discriminate among possible hot components in symbiotic systems. Obviously, the data required to apply this method are continuum magnitudes in the UV spectral range. Since the symbiotic star AS 338 is presently bright enough to make its continuum accessible to the IUE low-dispersion mode, I have applied for observing time with the IUE satellite, to make use of this opportunity. In addition, the observers of the Sterken group (*The Messenger*, **33,** 10) are going to monitor the optical brightness variations of AS 338, using one of ESO's photometric telescopes.

Although my story ends here, it is not at all finished. A hint in favour of the accretion event model is given by the polarimetric observations. But, for the time being, we have to wait for the ultraviolet observations to derive, as I hope, the nature of the hot component in my pet symbiotic system.

A Near Infrared Survey of the Southern Galactic Plane

N. Epchtein, Observatoire de Meudon

1. Infrared Sky Surveys

Beyond the photographic spectral range, three major infrared sky surveys have been performed till now: (i) the Two Micron Sky Survey (TMSS) achieved by Neugebauer and Leighton (1969) which provided a catalogue (IRC) containing about 5,600 sources brighter than K ~ 3.5 at declination north of –35°; (ii) the Air Force Geophysical Laboratory (AFGL) survey at 4, 11, 20 and 27 micron (Price and Walker, 1974), a rocket-borne survey covering large parts of the sky but suffering many gaps, mostly in the southern sky, and (iii) the Infrared Astronomical Satellite (IRAS) mission, mainly dedicated to a complete and deep sky survey at 10, 20, 60 and 120 micron whose results have just been released to the astronomical community.

The first two surveys, even though they were sensitivity-limited and incomplete, have led to a large amount of follow-up observing programmes in the optical, infrared and radio ranges. For many years, they have been the unique sources of homogeneous data on a large number of infrared objects. They revealed new important classes of dusty celestial objects such as the so-called OH-IR sources, an extreme class of late-type stars and the compact infrared objects, which are probably very young massive stars still embedded in their protostellar envelopes.

Mostly sensitive to cool stars (1,000–4,000 K), the TMSS has shown that the appearance of the sky in the infrared and in the visible are definitely different. It has revealed many extremely luminous, but invisible or optically very faint stars.

The reddest IRC sources (see list in Kleinmann and Payne-Gaposchkin, 1979), such as +10216, +10011, +10401, have been shown to be extreme late carbon or oxygen-rich stars surrounded by a dense cool (500 to 1,500 K) expanding envelope of dust and gas, revealed by the infrared spectral signatures of grains. Many of them are long-period variable stars and exhibit thermal and maser molecular emission lines in the millimetre range (see, e.g., Nguyen-Q-Rieu et al., 1983). They still deserve further observations to be fully understood and modelized.

Unfortunately there has been no attempt to complete the TMSS in the southern sky during the last 15 years. Even after the completion of the IRAS mission, which does not cover the near infrared spectral range, a large part of the sky still remains essentially unknown in the 1–10 micron range.

2. The Valinhos Survey

In order to partly fill up this gap, we have undertaken, in collaboration with astronomers at Instituto Astronomico e Geofisico (IAG) of the University of São Paulo (USP), a 2.2 micron survey of the southernmost part of the galactic plane. The primary aim of the project is to show up the brightest near IR point sources for future observations at longer infrared and radio wavelengths, which will be possible thanks to the developments of powerful infrared and millimetre telescopes and instrumentation in the southern hemisphere, more specifically at La Silla.

The achievement of a survey, even within a limited area, needs the availability of a telescope for a long period and a "staff" of observers, ready to spend many nights observing. By the beginning of the 80s, several opportunities were favourable to a completion of the TMSS in the south. I was involved in a joint programme with astronomers at USP and was told that this University was operating a modern 60 cm telescope at A. de Moraes Observatory located 80 km north of the large city, atop a 1,000 m high hill, above the small city of Valinhos.

An increasing amount of commercial and industrial lights around the observatory was making optical observations more and more difficult, and therefore this telescope was little used. Since infrared observations are much less sensitive to light pollution, the telescope could be almost full time dedicated to IR observations. Actually, owing to the Brazilian climate, observations were undertaken only during the (relatively) dry winter season, from May to October, which, fortunately, corresponds to the night transit of the galactic plane.

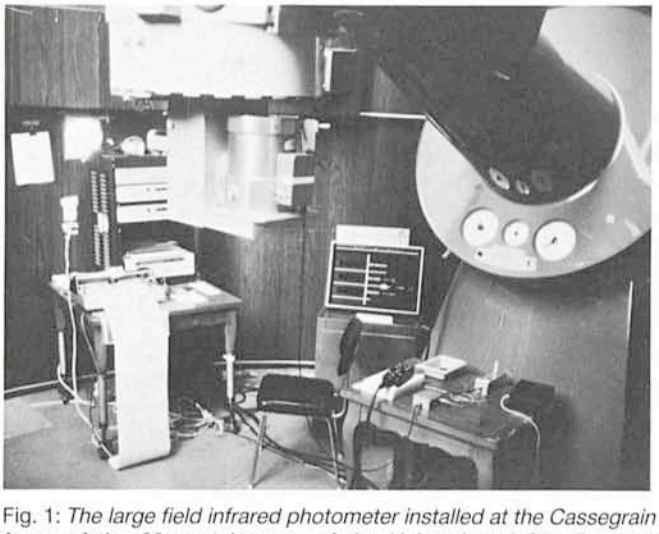

Fig. 1: *The large field infrared photometer installed at the Cassegrain focus of the 60 cm telescope of the University of São Paulo at Valinhos. This very simple device has been used since June 1982 to survey the southern galactic plane at 2.2 micron with a 3.5 arcminute diaphragm. So far, more than 1,500 sources have been detected.*

Moreover, a large field InSb photometer was left unused by the Institut d'Astrophysique de Paris. In a short time it was decided, jointly with astronomers at USP, to design a mechanical and optical interface and to apply for a bilateral agreement between French CNRS and Brazilian CNPq to finance this project. The first step of the project was to scan an area of 100° of galactic longitude on 10° of latitude, limited by 260° $< l < 360°$ and $|b| < 5°$. With a small amount of money and a lot of perseverance, the project turned out to be viable. On the Brazilian side O.T. Matsuura, J. Lépine, E. Picazzio, M.A. Braz, P. Marques Dos Santos and P. Boscolo participated in the observations while T. Le Bertre, A. Roussel and I came several times from France, sometimes on the way to La Silla, to observe at Valinhos.

The instrument is as simple as it can be. A room temperature box holds the dewar at the Cassegrain focus of the telescope, it contains two 45° plane mirrors, one is used to send the telescope beam to the detector, the other, removable, to an eyepiece (Fig. 1). The liquid nitrogen cooled dewar contains a 2 millimetre diameter Indium antimonide cell equipped with a K band filter ($\lambda = 2.2$ μm, $\Delta\lambda = .5$ μm), a Germanium Fabry lens and a field diaphragm of 3.5 arcminutes diameter. The photometer is used in a direct mode of detection, without chopping nor lock-in amplifier. The signal is only filtered in order to eliminate the DC component and recorded on a chart recorder. The coordinates of the telescope are given by the numeric read-out of the telescope. The scanning of the sky is achieved by moving the telescope in RA in "set" mode at a rate of approximately 3 arcmin/sec. During the best nights, the 3 σ limiting magnitude in this mode was $K \sim 4.5$. In order to discriminate between sources and spurious signal generated by clouds or other atmospheric perturbations, a second scan, close to the position where a signal was detected, was performed for confirmation, making the final results quite reliable.

3. Results and Follow-up Programme at La Silla

So far, the area extending between Carina and Scorpius ($l = 285°$ to $l = 360°$) has been almost fully surveyed. A few gaps still remain which will be filled up in 1985. More than 1,500 sources have been detected. Their position accuracy is 2 arcminutes rms and only a rough estimate of their flux density can be derived from the observed signal. The selection of objects for further observations requires more information on their nature and more accurate positions. Therefore, a complementary programme is carried out with the ESO 1 m telescope and its standard infrared photometer. Since the objects are rather bright, it is a very suitable programme for day-time use of this telescope. Positions to within 10 arcseconds rms and JHKLM photometry of 338 objects selected among the sources with faint or without optical counterparts (as seen in the 10 cm finder of the 60 cm telescope) have been obtained during two runs at La Silla in September 1983 and September 1984. Identifications with catalogued stars is achieved with the help of the "Centre de Données Stellaires" at Strasbourg. More than two thirds of the subsample remain unidentified and can be considered as "new" objects. They

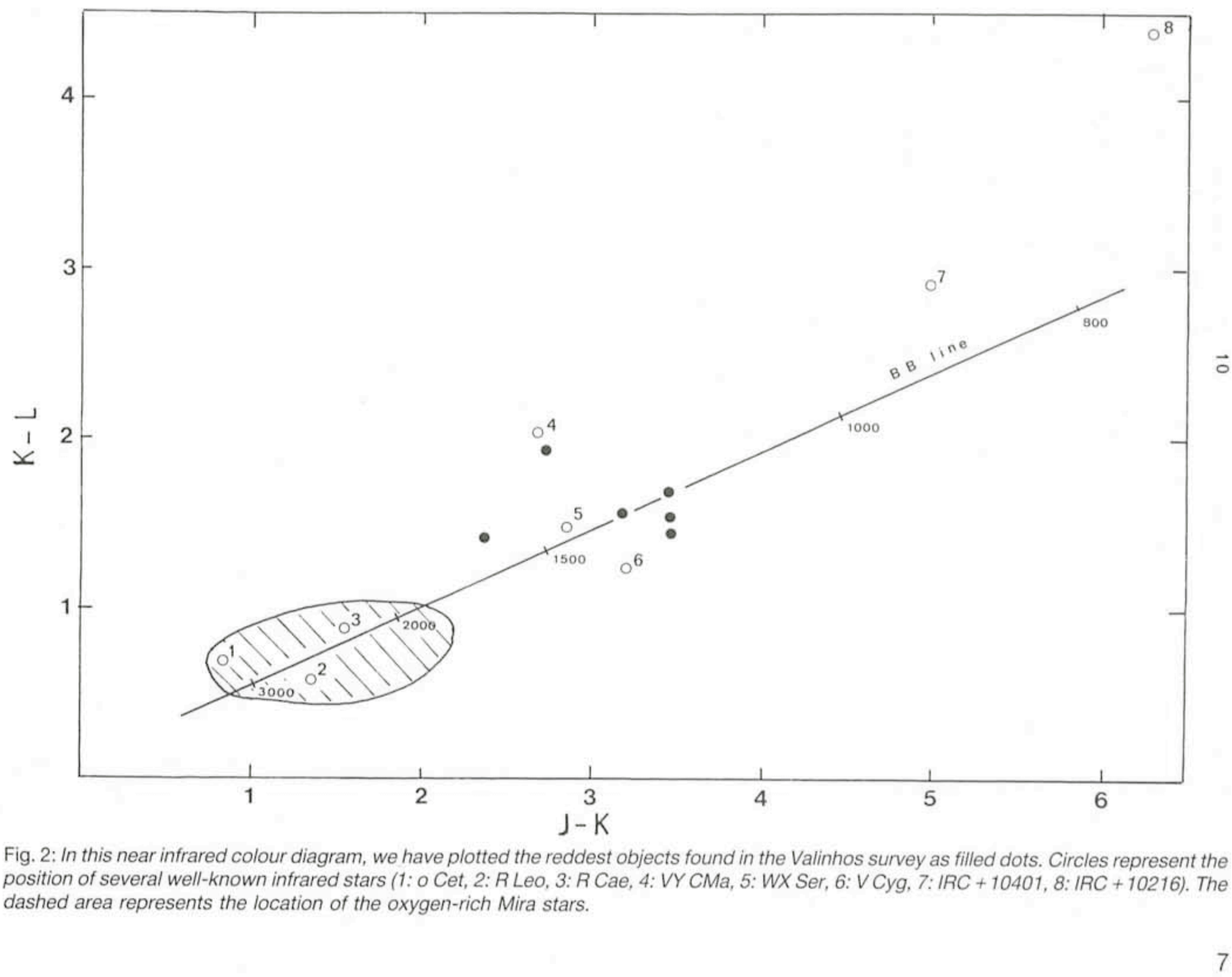

Fig. 2: *In this near infrared colour diagram, we have plotted the reddest objects found in the Valinhos survey as filled dots. Circles represent the position of several well-known infrared stars (1: o Cet, 2: R Leo, 3: R Cae, 4: VY CMa, 5: WX Ser, 6: V Cyg, 7: IRC + 10401, 8: IRC + 10216). The dashed area represents the location of the oxygen-rich Mira stars.*

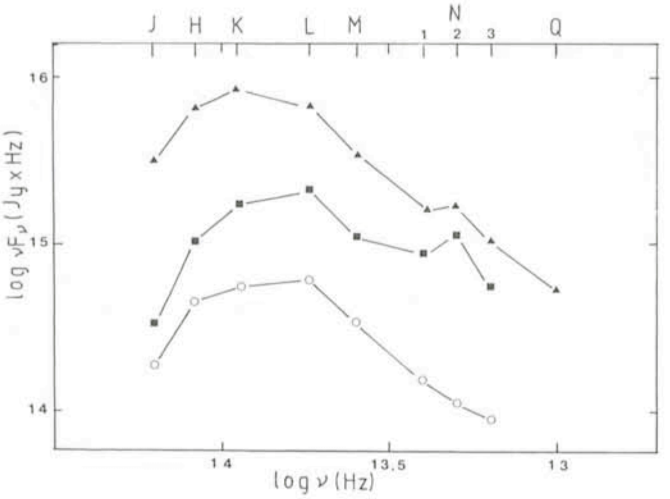

Fig. 3: *Infrared energy distribution of 3 among the reddest objects found in the Valinhos survey: IRSV 1145–6245 (▲), IRSV 1246–6418 (■) and IRSV 1412–5845 (÷ 10) (○). The first two objects clearly exhibit a silicate emission feature at 9.7 micron. They are likely to be oxygen-rich LPVs (observations carried out by T. Le Bertre in December 1984).*

have been designated as IRSV (i.e. Infrared Survey Valinhos) followed by their equatorial coordinates (1950). The complete list and photometric data will be published shortly (Epchtein et al., 1985) and can be supplied on request.

Most of the newly found objects are likely to be late-type stars surrounded by a dust shell. Several objects observed at different epochs have shown a definite variation in the IR bands. They are likely to be long-period variable stars (LPVs). Others, not variable, are more probably very reddened giant or supergiant stars. The reddest objects are represented in a (J–K), (K–L) colour diagram (Fig. 2) together with some well-known infrared stars. No object as red as IRC +10216 has been found yet, but the reddest stars exhibit near IR colours similar to those of sources such as VY CMa (a star which displays a non-spherically symmetric envelope), or V Cyg (a carbon star). It is still rather hazardous on this basis to claim that we have discovered new carbon stars or asymmetrical envelopes, but it is clear that many new variable late-type stars have been found thanks to this survey. They deserve further observations in the visible and in the infrared in order to determine their spectral types, luminosity classes and variability types. Recently, T. Le Bertre observed about 30 very red new objects with the bolometer in the 10 micron bands on La Silla. In several sources he found the typical silicate emission feature at 9.7 micron which characterized oxygen-rich LPVs (Fig. 3); they will be worth observing in radio molecular lines. Finally, the results of the Valinhos survey, combined with the IRC will allow a study of the distribution of the brightest late-type stars in the whole galactic plane. It is also expected to identify some IRAS sources in the region where the space mission was suffering a maximum of confusion.

4. Next Step: A Deep, Complete Near IR Survey?

In a statistical study of the AFGL survey data, Grasdalen et al. (1983) have shown that the stellar populations detected at near IR wavelengths (2–4 μm) and at 10 μm are distinct. For a large class of optically invisible or very faint stellar sources at temperatures ranging between 800 and 2,000 K, ground-based near IR surveys may easily overcome space missions such as IRAS. In the near future, the large gap which separates IR photographical and the 10 μm IRAS surveys could be filled. Our complement to the TMSS was limited in area and sensitivity due to the use of a single detector and the direct mode of detection, but it is expected that a complete ground-based sky survey at 2–3 μm with a limiting K magnitude of 10–12 could be shortly achievable with a multidetector such as an InSb CID array and a 1 metre class telescope.

Acknowledgements

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