G. O. Abell
University of California, Los Angeles

The distribution of rich clusters of galaxies revealed on the photographs taken for the National Geographic Society-Palomar Observatory Sky Survey shows a strong clumpiness on a scale of 100 Mpc (for H = 50 km s^{-1} Mpc^{-1}), with vast intraclump regions apparently void of rich clusters (Abell 1958; 1961). Studies of the n-point correlation function by Peebles and his associates (e.g., Peebles 1980 and references therein) show that this large-scale clumpiness applies also to individual galaxies. Peebles' statistical approach does not, of course, indicate individual superclusters or their structures; that kind of information awaited the breakthrough provided by the development of high-speed detectors, with which radial velocities of large numbers of galaxies can be obtained in reasonable observing times.

Now, extensive magnitude-limited redshift surveys have revealed for the first time that most (if not nearly all) visible galaxies are in superclusters. The first such survey was of a region west of the Coma cluster by Chincarini and Rood (1976). An important recent survey is that of the Center for Astrophysics (Davis et al 1982), which gives velocities for more than 9,000 galaxies brighter than B=14.5 in both galactic polar caps. Superclusters are clearly delineated as strong concentrations of galaxies in discrete bands of redshift, with empty voids between them. In addition, Ford et al (1981) have obtained radial velocities of recognizable clusters and groups within two very large superclusters in the Northern Sky, and Corwin (1981) has determined luminosity functions of groups and concentrations of galaxies to estimate their relative distances and so obtain information on the structure of a great supercluster in Indus.

In all, more than a dozen individual superclusters have been studied in some detail. Approximate data for nine are summarized in Table 1. Some of the data have been adapted from an excellent review article by Oort (1982). Successive columns give the supercluster, its distance in Mpc, its maximum observed diameter in degrees and in Mpc, the ratio of its largest to smallest projected dimension, the number of Abell clusters contained, source, and notes.

A typical supercluster has a diameter of 100 Mpc, a mass

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of 10^{16} and luminosity of 10^{14} (in solar units), contains two Abell clusters, is at least five times as large in its greatest as in its least dimension, and may be filamentary. But this description grossly oversimplifies the structure of a supercluster. Actually, very little can be said of the detailed structure of any supercluster -- even of the Local Supercluster. Almost all information on distance (or structure in depth) comes from radial velocities. The velocity field, however, does not translate directly into distances, because it is distorted, not only by the internal dynamics of the richer clusters,

TABLE 1

Approximate Data on Some Superclusters

Super-cluster	r (Mpc)	D (o)	D (Mpc)	a/b	n(cl)	Reference	Notes
Local	---	---	50(?)	6/1	0	Tully (1982)	
Hydra-Centaurus	60	60	90	4/1	1	Chincarini & Rood (1979)	
Perseus	100	45	70	filaments	4	Einasto *et al* (1980)	
Lynx-Ursa Major	100	40	70	20/1	0	Giovanelli & Haynes (1982)	a,b
Coma	140	40-60	90-150	6/1	2	Gregory & Thompson (1978)	
Hercules	200	40	140	?	6	Tarenghi *et al* (1979, 1980)	
Indus	450	10-15	115	ring(?)	--	Corwin (1981)	c
1451+22	700	6.6	65	2/1	7	Ford *et al* (1981)	d
1615+43	800	6	70	5/1	6	Ford *et al* (1981)	d

Notes:

a: may be an extension of the Perseus supercluster
b: also has filamentary structure
c: 25,000 galaxies counted
d: axial ratio estimated from Abell clusters

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but also by the gravitational perturbations on the smooth expansion of the supercluster itself (for example, by the so-called "Virgo infall" within the Local Supercluster). Moreover, available velocities are almost always for magnitude-limited samples of galaxies, and hence are weighted toward fainter nearby and brighter distant galaxies. Although the Local Supercluster can be represented by a rather flat disc with surrounding filaments (Tully 1982), there is no evidence to suggest that the "disc" is particularly smooth, and certainly no evidence for axial symmetry. Neither is the evidence very overwhelming for a strong central concentration at the Virgo cluster, which is almost certainly not a single cluster, even within the inner 6-degree radius (Eastmond 1977). Other superclusters also seem to be flat, but without axial symmetry or central concentration; some (e.g., Coma and Hercules) have two or more concentrations that are widely separated from each other.

Some superclusters show marked filamentary structure, and Einasto (1983) suggests that such filaments are the primary structure of all superclusters. The evidence is increasing that at least some superclusters merge into one another, and Einasto (in particular) describes the universe as having an irregular cellular structure, the cells being the empty or nearly empty voids in space, and superclusters being flat filamentary structures serving as interstices of matter between the voids. The latter view is consistent with the scenario proposed by Zel'dovich and his co-workers (see, e.g., Zel'dovich 1978), in which large adiabatic condensations produced "pancakes", which in turn formed the systems of stars, galaxies and clusters we know as superclusters. Numerical simulations based on the Zel'dovich model suggest that the pancakes eventually become filamentary and coalesce. Unfortunately, because of the irregular and filamentary nature of superclusters, all overlapping in projection, details of their structures are elusive, and will require a heavy commitment of observing time to sort out.

Counts of galaxies as a function of magnitude by Rainey (1977, and Abell 1978) provide evidence that superclusters are the end of the hierarchy. For $V > 16$, the counts are smooth and highly consistent from field to field. Rainey has shown that he would easily have detected distortions due to superclustering, were it general, on scales of 300 Mpc or greater.

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