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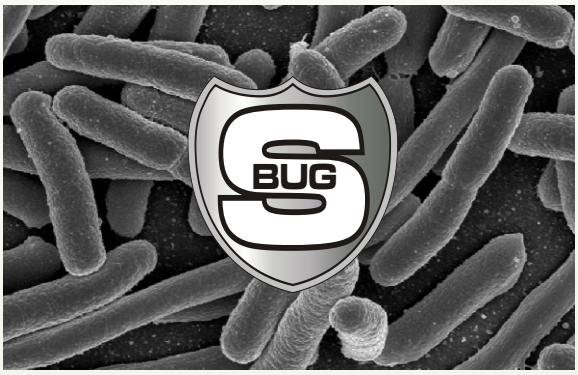
HOSPITAL SUPERBUGS - EVIDENCE FROM ANTIBIOTIC RESISTANCE

Number 4 in the Evidence series from Creation Research.



ARE BACTERIA EVOLVING?
IS ANTIBIOTIC RESISTANCE EVOLUTION?
WHY DO BACTERIA CAUSE DISEASE?
WERE BACTERIA CREATED?

ARE THE GERMS WINNING?

One medical triumph of the 20th Century was the defeat of many bacterial diseases through the use of antibiotics. However, these old enemies are making a comeback as "superbugs" that can resist our most powerful antibiotics. Such resistant bacteria are often presented as proof of evolution. The logic is easy to follow: fifty years ago germ x was killed by antibiotics, but now it is not. Therefore, it must have evolved new characteristics that fight off antibiotics. One advanced Biology text book states: *We have to go on trying to find more and more antibiotics, because bacteria evolve to become resistant to them, as described in Section 16.10. The more we use antibiotics, the more selection pressure we put on bacteria to evolve resistance.* (Ref. 1)

Are Bacteria Evolving?

Evolution is a process where non-living chemicals evolved into primitive life forms that gradually changed into complex, fully functioning organisms. Bacteria are usually presented in textbooks as simple primitive organisms, yet all bacteria that have been studied are able to perform complex chemical processes that man has only been able to copy by sophisticated chemical engineering. Like all living organisms bacteria produce chemical energy, grow and reproduce themselves, and defend themselves from damage by unfriendly environments. It is this last property that has caused problems for humans seeking to kill bacteria with antibiotics.

WHAT ARE ANTIBIOTICS?

Antibiotics are substances that destroy bacteria by damaging their cell wall or by interfering with their biochemical processes so they cannot grow and reproduce. Many of these substances are naturally occurring chemicals produced by other living organisms. The most famous antibiotic, penicillin, is produced by a fungus. Some antibiotics, such as Tetracycline and Erythromycin, are produced by a group of soil dwelling bacteria called *Streptomyces*. Scientists have been able to make antibiotics more effective by making changes to the chemistry of the original naturally occurring substances. Such antibiotics are called semi-synthetic, and were developed to kill bacteria that were resistant to natural antibiotics. Some bacteria are now able to resist them. Surely, it is argued, this new resistance must be evidence of evolution.

How do bacteria resist antibiotics?

Antibiotic resistance is a survival mechanism for bacteria. From the bacteria's point of view, any chemical that hinders its ability to survive is a poison it must avoid, or remove. The main methods of resisting antibiotics are as follows.

1. Changes to the permeability of the cell wall so that the antibiotic cannot get into the cell and damage it.

2. Enzymes - large proteins made by the bacteria that break down antibiotics or block their actions. These may be secreted into the surrounding environment to prevent the antibiotics gaining access to the bacteria.

3. Pumps that remove antibiotics from the bacterial cell before they can cause too much damage. These pumps may be non-specific, i.e. they will throw out many potentially harmful substances, such as dyes and detergents, as well as antibiotics. The "non-specific" property explains why some bacteria can resist synthetic substances that don't occur in the natural environment. The bacteria simply recognise that they are harmful and throw them out.

4. Alternative metabolic pathways that bypass the biochemical reactions that are damaged by the antibiotics.

5. Variations in cellular components, e.g. cells walls or protein making machinery, which change their structure so that they are no longer damaged by antibiotics.

HOW DO BACTERIA BECOME RESISTANT?

In-Built Resistance

For some bacteria antibiotic resistance is a built in feature that is turned on when they find themselves in an environment that contains antibiotics. For example: Resistant forms of *Staphylococcus aureus*, a notoriously nasty bacterium otherwise known as golden staph, are able to deactivate antibiotics by making an enzyme that breaks up the antibiotic molecule. However, the bacteria don't make the enzyme all the time, only when they are exposed to antibiotics. A protein in the bacterium's wall detects antibiotics and turns on the gene that codes for the enzyme. The gene is turned off in an antibiotic free environment. (Ref.2) Some bacteria turn on resistance genes in response to signals from other bacteria that have been exposed to antibiotics. (Ref.3).

Some bacteria can simply go dormant in an environment containing antibiotics. When the antibiotics are removed they become active again. This explains why some infections reappear after apparently successful treatment with antibiotics. (Ref. 4).

Biofilm Resistance

Many bacteria form can organise themselves into closely packed layers called biofilms so they can attach to and live on solid surfaces. Within these biofilms the bacteria are bound together by gel-like matrix which is very difficult for antibiotics to penetrate. The bacteria also seem to change their cellular functions to a more antibiotic resistant state, even though they are genetically unchanged. If the bacteria leave the biofilm and swim around as individual cells they lose the antibiotic resistance they had in the biofilm. (Ref. 5) The bacteria have not evolved; they have simply changed from one normal physiological state to another.

Mutations

Mutations occasionally occur in the genes that control the shape of protein-making machinery in bacteria. The altered protein making machinery is less susceptible to interference by those antibiotics that work by preventing bacteria from making proteins. This may sound like evolution but it is actually degeneration. The mutated bacteria have not changed into new kinds of bacteria and are actually less efficient at making proteins than non-mutated bacteria. When antibiotics are removed from their environment the mutated bacteria remain the same inefficient bacteria and do not function as well as normal bacteria. Therefore, they only have an advantage in an environment containing antibiotics.

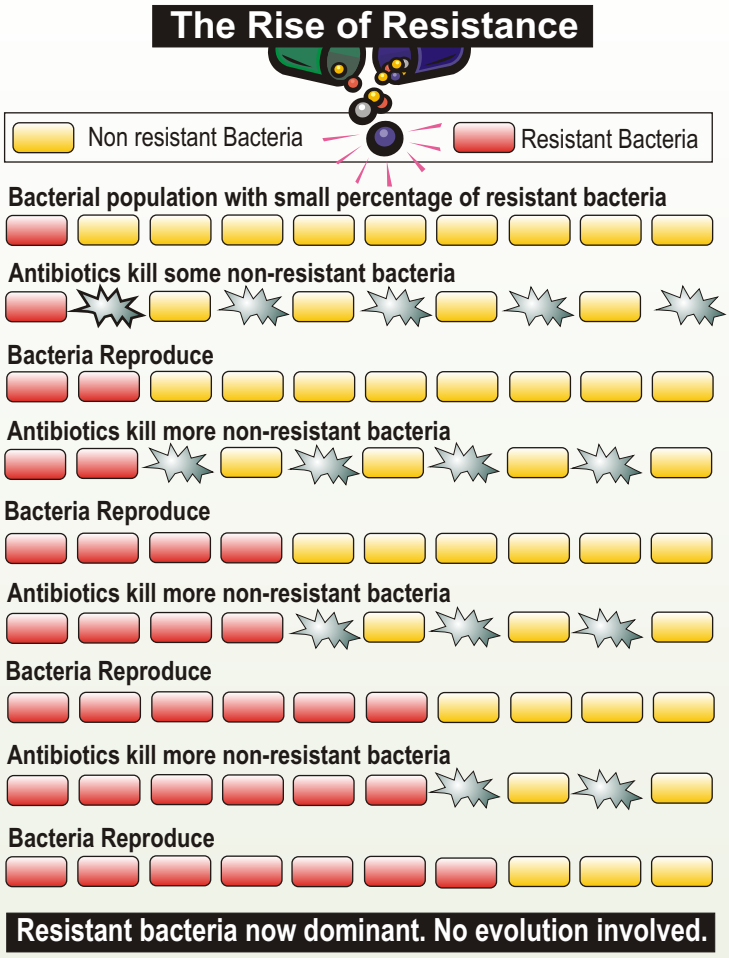
THE RAPID RISE OF RESISTANCE

Not all bacteria have built-in or mutated genes for antibiotic resistance, so what accounts for the enormous increase in resistant bacteria that is causing problems in hospitals today? The answer is natural selection, plus the strange ability to borrow genes, neither of which is evolution.

Selected Resistance

In any population of bacteria some forms are resistant to antibiotics and some are not. If a mixed population of resistant and non-resistant bacteria is exposed to antibiotics, many non-resistant ones will be killed but the resistant ones will survive. When the survivors reproduce the next generation of bacteria will contain more resistant bacteria than the previous generation. If this happens many times over the resistant bacteria eventually becomes the dominant strain in that population. Bacteria reproduce very rapidly, so this process can occur in a matter of months in an environment containing high levels of antibiotics, such as a hospital. (See diagram on next page)

Evidence that resistant "superbugs" are simply the resistant strains that have survived after antibiotics have wiped out the other strains is seen in recent research into how many different strains of bacteria cause hospital acquired infections and childhood pneumonias. Molecular biologists at Rockefeller University recently surveyed 3,000 samples of methicillin-resistant *Staph aureus* from 14 different countries and found that 70% of infections were from five strains. (There are over 4,000 known strains of this bacterium.) Almost half the drug resistant



childhood pneumonias surveyed by the Pneumococcal Molecular Epidemiology Network (USA) were caused by one strain of pneumococcus, named Spain 23-F. (Ref. 6)

This is natural selection at work, but it is not evolution. Resistant strains have thrived in preference to others because they were already able to cope in hostile (to the bacteria) environments. The bacteria have not changed from one kind into another.

Acquired Resistance by Gene Transfer

Many bacteria carry the genes for resistance on small pieces of DNA called plasmids. These can be passed to other bacteria. As far as can be proven, bacteria have always had plasmids. They did not evolve after the medical use of antibiotics. Plasmids have been found in bacteria kept in cultures begun in the 19th century which have never been exposed to antibiotics. They have also been found in bacteria found frozen in Arctic ice cores believed to be 3,500 to 7,100 years old. (Ref. 7)

The discovery of the gene exchange process has helped explain the rapid spread of antibiotic resistance among bacteria, and at the same time proved that gaining resistance is not the result of evolution. For example: microbiologists at the University of Illinois Urbana (USA), studied bacteria that live only inside the human digestive system and found they contained genes for antibiotic resistance, even though the humans the bacteria were residing in were not taking antibiotics. The resident bacteria had gained these by swapping genes with food borne bacteria that were carrying genes for resistance. (Ref. 8) Resistant bacteria occur in food because of widespread antibiotic use in farming as well as in medicine. This has killed many non-resistant organisms in the general environment and left only the already resistant forms to reproduce and spread resistance genes to other bacteria, wherever they meet. No evolution is involved.

Bacterial gene swapping explains why antibiotic resistance has become so widespread among many species of bacteria. However, bacteria that have acquired resistance by gene transfer remain the same species of bacteria. The genetic information needed for antibiotic resistance has not evolved; it has simply been redistributed.

Bacteria are also able to transfer genes from their main chromosome to plasmids, but, again, this is not evolution just another form of redistribution. Furthermore, it didn't happen because of human use of antibiotics. Molecular biologists at University of Rochester, New York, studied a gene for penicillin resistance in *Salmonella* (bacteria that cause food poisoning) and concluded that the gene had existed for millions of years and had moved from chromosome to plasmid three times. (Ref 9)

After the bacteria have acquired resistance genes, natural selection then acts on them and the newly resistant bacteria survive and thrive in an environment containing antibiotics. If the environment becomes free of antibiotics some bacteria off-load plasmids because the extra genetic material is not useful but requires metabolic energy to maintain. They then become non-resistant bacteria, but this is not evolution either.

ISN'T NATURAL SELECTION THE SAME AS EVOLUTION?

Natural selection can only change the proportion of antibiotic resistant strains in a population, but it cannot produce antibiotic resistance, so it is not evolution.

To select something means to choose it from a group of pre-existing options. But choosing something is not the same as making something. In the same way natural selection has not caused bacteria to produce new genes for antibiotic resistance; it has merely forced the choosing of some already-existing genes in preference to others, on the basis of which are more able to survive in the prevailing environment. In other words, the already-resistant bacteria are selected by the antibiotics; they are not created (or evolved) by the antibiotics.

The process of natural selection is sometimes summarised as "survival of the fittest.": However, ***survival* of the fittest does not explain *arrival* of the fittest.** Showing how plasmids help bacteria survive exposure to antibodies does not explain where plasmids originally came from.

(For further examples of natural selection that are not evolution, see **page 7** on how to obtain a **FREE** copy of ***Evidence from Biology*, *No. 1*** in the Creation Research Evidence series .)

IF BACTERIA WERE CREATED, WHAT WOULD THE EVIDENCE BE?

If bacteria were specially created as the Book of Genesis says all living things were, then there will be two main types of evidence for us to observe:

1. They will show evidence of **design** in the way they function and in the way they interact with their environment.

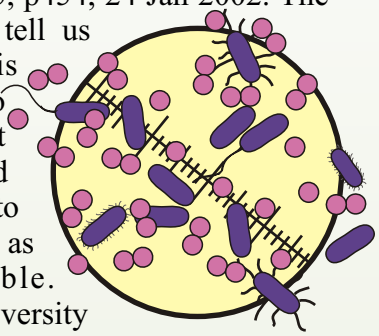
2. They will show evidence that they reproduce **after their own kind**.

Bacteria by Design

Design is the manipulation of matter and energy to achieve a structure or system that is more than just the materials that it is made from. For example a wooden table is more than just the wood it is made from. It functions as a table because it was designed and built by a carpenter who knows how a table functions. No-one looking at a wooden table would claim the wood made it, or that it came about by chance random processes knocking the wood around.

Some of the best evidence of design in bacteria is the way they carry out physical and chemical processes that are beyond human engineering. Below are three examples of recently discovered evidence of intentional design from the Creation Research e-mail newsletter, with editorial comments (ED. COM.) from Creation Research.

BACTERIA EXCEL AT THERMODYNAMICS, according to a study reported in *Nature*, vol. 415, p454, 24 Jan 2002. The Laws of thermodynamics tell us that whenever energy is converted from one form to another some is always lost as waste heat. Engineers and physicists constantly strive to build machines that waste as little energy as possible. Microbiologists at the University of Okalahoma studied several anaerobic bacteria and found them to be extremely efficient using energy in their biochemical processes with very little energy wasted. They concluded "that bacterial metabolism can proceed at near thermodynamic equilibrium a condition often thought to be a biological impossibility."



ED. COM. Anaerobic bacteria are bacteria that can live without oxygen. They are considered to be primitive organisms that evolved before other forms of life. However, the above study shows there is nothing primitive about them. They show evidence of having been designed by a far better physicist or engineer than the human designers of any man made machinery. Bacteria work at "near thermodynamic equilibrium" because they were designed by God, who also designed the laws of thermodynamics.

GERM POWER FOR HYDROGEN ECONOMY, according to Nature Science Update, (www.nature.com/nsu) 8 Oct 2001. Hydrogen is considered a "clean, green" fuel but it is difficult and expensive to produce by normal industrial chemical processes. However, some bacteria produce hydrogen as a by-product of converting carbon dioxide and nitrogen into complex organic molecules. Chemists at University of Illinios, Urbana-Champagne studied these bacteria and found they used an enzyme containing a core of iron and nickel atoms associated with other small molecules wrapped in a protein coat. The core is the active part of the molecule, so the scientists hope to build a molecule that acts like the bacterial core, but doesn't need the protein coat. If they succeed they will have a much cheaper method of producing hydrogen than at present.

ED. COM. This is another example of bacteria being able to carry out chemical processes that are difficult for intelligent, educated industrial chemists. When universities or chemical companies want to find new and better ways of using chemical reactions they employ the smarter chemists. The fact such clever scientists had to resort to copying bacteria is proof that bacteria were designed by a much cleverer chemist.

BACTERIAL BATTERIES USE MUD POWER to clean up pollution and power under-water sensors according to a report in *Science* vol. 295, p425, 18 Jan 2002. Microbiologists have found bacteria that can generate electricity using underwater organic sediments. The bacteria, Desulfuromonas acetoxidans are a type of geobacteria, whose main claim to fame is the ability to detoxify toluene and other organic solvents. As such they are also useful in pollution control. The amount of power they produce is not very great but it is enough to power scientific instruments used to measure water currents and temperature - important information used in weather reporting.

ED. COM. Bacteria are proving to be a wonderful resource in many ways. Putting them to work to clean up pollution or power scientific instruments is a good application of the mandate were given at creation to rule over the earth and the living creatures on it. It also reminds us that God promised to supply all our needs.

Even before bio-technologists put bacteria to work in such high-tech ways, bacteria had (and still have) essential functions in maintaining the quality of the environment and providing food for all other living things including humans. Bacteria are essential for breaking down leaf litter and any biological debris into nutrients for plants. Nitrogen fixing bacteria provide fertiliser by converting atmospheric nitrogen into ammonia which plant roots can absorb. People have used bacteria to make and preserve foods such as cheese and yoghurt for thousands of years. As far as we can tell bacteria have always been able to carry out complex chemical processes.

Bacteria: After their Kind

Further evidence that bacteria have not evolved, but were created as fully functioning organisms, comes from the fact that the oldest bacteria discovered to date are the same as those living today. Microbiologists have found live bacteria in salt crystals they claim are 250 million years old. The bacteria are a type of *Bacillus*, a large and varied genus found all over the world. Partial analysis of the bacteria's preserved DNA suggests it is similar to Bacillus marismortui that lives in present-day high salt environments e.g. the Dead Sea. (Ref. 10) No matter how old scientists believe these bacteria are, the fact that they can immediately be classified into a genus of living bacteria is good evidence such bacteria have reproduced their own kind all the time these bacteria were trapped in the salt crystals, i.e. bacteria have not evolved.

The fossil record of bacteria also indicates they have reproduced after their kind. Here is another item from the Creation Research newsletter.

OLDEST FOSSIL AUSSIE found as evolutionist Birger Rasmussen (University of Western Australia) claims discovery of sulphur deposits containing fossil micro organisms, as reported in *Nature* Vol 405, p676, 8 June 2000. The fossils consist of microscopic filament layers within the rocks, similar in size and structure to living filament forming bacteria. The filaments were embedded deep in rocks near Sulphur Springs in northwest Western Australia. The rocks are believed to have originally formed around geothermal vents (underwater volcanic sources) and are claimed to be 3,235 million years old, 2,700 million years older than the previously claimed "oldest" bacteria.

ED. COM. Today's geothermal vents host many bacteria which extract chemical energy needed to sustain life from sulphurous inorganic matter. They live in harsh environments only by carrying out complex chemical processes that modern industrial chemists envy. If the Western Australian fossils have been correctly identified, this discovery does verify that from the time Sulphur Spring rocks formed up to the present, filament forming bacteria have not evolved into anything else. They are evidence that complex, fully functioning bacteria have been on earth from the beginning and have reproduced their own kind ever since. The Biblical record in Genesis says this is how life was created to function (Gen 1:11-31).

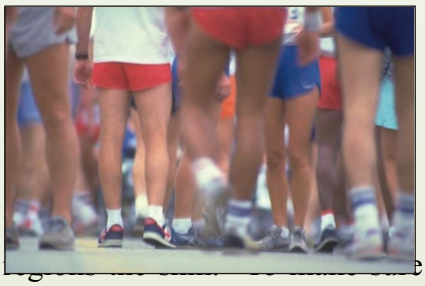
MORAL DILEMMA: WHAT ABOUT DISEASE BACTERIA?

Many people ask: if bacteria were created, why would God make them to cause disease? Charles Darwin finally abandoned any Christian faith he may have had after his beloved daughter Annie died of a bacterial disease. (Ref. 11)

Would it surprise you to know that bacteria only cause disease when they get into the wrong place? We have many bacteria living on our external and internal body surfaces, such as the lining of the mouth and bowel, that do us no harm. These are called "normal flora" and are actually good for us. They help maintain the right chemical environment on our body surfaces. Some even make vitamins we can use. Our bodies have many built-in ways of keeping them in their place. However, if bacteria get into the blood, body fluids or body tissues, they can cause much trouble and our bodies also have many methods of hunting down and killing bacteria if they get in the wrong place.

The Skin Barrier

Intact skin is the best way of keeping bacteria out of harm's way. Most skin surfaces are too dry and acidic for bacteria to grow and multiply and those that can live there cannot penetrate the skin's outer layers. Bacteria like warm, moist environments and will grow on sweaty of



bacteria remain under control, even in these bacteria friendly regions, skin makes a bacteria-killing protein named dermicidin and secretes it in sweat. (Ref. 12) Skin also produces nitric oxide, which kills bacteria. But when we put our feet into the man-made environment of socks and shoes, our skin cannot produce enough nitric oxide to cope with the bacteria that thrive in the hot, wet microclimate created around shoe encased feet. The result is smelly feet, and even worse smelling socks and shoes. Some enterprising scientists are hoping to develop a deodorising box that uses nitric oxide to kill bacteria residing in sweaty running shoes, and therefore remove the smell. (Ref. 13)

Malodorous feet may seem a trivial problem compared with pneumonia or a golden staph wound infection but they do remind us that bacteria are wonderful opportunists. They will take advantage of any situation where human beings are out of sorts with their environment, and this is the underlying cause of most of our problems with bacteria.

Internal Controls

Bacteria also live on internal body surfaces without causing harm because a healthy body can keep them under control. The most effective way of keeping them under control is the constant movement of fluid across the surface. Many bacterial infections occur because the flow of fluid secretions has stopped, and the bacteria are allowed to build up. Body secretions such as saliva, tears, mucus and digestive fluids also contain substances that kill some bacteria and prevent others from reproducing or forming biofilms. (Ref. 14)

Normally, any bacteria that penetrate into the blood or body tissues are hunted down and killed by the immune system - an army of cells that constantly surveys the internal body fluids for foreign invaders. If, for any reason, our bodies become less efficient at keeping bacteria in their rightful place, the bacteria are quick to move in and grow. For bacteria our bodies are the equivalent of a five-star hotel, and once established in the body, they will not move out without a fight. We see this happening most obviously in people whose internal body surfaces have been damaged by diseases such as cystic fibrosis, or whose immune systems are inefficient at recognising or killing invading bacteria.

Medical scientists continue to discover new bacterial diseases resulting from more subtle human degeneration. A bacterium named *Bartonella* is now suspected of causing the sudden unexpected death of some very fit orienteers in Sweden several years ago. Not much is known about *Bartonella* yet, but according to Didier Raoult of the University of the Mediterranean, France, "Every year we are finding two or three new diseases caused by *Bartonella*." (Ref. 15)

An intriguing clue as to how bacteria become pathogenic (disease causing) occurred in the Bosnian war in 1995 when a wounded soldier was found to have an infection caused by *Bacillus thuringiensis*, a bacterium used as a natural pesticide and considered to be harmless to human beings. After microbiologists studied the bacterium in laboratory mice, they found it caused infections only after it had been cultured in a medium containing blood. (Ref. 16) If it can't get into

Bacterial Degeneration

The disease causing association between bacteria and people is reinforced by the fact that the bacteria degenerate as well. Some bacteria seem to have lost the ability to look after themselves in the external environment and can now only live inside other living cells. The bacterium that causes leprosy is a good example of this. Scientists have recently mapped the leprosy bacterium's genome and found it to be unusually small and contained many non-functional genes. They claimed this was an example of "reductive evolution." (Ref. 17)

"Reductive" it may be, but "evolution" it is not. Loss of genetic information has turned a fully functioning bacterium into a partially defunct bacterium that can no longer carry out important chemical processes that would allow it to live an independent life. Breakdown in the human immune system has allowed this bacterium to invade human cells, where it can live by absorbing the nutrients it cannot make by itself. However, this close association means the bacterium's waste products are released into the tissues where they damage other cells. The combination of bacterial and human degeneration has resulted in a devastating disease that was not part of the original creation.

Conclusion:

Antibiotic resistance and disease causing bacteria are not evidence of evolution - they are evidence that bacteria were designed as fully functioning organisms that have degenerated, or taken advantage of degeneration around them.

Antibiotic resistance in bacteria is actually good evidence that bacteria are sophisticated organisms, well designed to survive in a complex environment with other life forms, such as fungi, that produce potentially harmful chemicals. This is evidence of purposeful creation, not random evolution.

The Book of Genesis tells us that all living organism were created to multiply after their kinds and originally lived in a perfectly balanced ecosystem. That system became unbalanced when the first man, Adam, disobeyed God, resulting in a history of change by degeneration, not by evolution. Based on Genesis we can predict we will yet see many new bacterial diseases, not because bacteria are evolving, but because man and bacteria are both degenerating, and their once-perfect balanced relationship has gone wrong.

This brings up other questions such as:

Is there evidence of original creative design in other living organisms?

Do other living things show evidence of degeneration from perfection?

Do fossils show that degeneration has been the history of the world?

Does the universe show degeneration is now the norm?

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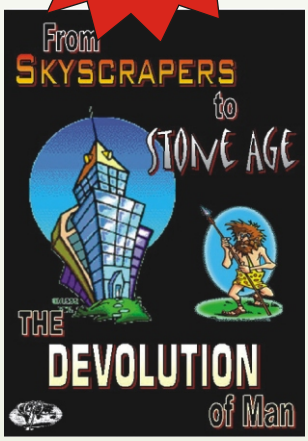

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KALGOORLIE Geologist Wade Evans (below) speaks to the crowd, as both he and John Mackay led some forty people including Uni lecturers, geologists, students and layman, into the wilds of Australia's gold fields. The Pillow Basalt Wade is standing on is definite evidence the whole area formed under water.

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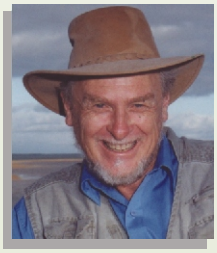

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