Biology

Gardiner Morse reports from the symposium on the origin and evolution of sex at the Marine Biological Laboratory in Woods Hole, Mass.

3-D algae sex

Chlamydomonas is a single-celled, eukaryotic, photogenic green alga that mates when it's deprived of nitrogen. Specifically, explains Ursula Goodenough of Washington University in St. Louis, if you're *Chlamydomonas,* "when you starve, you do sex." This penchant for mating on cue makes this alga — one of the simplest sexual organisms — a cooperative creature in which to study one of life's most basic fertilization mechanisms.

Goodenough presented her group's findings in a talk subtitled "Close Encounters in the Third Dimension," accompanied by dramatic 3-D slides taken through a scanning electron microscope. The audience was given cardboard glasses with polarized lenses that are needed in order to see the 3-D effect.

The tear-drop shaped *Chlamydomonas* has two mating types, plus and minus (analogous to female and male), each sporting two flagella that extend from the cell body something like rabbit ears from a TV. Goodenough's group has found that rod-like agglutinin proteins with distinct round heads and hooked tails ("one of the most beautiful proteins," Goodenough says) play key roles in mating. When a hungry plus and minus contact, their flagella, coated with agglutinin, stick to each other by their tips, a process called "tipping." Tipping signals the cell's walls to dissolve and a protuberance called the "mating structure" emerges from (oddly enough) the "female" and initiates the fusion of the two cells. This fusion is fertilization, and ultimately results in four daughter cells.

Disappearing DNA explained

When plus and minus *Chlamydomonas* alga mate, the two cells fuse to form a zygote that then divides to form daughter cells. Both the plus and minus contribute chloroplast genes (chloroplasts carry out photosynthesis) to this zygote, but only plus chloroplast genes turn up in the daughters. How come? Ruth Sager and colleagues at Harvard Medical School in Boston report that the plus chloroplast DNA is protected from degradation by prior chemical modification (in a process called methylation), while the minus chloroplast DNA is destroyed.

Protozoan gene pieces in flies, yeast

What do fruit flies, yeast and the single-celled protozoan *Tetrahymena thermophila* have in common? One shared feature, reports Peter J. Bruns of Cornell University in Ithaca, N.Y., is a segment of DNA that is active during *Tetrahymena* sex. What are fruit flies and yeast doing with the same DNA? "I'm not trying to suggest that I know what it does yet," Bruns says, but that it has been "evolutionarily conserved" (hung onto over the millenia) means that "it's certainly worth looking into."

The 300-nucleotide DNA fragment these creatures share is part of a "meiosis-associated" gene Bruns and his colleagues first detected in *Tetrahymena.* During meiosis a cell nucleus with a given number of chromosomes divides to form daughters with half that chromosome number; it accounts, for instance, for the production of sex cells such as sperm and eggs. In *Tetrahymena,* meiosis yields nuclei required for gene exchange (sex) between cells.

Using a molecular probe based on that gene, Bruns' group screened yeast, fruit fly and bacterial DNA for similar sequences. The bacterial DNA had no such sequences, as might be expected since bacteria don't undertake meiosis. In yeast, the related gene segment was found to be active only during spore formation, a process requiring meiosis. The matching fruit fly DNA, which appears to be active throughout the fly's life cycle, was found to sit next to a gene "that's associated, maybe, with chromosome pairing," Bruns says. What these, and other findings suggest is that "maybe, in fact, what we're looking at is a conserved function."

Currently, Bruns and colleagues are sequencing the *Tetrahymena* gene in order to see if it has "an open reading frame" that could tell whether it encodes a protein product.

Science & Society

Recent population trends in China

For 30 years, Western demographers have been thwarted by a lack of data from tracking changes in the world's most populous populace. Last year, however, the Chinese government unexpectedly opened up a statistical floodgate, and numbers on that nation's fertility, marriages, age distribution and mortality have at last fallen into the laps of eager Western researchers. After quickly sifting through these long-awaited statistical pearls, some trends are emerging. And an accounting of them has just been published by the National Academy of Sciences (NAS) in Washington, D.C.

Among the report's principal findings:

- A number of "internal checks" validate the new data as true, thereby establishing that "official data" has in the past significantly under-reported births and deaths. Explains Princeton University demographer Ansley Coale, who chaired the panel that analyzed the Chinese data for NAS, the official birth rates reported in China for the 1950s were low by 15 percent, were low by 10 percent through the 1970s, and have become low by more than 15 percent again since 1979. Annual death rates were even more in error—low by up to 38 percent at times. However, Coale says, much of the under-reporting probably stems more from philosophy than an attempt to hide the truth. He points out, for example, that children dying within a week of birth are usually not considered worth listing as either being born or having died.
- China's death rate is now lower than in this country, in part because China's population is younger. Along with a drop in its death rate has come an increase in life expectancy: Today it's roughly 66 years for men, 69 for women.
- Incentives for limiting family size have reduced fertility by more than 50 percent in a decade — an astounding change. What's perplexing, however, is a striking anomaly in the reported sex ratio. That ratio, regardless of culture, has been "almost as constant as the speed of light," Coale says: 105 to 107 males for every 100 females born. Though today the norm is for Chinese families to have only one or two children, some families are larger. Puzzling demographers is why for third and fourth births in China, the sex ratios have moved to 113 males to 100 females and 115 males to 100 females, respectively. Says Coale, "This doesn't make any biological or demographic sense." That's why U.S. analysts suspect up to 60,000 female births annually are somehow being left out of official figures (some share of them undoubtedly the victims of female infanticide, a practice that China reluctantly admits still occurs).
- Finally, despite its low fertility rate, China faces an imminent population surge. Because the Chinese don't believe in cohabitation, a recent national ban on marriages put a large strain on society, explains Coale. When the government became confident of its success in encouraging the "one child policy" it lifted the ban, which caused a veritable marriage boom. And Coale says that this will translate into a baby boom as each of these delayed families has its first (and perhaps only) child at about the same time. "I don't think [the Chinese] have anticipated this resulting baby boom," Coale says. Why not? "They still don't have many demographers."

A chink in the chemical armor

U.S. soldiers lack adequate means to detect, identify and monitor chemical weapons such as nerve gases or biological agents such as anthrax bacteria, according to a report that the National Academy of Sciences prepared for the U.S. Army. The report says current systems for detecting chemical weapons are slow and hard to maintain, and that no available sensors can detect all possible chemical and biological weapons. But even advanced equipment now being developed will not be ready until the 1990s and by then would be so outdated it would counter only an "ancient threat," says the report.