

# SIDEREAL EXPLORATIONS<sup>1</sup>

## INTRODUCTORY STATEMENT

**I**N the following pages I present an account of a series of explorations. The quests are cosmographic rather than geographic, and therefore differ widely from terrestrial expeditions in equipment and aim; but there are some features in common—the optimistic accounts of partial successes, the complaints about obstacles, weather, and insufficient equipment, and the suggestions of still more fascinating regions down mysterious by-roads, or out beyond the horizon.

The report is concerned with the progress, throughout eight regions, of researches which, considered in sequence, exhibit our expanding knowledge of the sidereal universe. The account concerns some of the plans for the future as well as current work, and deals almost wholly with observations and studies that are carried on at the Harvard Observatory at Cambridge and at its southern station, formerly in South America, now at Bloemfontein, South Africa.

The general line of attack on problems of galactic measurement and analysis was outlined many years ago; but only recently have we been able to proceed effectively with explorations into all the territories included in the general program. The survey extends from the nearest stars of the Solar Neighborhood to the remotest nebulous patches that we can photograph in our telescopic surveys of the

<sup>1</sup>Based on lectures given at the Rice Institute, March 9, 10, and 11, 1931, by Harlow Shapley, Ph.D., Director of the Harvard College Observatory and Professor of Astronomy in Harvard University.

Metagalaxy. Progress can be claimed in all territories, but not conquest. Our acquisitions are small compared with the unfolding unknown. Some parts of the program may be satisfactorily completed in ten or twenty years; other phases extend indefinite decades into the future. Meanwhile we shall approach understanding through sampling processes and through reasonable extrapolation, leaving to future astronomers the pursuit of detailed studies in fields now but provisionally explored.

Limitations of space will prevent full discussion of the work in all eight regions. Previous studies are summarized very briefly, and current investigations are only partially reported; but throughout the discussion many results heretofore unpublished are given in text and diagram.

The eight territories, in order of distance, are the following:

1. *The Solar Neighborhood*, out to a distance of fifty light years, explored chiefly through studies of the motions of nearby stars.

2. *The Sphere of Lucid Stars*, extending five hundred light years from the solar system, and studied by us mainly through that joint agency of photometry and spectroscopy—the method of spectroscopic parallax.

3. *The Local System*, out to five thousand light years or so, investigated statistically, for the most part, on the basis of the spectral classifications, magnitudes, and positions of tens of thousands of faint stars; but also explored by means of spectroscopic parallaxes, star counts, and studies of variable stars and galactic clusters.

4. *The Milky Way*, with a radius in excess of fifty thousand light years, and yielding its secrets very slowly to our probing by means of variable stars.

5. *The System of Globular Clusters*, coextensive with the

Milky Way itself, or perhaps larger, and explored mainly through photometry of the giant and supergiant stars, variable and invariable, which are congregated into the hundred known globular systems.

6. *The Clouds of Magellan*, almost a hundred thousand light years distant, and yet the nearest of all external galaxies and the most easily studied, whether photometrically, spectroscopically, astrometrically, or statistically.

7. *The Supergalaxies*, varying in distance from one million to a hundred million light years and more, and in brightness from naked-eye visibility to the ultimate of telescopic faintness, composed of many unit galaxies, sometimes of hundreds or even thousands—measured with increasing difficulty as the distances increase and the light grows fainter.

8. *The Metagalaxy*, extending beyond the limits of the greatest existing telescopic power, composed of millions of individual and clustered galaxies, including also the Magellanic Clouds, the globular clusters, our Milky Way, and the Local System. The faint external galaxies, which constitute the body of the Metagalaxy, are investigated, in our explorations, for brightness, position, form, size, distance, and velocity. It is in this extensive metagalactic realm that we find some evidence of a literally expanding universe, as remarkable as the expanding knowledge of the sidereal world.

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To several members of the Observatory staff I am indebted for assistance in presenting this interim report on our joint researches in galactic measurements and structure. The details of our investigations are published principally in the *Bulletins*, *Circulars*, and *Annals* of the Harvard Observatory.

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