

# Activities and Achievements of the Double Star Committee of the Société Astronomique de France

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## 1. French amateurs as precursors of the Double Star Committee

In a synthesis article (see ref. below), the double star expert Paul COUTEAU put the work of French pioneers of double stars observation in the perspective of the double star work carried in the world. After Antoine Yvon VILLARCEAU and Camille FLAMMARION, one prominent pioneer of double stars was Robert JONCKHEERE (1888–1974), an amateur before circumstances prompted him to become a professional astronomer, who devoted his life to double stars. Kenneth Glyn Jones wrote a biography and Charles Fehrenbach his obituary. Jean-Claude Thorel studied his life and career in double star observations (see Section 10 below). In the 1930s, another precursor of the Commission des Étoiles Doubles, Maurice DURUY (1894–1984) invented the micrometer with a comparison star, and applied the diffraction micrometer invented by Ejnar Hertzsprung to the measure of double stars, which he regularly observed at Nancy with a 275-mm telescope, at Lyon with a 162-mm telescope and in his observatory of Beaume-Mêlé with a 40-cm and later a 60-cm telescope at Le Rouret (Alpes-Maritimes). He measured standard pairs of the list of Paul Muller and published his measures in the *Journal des Observateurs*; these measures requested by Paul Muller aimed at comparisons of between observers. He also collaborated with the Webb Society of Great Britain; Glyn Jones published his astronomical biography. Already in 1924, the pediatrician Paul BAIZE (1901–1995) had started the measurement of double stars as an amateur. He was granted permission to measure them with the 38-cm of the Paris Observatory and made an impressive number of measures during his long “career” (24044). He also made orbit calculations and established a formula for the calculation of dynamic parallaxes in 1946. He wrote articles explaining new observation techniques devoted to double stars in the magazine *L’Astronomie* and continued his astronomical activity until the beginning of the 1990s. Glyn Jones published an astronomical biography of Paul Baize. In the 1960s, Bernard CLOUET and the late Robert SAGOT (1910–2006) made double star observations for the book which was then in preparation under the title *La revue des constellations*. Their measures remained unpublished; but publication of the measures made by Robert SAGOT is in preparation. At about the same time, the neurology professor Jacques LE BEAU (1908–1998) made the acquaintance of renowned professional astronomer Paul COUTEAU and learned from him how to measure double stars. Each year, he stayed for two weeks at Nice and conducted his observations with the 50-cm refractor of the Nice

Observatory. In 1978, Paul COUTEAU published the first book in French devoted to double stars: *L'observation des étoiles doubles visuelles*. That book triggered the interest of more amateur astronomers for double stars and indirectly influenced the creation of a group of double star observers which was transformed into the *Commission des Étoiles Doubles*.

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## 2. The creation and the life of the Commission des Étoiles Doubles

In 1979, Pierre DURAND, a professor of future teachers, announced in the magazine *L'Astronomie*, published by the Société Astronomique de France, the creation of a group of amateur double star observers and aroused the interest of a few persons. This group met in 1980. With the support of professional astronomer Paul MULLER (1910–2000), this

group was recognized in 1981 as a *commission* (committee) of the Société Astronomique de France. Pierre DURAND became its president and Frédéric HONNART its secretary. Paul MULLER and Paul COUTEAU became scientific advisers to the committee. Ever since, the Double Star Committee has constituted a forum of exchange of experiences and information in the field of double stars, particularly visual. In the summer of 1982, Pierre DURAND organized a first summer meeting at the Marseilles Observatory and in the summer of 1983, an observation workshop at the observatory of Aniane (Hérault). By an article in the magazine *L'Astronomie*, he encouraged amateur astronomers to turn their attention to double stars. Professional astronomers Pierre BACCHUS and Jean DOMMANGET joined the committee as scientific advisers. They soon suggested to its members to turn their efforts to binary stars which would be in the INPUT catalogue of the HIPPARCOS program; as a result of their suggestion, a call to observers of double stars was published in *L'Astronomie*. Their suggestion entailed three parts:

- a) the position of a binary star in the binary star section of the INPUT catalogue was checked.
- b) If the binary was found, binarity was confirmed for the INPUT catalogue. If the star seen at the given position was single, the observer was to search for the binary star and record its correct position.
- c) the parameters of the pair  $\rho$  and  $\theta$  were measured.

Jean-Louis AGATI, Pierre DURAND, René-Georges HURET, Maurice SALAMAN, and Yvonne and Jean-Claude THOREL were among the first to take up this suggestion and to contribute to corrections of the INPUT catalogue. These corrections related to double stars made and amateurs resulted in a publication by Pierre BACCHUS. The preparation of the double star part of the INPUT catalogue led Jean DOMMANGET to the creation of the *Catalogue de Composantes d'Étoiles Doubles et Multiples*. Other professional astronomers also became scientific advisers to the committee: Frans van't VEER, Daniel BONNEAU, Marco SCARDIA, David VALLS-GABAUD and Josefina LING. The honorary president Paul BAIZE and the scientific advisers encouraged the amateurs to pursue observational goals which carry the perspective of scientifically useful results, such as the measurement of physical pairs for which an orbit calculation will become feasible within a few decades. With the initial impulse by Pierre DURAND and under the aegis of the committee, amateurs started missions at several French observatories: Bordeaux, Lille, Nice, Pic du Midi-de-Bigorre. For the past ten years, most missions were made at the Nice Observatory with the 50-cm refractor. These missions have strongly stimulated the activities of observation and measurement of double stars. Following the creation of the committee, its board started the publication of projects and accounts in the magazine *L'Astronomie*. Double stars were once the subject of a game proposed to observers for the summer of 1984 (see Debackère). A very recent project raised up by Jean DOMMANGET has the purpose to eliminate the ambiguity pertaining to the node angle  $\Omega$ . Usually an orbit determination of a visual binary only provides a direction, namely an angle known  $\pm 180^\circ$ . If the signs of the radial velocities of the components are known, the ascendant node may be determined; therefore, the plane of the true orbit and the rotation axis of the couple may also be determined. This project implies the combination of visual orbits and radial velocities. Coordinated by Jean Dommanget and Daniel Bonneau, a group comprising Pierre Bacchus, Pascal Mauroy, Louis Pinatelle and Pierre Verhas has started work.

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### 3. Micrometric measurements with a filar micrometer

Over many years, Pierre DURAND, Jacques LE BEAU, Yvonne and Jean-Claude THOREL made regular missions at Nice using the 50-cm refractor which is equipped with a filar micrometer with electronic recording. The 74-cm refractor was used occasionally. Yvonne and Jean-Claude THOREL observed more than 650 pairs, made ca. 4000 measures and published more than 1300 mean positions. In the course of their observations, four new pairs were discovered (JCT 1 to 4).

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#### 4. Photographic measurements of binary stars

This technique was investigated by Pierre DURAND and Daniel SIMIER with a telescope having an aperture of 20 cm. The late medicine professor Pierre JANNY (1921–1993) applied the photographic technique to the measure of double stars and constructed an apparatus to measure the images. This technique is now superseded by that based on the use of a charge coupled device (CCD).

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#### 5. Measures by the transit method

The transit method described by Pierre DURAND and André DEBACKERE appeared especially attractive because the only specific accessory which is required is a chronometer. This method was practised for several years by members of a group led by André DEBACKERE and comprising Jacques CAZENEUVE, Michel LEFEBVRE and the late Paul VIEL. Great care was taken to evaluate the precision with which the parameters were determined. As shown by Paul VIEL, the precision obtained was less than that obtained with either a filar or a double-image micrometer. A few years later, Paul BAIZE independently said that, after a period of training, observers should leave this method for a more precise one — and get equipped with a micrometer.

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## 6. The double image micrometer with a spar plate

Between 1941 and 1943 at the observatory of Pic du Midi de Bigorre, the astronomer Bernard LYOT (1897–1952) devised a double image micrometer for the measurement of double stars. Henri CAMICHEL (1917–?) was the first to construct a micrometer based on his concept. He measured double stars with it at the observatory of Pic-du-Midi-de-Bigorre between 1943 and 1946 and in the same article, he briefly described the micrometer and published his measures. This micrometer was used by Audouin DOLLFUS for the measurement of double stars at Pic-du-Midi-de-Bigorre in 1954 and later for the measurement of diameters of Jupiter's satellites. The principle of this micrometer is as follows: as a result of the birefringence of the spar plate with parallel faces, each component of a binary star produces two images. The plate may turn about its optical axis and also about a perpendicular axis. By orienting the plate, the observer can align the four images and have them equidistant. From the orientation of the plate, he can then deduce the position angle and the angular separation of the pair.

In 1988, under the direction of Jean-Louis AGATI, the Commission des Étoiles Doubles conceived a light (mass under 650 grams) and accurate micrometer based on the invention of Bernard Lyot. The rotation of the plate around a direction perpendicular to its optical axis is made with toothed wheels equipped with an elastic device which cancels backlash; this device enables the accurate determination of the plate position. This model has been validated by observers who made good measures with it. The Commission arranged the fabrication of a small series of spar plate micrometers by the MECA-PRECIS company. A score of micrometers were sold to European amateurs.

Independently, Paul MULLER invented another type of double image micrometer, which uses two birefringent half prisms, glued together. This micrometer has been used by professional astronomers.

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## 7. The application of CCD cameras and webcams to double stars and the data treatment with appropriate software

In the 1980s, the cost of CCD cameras, which had been quite high, significantly decreased. At the same time, their use for astronomy became simpler. These two factors contributed to incite amateur astronomers to use them. Within the Double Star Committee of SAF, Guy MORLET, Maurice SALAMAN and the late Ghislain de FROMENT created a working group in 1990 to investigate their application to the measurement of pairs. Images were acquired thanks to two cameras of different brands (brand SBIG, model ST4; brand LE2IM, model HiSis22) at various places: Observatoire du Mont-Chiran, Corsica, Observatoire de Haute-Provence. Several computer programs aimed at the determination of the position angle, the angular separation and the magnitude difference were tested, as well:

- a program developed by the *Association Nationale Sciences Techniques Jeunesse* in 1981
- a program based on the method of inertia moments, developed by Pierre Bacchus
- the program *CERCLE* developed in BASIC by Guy Morlet in 1995

These different programs gave good results for pairs whose angular separations is significantly larger than the resolution limit of the telescope, but they failed in the case of close pairs. The program *QMIPS32* by Christian Buil was interesting because it enabled to process the image by the wavelet method to obtain a measure; but it implied many constraints for the user.

The program *SCAN*, developed by H. Jenkner and improved by D. Sinachopoulos, relied on a comparison between the profiles of observed and calculated illuminations along two directions which are parallel to the image sides. But this program was ineffectual when the segment joining the pair components is roughly parallel to a side of the image. Its existence suggested the development of a program which would compare the maps of observed and calculated illuminations, instead of only two profiles. Whereas Jenkner and Sinachopoulos had used the empirical function of Franz in order to empirically model the spread of illuminations of a star image resulting from both the diffraction by an aperture and the atmospheric agitation, Pierre Bacchus proposed a simpler function which better represents the real spread of illuminations, namely the product of a Cauchy–Lorentz function and a Gauss–Laplace function. Two developments were made in parallel. In the first, Guy Morlet wrote BASIC routines which read the image files and display the images on a computer screen, whereas Edgar Soulié wrote in FORTRAN a program fitting the nine parameters which define the map of calculated illuminations by minimization of the sum of squares of differences between the observed and calculated illuminations.

In the second development, Guy Morlet and Pierre Bacchus wrote in the *C* programming language the program *SURFACE* which combines the reading of the recorded image file, the parameter fitting and the display of the observed and calculated images. This program resorts to a single programming language. In 2002, Guy Morlet wrote this program again in Visual BASIC. Ancillary programs sort the selected images and combine them before the parameter fitting is applied. In order to solve particular cases involving components which are close or whose magnitude difference is important, René Gili at Nice has used the *wavelet* function of the *IRIS* program (see Buil). Double star images have been acquired during missions with the 50-cm refractor of the Observatoire de Nice from 1997 to 2004 and measured with the *SURFACE* program. The measures have been published.

Independently of CCD cameras, amateur astronomers got acquainted with webcams and used them, modified or not, for astronomical images. This new image acquisition device aroused a few new inclinations for the measure of double stars and the development of a new program *REDUC* in the DELPHI programming language by Florent Losse. The program connects the sorting of images, the measure on selected images and the mean of these measures. Recently, the *SURFACE* program was integrated in *REDUC*.

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## 8. Reobservation of MLR pairs

Between 1953 and 1989, the French astronomer Paul Muller (1910–2000) discovered ca. 700 pairs, most of them at the Nice Observatory. A few of these have given remarkable orbits, for example MLR 4 = HIP 116849 (period of 20 years). The complete list of the MLR couples with measurements is available on the *SIDONIE* server at Nice Observatory. Unfortunately, these pairs are seldom reobserved because they are close and/or have a large magnitude difference, which require a high quality instrument. The 50-cm refractor at the Nice Observatory is among them.

Number of entries in the WDS	644
MLR couples missing in the WDS	76
Percentage of pairs with separations between 0".1 and 0".3	30%
Percentage of pairs with less than three measures	20%
Percentage of pairs not observed since 1989 (last publication)	34%
Number of calculated orbits	12

Starting in September 2001, Pierre DURAND and Claude PINLOU have undertaken a systematic reobservation of these pairs using the 50-cm refractor of the Nice Observatory with which they were discovered and a CCD camera. They used the software *SURFACE* (see above). In 2006, a quarter of the program has been achieved. It unfortunately pertains to the widest pairs, probably the least interesting. The close pairs, between 0".15 and 0".4 have so far been seldom visited because the images were unstable during the five missions which have been made. A publication is in preparation. It shows that the last discoveries made by Paul Muller have not all been included in the WDS catalogue, that accurate identifications of pairs with low brightness are missing and that pairs are in motion, promising the future determination of orbits.

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## 9. Orbit calculations

Before the Second World War, Dr. Paul Baize had not only made measurements of pairs but also determined about 150 orbits. In 1954, he published an article in *L'Astronomie* in which he explained how orbits may be determined by a graphical method. In 1983, the late Michel Walbaum and Jean-Louis Duvent tackled the search for invisible companions of binary stars by investigating the perturbations which these companions induce on the orbits; their article contained a prophecy which has since been realized: *We are near to discover giant planets similar to Jupiter*. In 1986, Edgar Soulié published a new method for the orbit improvement of visual double stars. The corresponding software was published in *Observations et Travaux*. Using this and other software, René Manté started a long series of calculations of preliminary orbits of close pairs, which have been regularly published in the *Information Circular* of Commission no. 26 (Double Stars) of the IAU. Jean Dommange presented the Thiele-van den Bos method.

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## 10. History of double star observers

Jean-Claude THOREL has published a biography of Robert Jonckheere, at first an amateur who devoted his life to double stars and created his observatory at Hem in the vicinity of Lille (département du Nord). Due to the First World War, Robert Jonckheere sought refuge in England and made observations at Greenwich Observatory. In 1930, his equipment was sold to the University of Lille, which created a new observatory in 1934, which houses the 35-cm refractor. Robert Jonckheere became a professional astronomer and ended his career at the Observatory of Marseilles. Jean-Claude Thorel published an obituary of Paul Muller. In an article, Edgar Soulié summarized the activities of French astronomers, whether professional or amateur, involved in double star studies from the origin of the field until the present.

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## 11. The Internet site of the Commission:

After a period of creation and testing, the Internet site of the Commission created by Sébastien CAILLE was opened in January 2006 at the address:

<http://saf.etoiledoubles.free.fr> In development, this site is bound to evolve with contributions of members of the Commission. It has the purpose to make the activities of the Commission known and to arouse vocations within the community of amateur astronomers. The column "Articles/documents" makes available in electronic form the book of the honorary president of the Commission Paul Couteau entitled *L'observation des étoiles doubles visuelles* (Flammarion Paris, 1978) articles and miscellaneous documents relevant to binary stars. The column "Outils" offers the possibility to load or to connect oneself to several tools which are useful for double star observers. One of them is a search engine for double stars recorded in the WDS catalogue: <http://doublestars.free.fr>, developed by Sébastien CAILLE. Software specific to reduction of double star data can also be loaded. The column "Observation" presents the observation projects as well as calls for observations.

## 12. International contacts

The Double Star Committee established contact with foreign amateur astronomers, among them Andreas Alzner in Germany, Tamas Ladanyi in Hungary, Jordi Cairol, Jaime Planas, Francisco Rica Romero, coordinator of the Liga Ibero Americana De Astronomia (LIADA), Tofol Tobal in Spain, Robert Argyle, president of the Webb Society, John Larard, Chris Lord and in the United Kingdom, Brian Mason, William Hartkopf, and Ronald Tanguay in the United States. The contact with Spanish amateurs resulted in a joint meeting between Spanish and French double star amateurs which took place at Castelldefels (Catalunya) in Spain in October 2000. Florent Losse, deputy editor of the journal *Observations et Travaux*, sends the electronic files of the double star measures published in this journal to William Hartkopf at the United States Naval Observatory for inclusion in the WDS catalogue of measures. Tofol Tobal contributed an article for the special issue on double stars and Tamas Ladanyi published an astronomical biography of the Hungarian amateur Erno Berko in a recent issue of the journal *Observations et Travaux*. Josefina Ling, scientific adviser, published an article describing an observatory and Robert Argyle published a presentation of the Webb Society and its double star section in *L'Astronomie*.

### Reference:

- Robert Argyle, "La section des étoiles doubles de la Webb Society", *L'Astronomie*, vol. 120 (janvier 2006) pp. 463-464
- Tamas Ladanyi, "Un dupliciste hongrois: Erno Berko", *Obs. & Travaux*, no. 60 (novembre 2005) pp. 21-22
- Josefina Ling, "L'observatoire de Llano del Hato", *L'Astronomie*, vol. 116 (décembre 2002)
- Tofol Tobal, "Mesures d'étoiles doubles visuelles", *Obs. & Travaux*, no. 52 (juin 2000) pp. 67-72

## 13. Eclipsing binaries studied by a sister group

Independently of the Commission, the "Groupe Etudes et d'Observations Stellaires" made observations of eclipsing binaries which were published in *Observations & Travaux* and *L'Astronomie*.

**Reference:**

- Nicola Beltraminelli & Davide Dalmazio, “L'étoile variable NSV 11321 Lyr”, *Obs. & Travaux*, no. 52 (juin 2000) pp. 3-7
- Michel Dumont & Roland Boninsegna, “Observations de l'étoile NSV 12040”, *L'Astronomie*, vol. 101 (mai 1987) pp. 315-319