on the UK Schmidt telescope. FLAIR-2 is a fibre-fed spectrograph which will be able to obtain spectra of up to 100 objects per exposure down to B $\approx$ 18.5 and agreement has been reached to ride piggy-back on another programme working at the SGP. The remaining 235 candidates in this magnitude range in the other selected fields would need to be observed with the 2.2-m, 3.6-m or NTT.

In addition, experience from the EMSS follow-up has shown that often more than one stellar object with a reasonable f_x/f_v ratio is associated with one X-ray source. The secondary criterion for stellar X-ray identification is the presence of chromospheric emission lines or rotationally broadened absorption lines in the spectrum of the star. This will require higher-resolution spectroscopy particularly for RS CVn and W UMa binaries and solar-type stars with moderate levels of chromospheric activity. Therefore, towards the end of the survey this type of spectroscopic work will be necessary for an estimated 250 stars.

All members of our team feel that it is important to allow time for follow-up observations of important, exciting, interesting or new objects as soon as possible. We have therefore requested that, contiguous with the time allotted specifically to meet the requirements of identification, an extra allocation be made to allow for follow-up. This will allow team members to profit better from the somewhat arduous tasks of survey identification.

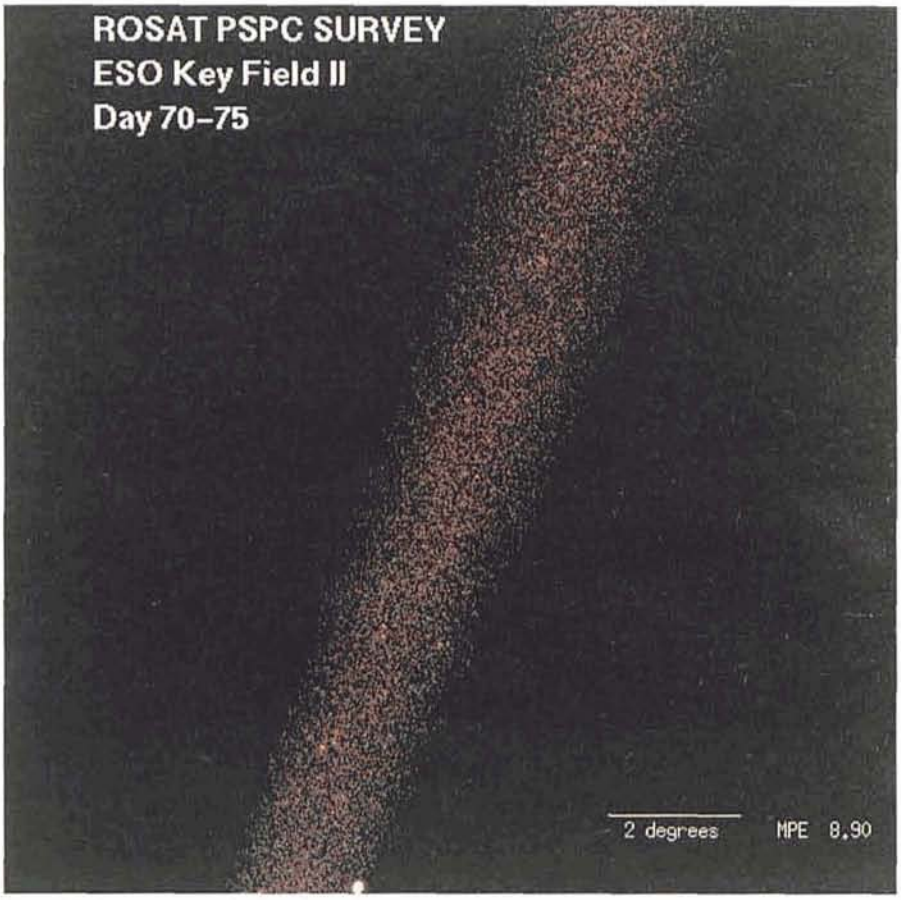

Figure 3.

PROFILE OF A KEY PROGRAMME

Stellar Evolution in the Galactic Bulge

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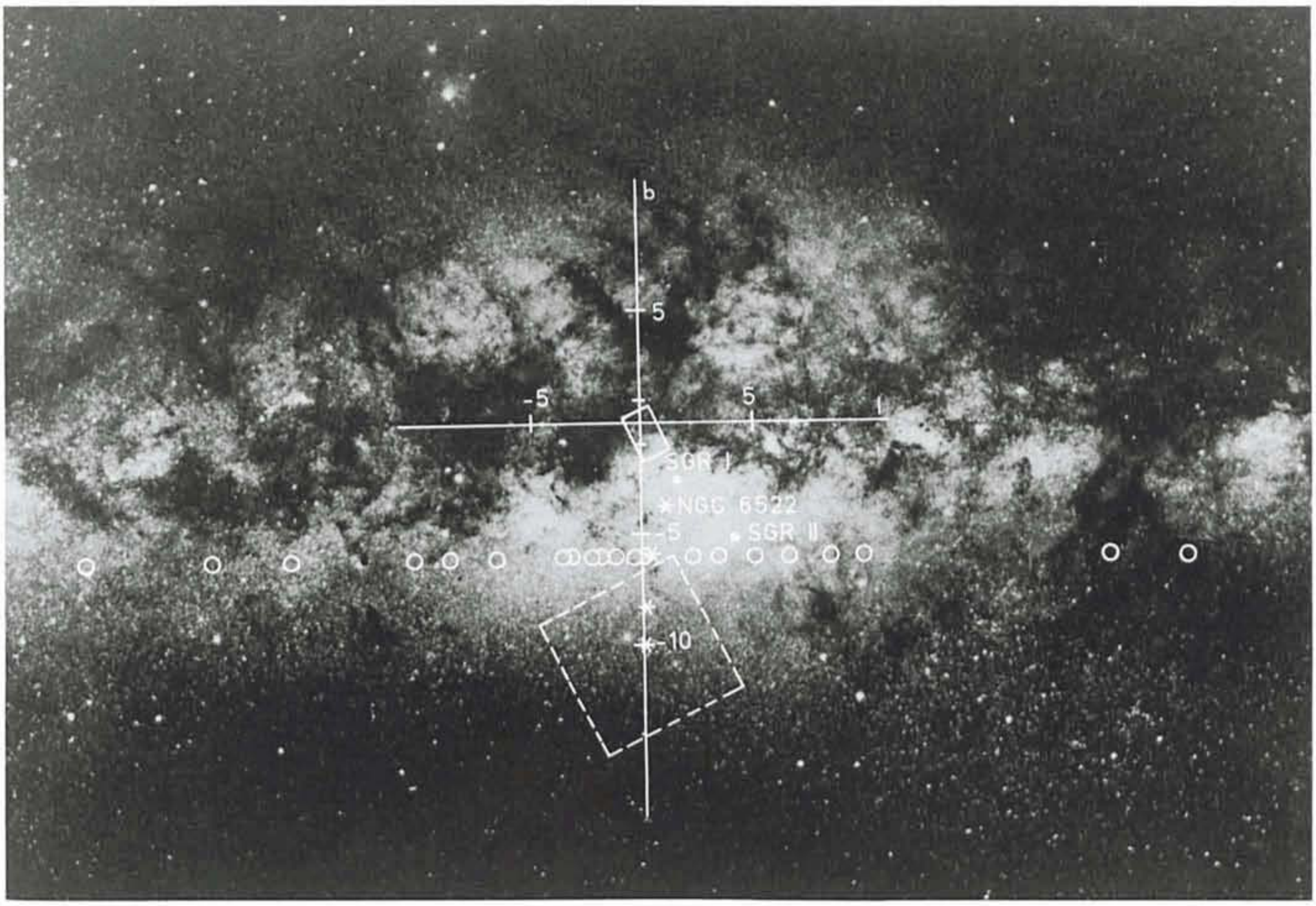
Large-scale maps at infrared wavelengths obtained with IRAS and COBE show our Milky Way as an edge-on spiral galaxy, and clearly reveal the Galactic Bulge. This separate component of our Galaxy can be considered as the nearest ellipsoidal stellar system. Studies of its stellar content are crucial not only for our understanding of stellar evolution and stellar populations in general, but also for calibrating the measurements of the colours and line strengths of the integrated light of elliptical galaxies (Whitford, 1986).

Some parts of the Galactic Bulge outside the galactic plane can be studied optically. In particular, there is a $6\overset{\circ}{.}5$ by $6\overset{\circ}{.}5$ field (900 pc by 900 pc) of low and homogeneous extinction, centred at $l = 0°$, $b = -10°$, which in the mid-fifties was chosen by Baade and Plaut as a good field to search for variable stars by photographic techniques (cf. Blaauw, 1955). It is often referred to as the Palomar-Groningen Field Nr. 3, or simply as the Baade-Plaut field. Its location is illustrated in Figure 1. Recently, Wesselink (1987) has repeated part of Plaut's painstaking work by measuring B and R Schmidt plates with an automatic measuring machine, and using a photo-electric calibration sequence. He obtained more accurate magnitudes, and confirmed Plaut's list of variable stars. As a result, nearly all Miras, Long-Period Variables, Semi-Regular Variables, and also the RR Lyrae stars have now been identified. Accurate periods and light curves have been determined for all stars with periods less than 300 days. We are extending Wesselink's work, with the aim of constructing a



The Bulge of our Galaxy (ESO photograph, 1986, The Messenger, ***46****, 14–15). The photograph covers approximately 60 by 45 degrees. The Baade-Plaut field is indicated by the dashed square. Terndrup's (1988) deep CCD photometry fields are denoted by asterisks. The open circles are Blanco and Terndrup's (1989) survey fields for late-type giants. The solid rectangle indicates the central field studied in the IR by Catchpole et al. (1990). Baade's Windows: NGC 6522, Sgr I and Sgr II.*

Hertzsprung-Russell diagram for a sample of more than one million stars in the Baade-Plaut field. This is done by means of automated photographic photometry (in U, B, R, I) which yields magnitudes and colours to an accuracy of 0.03 mag. Because the number of stars is so large, we expect that even "fast" evolutionary phases will be well represented.

The evolution of low and intermediate mass stars (1–8 $M_{\odot}$) ultimately leads to the Asymptotic Giant Branch phase (AGB), which is followed by the formation of a planetary nebula. Miras and OH/IR stars are situated at the top of the AGB. They are very luminous, long periodic, mass-losing variables: Miras have periods up to 500 days, while IR stars have even larger periods. During this phase the stars enshroud themselves in a circumstellar gas/dust shell. General scenarios for AGB evolution are available (e.g., van der Veen 1989), but much more quantitative work has to be done and several details have to be cleared up. In particular, at present it is unclear whether or not there is increasing mass loss on the upper AGB, and if there is, what consequences this has for the evolution of these late-type stars. Do Miras evolve into IR stars by an increasing mass loss or do these two groups represent late-type stars with different masses and therefore different luminosities? It has always been difficult to distinguish between these two scenarios as distances and therefore luminosities generally are uncertain.

The Baade-Plaut field is ideal for a study of the late and luminous stages of stellar evolution in the Galactic Bulge. All the objects are at about the same distance, and many of the AGB stars have been found already through Wesselink's work. In addition, we have a sample of candidate IR stars selected from the IRAS Point Source Catalogue by means of the F25/F12 flux ratio criterion (cf. Whitelock et al., 1986). We are carrying out near-infrared photometry on these objects to investigate the nature of the IRAS sources, and to determine the bolometric luminosities of the AGB stars (cf. Whitelock et al., 1990). When repeated sufficiently often, such measurements will also give the pulsational period of the star. Finally, we will also search for planetary nebulae by comparing narrow band exposures with the ESO Schmidt telescope – centred around the prominent Hα or [OIII] emission lines – with available continuum UK Schmidt R plates.

We expect to obtain many objects in all phases of the AGB evolution, so that a comparison of the relative numbers will yield the duration of each phase, including the fast ones. The results will be analysed using state-of-the-art stellar evolutionary tracks. This should allow a precise delineation of the link between Miras, Long-Period Variables, Semi-Regular Variables and OH/IR stars, and a derivation of an accurate period-luminosity relation. The direct relation between mass-losing giant stars and planetary nebulae can be established independent of distance-scale related problems.

We are taking optical spectra of many of the Mira's, from which we hope to derive their metallicities, so that we can address the luminosity/metal abundance differentiation. The spectra will also provide radial velocities, thus shedding light on the dynamics of the Bulge. The mix of stellar objects as a function of galactic latitude (or metallicity) can be determined, in particular when our study of the Baade-Plaut field is combined with similar studies of other Bulge fields, such as Baade's window (Terndrup, 1988; Rich, 1989), and the central region (Catchpole et al., 1990). This is important also for the understanding of the stellar composition of the bulges of other galaxies.

In summary, this Key Project aims at improving our understanding of stellar evolution on the AGB by a comprehensive study of the Baade-Plaut field in the Galactic Bulge. Thise will provide information on the history of the Bulge.

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PROFILE OF A KEY PROGRAMME

Kinematics of the Local Universe

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Introduction

How matter is organized in the Universe is a fascinating problem to solve because it imposes severe constraints on the scenarios describing how matter was created and how it has evolved. Unfortunately, the way is hard because of our necessarily subjective point of view and the subtle biases which affect this description. Historical evidence shows that understanding the determination of the velocity field is of fundamental significance. For instance, the discovery of the location of the centre of our Galaxy is one of the most typical examples: the location, first discovered by H. Shapley (1) from the asymmetry of the distribution of globular clusters, was accepted only when dynamical arguments were given by J.H. Oort (2).

Later some astronomers (3, 4) pointed out that the galaxies are arranged in a kind of belt almost perpendicular to

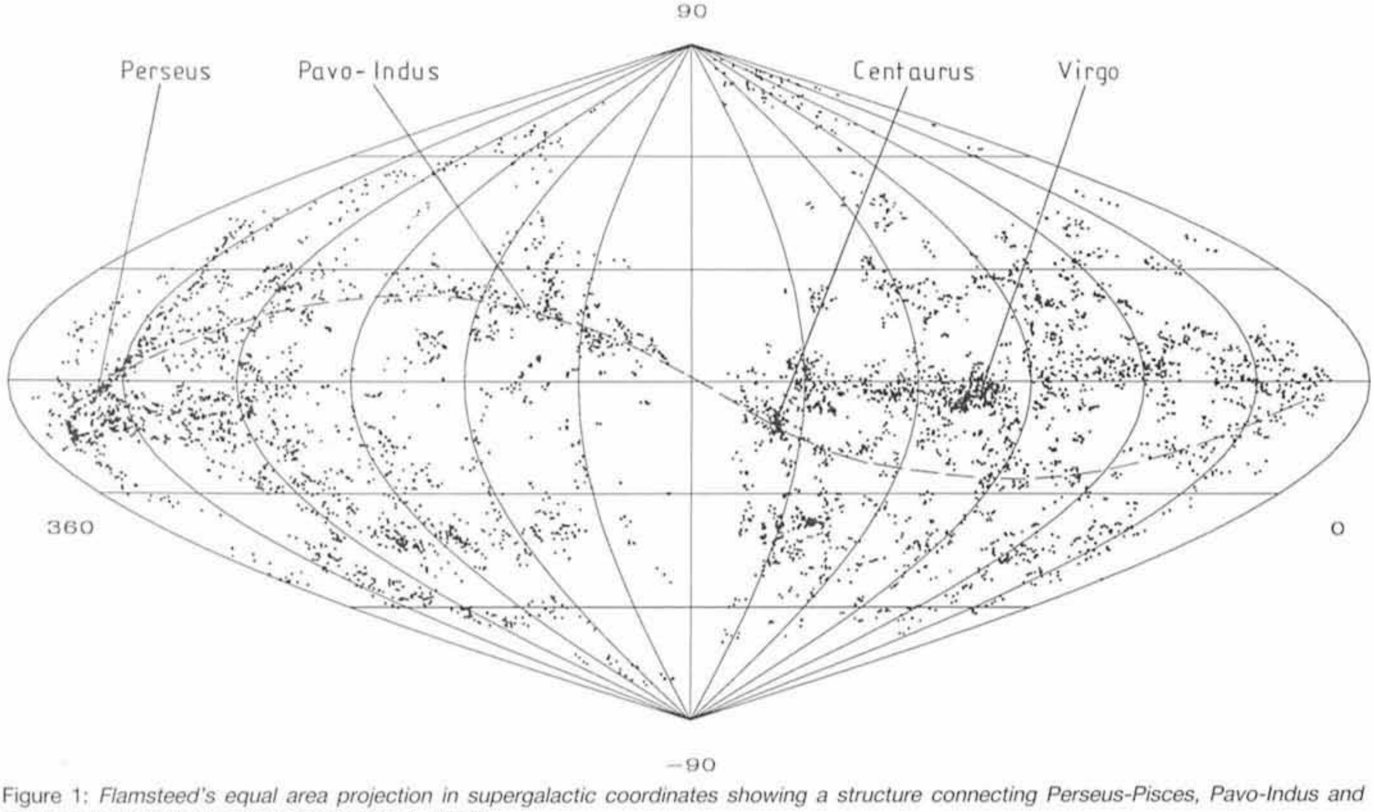

Figure 1: *Flamsteed's equal area projection in supergalactic coordinates showing a structure connecting Perseus-Pisces, Pavo-Indus and Centaurus Superclusters (see Paturel et al., 1988).*