Aquatic Viruses Unexpectedly Abundant

Using a high-speed centrifuge and a sensitive electron microscope, scientists have discovered that even pristine marine and freshwater environments harbor astonishing numbers of aquatic viruses.

The newly discovered viral concentrations exceed by up to 10 million times those previously recorded in aquatic environments, suggesting these minuscule microbes — some as small as 60 nanometers — represent a much bigger piece of the ecological puzzle than scientists believed. Moreover, although the viruses themselves appear incapable of infecting humans, they may create a health threat by injecting disease-causing genes into common bacteria.

Gunnar Bratbak and his colleagues at the University of Bergen in Norway subjected filtered water samples to 100,000 times the force of gravity and analyzed the resulting sediment. Among other findings, they determined that 1 teaspoon of North Atlantic seawater taken from 10 meters below the surface contained 75 million individual viruses. More than 1 billion viruses appeared in a teaspoon of water from a nutrient-rich lake, they report in the Aug. 10 NATURE.

"This is very exciting and important work," says biologist Mary E. Silver of the University of California, Santa Cruz. "With so many [viruses] there, it raises the question of what they are all doing."

Most seem busy infecting aquatic bacteria, possibly accounting for the immense and unexplained bacterial turnover rates in water, Bratbak says. Every minute, grazing protozoans gobble huge numbers of aquatic bacteria, yet studies indicate bacterial reproduction far exceeds these grazing rates. The new findings suggest that viruses, which can multiply in bacterial cells before killing them, may account for a third or more of aquatic bacterial mortality.

The implications of this covert infection frenzy are many, says Evelyn B. Sherr of the University of Georgia Marine Institute on Sapolo Island. For ecologists, it suggests that a surprisingly vast majority of the energy exchange in the aquatic food web occurs among organisms small enough to pass right through the sieves of the smallest filter-feeding animals. This could radically alter current models of aquatic nutrient cycles, which have focused on larger plankton as the food chain's first significant link (SN: 7/30/88, p.68).

Sherr adds that high rates of virus-induced bacterial rupture might account for much of the free DNA found in seawater — scraps previously attributed to "sloppy feeding" by protozoan grazers.

Moreover, high viral concentrations might result in unusually high rates of bacterial evolution, since viruses can carry bits of bacterial DNA from one bacterium to another. On a positive note, this could result in the rapid emergence of bacteria capable of digesting toxic wastes after a spill. "On the other hand," Sherr says, some bacteria "might develop enzymes that degrade things like boat bottoms."

More worrisome, she says, is the possibility that genes for antibiotic resistance or increased bacterial virulence — common in the raw sewage flushed into waterways — may rapidly spread via viruses to benign bacterial strains.

And Bratbak warns that if laboratory-engineered bacteria make their way into waters teeming with viruses, they may be more likely to pass their altered genes to native bacteria. So far, scientists have looked only on land for such DNA donations and have used the negative findings to justify further releases. — *R. Weiss*

Asian human-origin theory gets new teeth

An analysis of prehistoric and modern human teeth from around the world suggests anatomically modern humans arose in southeast Asia, not in Africa as a number of researchers have proposed.

The study indicates modern humans originated from only one geographically distinct population sometime between 50,000 and 100,000 years ago, says anthropologist Christy G. Turner II of Arizona State University in Tempe, who presented his data last week at the Circum-Pacific Prehistory Conference in Seattle. Since then, he contends, two large population clusters — easily recognizable by their dental features — have evolved. One cluster consists mainly of northeast Asians and residents of the Americas; the other encompasses Europeans, Africans, native Australians and southeast Asians. This "great web of humanity" apparently originated in southeast Asia, Turner says.

His findings contradict several studies of genetic material in modern populations, which indicate Europeans and Asians are linked together while Africans stand apart and probably formed the founding group of anatomically modern humans. The fossil record also holds suggestions that modern humans originated in Africa or the Middle East (SN: 2/27/88, p.138).

Turner's analysis of teeth in human populations involved more than 20 years of research. He based it on the measurement of "secondary traits," such as the number of bumps on the molar biting surface and the number of roots a tooth possesses. Primary traits, such as the number and types of teeth, remain stable across human populations. The frequencies of secondary traits provide a glimpse of population history and movement, Turner asserts, because they differ markedly between groups but are relatively stable over time within a group. They also remain largely unaffected by environmental factors such as climate, he says. In his view, secondary dental traits are most likely shaped by random genetic changes as small populations expand into new territories.

Turner's new study uses measurements of 28 secondary dental traits of more than 12,000 individuals from around the world. Most of the dental specimens come from archaeological collections, but Turner also included teeth from modern populations.

A statistical analysis and comparison of dental measurements for the 83 geographic populations in the sample shows that the southeast Asian dental pattern displays the least-specialized features of any group and provides the closest match of any single group to average dental measurements of all other world populations. Divergence from the average measurements of other populations increases with geographic distance from southeast Asia, Turner notes. If the evolution of secondary traits is largely influenced by random genetic change as colonies migrate to new areas, he theorizes, the region with the least divergence from other populations — southeast Asia — is where the colonists originated.

Turner says the dental data also suggest that most Native Americans are closely related to one another and originated in northeast Asia; Polynesians and Micronesians are more like southeast Asians than like native Australians and Melanesians; and native Australians most closely resemble Africans.

Dental analysis of population movements is still in its infancy, but Turner and two colleagues in an earlier study proposed the New World was probably settled by three waves of migrants from northeast Asia. Their analysis, described in the December 1986 CURRENT ANTHROPOLOGY, combined studies of variation in language, genetics and dental patterns, as well as archaeological finds. But the roots of east Asian populations prior to the appearance of modern humans remain unclear, Turner says.

— *B. Bower*