

French astronomers, visual double stars and the double stars working group of the Société Astronomique de France

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1. A long tradition :

The discovery of the orbital motion of visual double stars by William Herschel aroused the interest of French astronomers for the observation of double stars and the computation of their orbits at the beginning of the XIX-th century. Thus, the first orbit determination, pertaining to the binary κ Ursae Majoris, was made by Félix Savary in 1827 (1). About twenty years later, Antoine Yvon Villarceau, whose career was surprisingly varied (see his biography in ref. 2), proposed an elegant method for the determination of the apparent orbit and an algorithm to deduce the real orbit (3).

Camille Flammarion, the founder of the Société Astronomique de France whose biography was published in 1994 (4), observed visual double stars, calculated orbits and published in 1878 a book entitled "Catalogue des étoiles doubles et multiples en mouvement relatif certain..." (5).

Guillaume Bigourdan, inventor of a method for setting an equatorial instrument into an appropriate position which bears his name, observed them between 1880 and 1895, and analyzed the personal factor in the measurement process (6). In the second volume of his treatise on stellar astronomy (7), Charles André devoted seven chapters to binary stars, in which the knowledge of the time on the various categories of double stars are gathered. In particular, methods for orbit determination are given for each category. In this treatise, he published among other things the list of binaries, the orbits of which were known in 1900. At the beginning of the XX-th century, Maurice Farman, before he associated with his brother Henri, a famous pioneer of aviation, to manufacture airplanes, observed double stars at Chevreuse near Paris (8). Another amateur, Robert Jonckheere, measured close double stars at his observatory in Hem with a 33 cm refractor. During his observations made successively at Hem, at Greenwich during World War One, at Hem again and finally at Marseilles, he discovered 3350 couples of low brightness and published a catalogue of them(9).

A mine engineer and amateur astronomer, Maurice Duruy measured double stars first with an 18cm refractor, then a 27.5 cm refractor in Nancy and later at the Observatory of Lyon at Saint-Genis-Laval (10), and at his observatory at Le Rouret near Nice. He used the diffraction grid micrometer, which is described in refs. 11 and 285. Maurice Duruy actively collaborated with the Webb Society of the United Kingdom (see ref. 11). During the same period, a young pediatrician, Dr. Paul Baize, began to measure double stars in 1925 with a 10.8 cm refractor. He obtained the permission to use the 30 cm refractor of the Paris observatory between 1933 and 1949, and the 38 cm refractor between 1949 and 1971. He made 24044 measures over 47 years. In 1943, he published a study on the mass-luminosity relationship (12) and in 1946 with Lucien Romani a method for calculating dynamic parallaxes (13).

At the observatories of Paris, Nice and Strasbourg, professional astronomers, Mme Edmée Chandon (14), who was the first woman appointed in France as professional astronomer, Michel Giacobini (15) and Pierre Fatou (16), Rose Bonnet (17) also measured visual double stars. Abel Pourteau discovered wide double stars on the photographic plates of the Carte du Ciel (18). René Baillaud, former director of the Observatory at Besançon and author of interesting memoirs (19), discovered 3016 double stars from a photographical catalogue of the sky (20).

André Danjon invented a interferometric micrometer with a half wavelength plate (21) which enabled him to make hundreds of precise measurements using the 49 cm refractor of the Strasbourg observatory. André Danjon devoted a chapter of his famous book "Astronomie générale" (22) to double stars. The micrometer invented by André Danjon led Paul Muller to invent in 1936 the double image micrometer with two glued quartz prisms (23). In his career devoted to double stars at the observatories of Strasbourg, Meudon and Nice, Paul Muller made ca. 13000 precise measurements, which were published in the Journal des Observateurs

and afterwards in *Astronomy & Astrophysics, Supplement Series* (24). Realizing that the survey made by Aitken was not complete towards the north pole, he searched for double stars in the northern sky between the declination 52 degrees and the pole after 1967 (25). Using the large 83cm refractor of Meudon and then the 50 cm refractor at Nice, he discovered 705 couples (26). Bernard Lyot invented a double image micrometer which I shall mention again below.

After his doctoral dissertation, at the proposal of André Danjon, Paul Couteau devoted his research to the observation of visual double stars. He has measured them at Nice with the refractors of 38,50 and 76 cm for more than forty years, since 1951. Exploring the sky between the declinations 17 and 52 degrees, he discovered 2700 couples (27), among which several have relatively short periods of less than twenty years. His book entitled "The observation of visual double stars" published in 1978 (28) renewed the interest of amateurs for these celestial objects. In 1986, he published a Fifth catalogue of ephemerides of visual double stars (29) and in 1988, a book entitled "These astronomers mad of the sky or the history of the observation of double stars" (30).

2. The amateurs get organized :

In 1980, Pierre Durand created a working group of amateurs, to which Paul Muller participated from the beginning as scientific adviser. In 1981, under the official name "Commission des étoiles doubles", this group became part of the Société Astronomique de France and several other professional astronomers became its scientific advisers.

The group regularly holds two meetings per year, one in Paris, the other at a place which changes each year. The creation of the group enabled tens of amateur astronomers to be initiated to the observation of double stars, notably thanks to missions at French astronomical observatories (Bordeaux, Haute-Provence, Lille, Nice, Pic-du-Midi-de-Bigorre). Other amateurs learnt the measure of wide double stars by the passage method. At the suggestion of Pierre Durand and under the guidance of Jean-Louis Agati, the working group undertook the development of the double image micrometer with a spar plate of Lyot, announced in many astronomical magazines (31). Jean-Louis Agati and René-Georges Huret (32) described in detail the principle of its operation and the design of a first series. In a sheet currently available in English, French or Swedish, the Commission des Etoiles Doubles stated the purpose of this micrometer, its requirements and technical specifications (33). This micrometer is now made and distributed by the company MECA-PRECIS, and supplied with an instruction manual elaborated by the working group.

3. Original and useful observation programs :

The two main observation programs which are conducted within the "Commission des étoiles doubles" are :

- a. the identification of couples (34) in conjunction with the preparation of the "Input catalogue" for the astrometry satellite Hipparcos and of the catalogue of components of double and multiple stars (CCDM) by Jean Dommangeat (35) of the Royal Observatory of Belgium, scientific adviser to the Commission des étoiles doubles.
- b. the measurement of "neglected pairs", namely pairs which have not been observed for decades, even since their discovery. Paul Muller established a list of such pairs for amateurs (36).

At Nice, Jean-Claude Thorel, Jacques Le Beau and René Gili regularly measure double stars with a 50 cm refractor. Jean-Claude Thorel discovered three double stars.

Other members of the group make photographs of double stars and measure their films with a measuring machine which they have built.

A keen interest has emerged for the acquisition of images of double stars thanks to charge transfer devices (CCD). Several members of the group have mastered the technique. Guy Morlet and Maurice Salaman (37) have obtained good images of visual double stars having angular separations above 1.5". Software for data reduction based on algorithms by Pierre Bacchus, scientific adviser to the Commission des étoiles doubles, and Christian Buil has been developed.

In parallel, Edgar Soulié proposed a new method for improving the orbit of a visual double star (38) and published software for orbit determination (39). René Manté (40) attacked again the determination of a first orbit of a visual double star using "Gleitpunkte" (ghost-points) introduced by Valbousquet (41).

On the other hand, the astounding evolution of the computing equipment in the course of the past few years prompts several members of the group to develop software for consulting double star catalogues and lists of measures of visual double stars. Furthermore, Jean-Claude Thorel participates to the program FIDO, which has the purpose of transferring the handwritten files of measures accumulated over the course of time by Paul Couteau on bristol cards to a computer disk.

During meetings of the group scientific lectures were given by professional astronomers in order to inform the amateurs about new observation techniques, such as aperture synthesis and speckle interferometry, and other types of double stars, such as spectroscopic binaries and eclipsing binaries.

4. Varied publications and contacts :

Pierre Durand wrote a chapter on double stars for a manual on the techniques of the amateur astronomer which appeared in 1987 (42). Edited by Pierre Durand and Frans van 't Veer, a special issue of the magazine "L'astronomie" devoted to double stars was published in december 1988 and contains the article of Jean-Louis Agati and René-Georges Huret quoted above (see ref. 32).

Jean-Claude Thorel (43) and Jacques Le Beau (44) publish their measures in the magazine "Observations et Travaux" of the French Astronomical Society and in "Astronomy & Astrophysics, Supplement Series". In the latter, Paul Baize, honorary president of the Commission des étoiles doubles since its creation until his death in october 1995, published more than two hundred orbits (45). René Gili publishes his measures in *Astronomische Nachrichten* (46).

Since its creation, the working group publishes an internal bulletin which serves as a working tool for its members. Finally, the group has established a relationship with the organizers of specialized groups in Brasil, Hungary, Spain, United-States of America, and with observers in Germany, Italy, South Africa and the United Kingdom. The Commission wishes to establish contact with professional and amateur astronomers of other countries interested in double stars.

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