Earth Sciences

Turtles and trains imperil coral

When Henry Flagler built his Oversea Railroad linking Miami to Key West in the early part of this century, the well-being of corals was probably not his top priority. But it is for J. Harold Hudson of the U.S. Geological Survey in Miami Beach, who suspects that the construction of Flagler's railroad led to the demise of *Montastraea annularis* corals at the Looe Key National Marine Sanctuary, an underwater preserve located near the Florida reef tract. Using X-rays to read the growth bands of 12 coral samples, he discovered that the annual growth rate of nine has been falling for 75 years.

Hudson, who presented his findings at the Oct. 26-28 meeting on Advances in Reef Sciences held at the University of Miami (Fla.), concedes that reduced skeletal growth could be entirely normal for corals of this type that are very old. However, since the decline in growth began at the same time — in 1908 — for 75 percent of the samples, Hudson suggests that the decrease was triggered by some permanent and dramatic change in the Florida Keys ecology. And he thinks that Flagler's railroad, built between 1904 and 1916, is a likely candidate. Hudson believes that the construction of 32 kilometers of earthen causeways spanning the island areas in the middle Keys irreversibly dammed up many of the channels through which water circulated to and from the gulf bay. As a result, a large amount of sediment-laden water, chilled in the bay during winter, is diverted to the lower Keys, where it stunts the corals' growth.

Also at the conference, Michael Risk of McMaster University in Hamilton, Ontario, reported that high bacterial levels in seawater can lead to greater bioerosion of *Montastraea cavernosa* corals by enhancing the population of *Cliona delitrix* sponges that bore into the coral skeleton. Risk and Christopher Rose of the University of Victoria in British Columbia measured the biomass of sponges and corals at a reef located in the sewage plume of the Cayman Turtle Farm in Grand Cayman, which discharges 160 cubic meters of untreated turtle fecal matter per hour. The researchers found that the infestation rate of coral at the turtle farm was 70 percent, as compared with 10 percent at a control site. The biomass of the sponge was elevated five times, and the abundance of bacteria, upon which the sponges feed, was six times higher. Rose says that the elevated bacteria count also signals the presence of high levels of organic matter that nourishes the sponges. In addition, it was found that the amount of lime silt, produced from the calcium carbonate chips excavated from the coral framework by the sponges, was 4.7 times greater at the turtle farm site.

Putting the undersea under glass

When marine ecologists wish to take a closer look at seafloor life, they must dislodge and transport a bit of the seabed out of the ocean and into the laboratory to be scrutinized under a microscope. Now, a graduate student at the University of Sydney in Australia has found a way, instead, to bring a bit of the laboratory to the seafloor.

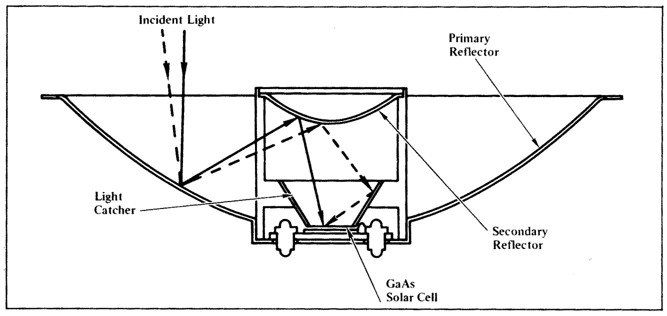
Steven Kennelly modified a regular light microscope so that it can operate underwater. The main advantage of this underwater microscope is that specimens, particularly small or very young marine life, can be studied in their natural environment. In the absence of Kennelly's device, researchers must either chip off a piece of rock or lay down an artificial substrate to which the organisms can attach themselves. Both methods are destructive and tend to alter the behavior of the seabed life.

According to the Australian SCIENCE AND ENERGY NEWSLETTER, previous underwater microscopes were too fragile and expensive to use in natural environments. For the really dedicated researcher, Kennelly's microscope also comes with an accessory — an underwater tape recorder so that the diver doesn't have to look up from a sample to take notes.

Space Sciences

Solar array uses telescope principle

A solar array design being considered to provide electricity for large structures in space such as a space station would have each of its solar cells mounted at the focus of a pair of mirrors like those used in many of the world's largest astronomical telescopes. In such a "Cassegrain" telescope (the 200-inch Hale telescope on Palomar Mountain is one, for example), incoming light collected by a curved (parabolic) primary mirror is reflected onto an oppositely curved (hyperbolic) secondary mirror that focuses the rays back through a hole in the primary. But where the telescope would have an eyepiece or other observing instrument, each unit of the much tinier version being studied at TRW Inc. in Redondo Beach, Calif., has a high-efficiency gallium arsenide solar cell.



TRW

Although gallium arsenide is a more efficient generator of electricity than the silicon material used in conventional solar cells, it is also considerably more expensive. This could be a major factor in designing arrays for high power requirements, particularly if, as in the case of silicon, such arrays may involve large expanses of the photovoltaic material that converts solar energy into electricity. According to TRW's Robert E. Patterson, the "Cassegrainian concentrator" design takes advantage of gallium arsenide's efficiency by using a 0.25 square centimeter cell of it to produce as much power as a typical flat silicon cell of 30 cm^2. (The surrounding primary mirror for such a cell, notes colleague Hans Rauschenbach, would be about 5 cm in diameter.)

The Cassegrainian system, says Rauschenbach, requires the cells to be pointed within 1° to 2° of the sun (although an auxiliary "light catcher" surrounding each cell could markedly increase that margin), in contrast with the 10° to 20° permitted by planar silicon arrays. But the required pointing accuracy is well within the capabilities of most satellites and spacecraft. An area requiring development, however, would be the dimensional stability of large panels of such cells, so that thermal and dynamic distortions do not leave some of the cells misaligned. Getting the most out of the Cassegrainian system involves optimizing trade-offs of weight, overall cost and other factors, but TRW estimates that the cost of the photovoltaic material itself for a given power output would be about 10 to 100 times less than with a conventional planar silicon system.

Centers for space biotechnology

Two university-based "centers of excellence" in the field of biotechnology have been established by the National Aeronautics and Space Administration, in hopes of stimulating biological research in the near-weightless environment of space. Two grants, each providing up to three years of $450,000 annual "seed money," have been awarded to the University of Arizona in Tucson and to the University City Science Center of Philadelphia, which involves nine universities and three medicine-related colleges. Research at the centers will focus on the areas of organic separations, bioprocessing and pharmaceutical analysis, with additional support sought from industrial and educational sources.