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four-inch finder of the Lamont 27-inch telescope. This finder is equipped with an iris diaphragm and a magnitude scale calibrated by means of photometric stars from the Henry Draper Catalogue.

The author has now discontinued both the searching for and the measuring of double stars. During 1952, his final year of service at the Lamont-Hussey Observatory, he is preparing for publication the 30,000 measures of the 7350 new double stars of the 24 years' program carried on at the Lamont-Hussey Observatory. During 20 of those 24 years much more time and effort was regularly given to the search program than to the measurement of the new double stars found. Relatively little time was allotted to the remeasurement of known double stars.

Three quarters of the financial support during the final five years of the program has been furnished by the University of Michigan and one quarter by the City of Bloemfontein.

In the list that follows, column 1 gives the Rst Number; column 2 the catalogue degree and number (C.P.D., Cor. D.M. or Schonfeld D.M.); columns 3 and 4 the 1900 right ascension and declination; columns 5 and 6 the position angle and separation; column 7 the magnitudes of the components; and column 8 the date of discovery.

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Lamont-Hussey Observatory,
Bloemfontein, South Africa,
1952 September.

EVIDENCE FOR A LOCAL SUPERGALAXY

By GÉRARD DE VAUCOULEURS

From an analysis of the radial velocities of about a hundred galaxies within 4 megaparsecs Mrs. V. Cooper Rubin recently found evidence for a differential rotation of the inner metagalaxy.[1] The pole of the rotational plane of the system was placed at $l = 14°$, $b = +10°$.

An investigation of the spatial distribution of the galaxies in the Shapley-Ames Catalogue[2] gives independent evidence of the existence of a local cloud of galaxies, or supergalaxy, within which our own galaxy is situated. The strong flattening of the system supports the assumption of a general rotation.

The accompanying diagram (Fig. 1) gives a schematic interpretation of the apparent clustering of nebulae brighter than the 13th magnitude in both galactic hemispheres, the objects of the nearby Local Group being excluded. Although some of the features are probably spurious and due to chance fluctuations in the general field, there is nevertheless quite independent of any subjective interpretation of the data definite evidence of a strong concentration of the nebulae towards and along a great circle of the sphere crossing almost at right angles to the galactic equator at longitudes $l = 105°$ and $l = 285°$, (possibly 110°–290° in the southern galactic hemisphere.)

In the northern galactic hemisphere this band includes the Virgo cluster and its well known extensions in Centaurus on one side and in Coma, Canes, Ursa Major and beyond toward Cassiopeia on the other. In the southern galactic hemisphere the band is much more sparsely populated (especially along $l = 290°$), although still well indicated by the bright galaxies scattered across Andromeda, Pisces, Cetus, Sculptor, and beyond the south galactic pole into Phoenix, Tucana and Pavo.

Excluding the dense group marked SS in the diagram, this 'Milky Way' of galaxies, which with an average width of about 12° represents only 10 per cent of the surface of the sphere, includes about two-thirds of the total number of nebulae brighter than the 12th magnitude. Taking into account the area hidden by the Milky Way itself, this means that the nebular density is about 10 times as great in the band as outside. The supergalactic concentration decreases as one goes to fainter magnitudes reaching out to greater distances in the general field. This phenomenon contrasts with the familiar result in the stellar system where the galactic concentration increases with decreasing brightness but could be expected if the local supergalaxy is of the same order of size as other known metagalactic clouds.

The supergalactic pole defined by the central line of the band as shown on the diagram is near $l = 15°$, $b = +5°$, i.e. close to the rotational pole found by Mrs. Rubin. This agreement seems to

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lend strong support to the hypothesis of a local supergalaxy as a dynamically flattened cloud of nebulae.

There is however one disagreement. From the radial velocity analysis Mrs. Rubin suggests for the direction of the centre of rotation $l = 104°$, $b = +5°$ or $l = 284°$, $b = -5°$. The probable errors are not given in Mrs. Rubin's paper, but it is understood that these were rather large.

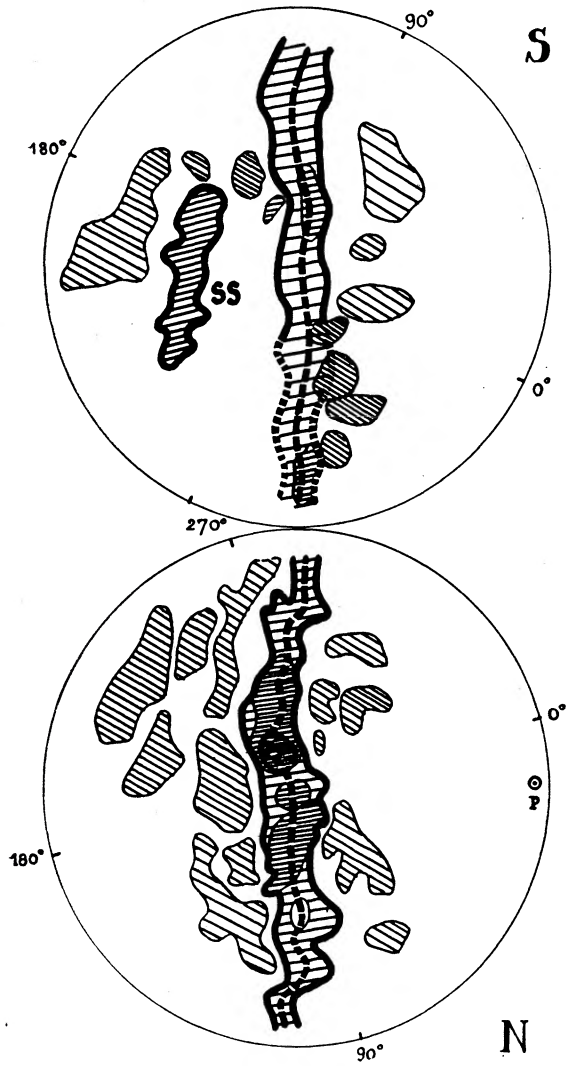

Figure 1. Apparent clustering of the bright nebulae ($m < 13$) in the southern (top) and northern (bottom) galactic hemispheres showing the path of the local supergalaxy (LS) and the southern supergalaxy (SS). The density of shading gives in a qualitative way a rough idea of the nebular density in the various areas; the densest part near the north galactic pole is the Virgo cluster. The north pole of the local supergalaxy is shown in P.

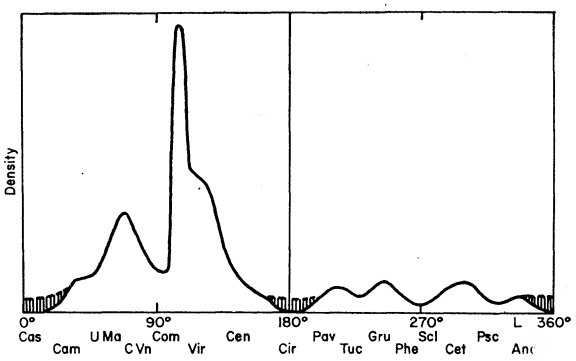

Figure 2. Smoothed density distribution of nebulae brighter than $m = 12$ along the central line of the local supergalaxy. The abscissae are supergalactic longitudes L reckoned from the ascending node of the supergalactic equator on the galactic equator ($l = 105°$, $b = 0°$). The sharp maximum at $L = 100$–$110°$ marks the Virgo cluster. The minima at $L = 0$ and $L = 180°$ correspond to the crossing of the zone of avoidance; the probable course of the curve in the absence of galactic absorption is shown by the interrupted line. The main constellations traversed by the supergalactic equator are shown at the bottom.

The distribution curve of nebular density along the supergalactic equator, as shown in Figure 2, would suggest a center in the general direction of the Virgo cluster ($l = 255°$, $b = +75°$) or of the north pole of the galaxy. If the Virgo cluster does indeed constitute, if not a nucleus for the local supergalaxy, at least a dominant condensation well within its borders, then the overall diameter of the latter may be of the order of 5 to 6 megaparsecs, with its outer fringes reaching to about 0.5 to 1.0 megaparsec beyond the galaxy in the general direction of the south galactic pole.

This situation readily accounts for the well known excess of bright galaxies in the northern galactic hemisphere.[3] It also explains the vanishing of this excess at $m = 18$ to 19 for this is the apparent magnitude which the faintest dwarf galaxies of $M = -10$ to -11 would have at a distance of about 6 megaparsecs; it is not until this faint limiting magnitude ($m = 18$ to 19) is reached that nebular counts reach clear out of the local system into the general metagalactic field, although of course the census of giant galaxies in the system is complete long before and for these a general metagalactic gradient as advocated by Shapley[4] may also play some role in the unbalance between the two hemispheres.

It may be noted that as early as 1923 the tendency of the large spirals to cluster along the galactic meridian $l = 100°$ in both hemispheres had been pointed out by J. H. Reynolds,[5] but the significance of this fact could probably not

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be appreciated at the time. More recently from the magnitude distribution of nebulae brighter than about the 14th magnitude in an area of 40° radius around the north galactic pole A. Reiz found in 1941 evidence for a metagalactic cloud extending to about 8 megaparsecs in that direction,[6] confirming earlier results by E. Holmberg based on a somewhat less extensive material and a smaller area.[7] This value of 8 Mpc may well be on the high side owing to the use of too bright a value ($M_0 = -15.0$) for the mean absolute magnitude of the galaxies. The calculations could now be revised using better data for both the apparent magnitudes and the luminosity function. Much further work will be necessary to clarify the intricate structure of the inner metagalaxy in the northern hemisphere.

In the southern hemisphere however the great elongated swarm of galaxies, marked SS in Figure 1, extending from Cetus to Dorado through Fornax, Eridanus and Horologium seems to constitute another very clearly limited supergalactic cloud of strong flattening seen edge-on; its nucleus is marked by the dense group near NGC 1380–1399. With an estimated distance modulus $m - M = 27.0$ mag., it is only slightly farther away than the Virgo cluster; its apparent dimensions of at least 10° by 50° correspond to a thickness of about 0.5 Mpc and a diameter of 2.5 or 3 Mpc. It is probably the closest and most sharply defined of the large supergalactic systems beyond the limits of the local supergalaxy. A detailed investigation of this system is under way at this observatory.

A somewhat similar situation to that of the local supergalaxy and the nearby southern supergalaxy is found in the distant double supergalaxy in Hercules mentioned by Shapley in the George Darwin Lecture for 1934.[8] From this analogy no strong rotational symmetry is expected for the local supergalaxy and this may account for the discrepancy between the directions of the centre derived from the rotational velocities and the nucleus suggested by the nebular counts. Further, a velocity analysis not taking into account the structural features just described is likely to be confused by the inclusion of objects which do not belong to the system.

The highly simplified and idealized picture of the local supergalaxy and the southern supergalaxy given in Figure 3 will help in visualizing the spatial arrangement of the system.

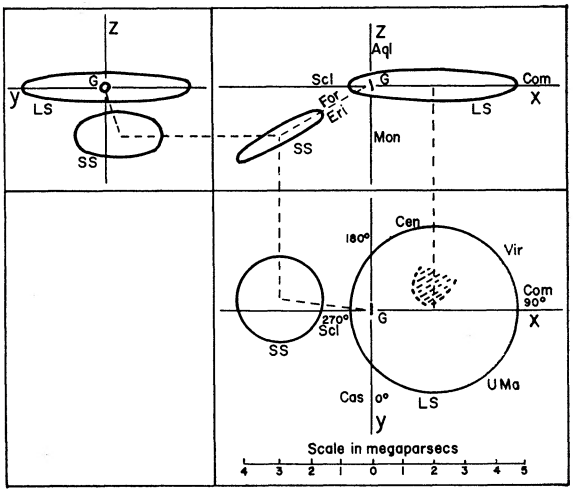

Figure 3. Spatial arrangement of the local supergalaxy (LS) and the southern supergalaxy (SS) shown by the projections on the XY plane (that of LS), the XZ plane and the YZ plane (e.g., as seen from the Coma cluster). The galaxy is shown (not to scale) in G; the Virgo cluster is indicated by the interrupted contour on the XY projection. The directions of a few constellations are given for orientation.

A detailed account will be published in due course.

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Research School of Physical Sciences,
Australian National University, Canberra,
and Commonwealth Observatory,
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