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## Genesis: By air or by sea?

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In the beginning ... what? A methane-ammonia atmosphere, zapped by lightning that, when combined with the oceans, formed a great, primordial, organic soup? Clusters of amino acids, washed ashore, that gradually mustered all they needed to grow and reproduce and finally became a self-sustaining cell? Probably, say most biologists.

No, says Carl R. Woese. In the beginning, it was all up in the air — literally. In the beginning, he says, there was no ocean; it was too hot. In the beginning, he told a recent workshop on the origin of life, when the earth's atmosphere was a cooler version of Venus's today, dusty, saltwater droplets in the heavy, swirling clouds collected prebiotic chemicals. Trapping sunlight to fuel their primeval metabolisms, using their vast, membrane-like surfaces, they created more chemicals. Gobbling up carbon dioxide and hydrogen, yielding methane and water, they broke the balance that maintained the greenhouse atmosphere. It cooled and it rained, and the droplets, already cell-like, fell into the embryonic ocean.

Woese's theory, needless to say, represents a major break from the prevailing, earthbound thinking about the origin of life. Though the University of Illinois at Urbana biologist's talk did not garner unanimous approval, "the feeling is that we were at the hatching of a really important scientific idea," says K. E. Van Holde, co-organizer of the NASA-sponsored meeting at the Woods Hole Marine Biological Laboratory in Massachusetts.

The airborne droplet theory, Woese told *SCIENCE NEWS*, represents an offspring of his earlier research, which showed that methanogens (methane-producing bacteria) may be among the earliest, if not the earliest, bacteria (*SN*: 11/12/77, p. 310). His theory neatly incorporates several appealing and increasingly accepted ideas — a Venus-like atmosphere for early earth, methanogenesis as the first metabolism, the droplet as a natural definition of the cell, the importance of membrane-associated reactions to life. Particularly intriguing, Van Holde notes, is the idea that the development of life halted the "runaway greenhouse" atmosphere by breaking down CO<sub>2</sub>. "It really means that the whole world is as it is today because of life," he said.

But other parts of Woese's theory don't sit well with some researchers. Most scientists, for example, believe the first organisms absorbed all their nutrients from the environment. Woese suggests that they were, in some sense, photosynthetic. Modern photosynthesis, as Van Holde points out, is a sophisticated process. However, unpublished research by Allen J. Bard and Harald Reiche of the University

of Texas shows that titanium dioxide and platinum in solution with water, ammonia and methane can capture and use sunlight to produce amino acids. Were similar "semiconductor" particles caught up in Woese's droplets, they may have created primitive photosynthesis.

Other researchers dispute the backbone of the theory — the suggestion of airborne droplets. Droplets or aerosols,

because they are unstable, are "conductive to destruction, not creation," says Lynn Margulis of Boston University. While she agrees with much of Woese's theory, Margulis points out that no now-living species could survive a lifetime suspended in a very hot, steamy atmosphere, "like an autoclave." "It is more likely," she says, "that life arose under conditions conducive to it now." □

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## Self-made cocoons protect tumors

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One of the most distressing characteristics of cancer is the apparent failure of the body's immune system to combat the run-amok cells. Cancer tumors seem remarkably able to elude, or delude, the natural defenses that manage to ward off most other diseases.

Now, studies at Massachusetts General Hospital in Boston of two types of induced cancer in guinea pigs suggest that some tumors may avoid the immune system by wrapping themselves in fibrin cocoons of their own creation and by manipulating the host defense system for their own use. Noting that the research, summarized in two papers in the June *JOURNAL OF THE NATIONAL CANCER INSTITUTE* and the *JOURNAL OF IMMUNOLOGY* (122: 166-174, 1979), used experimentally induced cancers and guinea pigs, the investigators caution against prematurely generalizing their findings to other tumor systems. Since publication, however, researcher Harold F. Dvorak told *SCIENCE NEWS*, similar fibrin sheaths have been found surrounding human tumors.

Intrigued by cancer's immunological imperviousness, Dvorak, his wife, Ann M. Dvorak, and co-workers decided to study the physical boundary between the tumor and the host. They injected guinea pigs, whose immune response is similar to humans', with cells from two strains of guinea pig tumors. In each case, the researchers noted the growth of a translucent gel-like coating made of fibrin strands around the tumor cells. The fibrin gels occurred around the tumors regardless of the conditions under which the cells were introduced and did not grow around non-

cancerous cells injected into the animals. Though such deposits occasionally had been noted previously, Dvorak said, their extent had been underestimated due to lack of techniques such as immunofluorescence and electron microscopy.

Noting that the fibrin sheaths appear similar to deposits formed by the activation of a clotting agent in the blood called fibrinogen, the researchers tested cultures of the tumor cells for such an activator. Indeed, the cells were found to produce a fibrinogen activator. Moreover, the investigators discovered, the tumor cells produce a factor that alters blood vessel permeability, a plasminogen activator (plasminogen is the blood component that dissolves clots; plasminogen activators were discovered in tumor cells as early as 1925) and a substance that halts the onslaught of macrophages.

The discovery of the four mediators suggests the mechanism for growth of the fibrin cocoon. According to Harold Dvorak, the vessel-permeability-altering substance causes the blood vessels around the tumor to leak, releasing plasminogen and fibrinogen. As the tumor-secreted activator causes the fibrinogen to form the fibrin cocoon, the plasminogen diffuses through the sheath. On contact with the plasminogen activator in the tumor cells, the plasminogen begins dissolving the gel from the inside, which allows the tumor cells room to grow. Shielded inside the expanding fibrin gel and warding off macrophages, the tumors act "as sophisticated parasites," say the researchers, "turn[ing] the host defense system to their own advantage." □

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## Health in women and women in health

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"The plain, indefensible truth is that ... women are second-class citizens in all aspects of the health care system" — so Sen. Edward M. Kennedy (D-Mass.) opened the August 1 hearing before the Senate health and scientific research subcommittee on women in health and science. Kennedy lambasted current health insurance programs that "often tie coverage of married women to their relationships with their husbands." He then cited recent studies in the *JOURNAL OF THE AMERICAN MEDICAL ASSOCIATION* (241: 2186-2187) showing that male physicians take medical illness more

seriously in men than in women, and that they give men more extensive medical examinations. Finally, Kennedy condemned the condition of women scientists in the United States, where unemployment among them is five times higher than among their male counterparts. "Less than 10 percent of the nation's physicians, 3.4 percent of the dentists, and only 11.9 percent of the pharmacists are women," said Linda Ray Murray of Chicago's Cook County Hospital.

Sidney M. Wolfe, head of the Public Citizen's Health Research Group, took Ken-

nedy's criticism of women's health care a step further. He said that the over-prescription of "minor tranquilizers," including Valium, and of the hormones estrogen and progesterone "have the potential to and actually succeed in making healthy women sick." Women aged 20 to 39 are given 2.2 times more tranquilizers than men the same age, he said. The continued prescription of DES (diethylstilbestrol), a synthetic estrogen used both as an emergency contraceptive and to prevent miscarriage, and believed to cause cancer in women and their children, "is an open and shut case of malpractice," he said. The Food and Drug Administration has included a warning in DES packages against possible hazards, but Wolfe called these warnings inadequate. He went on to condemn the use of estrogens and progestins in general. Women using these hormones appear to have higher rates of cancer, blood clots, hypertension, gall bladder disease and, as reported in the July 21 LANCET, higher cholesterol and triglyceride levels that could lead to heart attacks (SN: 4/14/79, p. 247).

Author Barbara Seaman, co-founder of the National Women's Health Network, agreed with Wolfe on the dangers of using hormones as birth control. She accused the FDA of ignoring "harmless methods of contraception," such as the cervical cap (widely used in Europe), which is safe, cheap and convenient. The cap fits over the cervix and acts as a barrier to sperm, as does the diaphragm, but the cap has one important advantage—it requires little or no spermicide. For that reason, Seaman says, U.S. companies that manufacture the diaphragm are not interested in developing the cap. Spermicidal jelly is the profitable feature of the diaphragm, she says. Further, the cap could be fitted by a paramedic or a nurse, eliminating costly visits to a doctor. An FDA panel on contraceptives has classified the cap as "not to be used as contraceptive... because its effectiveness for this use has not been proven in the United States." Research is now underway in many states.

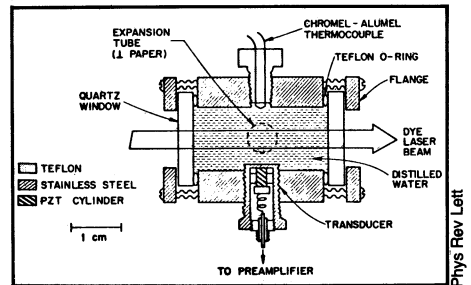
Seaman also added to Wolfe's testimony on drugs, noting that neuroleptics (antischizophrenic agents) such as Thorazine, Mellaril and Prolixin, have been associated with a seemingly permanent nerve disorder known as "tardive dyskinesia" in about half the patients who use them. Two-thirds of the prescriptions for neuroleptics are written for women, she says.

Eleanor C. Smeal, president of the National Organization for Women, blames "the male domination of the medical establishment" for the situation. While the high frequency of certain operations unique to women—hysterectomies, cesarean sections and radical mastectomies—is only beginning to be questioned, she warned that continued sex-stereotyping of women in medicine affects their families as well—women are the medical "brokers" for them also. □

## Vive la maser: New French development

When they were first developed in the 1950s, they opened up an entire new field of physics. Masers finally enabled scientists to generate a beam of radiation at a precise wavelength and phase, in this case microwave radiation. The idea was soon extended to the visible spectrum, resulting in the maser being overshadowed by its fraternal twin, the laser. But even though masers haven't been in the public eye, the devices in use today perform a variety of tasks—from keeping time as atomic clocks to amplifying signals in satellite communications. And now a group of French scientists at the Laboratoire de Physique de l'École Normale Supérieure in Paris have developed a maser system that can detect the emission of a single microwave photon and count individual atoms. They're calling it a Rydberg maser.

Conventional masers typically work with a billion to 100 billion atoms or molecules in the maser cavity. These atoms are excited to higher energy states and then stimulated to radiate that excess energy at the same frequency. The new maser, on the other hand, works with only about 1,000 atoms in its cavity. The French researchers, led by M. Gross, were able to do this by using "Rydberg atoms." These are atoms whose outer electrons have been excited to very high energy states far from the nucleus, making them look almost hydrogen-like. Such atoms are very strong absorbers and emitters of microwave radiation. In the experiment reported in the July 30 PHYSICAL REVIEW LETTERS, the Rydberg atoms were a stream



Schematic of Rydberg maser.

of sodium atoms excited by two dye-laser beams.

Because of the small number of atoms involved in producing the maser's microwave pulses, the power output was very low, only about  $10^{-13}$  watts in each pulse. Since it is difficult to directly detect such a small burst, it was detected by an indirect method called field-ionization. After the sodium atoms left the maser cavity, they were ionized in an electric field, accelerated and then detected by an electron multiplier. By observing the ionization current over a certain time interval, the researchers could see how many atoms were in each different energy state, including the ones that had emitted their energy in a maser pulse.

The field ionization method is so sensitive that it can be used to count single Rydberg atoms in each energy level and as a result indirectly detect the single microwave photons that they emitted. Thus, the researchers envision its use as a very sensitive microwave spectrometer. One reported wavelength of their maser pulse was 1.49 millimeters. But with selective filtering, they believe it can be used as a tunable, broadband microwave source for Rydberg-state spectroscopy. □

## H<sub>2</sub>O: An absorbing story

Close your books, take out a pencil and answer this question. Which of the following physical constants have been known for a long time: (a) speed of light, (b) mass of electron, (c) absorption coefficients of water, or (d) all of the above.

If your answer was d, you're wrong. Over the years, surprisingly enough, researchers have come up with different numbers in describing how the various wavelengths of visible light are absorbed by water. Some absorption coefficients differ by as much as a factor of two. One problem has been trying to correct for light scattering by particles suspended in the water.

But now C. Kumar Patel and Andrew C. Tam of Bell Laboratories claim they have made the first reliable absorption spectrum of pure water at 21°C using an opto-acoustic technique they developed last year. As described in the July 26 NATURE, they shone a laser beam through a quartz window into a 1-inch stainless steel cell containing triply distilled water. As the light energy was absorbed, it suddenly ex-

panded the water, setting up acoustic waves. Those waves were then measured by a piezoelectric transducer submerged at the bottom of the cell. In this way, absorption was measured directly without having to worry about scattering. The absorption coefficients were simply related to the ratio between the absorbed energy detected by the transducer to the total energy of the laser pulse.

Using a tunable dye-laser, Patel and Tam measured absorption from the blue end of the visible spectrum to the red end. The energy of green light, for example, would be cut in half after it traveled 20 to 30 meters through water. Bell Labs is interested in such information because of its application to transmitting laser signals underwater. "It would be possible to transmit light over a kilometer underwater," says Patel, "for conveying small amounts of information." He would now like to apply his opto-acoustic technique to studying solids, such as the glassy materials used in fiber optics. □