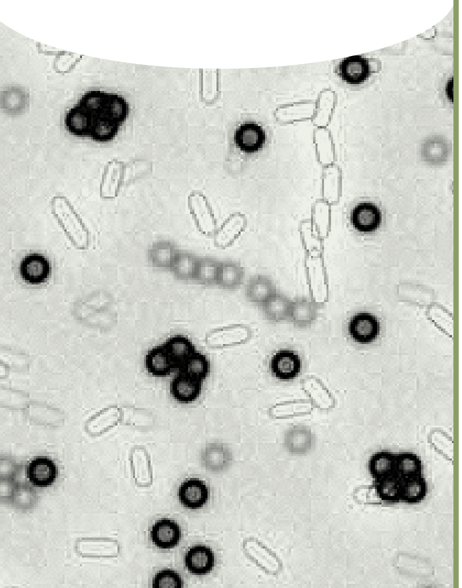


# Sex, Symbiosis and Antibiotics

Many of us are aware that there is an emerging crisis around the overuse of antibiotics. Mainstream medicine has us believe that the solution to this crisis is new and better antibiotics. However, if one looks closely at the interrelationship of bacteria and their relationship to the planetary ecosystem, it becomes clear that there is a better approach. The following article looks at the science of bacteria from the larger perspective of their function in the ecosystem. We need to reconceive our relationship to bacteria, not simply continue on the path of eradicating the latest "bad" ones.

By Joel Kreisberg, DC, CCH

**Bacteria stabilize the atmospheric gases that humans as well as all animals and plants require.**

## Bacteria Have Sex With Dead Partners

Fredrick Griffith discovered in 1928 that living pneumococci are capable of acquiring traits from other pneumococci even though the latter organisms are dead. (Margolis & Sagan 1986) This property of bacteria initiated the research leading to the discovery of DNA in 1944. DNA does not have to be living to be able to transfer information to live bacteria. Watson and Crick were awestruck by this feature of DNA and subsequently studied bacteria, thoroughly articulating how DNA worked in 1953.

**COMMENTARY:** *Actually, reproduction for bacteria, as for most living things, is much different than the usual reproductive process of the animal kingdom. Sex is not required for members of the other four kingdoms of living things (bacteria, protoctista, fungi, and plantae).*

## Bacteria Reproduce In Three Ways—All Without Sex

Bacteria grow larger, then simply divide in half. They also bud, meaning that their DNA replicates, then a small portion of the mother cell forms a separate cell and breaks off, growing into another adult. A third way involves the DNA of bacteria becoming encased in a spore that survives rough times to reemerge as a new bacterium when conditions are favorable.

**COMMENTARY:** *In vertebrates, reproduction and the exchange of genes occur simultaneously. In bacteria, reproduction has little if anything to do with genetic exchange, which takes place independently from reproduction.*

## Bacteria Have Sex Any Time

Genetic exchange (bacteria's version of sex) happens all the time. Bacteria are prokaryotic cells, meaning they do not have a single nucleus that holds the genetic material in one central place. Therefore they are constantly exchanging bits and pieces of their genetic material in a rather random fashion. Since there is much less genetic material in prokaryotic cells, individual bacteria operate with a 'bare-bones' minimum set of instructions for maintenance and replication.

If there are situations that require more information for bacteria to function, they use visiting genetic particles called 'replicons'. These replicons are shared during bacterial sex. Sometimes they are used and incorporated into the DNA of individual bacterium. Sometimes they are used on their own, like a 'satellite' strand of DNA.

**COMMENTARY:** *Why is this so important? Because these reproductive and genetic skills mean that all bacteria* potentially *share the same genes. Different bacterial species in the formal sense do not exist.*

### All Bacteria Are One Organism

This giant superorganism is capable of genetic engineering on a planetary or global scale. Small replicons can travel from one bacteria to another in a process known as transduction. Another technique called conjugation involves a tiny tube forming between two cells. These are two exceptional ways that bacteria can share immunity (to household disinfectants, drugs, chemotherapy, and even radiation). These exchanges happen so frequently, there are few if any individual bacteria. In many ways, there is one bacterium superorganism (Margolis & Sagan, 1986).

**COMMENTARY:** *The point is that bacteria never function as individuals. They work as a team in any given ecological niche. Lynn Margolis and Dorion Sagan believe that bacterial teams act as organs do in animal bodies. "Dispersed, as our blood cells, in any viable corner of our planet, the composition of a given team becomes adjusted for local conditions. The arrangements are dynamic, ready to change or to start in a new way if conditions around them change . . . The teams even maintain their own microclimate and temperature control. In addition, throughout the biosphere bacterial teams interact with various plants, animals, and fungi . . . These larger consortia also operate with the dynamic harmony of a single organism." (Margolis & Sagan, 1986 p. 91-92)*

### Bacteria Condition The Entire Planet

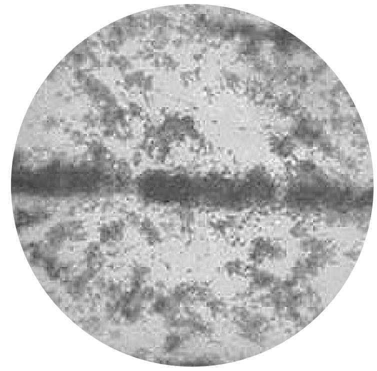
Bacteria are responsible for the cycling in the biosphere of organic and inorganic matter such as carbon, nitrogen, and sulphur. Bacteria purify water and render soils fertile. They recycle a constant fresh supply of the important gases that make up earth's atmosphere. James Lovelock (1983) argues that these microbial-produced gases act as a control system stabilizing the living environment.

**COMMENTARY:** *Because bacteria and the environment are so interwoven, there is no clear boundary between life and inorganic non-life. Bacteria everywhere are at this edge, and they live there very successfully.*

### Bacteria Are Immortal

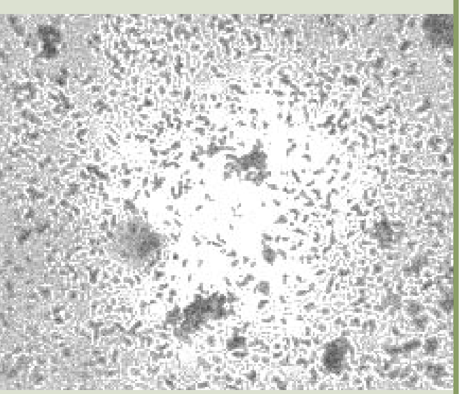
Because bacteria trade genetic information in the same generation—directly to their neighbors—they are functionally immortal. While an individual organism may die, its genes live on and can be passed along indefinitely. Teams of bacteria are continually selecting the best solutions to maintaining life on earth. Bacteria stabilize the atmospheric gases that humans as well as all animals and plants require. The surface environment remains stable for other life forms, including animals and plants. Without bacteria we humans couldn't exist.

**COMMENTARY:** *A deeper way of looking at it is to say that bacteria have a symbiotic relationship with all other life forms on the planet. Symbiotic means that the relationship between bacteria and most life forms (including humans) is mutually beneficial. There may be up to one trillion bacteria on the skin of a normal, healthy human being. The total bacteria living around and inside an individual human weighs close to one pound. (Lappe, 1995)*



**The point is that bacteria never function as individuals. They work as a team in any given ecological niche.**

**Alexander Fleming, the discoverer of penicillin, predicted back in 1945 that it would lead to resistant bacteria.**



### Antibiotics Produce Drug-Resistant Bacteria

In 1942, Merck and Company introduced a new drug—penicillin—in a live clinical trial. Penicillin, isolated from mold by the British scientist Alexander Fleming in 1928, had shown its ability to destroy staphylococcus, a bacteria causing infection through the skin. The results for the burn victims from the Coconut Grove fire in Boston brought this drug into the limelight, offering new hope in the search for medical treatments.
Yet Alexander Fleming himself predicted the development of resistant bacteria within three years of penicillin's introduction. In a little-known comment in 1945, he suggested that the misuse of penicillin would lead to mutant forms of bacteria that become resistant to this drug. In fact he had already grown those strains of bacteria. By 1946, 14% of the strains isolated from sick patients were resistant to penicillin, and nearly 60% were resistant by the end of the decade. (Levy 1998)

**COMMENTARY:** *Initially these shocking findings were only true in city hospitals, but by the middle of the 1970s these resistant bacteria began to appear throughout community hospitals and finally throughout local communities.*

### Drug-Resistant Gonorrhea Spreads in SE Asia Brothels

Scientist believe that resistant strains of gonorrhea grew because penicillin had been routinely given prophylactically in brothels in southeast Asia, where servicemen were in regular contact with prostitutes.
*H. influenzae* was resistant to penicillin. It turns out the gene in gonorhea was the same one found in *H. influenzae.* The identical gene had been picked up by these two different bacteria. (Levy 2002 p. 12)

**COMMENTARY:** *The problem with resistant strains of bacteria goes beyond simply finding new antibiotics when old ones don't work. After the initial peak of antibiotic effectiveness, many of the bacterial diseases thought to be under control do not just return, they become increasingly difficult to treat. In 1942, there were 600,000 cases of syphilis in the United States. By 1955 there were less than 100,000. But in 1985 syphilis infections began to rise sharply again. Salmonella infections have increased dramatically over the last 30 years; tuberculosis and pneumococcal pneumonia are on the rise after years of decline. (Lappe, 1995) These infectious diseases have become resistant to most antibiotics.*

### Resistant Bacteria Can Destroy Antibiotics

At this very moment tetracycline, trimethoprim, sulfonamides, and quinolones are met by more and more resistant bacteria. Since non-resistant bacteria can't survive these drugs, resistant forms are more prosperous. The resistant bacteria even learn how to destroy antibiotics "Antibiotics are deposited in the environment via human and animal excrement in a 'post-treatment' phase, where they can continue to select resistant bacteria. This period may be called their 'life after treatment'." (Levy p. 102)

**COMMENTARY:** *Antibiotics are now found in soils and municipal waters. These low concentrations will continue to place selection pressure, killing non-resistant forms of all bacteria and thereby favoring resistant forms.*

### Cipromania, Anthrax, and the Fear of Bioterrorism

"The run on *Cipro* thus becomes a further threat to our national health and welfare.

Ingestion of this drug by millions of people who stockpiled it will cause a significant change in the microbial environment." (Levy, p. 318) One unintended consequence of the events of 9/11 is the stockpiling of the antibiotic *Cipro*. The use of massive doses of antibiotics will accelerate the shift towards more and more resistant strains of bacteria. Self-medication and antibiotic overuse will have a significantly greater detrimental effect on our long term health than the number of anthrax attacks we have currently suffered.

**COMMENTARY:** *The use of antibiotics for confirmed cases of serious illness such as anthrax is not in question. However, the misuse of antibiotics on a mass scale—to prevent a disease before there is even exposure—has the potential for devastating ecological damage. It will produce infectious illnesses that are far more difficult to treat. (See "AMA: Don't Prescribe Antibiotics for Potential Bioterrorism" in Bacteria in the News, p. 6.)*

## Humans Develop Natural Immunity To Bacterial Pathogens

Human beings normally adapt to bacteria in a relatively short time, even those causing epidemics of fatal illnesses. "The adaptive processes which increase resistance to infection are an important aspect of ecological equilibrium between microbes and their potential victims." (Dubos 1959 p. 66) In numerous epidemiological studies, human-bacterial interactions always lead to ecological equilibrium.

The initial response to virulent bacterial exposure involves epidemic mortality. However, by the fourth generation of exposure within a family, susceptibility often drops to less that 1%. More importantly, bacterial infections take a more chronic course involving less virulent expression (Dubos 1959) An example of this is polio, which is now endemic in Africa, rarely causing symptoms more serious than a respiratory infection.

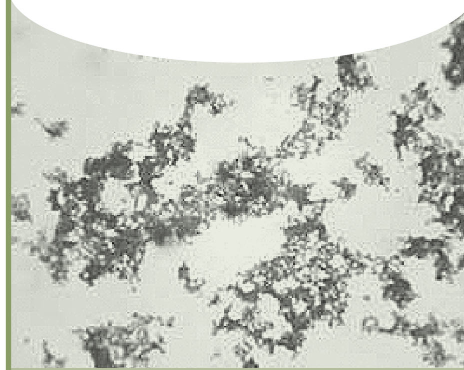
**COMMENTARY:** *Rene Dubos, a contemporary of Fleming, isolated soil bacteria with antimicrobial activity as early as 1939. This led to the isolation and production of several important bacterial-based antibiotics. Dubos predicted the limitation of the bactericidal approach, foreseeing antibiotic-resistant bacteria. Dubos' continued research into bacteria's symbiotic/parasitic relationships and the role of antibiotics revealed startling ecological implications.*

## Killer Microorganisms Usually Produce Only Self-limiting Diseases

If a parasite kills its host, ultimately the parasite itself is destroyed. No host, no food. To Dubos' mind it would seem that a successful parasite allows its victim "as much life as possible." (p. 77) Inevitably, an equilibrium is established.

**COMMENTARY:** *Many disease-causing organisms, even fatal ones, can persist in humans for extended periods without causing any illness at all. "Disease, when it occurs, is due to a change in the conditions under which the ecological equilibrium had evolved." (Dubos p.19) Dubos argues that these changes are caused by many factors, either internal or external, including but not limited to weather, nutrition, work habits, economic status or emotional stress.*

*The common notion that the presence of bacteria or virus equates with the presence of the illness may not be entirely accurate. For example, recent research into the prevalence of streptococcal bacteria shows that a large percentage of the human population harbors it without showing any symptoms. When the immune system is lowered, symptoms can arise from the resulting overgrowth of bacteria.*



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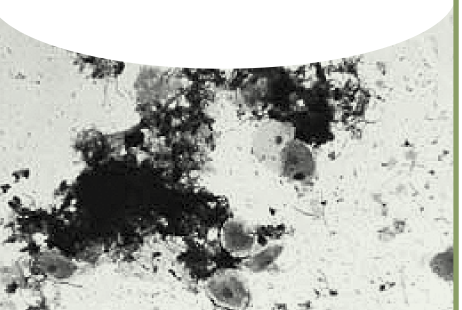

**Disease decreases when flexibility within the environment increases, leading to improved states of well-being.**

### Do Germs Cause Diseases, Or Diseases Cause Germs?

"The characteristic microbe of a disease might be a symptom instead of a cause." (G.B Shaw in Dubos 1959) The difference between health and disease, symbiosis and parasitism is one of equilibrium. Many, if not most, bacterial diseases express failure of equilibrium. "The outcome of the interplay between two individuals is determined not only by their intrinsic endowments but also, and even more, by the conditions under which they come into contact." (Dubos p. 75)

For example, a frequent contemporary illness is the problem of 'yeast' (overgrowth of Candida albicans). Candida is part of the normal microbial flora in healthy humans. This yeast overgrowth and associated symptoms are not the real disease. Why yeast grows unchecked is the issue. Symptoms of 'yeast' are caused by a weakened immunity, allowing the yeast to grow out of control. The ecological equilibrium has shifted, allowing an explosive overgrowth of yeast.

**COMMENTARY:** *Ecological equilibrium is established out of necessity, either through immune functioning, adaptation, or in the grossest form, survival of the fittest. As noted before, over several generations, even the most virulent form of pathogen will stabilize, returning to a less virulent equilibrium. This could be viewed as a function of the larger immune system of planetary ecology. (Lovelock 1988)*

### Bacteria 'R' Us

Bacteria have evolved as an integral symbiotic partner in the functional health of our cells. Mitochondria as well as the cilia are thought to be permanent evolutionary adaptations of early symbiotic bacteria. (Margolis & Sagan 1986) Intestinal bacteria are an easily recognized example of symbiosis: they produce our vitamin K, biotin, and riboflavin, to name a few nutrients. Shifting away from a pathogenic model of health and disease to an ecological perspective favoring organismic equilibrium within the biosphere will promote strength and vitality for many of the organisms involved in the relationship.

**COMMENTARY:** *Many of the complementary and alternative medical practices, including acupuncture, homeopathy, chiropractic and osteopathy, are ecologically sustainable because they improve the capacity for humans to maintain equilibrium with their environment. Proper metabolic functioning, biomechanical integrity, nutrition, and emotional and spiritual well-being promote healthy relationships with the macroenvironment as well as a healthy internal environment. Increased ecological equilibrium between human beings and the biosphere can be achieved. Disease decreases when flexibility within the environment increases, leading to improved states of well-being.*

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