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[ANONYMOUS]. [On the Composition and the Uses of a Combined Nocturnal and Sun Dial];
[ANONYMOUS], *De confectio baculi Jacob* [On Making a Cross-staff]
In Latin, manuscript on paper
Eastern France, Franche-Comté?, c. 1515-1530

12 ff., preceded and followed by three flyleaves, single quire of 12, lacking leaf or two at the end, also perhaps missing an unidentified a leaf at the beginning [perhaps containing a preface?], on paper (watermarks close to Briquet: "Lettres soudées," no. 9755, Luxeuil, 1518-1519; Dôle, 1522-1530), written in dark brown ink in a Gothic cursive script on up to 26 lines, on unruled paper, opening initial H with pen flourishing, tables placed in the body of the text, modern inscription imitating Gothic lettering on third front flyleaf: "Cy est manuscript de Astronomie." Bound in a modern half binding of polished tan calf, boards covered with marbled paper, smooth spine with title gilt: "Astronomie" (Sound condition).
Dimensions 190 x 145 mm.

An important resource for the study of late medieval and early Renaissance Gnomonics—the art and science of constructing dials—, this manuscript contains two unpublished astronomical treatises on how to build and use 1) an instrument that appears to be a nocturlabe combined with a sundial and 2) a cross-staff. Neither treatise is recorded by Thorndike and Kibre, but both figure in the Jordanus database of scientific manuscripts, which records just one copy of the former and five of the latter.

PROVENANCE

1. Script and watermarks suggest an Eastern France origin for this manuscript, likely the Franche-Comté region, or even the Lyonnais. We do not know the name of the scribe (nor the author, since both treatises are to this day anonymous), whose only intervention is placed at the end of the first treatise on the Nocturlabe and Sundial: "Pro scriptore ora" (f. 11).

2. Private Collection, France.

TEXT

f. 1, Table of contents, heading, *Hec sunt utilitates punctis (?) instrumenti infrafiendi* [Here are the uses of the present instrument]; "Prima utilitas est de hora noctis / Secunda de quantitate eiusdem noctis actque [sic] diei / Tercia de ortu solis et occasu eiusdem ac semidiurni et seminocturni eiusdem / Quartu de mense usuali et de die cuiuslibet mensis quota sit / Quinta de hora diei / Sexta de equinocis vernali et automnali / Septima de solsticio hiemali et estivali / Octava de altitudine solis et

stellarum / Nona de excelsarum rerum mansuratione / Pro instrumenti compositione pro quod faciliter hora noctis in tempore secundum integrum sine medium horologium ortus occasusque solis cum quantitate diei et noctis quis habent faciliter poterit sequitur."

ff. 1v-11, [Anonymous]. [On the Composition and the Uses of a **Combined Nocturnal and Sun Dial** (*Horologium diei et noctis*)], incipit, "Primo sumatur asser planis equalis spicitudinis..."; chapter 2, "Capitulum secundum de preparatione rotulo *medii horologii*..." [our italics: here figures the designation "horologium"]; heading, *Nota de utilitate istius instrumenti* [Note on the use of this instrument]; explicit, "[...] utilitatibus istius instrumenti. Pro scriptore ora";

This small treatise contains a description of the composition (or the steps to follow in order to build one's own instrument) and the various practical applications of an unidentified astronomical instrument. The instrument is not named specifically (a first leaf or preface could be missing, where the actual name of the instrument may have been provided for the reader). However, it seems more than plausible that the instrument described could be a nocturnal combined with a sundial, as the uses point directly to those ensured by these instruments. The instrument is made of wood, with parchment or metallic elements ("[...] post ea rotula quedam de forti pergameno aut alio metallo..." (fol. 2). We have located a single other copy of this text, Vatican, Codices Palatini Latini 1384, ff. 55-57v, "Horologium diei et noctis" (see "Online Resources" Jordanus, *An International Catalogue of Mediaeval Scientific Manuscripts*). The Vatican manuscript is also anonymous.

After a detailed description of the different steps necessary to build the instrument, whose base is made out of wood (*asser planis*), the treatise lists and provides explanations on the practical applications of the instrument, which was clearly devised as an astronomical surveying instrument. There are nine applications for the instrument, including determining time at night, assessing the length of night and day, determining the time of sunrise and sundown, but also determining time during daylight, precessions of equinoxes and solstices, the height of the sun and stars etc. (nine "uses" are listed on f. 1 and detailed further on ff. 8v-11). The designation of the instrument as "horologium" is found in a number of instances (f. 1, heading; f. 2: "Capitulum secundum de preparatione rotulo medii horologii..."). **Typical uses** of sundials and nocturnals—much like astrolabes and quadrants (an astrolabe reduced to a quadrant with no moving parts)—include finding the time during the day or night (as here in the present treatise that details the various uses of the described instrument: "Prima utilitas est de hora noctis"; "Quinta de hora diei"), finding the time of a celestial event such as sunrise or sunset ("Tercia de ortu solis et occasu eiusdem ac hora semidiurni et seminocturni eiusdem"; "Octavia de altitudine solis et stellarum").

Nocturnals and sundials, as well as quadrants and astrolabes, were widely used in Europe in the late Middle Ages and Renaissance, peaking in popularity in the fifteenth and sixteenth centuries. They constitute basic astronomical education tools, also essential to maritime navigation. Knowledge of astronomy was considered to be fundamental in education, and skill in the use of the astrolabe was a sign of proper breeding and education. Geoffrey Chaucer thought it was important for his son to understand how to use an astrolabe, and his 1391 treatise on the astrolabe demonstrates a high level of astronomical knowledge. Astrolabists, such as the famous Jean Fusoris or his student Henri Arnaut, were also fabricators and inventors of other astronomical instruments, a logical extension of their expertise (Jean Fusoris built astronomical clocks for such important patrons as the Duke of

Orléans in 1397-1398, as well as the famous Horloge of the Cathedral of Bourges; see Poulle, *Un constructeur d'instruments...*, 1963, "Horloges," pp. 27-40). Gnomonics—the art and science of constructing dials—was a recognized branch of applied mathematics from the Greek antiquity on. The variety and technical precision of ancient sundials and nocturnals that survive show us that ancient dialers were prolific and inventive.

ff. 11v-12v, [ANONYMOUS], *De confectio baculi Jacob* [On making a Cross-staff], heading, *Baculus Jacob*; incipit, "Si vis baculum Jacobi artificialiter conficere accipe virgam unam quadratum vel rotundam..."; explicit, "[...] spacium inventum inter duas stationes quod significant altitudinem..." [text breaks off].

This is a brief treatise concerning the construction and use of the "Baculus Jacob" or Cross-staff which appears to be anonymous, but is heavily indebted to Levi ben Gerson's chapters concerning the "Baculus Jacob" in his work *Wars of the Lord*.

The "Baculus Jacob" or Cross-staff or Jacob's staff (in French "arbalestrille") is an early astronomical instrument used to measure angles. It was mainly used as a navigational instrument and is considered to be functional predecessor of the octant and the sextant, enabling mariners to measure angular separation between two celestial bodies. Levi ben Gershon or Gersonides (1288 - 1344), Biblical commentator, mathematician, and astronomer (sometimes referred to as the "greatest Jewish philosopher after Maimonides") popularized the "Baculus Jacob." He composed in Hebrew around 1318 an important work entitled *Wars of the Lord*, with Treatise V, Part I devoted to Astronomy, in which one finds the description and uses of the Cross-staff. These chapters were translated into Latin by Peter of Alexandria (see Paris, BnF, MS lat. 7293, ff. 9-17) and Jacob's staff was called "revelator secretorum" because the staff allowed many astronomical secrets to be solved.

We have traced only five manuscripts containing this anonymous treatise, found with various titles. These are: Paris, BnF, MS lat. 7717; Paris, BnF, MS lat. 10266 (see E. Poulle, *Un constructeur...*, 1963, p. 84: "Deux textes anonymes de la B. N. ont trait à son usage, uniquement géométrique... Si vis artificiose baculum Jacob conficere..."); München, Universitätsbibliothek, Cod. 746, Gotha, Forschungs- und Landesbibliothek, Chart. B 1423; Jena, Universitätsbibliothek, El. phil. qu. 3; Wolfenbüttel, Herzog August Bibliothek, Cod. Guelf. 1127.

LITERATURE

Freudenthal, Gad. "Levi ben Gershom as a Scientist: Physics, Astrology, and Eschatology," *Proceedings of the Tenth World Congress of Jewish Studies, Division C, Vol. 1: Jewish Thought and Literature* (Jerusalem, World Congress of Jewish Studies, 1990), pp. 65-72.

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Horsky Z. and Otilie Skopova. *Astronomy Gnomonics. A catalogue of instruments of the 15th to the 19th centuries in the collections of the National Technical Museum, Prague*, 1968.

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Poulle, Emmanuel. *La bibliothèque scientifique d'un imprimeur humaniste au XVe siècle: catalogue des manuscrits d'Arnaud de Bruxelles à la Bibliothèque nationale de Paris*, Geneva, Droz, 1963, p. 70 (n° 25).

Poulle, Emmanuel. *Un constructeur d'instruments astronomiques au XVe siècle. Jean Fusoris*, Paris, Champion, 1963.

Poulle, Emmanuel. "L'astronomie latine au XIVe siècle," G. Dahan, ed., *Gersonide en son temps*, Louvain, Peeters, 1991, pp. 253-64

Steinschneider, Moritz. "Levi ben Gerson und der Baculus Jacobi," in *Bibliotheca Mathematica* 4 (1890), p, 107.

Thorndike L. and P. Kibre. *A Catalogue of Incipits of Mediaeval Scientific Writings in Latin*, London, Mediaeval Academy of America, 1963.

ONLINE RESOURCES

Jordanus, *An International Catalogue of Mediaeval Scientific Manuscripts*
<http://jordanus.ign.uni-muenchen.de/>

Overview of Astrolabe Principles
<http://www.astrolabes.org/>
<http://www.astrolabes.org/history.htm>

On the Nocturlabe and the Astrolabe
http://www.louisg.net/mesure_temps3.htm

On the Astronomical Clock
http://en.wikipedia.org/wiki/Astronomical_clock

On the History of Sundials and Gnomonics
<http://www.sundialsoc.org.uk/>

Example of a cross-staff
<http://www.adlerplanetarium.org/research/collections/4d.shtml>

Bibliography on Levi ben Gerson
<http://hcc.haifa.ac.il/Chairs/Wolfson/gersonideana/science.htm#astronomy>