

“A little bit of dirt does you good”

Summer Conference 2002 Essay Competition Winner

IN the western world the presence of dirt and germs is viewed as a bad thing with people going to increasing lengths to eliminate both from their surroundings. This can be demonstrated by looking at the large number of antimicrobial cleaning products now available for household use. Recent research suggests that this may not be as wise as it first seems. Increasing incidences of both allergy and auto-immunity are now being closely linked to decreased contact with microorganisms (Hamilton, 1998).

exposure to microbial antigens (molecules identifying the microorganism as foreign to the immune system). It has been compared to the brain in that it needs to learn from its environment in order to function correctly (Rook & Stanford, 1998). The “hygiene hypothesis” states that when this stimulation is greatly reduced or removed entirely the immune system malfunctions (Strachan, 1989). As the immune system develops most rapidly in the first years of life early antigen deprivation will have the largest effect.

Normally the first exposure to an infectious agent will prime the immune system so that second and subsequent responses to the same organism will be faster and more effective - the immune system has “memory”. It is widely known that a person will only very rarely suffer from a disease such as measles more than once. If the same person is exposed to the measles virus again the immune response will be so fast and intense that the virus particles will be destroyed before the disease gets a toehold and the person will not even notice the exposure. In addition to this highly specific response, other long lasting non-specific systemic effects on the immune system have been discovered. Studies have shown that children that have naturally recovered from measles are half as likely as children vaccinated against measles to suffer from atopy (hypersensitivity) or allergic reactions to house dust mite (Rook & Stanford 1998). This

indicates that recovery from the disease confers a protective effect that vaccination does not. Measles is a serious disease that causes many deaths each year but with less serious diseases the benefit of developing an immune response without artificial aids may be significant.

Several workers have proposed that the malfunction in the immune system is due to an unbalancing of two of its pathways (Rook & Stanford, 1998). These are the T helper 1 (Th1) and T helper 2 (Th2) pathways, and they are mutually inhibitory. The Th2 pathway is dominant in the foetus and the newborn infant. It is also the pathway that causes the symptoms of hyper-responsiveness seen in allergy (Settipane & Settipane, 2000). The Th1 pathway is strengthened by repeated stimulation by microbial antigens and when exposed to sufficient microbial stimulation will increasingly dominate the Th2 pathway with age. If microbiological contact is limited the Th1 pathway will not be strengthened and the immature immune system will persist into adult life. This can lead to increased incidences of asthma, hay fever and other allergies (Rook, 1998). Unfortunately, the majority of modern vaccinations (with the exception of the BCG vaccine against TB) also work by stimulating a response from the Th2 pathway so these may also contribute to the increased incidence of allergy.

This theory of a shift from a Th1 to a Th2 response does

Congratulations to **Miles Roe**, a recent graduate of the University of Bradford, winner of our 2002 summer conference student essay competition. Miles is pictured receiving his prize and certificate from one of his microbiology tutors, Dr Hilary Dodson.



Commonly quoted studies compare the incidences of allergy in children that live in “dirty” environments or are exposed to large numbers of microbes with children that live in cleaner environments or are exposed to much smaller numbers of microbes. In the vast majority of cases there is a significantly smaller incidence of allergic diseases such as asthma, eczema and hay fever in the children that live in the dirty environment (Strachan, 1999).

The immune system has developed with constant stimulation from the environment in the form of

not adequately explain the increase in autoimmunity seen in the same communities as the increase in allergy, since autoimmunity is usually due to a Th1 response. Experiments using mycobacteria, which are present in the soil and untreated water, appear to show that exposure to them can protect against allergy and autoimmune diseases such as type 1 diabetes. A mechanism has been suggested whereby exposure to mycobacteria promotes production of T regulatory cells that modify both the Th1 and Th2 responses (Black, 2001).

Another theory suggests that infection by parasitic helminths may protect against allergic disease (Yazdanbakhsh *et al*, 2001). Epidemiological studies show that allergic diseases are rare in areas where helminth parasitism is common. This could indicate that either the populations in these areas have some protective mechanism from allergy that makes them susceptible to helminth infection or that the actual infestation protects from allergy. Without treatment helminth infections are long

lasting and stimulate a Th2 response rather than the Th1 response elicited by other microorganisms such as bacteria and viruses. As helminths stimulate the Th2 pathway it would be reasonable to expect helminth infections to cause an allergic-type response. This doesn't happen though, instead a dulled Th2 immune response is seen, which also seems to reduce the response to allergens that the immune system has already been primed for. Somehow helminth infection reduces the allergic response in people normally susceptible to it. It is unclear whether this is due to the organisms or if it is a protective mechanism of the immune system.

Apart from effects on the immune system some bacterial species have other unexpected properties. There is some evidence that *Lactobacillus acidophilus*, which is present in milk and some yoghurts, can act to reduce cholesterol levels and protect against some cancers (Mital & Garg 1995). It is also able to colonise the human gut effectively and suppress

pathogenic organisms thus providing protection against foodborne illness.

It seems that we pay a heavy price for the desire to live in an environment free from microbes of any sort. Although we may reduce the incidence of infectious diseases other types of disease such as autoimmunity and

allergy appear to be on the rise as a direct consequence of this. There is also the danger that beneficial bacteria are eradicated along with any health promoting effects that they may have. □

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Bacteria Broadcast Over the Airwaves

An article published in the June edition of **Laboratory News** reports a team of scientists at QinetiQ, formerly the larger part of DERA, has found that bacteria can transmit information through air

THE discovery is thought to be of significant importance in the growing problem of the resistance of bacteria to antibiotics, and in particular preventing the growth of biofilms, which often cause infection in surgical prostheses and catheters.

That bacteria can exchange chemical messages by releasing substances into the medium in which they are growing is well-known, but scientists Professor Alan Parsons and Dr. Richard Heal at QinetiQ's Winfrith facility, believe they can also send signals through the air-telling other bacteria to turn on their resistance genes or to activate some other resistance

mechanisms.

Professor Parsons and Dr. Heal conducted their experiments using a Petri dish divided into two compartments, connected by a 5mm air gap between the top of the wall and the lid. In one compartment they placed drops of *E. coli*, together with various antibiotics. When the other compartment was empty, the bacteria died, killed by the antibiotics. However, if thriving colonies of *E. coli* were placed in the other compartment, the first lot of bacteria not only survived, but also began to multiply. Yet, if the gap between the compartments was sealed, the bacteria in the first compartment died. Professor Parsons and Dr. Heal

concluded the bacteria in the second compartment must have been sending some kind of airborne 'survival' signal, probably in the form of a volatile chemical.

"We have demonstrated that a healthy colony of *E. coli* bacteria generates a signal that helps a neighbouring colony to resist attack from at least three common antibiotics: ampicillin, tetracycline and rifampicin. The next step is to identify the signal," said Dr. Richard Heal. "When the signal is identified it might be possible to block it, and so stop new colonies of bacteria (biofilms) growing or stop them developing resistance to antibiotics." □