

## **Looking Back to See the Way Forward Through Evolutionary Medicine**

***Evolution in Contemporary Human Populations: Medical, Genetic, and Behavior Implications* conference will explore the connections between medicine and evolution**

**WHEN: May 23-26, 2007**

**WHERE: National Evolutionary Synthesis Center (NESCent), Durham, NC, USA**

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It may be odd to think of humans as evolving, but we are. And so, constantly, are bacteria, viruses, and other pathogens that seek to invade our bodies and do us harm. Evolution is going on all the time in all living things, and understanding the process has much to tell us about how to make us healthier. A new field called *evolutionary medicine* is emerging as biomedical researchers and evolutionary biology scientists are increasingly recognizing that they have much to learn from each other. The May conference at the National Evolutionary Synthesis Center promises to be a landmark event in the convergence of these fields, and in the emergence of an important new scientific discipline.

## **Background**

### **“Mismatches” between our bodies and our lifestyles**

The good news: improved health care is reducing occurrences of intestinal parasites, such as hookworms, worldwide. The bad news: at the same time, rates of asthma are increasing worldwide. The link between these trends? Evolution – human evolution. The human immune system has evolved in the constant presence of intestinal parasites. The immune system is designed to react to these parasites – in their absence, the immune system overreacts to simple allergens such as dust mites, resulting in asthma.

As we change the way we live, we find that our bodies, finely tuned to a particular lifestyle by evolutionary forces, don't always react to “improved” conditions as we expect. These mismatches between what our bodies are prepared for and what they are currently exposed to result in various medical problems, including the increased risk of diabetes, obesity, and heart disease. Since evolution is responsible for our biological system, evolutionary research can play a key role in explaining and guiding development of appropriate medical treatments.

## **The Role of Selective Pressures**

In his book *Evolution in Health and Disease* (Oxford University Press, 1998), meeting co-organizer Dr. Stephen Stearns examines the relationship between human biology, lifestyle and health. He describes how human biology is the result both of *macroevolution* – changes occurring over a long period of time, and *microevolution* – changes occurring in the short term. These changes are driven by selective pressures.

Selective pressures are the environmental conditions that prevent or make possible survival and reproduction for an individual. In a given environment, certain characteristics or traits will be beneficial, and individuals with those traits will survive and reproduce more frequently. These beneficial traits are passed on to their offspring, and over time as individuals with favorable traits reproduce more, the majority of the population will be made up of individuals with these favorable traits.

As the environment changes, the selective pressures change. Normally, these changes occur very slowly over long periods of time. For example, the ice ages didn't just end. Temperatures rose and glaciers retreated over hundreds of years. This slow process means that newly favorable traits can become more common as individuals with those traits reproduce. To return to the ice age example, obviously a thick coat of fur is a favorable trait when the weather is cold, but if one were to compare the coats of 10 different ice age foxes, there would be variation in the coats. As the temperature rises, those foxes with the least thick fur become the most favored and pass this slightly thinner coat on to their kits. In this way organisms adapt to their environments through evolution.

The recent history of humans includes major changes in lifestyle in both industrialized and developing countries. These new lifestyles are so different from the conditions under which people evolved that the human biological system has problems coping. The selective pressures are very different as humans eat different foods, engage in less physical activity, are exposed to new chemicals, and receive new medical treatments. These are not bad conditions, in and of themselves. Everyone should have enough to eat, good medical care and not have to work 'til they drop. However, the human system is not designed to function under these new selective pressures, and because the change was so rapid, traits that are better suited to these conditions have not become widespread. The result is an increased risk of systemic medical problems such as allergies, asthma, obesity, and cancer. Could evolutionary "mismatches" be contributing to the increasing prevalence of many of these common, complex diseases?

## **Battling the Bugs**

Another aspect of our evolutionary heritage is our relationships with other organisms who have shared our environment. We have evolved under certain conditions with certain companions – parasites, bacteria, and other pathogens. As we evolved defenses against harmful organisms, those organisms evolved new ways to attack. Some of those relationships, such as the one with some of the intestinal parasites, reached a balance

where they didn't do us too much harm as long as our immune systems kept them in check. Without the challenge presented by these parasites, our immune system goes into overdrive, looking for enemies and making us sick in the process. Others, like bacteria, continue to evolve at a fast pace and we struggle to keep up. The discovery of antibiotics gave us an enormous advantage over disease-causing bacteria – for a while. Now traits that allow bacteria to resist antibiotics are spreading through bacterial populations. Our best hope for developing effective long-term solutions to living with these neighbors is a thorough understanding of how humans and pathogens have evolved. If we understand how the system works, we may be able to figure out how to achieve our goals within that framework. “These ideas are novel, exciting, and much in need of further investigation and testing,” says Stearns. “Evolutionary thinking definitely sheds useful light on medical research.”

### **Enter Evolutionary Medicine**

Evolution has not traditionally been considered an important aspect of medicine, but recently researchers from various fields are finding connections based on evolutionary biology that are leading them to new conclusions about their research and results. Combined with the vast quantities of data available due to the genomics revolution and various long-term health surveys such as the decades-long Framingham Heart Study, this “big picture” synthetic view is leading to a new approach called *evolutionary medicine*.

Dr. Stearns and two other leaders in this emerging field, Dr. Peter Byers of the University of Washington and Dr. Diddahally Govindaraju of the Boston University School of Medicine, have organized this meeting to bring together leading researchers from evolutionary biology, medicine, human biology and genetics, and public health. The objective will be to find common ground among these fields and encourage communication and collaboration in addressing medical issues through evolutionary research.

Meeting participants will examine how evolutionary research can be applied to long-term health studies. Long-term studies such as the Framingham Heart Study can provide vast amounts of information about groups of people over time. “Multigenerational and longitudinal clinical cohorts such as the Framingham Heart Study population provide unique opportunities to study ongoing evolutionary processes,” says Govindaraju. “In some of these populations, risk factors that lead to overt manifestation of diseases...have been accurately measured [in] thousands of individuals. Thanks to this wealth of data, he adds, “these epidemiological studies provide a perfect scenario to study evolutionary changes that are taking place at the genomic, physiological and morphological levels among individuals, families and populations, and to extend these results to prescribe medications based on natural relationships of individuals based on evolutionary principles.”

By catalyzing a synthesis between medicine and evolutionary biology, the meeting will help document ongoing evolutionary processes in modern human populations and the influence of evolutionary principles on human health and disease processes. Ultimately,

the conference will help to advance a new scientific discipline rich with the potential to increase understanding of human health and disease, and improve human health and longevity.

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This meeting is closed to the press while in session, however, the organizers have agreed to meet with any interested press following the meeting.

The National Evolutionary Synthesis Center (NESCent) is an NSF-funded center designed to promote synthetic research in evolutionary biology. NESCent (rhymes with “crescent”) is a collaboration among Duke University, the University of North Carolina at Chapel Hill, and North Carolina State University. More information about NESCent is available at [www.nescent.org](http://www.nescent.org)