and 3.5). Higher dispersion spectroscopy of these objects and a detailed colorimetric study could provide a starting point for an investigation of the surface density of high redshift quasars, the present knowledge of which is greatly unsatisfactory. There is evidence of a decrease of the quasar space density beyond z = 3.5, but a detailed unbiased analysis is still lacking. This subject is of course of fundamental importance since it brings direct inferences on the evolutionary history of these objects and of the Universe itself.

Other independent methods can be applied to test and improve the completeness of the sample, and at present an automatic search for faint variable objects in the 6.5 x 6.5 sq. deg. field investigated by Braccesi et al. in 1970 is under way by Hawkins, M. R. S., Cristiani, S., Véron-Cetty, M. P., Véron, P., and Braccesi, A. This technique provides a powerful independent method of selecting quasar candidates which is particularly valuable in this case, since the completeness of the sample is checked and, at the same time, a statistically significant analysis of the quasar variability can be carried out, with remarkable consequences for the understanding of the physical processes involved in the quasar phenomenon.

Fig. 3 summarizes the present knowledge of the quasar surface density which is for astronomers a cause of dissatisfaction, for many questions are unanswered and a quantity of work still remains to be done, and at the same time a reason for pride, since properties of objects as far as several billion light-years have been determined.

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The Story of the Eclipsing, Double-lined Binary HD 224113

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For an observing astronomer it is always very exciting to record an unexpected event, even if this is "only" the detection of the optical variability of a spectroscopic binary. This happened to me in July 1978 when I performed a photometric programme at the ESO 50 cm telescope. Since the allotted observing time was a bit too late to follow my programme stars until the end of the night, I had prepared a list of about 20 radial velocity variables to check their photometric behaviour during the remaining hours. The first object I selected was HD 224113, a B6V star with a magnitude of $V \sim 6.1$. Suddenly, after some minutes of observation the brightness dropped off and faded away continuously until the rising sun prevented further measurements. The nature and range of the variation ($\triangle V \sim 0.2$) indicated that an eclipse had been observed. Of course, for the nights to come, the hours before dawn were devoted to further observations of this star. However, no further variations were recognized, HD 224113 showed a constant brightness all the time.

Back at home I learned (a little disillusioned) that HD 224113 was known to be a single-lined spectroscopic binary with a period of about 2.5 days (Archer and Feast, 1958, *Monthly Notices of the Astronomical Society of Southern Africa* **17,** 9) and that it appeared in my list only because the radial velocity catalogue (Abt and Biggs, 1972) which I used as reference was incorrect: This star was marked only as variable in radial velocity and not as spectroscopic binary. A note in the paper by Archer and Feast that "a faint secondary spectrum is suspected on several of the spectrograms" was the stimulant to let things not rest. Eclipsing binaries showing in their spectra the lines of both components are the only sources for a precise determination of the system parameters in absolute units, including especially the masses. The knowledge of reliable empirical masses is essential for the theory of stellar structure and evolution. At that time system parameters of less than two dozen B-type main-sequence stars were known with high precision, among them only one B6V star. Since their masses and radii indicated a significant revision of the empirical mass and radius scale for B stars, a closer investigation of HD 224113 seemed to be worthwhile.

During the following years (1979, 1980, 1981) more than 2,700 uvby measurements were collected using the ESO 50 cm telescope. Descending and ascending part of the primary minimum as well as the whole secondary minimum could be covered several times allowing for a precise determination of the period. From the shape of the resulting light curves it is obvious that the interaction between the components is rather weak. The small displacement of the secondary minimum from midphase indicates a slight non-zero eccentricity of the orbit. For illustration the V light curve is presented in Fig. 1. In the course of two observing runs in 1979 and 1980, 36 high-dispersion spectra ranging from the blue to the infrared region could be obtained using the coudé spectrograph of the 1.5 m telescope. A careful inspection revealed that the only detectable lines of the secondary spectrum were those of Ca II-K and Mg II λ 4481, both very weak on the baked IIIa-J plates. The hydrogen lines cannot be seen distinctly double; there is only a variable asymmetry in the wings of the Balmer lines. A preliminary analysis (Haefner, 1981, *IBVS* No. 1996), based on radial velocities of the Ca II-K lines and on part of the photometry (Russell-Merrill nomogram method), yielded surprisingly good results for the system parameters when compared with the final solution.

In the meantime I learned that the optical variability had been detected independently by Balona (1977, *Mem. R. A. S.*, **84,** 101) and Burki and Rufener (1980, *Astronomy and Astrophysics* **39,** 121). The roughly 100 photometric measurements of Burki and Rufener which span the orbital period were analysed by Giurcin and Mardirossian (1981, *Astrophys.*

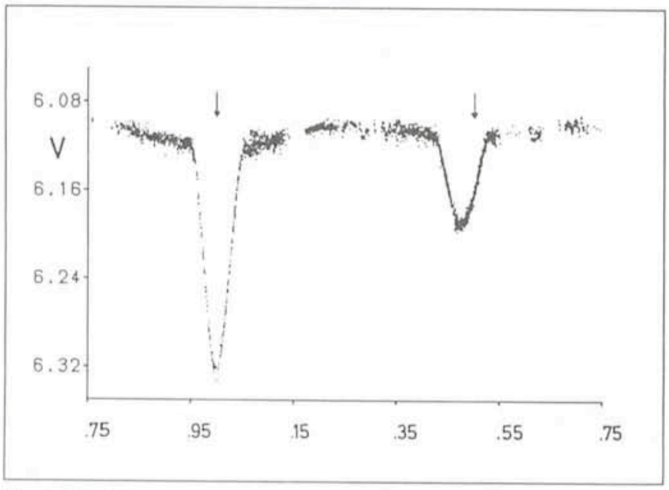

Fig. 1: *The V light curve of HD 224113. Included are 21 measurements kindly provided by H. J. Schober and 41 observations obtained by C. Sterken (1982,* IBVS *No. 2166). The phases 0 and 0.5 are marked by arrows.*

Space Sci. **74,** 83) using a light curve synthesis programme. Besides this, Dean and Laing (1981, *M.N.A.S.S.A.* **40,** 48) published a Russel-Merrill analysis based on about 120 measurements. However, the results of their analyses are rather discordant, reflecting the paucity of the photometric data as well as the unawareness of the radial velocity curve of the secondary. The latter forced them to rely on quantities which then can only be estimated.

The amount of the available spectroscopic material could considerably be increased by the cooperation of Mart de Groot (Armagh Observatory) who brought in 23 blue spectra which he had obtained on IIa-O plates at the coudé spectrograph of the 1.5 m telescope during the years 1970 to 1976. Using the facilities of the St. Andrews Observatory, I. Skillen determined the radial velocities from altogether 47 blue spectra and derived the orbital parameters from the resulting radial velocity curves (Fig. 2). Since the signal-to-noise ratio of the spectra recorded on IIa-O emulsion was inferior to that of the IIIa-J plates the velocities derived from the former showed more scatter. This was particulary evident for the secondary lines. It seemed therefore very promising to use the newly available CAT/CES/Reticon combination on La Silla to check or improve the radial velocity curve of the secondary. Among other advantages, the high resolving power makes this combination an ideal system to record very weak lines with hig precision. However, due to extremely bad weather conditions prevailing during my observing run at the end of July 1982, the outcome was quite poor with respect to the number of spectra: Only 5 Ca II-K and 2 Hα observations could be obtained. Fig. 3 presents the Ca II-K line complex showing in particular the very weak and shallow secondary line and the resolved interstellar component for different phases. The radial velocities were determined using the iterative simultaneous least-squares fit for multiple spectral lines of the IHAP system. Despite the fact that these few observations could not substantially improve the radial velocity curve of HD 224113 the combination CAT/CES/Reticon and the IHAP software is highly recommendable for precise investigations of faint secondary lines of spectroscopic binaries.

For the final analysis of the light curves I have used the light curve programme of Wilson and Devinney (1971, *Astrophysical Journal* **166,** 605) in a version running at the Bamberg Observatory. This programme generates wavelength-dependent light curves as a function of 15 parameters on the basis of a physically realistic model which allows for rotational and tidal distortion, the reflection effect, limb darkening, and gravity darkening. In principle a least-squares differential correction procedure enables one to fit a calculated light curve to the observations and to determine the best set of these parameters. Since some of them are better determined by the spectroscopic analysis (e.g. mass ratio) or are known to be generally valid for early-type stars (limb-darkening coeffi-

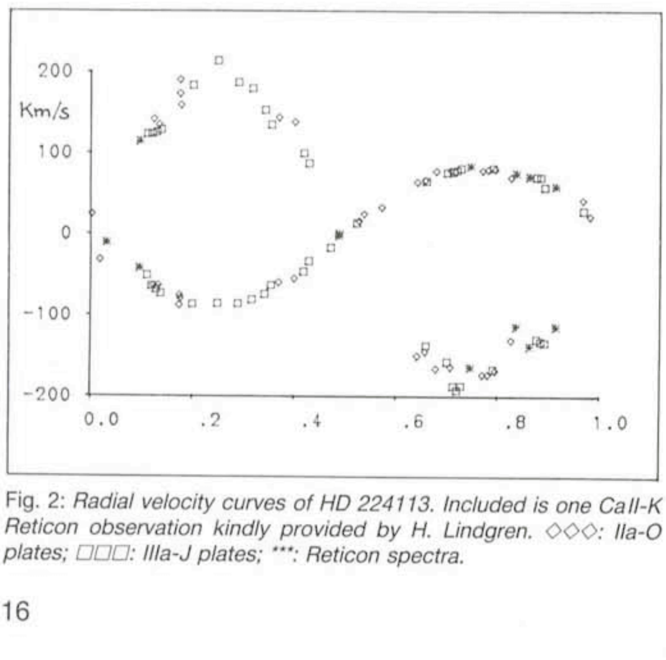

Fig. 2: *Radial velocity curves of HD 224113. Included is one Ca II-K Reticon observation kindly provided by H. Lindgren. ◇◇◇: IIa-O plates; □□□: IIIa-J plates; ***: Reticon spectra.*

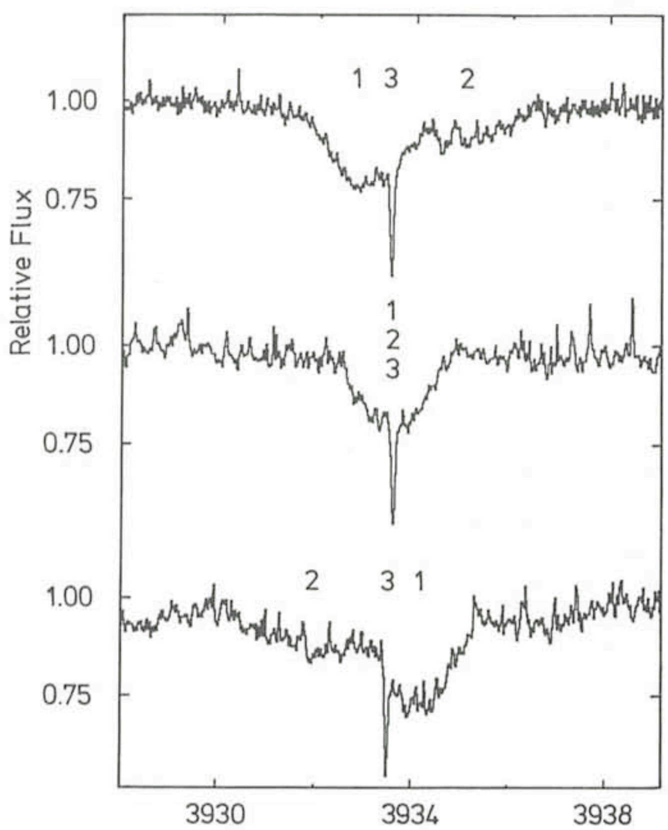

Fig. 3: *Reticon observations of the Ca II-K line complex for different orbital phases. 1: primary component; 2: secondary component; 3: interstellar component. Upper and lower spectrum were obtained half a period apart at phases where primary and secondary lines show about half the maximum separation.*

cients, bolometric albedos, etc.) the number of adjustable parameters could be appreciably lowered. The analysis revealed that the system HD 224113 is a detached one with the secondary being an A0V type star. The results for the masses and radii of both components strongly support the trend to values which are about 20–30 % smaller than standard values commonly used up to now. For detailed results the reader is referred to my article which will soon be published in *Astronomy and Astrophysics.* It is quite funny that an error in a radial velocity catalogue caused this investigation revealing one more early-type binary suitable for a high-precision determination of the absolute system parameters.

Some Old and New Facts About the Local Group of Galaxies and the Extragalactic Distance Scale

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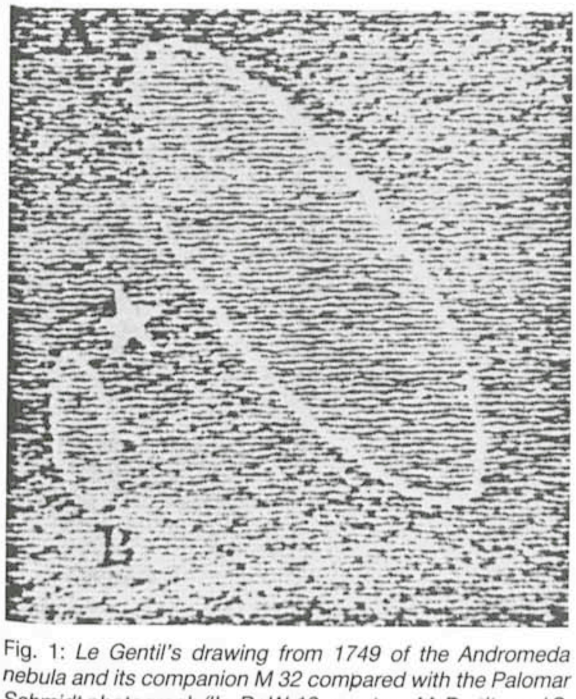
The number of nearby external galaxies known or believed to lie within about 1.5 Mpc of our own Galaxy (an often used value for the size of the local system) is a rather interesting function of time. In Table 1 I have listed all known such galaxies ordered by absolute magnitude, their date of discovery and some modern data. They form what is called—since nearly 60 years now—the *Local Group* (LG). (The information given in the tables is not claimed to be complete. A reader with a flair for detective work may succeed in adding all the missing data. My primary source for the historical data was the book *The Search for the Nebulae* by Kenneth Glyn Jones [1975, Alpha Academic, The Burlington Press, Foxton, Cambridge].) Before the invention of the telescope only three galaxies were known with certainty, out of which only one appeared in old catalogues, namely the Andromeda nebula. In Fig. 1 the drawing of G.-L. Le Gentil is shown together with a modern photograph. This is in fact the first drawing of a nebula in the history of astronomy. The Persian astronomer Al-Sûfi (903–986), who included the nebula in "the girdle of Andromeda" in his star catalogue, may also have known the LMC, which—according to R. H. Wilson (1899, *Star Names and their Meanings,* 1963 reprinted as *Star Names, Their Lore and Meaning,* Dover Publ., New York)—he might have meant with an object called the "white ox" (Al-Bakr). Both Magellanic Clouds were certainly known since the earliest voyages to the southern hemisphere and they are mentioned from 1515 on, when the Italian navigator Andraes Corsali (in 1516) drew a (rather crude) map of the southern sky. In the latest edition of his famous catalogue, Charles Messier in 1781 mentioned 3 members of the LG, but not the Magellanic Clouds and—even stranger—not NGC 205. This latter galaxy (proposed by K. Glyn Jones to be named M 110) was found on the 27th of August 1783 by Caroline Herschel. In a later paper C. Messier claimed to have detected it already in 1773; this claim has later been supported by H.-L. D'Arrest. William (Wilhelm Friedrich) Herschel and his son, John Herschel, who detected most of the nebulae listed later by J. L. E. Dreyer in his *New General Catalogue of Nebulae and Clusters of Stars* (1888, abbreviated as NGC),



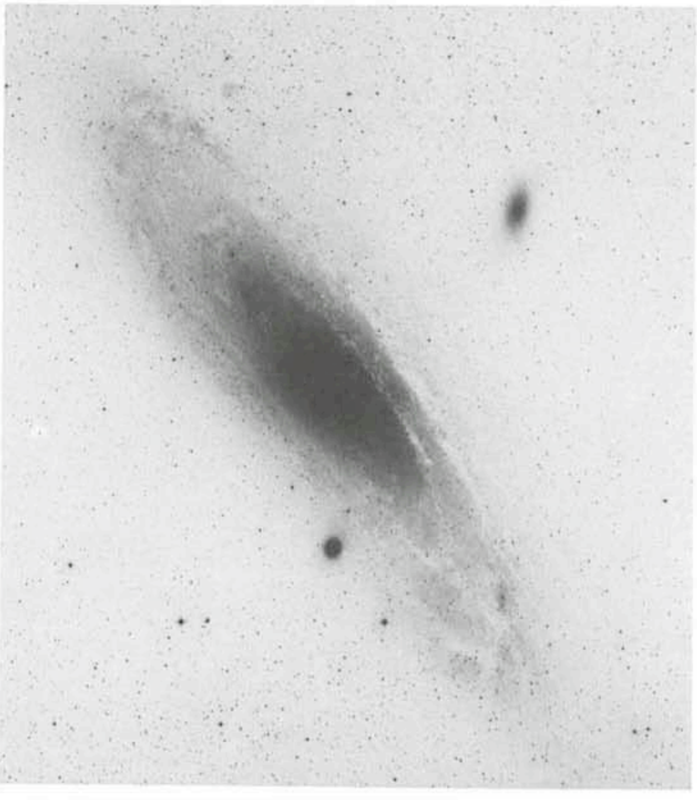


Fig. 1: *Le Gentil's drawing from 1749 of the Andromeda nebula and its companion M 32 compared with the Palomar Schmidt photograph (IIa-D+Wr12, courtesy M. Dopita and S. D'Odorico). The identification of the drawn star is not completely obvious (another supernova?). North is up and east to the left.*