INTRODUCTION

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Research on galaxies is only little more than half a century old. In my student days, around 1920, astronomers as well as students generally assumed that spiral nebulae were distant stellar systems, but interest was focussed on other things. The small significance of extragalactic research in the earlier years of this century is well illustrated by Newcomb-Englemann's standard work "Populäre Astronomie". In the more than 800-page edition of 1914 the galaxies were discussed in a section "Sternhaufen und Nebelflecke" as just another class of nebulae, in between the gaseous and the reflection nebulae. The possibility that the spirals might be independent stellar systems was not even mentioned. But only a few years later the subject became immensely interesting in two ways: V.M. Slipher's discovery that some nebulae had exceedingly large radial velocities was followed by W. de Sitter's suggestion in 1917 that these might be due to an expansion of the universe, as deduced from Einstein's theory of gravitation. The second way, full of speculations relevant to this Symposium, may be illustrated by Jeans' inspiring book "Problems of Cosmogony and Stellar Dynamics", published in 1919. Its chapter on "The Evolution of Rotating Nebulae", featuring the first Mt Wilson photographs of spiral and elliptical nebulae, contains the following statement about spiral arms: "That these arms really represent an ejection of matter from the central nucleus is almost proved by the two instances of M51 and M101 already discussed in §4. All this is quite in accordance with theory." As a physicist specialized in the kinetic theory of gases Jeans approached the subject largely from a gas-dynamical point of view. The "central nucleus" was a rotating mass of gas (tentatively identified with the elliptical and lenticular nebulae) which upon concentration becomes unstable and sheds material from its outer edge. Jeans remarked that condensations would be formed in the ejected arms, and he conjectured that the spiral nebulae would be huge swarms of stars, or "island universes".

A fantastic extension of observational data on galaxies followed upon the successful construction of the reflectors of the first half of this century. Directly related to our present topics were Hubble's classification system, now so monumentally presented in the Hubble

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Atlas, Hubble's discovery of the remarkable similarity and structural simplicity of elliptical systems, his discovery of Cepheid variables in the Andromeda nebula and Baade's discovery in the dark war nights of 1942-45, of the two stellar populations, through which stellar ages and the birth of stars made their entrance in galactic and extragalactic astronomy.

After the early attempt by Jeans the theory of spiral structure has at present reached a first stage of completion, due to the development of the theory of waves in stellar systems, started by Bertil Lindblad in the twenties, but only now worked out satisfactorily by Lin and his co-workers. The proceedings of the Symposium show how much has been accomplished, both in the theory and in its confrontation with various kinds of observation. The most important of the latter are: (1) The first successful photometric measurement of spiral gravitational fields; (2) 21-cm line observations of the response of the interstellar gas to this field; and (3) the observation of star formation in the spiral shock. An important turnpike has been reached. The further stretch of the road, which should lead to insight into the origin and driving mechanism of the waves, is still full of obstacles. There is a feeling that deeper knowledge of bar structures might be an important prelude to such an understanding.

An unexpected development has occurred in the field of elliptical nebulae. Jeans, as we have seen, considered them as rotating masses of gas, flattened by their rotation. Such a model had to be abandoned when it became clear that they consisted of stars. But it seemed natural to retain the idea that they had originally been such rotating gaseous bodies, and that the stars formed within them had roughly conserved the flattened distribution of the gas. Recently, however, as pointed out in the first introductory report, evidence has been found that the majority of ellipticals may not be oblate spheroids, and that their evolution will therefore have been quite different from that of a rotating mass of gas.

A class of phenomena which could hardly have been imagined in my student days is that concerning the activity of galactic nuclei. Many phenomena connected with nuclear activity can best be studied in the nearby galaxies forming the theme of the present symposium. The subject is of much importance, not only for the secret of the nuclei themselves, but likewise for the effects which nuclear activity can apparently exert on the structure of the surrounding galaxy. These effects were mainly revealed by radio astronomy.

The final section of the Symposium dealt with the outermost regions of galaxies, and with their surroundings. It illustrates some of the information obtained in recent years about the vast complexes of intergalactic gas drifting around and doubtlessly continually falling into the large spiral galaxies of our vicinity. The subject is gaining importance on account of its consequence for the general evolution of galaxies and for the dynamics of their outskirts.