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Research in Progress

STRANGE GALAXIES

A sampling of some peculiar and interesting astronomical objects recently photographed by Astronomer Halton Arp with the 200-inch telescope on Mount Palomar.

The National Geographic Society-Palomar Observatory Sky Survey was completed in 1956. For seven years the 48-inch Schmidt telescope had surveyed the sky north of declination —27°. The 1,758 highest-quality plates that were finally accepted penetrated about three times deeper into space than any previous survey had ever reached. Astronomers are still studying and cataloguing the information contained in this survey, and will continue to do so for many years to come.

One of the first astronomers to use the prints of the Sky Survey Atlas for a systematic study was Professor Vorontsov-Velyaminov, a Russian astronomer at the Sternberg Astronomical Institute in Moscow. In 1959 he published a list of 355 peculiar and interesting galaxies. Last year Dr. Halton Arp of the Mount Wilson and Palomar Observatories started to systematically photograph a representative sample of these objects with the 200-inch reflector on Mount Palomar, the most powerful telescope in the world.

This procedure realizes a hope and plan which was originally behind the building of the 48-inch and the 200-inch telescopes on Mount Palomar. The fast-f/ratio, wide-field 48-inch Schmidt was designed to survey and find the astronomical objects of most interest. The tremendous light-gathering power and resolution of the 200-inch was to be turned on each worthwhile object individually.

The photographs shown on the following pages attest to the success of this plan. In the catalogue made up from the Schmidt plates, one can usually just barely detect where a peculiar or interesting galaxy is, but cannot tell much about it. Under the photographic gaze of the 200-inch, however, many of these objects resolve into fascinating and provocative subjects. Arp's 200-inch project is only about one-third complete now, but already whole new classes of objects are beginning to appear.

These new classes of objects seem to be pointing at physical-galactic processes which we do not yet understand. Close study of the objects, however, will certainly reveal some of the mechanisms taking place, and cannot fail to illuminate the problems of how galaxies and stars are formed, how they age, and what their long-term future holds.

Samples of two of the most interesting classes of objects to appear so far are shown on the next three pages.

THE SIX PICTURES on these two pages show galaxies with companions or satellites. The first galaxy shown above (and on the cover of this issue) is the nearby and famous M 51 or whirlpool nebula. This one picture was taken by the 48-inch telescope—not the 200-inch. It has been debated occasionally whether the companion in this case is not just an apparent projection onto the end of one of the spiral arms of the main galaxy. The remaining pictures taken with the 200-inch telescope demonstrate, however, that numbers of similar objects can be found, all with their satellite galaxies at the end of one arm.

Just to the right of M 51 is shown NGC 7753 and NGC 7752.

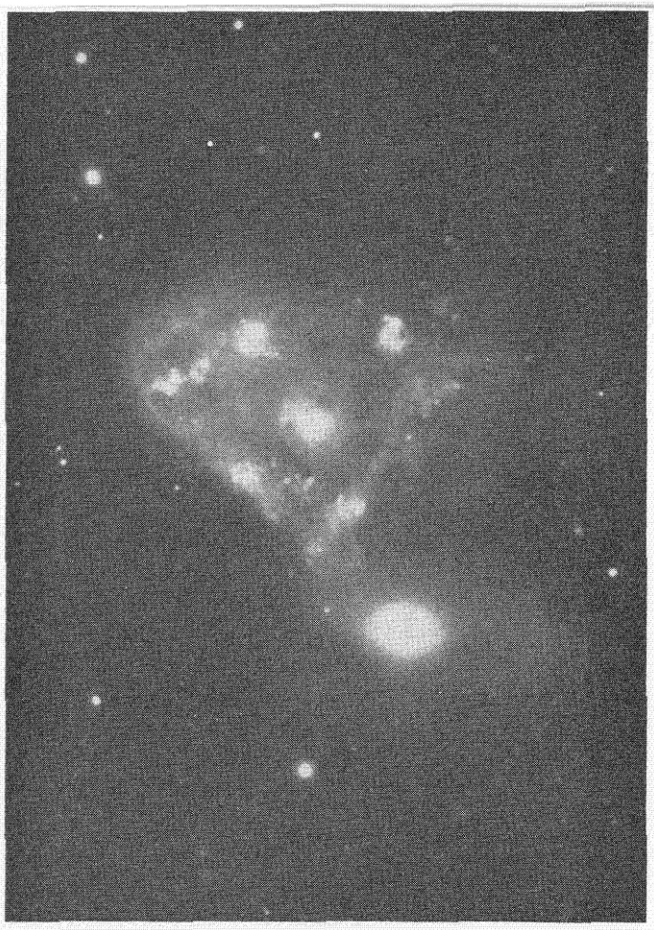
The third picture over shows a more open Sc (S standing for spiral and c for a later stage of development) with long, filamentary arms. This pair is NGC 2535 and 2536 and the companion, apparently itself in rotation, is also showing incipient spiral structure.

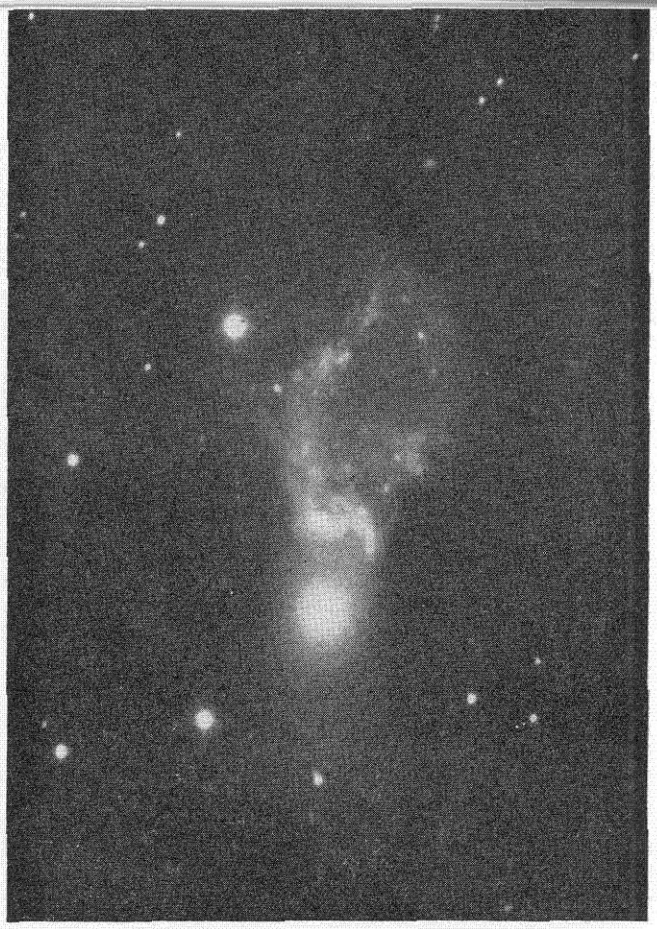
The fourth picture shows a triplet of spirals with linked arms.

The final two pictures show spirals whose companions — still at the end of one arm — are unmistakably elliptical (spheroidal) galaxies which generally do not associate with spirals; and which normally contain faint, cool, old stars, in contrast to the hot, bright, young stars of the spirals.

A number of important puzzling questions arise from inspection of this group of galaxies. For example, how long do these filamentary connection, which prevents the gas that is making postulate a magnetic field running along the connection, which prevents the gas which is making (or has made) stars from diffusing very rapidly away into space. Have these galaxies formed at the same time out of the same gaseous nebula? Are they in orbit around each other with gravitational perturbations causing their peculiar connections? Or have they collided and pulled out ionized gases along an ever-stretching magnetic field, like a great taffy pull.

The explanation Arp personally favors as a preliminary working hypothesis is different from all of these. He would suggest that, as rotating, condensing matter twists an internal magnetic field, the disk rigidifies and the object either disrupts (i.e. fissions), or matter starts flowing out at one point to collect again further outside.





THIS SECOND GROUP of four pictures shows elliptical galaxies which may be in some collision process, but their appearance is more suggestive of exploding or ejecting matter. Perhaps it is gas pressure which is responsible for the appearance of the observed material, perhaps radiation pressure. Or perhaps we are only seeing the gravitational effect of the central elliptical galaxy on a surrounding medium. Analysis of the colors, spectra, polarization — and hence the temperatures, velocities, pressures, and magnetic fields — may reveal in the next few years what exactly is taking place in these and other kinds of objects now under observation.