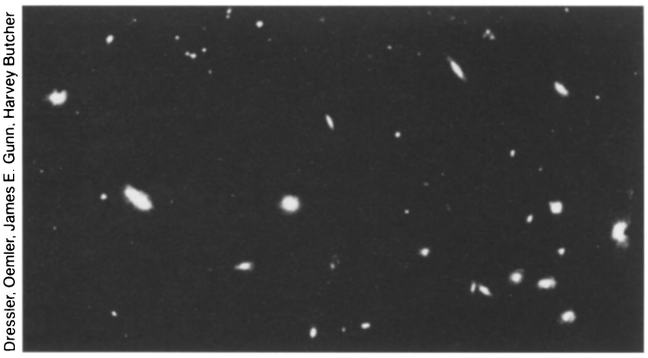
Were spiral galaxies once more common?



Dressler, Oemler, James E. Gunn, Harvey Butcher

Hubble image of part of the galactic cluster CL 0939+4713, as it appeared when the universe was two-thirds of its present age, suggests that spiral galaxies were more common in clusters in the past.

Using the Hubble Space Telescope to peer back in time, astronomers have found the first direct evidence that spiral galaxies may have been more common in clusters of galaxies several billion years ago than they are today. One of the Hubble pictures also reveals a smaller galaxy cluster that might be the most distant grouping of galaxies ever imaged.

These findings suggest that some spirals that existed in the early universe are the ancestors of galaxies in today's clusters, says Alan Dressler of the Observatories of the Carnegie Institution of Washington in Pasadena, Calif.

Dressler and his colleagues, including Augustus Oemler of Yale University, began their study as a follow-up to ground-based observations that distant clusters of galaxies have an unexpectedly blue appearance. While telescopes on the ground couldn't discern the shapes of individual galaxies in these faraway clusters, the blue color is associated with spirals, the galaxies most likely to be in the throes of starbirth. In contrast, nearby clusters – known to contain many elliptical galaxies – appear redder, indicating very little star formation.

Despite its flawed optics, Hubble has now revealed the shapes of the galaxies – an atlas of youthful elliptical, spiral, and lens-shaped bodies – in a pair of distant clusters. Each cluster lies about 4 billion light-years from Earth, meaning that Hubble views the clusters as they appeared 4 billion years ago. At a press briefing this week in Washington, D.C., Dressler reported that 30 percent of the galaxies in these clusters are spirals, compared with just 5 percent in more modern, nearby clusters.

So where did all the spirals go? Dressler notes that they might not have disappeared, but in their old age may simply have stopped forming so many stars and thus faded from view. But the Hubble pictures show that the churning, "Cuisinart" environment of dense clusters can rip spirals apart and cause colliding spirals to merge. And such mergers might transform the flat disks of spiral galaxies into the round balls of ellipticals, he says.

To determine whether spirals really are the ancestors of ellipticals, researchers need to examine groupings of galaxies even more distant, Dressler notes. One of the Hubble images may contain such a grouping. An enlargement of the image reveals a cluster whose small, compact appearance suggests it lies much farther away than the pair of clusters Hubble imaged. Moreover, this compact cluster lies along the same line of sight – though not necessarily at the same distance – as a quasar that resides 10 billion light-years from Earth.

If the cluster, which seems to show starlit fragments of infant galaxies, indeed lies 10 billion light-years away, it would represent the most distant cluster ever observed, Dressler says. He adds that while Hubble's impaired optics can't resolve the shapes of galaxies in this grouping, the cluster's very blue appearance hints that it contains many star-forming systems.

Lennox L. Cowie of the University of Hawaii in Honolulu notes that galaxies in dense clusters may evolve more rapidly, and perhaps far differently, than the greater number of galaxies in the universe at large. In fact, he says, some observations hint that elliptical galaxies outside of clusters might become spirals, rather than the other way around. Cowie speculates that over different time scales, today's collection of galaxies in and outside of clusters may ultimately have resulted from the merger of millions of minigalaxies (SN: 7/11/92, p.22).

– R. Cowen

Breast milk: Can it slime away disease?

Mucin. Most people know this slimy protein as the prime constituent of mucus – the slippery gunk that clogs the noses of head-cold sufferers. Mucin also occurs in human breast milk, a team of researchers has found. Moreover, their animal data show, even small amounts of milk mucin can inhibit infection by viruses that cause severe diarrhea.

Each year, these rotoviruses cause 3.5 million cases of diarrhea in the United States – and perhaps 100 deaths. In developing countries, rotoviruses and related diarrheal agents rank as the second leading killer of children under age 5 – accounting for 23 percent of all deaths in this age group, according to Elizabeth Sherwin of the World Health Organization in Geneva, Switzerland.

Physicians, including Robert H. Yolken, chief of the infectious-disease division of Johns Hopkins Children's Center in Baltimore, had assumed maternal antibodies – infection-fighting proteins of the immune system – accounted for the tendency of breast-fed infants to suffer fewer, less severe bouts of diarrhea. Mucins now appear to pack about half of breast milk's antiviral punch, says Yolken, who led the new study.

No one was more surprised by the finding than Yolken. In experiments aimed at confirming the primacy of antibodies, his team separated them from breast milk and incubated rotoviruses in what was left. Contrary to expectations, the viruses didn't multiply.

"I kept thinking we'd mislabeled the [test] tubes or did something wrong. So we did the experiment over and over," Yolken says. "Finally, we convinced ourselves that most of the antiviral activity is not in the antibody fraction."

In the just-released November JOURNAL OF CLINICAL INVESTIGATION, Yolken's team identifies mucins as the second class of infection-fighting proteins in breast milk. They also found a much smaller protein in breast milk that inhibits the replication of rotoviruses – and apparently by the same mechanism: a binding of the virus to sialic acid, a sugar.

If this active ingredient acts against all or most rotoviruses and can be synthesized, "it could be a useful supplement, especially in infant formulas," notes Dorsey M. Bass, a pediatric gastroenterologist at Stanford University Medical Center. However, his own animal studies indicate mucins in the gastrointestinal (GI) tract also inhibit rotovirus infection. If GI mucins work similarly in humans, Bass says, "then it's hard to know how much additional benefit you'd get from those in breast milk [or supplemented formulas]."

But Yolken says "the newborn probably doesn't have intestinal mucins," so most of its mucin-derived protection "would come from the breast milk." As babies develop, he speculates, "they probably make their own mucins." Interestingly, he notes that cow's milk also contains mucins – though apparently in lower concentrations. However, these mucins "are almost certainly not in the standard formulas [made from cow's milk]," Yolken says, because most of the milk's protein is filtered out during manufacturing.

– J. Raloff