what was around [enzymatically speaking] to fill a structural role," he says. Whether the lens crystallins have any enzymatic activity in the eye is doubtful, because the eye appears to lack the appropriate substrates. The new information blurs the once clear-cut distinction between structural and functional proteins.

Another puzzle for developmental biologists is understanding the processes that determines cell identity. Michael Levine of Columbia University and his co-workers attribute these events partly to the coordinated effort of homeo box genes. "Many, but not all, of the genes in *Drosophila* that specify spatial information are homeo box genes," he says. Fruit flies sport a total of about 30 such homeo box genes and 18 of them have been sequenced. But homeo box genes themselves must be regulated precisely, and Levine proposes that different mechanisms account for their expression at different times in development.

For example, homeo box genes called *eve* and *ftz* (pronounced 'futz') regulate the position of even-numbered and odd-numbered body segments, respectively, in fruit-fly embryos. Early in development, says Levine, so-called *gap* genes control their expression; later other regulatory genes take over. *Zen* genes, however, differ in several respects. These homeo box genes regulate the pattern of development in the other direction—along the top-bottom axis of the fly. Unlike *eve* and *ftz*, *zen* genes are active very early in development—as soon as 1½ hours after fertilization. At this time the *zen* gene is on in the top part of the animal and off in the bottom region, owing to an inhibitory factor present in the fertilized egg. Later in the development of the embryo, other mechanisms refine the pattern of *zen* gene expression, Levine says.

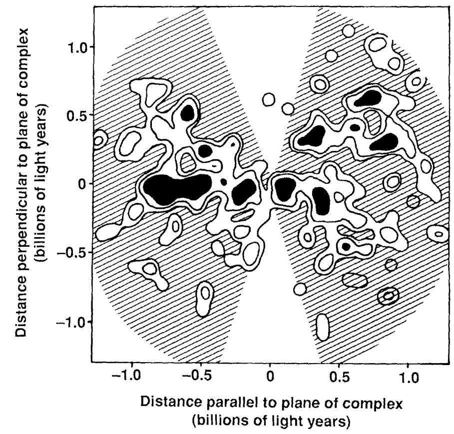
Corey Goodman of Stanford University and his collaborators find another role for homeo box genes later in development as the insect's nervous system is forming. Goodman reports that *ftz* gene expression, which helps regulate segmentation stripes early in development, reappears during the genesis of the nervous system at the time that a precursor cell's fate is determined.

Many scattered neuronal precursors appear to express the *ftz* protein transiently until they begin to mature and make neurotransmitters and synapses with other cells. And if *ftz* gene expression is selectively eliminated during neurogenesis, then the identities of some neurons are switched from one type to another. Goodman also says that "the control elements for *ftz* expression are different in segmentation versus neurogenesis." ■ DEBORAH M. BARNES

The Large-Scale Structure of the Universe Gets Larger—Maybe

"A decade ago, we'd have thought that as we went to larger scales we'd see more homogeneity in the universe," says R. Brent Tully of the University of Hawaii. "In fact, we see more *in*homogeneity."

Indeed. During the past decade or so, observers have been finding evidence for bubbles, filaments, and sheets of galaxies on a gargantuan scale. Our own Milky Way galaxy lies near the edge of a huge flattened complex of galaxies known as the Local Supercluster, which is roughly 100 million light-years across. Other superclusters are considerably larger than that. Now, however, Tully has postulated a structure to dwarf them all. If real, his "Pisces-Cetus complex" includes our Local Supercluster as well as all its neighbors, and extends for more than 1 billion light-years. Moreover, says Tully, "the structure is bizarre in that it's defined by a plane—which also happens to be the plane of the Local Supercluster."



The Pisces-Cetus complex. *Here the density of galaxy clusters is plotted over a billion-light-year span. The band across the center is Tully's Pisces-Cetus complex. The light sectors perpendicular to it represent the "zone of obscuration" in our own galaxy.*

In fact, it was Tully's earlier work in mapping the Local Supercluster that first led him to Pisces-Cetus. "I kept trying to find the edge," he says. Eventually he went to the published literature, where he collected the redshifts that others had obtained for clusters in the classic catalog compiled by the late George Abell in the 1950's. Confining himself to clusters within about a billion light-years, where the Abell catalog is reasonably complete, and using the Hubble relation to convert redshifts to distances, Tully then mapped the clusters in three dimensions. The flattened Pisces-Cetus structure was the result.

Tully is the first to admit that his map is hardly conclusive. "The Pisces-Cetus plane has all kinds of holes in it," he says. "We're over to one edge in the Local Supercluster, and there happens to be a deficit of nearby galaxies between us and the center. So I'm talking about an alignment of planes here, not an actual connection."

On the other hand, says Tully, a chance alignment this good would be an incredible fluke. Moreover, the center of the Pisces-Cetus complex happens to lie in the south celestial hemisphere, where the data on galaxy clusters is still relatively poor. "My guess is that when we look, we're going to find the connection," he says.

Among other astronomers, however, the universal comment is "I'm skeptical." The theorists know of no way such a monster could have condensed in the time available since the Big Bang, especially considering that the 2.7 K background radiation reveals a universe that was very homogeneous in the beginning. "If this is more than just join-the-dots then it's very difficult to understand," says Simon White of the University of Arizona.

The observers likewise point to well-known deficiencies in the Abell catalog. In particular, it was all too easy for Abell (or anyone else) to miss distant clusters near the plane of our own galaxy, where they are obscured by interstellar gas and dust. Is it pure coincidence that Tully's hypothetical complex happens to lie almost perpendicular to that plane? And in any case, says Alan Dressler of the Mount Wilson and Las Campanas Observatories in Pasadena, "we don't know enough about the very large scale structure of the universe even to compare this structure with what you would expect from statistical effects."

On the other hand, few researchers seem willing to dismiss the finding out of hand. Tully is not the only one finding evidence for very large structures these days. Dressler, for one, has recently been advocating that our Local Supercluster is under the gravitational influence of a "Great Attractor," a mass concentration some 150 million light-years away. (The Great Attractor would also be a part of Pisces-Cetus.) Even this structure is hard for the theorists to accommodate, says Dressler, although it is only one-fourth the size of Tully's. But then, he adds, it is only when our theories fail that we begin to learn something. ■

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