EDITOR'S NOTE:

It is the intention to bring in the "Messenger", from time to time, a brief review of certain astronomical problems, written by astronomers who have worked on them with ESO telescopes. Professor Adriaan Blaauw, Director-General of ESO from 1970 to 1974, and now Professor at the Leiden University, is one of the foremost authorities on the structure and kinematics of our Galaxy. We are much indebted to Professor Blaauw for having so positively responded to our request.

The McCormick Areas Programme

A. Blaauw

For several years now, work has been done with the La Silla telescopes on what we call the "McCormick areas programme". The following is a description of its aims and present status.

Its principal aim is to contribute to the studies of evolution in our Galaxy, especially its local evolution. The problem of the evolution of the Galaxy as a whole has been the subject of a variety of studies by many authors in recent years. Broadly speaking, we imagine the Galaxy to have acquired its present structure and composition as the result of a development starting with the gravitational collapse from a larger, probably roughly spherical gaseous mass in which star formation took place since the beginning. The present structure of the Galaxy then is the result of the initial conditions—among which the total angular momentum—and the time over which this process has been taking place. Understanding of the properties of the Galaxy in terms of such a theory of evolution is important also in connection with the interpretation of observations of other stellar systems; their evolution appears to have led to the well-known great variety of types of extragalactic systems.

Unravelling the evolution of the Galaxy as a whole is a very ambitious programme of which only small bits can be taken up at this time. One of these bits, and an obvious one, is the question of the local evolution. That is: can we understand the local properties of our Galaxy—i.e. those of its local content of gas and stars—as the product of the evolutionary process mentioned before? The approaches to this problem made so far appear promising. It is important in this context to realize that the majority of stars now present in "our" region of the Galaxy must have been formed under rather similar conditions, namely the conditions prevailing at distances between, say 8 and 12 kiloparsecs from the galactic centre. We base this statement on the study of the individual motions of the stars which shows that the region of star formation for most of them must have been within this ring-shaped zone. It is in this sense that we may speak of the local evolution—an evolution largely independent of, for instance, the remarkable processes taking place in the central regions of our Galaxy.

Basic observational information for these studies are the local relative amounts of interstellar matter and stars, and for each of these constituents, the chemical abundance distributions. The abundance distribution in the interstellar matter is considered to be the product of the initial composition (hydrogen, helium) and enrichment with heavier elements as a consequence of the formation of stars and their ejection of processed (enriched) gaseous material. The abundance distribution of the stars depends on how the rate of star formation has changed in the course of time and on the gradual change in the chemical composition of the gas out of which the stars were formed.

In the frame-work of these investigations, we consider that an important piece of information is, within the local "zone", the variation of the local properties with the distance from the galactic plane. Whereas all the population up to, say 2,000 parsecs from the plane must be considered to belong to the local zone, this variation with distance from the plane must provide information relating to a basic feature of the local evolution: the gradual decrease of the thickness of the layer of gas out of which the stars were formed. Particularly the latest stages of the flattening of the system may well be revealed by the study of the stars accessible to our observational programme, as these do cover the last two-thirds or so of the estimated age of the Galaxy.

The McCormick areas programme has a bearing especially on the latter aspect. It aims at determining the properties of the local population up to distances of several kiloparsecs from the galactic plane by, first of all, studying the population in the direction of the galactic poles. Stars are classified according to their ages and chemical abundances by means of narrow-band photometry and these data are supplemented by measures of the kinematics of the stars (proper motions and radial velocities) and spectral classifications.

So far, photometry and proper motions have been finished in the polar cap areas which allow a first exploration of the problem. The photometry, although not of significant accuracy for the discussions of individual stars, has already revealed that there is a statistical relation between the mean chemical composition of the stars and the distance from the galactic plane in the sense anticipated on the assumption that the youngest and more metal-rich stars are more strongly concentrated to the galactic plane than the older ones. We find that over the distance range from 200 to 700 parsecs, the mean metal content decreases by a factor of about 0.5, in line with predictions based on the study of those stars which now are located near the plane but whose individual orbits reach well above or below it. For the study of this metal-content variation at larger distances from the plane, these predictions are insufficient and we will have to rely principally on the further results of our programme.

Our photometry was carried out partly on La Silla and partly at Kitt Peak Observatory in Arizona, USA. The proper motions, all measured at the McCormick Observatory in Charlottesville, Virginia, USA, are complete for the areas in the polar caps and the provisional analysis confirms the difference in kinematical behaviour we would expect for stars of different ages and different distances from the galactic plane.

One of the intriguing questions within the context of the general problem of the local evolution is that of the occurrence of old, metal-poor stars. Theory so far has not satisfactorily accounted for the relatively small proportion of such stars in our local sample. A check on their real proportion is therefore especially desirable. One of the current surveys on La Silla, executed with the "Grand Prism Objectif" (GPO) aims at picking out such "underabundant" old stars by searching for them in and around the McCormick areas at high and intermediate galactic latitudes.

An interesting feature of the McCormick areas programme is its broad base of international collaboration. Apart from Dr. West of ESO and myself are also involved Drs. C. R. Tolbert, Ph. Ianna and Katy Garmany of the McCormick Observatory, and Dr. R. A. Bartaya of the Abastumani Observatory in Georgia, USSR.

The ESO 3.6 m Telescope Control System Departs for La Silla

The ESO 3.6 m telescope control system, which left Geneva on May 2, 1976 for La Silla, has been developed by the Controls Group of the TP Division. It incorporates many novel features, some of which have also been implemented in other ESO control systems, notably those for the ESO 1 m photometric, the ESO Schmidt, and the Danish 1.5 m telescopes. The first two have in effect served as operational prototypes for several years (cf. ESO Technical Report No. 6, May 1975).

Although based on the same principles, the 3.6 m control system will have the possibility of a more automatic operation and more precise presetting and tracking, thereby facilitating the optimal use of the available observing time.

In addition to the integral computer (System 1) that serves as controller for all hardware components of the telescope, a larger computer configuration (System 2) serves as an operator for System 1. It performs continuous corrections for the telescope flexure, the refraction caused by the terrestrial atmosphere, and other reproducible non-linearities. It also allows the observer to prepare an observation file on the computer's disc storage and to edit his files by means of an alpha-numeric terminal. Several of these terminals are available and may be used simultaneously.

System 2 is also ready for connection to other, similar "front-end" computers, for instance the computer connected to a photometer or a spectrograph with a scanner.

Several months will now pass, before the System 2 computer will really start serving astronomy. It may be compared to the 3.6 m telescope building, which had to be erected basement first, although the astronomical observations take place only on the upper floors. To begin with, System 2 will be used for development and running-in of programmes, to test the electronic hardware, and later for the important check-out of the large optical elements by Hartmann and coma tests.

Upon arrival on La Silla, the 3.6 m telescope control system will first go to work in the so-called "1-metre mode", in which the System 1 computer does the job alone, without help from System 2. However, when a more detailed knowledge of the pointing, focusing, and alignment performance of the mechanical and optical structures becomes available, System 2 will gradually be charged with responsibility for these tasks.

Main desk of the ESO 3.6 m telescope control system in the ESO assembly hall before departure to La Silla.