about the mass ratio must be delayed until a spectroscopic determination of q will be available. It is planned to collect the necessary rv data in July 1991 at the ESO 1.52-m telescope (with ECHELEC).

It should be noted that in a review of early-type binaries by Hilditch and Bell (1987) two objects with very similar parameters appear: V Puppis (B1V, P = $1\overset{d}{.}495$) and TX Aurigae (B1V, P = $1\overset{d}{.}210$); these are semi-detached systems, with secondaries filling their Roche lobes. The detached system V1331 Aquilae therefore seems to be an important addition to the sample of the earliest binaries. In the following, a few more complex interacting binaries are briefly described, for which recent solutions were derived in the scope of this programme.

AH Cephei

AH Cephei (B0V + B0.5V, P = $1\overset{d}{.}775$) is an early-type close detached system. Light curves from two widely separated epochs (1930 and 1984) with clearly different depths of eclipse minima were analysed. The derived time variation of the orbital inclination suggests the presence of a third body in the system, which manifests itself not only by light-time effect, but also by the precession of the orbital plane of the eclipsing binary. This finding is further confirmed by a fraction of third light of about 5 per cent, as is evident from the solution of the light curves. Besides IU Aurigae, AH Cephei is a unique example for a triple system, where the presence of a physical third component is not only proved by the light-time effect or third light, but also by a time change of the orbital inclination (Drechsel et al., 1989).

IU Aurigae

IU Aurigae (B0Vp + B0.5, P = $1\overset{d}{.}811$) is a semi-detached system with the secondary filling its critical Roche volume. As in the case of AH Cephei, IU Aurigae is a rare case for which the presence of a third body can be confirmed beyond any doubt by light-time effect, third light of about 20 per cent, and in addition by the time variation of the orbital inclination due to the precessional motion of the binary orbit triggered by the third body (Mayer and Drechsel, 1987).

LY Aurigae

LY Aurigae (O9.5III + O9.5III, P = $4\overset{d}{.}003$) is a massive contact system. A close visual field star with an angular separation of 0.5 arcseconds contributes appreciable third light to the total flux. This might be one reason for partly contradictory previous results concerning the mass ratio and system configuration. The recently obtained light-curve solution yields a third-light contribution of 10 per cent and a mass ratio of about 0.6, which is compatible with the spectroscopic value (Drechsel et al., 1989).

4. Future Prospects

We have shown that the sample of absolute dimensions known for very early stars can be enhanced by inclusion of interacting close binaries with hitherto unexplored or uncertain system parameters. The current programme not only aims at the measurement and solution of eclipse light curves, but will also complement radial-velocity data necessary for independent spectroscopic determinations of mass ratios, which are necessary for reliable photometric results. An essential subject of future investigation will be an adequate treatment of radiation pressure effects, which have already been shown (Drechsel et al., 1991) to be of major importance for the shape and configuration of early-type close binary stars.

Even at the end of the pre-VLT era and certainly also in the future, bright stars are far from being exhaustively explored. For good reasons, large instruments are not available for such objects, while medium- to small-size telescopes are still able to provide a wealth of important new data – especially if they are located at such marvellous sites like La Silla.

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Hunting the Brown Dwarf

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1. What are "Brown Dwarfs"?

During the seven last years there has been a considerable interest developing in view of the discovery and observations of presumed sub-stellar objects, also named "brown dwarfs". This illustrative term denotes a class of objects that appears naturally in the theory of star formation: recent models predict that the collapse and fragmentation of a molecular cloud should produce clumps down to 0.02 solar masses. Between this lower limit and 0.07 solar masses, the fragment is not massive enough to ignite nuclear reactions inside its core and ends as a "failed star", faintly shining in the infrared due to the release of gravitational energy associated with its progressive contraction. Observations of some members of this new class of celestial bodies would of course be of the highest importance for the theory of very low mass star formation, and models have been proposed which aim at predicting the photometric and spectrophotometric characteristics of brown dwarfs and their evolution with respect to their birth mass and age.

Another reason for the revival of this observational activity is of course to be found in several breakthroughs achieved in astronomical instrumentation, specifically at infrared wavelengths, which opened the door to the possible direct detection of at least the brightest, i.e. the youngest, brown dwarfs: high efficiency infrared arrays and diffraction-limited imaging techniques in the IR are prime weapons in this hunting.

2. First Attempts

The first observers to spot something were McCarthy et al. (1985). They used infrared speckle interferometry to detect brown dwarf companions possibly or-

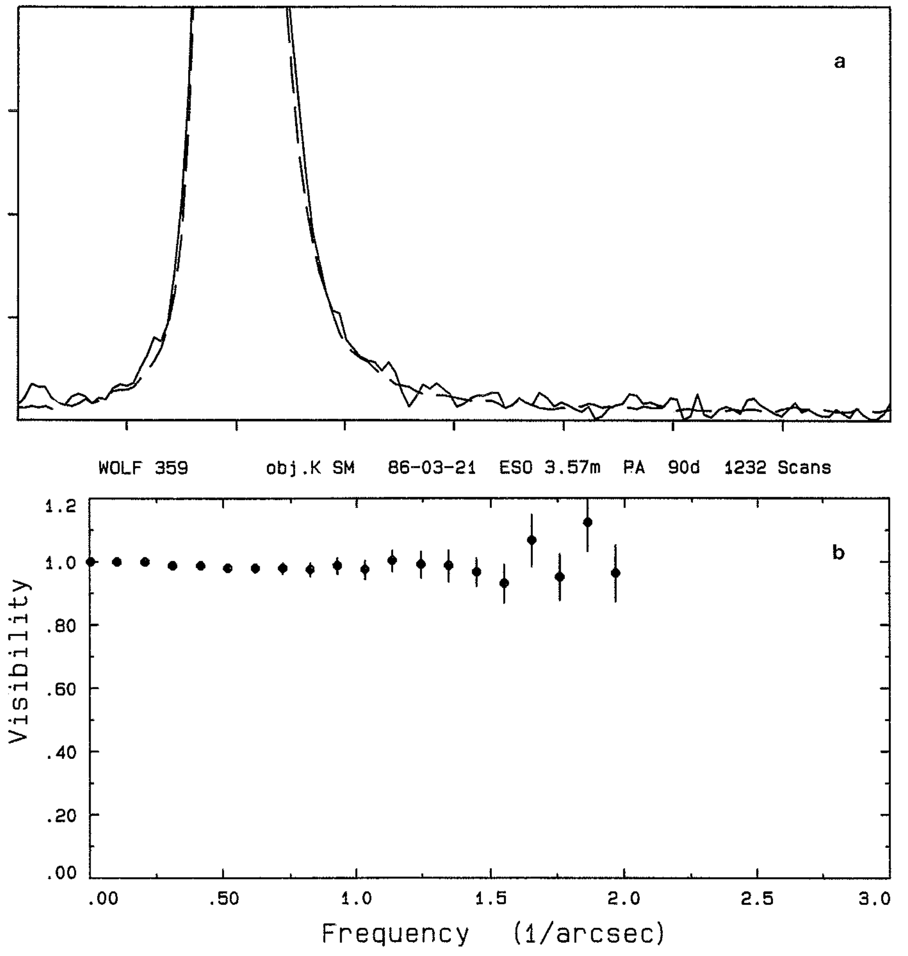

Figure 1: *Long-exposure image and visibility of Wolf 359 at 2.2 microns.*
1.a: Superimposed East-West profiles of the source and of a reference star (dashed line) enlarged 20 times with respect to peak value. The total scan amplitude is 18.4 second of arc. The r.m.s. noise value measured on the sky (right half of the scan) corresponds to a magnitude K = 13.2.
1.b: Corresponding visibility showing that the image core is not resolved: any companion with K<11 and at a separation larger than 0.5″ would produce a detectable sinusoidal modulation of the visibility.

biting the nearest red dwarfs in the northern hemisphere. The reason to search for brown dwarfs in binary systems is that, unlike Lewis Carroll's Snark that can be recognized thanks to "five unmistakable marks", one, and only one, parameter allows yet to confirm the sub-stellar nature of an candidate brown dwarf, namely its mass. The reason to use speckle-interferometry, a technique achieving imagery at diffraction-limited angular resolution, is that it gives access within a distance of 10 parsecs to separations of the order of 1 A.U., and therefore to binary systems with typical periods of a few years.

3. Observations at La Silla

Following these tracks, we have started in 1986 a programme of observation of the closest southern hemisphere stars with the infrared speckle system available at the La Silla 3.6-m telescope, in order to complement the on-going northern hemisphere survey. Among others, our target list included some famous sources, such as Proxima Centauri, Barnard and Kaptein's stars, as well as some extreme low-luminosity stars such as Ross 154, Wolf 359 and some Van Biesbroeck's stars (VB4 and VB5).

Alas! Our first observations turned out to be rather disappointing: not only not a single new sub-stellar companion appeared in our visibility curves (see Fig. 1), but VB8B itself, the unique candidate specimen of the class, proved to be only a mere artifact, caused by a tenuous calibration problem (Perrier and Mariotti, 1987): the number of detected brown dwarfs was reduced from 1 to 0!

Further observations in 1987 and 1988 did not allow us to invert this unfortunate result. In the meantime, several discoveries of new candidates were reported, but up to now none of them is clearly confirmed as sub-stellar, because an unambiguous determination of the mass is always lacking.

A by-product of our first observation campaign has been, however, to lead to new separation measurements of several low-mass red-dwarf binaries, including the determination of the masses and orbital parameters of Gliese 570B (Mariotti et al., 1990), a binary system independently discovered as a spectroscopic SB2 system by Duquennoy and Mayor (1988). Indeed, infrared speckle interferometry turned out to be an extremely powerful technique when applied to the observations of binaries previously detected or suspected because of their radial-velocity variations:

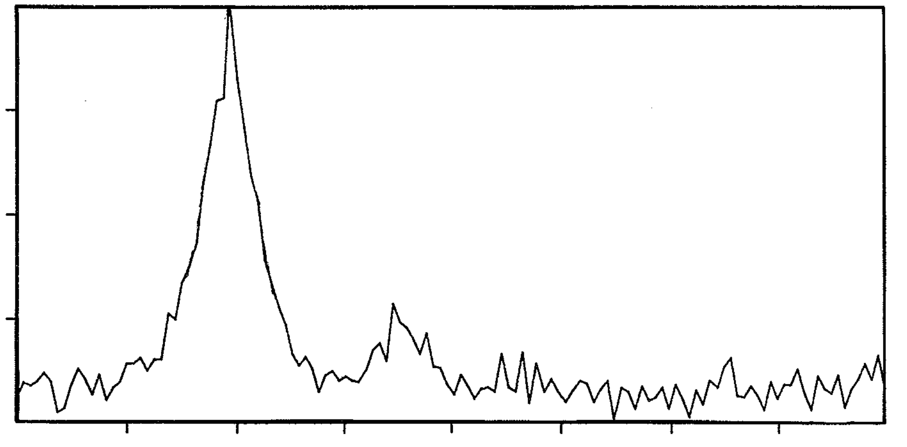

Figure 2: *A sub-stellar companion of Gliese 440?*
In January 1990, we detected a very faint and red object a few seconds of arc away from Gl 440, one of the closest white dwarfs with a distance of 5 pc. Further observations in March 1991 revealed that the separation of the two objects has increased by about 2 seconds, i.e. exactly the amount and the direction due to the proper motion of Gl 400: the "companion" is hence not a brown dwarf, but rather a background "normal" red star lying for a while on the line of sight. The figure displays the Jan. 90 image profile at 1.6 microns: scan direction is E-W, intervals between ticks are 1.5 second of arc.

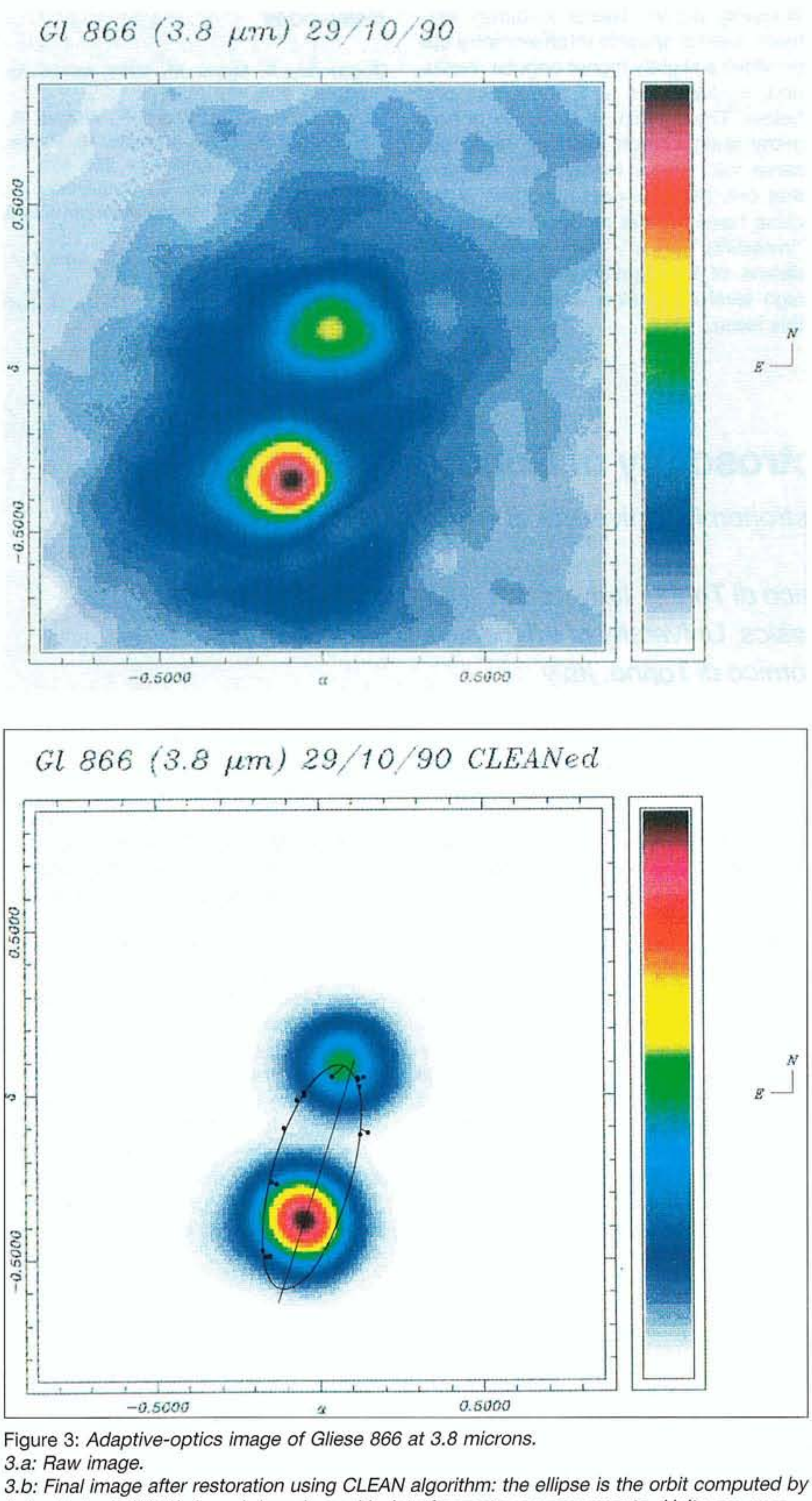

Figure 3: *Adaptive-optics image of Gliese 866 at 3.8 microns.*
3.a: Raw image.
3.b: Final image after restoration using CLEAN algorithm: the ellipse is the orbit computed by Leinert et al. (1990) from infrared speckle interferometry measurements. Units on axes = arcseconds.

this has led us to propose, in collaboration with A. Duquennoy and M. Mayor of Geneva Observatory, a study of a few dozen candidate red-dwarf binaries selected from the CORAVEL database. We have just completed the fourth of a series of systematic speckle observing runs devoted to this programme that turned out to be extremely successful and on which we will report in a forthcoming article.

But again, according to the preliminary analysis of the data, no new brown dwarf candidate was spotted during these observations. Sometimes a faint sign has revived our hopes, but up to now always in vain (Fig. 2). Indeed, it is well known that speckle interferometry is a technique rather limited in terms of dynamic range. In other words, the maximum magnitude difference between the primary and the companion that we can hope to reach is at best 4.5: so, even the "brightest" brown dwarfs can be detected by speckle interferometry only if they orbit very low luminosity red dwarfs ($L < 2 \cdot 10^{-3} L_\odot$), i.e. of type dM5 or later, which severely restricts our target sample.

4. New Techniques

Fortunately, the on-going development of the infrared observational techniques offers us a new and powerful way of tackling the difficult problem of spotting the dim light of a brown dwarf close to a (relatively) glaring star: Adaptive Optics can already provide at the 3.6-m telescope diffraction-limited images at a wavelength of 3.6 microns and nearly diffraction-limited images at 2.2 microns with an excellent dynamical range *The Messenger,* **60**, p. 9 and **63**, p. 76). This is why we have proposed to resume our hunting equipped with this new weapon.

In October 1990, we observed again a dozen of the closest stars of the southern hemisphere: although the final data reduction is not complete at the time of this writing, the real-time quick look on the data did not lead to any positive detection. However, we have taken this opportunity to image a few previously known red dwarf binary systems, and Figure 3 illustrates the efficiency of Adaptive Optics applied to the detection of close binary systems: Gliese 866 was first resolved by speckle interferometry, and has been followed since then during two orbits by several groups around the world including our team (Leinert et al., 1990). In contrast with the strict and rather tedious procedure mandatory in speckle observations, the Adaptive Optics observations revealed the binary nature of the source after only a few tens of a second of exposure time. The magnitude difference between the two components of this binary is small but it is clear from Figure 3 that a high dynamical range can be reached in the clean images provided by this technique.

If necessary, a coronographic mask could further improve the detection limit of a very faint companion: this is one of the advantages of the *a priori* compensation provided by adaptive optics compared to the *a posteriori* nature of speckle interferometry restoration. Another advantage is that, if the separation of the system is larger than one Airy disk, as it is the case here, the two components can be independently analysed by, for instance, feeding the corrected image into a spectrograph.

5. Outlook

Considering these advantages, we have no doubts that Adaptive Optics is on the verge of becoming the most convenient way of first detecting, then studying, brown dwarfs in binary systems, even if speckle interferometry still provides a slightly higher angular resolution, in particular at 2.2 microns and below. The remaining question is how many such objects we can really observe with these techniques, knowing that only the youngest members of the class have not yet plunged behind the "invisibility barrier". The recent ups and downs of the hunting still prescribe a high level of caution when addressing this issue.

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Low-Resolution Spectroscopy of Southern Old Novae

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Current Views about Classical Novae at Minimum

Old novae, like dwarf novae, recurrent novae and nova-like variables, are Cataclysmic Variables (CVs). CVs are interpreted as interacting close binaries with a white dwarf primary and a red dwarf, or seldom a red giant secondary filling its Roche lobe. According to the current views, in many CVs matter from the secondary flowing through the inner Lagrangian point forms a hot viscous accretion disk around the white dwarf. Due to dissipation of angular momentum, this material moves inward across the disk until it is accreted by the white dwarf. The modes of accretion are different in CVs with strongly magnetized white dwarfs (their surface magnetic field is however only up to 10^8 Gauss, much less than the 10^{10} Gauss that isolated white dwarfs can reach).

In such objects accretion can occur without a disk, with flow of material to the polar caps as in AM Her systems, or a disk may exist but its inner part be disrupted, as in Intermediate Polars. Periodic thermonuclear runaways in the envelope accreted around the white dwarf are believed to produce the classical nova phenomenon (see Starfield, 1989 and references therein). Dwarf novae instead, show recurrent small amplitude outbursts which are believed to be caused by instabilities of the disk or of the mass transfer from the secondary. Old novae appear brighter and hotter than dwarf novae and this is thought to be due to larger mass transfer rates ($10^{-10} - 10^{-8}$ $M_\odot yr^{-1}$ vs. $10^{-13} - 10^{-11}$ $M_\odot yr^{-1}$). For accretion rates above 10^{-10} $M_\odot yr^{-1}$ CV disks should be stable.

Current views of CVs, however, admit and suggest that secular changes of the mass accretion rates might cause an object to transit from one sub-class of CVs to another. To justify the space density of old novae, too low compared to the nova frequency, it has been hypothesized that most of the life of nova systems is spent in a state of "hibernation", with a very low mass transfer rate that makes most old novae faint and even undetectable (Livio et al., 1990). The nova phenomenon should then occur during the "high-state" of the mass transfer rate. Dwarf-nova like outbursts of three old classical novae have been observed and seem to confirm this theory (Vogt, 1986). Presently, however, the observational evidence for such an interpretation is still rather poor and modifications to the "hibernation" theory have already been suggested (Livio et al., 1990).

Some of the oldest recovered novae tend to become fainter, but their photometric behaviour can also be interpreted as very long term light oscillations, recently revealed for all CVs. The secondary components seem to have solar-type activity cycles which modulate the mass-transfer rate even long after the nova explosion (Bianchini, 1990, and references therein).

Many other features of the post-outburst behaviour of classical novae are

Table 1

Nova	Year	Mag (Dürbeck)	Mag (observed)
OY Ara	1910	17.5_p	19.5
CG CMa	1934	15.9_p	16.5
nova Car	1953	19.0_p	17.5
nova Cen	1986 N. 1	14.5_v	15.0
AR Cir	1906	15.0_p	14.2
BT Mon	1939	15.5 (var.)	17.3
GI Mon	1918	18.0_p	16.1
V616 Mon	1975 X-ray	20.2_B	18.2
RR Pic	1925	11.9_p	12.2
T Pyx	recurrent	15.3_p	15.5
CP Pup	1942	15.0_v	15.1
HS Pup	1963	20.5_p	18.1
HZ Pup	1963	17.0_p	17.4
nova Pup	1673	20.0_p	20.0
XX Tau	1927	18.5_p	20.0
CN Vel	1905	17.0_p	18.4–17.8