Variable star research at the Konkoly Observatory
The first 75 years

Dedicated to László Detre's memory at the 100th anniversary of his birth

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Introduction

It is now evident that at some level, the light output of stars, including our Sun, varies over different length of time. Little wonder that the investigation of variable stars has a special place in astronomy. Almost all of our knowledge of stellar interior come from the study of pulsating variables. The observed surface luminosity, radius and colour variations probe into the stellar interiors in much the same spirit as in terrestrial seismology. The fact, that the light curve parameters and periods of pulsating stars are closely related to their physical state and are well measurable renders them as excellent calibration objects.

The study of other types of variable stars has also large impact on our knowledge about the physics of stars. The eclipsing variables tell us information about the size and mass of the stars. The observations of variable young objects enlighten the process of birth of stars and draw picture on the interaction between stars and interstellar matter. The cataclysmic variables (dwarf novae and their violent relatives, the novae and supernovae) are clue objects in a number of astrophysical problems. Stellar activity manifests itself in luminosity variability in a broad spectral range from X-ray to radio wavelength. The rapid rotation and the convective atmosphere of the cool-surfaced stars render the operation of dynamo possible, producing a magnetic field that drives spot formation and other phenomena of stellar activity. Spotted stars allow to directly measure the stellar rotation, even the differential rotation.

The start of the systematic study of variable stars goes back to the mid-19th century when F. W. A. Argelander's epoch-making paper was published in Schumacher's Jahrbuch

(1844). At that time only one and a half dozen stars of this type were known. This appeal for observing variable stars incited astronomers all over the world. By the end of the 19th century almost one thousand variables were already known mainly due to the rapid development of the photographic technique.

The light variation caused by eclipses of two stars orbiting each other was easy to explain as it was mainly an optical and mechanical problem. The understanding of the physics of intrinsic variables, however, proved to be more difficult. The pulsation theory was put forward as a hypothesis for discussion by H. Shapley[1] and soon the hypothesis for discussion to the rank of major astrophysical theory by A. S. Eddington[2]. The explanation of light variation of cataclysmic and related objects required more knowledge about energy production of stars and became reality only half a century later.

In the second half of the 19th century the observers in Hungary were rather interested in the objects of the Solar System, the planets and comets, so little wonder that records of star observations made here can hardly be met from this time. The first variable star observations in Hungary were made in 1879 by Friedrich Schwab, a German mechanician who worked for a while in our country[3]. Afterwards, apart from Miklós Konkoly's scarce spectroscopic observations no variable star research of scientific value was carried out in Hungary until the beginning of the 20th century.

Ó-Gyalla, after the nationalization

In 1899 Miklós Konkoly Thege handed over his private observatory at Ó-Gyalla to the Hungarian state. It was, indeed, a mile-stone in the history of the Hungarian astronomy. An institute run by the state had greater possibilities and a more prosperous future.

Konkoly Thege was keenly interested in the bodies of the Solar System, planets, comets, and meteors and was a passionate pioneer of photography and spectroscopy. Soon after the foundation of his private observatory regular sunspot observations had been performed. The change in the status of the observatory, however, necessitated the reconsideration of the scientific program and, in conformity with the scientific attitude of that time, a shifting of stress set in toward the study of the physics of stars. In view of the modest optical instruments available then at Ó-Gyalla, the photometric observation of variable stars was chosen as the principal program (Tass 1904b) but, of course, the traditional work had also been pursued. The 6 and 10 inch refractors of the observatory were used for the photometry. In 1901 and 1902 a wedge photometer manufactured in Töpfer's workshop in Potsdam was put to use for stellar brightness measurements. In order to eliminate the disturbing illumination of the scale of the wedge, its position was registered[4]. Later, from 1902, Zöllner-type photometers were mostly used for brightness measurements. The small Zöllner-type photometer was also acquired from O. Töpfer, in 1903. This photometer was then further developed in the workshop of Ó-Gyalla. Instead of paraffin flame (that was used before) an electric lamp provided the artificial star.

The variable star observations in Ó-Gyalla started on the evening of September 19, 1900. The permanent staff members of the observatory, baron Béla Harkányi, Antal

[1]Astrophys. J., 40, 448, 1914

[2]Mon. Not. RAS, 79, 2 and 177, 1918

[3]P. Brosche & E. Zsoldos: Zwischen Handwerk und Wissenschaft: Friedrich Schwab (1858-1931), in: Beiträge zur Astronomiegeschichte, Acta Historica Astronomiae, 18, 182, 2003

[4]The flash of wit that a device should be used to register the wedge position instead of direct reading came from Jenő Gothard (Zeitschrift für Instrumentenkunde Jg. 1887, S. 347)

Tass and Lajos Terkán took part in the ambitious program. Later Emil Czuczi and Zsigmond Fejes joined forces with the principal observers for a while. Harkányi, Tass, and Terkán selected the program stars very carefully. They consulted with S. C. Chandler's "Third Catalogue of Variable Stars"[5], E. Hartwig's "Ephemeriden veränderlicher Sterne" regularly published in the "Vierteljahrsschrift der Astronomischen Gesellschaft" and E. C. Pickering's list published in a note on "Cooperation in observing variable stars"[6]. Of course, the selection of program stars was confined by the limited efficiency of the modest instruments and the latitude of the observatory.

The unfavorable air conditions in the surrounding of Ó-Gyalla very often made the observations difficult. Three rivers, Zsitva, Nyitra, and Vág met near Ó-Gyalla, and the Danube streamed close to it. Due to the frequent fog it rarely happened that photometric observations could be carried out on some consecutive nights.

Between September 19, 1900 and January 2, 1903, 22 variables such as miras, δ Cephei type stars, eclipsing variables, and a nova were observed on 116 nights with the wedge photometers. During this period 425 observations were collected.

Between April 12, 1903 and November 16, 1908, the Zöllner-photometer was used for the photometry of variables. On the whole 1870 observations were obtained on 372 nights. 129 variable stars, mostly miras, red semi-regular stars, cepheids and eclipsing variables were on the list of observation. After 1908 only sporadic observations (5 nights in 1909, one night in 1910 and 8 nights in 1913) could be made, for the principal observers (A. Tass and L. Terkán) had other task, the photometric survey of the southern sky from 0° to 15° southern declination was undertaken, a continuation and extension of the "Potsdam Durchmusterung" to the South. This program was only partly executed, the visual photometry of all stars of the BD down to the magnitude 7.5 in the zone from 0° to 10° southern declination had been carried out and published (Tass & Terkán 1916).

The variable star observations were published in a series of papers (Tass 1904a, 1904b, 1905b, 1906, 1908a, 1908b, Terkán 1905). While observing the program stars two stars were suspected to be variable. In Cassiopeia, near T Cas, the 8th magnitude star BD+54°49 (=190.1904 Cas) was one of the variable candidates (Tass 1905a, 1905c). J. G. Hagen[7], however, doubted its variability. It is worth mentioning that later the star was identified as Bamberg variable BV328 and classified as an eclipsing variable with a period of 0.602625 day and amplitude of 0.3 magn.[8]. The fact, however, is that neither the Hipparcos photometry nor the NSVS[9] prove the variability of the star with an amplitude larger than 0.03 magn.

Tass had hard luck with his other discovery, too. He noted that the star BD+22°1576 in Gemini, close to the program star R Gem, varied in brightness (Tass 1905d) and it received later the variable star name TW Gem. The observations of C. Payne-Gaposchkin[10], however, gave no indication of variability. R. Prager[11] summarized the behaviour of the M3 III type star as of small range and irregular, if it were variable at all.

On February 21, 1901 $14^{h}40^{m}$ GMT Th.D. Andersson[12] discovered a $2\overset{m}{.}7$ bright new

[5] Astron. J., 16, 145, 1896

[6] Astron. Nachrichten, 154, 405, 1901

[7] Astron. Nachrichten, 168, 11, 1905

[8] W. Strohmeier & R. Knigge, Veröffentl. Bamberg, 5, Nr. 6, 1960; W. Strohmeier, Inf. Bull. Var. Stars, No. 26, 1963

[9] P. R. Wozniak, W. T. Vestrand, C. W. Akerlof et al., Astron J., 127, 2436, 2004

[10] Harvard Ann., 118, No. 15, 1952

[11] Geschichte und Literatur des Lichtwechsels der Veränderlichen Sterne, 1, 109, 1936

[12] Astron. Nachrichten, 154, 363, 1901

star in Perseus. The new bluish-white variable received the provisional name 3.1901 Per and later the official variable star name GK Persei. On February 19, the star was invisible (fainter than 11^{m} magn.) and attained to its maximum brightness of about $0\overset{m}{.}0$ around February 23. The observers at Ó-Gyalla (b. B. Harkányi, A. Tass, and L. Terkán) immediately commenced the observations of the new star on the first clear night (*Fig. 1*). Between February 28 and December 29, 1901 294 brightness measurements were made on 63 nights. The observations had been interrupted only in May and June, when the constellation Perseus was near the Sun, and in September due to technical problems. At the end of 1901 the star's brightness became fainter than 7th magnitude, the attainable limit of the 16 cm refractor with the wedge photometer. Throughout the observations the comparison stars were taken from the Potsdam Durchmusterung (Harkányi 1901a, 1901b, 1903). The Ó-Gyalla observations were in very good agreement with other observers' results indicating the high accuracy of the Ó-Gyalla photometry. The nova, during its descending phase, showed fast light fluctuations with amplitudes of 1-2 magn. This behaviour, first observed in GK Per is a characteristic feature of cataclysmic variables with rapid development. Nova GK Per is one of the best observed novae and the typical representative of its class.

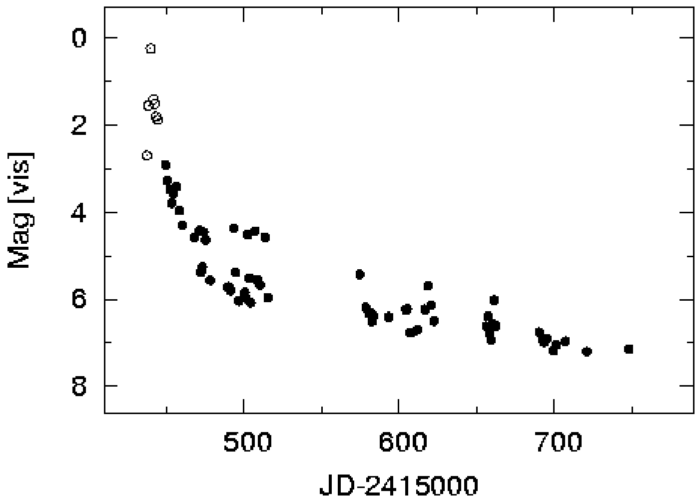

Figure 1: The nightly mean observations of GK Persei (Nova Per 1901) made at the Ógyalla observatory between 1901 February 28 and December 29 (filled circles). The nova, during its descending phase, showed fast, large light fluctuations. The observations of other observers before February 28 are also indicated (open circles).

Tass took part in the observations of another nova, too. Nova Aquilae 3 (=7.1918 Aql) was discovered on June 8, 1918 by L. Courvoisier[13]. The same night F. Schwab[14] estimated its brightness as 1st or 2nd magn. and remarked that is was "in Zunahme", still brightening. It attained the maximum brightness of −0.3 magn. on June 9. Tass (1918) observed the nova on June 14, 15, 16 and made 7 estimates both with the wedge and the Zöllner photometers on the 16 cm refractor. During these three nights the nova had been continuously fading from 0.74 to 2.18 magn.

[13] Astron. Nachrichten, 207, 17, 1918
[14] Astron. Nachrichten, 207, 17, 1918

One hundred years ago the explanation of light variation of stars was certainly known only for the class of eclipsing variables. Little wonder, that the staff of Ó-Gyalla Observatory of Konkoly's Foundation actively took part in the observations of bright eclipsing variables. Terkán (1906a, 1906b) analyzed his photometry of β Lyrae obtained with the Zöllner photometer between July 14 and November 26, 1905 and determined the orbital elements of the system. This kind of investigation proved the applicability of the photometry for solving astrophysical problems, e.g. determining the size and mass of the stars.

At the very beginning of the 20th century, in line with the rapid development in physics (both experimental and theoretical) intensive investigations started around the world in order to get better insight into the problems of radiation and temperature (colour) of stars. At the same time, the use of photographic photometry just entered into astronomical application. This kind of investigations and works also started in Ó-Gyalla (Harkányi 1910, Terkán 1904, 1910). Terkán (1910, 1926) made an attempt at determining the colour and temperature variation of the eclipsing variables β Lyrae and β Persei.

The promising research was interrupted, the World War I broke out and the observatory got into a desperate situation. The comprehensive compilation of the variable star observations obtained at Ó-Gyalla could only be published later (Tass 1925). In consequence of the peace treaties, after the war Ó-Gyalla had belonged to Czechoslovakia, thus the staff left for and most of the instruments were transferred to Budapest. The Royal Hungarian Observatory of Konkoly's foundation found its new home on Svábhegy, a hill near Budapest.

The Start at Budapest-Svábhegy

In spite of the severe condition of the country, the Konkoly's Foundation reviewed in its new home near Budapest on Svábhegy, at an altitude of 470 m. The construction of the main building and domes was completed by 1929. The new 60 cm Newton-Cassegrain reflector was erected in a dome of 10 m diameter. The 20 cm Heyde refractor brought from Ó-Gyalla was housed in a 5 m dome and furnished with a new Graff-type wedge photometer. In 1932, the observation of bright stars using the Zöllner photometer attached to the 15 cm refractor that was also transferred from Ó-Gyalla to Budapest, was finished. Then, this telescope was dismantled and was replaced by a 17 cm Cook refractor from Kiskartal, from the private observatory of the Podmaniczky family. A 16 cm astrograph was fitted out to this telescope on purpose to start photographic photometry.

The scientific programs were essentially the same as those carried out at Ó-Gyalla. So, astrophotometry became the principal activity, with special emphasis on the photometry of variable stars. The regular observation of the Sun and shooting stars was, however, given up.

The visual observations of variable stars were already commenced with the Heyde refractor in 1929 and had been kept up as long as for 7 years, until 1936. Two ambitious astronomers, László Detre and Károly Lassovszky performed the variable star observations. Lassovszky took his doctor's degree at Pázmány University, Budapest in 1920 and then joined the staff of the reviving Konkoly Observatory. During time of the setting up of the observatory, he developed his knowledge at different North American and European astronomical institutes. Detre defended his doctoral dissertation at the Friedrich-Wilhelm University, Berlin in 1929 and, immediately after his returning, he started the research work at the observatory. Lassovszky took interest in eclipsing binaries in the first place, while Detre was keenly interested in pulsating variables. Nevertheless, both of them had either type of variables on their observing list. These years were very productive, a number of papers had been published mostly in the journal Astronomische Nachrichten. Detre and Lassovszky made the visual observations very carefully. Repeatedly, they checked the calibration of the wedge by measuring the stars of the North Polar Sequence or Pleiades. They found that the wedge-constant was not stable from night to night, therefore the sequence "variable + comparison stars" was chosen with great care. The linearity of the wedge, however, remained, which facilitated the reduction of the measurements. The main source of error of the Graff-type wedge photometer was, however, the inequality in the structure of the natural and artificial stellar images. The natural images heavily depended on the air conditions during the night (Lassovszky 1933c, Detre 1934c).

During the seven years, Detre and Lassovszky observed more than thirty stars visually and obtained more than 12000 observations. As mentioned Lassovszky was rather specialized in eclipsing binaries. He made extensive visual observations of four eclipsing variables. KR Cygni (Lassovszky 1936a) was observed on 81 nights and 1225 brightness estimates were obtained, while for AT Pegasi (Lassovszky 1935b) 1060 observations were collected during 59 nights. Similarly, for AB Persei (Lassovszky 1934) 718 visual observations were made on 115 nights, and for SV Tauri (Lassovszky 1938) 1260 observations during 100 nights. AT Peg, AB Per, and SV Tau are Algol type variables, while KR Cyg is of β Lyrae type. Lassovszky made an attempt at deriving the orbital parameters, furthermore the size of these stars. Of course, these results are outdated, but his photometry is still of high value and is used for studying these stars' period changes. In 1931 Lassovszky (1931b) made a short scientific visit to Babelsberg Observatory and measured some variables exposed on Ernostar plates with the 40 cm astrograph, but the observations were scarce to do rigorous investigation. Nevertheless, he discovered a new variable (Lassovszky 1931a,c), that received the preliminary name 381.1931 And, later the final name AP Andromedae. Then he made a series of exposures on Ernostar plates with the 40 cm astrograph and was able to derive the type and the period of the new variable. It proved to be an Algol type eclipsing variable with a period of 1.59 days. The star was, however, too faint for the Heyde refractor at Svábhegy, Budapest, and it could not be observed visually (Lassovszky 1932a).

Detre observed visually only one eclipsing binary, SV Cam (Detre 1932c, 1933b). During 34 nights he obtained 489 visual observations with the Heyde refractor. Some forty years later this star turned out to be a very interesting object. It is not only an eclipsing binary, one of its components is an active, spotted star. The visual observations, as a matter of course, did not reveal this behaviour.

Over and above the eclipsing variables, Detre and Lassovszky had 6 RR Lyrae stars and 8 Cepheids on their list of visual photometry. Detre observed SW Andromedae (Detre 1934c) on 38 nights (550 observations), W Canum Venaticorum (Detre 1935b) during 55 nights (369 observations), RZ Cephei (only the times of light maximum were published, Detre 1931, Balázs & Detre 1938) on 39 nights (590 estimates), XZ Draconis on 20 nights (344 observations) and RU Piscium (Detre 1934a) on 37 nights (472 observations). Of these RR Lyrae stars only short discussions about the period changes were published, since in 1934 Detre and his co-worker, Júlia Balázs decided to carry out a more detailed and thorough investigation of RR Lyrae stars (see next chapter). Here I only mention one result that shows how accurate Detre's visual observations were: several observers[15] thought that W CVn had light curve variations and short period waves were superimposed on the light curve. Detre's data, however, exhibited strictly repetitive character of light variation of the star. Several decades later, J. Tremko[16] investigated this variable and found that the star had stable and smooth light curve.

The visual observations of cepheids provided useful data to study the changes in periods of these stars. Both Detre and Lassovszky took part in the work and they collected 2515 observations for 8 cepheids. The program stars were YZ Aurigae (Detre 1935c, on 121 nights 239 observations), RW Cassiopeiae (Lassovszky 1932b, on 103 nights 520 observations), SZ Cassiopeiae (Detre 1933a, on 100 nights 344 observations), XY Cassiopeiae (Detre 1932a, on 87 nights 325 observations), SZ Cygni (Lassovszky 1933a, on 90 nights 265 observations), VY Cygni (Lassovszky 1933c, on 79 nights 240 observations), Z Lacertae (Lassovszky not published, on 93 nights 309 observations) and RR Lacertae (Lassovszky 1935a, on 92 nights 273 observations). Here only I mention two results. Lassovszky showed that the light curve variation of RW Cas suggested by M. Beyer[17] was not real. The data used by Beyer were inhomogeneous, simply they were obtained by different colour sensitive instruments (Detre & Lassovszky 1939). Detre investigating the behaviour of XY Cas presented arguments in favour of smooth changes in the period of the star rejecting the sudden change as propounded by L.V. Robinson[18].

The accurate visual observations of Detre and Lassovszky proved the constancy of some stars that were supposed to be variable by previous observers. These stars are X Canum Venaticorum (Detre 1932b), TV Cygni (Lassovszky 1933b), TW Geminorum (Detre 1936b), TZ Herculis (Detre & Lassovszky 1934b, Detre 1936b) and UY Herculis (Detre & Lassovszky 1934b, Detre 1936b).

Among the program stars there were several stars classified as semi-regular variables. The visual observations of two of them were published. UZ Aurigae was observed on 146 nights and 350 observations were obtained (Detre 1934b, 1935a). UU Herculis was also intensively observed, on 135 nights 517 estimates were made (Detre & Lassovszky 1934a, Detre 1936b). Some 50 years later this star turned out to be a very interesting object with alternating periods and it has been recognised that this supergiant star is a representative of a new class of variables.

The summary of the visual photometry carried out with the wedge photometer on the 20 cm Heyde refractor of Konkoly Observatory is found in one of the observatory's publications (Detre & Lassovszky 1938).

Károly Móra was associate professor at the Astronomy Department of Pázmány University, Budapest and took active part in the work of the observatory. In the middle of thirties he joined the staff of the observatory and became its director in 1936. He published important papers on R Scuti, an RV Tau-type variable (Móra 1930, 1934). This star's variability was discovered by E. Pigott[19] in 1795 and since that time a great number of observations had been published. Móra collected more than 13000 observations of R Scuti from different sources, from publications and archives, and even unpublished

[15]E. Zinner, Astron. Nachrichten, 190, 379, 1912; ibid 202, 233, 1916; N. Bougoslawski, Astron. Nachrichten, 229, 203, 1927; F. C. Jordan, Allegh. Publ., 7, 1, 1929; L. V. Robinson, Harvard Bull., 876, 1930

[16]Mitteilungen Budapest, No. 67, 1974

[17]Astron. Nachrichten, 252, 85, 1934

[18]L. V. Robinson, Harvard Bull., No. 872, 1930

[19]Philosophical Transactions of the Royal Society, London, p. 133, 1797

data were included through correspondence. In this way, he was able to follow the star's behaviour throughout almost 340 pulsation cycles. Móra's work became significant half a century later when it was recognized that the star's pulsation was determined by low dimensional chaos.

Lassovszky, following the tradition of Ó-Gyalla, observed the bright Nova 605.1936 = CP Lac on 9 nights. The nova was discovered by A. V. Nielsen[20] on June 18, 1936, while on board "Strathaird" as a member of the eclipse-trip in Mediterranean.

The observations of Lassovszky were made on the nights June 20, 21, 22, 23, 25, 27, July 5, 6, and 7, with a Zeiss Petzval-7 cm Astrocamera on Eastman plates. During the two weeks of observation the photographic brightness of the nova dimmed from $2\overset{m}{.}40$ to $5\overset{m}{.}92$ (Lassovszky 1936b,c).

Detre's last visual observations were performed during a scientific visit in München (Detre 1942). Using the 10.5 inch telescope of the Universitäts-Sternwarte, München with a wedge photometer, he studied the brightness difference of binary components. Between the Right Ascensions 15^h and 0^h30^m and Declinations $-8°$ and $+47°$, he measured 173 pairs from the Aitken's catalogue[21] of visual binaries and 37 ones from other sources. On the whole he made 11570 estimates.

The RR Lyrae program

At the end of the 19th century, a great number of short period variable stars were discovered in globular clusters. Soon the first field variable star of this type was also discovered by W. P. Fleming[22] in the constellation Lyra. The star RR Lyrae has become the prototype of the class of variables of this type. The number of discovered RR Lyrae stars grew rapidly. At the beginning of the thirties, the number of known RR Lyrae stars brighter than 12^m was already several dozens.

In 1907 S. Blazhko[23] made an interesting discovery. He found that no constant period could satisfy the times of light maxima of RW Draconis (=87.1906 Dra), an RR Lyrae type star discovered in those days. He had to postulate periodic changes in the fundamental period with a secondary period of 41.6 days. Later Blazhko[24] carried out further studies on RR Lyrae stars and found that XZ Cygni changed its light curve from cycle to cycle with a secondary period of 57.4 days.

The striking changes in the maxima of the light curves of RR Lyrae that turned out to be periodic was first stated by H. Shapley[25] some 90 years ago. He obtained a secondary period of 40 days and an amplitude of 37 minutes for the time oscillation of the median magnitude of the ascending branch. This results were fully confirmed by E. Hertzsprung[26] in 1922.

Apart from the discoveries mentioned above, several observers fancied that other RR Lyrae stars also had irregularities, non-repetitive features, changing light curves, short term or sudden period changes etc. As the observational accuracy left much to be desired,

[20]IAU Circ., No. 594, 1936

[21]R. G. Aitken, New General Catalogue of Double Stars within 120° of the North Pole. 1-2., Carnegie Inst. Washington, 1932

[22]E. C. Pickering, Harvard Circ., No. 54, 1901

[23]Astron. Nachrichten, 175, 325, 1907

[24]Annales de l'Observatorie de Moscou, 2-me série, Vol. VIII. No.2, 1922

[25]Astrophys. J., 43, 217, 1916

[26]Bull. Astron. Netherl., 1, 139, 1922

the observed and published irregularities were often doubtful. L. Detre strongly advised that the visual photometric observations were subject to significant systematic errors that could bring about ostensible light curve variations (Detre 1934c). Likely, the disputable irregularities stimulated Detre to conduct a systematic survey of "short periodic cepheids" and to scrutinize these objects. At that time, all pulsating stars with periods shorter than one day were called short period cepheids and no distinction was drawn between δ Scuti and RR Lyrae type stars. The very short periodic pulsating stars with period less than a quarter of a day, nowadays called HADS and SX Phe type stars also captivated Detre's interest.

In the thirties, the photographic photometry was the most simple technique that provided accurate observations exempt from systematic personal errors and could be carried out in small institutes with modest instruments. Therefore, Detre and his associate, Júlia Balázs (his wife to be) decided to execute a comprehensive photographic observing program of RR Lyrae stars. An astrograph fitted out with a photographic doublet of Zeiss (16 cm diameter, f/14) and a Rosenberg type micro-photometer were at their disposal. They tested different kinds of emulsions, measured the limiting magnitude at different exposure times and the field correction by measuring a number of stars in Selected Areas, North Polar Sequence, Pleiades and Coma Berenices. Their experience was that under favorable conditions $0\overset{m}{.}01$-$0\overset{m}{.}02$ accuracy could be achieved, an accuracy that certainly hit the target set by themselves. The program and the results in general were described in several papers (e.g. Balázs 1963, Balázs & Detre 1961b, Detre 1957, 1960, 1965a, 1966a, 1967, 1970a, 1973).

The first variable photographed was XZ Cygni on July 20, 1934 and the last one VZ Herculis on July 8, 1958. During 24 years more than 50 variables were observed and about 60000 exposures were made on more than 3800 photographic plates. The exposition times were chosen between 30 sec and 5 min depending on the brightness of the stars. Several fellows, such as Imre Csada, Loránt Dezső, István Földes, István Guman, Tibor Kolbenheyer, and others joined forces with J. Balázs and L. Detre for a short while.

Detre always made great efforts to improve the accuracy of observations. During the General Assembly of IAU held in Zürich, in 1948, he received an 1P21 photoelectric multiplier tube from H. Shapley as a present. The experiments with this tube were started in December 1, 1949 (*Fig. 2*). The photometer was attached to the 60 cm telescope at its Newtonian focus. The measurements revealed some defects of the equipment, the stability and linearity of the amplifier were not always granted. The troubles with the electronics seemed insolvable since during the post-war and cold war time good-quality electronic parts were not to be had in Hungary. In the long run, Th. Walraven helped to overcome the difficulties. He gave an amplifier to the observatory constructed by himself. Then the photoelectric photometry of variable stars had been carried out unbroken until the eighties, when the reconstruction of the telescope and dome was started. The 60 cm mirror of the telescope was first aluminized in 1962 and afterwards, the three-colour (UBV) observations were routinish running. Later, on the mountain station of the observatory a 50 cm Cassegrain telescope was put into operation. The photometer to this telescope was constructed at the observatory's workshop by Géza Virághalmy.

In the photoelectric observations almost all staff members of the observatory took part. The list of program stars of the photoelectric photometry was essentially the same as was chosen for photographic photometry in 1934.

In the course of observations, it promptly turned out that a variable was misclassified as an RR Lyrae star, or in reality, it was an eclipsing or a variable of an other type or a

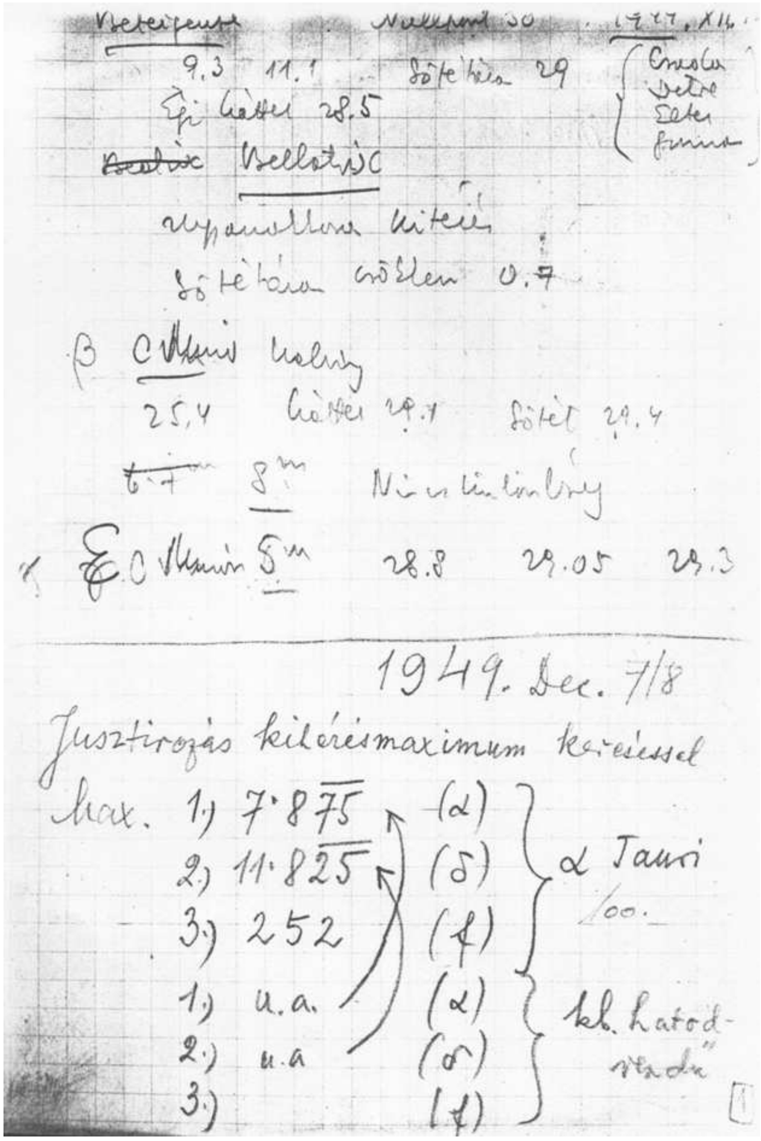

Figure 2: The start of the photoelectric observations at the Konkoly Observatory: First page of the log-book.

non-variable star. In this case, the observations and analysis had been published and the object was crossed out of the program.

The first object that was scrutinized within the scope of the RR Lyrae program was AV Pegasi. 217 observations were obtained during five nights in 1935 and neither light curve variations nor short term period changes were detected (Balázs 1935).

In the pulsation of VZ Herculis secular period change and light curve modulation were found by N. F. Florja[27]. In order to investigate the reality of these findings, 335 exposures of this star were made on 12 nights in 1935. Júlia Balázs' result contrasted with that of Florja. She found no modulation in the light curves of the star. The height of light maxima was constant within the accuracy of photographic observation (Balázs 1936a).

The variability of RR Leonis was discovered in 1907. During the subsequent 30 years, a great number of both visual and photographic observations of the star were obtained. The

[27]Leningrad Bull., 4, 1934

different observers[28] gave dissimilar light curve's amplitudes, and some of them referred to short term period changes. At the Konkoly Observatory 247 photographic observations of this star were secured during six nights in 1936. The investigation of the data unambiguously showed that RR Leo was a single periodic RR Lyrae star and its period was subject to only very slow secular change (Balázs 1937a).

BH Pegasi was also thought to be an RR Lyrae star with variable light curve by F. Lause[29]. In order to investigate the possible modulation of the light variation 249 observations with 3-5 minute exposures were obtained on 16 nights in the years 1934-1936. The results clearly refuted Lause's suggestion, BH Peg had a stable light curve. There was a very strong long lasting hump on the rising branch, probable this feature deceived the visual observers (Balázs 1937b).

DH Pegasi was observed on six nights in 1935 and 465 photographic observations were obtained. The star is of RRc type and has a stable character (Balázs 1937c).

The behaviour of AA Aquilae was also questionable. Both K. Bohlin[30] and N. Ivanov[31], based on their visual observations stated that this RR Lyrae star had strong light curve variations. As the inference drawn from visual photometry was many times not real, photographic photometry of the star was carried out at the Konkoly Observatory on 14 nights in the years 1935-1936. In all, 211 observations were obtained and six light maxima were well measured. The heights of light maxima were constant within the errors of photographic photometry. Neither light curve variations nor noticeable period changes were found (Balázs 1938).

In order to study the very short period pulsating variable RV Arietis, a number of photographic observations were made. One of the stars used as comparison proved to be variable in brightness. The new variable 624.1936Ari discovered by Detre received the final name RW Ari, a typical RRc star with a period of 0.3543 day (Detre 1937a, 1937b).

RU Piscium is also an RRc type star. There were hints in the literature on the unusual period behaviour of the star. Between 1936-1942, on the whole, 759 photographic observations were made and analyzed by Loránt Dezső (1945, 1949). He did not find any modulation in the light curve, only the period of RU Psc varied slowly. He suspected that this variation was periodic (with a period of three years and an amplitude of 0.0002 day). Later on, J. Tremko[32] pointed out that the variation in period of the star was more complicated and the existence of light curve modulation with a secondary period of 28.8 days was possible.

Although the variability of VZ Pegasi was discovered in 1921, and was considered as an eclipsing variable, only in the fifties S. Kato[33] suspected that the variable was in truth, an RR Lyrae star. To be sure of its real character, it was ranged among the RR Lyrae program stars. Photoelectric observations of three nights revealed that the star belonged to the homogeneous group of RRc type variables showing no sign of light curve variation (Barlai & Szeidl 1965).

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[28] C. Martin & H. C. Plummer, Mon. Not. RAS, 81, 458, 1921
F. C. Jordan, Allegh. Publ., 7, 34, 1929
P. Th. Oosterhoff, Bull. Astron. Netherl. 6. 39, 1930
L. V. Robinson, Harvard Bull. No. 867, 1930
L. B. Allen & F. F. Marsh, Harvard Bull. No. 888, 1932

[29] Astron. Nachrichten, 245, 333, 1932; ibid 249, 380, 1933

[30] Astron. Nachrichten, 221, 195, 1923; ibid 224, 403, 1925

[31] Astron. Nachrichten, 223, 287, 1924; ibid 228, 143, 1926

[32] Mitteilungen Budapest, No. 55, 1964

[33] Tokyo Astronomical Bull., Ser. II, No. 110, 1958

From his visual observations A. A. Batyrev[34] came to the conclusion that the RRab star AN Serpentis had strong light curve variation with a period of 22.94 days. On the one hand, this result was uncertain because of the large scatter of the visual observations, on the other hand, the short modulation period, if true, would make AN Ser an interesting object. Therefore, the photoelectric observations of the star were commenced at the Konkoly Observatory in 1967. Between 1967 and 1971 some 980 observations were obtained during 17 nights (Szeidl 1968b, Kanyó & Szeidl 1974). The results were disappointing, AN Ser was a single periodic RRab star.

AT Andromedae represented a similar case. O. V. Tchumak[35] stated that this star had strong light curve variation with a secondary period of 82.75 days. More than 1300 photoelectric observations were obtained at the Konkoly Observatory during 18 nights in 1974 and 1975 but no light curve variation was detected (Oláh 1974).

Those objects are also worth mentioning, which were erroneously classified as RR Lyrae stars and the Konkoly observations revealed their true nature.

The variability of WZ Cephei was discovered and mistakenly classified as an RRc star by H. Schneller[36]. Júlia Balázs obtained 206 photographic observations on eight nights in 1935 and showed that the star was, in fact, a W UMa type eclipsing binary (Balázs 1936c). L. Detre supplemented J. Balázs data with 208 measurements (five nights in 1939-1940) and analyzed the light curve and derived the system parameters (Detre 1940).

WY Tauri was also classified as an RR Lyrae star by A. S. Williams[37], the discoverer of the star's variability. Therefore, the variable was included in the list of program stars. From some nights' observations it was clear that the star was not of RR Lyrae type but a β Lyrae type eclipsing variable (Balázs 1936b). In order to analyze the light variation, additional observations were made (altogether 403 measurements on 16 nights during the years 1935, 1936, 1937 and 1939) and the period and light curve parameters, furthermore the system constants have been determined (Balázs & Detre 1940).

The classification of ZZ Persei was also questionable. K. Nakamura[38] suspected RR Lyrae, while V. M. Bodokia[39] suggested β Lyrae type light variations. 60 photographic observations were obtained in 1935 which did not show any noticeable variations within the error of measurements (about $0\overset{m}{.}02$-$0\overset{m}{.}03$), so the star could be regarded as constant (Lovas 1952).

A. G. Lange[40] suggested that AV Vulpeculae was an RR Lyrae star resembling AC Andromedae. 489 observations were obtained and the star proved to be a long period irregular variable (Guman 1952).

The Second Edition of GCVS (1958) classified both AT Herculis and BP Vulpeculae as RR Lyrae variables. AT Her was observed photoelectrically on 9 nights in 1960 but no light variation was detected. According to the spectrum, the star is of K0 V spectral type and is certainly not an RR Lyrae variable. The variability is questionable at all (Illés 1963). The photoelectric photometry of BP Vul was carried out during 11 nights in September and October 1959. It turned out that it is, in reality, an Algol type eclipsing binary (Illés 1960).

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[34] Peremennye Zvezdy, 12, 137, 1957; ibid 15, 278, 1964
[35] Peremennye Zvezdy, 15, 569, 1965
[36] Astron. Nachrichten, 233, 41, 1928
[37] Mon. Not. RAS, 87, 172, 1926
[38] Kyoto Bull., 8, 10, 1922
[39] Abastumani Bull., 1, 1937
[40] Astron. Tsirk., No. 20, 1943

A summary of the photometry of RR Lyrae stars made at the Konkoly Observatory until 1956 was presented by Detre at the Variable Star Colloquium held in Budapest, 23-28 August, 1956 (Detre 1957). Likewise, Detre gave a review on the photoelectric observations of RR Lyrae stars with stable light curve carried out at the Konkoly Observatory at the first Bamberg Variable Star Colloquium (Detre 1960). Here, he gave an account of an interesting connection between the length of the stillstand on the rising branch and the amplitude of RR Lyrae stars.

At first, the photoelectric observations were made only in two colours, then from the beginning of the sixties in three colours. These observations made the investigation of the position of RR Lyrae stars in the colour-colour and colour-magnitude diagrams possible. Such an investigation was made for the variables of ω Centauri based on photographic photometry (Geyer & Szeidl 1965, 1970).

The Blazhko effect

Since S. Blazhko was the very first to notice the periodic oscillation in the phase of light maximum of an RR Lyrae star (namely of RW Draconis) we refer to this periodic variation as Blazhko effect. Later H. Shapley demonstrated that the phase oscillation was accompanied by the periodic variation in the shape of the light curve and in the height of maxima with the same period in RR Lyrae.

In truth, the investigation of the amplitude and phase modulation of RR Lyrae stars, the Blazhko effect, has brought in the international reputation of the Konkoly Observatory. The results of these investigations have been published in a series of papers.

The planned research and the preliminary list of program stars were described in one of the first publications (Balázs & Detre 1938). The first program star to be studied in detail, was RW Draconis. During 143 nights in the years 1936-1938, 1941, 1942, 1944, 1945, 1947-1952 taken as a whole, 7210 photographic observations were obtained at the Konkoly Observatory. The old visual observations from 1907 made the investigation of long term variations in both the fundamental and the Blazhko period possible. The changes in the characteristics of Blazhko effect could also be studied. The amplitudes of both the phase and the amplitude modulation were the largest in 1937, 0.085 day $\approx$ 2 hours and $1\overset{\mathrm{m}}{.}0$, respectively. The amplitudes of modulation were much smaller after 1937, e.g. in 1941, 0.04 day $\approx$ 1 hour and 0.5 magn., respectively. The striking change in the effect had to take place around 1938-1939, but that time no observations of the star were made at the Konkoly Observatory. Fortunately, observations of RW Dra were obtained at the Leiden Observatory in 1938. These unpublished observations were placed at J. Balázs and Detre's disposal and it became clear that the sudden decrease in the effect took place in 1938 (*Fig. 3*).

Making use of unpublished photoelectric observations, the changes in both the main and secondary periods could be investigated for a time span of 60 years. The very strong change in the amplitude of the effect in 1938 was accompanied by a very large sudden change in both periods. These variations were anticorrelated, the O$-$C diagrams were mirror images to each other.

The photographic observations obtained at the Konkoly Observatory also made the detection of a small amplitude 120 day period (almost three times of the conspicuous 41.6 day Blazhko period) possible. This longer period variation clearly came in sight when the Blazhko effect was stronger than average. The investigation of the long term variation in the phase modulation revealed a 7.4 year period, that could be barely noticed in the O−C diagrams of the pulsation and Blazhko periods (Balázs 1957, Balázs, & Detre 1938, 1952, 1962).

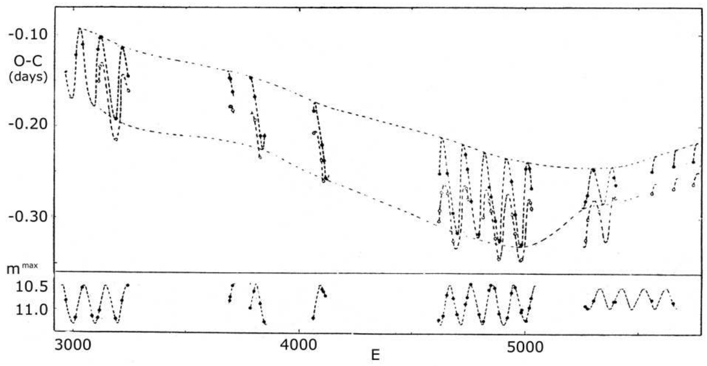

Figure 3: Sudden change in the Blazhko effect of RW Draconis in 1939 (after J. Balázs 1957).

The RR Lyrae stars with light curve modulation were usually observed only in a very limited phase interval of the pulsation period, during minimum, ascending branch and maximum light. J. Balázs and Detre carried out a comprehensive study of the Blazhko star AR Herculis: they covered the whole pulsation cycles at different phases of the secondary period, so thus they were able to construct the so-called light surfaces, the light curves at different fixed Blazhko phases. (More exactly, they gave the $m(\Phi, \Psi)$ brightness of the star in tabulated form, where Φ is the phase of the pulsation and Ψ is the phase of the modulation.) In this way, the study of the Blazhko effect on the whole pulsation cycle became possible. These results aroused the interest of variable star researchers, even Leon Campbell and Luigi Jacchia spent one page expounding these results in their well-known book The Story of Variable Stars (The Harvard Books on Astronomy, eds.: H. Shapley and B. J. Bok, 1941).

The phase modulation of light maximum of the 0.470 day period RR Lyrae star, AR Herculis was first noted by S. Blazhko[41], but apart from the scarce, mostly visual observations no serious investigation was devoted to the star before 1935. This is why J. Balázs and Detre decided to study it intensively. The photographic observations based on their investigation were made during 81 nights between 1935 and 1939. In all, 3363 observations were obtained and scrutinized.

The amplitude of the light variation varied between 0.90 and 1.77 photographic magnitudes during the 31.5 day Blazhko cycle, while the amplitude of the time oscillation of light maximum was 0.06 day ≈ one hour and a half (*Fig. 4*). During the modulation cycle the brightness of maximum was nearly the least when the momentary pulsation period was the longest (Balázs & Detre 1939).

Twenty years later Iván Almár repeated the investigation of AR Herculis on new extended photographic and photoelectric data sets. During the years 1946, 1948-1953, 1955-1957, 3511 photographic observations were obtained during 117 nights and, in the years 1958 and 1960, 1141 photoelectric measurements were made. These new data revealed that a 90.8 day period was also present (2.87 times longer than the 31.5 day Blazhko

[41]Leningrad Eph. of short period Ceph., 1932

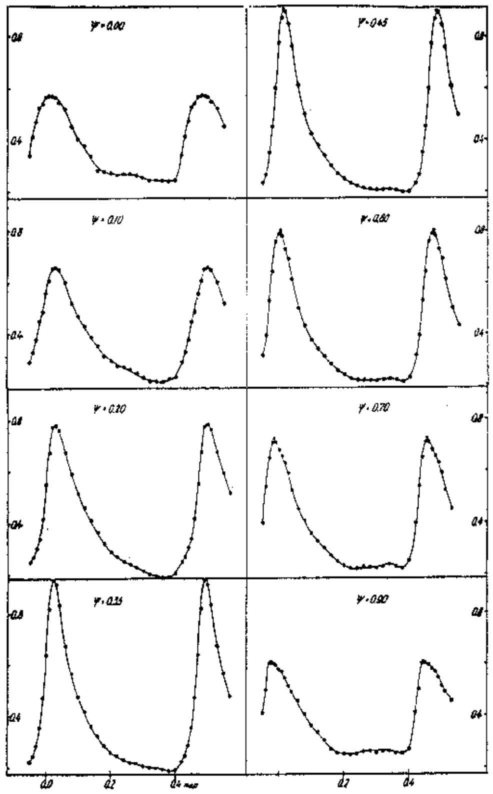

Figure 4: Light curves (light surfaces) of AR Herculis at different Blazhko phases (after Balázs & Detre 1939).

period). A comparison with the previous studies showed that in spite of the strong variations in the Blazhko effect during the decades the brightness of the brightest maximum in the modulation cycle practically had not changed and the form of the relation between the brightness and phase oscillation of light maximum was essentially the same for the different observing seasons. The amplitudes of the brightness and the phase oscillation of light maxima were subject to strong long term variations and between these variations no connection was found.

The new photometry and the published data made the investigation of the secular changes in both the fundamental and the modulation periods possible. Both of them exhibited perceptible changes: the pulsation period changed rather irregularly, the O−C diagram of the Blazhko period resembled a sine-like curve. Between the changes of the two periods no connection could be revealed (Almár 1961).

One of the most favorite Blazhko stars at the Konkoly Observatory was RR Lyrae itself. During the decades a large amount of observations of RR Lyr had been obtained by different observers at different sites, but the results were contradictory. H. Shapley[42] found a 40 days long modulation period, while A. de Sitter[43] gave a value of 38.21 days for it. T. E. Sterne[44] hinted at the possibility that de Sitter's result was affected by the selection of data. In order to clear up the matter in dispute, the star was intensively observed at the

[42]see footnote 25
[43]Bull. Astron. Inst., 6, 215, 1932
[44]Harvard Circ., No. 387, 1934

Konkoly Observatory. During 27 nights in the years 1935, 1938, 1939, and 1941 as a whole, 6512 photographic observations were made. Their own observations and several thousand data (mostly photographic) published by 18 observers were reanalyzed. It became evident that in 1899 (at the discovery of the variability of RR Lyr) the modulation period was around 40.5 days and increased to 41 days up to 1943. During that time interval the pulsation period showed irregular changes. The amplitudes of oscillation in times and heights of maxima were fairly large around the end of the thirties: 0.055 day ≈ one hour and 20 minutes and 0.33 photographic magnitude (Detre 1943, Balázs, & Detre 1943, 1962).

The light curve variation of RW Cancri was discovered by S. Blazhko[45] in 1922 and he derived a modulation period of 87 days. The variable was also ranged among the program stars of J. Balázs and Detre. In the years 1938-1940 and 1950, 1210 photographic observations were collected at the Konkoly Observatory during 44 nights and 40 light maxima were observed. In the course of the analysis of the data RW Cnc proved to be one of the most interesting Blazhko stars. During the Blazhko cycle the brightness of light maxima changed between $10^{\mathrm{m}}_{\cdot}74$ and $11^{\mathrm{m}}_{\cdot}80$, while that of the minimum between $12^{\mathrm{m}}_{\cdot}55$ and $12^{\mathrm{m}}_{\cdot}34$. The highest maximum was always preceded by the deepest minimum, so thus the extreme values of amplitude of the light variation were 1.81 and 0.54 photographic magnitude. Such a large amplitude variation had never been observed previously in any other Blazhko star. Two modulation periods were present $P_{B1} = 29.9$ days and $P_{B2} = 91.1$ days, that were increasing. The fundamental period showed both increasing secular and cyclic variations with a suspected 25 year cycle length (Balázs & Detre 1950).

One of the most puzzling Blazhko stars is SW Andromedae. H. Shapley[46] stated that strong light curve variations were present, but no other visual observer mentioned it. Detre's visual observations showed $0^{\mathrm{m}}_{\cdot}07$ scatter in light maximum, that proved if Blazhko effect had existed in the star at all, it diminished to below the detectable limit. In order to reveal the real behaviour of the star 915 photographic observations were made on 23 nights in the years 1936, 1937, 1941, 1942, 1951 and 1952. These observations, however, could only be used to study the changes in the fundamental period, the accuracy of the photographic observations did not allow tracing the light curve variation. The pulsation period was steadily decreasing with a rate of 2 seconds in a century. The earlier assumption of an abrupt change in the period could not be confirmed.

In 1950 and 1953, 864 additional photoelectric observations were obtained on 22 nights. It was noticed that the length of the stillstand on the rising branch of SW And was changing with a period of 36.83 days, while the height of maximum varied $0^{\mathrm{m}}_{\cdot}03$ at the very most. This kind of light curve variation of SW And probably represents a specific type of Blazhko effect (Balázs & Detre 1954).

All the previous visual and photographic observers indicated that RV Ursae Majoris showed well-perceptible strong light curve variations, but were unable to establish the regularity of these variations.

In the years 1936, 1937, 1946-1952, 1229 photographic observations were obtained during 27 nights. From 1955 May to 1957 July RV UMa was observed photoelectrically on 35 nights and 1008 data were collected. The considerable part of the photoelectric observations were made in 1957, in all, 21 maxima were observed in that year, so thus the modulation period could easily be determined. The variable exhibited strong amplitude

[45] Astron. Nachrichten, 216, 103, 1922
[46] Mon. Not. RAS, 81, 209, 1921

modulation, while the phase modulation of maximum was rather small. The variations could accurately be described by the combination of the 0.4680 day fundamental period with a secondary period of 90.1 days. The same periods were apparent in the earlier visual and photographic observations. Having used all the published observations, the O−C diagrams for both periods could be constructed. These diagrams contain cycles of the same length, but of opposite phase (Balázs & Detre 1957).

The investigation of RV Ursae Majoris proceeded at the Konkoly Observatory after 1957. In the years 1958, 1959, 1961-1965, 1968, and 1969, 5966 photoelectric observations (2378 in V, 2627 in B, and 961 in U band) were obtained on 150 nights.

As for the period changes the previous results were confirmed on a longer time base, the O−C diagrams of the pulsation and modulation periods run opposite in phase. During the Blazhko cycle there was no significant change in light curve in the phase interval 0.35-0.55. It was, however, a rather surprising discovery that, around phase 0.94, there was a point on the ascending branch that did not show any significant oscillation either (Kanyó 1976a).

Y Leonis Minoris was a known Blazhko variable. D. J. Martynov[47] derived its modulation period as $P_B = 33.4$ days. As the successive Blazhko cycles differed from each other both in shape and length, J. Balázs decided to reanalyze the published data, and came to the conclusion that the star had a second modulation period of 82.2 days, with a smaller amplitude ($0\overset{m}{.}25$) and phase (0.016 day) modulation. The pulsation period was increasing and also showed a cyclic variation with a period of 7.7 years (Balázs 1955).

The search for light curve modulated RR Lyrae stars and determination of the accurate Blazhko periods were also an important part of the program.

M. Beyer[48], from his visual observations, suspected that XZ Draconis had light curve variation. Its photographic observation was commenced by J. Balázs in 1936. Using some observations obtained up to 1940, the Blazhko period turned out to be 76 days (Balázs & Detre 1941). The star has been kept observing photographically and photoelectrically later on.

V. P. Tsessevich[49] observed strong light curve variation in the RR Lyrae star DL Herculis and gave the modulation period as 49.1 days. Some 750 photoelectric observations were made of this star at the Konkoly Observatory on more than ten nights in 1963 and it turned out that the real value of the Blazhko period was 33.6 days. The modulation amplitude of the phase and height of light maximum were more than 0.02 day ≈ half an hour and about $0\overset{m}{.}3$ in blue light, respectively (Szeidl 1963).

The earlier photographic observations made at the Konkoly Observatory indicated that Z Canum Venaticorum had Blazhko effect. The star was photoelectrically measured at the observatory in 1964 and almost 500 observations were made on 12 nights. From the analysis of these data the Blazhko period proved to be 22.75 days, a surprisingly short secondary period for a star with a fairly long, 0.6538 day pulsation period. The height of the light maximum varied $0\overset{m}{.}45$ in B and $0\overset{m}{.}38$ in V during the modulation cycle, while the amplitude of the phase oscillation of maximum was 0.04 day ≈ one hour (Kanyó 1966).

AR Serpentis was investigated by V. P. Tsessevich[50] who gave the element of its light variation and found strong fluctuation in the period, suggesting the presence of the Blazhko effect. In 1967, some 960 photoelectric observations were obtained in blue and

[47] Engelhardt Obs. Bull., 18, 1940
[48] Astron. Nachrichten, 252, 85, 1934
[49] Odessa Isv., 3, 257, 1953
[50] Astron. Tsirk., No. 353, 3, 1966

yellow lights on 15 nights and a Blazhko period of about 105 days could be derived. The star possessed extremely strong light curve variation, the amplitude of the phase oscillation of maximum exceeded 0.12 day ≈ three hours, while the light amplitudes varied between $0\overset{m}{.}41$ and $1\overset{m}{.}09$ in V and $0\overset{m}{.}49$ and $1\overset{m}{.}32$ in B light (Szeidl 1967).

W. S. Fitch, W. Z. Wisniewski, and H. L. Johnson[51] observed a large sample of RR Lyrae star, among them TT Cancri as well. The observed light maxima differed from each other indicating that TT Cnc was a Blazhko star. From 1967 December up to 1968 April 1080 photoelectric observations were obtained in UBV colours. During this time interval 13 light maxima were observed. The modulation period turned out to be 89 days. The amplitudes of phase modulation of maximum light was 0.035 day ≈ 50 minutes and of the variations in height of light maxima were $0\overset{m}{.}30$ in V and $0\overset{m}{.}35$ in B light, respectively (Szeidl 1968a).

Inspired by a notice of L. J. Robinson[52] on a possible Blazhko effect in the light variation of SZ Hydrae, photoelectric observations were commenced by S. Kanyó at Catania Observatory during a scientific visit in order to determine the length of its secondary period. Although only four maxima could be observed, their favorable distribution in phase enabled the determination of the secondary period: $P_b = 25.8$ days (Kanyó 1970).

All the studies on Blazhko effect were focused on RRab stars. It was a question if RRc stars could also possess the effect. Detre observed TV Bootis, an RRc star, photoelectrically on several nights in 1955 and found that this star also showed light curve variation with a period of 33.5 days (Detre 1965b).

The globular clusters usually contain great number of RR Lyrae stars (e.g. Messier 3 contains over 200), therefore, their study is particularly suitable for determining statistical properties of Blazhko variables. It was concluded from the study of the variables in M3 that about 25-30% of the RRab stars showed the effect. A statistics of field RRab stars led a (less reliable) frequency of 15% (Szeidl 1965, 1973, 1976). As to the Blazhko stars in M3, another interesting observation was that for stars exhibiting variable light curves, the largest modulation amplitudes fitted the period-amplitude diagram valid for RRab stars with single period (Szeidl 1965). A definite negative correlation was found between the noise of pulsation period and the length of the Blazhko period (Kanyó 1976b).

During the years considerable knowledge accumulated at the Konkoly Observatory on the RR Lyrae stars with Blazhko effect. From time to time, it was summarized and published in review papers (Detre 1954, 1956a, 1957, 1962a, Szeidl 1976). In one of the reviews, Detre made an interesting observation. He arranged H. W. Babcock's[53] measures of the magnetic field intensity of RR Lyrae according to the phases of the pulsation and the Blazhko period. There was no correlation with the pulsation period, but a separation of positive and negative values was apparent in the course of the 41 day secondary period. Brightest maxima coincided with the largest negative, lowest maxima with the largest positive values of field intensity. As the number of the magnetic observations was small, the correlation could not be considered definitive (Detre 1962a).

Júlia Balázs propounded the oblique pulsator model as an explanation for Blazhko effect almost fifty years ago (Balázs 1960). If the magnetic axis inclines to the rotation axis of the pulsating star, then, depending on the geometry and the strength of the magnetic field, the Blazhko effect may have a natural explanation. If this hypothesis holds, then the Blazhko period equals to the rotation period. During the years, competitive theories

[51] Commun. Lunar and Planetary Lab., No. 71, Vol. 5, Part 2, 1966
[52] Peremennye Zvezdy, 16, 62, 1966
[53] Astrophys. J. Suppl., 3, 141, 1958

have been advanced but we still lack for understanding of the Blazhko effect.

The situation became more complicated, when the 4-year cycle of RR Lyrae was discovered. After discussing and publishing their early photographic observations of RR Lyrae (Balázs & Detre 1943) its observation was kept on photographically, then photoelectrically from 1950. It seemed that the intensity of Blazhko effect had irregularly changed during the years. Detre wanted to mention it as an example for non-periodic effects in his introductory talk at the IAU Colloquium "Non-periodic Phenomena in Variable Stars" (Detre 1969c).

While preparing the figure of phase and amplitude modulation of RR Lyrae for different years by the author of the present review at Detre's request, it became conspicuous that the effect almost disappeared in the years 1963 and 1967, suggesting that the Blazhko effect might have a 4-year cycle. A very intensive observation of the star was started in 1969 and the transition between the new and old cycles was observed in 1971. At the end of the old 4-year cycle the phase variations during the 41-day Blazhko cycle died down almost completely and then, the new cycle started with a rapid increase of the amplitude. The amplitude of the maximum-variations was only $0\overset{m}{.}07$ at the end of the old cycle, and then very rapidly became as large as $0\overset{m}{.}16$ during 1971 and increased to $0\overset{m}{.}27$ in 1972. The beginning of the new cycle was accompanied by a phase shift of 10 days, about a quarter in the phase of the 41-day Blazhko cycle (*Fig. 5*).

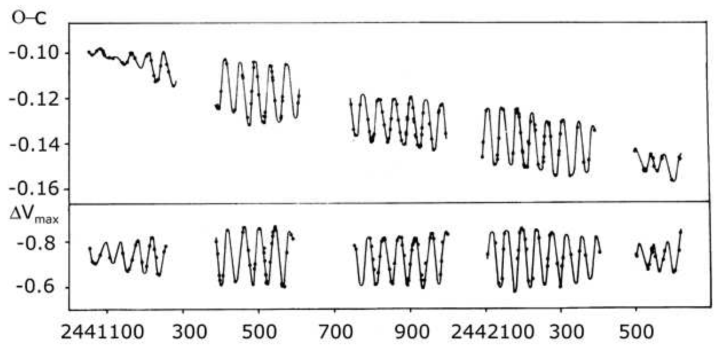

Figure 5: A whole 4-year cycle of RR Lyrae (after Szeidl 1976).

The Konkoly Observatory had almost forty thousand unpublished observations of RR Lyrae in 1972. Supplemented by others' photoelectric observations (1947: Th. Walraven[54], 1953: R. H. Hardie[55], 1955: P. Broglia & A. Masani[56], 1958-1959: G. Cocito & A. Masani[57], 1961-1962: B. Onderlicka & M. Vetesnik[58], 1962-1964: G. W. Preston, J. Smak, & B. Paczynski[59]) the 4-year (more exactly 4.3-year) cycle could be traced back to 1944 (Detre & Szeidl 1973a,b).

These results were fully confirmed by new observations, the transition from the old to the new cycle was also observed in 1975, and the phase discontinuity in the 41-day period was again about 10 days (Szeidl 1976).

[54]Bull. Astron. Netherl., 11, 17, 1949
[55]Astrophys. J., 122, 256, 1955
[56]Contr. Oss. Astr. Milano-Merate, Nuova Serie, No. 105, 1957
[57]Contr. Oss. Astr. Torino, Nuova Serie, No. 27, 1960
[58]Astron. Inst. Univ. Brno (Czechoslovakia) Publ., No. 8, 1968
[59]Astrophys. J. Suppl., 12, 99, 1965

The identification of the 4-year cycle with magnetic cycle was very tempting and later it become the subject of heated debate.

Period Changes

W. Ch. Martin's[60] discovery, that the periods of the RR Lyrae stars in ω Centauri are predominately increasing, aroused the variable star astronomers' interest. Well it was thought that the O−C diagrams were simply accumulated evolutionary changes in the periods. Little wonder, then that the deviations of the epoch of variable stars from the linear elements were represented by second order equations, where the coefficients of the second order terms were supposed to describe the progressive changes in the periods. It was hoped that these coefficients would give some informations on the rate and direction of evolution of horizontal branch stars through the instability strip and would provide a strong test of the theory of stellar evolution. The study of RR Lyrae stars in globular clusters seemed to be particularly promising: at the same time, the period changes of a large sample of homogeneous group of RR Lyre stars could be investigated.

In 1937 L. Detre commenced the study of RR Lyrae stars of globular clusters M3 and M15 at the Konkoly Observatory. Later M. Lovas started the observation of RR Lyrae stars in M5 in 1951, and M56 and M92 were also included into the program. During the years 1937-1966 more than one thousand photographic plates were made on these clusters with the 60 cm Newton telescope. The plates were taken by Júlia Balázs, Katalin Barlai, L. Detre, G. Kulin, M. Lovas, I. Ozsváth, and B. Szeidl.

I. Izsák started investigating the period changes of the RR Lyrae stars in M15. The preliminary results were presented in the 1956 Budapest variable star conference (Izsák 1957). In the course of this study three new variable stars were discovered in M15 (Izsák 1952).

Between 1937-1951 115 plates of M56 were taken with 20 minutes exposure time. Júlia Balázs started analyzing the variables in this cluster. Comparing eight pairs of plates, she discovered two new variables (Balázs 1952a).

The study of period changes of RR Lyrae stars in M3 was started by I. Ozsváth. A short account on the preliminary results was given also at the 1956 variable star meeting (Ozsváth 1957).

For the final investigation of the variables of M3, 214 plates obtained at Budapest and 17 plates supplied by the Hamburg Observatory were used. 121 variables were measured with the microphotometers of the Konkoly Observatory and 13 variables (that could not be measured owing to crowding effect) were estimated. Out of the 134 objects measured, there were one red semiregular variable and one W UMa type eclipsing binary (RV CVn), a foreground star. As a whole, O−C diagrams of 125 RR Lyrae stars have been constructed, for most of them (116) for almost a 70 years timebase. Considering only the variables observed since Bailey's discoveries, the O−C diagrams could be fitted by a straight line for 8, by a positive parabola for 23 and by a negative parabola for 25 variables. No systematic trend was found in the direction of period changes. About half of the O−C diagrams could not be approximated by quadratic formulae. As a rule, the variables with secondary period had very complicated O−C diagrams. It was also an interesting observation that several RR Lyrae stars (both RRab an RRc) had sine-like O−C diagrams.

A review on the period changes of RR Lyrae stars in globular clusters was given by

[60]Leiden Ann., 17, Part 2, 1938

Szeidl at the IAU Symposium on Variable Stars and Stellar Evolution held in Moscow in 1974. There were doubts about the character of the changes, whether the periods were relatively constant (apart from slow secular evolutionary changes) for long time intervals followed by brief intervals of spontaneous, abrupt changes or, whether the variations were relatively smooth. Two field RR Lyrae stars which were on the Konkoly Observatory's program provided examples for both cases. The period of RR Leonis (Balázs & Detre 1949) had increased smoothly, but the rate of change was not at all constant. On the other hand, the period of RR Geminorum changed suddenly around JD 2428900 within a brief interval. It was originally hoped that the period variations would depend on the positions in the colour-magnitude diagram, this expectation, however, was not fulfilled. We could not find any connection between the position of a star and its period change either in M3 or in M15. The final conclusion was that it was impossible to attach any evolutionary significance to the observed period change of an RR Lyrae star. Likely, ω Centauri is the only exception, in which some evidence for evolution effects may be present (Szeidl 1975).

L. Detre made an attempt at investigating the period changes of field RR Lyrae stars, but the sample was too small for drawing statistically significant conclusion (Detre 1955, 1970b). These studies, however, showed that, over and above evolutionary changes, some kinds of other effects exerted significant influence on the period causing period changes of different amount and of different direction.

Júlia Balázs and L. Detre called attention to mechanisms which were not connected closely with the physics of the star and could produce apparent period changes. If a variable moves as compared with the observers (even if in straight line with constant velocity) its observed period changes in consequence of the Doppler effect. In the case of constant velocity, the period is apparently increasing (Detre 1969b, 1970b). In a paper on period changes in variables and evolutionary paths in the Hertzsprung-Russell diagram Júlia Balázs and L. Detre applied the theory of random walk to the O−C diagrams of pulsating variable stars. If the period has random fluctuations, noise with σ standard deviation, then the O−C diagrams are random walks due to the cumulative nature of the fluctuations and do not represent real period changes. It was found that σ was an important parameter of variable stars and correlated with the rapidity of evolution (Balázs & Detre 1965).

Other pulsating variables

- *δ Scuti variables*

In the early days (in the thirties) δ Scuti stars were not distinguished from RR Lyrae stars, so it is not a wonder that they were also on the observing list at the Konkoly Observatory.

Immediately after the discovery of the variability of 391.1934 Aqr = CY Aquarii, its photographic photometry was commenced by J. Balázs and Detre. During nine nights in 1934, almost 200 observations were obtained and the elements of the light variation were derived. Nine maxima were observed that pointed to single periodic nature of the star (Balázs & Detre 1934, 1935). Later, it was observed photoelectrically that confirmed the previous results (Detre & Chang 1960).

Previous observers of XX Cygni referred to its light curve variations. Analyzing more than 300 photographic observations obtained in 1936, no sign of secondary periodicity was found (Detre 1936a).

Based on his visual observations, A. G. Lange[61] stated that RV Arietis exhibited irregular variations. About 300 photographic observations made in 1935-1936 during 16 nights revealed the star's real nature: a short period pulsating star (Detre 1936c, 1936d, 1936e, 1937b). Later, Detre succeeded in disclosing the double mode behavior of the star and determined its secondary period making use of the accurate photoelectric observations of P. Broglia and E. Pestarino[62] (Detre 1956b). It turned out that this variable belonged to the subgroup of AI Velorum stars. In order to get more accurate periods and the period ratio, new observations were made during nine nights in the years 1951, 1953, 1954, 1955, and 1956. As a whole, 261 photographic observations of RV Ari were obtained and discussed (Balázs 1956).

In the thirties, the question of multimode stellar pulsation aroused the interest of the variable star astronomers and captivated Detre's interest, too. He analyzed the photoelectric data set of δ Scuti obtained by E. A. Fath[63] and interpreted the star's secondary period as interference of two oscillations with close frequencies (Detre 1941).

At the Konkoly Observatory the observation of δ Scuti stars has proceeded forth photoelectrically (Detre 1957). I. Guman (independently from W. Fitch) discovered that VZ Cancri was also a double mode variable. He observed the star photoelectrically between April, 1951 and February 1954, and collected more than 1200 observations on 24 nights. The measurements were made without filter. The light curve variation and the differences in height of the 26 observed maxima were conspicuous. According to both the periods and the light variations the star behaved resembling AI Velorum and SX Phoenicis (Guman 1955a).

The variability of SZ Lyncis was discovered by C. Hoffmeister[64] and H. Schneller[65] classified it as a short period RR Lyrae star. In 1962 February and March 600 photoelectric B and V observations were collected and the period was derived. It was shown that the star was a single periodic dwarf cepheid (Gefferth & Szeidl 1962).

V. P. Tsesevich[66] called the attention to the possible light curve variation of the Bamberg variable BV92[67] = AE Ursae Majoris. More than one thousand photoelectric observations in two colours were made between January and April 1974 on 12 nights. The observed 18 maxima allowed to determine both the fundamental and first overtone periods. The period ratio 0.773 was very characteristic of the radially pulsating double mode δ Scuti stars. The light curve variations of AE UMa proved to be very strong, during a modulation cycle the height of maxima varied almost $0\overset{m}{.}3$ while the phase of maxima almost 10 minutes (Szeidl 1974).

- *AC Andromedae*

Soon after P. Guthnick and R. Prager[68] discovered the variability of BD+47°4104 (= 9.1927 And) it became evident that the star (soon receiving its variable star name, AC

[61] Tadjik Tsirk., 4, 1935
[62] Mem. Soc. Astr. Ital., 26, 429, 1955
[63] Lick Obs. Bull., No. 479, 1935; Lick Obs. Bull., No. 487, 1937
[64] Astron. Abh. (Erg.-H. zu den AN), 12, 21, 1949
[65] Astron. Nachrichten, 286, 102, 1961
[66] Astron. Tsirk., 775, 1973
[67] E. Geyer, R. Kippenhahn, & W. Strohmeier, Kleine Veröff. Bamberg, Nr. 11, 1955
[68] Astron. Nachrichten, 229, 455, 1927

And) is a unique variable. Through intensive observation, N. T. Florja[69] could derive the type of variability and periods of AC And. He could describe the light variation as superposition of two oscillations with periods 0.525 day and 0.711 day, and he interpreted this result in such a way that two RR Lyrae stars optically coincided with each other. Later, G. Münch[70] refuted this assumption on the basis of spectroscopic observations and suggested that AC And was rather of AI Vel type.

Little wonder, that the strange behavior of this star aroused L. Detre's interest and in 1935 he included AC And into the observing program of the Konkoly Observatory. Between 1935 and 1954, 5670 photographic observations were obtained that were later analyzed by I. Guman.

In order to get a real picture about the nature of the light variation of AC And, the star's intensive photoelectric photometry started in 1958 at the observatory. For the year 1962 Detre organized a campaign, too (Detre 1962b). In the long run, AC And was observed photoelectrically on a total on 78 nights in the years 1958, 1960, 1961, and 1962 and more than 10000 observations were secured in the Johnson U, B, and V bands. The analysis was, however, restricted to the 4662 yellow magnitudes, and revealed that AC And had its fundamental and first and second overtone radial pulsation modes, all excited and nonlinearly coupled. This variable star was found to have a mass of $M = 3.1 M_{Sun}$ and to be a high-mass analog of the δ Scuti stars, in the hydrogen-shell-burning and helium-core-contraction stage of evolution (Fitch & Szeidl 1976).

- *Cepheids*

In order to test the photoelectric photometer, L. Detre observed bright cepheids, such as FF Aql, η Aql, SU Cas, TU Cas, δ Cep, X Cyg, SU Cyg, S Sge, and T Vul, but these observations have not been published.

The long period cepheid CY Cas was investigated on Moscow archive plates and its period was corrected (Almár 1959).

The beat period cepheid TU Cassiopeiae was intensively observed by Erzsébet Illés in 1960-62 and by L. Szabados after 1971. The light-surface at different beat phases was constructed and the variation of the periods was studied (Illés 1968, Illés & Szabados 1976).

The Observatory's new photometer on the 50 cm Cassegrain telescope was put into operation in 1972. The instrument equipped with a UBV photometer made the expansion of the observatory's program possible. The observations of northern cepheids brighter than 12^{m} were started in 1972. One of the purposes of this observational program was the search for beat cepheids. One new double mode cepheid was discovered: BQ Serpentis had two periods, $P_0 = 4.271$ days fundamental and $P_1 = 3.012$ days first overtone, and $P_1/P_0 = 0.705$ period ratio (Szabados 1976a). Some results of the survey as by products were achieved right away. V445 Cas was wrongly classified as a cepheid, it is in reality an eclipsing variable of β Lyrae type (Szabados 1974a). V361 Per was catalogued as probable cepheid. It turned out to be an early type irregular variable (Szabados 1974b). The Bamberg variable BC Dra was assigned to cepheid. In truth, the star is an RR Lyrae variable of long (0.720 day) period (Szabados et al. 1976). J.D. Fernie and J.C.

[69] Astron. Zhurnal, 14, 1, 1937
[70] Astrophys. J., 114, 546, 1951

Hube[71] reported BD+56°2806 as a probable cepheid. The observations showed that it was, indeed, a cepheid with short period (Szabados 1976b).

In 1966, S. Demers and J. D. Fernie[72] called attention to the strange behavior of the Population II cepheid RU Camelopardalis. The observations of this star started at the Konkoly Observatory already in August 1966 (Detre 1966b, Detre & Szeidl 1967, Detre 1969a, Szeidl 1969b).

- *β* *Cephei type*

RS Sextantis was identified as "related to the β Canis Majoris stars" by A.B. Underhill[73]. The projected velocity of rotation of RS Sex turned out to be fairly high, 260 km/s (Almár 1968).

- *Red variables*

On the plates taken for the RR Lyrae program, variable stars of other types may be found and could be investigated. BT Lyrae appeared on the plates (close to their edge) taken on the globular cluster M56 and its measurements showed that there were departures from regularities and the form of successive maxima and minima strongly varied. The period could be corrected to $P = 167.85$ days (Balázs 1952a). ST Draconis is near RW Dra. E. Hartwig[74] found it to be variable, but conformity with the photographic observations it proved to be constant within some hundredth of magnitude (Balázs 1952b).

On the plates taken for the study of AC And, two other variables could be found and measured. AI Andromedae is a Mira type variable and showed strong period variation (Guman 1952, 1955b). BE Andromedae is an M6 type semiregular variable. Its average period was newly determined, 157 days as against the previous value of 137 days, but the actual periods showed large fluctuations (Guman 1955b).

- *Cataclysmic variables and flare stars*

Nova Herculis 1963 was discovered by E. Dahlgren[75] on February 6, 1963. This object was observed at the Konkoly Observatory in three colours from February 9, 1963 to October 2, 1964. During 43 nights more than 900 observations were made and spanned almost 8^{m} of the brightness decrease. Rapid fluctuations in brightness and colour had been found (Almár & Illés 1966).

One of the light outbursts of the very interesting object Rosino-Zwicky near M88 was detected on plates taken by the observatory's 60/90 cm Schmidt telescope for the supernova search program. The object brightened by 6 magnitudes from the middle of March to the beginning of April 1965 (Lovas 1965). In the course of the flare statistics program, a new U Geminorum star was found in Cancer (Jankovics 1973).

The observatory took part in the photoelectric monitoring of flare stars. AD Leonis was observed and events were recorded (Szeidl 1969a, Barlai et al. 1972).

[71] Astrophys. J., 168, 437, 1971
[72] Astrophys. J., 144, 440, 1966
[73] The Early Type Stars, D. Reidel Publ. Co. Dordrecht, p. 259, 1966
[74] Astron. Nachrichten, 177, 70, 1908
[75] BAV Rundbrief, 12, 3, 1963

- *Binary stars*

Although the observatory's main program was the study of intrinsic variables, some eclipsing and spectroscopic binaries were also investigated.

On the plates made for studying AV Vul, the β Lyrae type variable, CD Vulpeculae could also be measured. The amplitude of the primary minimum was about 1^{m}, and that of the secondary minimum about $0\overset{\mathrm{m}}{.}4$ (Guman 1951).

The long period eclipsing binaries Z Aurigae and 32 Cygni were photoelectrically measured (Detre & Herczeg 1952, Herczeg 1956a, 1956b).

The orbits of visual and spectroscopic binaries were also discussed in several papers (Batten & Szeidl 1972, Herczeg 1957a, 1957b).

In 1959, K. K. Kwee[76] organized an international campaign of observations of VW Cephei. In the frame of this program during seven nights in 1959 more than 1000 photoelectric observations were secured in U, B, V, and R bands (Detre & Kanyó 1961). In connection with this program photoelectric observations obtained previously at the observatory (in 1950, 1952, and 1959) were also published and discussed (Balázs & Detre 1961a).

Attempt was made to interpret the O−C diagrams of four eclipsing binaries (W Delphini, Z Draconis, TX Herculis, and RV Lyrae) with the effect of a hypothetical third body, and the mass functions and orbital elements were determined (Illés & Almár 1963a,b)

Putting into operation the 50 cm Cassegrain telescope, more telescope time was at disposal of the staff and the starting of new programs become possible.

The regular photoelectric observations of minima of eclipsing variables were commenced in 1973 (Patkós 1975, 1976).

Epilogue

In this review I made an attempt to summarize the results of variable star research at the Konkoly Observatory published until 1976. This date was chosen for the simple reason as I tried to stress the results and achievements "in which László Detre had a hand". Of course, there were research works commenced before 1976 and concluded and published later on. Here I quote only some examples.

The old photographic observations of AC And were measured and analyzed[77]. The photographic and photoelectric observations of nine single mode RR Lyrae stars (AT And, SU Dra, TW Her, VZ Her, RR Leo, TT Lyn, AV Peg, AR Per, and TU UMa)[78] and the Blazhko stars RW Dra[79], XZ Dra[80], and RR Lyr[81] were published and the basic parameters of the light curves (e.g. times of maximum light) were also given. Still we have old photographic (from the 1930-1950s) and photoelectric observations (from the 1950-1960s) of RR Lyrae stars not yet elaborated.

The period changes of single mode high amplitude δ Scuti stars (CY Aqr, YZ Boo, XX Cyg, DY Her, EH Lib, SZ Lyn, and DY Peg) were investigated also making use of the

[76] Resolution on co-operative programs, IAU Comm. 42 Transactions of IAU, vol. 10, p. 638, 1958

[77] I. Guman, Budapest Mitt., Nr. 78, 1982

[78] K. Oláh & B. Szeidl, Budapest Mitt., Nr. 71, 1978; B. Szeidl, K. Oláh, & A. Mizser, Budapest Mitt., Nr. 89, 1986

[79] B. Szeidl, K. Oláh, K. Barlai, & L. Szabados, Budapest Mitt., Nr. 102, 2001

[80] B. Szeidl, J. Jurcsik, J.M. Benkő, & G. Bakos, Budapest Mitt., Nr. 101, 2001

[81] B. Szeidl, E. F. Guinan, K. Oláh, & L. Szabados, Budapest Mitt., Nr. 99, 1997

old photographic and photoelectric observations of the observatory[82]. The photoelectric observations obtained in the fifties and sixties were also included in the study of double mode HADS (RV Ari and AE UMa)[83].

The behaviour of the peculiar W Vir type star, RU Cam had been followed from 1966 during 16 years. The unique data set covered almost continuously the light variation for that time interval[84].

In the frame of the photographic observational program of RR Lyrae stars in globular clusters, a great number of plates were taken with the 60 cm telescope on different clusters from 1937 up to 1966. Measurements of variables in M15 were accomplished[85], but the investigation of RR Lyrae stars in M5 is still the task for the future.

In this review I have not alluded to two subjects, although both belong to the field of variable stars. In order to make the most the 60/90 cm Schmidt telescope, L. Detre initiated the search for extragalactic supernovae (Detre 1974) and for flare stars in galactic clusters[86]. The motive for setting aside these subjects was that the aim of the searches was the study of the frequency of supernovae and flare stars and not the study of physics of their variability.

The variable star research at the Konkoly Observatory had new perspective when the development of its mountain station was completed in 1975. The new 1 m RCC telescope was right away furnished with an uncooled UBV, and later on with a refrigerated photon-counting UBV$(RI)_C$ photometer[87], that made the broadening of the field of variable star research at the Konkoly Observatory possible. Based on the three photometric telescopes (60 cm Newtonian at Budapest, Svábhegy, 50 cm Cassegrain and 1 m RCC at Piszkéstető mountain station) the author of this review initiated the study of all types of variables in classical instability strip of HRD and of the phenomena of stellar activity. The 1 m telescope also proved to be an ideal equipment for the investigation of variables in globular clusters, to pursue our classical program. Large number of photographic plates were exposed on M3, M5, and M15 before the CCD era.

The variable star research at the Konkoly Observatory well-founded by L. Detre during his life has always had international reputation and the variable star community of the observatory has always taken active part in the international co-operation. Since 1961 the Information Bulletin of Variable Stars, the official publication of the IAU Commissions 27 and 42 has been issued by the observatory. The editors and co-editors were/are L. Detre (1961-1974), B. Szeidl (1968-1990), L. Szabados (1983-2000), Katalin Oláh (1990-) and Johanna Jurcsik (2000-). L. Detre and B. Szeidl fulfilled the duty of presidency of the IAU Variable Star Commission in the years 1967-1970 and 1985-1988, respectively. The observatory organized three international conferences on variable stars before 1976:

- Konferenz über veränderliche Sterne, Budapest, 23-28 August 1956
- Non-periodic Phenomena in Variable Stars, IVth Colloquium on Variable Stars, Budapest, 5-9 September 1968

[82]H.A. Mahdy & B. Szeidl, Budapest Mitt., Nr.74, 1980; B. Szeidl & H. A. Mahdy, Budapest Mitt., Nr.75, 1981; B. Szeidl, Budapest Mitt., Nr.84, 1983

[83]B. Szeidl & G. Virághalmy, Budapest Mitt., Nr. 98, 2000; M. D. Pócs & B. Szeidl, Astron. Astrophys., 368, 880, 2001; M. D. Pócs, B. Szeidl, & G. Virághalmy, Astron. Astrophys., 393, 555, 2002

[84]B. Szeidl, K. Oláh, L. Szabados, K. Barlai, & L. Patkós, Budapest Mitt., Nr. 97, 1992

[85]K. Barlai, Budapest Mitt., Nr. 92, 1989

[86]This program was carried out in cooperation with the Byurakan Observatory, Armenia

[87]The photometers to the 50 cm Cassegrain and 1 m RCC telescopes were designed and built by G. Virághalmy.

- Multiple Periodic Variable Stars, IAU Colloquium No.29, Budapest, 1-5 September 1975

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In this short review I essayed to outline the first 75 years history of variable star research carried out at the Konkoly Observatory. Although the circumstances were not always favourable for research work, the accomplishment was impressive and has inspired, and may inspire the succeeding generations. The publications of staff members of the Konkoly Observatory on variable stars between 1901 and 1976 are given in the references section.

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