IT WASN’T UNTIL THE 1920S THAT ASTRONOMERS REALIZED THAT THERE WERE OTHER galaxies in the universe besides our own. Using the 100-inch telescope at Mount Wilson in California, Edwin Hubble determined the distance to Andromeda (M31) and to the Triangulum (M33) and concluded that each was an “isolated system of stars and nebulae, lying far outside the limits of the galactic system.” Before that, these and other galaxies were classified as nebulae, extended objects other than planets or comets; although their location was a matter of great debate, they were generally thought to be within our galaxy.

Nowadays there is no doubt that the universe extends well beyond the confines of the Milky Way and that our galaxy is just one among many. Telescopes much more powerful than those used by Hubble have produced ever-larger and more comprehensive surveys of galaxies. The detailed understanding of our galaxy has also evolved dramatically. As explained by Tolstoy (p. 176), the study of individual stars in the Milky Way can help us understand the history of our galaxy and the physical processes that happened when the first stars and galaxies formed. More generally, the history of star formation in galaxies tells us how the structure and average chemical composition of the universe have changed over its 14-billion-year history. On page 178, Dunlop discusses the different methods used to quantify this history back to about 500 million years after the big bang.

The biggest surprise in recent years may be the discovery that the life cycles of galaxies and those of the black holes that reside in their centers are intimately linked. To understand how galaxies formed and evolved, it is necessary to understand the role black holes play in the evolution of galaxies. Heckman and Kauffmann (p. 182) summarize the progress made in the past decade by studying the interplay between galaxies and their central black holes.

Researchers studying galactic evolution work on a wide range of scales. Some scrutinize the structures of individual galaxies; others analyze statistical patterns from huge data sets. In a pair of News stories, Bhattacharjee (p. 170) describes insights being gleaned from Andromeda, a nearby spiral galaxy similar in many ways to the Milky Way. Clery (p. 173) tells the story of the Galaxy Zoo, an online project that enlisted more than 100,000 volunteers to classify galaxies recorded by automated sky surveys.

Much of the progress described in this special section rests on the availability of state-of-the-art space telescopes, such as the Hubble Space Telescope. In a Policy Forum, Bonnet and Bleeker (p. 161) propose that the far-future, large-scale space facilities required to make groundbreaking discoveries in astronomy should be globally shared, and they suggest ways to improve international planning and cooperation. Although we need to start planning for those facilities now, we do not need to wait for them to make further progress. Some of the telescopes nearing completion, or in planning, both on Earth and in space, can potentially address some of the most pressing questions. Hopefully, they will surprise us again.

– MARIA CRUZ AND ROBERT COONTZ
A Universe of Galaxies
Maria Cruz and Robert Coontz (July 7, 2011)
Science 333 (6039), 169. [doi: 10.1126/science.333.6039.169]

Editor's Summary

This copy is for your personal, non-commercial use only.

Article Tools
Visit the online version of this article to access the personalization and article tools:
http://science.sciencemag.org/content/333/6039/169

Permissions
Obtain information about reproducing this article:
http://www.sciencemag.org/about/permissions.dtl