheep feces to Australian sheep, they too could eat the legume. The protective factor, a gut bacterium, was transmissible. This phenomenon was reported several years ago in the journal 'Systematic and Applied Microbiology.' What this microbe is doing inside the human mouth is a mystery. Five species have been found. They might help protect humans from similar vegetable toxins or they might be along for a free ride.



"[Other researchers have found] in human mouths microbes that usually thrive in lake sediment and a bacterium that causes a disease called cat scratch fever."

Dr. Abigail Salyers, microbiologist at the University of Illinois and an expert on human-microbial interactions said: "'The idea that whole tribes of microbes could get sick and thereby make humans sick is a new theme in microbiology. For example, bacterial vaginosis is a condition in which the normal microbes mysteriously change, resulting in a mild discharge and odor. It is not a sexually transmitted disease but rather a disorder of the microbes themselves. While harmless to the woman, it could promote premature births. We don't know how many other conditions are caused by a shift in these microbial populations. It's hard to study something this complex. . . .'

"Even friendly bacteria can cause disease. If a gunshot wound perforates your colon, gut bacteria can get into your blood stream and kill you. We build fences around these microbes to keep them in their proper place.

"But this is the exception, not the rule. Peaceful co-existence, even co-evolution is the rule between the ancient ubiquitous microbes and the human arrivistes. We're in equilibrium. They want a free lunch. We want to survive *in their world* and take advantage of it. Thus our bodies have evolved to accommodate microbes.

"We should love them. They're like our mother. They clean up our messes."
(Blakeslee, "From Birth")

MICROBES AND THE ENVIRONMENT

Dr. Carl Woese (pronounced woes) is an evolutionary microbiologist. He has devoted his life to convincing people—including other scientists—that microorganisms are in charge of nearly everything.

"'The problem with appreciating microbes is that they are invisible. But they make up at least 80% or perhaps even 90% of the biomass [the total mass of living matter within a given volume of environment]. In terms of living protoplasm, microbes outweigh all plants, insects and animals.

"'If you took all the fish and whales out of the ocean, it would not make a dent in the amount of living matter in the oceans.'

"Human beings like to think that biodiversity is represented by the rain forest, in the insects, plant life and larger animals that people can see and understand. But true biodiversity is found in microbes, which have been evolving for at least 3.5 billion years. The microbial world established the biosphere and sustains it.

"Bacteria were responsible for all the oxygen on the planet, via chloroplasts, which were once free-living bacteria and now reside in plants. They recycle carbon with infinite variation, regulate gases in the atmosphere and oversee mineral deposition. They invented biochemistry. Humans are merely jerry-built embodiments of microbial engineering. . . .

"Every time an [analysis] is made, new microbes are found. Those thought to live in only extreme environments, like boiling waters in Yellowstone, have relatives found in temperate oceans where they make up 50% of the microbial life. No one knows what they are doing there.

"People are beginning to pay attention to the microbial world, but Dr. Woese objects to the direction of the research. Much of the financing for finding and sequencing new microbes comes from the biotechnology industry, which wants

to put the microbes to work in laundry detergents, cleaning up toxic waste dumps and the like. They have it backwards. We should explore this world to ask deep questions about biology. Applications will certainly follow."
(Blakeslee, "Microbial Champion")

Another interesting microbial phenomenon discovered in the early 1980s is Serra Pelada, located in the Amazon jungle. "More than 100 tons of gold were extracted. This episode is often referred to as history's biggest gold rush.

"Scientists who later studied the site concluded that the rich lode was produced not by the accepted mechanisms of ore formation but by swarms of microbes that over millions of years concentrated the gold from jungle soils, rivers and rocks.

"[Today,] scientists are discovering that microbes dwelling up to miles deep in the planetary crust are responsible for creating and arranging the rocks, seas, oils, soils, gases, metals and minerals that make up the earth's surface. The implication is that this hidden biosphere of 'gazillions' of microbes and their ancestors has played a dominant role, perhaps *the* dominant role, in forming the planetary skin over the ages.

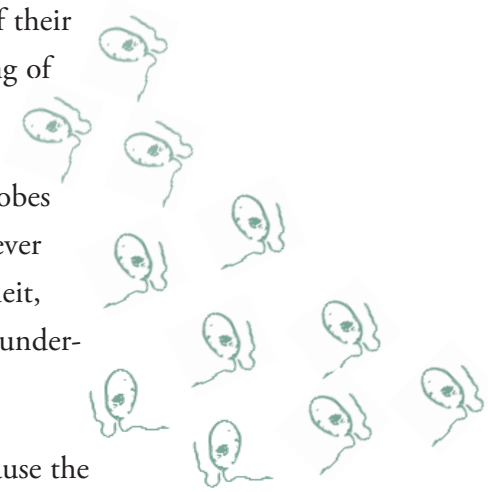
"Geomicrobiology studies the new view of how the earth's surface was shaped, which stresses the importance of subtle biological processes over the more overt ones of chemistry and physics. Supported by a growing body of evidence, it is shaking up the traditional disciplines of geology and microbiology. [Today's] 'hottest' earth sciences are geomicrobiology, microbial geology and environmental geochemistry. Scientists in these fields are producing a wave of new findings and clues about how microbes do things like generating fossil fuels, catalyzing geochemical reactions and concentrating valuable metals like iron and gold. 'The main conclusion is that if you don't understand the biosphere, you don't understand our environment' [says Dr. Fyfe of the University of Western Ontario]. Two decades ago scientists knew of thirty or forty compounds and minerals that were made or amassed by microbes, often as excreta or body parts, much as humans concentrate calcium to make teeth and bones. 'Today the number is hundreds. Every time we look harder, we find more.'

"Swarms of tiny microbes had proved to be adept at forming an enormous variety of minerals—carbonates, phosphates, oxides, sulfides and silicates as well as silver and gold." (Broad, "Earth's Dominant Life Form")

Studies are under way in the following areas:

- "[To] see whether carbon dioxide from burning of fossil fuels could be pumped underground into rocky formations where microbes would turn it into carbonates, which occur naturally and widely as limestone.
- "Microbes injected into wells might clean up polluted water and stimulate the production of natural gas.
- "Mining with microbes is also under study, including the tapping of gold ores normally too dilute for recovery.
- "Studying the earth's microbial ecology as a tool for understanding faraway places like Mars. A 1996 report by scientists [states] that the planet may have once harbored primitive microbes. Insights into terrestrial microbes and their effects can only aid Martian explorations that seek to find extraterrestrial life or evidence of its workings long ago. In general, scientists say, the microbial revolution is a key to understanding the universe and the earth's place in it.

"Although individual microbes are largely invisible to the eye, in general they are the oldest, most numerous and most diverse forms of life on the planet. Some of their habitats and effects are obvious, like microbial rusts that speed the weathering of rocks and microbial slimes that form mineral precipitates around ponds.



"But in the last decade scientists around the globe have discovered that microbes thrive in an even wider range of habitats. [They have been discovered] wherever there is water at temperatures from about 20 degrees to 250 degrees Fahrenheit, including the icy poles, the deep sea, hot springs, volcanic fissures and deep underground, in some cases miles down.

"The enormous range of microbial life was often overlooked in the past because the tiny creatures—so small that up to millions can inhabit a drop of water—are easy

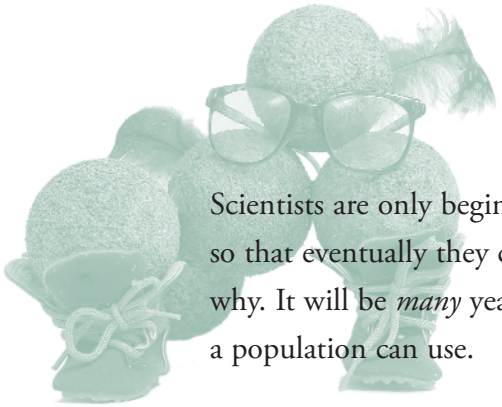
to miss and hard to investigate. So far, the world depth record for the finding of microbes appears to be 2.6 miles, where diverse colonies thrived at a temperature of 230 degrees F.

"So great is the aggregate bulk of these microbial organisms throughout the earth's crust that over the billions of years of geologic time, their cumulative biological mass is now seen as probably exceeding that of the planet as a whole—all 6 sextillion, 588 quintillion tons of it. It could be several times the mass of the earth [because] such estimates were extremely crude given the current state of microbial knowledge.

"A microbe's metabolism [can] prompt the making of minerals inside or outside its cellular walls, often by something as simple as excretions that change the acidity of surrounding solutions. For instance, blue-green bacteria living in naturally alkaline waters produce even higher alkalinity, precipitating carbonate minerals like calcite, the basic ingredient of limestone, chalk and marble.

"Microbes can also seek out metals and chemically process them to release energy for their growth, often concentrating the metals in the process, for instance, diverse oxides of iron and manganese.

"Scientists . . . studied a big natural gas field in Michigan that was thought to have been made as the earth's heat cooked rich organic remains in a bed of shale about 370 million years old. . . . But it turned out that the gas was actively produced by billions of microbes." (Broad, "Earth's Dominant Life Form")



CONCLUSION

Scientists are only beginning the arduous task of compiling data regarding microbes so that eventually they can draw conclusions about what makes microbes tick and why. It will be *many* years before quality, helpful conclusions are drawn that we as a population can use.

Co-creative science as it is being developed at Perelandra's Center for Nature Research connects us with the microbes' intelligence, and we can ask it directly for insight, information and the needed course of action. The Microbial Balancing Program is set up to allow microbes to lead the way to their own balance. We don't have to try to figure this out. We don't have to go through that arduous task of gathering data, nor do we have to risk drawing faulty conclusions from that data.

The ozone layer depletion is still a matter of scientific debate—as well as political and social. Yet while the scientists debate, *we* are left to figure out how to live and how our families are to live in an environment that includes harmful levels of ultra-violet rays. They debate—but *we* must deal with the practical issues of how to live safely. *We* must deal with the practical day-to-day issues while they argue and debate their respective positions and theories.

The same with microbes. While scientists debate about how best to "win the war" on microbes and gamble on new medical discoveries—like new antibiotics—that will temporarily hold the problem in check, we are faced with figuring out how to maintain health for ourselves and our families amidst a serious global crisis of infectious diseases. *We* have to get on with the task of living.

So—what do the scientists give us? Articles describing their newest findings in the overwhelmingly complex world of microbes. Data letting us know how many more new cases of skin cancer were diagnosed last year. And Madison Avenue cashing in on (and further hyping) mass concern and hysteria about microbial attacks. In lieu of a better solution, people address the infectious disease crisis by succumbing to Madison Avenue's lure of the latest antibacterial products. And to continue the hysteria in order to advance sales, they make *all* microbes into our enemies. Their anthem is "attack them, kill them all and make life clean again."

We must upgrade our concept of "clean." Clean should be synonymous with *balance.* Clean should not include or connote only a sterile environment, an environment devoid of microbes. When we approach our lives with a driving need for sterileness, we make decisions and conduct ourselves in ways that exacerbate the global microbial crisis. We join the war and we add to the overall picture of imbalance.

It's a war we'll never win. Microbes have the evolutionary history to prove it. Our intelligence *will not* control or overtake their need to survive. History has proven that.

The brilliance of the Microbial Balancing Program, what puts it way ahead of other scientists in microbial research and how it *effectively* addresses infectious disease is its reliance on the microbes' intelligence to provide the information that will restore a strong, positive, symbiotic balance with any microbial population within any host environment or body.

The biggest problem with the Microbial Balancing Program and why it is not used more widely is this reliance on the microbes' intelligence! People get into a philosophical debate about whether microbial intelligence actually exists—a debate similar to the one about the depletion of the ozone layer around the planet.

I say that every sane-thinking person *must* overlook their philosophical musings and concerns, make a courageous leap and allow microbial intelligence to move them successfully through this era of the infectious disease crisis. Let the scientists continue their laborious data gathering and debate while we use the tool that can successfully address the crisis. We'll get on with the practical day-to-day challenges of living in a microbially stressed world—a stress that we primarily created ourselves. This is the result of decades of our avoiding tough environment and lifestyle decisions, of hesitating and refusing to change our lives to live in ways that enhance environmental balance—to live *with* the planet and not at the planet's expense. We created this mess—not the microbes. They are only *reflecting* the mess and doing what they must in order to survive it. We created it and now we have to deal with the consequences. This is not a choice—it is an inevitability.

To overcome infectious disease, you don't indiscriminately destroy microbes. This only kills the majority of beneficial microbes for the sake of eradicating a relative few pathogens. This also leaves the host body open to a microbial repopulation that most likely will reflect a balance that is not mutually beneficial to the host environment. And more infectious problems occur.

You overcome infectious disease by *supporting* the beneficial microbes in the host environment. Help maintain *their* health and balance. Promote their growth in numbers. They will defend and maintain their balance and their "turf," and act against outside microbial threat. In a world that is beset by an infectious disease crisis, I believe this is the only sane and effective way we can move successfully through the gauntlet. It is the *only* way we can achieve a mutually beneficial balance with microbes without forcing them to mutate into "super microbes" in order that they may survive us.

We've got to change our perception about microbes and how they relate to us. And we no longer have the luxury to hesitate or stall with this. The crisis is here. It's not coming tomorrow. It faces us today.