Researchers Shed Insights into Higher Cells

Duke researchers have turned up new evidence that the cells that make up higher forms of life on earth evolved from a primordial partnership between bacteria and the progenitors of modern animal cells.

The discovery, presented yesterday at the 57th annual meeting of the Federation of Societies for Experimental Biology in Atlantic City, N.J., strongly supports the theory that the mitochondria of modern cells originated as free-living bacteria.

The research was conducted by Richard A. Weisiger, a medical science trainee, under the direction of Dr. Irwin Fridovich, professor of biochemistry.

The mitochondria are the tiny granules within the cell which carry out the chemical reactions necessary to produce energy for life functions. They are often called the "powerhouses" of the cell.

Since the late 19th century, scientists have been disputing the origin of this primary unit of the cell.

Weisiger and Fridovich have isolated an essential enzyme—superoxide dismutase—from liver mitochondria and found that it is of the same type found in present-day bacteria. This mitochondrial form of the enzyme was found to be different from the superoxide dismutase found in the rest of the material that composes higher cells.

This supports the theory that the modern cell descended from a unit formed when a primordial bacteria entered into a symbiotic, or mutually beneficial, relationship inside the membrane of a primitive animal cell. Although the two evolved into a single living unit, the Duke researchers found that each part has retained its own distinct form of superoxide dismutase.

The opposing theory has been that the primitive animal cell itself gradually evolved the mitochondrion from its own cellular material.

Superoxide dismutase is an enzyme necessary to all organisms which metabolize oxygen. It exists to protect the body against the toxic potential of oxygen.

Billions of years ago, the primordial atmosphere is believed to have been composed largely of ammonia, methane and water. Ultraviolet radiation from the sun reacted with these gases and slowly converted the atmosphere to nitrogen and carbon dioxide. Eventually, as nitrogen reacted with the minerals of the earth's crust, carbon dioxide became the major component of the atmosphere.

It was in this ancient oxygenless atmosphere that scientists believe life started, in the "organic soup" that made up the primordial ocean. The first living molecules, therefore, were anerobic.

But, as chlorophyll-containing cells proliferated in the ancient seas, carbon dioxide was gradually consumed and molecular oxygen took its place. Cells without chlorophyll were forced to adapt to a toxic oxygen environment by developing some form of the enzyme superoxide dismutase.

Duke researchers found in 1968 that eukaryotes—higher cells in which the nucleus is bounded by a membrane—possess a blue-green form of superoxide dismutase containing zinc and copper. Bacteria or prokaryotes—in which the nuclear material is scattered throughout the cell—developed a pink form of superoxide dismutase containing manganese.

Weisiger and Fridovich have for the first time isolated superoxide dismutase from the mitochondria of eukaryotes and found it to be the bacterial form containing manganese. The mitochondria used were from chicken liver. The same situation was shown to exist in mitochondria from pig hearts and wheat germ, and the researchers believe the same results will be found in all higher cells.

They believe this means that at some time in the ancient ocean, a eukaryote ingested a bacteria but didn't digest it. The bacteria stayed on inside the host cell, aiding with the respiration, and this relationship helped the cell to flourish and multiply, becoming the forerunner of higher life today.

"The only likely explanation for finding the manganese superoxide dismutase in both bacteria and mitochondria is that each is evolved from the same ancestral enzyme," the researchers said. "This is consistent only with the symbiotic theory of the origin of mitochondria."

—YVONNE BASKIN

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Toxic Substances Are Targeted

P.C. Center Assaults Accidental Death

A 14-year-old North Carolina boy decided one day last fall to make a batch of peanut brittle while his parents were away.

He didn't realize that the peanuts he used were seed peanuts, inappropriately treated with a very toxic organic phosphate insecticide, Thimet.

The boy shared the candy with five brothers and sisters and a nephew. All became ill and were taken to a local hospital. One two-year-old was dead on arrival at the hospital.

The doctor called the Duke Poison Control Center, described the symptoms and was given a recommended treatment. The other six children recovered.

Cases like this come in to the Poison Control Center at the rate of about 100 a month from all across the Southeast. The center handled more than 1,500 poisonings during the year that ended in November, about three-fourths of them by telephone. The cases included five deaths.

To Dr. Shirley Osterhout, a pediatrician and clinical director of the center, the most tragic thing about these cases is that more than half involve children under four years of age. And nearly all of them could have been prevented if adults had been more careful.

"It gives physicians a feeling of total helplessness to treat a child whose parents made no effort to make themselves aware of potentially harmful products and to keep them out of the reach of children," she said.

There are thousands of household items, from mouthwash and perfume to bug sprays and bleach, that can be fatal. Adults usually ingest such things by accident, but a small child will eat or drink almost anything he finds.

"It's really amazing how people get into things," Dr. Osterhout said. "I hear a new one every day."

Consider these recent cases handled by the center:

— The man who died after drinking the African Violet fertilizer which his wife had left in a lemonade pitcher.

— The teenage babysitter who mistook the bottle of photographic developing fluid in the refrigerator for water and used it in the baby's formula.

— The man who woke up in the middle of the night with indigestion, fumbled in the medicine cabinet for seltzer tablets and took a denture cleaning tablet by mistake.

— The child who brushed his teeth with a tube of skin ointment.

— The office worker who, without reading the warning label, sprayed a highly toxic industrial solvent onto a co-worker who had spilled something on her dress.

— The child who found a jar of unlabeled liquid in an abandoned farm outbuilding and drank it, also giving a fatal dose to her dog.

The shelves of the Poison Control Center in the Duke Hospital emergency area are lined with dozens of empty containers of oven cleaners, vitamins, paint thinner, furniture polish, hair sprays, moth balls, room deoderizers and other products involved in past poisonings. The walls are also lined with reference books, literature and file cabinets containing the chemical compositions and treatment procedures for thousands of toxic compounds.

Dr. Osterhout says the greatest number of poisonings come from three sources—cleaning agents, over-the-counter medications and insecticides.

"Just think about how many types of cleaners, all of them toxic, there are in the average home," she said. "There are cleaners for ovens, rust, tires, windows, floors, walls, toilet bowls, tile and furniture and dishwasher detergents, clothes detergents, liquid detergents, bleaches, wax removers and drain uncloggers."

In rural areas, insecticides are a particularly big problem, especially those jars and bags of unlabeled chemicals passed from neighbor to neighbor. These get stuck away in cabinets and outbuildings until no one can remember exactly what's in them. If a child drinks some or a man collapses from breathing the dust, the doctor has to treat them without knowing what poisoned them.

Aspirin and vitamin poisonings of children often occur when parents have left the bottles on a table or counter. The children, having been convinced by television or their parents that the flavored or sugarcoated products are "just like candy," may consume the whole bottle. Analgesics and the "combination of ingredients" pain relievers all contain aspirin, Dr. Osterhout said. But many people don't realize this and take several types of cold and sinus preparations along with aspirin. Before long they end up with nausea and a ringing in the ears, a sign of aspirin overdose. Some unwittingly take more aspirin, then in an attempt to

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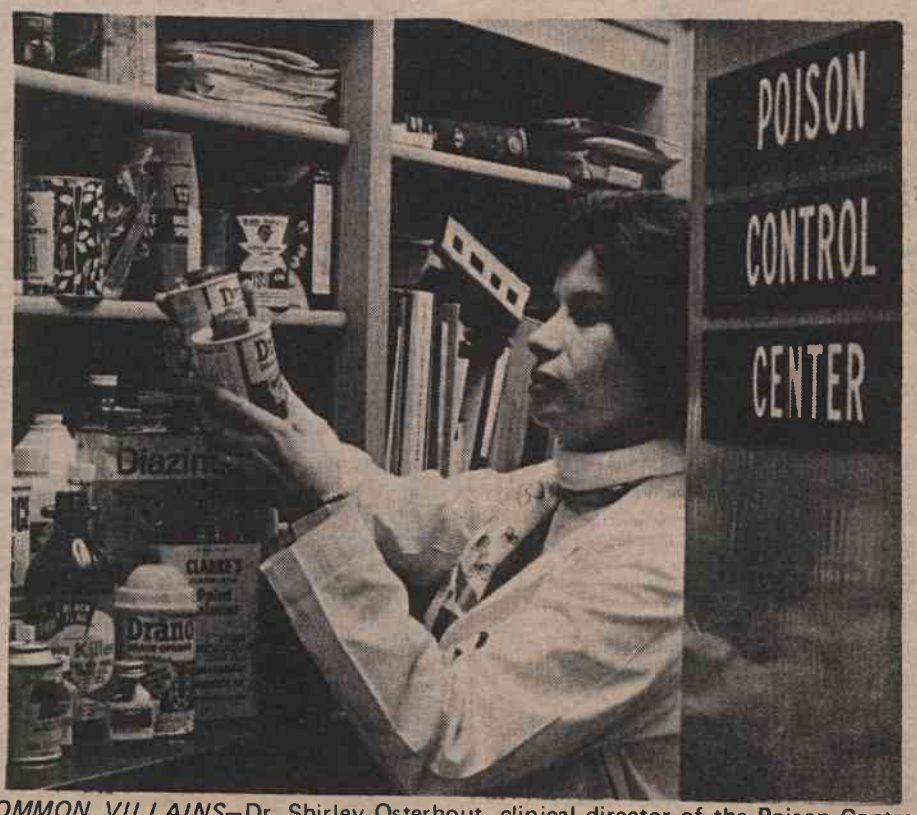

COMMON VILLAINS—Dr. Shirley Osterhout, clinical director of the Poison Control Center, examines her collection of products involved in past poisonings. Duke treats—either directly or by telephone consultation with physicians—about 100 poisoning cases a month. *(Photo by Jim Wallace)*