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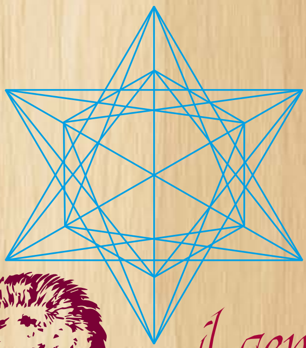
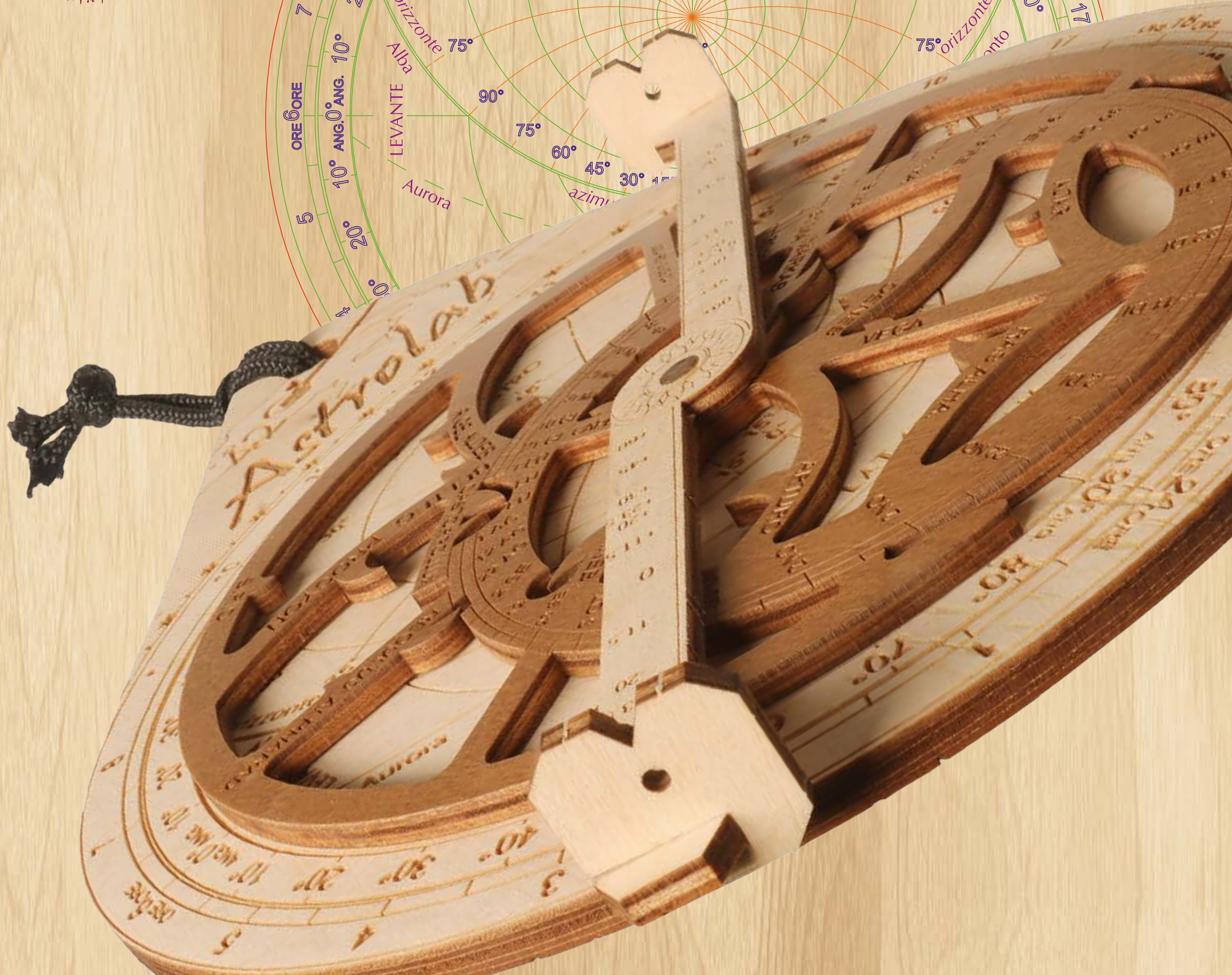


il genio in Bottega



progetto di Giovanni Paltrinieri

BRIEF GLOSSARY

ALTITUDE: The angular value of the arc that measures how high a star is above the horizon.

AZIMUTH: The angular value of the arc formed on the horizon between the position of the star and the meridian.

SOLAR DECLINATION: It is the angle that the Sun's rays form with the Earth's equatorial plane. The declination varies throughout the year between two extremes: approximately +23°27′ at the summer solstice, and approximately -23°27′ at the winter solstice. The declination is 0° when at the equinoxes.

ECLIPTIC: It is the Earth's orbit around the Sun, ideally projected in the sky, identifying itself with the great circle of the celestial sphere, apparently described by the Sun in its annual course. It is inclined to the Equator plane by about 23°27′.

EQUINOX: The moment when the Sun, moving along the Ecliptic, is found in the plane of the celestial Equator. This occurs twice a year: March 21 (Spring Equinox) and September 23 (Autumn Equinox).

CENTRAL EUROPEAN MEAN TIME (CEMT): It is the Italian Civil Time, which corresponds to the second time zone and is one hour ahead of Greenwich Civil Time.

PINHOLE: It is a small hole made on the wall of a "Camera Obscura." The sun's rays, passing through it, project inside it, reproducing the image of the star on the ground or the opposite wall. In the case of an Astrolabe, the Sun will project a ray of sunlight on the opposite base of the Alidade (see below).

GNOMON: An opaque body whose shadow, projected on the dial of a Sundial, indicates the time.

NADIR: It is the South Pole of the horizon, that is, the point of the invisible celestial hemisphere, intersected by the extension of the plumb line.

PRECESSION OF THE EQUINOXES: It is the result of a cyclic movement of the orientation of the Earth's rotation axis relative to the ideal sphere of fixed stars. It has a duration of about 25,800 years. The Earth's axis undergoes a precession and therefore a rotation of the axis around the perpendicular to the ecliptic, similar to that of a spinning top.
NOTE: In this discussion, Central European Mean Time is indicated, both the proper one used in the Winter Period and the Summer one (improperly called "Daylight Saving Time"). In both cases, it is the Civil Time in force at the moment the calculations with the Astrolabe are carried out, that is, the one indicated by our common clocks.

LOCAL TRUE TIME: It is the Solar Time of a given place: it marks 12:00 when the Sun crosses the Meridian.

TROPIC: It is a parallel of the celestial sphere that indicates each of the extreme declinations that the Sun reaches during its apparent annual motion; this occurs twice a year: June 21 (Tropic of Cancer) and December 21 (Tropic of Capricorn).

ZENITH: It is the point where the vertical passing through the observer meets the Celestial Sphere.

WARNING: Both the designer (Giovanni Paltrinieri) and the manufacturer of this instrument (Multitranciati srl) assume no responsibility for improper use of this educational instrument.

The ASTROLAB-42 has been created exclusively to be used as described in this operational manual, a manual that is considered inseparable from the instrument and vice versa. This operational manual must always be consulted before any type of measurement; the optical procedures described therein must always be carried out to the letter to avoid improper use of the object, which could cause permanent eye damage.

The most complete and sophisticated astronomical instrument of antiquity is certainly the Astrolabe. This analog machine allows for the rapid resolution of numerous spherical astronomy problems while simultaneously providing important topographical information. The oldest description of the construction and use of the Astrolabe that has come down to us dates back to the 6th century, authored by John Philoponus of Alexandria (490-566).

Although the name of its inventor is unknown, many historians attribute it to Hipparchus of Nicaea, born around 190 BC. It is known that he, along with Ptolemy, already made use of it, although its description is not present in the Almagest but only in minor works. Most likely, Hipparchus synthesized already existing instruments into one that was capable of immediately solving very complex astronomical problems. Over the centuries, it was gradually perfected. In Europe, the Astrolabe arrived only in the 11th century when it was introduced to Spain by the Moors, from where it quickly spread to all of Christendom. Its decline occurred only around the 17th century when it was replaced by the sextant and more modern machines. Its name derives from the Greek “astron” (star) and “lambano” (to take). Initially, many instruments with very different shapes and uses were called Astrolabe, all useful for locating stars in the sky. The concept of the Astrolabe uses the principle of “Stereography,” that is, the projection of the sphere onto a plane, in the same way that geographical maps are made today.

Consider the celestial sphere shown in **fig.1** in its entirety, intersected in half by the plane “Y-Y-Y-Y,” which constitutes our horizon and at the same time the plane of celestial projection with the point “A” understood as our Nadir. The point “o” (zero) is where we are on our horizon, which has “Z” as our Zenith. Now, suppose we observe the star “B” in the sky: it is indicated on the projection plane at B1. And so every other star or celestial object above our horizon. The position of “B1” on the plane is thus a perfect reproduction of what we observe on the celestial hemisphere.

From this simple but fundamental consideration, already two millennia ago, an instrument capable of projecting all celestial positions of the Sun and Stars onto a plane was created, excluding calculation but using only the theories of plane and spherical geometry. Geometry, in fact, was the only system in antiquity for solving mathematical calculation problems. The concept of the number Zero, for example—being a non-quantity—was philosophically impossible to express, as were negative numbers. Over the centuries, the shape of the Astrolabe has seen numerous variations, adapting to the needs it encountered over time; thus, the Height Clock, the Azimuthal, and the Stereoscopic were born. The Astrolabe described in these lines (to facilitate understanding and use) is presented in a simplified form and has the merit of having a didactic function particularly aimed at those who are not familiar with this instrument. This version is titled “**Astrolab-42**” because it only considers the Latitude of 42° North: a parallel that passes through Rome, that is, roughly in the center of Italy. The further we move away from it, the less precise it will be, but given the size of the Astrolabe, the latitude values within which Italy is situated, and its particular realization, the quality of the product is globally acceptable.

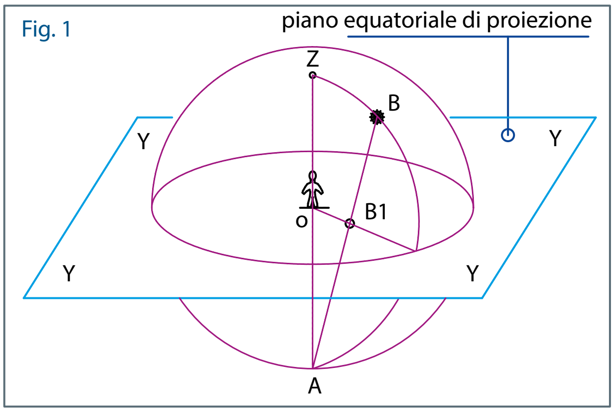


Fig. 1 *The stereographic concept of the Astrolabe equatorial projection plane*

Fig. 2 *ASTROLAB-42 in its complete form.*

The present instrument is considered in its basic essence, so as to make it easy to use even for those who have no familiarity with the world of astronomy and celestial instruments. It consists of three overlapping parts:

- **The Mater + Tympanum**
- **The Rete (with the Ecliptic)**
- **The Alidade**

THE MATER + TYMPANUM

In its most classical conception, this part is composed of two pieces: the mater, which serves as the base of the instrument, bearing an external division into 24 hours, and the tympanum, which carries a series of altazimuthal angular values arranged along the circumference. Here, however, to simplify the instrument, the Mater and Tympanum are one and the same: the latter calculated for the Latitude of 42°. Hence the name: "ASTROLAB-42."

Figure 3 provides the specifications for each series of lines present in this Astrolabe, to clarify the operational description discussed in the following pages. The center of the Tympanum coincides with the celestial North Pole and corresponds to the center of the stereographic circles of the Tropic of Cancer, the Equator, and the outermost Tropic of Capricorn, which marks the maximum visibility dimension of the celestial sphere. The stereographic Zenith of the observer, from which the azimuthal angles (azimuthal grid) and the Circles of Altitude (or Almucantars) (altitude grid) relative to the observer's position radiate, is located in a decentered position. Further down, we find the tracing of the Oblique Horizon (Sunrise–Sunset), and more distantly, the curve of Dawn and Twilight, calculated for a position of the Sun 18° below the horizon, marking the beginning and end of daylight diffusion. Additionally, the initials of the four Cardinal Points according to their ancient names are reported on the outside:

1) Cardo or meridian axis = north-south = austro – tramontana.

2) Decumanus = east-west = levante – ponente.

In practice, the instrument will only show celestial bodies that surpass the Oblique Horizon, which we can actually see both day and night in the sky relative to our location; those outside the Oblique Horizon are therefore invisible.

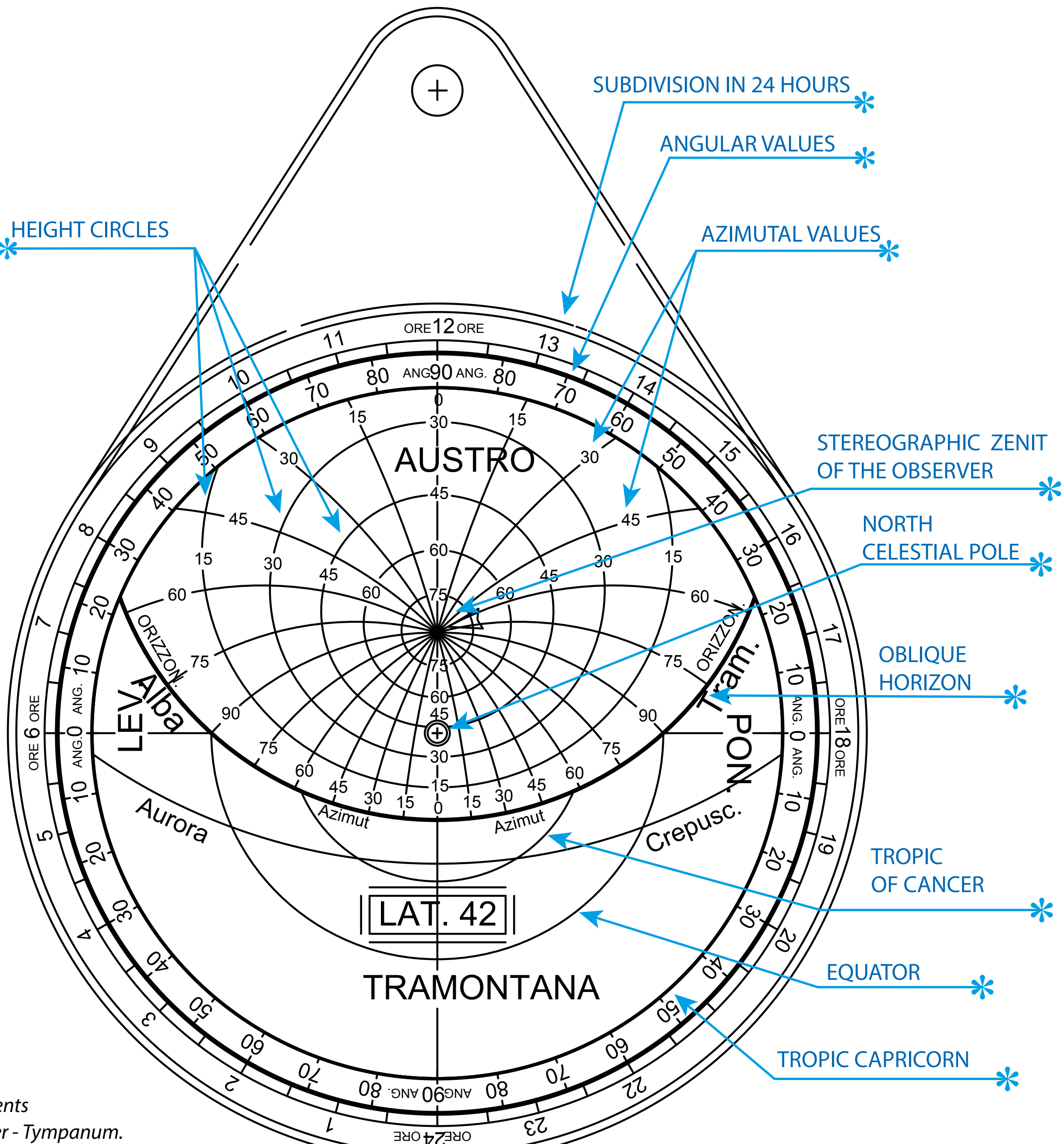


Fig. 3 *The components of the Mater - Tympanum.*

THE RETE AND THE ALIDADE

The RETE (Figure 4) is the second component of this instrument. It is called so because it consists of a grid on which both the annual path of the Sun in the celestial vault and a certain number of the brightest stars in the firmament are described. It features a decentered circle along whose circumference the days of the year around the 10th, 20th, and 30th of each month are marked. This is the Ecliptic, or Zodiacal Circle, which has as its base reference the date of March 21st, corresponding to the Spring Equinox. Usually, along this circumference, the sequence of zodiac signs is marked, which the operator refers to for setting the instrument; in our case, however, to facilitate use, the dates corresponding to the position of the Sun at intervals of about 10 days each have been directly inserted. Thus, it is always important to remember that the daily position of the Sun (sun point) throughout the year is indicated along this circumference.

The outermost circle of the Rete coincides in size with the circle of the Tropic of Capricorn on the Tympanum. Additionally, the Rete features 20 of the brightest stars in the sky; their positions on it are thus closely tied to that of the Ecliptic and derived from equatorial coordinates relative to the current Mean Equinox. These coordinates slowly change over time due to Precession, causing the instrument to gradually become less accurate. The lunar-solar Precession increases the longitude of the ecliptic by 50" per year, while the latitude remains unchanged. Consequently, the position of the stars on the Rete can be used to deduce with reasonable precision the date of an ancient Astrolabe's construction, provided the author created it accurately. The stars usually present on the Rete are of the first magnitude or otherwise well-known references for those familiar with them. In our Astrolabe, in pursuit of general simplification, there are 20 stars listed here with both their modern and classic names from Arabic nomenclature:
Alfa Tau: Aldebaran - Beta Ori: Rigel - Alfa Aur: Capella - Alfa Ori: Betelgeuse - Alfa C.Maior: Sirio - Alfa Gem: Castor - Alfa C.Minor: Procyon - Beta Gem: Pollux - Alfa Hya: Alpharad - Alfa Leo: Regulus - Alfa Uma: Dubhe - Beta Leo: Danebola - Alfa Vir: Spiga - Alfa Boo: Arturo - Alfa Oph: Ras Alhague - Alfa Lir: Vega - Alfa Aql: Altair - Alfa Cyg: Deneb - Beta Peg: Scheat - Alfa Peg: Markab.

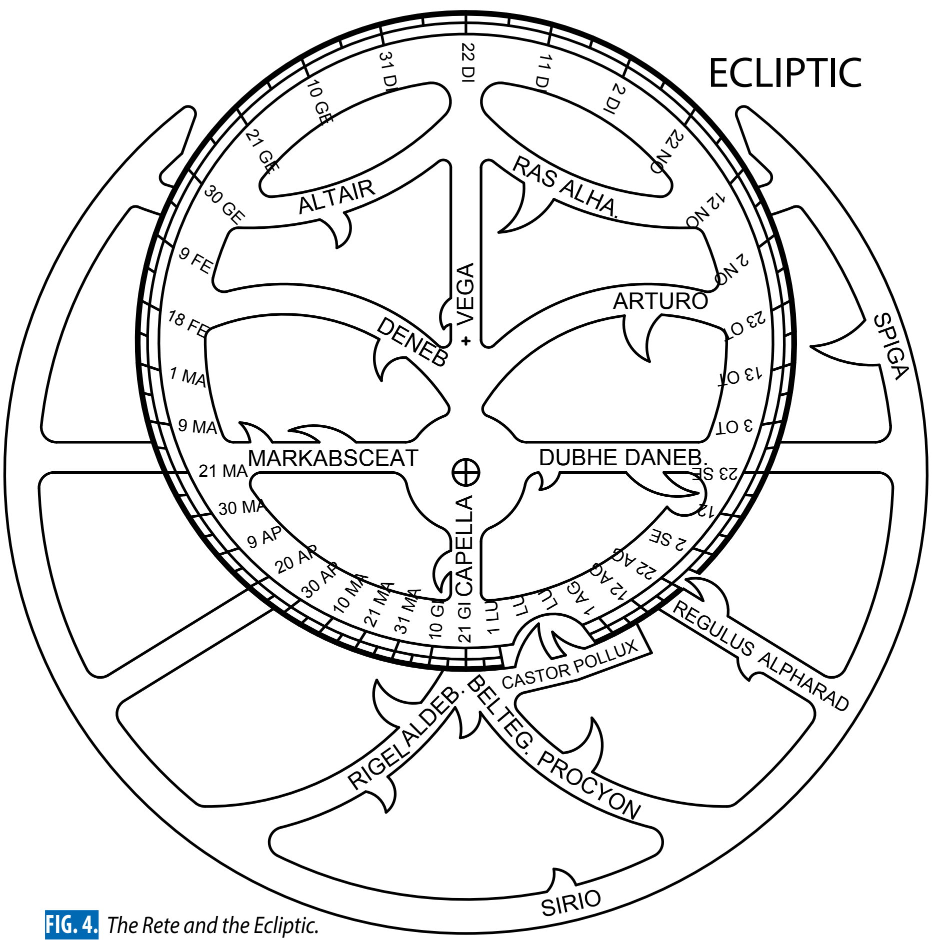


FIG. 4. *The Rete and the Ecliptic.*

THE ALIDADE

The ALIDADE, or Index (Figure 5), is the final component of our instrument. It bears the values of the Sun's Declination along its two arms. The Alidade essentially functions as a ruler that rotates around the central axis to find the correct alignment (sighting line) and primary reference of the instrument. The two opposing ends (bases) allow the determination or formation of an angular value, both in height and azimuth. This is achieved by having sunlight pass through the pinhole on one base and align with the other base, aligning or rotating the Alidade's sighting line to the desired angular or hourly direction.

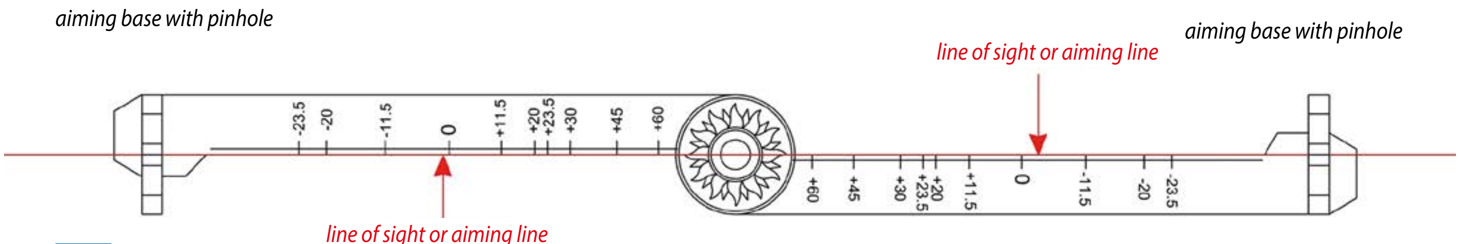


FIG. 5 *The Alidade.*

line of sight or aiming line

THE MEASUREMENT OF TIME

Before delving into the practical use of our Astrolabe, it is essential to make some fundamental considerations regarding the "Measurement of Time." The Astrolabe always refers to the "Local True Time" (LTT), which is the time of the location where the observer is. It is divided into 24 hours, with 12 o'clock coinciding with the moment of Solar Noon. On our Astrolabe, this hourly sequence is titled "Division into 24 hours." In relatively modern times (late 19th century), an International Convention created the Time Zone System, ensuring that territories within the same Time Zone had a single time. The zone that includes Italy is the first zone east of Greenwich, called Central European Time (CET). (This is the time we still use today, indicated by our normal mechanical and electronic clocks). Its base Meridian has a Longitude of 15° EAST (also called: the Meridian of Etna). From it, four-minute increments for each degree of Longitude extend in both directions, with Positive or Negative signs (see the "Italy-Longitude and Minutes" Map).

NOTE: In this discussion, Central European Time refers to both the standard time used in the Winter period and the Summer time (improperly called "Daylight Saving Time"). In both cases, it is the Civil Time in use at the time of the operation with the Astrolabe.

The transit of the Sun at the Meridian - and consequently the 12:00 Local Time - does not remain constant throughout the year due to the eccentricity of Earth's orbit. The difference that arises from the uniform time is called the "equation" (see the "minutes equation of time" table), and it can be either Positive or Negative. Therefore, to convert from one time to another, we offer here a completely new system, which involves two possible paths, each requiring two very simple mathematical operations as shown in Figures 6A-6B-6C. Figure 6 consists of two tables. The first, Figure 6A, presents a map of the Italian peninsula: it shows the progression of Longitude values from Greenwich at the top, and below, the minutes of Time that differ from the Base Meridian of our Time Zone, which has a Longitude of 15° East of Greenwich. These values in minutes can be either positive or negative. The second table, Figure 6B, presents the minutes of the Equation of Time, whose value, either positive or negative, covers the entire sequence of the twelve months of the year. At the bottom, Figure 6C indicates the operational method, which we illustrate here with an example:

Time transformation to convert from local true time to TMEC From the initial time, add or subtract the minutes indicated on the Italy map, and those indicated on the equation table. If Daylight Saving Time is in effect, add 1 hour. Suppose a Sundial in Genoa (on the Map = + 24 minutes) on July 1st (Equation = + 4 minutes) shows 12:00. During this period, Daylight Saving Time is in effect.
What will be the corresponding time in TMEC, i.e., the Italian Civil Time? Starting from 12:00, we add 24 minutes (since the sign on the map is positive), then we add another 4 minutes (since the Equation has a positive sign). Lastly, we add 1 hour (because Daylight Saving Time is in effect). Result: 12:00 + 0:24 + 0:4 + 1:0 = 13:28 Consequently, considering the example of 12:00 Local True Time, i.e., Local Solar Noon, it follows that at 13:28 TMEC (i.e., the time on our wristwatch), we can trace the shadow of a plumb line on the ground, and we will obtain a perfect Meridian Line running North-South.

TIME CONVERSION FROM "CET" TO LOCAL TRUE TIME

From the initial time (as indicated by our wristwatch), add or subtract the minutes indicated on the Italy map and those indicated on the equation table in the opposite direction. If Daylight Saving Time is in effect, subtract 1 hour. To perform the time conversion, we proceed in the reverse direction compared to the previous example. For the minutes indicated on the Italy map, we invert the sign, so for Genoa, we indicate -24 minutes. For July 1st, we also invert the sign of the Equation of Time = -4 minutes. With this data, let's suppose we want to perform the conversion for Genoa, starting from the CET time of 13:28 (as indicated by our wrist-

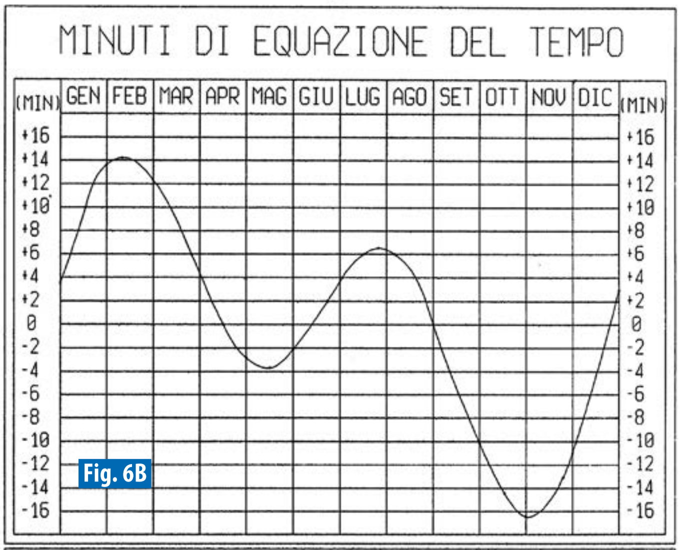


Fig. 6B

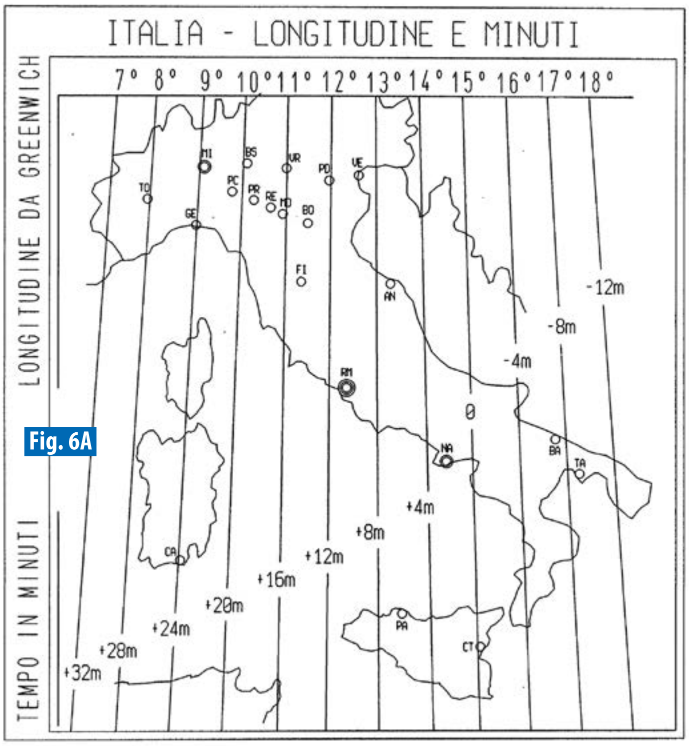


Fig. 6A

PER PASSARE DA TEMPO VERO LOCALE A TMEC:
-. Dall'Orario Iniziale, aggiungere o togliere i minuti indicati sulla Mappa Italia, e quelli indicati sulla Tavola dell'Equazione. Se vige il Tempo Estivo, aggiungere 1 ora.

PER PASSARE DA TMEC A TEMPO VERO LOCALE:
-. Dall'Orario Iniziale, aggiungere o togliere in senso contrario i minuti indicati sulla Mappa Italia, e quelli indicati sulla Tavola dell'Equazione. Se vige il Tempo Estivo, togliere 1 ora.

Fig. 6C

watch) and convert it to Local True Time (LTT). Starting from 13:28 CET, we subtract 24 minutes (contrary to what is indicated on the map), and we subtract another 4 minutes (contrary to what is indicated in the Equation of Time for July 1st). Finally, we subtract 1 hour (because Daylight Saving Time is in effect). Result = 13:28 – 0:24 – 0:4 – 1:00 = 12:00 LTT. Thus, this is Local Solar Noon.

Some General Considerations*

When working with the Astrolabe at a given CET time, we must always first convert that value to LTT by following the instructions described above. Conversely, if after an operation with the Astrolabe we want to convert from LTT to CET, we follow the other instructions described above. The results of these conversions are, of course, subject to a certain approximation due to the dimensions of the instrument and its construction. However, overall, it offers the advantage of operational speed, considering it would be more complicated to perform these operations through other means. The numbering running along the outer circumference of the Mater corresponds to the complete 24-hour rotation of the Rete, or the celestial vault. It is essential to always remember that on the Rete, the eccentric circumference corresponds to the Ecliptic, or the solar point referred to a certain date. Slowly rotate the Rete clockwise and perform a complete turn to simulate the path the star makes over 24 hours. When the solar position of the Ecliptic referred to a certain date intersects the Oblique Horizon marked with DAWN ("ALBA"), that is the moment of sunrise. In this situation, align the Alidade strip with it, and along the outer circumference, it will indicate the time when this occurs. As the hours pass, the Ecliptic continues its inexorable clockwise rotation, and consequently the solar point, until it intersects the Oblique Horizon of sunset, remains "above the Horizon." This means that the solar point, at any moment of the day, indicates the Height of the Star and its Azimuth on the dial, and additionally, through the Alidade, the time of these events.
Further information can be found corresponding to the curve at the bottom named dawn ("aurora") on one side and twilight ("crepuscolo") on the other, which allows us to determine these moments for any day of the year.

OPERATIONAL PREAMBLE OF THE ASTROLAB-42

The use of this Astrolabe is fairly simple but obviously requires some practice and a bit of good will, rewarding the user with a significant amount of information. Its setup, depending on the circumstances, can be of two types:

Vertical Setup

This operation is performed during the day, in the presence of the Sun, or at night to observe the Stars. The use of this instrument vertically is essentially "optical," suitable for measuring height values through the sight line. The operational procedure is described in the following "example no. 6."

Horizontal Setup

The use of this instrument is essentially like a "Slide Rule," except, as just mentioned, for operating with measurements on angular or azimuthal apertures. The results obtained do not require a specific setup, nor does the instrument operate in gnomonic situations.
Remember that the Tympanum has the Sun's Heights (height grid) and Azimuths (azimuthal grid) marked on it. Its operation is limited to the upper part of the Oblique Horizon, where Dawn and Sunset coincide. The two major circles are the Angular Division and the Hourly Division.
Superimposed, we find the Rete. The decentered Zodiacal Circle has along its circumference a series of dates usually referred to around the 10th, 20th, and 30th of each month.
The positions of twenty of the brightest Stars are also present, with their exact point at the tip of the arrow bearing their name.

The Alidade is the final part of the Astrolabe. It is a double ruler that bears the value of the Declination, and at the ends, two bases; sighting the Sun through one of the two pinholes

Note: Do not look directly at the Sun with your eyes, but indirectly as described in "example no. 6" – caution, risk of permanent eye damage.

The Sun projects a ray onto the opposite base; at this point, the height of the star above the horizon can be determined by reading the angular values on the tympanum.
Each base also includes a Sight which allows centering major stars at night and taking azimuthal measurements during the day.
The two arms of the Alidade are mirror images and can be used interchangeably.
The combination of the Tympanum, Rete, and Alidade allows for a wide range of astronomical operations, including Date, Height, Azimuth, and Hour. These operations can be performed during the day with reference to the Sun and at night with reference to the 20 Fixed Stars.

We conclude this discussion by presenting some examples of using the Astrolabe, demonstrating how this instrument can be considered "an exceptional computer of antiquity."

DIDACTIC EXAMPLES OF OPERATIONAL USE AND CALCULATION

When the instrument is used as a "slide rule," the azimuthal or zenithal values are estimated respectively on the "azimuth grid and/or on the altitude grid" (Figure 3) corresponding to the "solar point" found on the ecliptic (Figure 4) on the chosen date by intersecting the "sight line" (Figure 5) of the alidade, which is aligned with the chosen hour or angle for the calculation (on the tympanum). At the solar point on the Alidade, the Solar Declination is also read (see glossary). In the examples below, the lines starting with a Number refer to the operations of setting the Rete and/or the Alidade, while the lines starting with a Letter refer to the estimated readings to be obtained. All examples refer exclusively to the Latitude of 42°, and the LTT (local true time); if necessary, perform the transformation to CET.

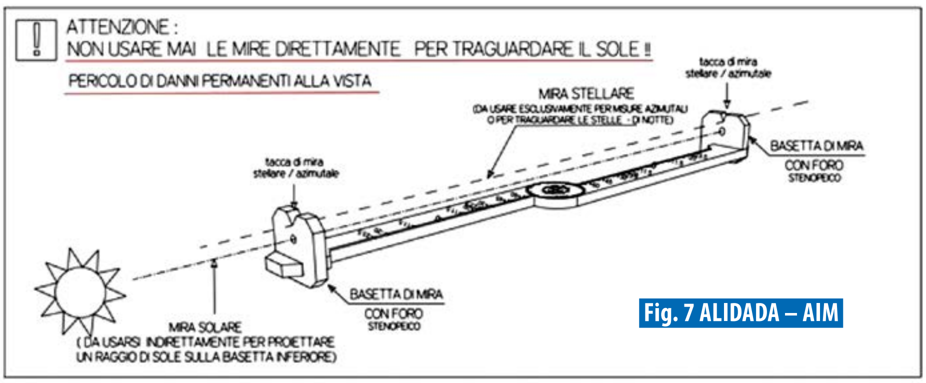


Fig. 7 ALIDADA – AIM

1st EXAMPLE: DETERMINATION OF THE DECLINATION AND HEIGHT OF THE SUN – USING THE INSTRUMENT AS A SLIDE RULE

DATE: March 21

LOCAL TRUE TIME: 12:00

UNKNOWN VARIABLES: Declination and Height of the Sun

1) Rotate the Alidade until the sight line corresponds to 12:00 on the tympanum (hour circle).
2) Rotating the Rete, align the sight line of the 12 o'clock arm with the Solar Point on the Ecliptic on March 21 (one of the two equinoctial dates).

Estimate at this intersection point:
A) Solar Declination = 0 (zero degrees). (on the Alidade)
B) Altitude of the star = 48° (on the altitude circle grid).

2nd EXAMPLE: DETERMINE THE POSITION OF THE SUN ON A GIVEN DAY AND TIME – USING THE INSTRUMENT AS A SLIDE RULE

DATE: April 9

LOCAL TRUE TIME: 16:00

UNKNOWN VARIABLES: Declination, Azimuth, Height

1) Position the sight line of the Alidade corresponding to 16:00 on the tympanum.
2) Rotate the Rete until the sight line of the 16 o'clock arm aligns with the Solar Point on the Ecliptic corresponding to April 9.

Estimate at the arm of the Alidade:
A) Solar Declination = +8°. (between 0 and +11.5, closer to +11.5).
B) Estimate on the azimuthal grid at the solar point the azimuth of the sun = 75° from South to West (towards Ponente).
C) Estimate on the altitude circle grid (at the solar point) the height of the sun = 26° (between 15° and 30°, closer to 30°).

3rd EXAMPLE: DETERMINE THE TIME OF SUNRISE – USING THE INSTRUMENT AS A SLIDE RULE

DATE: November 22

UNKNOWN VARIABLE: Time of Sunrise

1) Rotate the Rete positioning the ecliptic on November 22 at the Oblique Horizon of dawn (on the tympanum).
2) Rotate the Alidade (sight line) at this intersection.

Estimate on the outer circle of the tympanum = 7:25 LTT.

Similarly, the same procedure can be used to find the time of Sunset, Dawn, and Twilight, by positioning the ecliptic date respectively on the horizon line (on the sunset side) and/or on the dawn/twilight line.

4th EXAMPLE: ON WHAT DAYS DOES THE SUN RISE AT 7:00 LTT – USING THE INSTRUMENT AS A SLIDE RULE

1) Position the sight line of the Alidade corresponding to 7:00 (on the tympanum).
2) Rotate the Rete until the coincidences between the Alidade (7 o'clock arm), the Rete, and the dawn curve are found.

In this situation, only two dates are read on the Rete (Ecliptic) that coincide with the three indicators = November 2 and February 9.

5th EXAMPLE: FIND THE DAYS WHEN THE SUN'S HEIGHT AT 12:00 IS 30° – USING THE INSTRUMENT AS A SLIDE RULE

1) Position the sight line of the Alidade (12 o'clock arm) on the tympanum.
2) Rotate the Rete until the solar point on the ecliptic coincides along the 12 o'clock arm with the height of 30° (altitude circle grid).

In this situation, only two dates are read on the Rete (Ecliptic) that coincide with the two indicators = November 12 and January 30.

6th EXAMPLE: DETERMINE THE TIME AND SOLAR HEIGHT – USING THE INSTRUMENT OPTICALLY (CAUTION – FOLLOW THE PROCEDURES BELOW)

WARNING: When measuring the Sun's height above the horizon with the Alidade, NEVER DIRECTLY SIGHT THE STAR WITH YOUR EYES as it can harm your vision and cause permanent damage.

Always perform an indirect measurement when using the instrument optically.

This operation should be carried out exclusively by holding the instrument by the cord in its free vertical position with the fingers of one hand (at eye level). Rotate the instrument edgewise towards the Sun and observe the face of the astrolabe at a distance of about 40/50 cm; at this point, (with the other hand) rotate the Alidade until

the pinhole sight produces a bright spot on the lower base engraved on the Alidade itself. Center the engraving with the light beam, lock the Alidade in that position, and read the solar height on the Tympanum.

In this case, the instrument performs two functions:

Goniometer: Holding the instrument vertically suspended from the hole, align the sight line with the Sun (never perform direct observation!!). In this situation, read along the outer circumference the goniometric value of the Height of the Star. Suppose, for example, that on April 30 the Height of the Star is 60°.

Time Determination: Setting the instrument so that the date of April 30 on the Rete coincides with 60° Height, make the Alidade coincide with that point, which on the outer circle indicates that it is 11:05 LTT.

7th EXAMPLE: COMPASS FUNCTION WITH THE SUN – USING THE INSTRUMENT AS A SLIDE RULE AND OPTICAL INSTRUMENT

DATE: October 3

LOCAL TRUE TIME: 07:15

UNKNOWN VARIABLES: The Cardinal Points

1) Rotate the Alidade until the sight line is set to 07:15 (on the tympanum). Rotate the Rete (ecliptic) aligning the date of October 3 with the sight line of the Alidade.
2) Estimate the azimuth of the Sun on the azimuthal grid corresponding to the solar point = Azimuth from South to East 75°.
3) Trace the shadow of a plumb line on the ground at the predefined time of 07:15 on that day.
Using the goniometric circumference of the Mater, and making an angular rotation of 75°, relative to the plumb line shadow, the directions of the four Cardinal Points are obtained.

8th EXAMPLE: NAME OF AN OBSERVED STAR – USING THE INSTRUMENT VERTICALLY + OPTICALLY + AS A SLIDE RULE

DATE: June 21

LOCAL TRUE TIME: 22:00

IDENTIFYING THE STAR'S COORDINATES

1) Holding the instrument vertically by the strap, sight the star with the notches of the Alidade and read the height value on the tympanum.
2) With a compass, identify the azimuthal values of the star. Suppose these readings are: Star Height: 25°; Star Azimuth: 45° from South to West

UNKNOWN VARIABLE: Star identification

3) Align the sight line of the Alidade with the indicated hour (on the Tympanum).
4)Identify the Solar Point on the Ecliptic for the date of June 21, at the intersection of the sight line.

A) In this situation, orient the instrument with the Cardinal Points and examine the part of the sky on the Tympanum + RETE corresponding to the coordinates Height = 25° and Azimuth = 45° from South to West. It is quickly found that the star in question is Spica.

9th EXAMPLE: DETERMINE THE RISE AND SETTING TIMES OF A STAR – USING THE INSTRUMENT AS A SLIDE RULE

DATA: STAR RIGEL

DATE: September 22

UNKNOWN VARIABLES: Rise Time

1) Position the curved arrow of the star in question (Rete) on the curve of the oblique horizon (Tympanum).
2) Rotate the Alidade until the arm of the sight line coincides with the date of September 22 on the ecliptic.
3) Estimate on the hour circle of the tympanum (in alignment with the sight line of the Alidade) the time = 23:40.
Similarly, the sunset time can be determined = 10:40.

And now, as a concluding example, let's consider a rule that can apply to any of the twenty stars on the Rete.

10th EXAMPLE: COORDINATES OF STARS – USING THE INSTRUMENT AS A SLIDE RULE

DATA: STAR RIGEL

DATE: March 12

TIME: 21:15 LTT

UNKNOWN VARIABLES: Azimuth and Height (Coordinates)

1) Rotate the Alidade until the sight line is set to 21:15 (on the tympanum).
2) Rotate the Rete (ecliptic) aligning the date of March 12 with the sight line arm of the Alidade. On the Rete corresponding to the curved arrow of the star Rigel, estimate 60° on the azimuth grid and 20° on the altitude grid.

The ten examples presented here certainly provide a limited idea of work and research. They are intended only to offer an initial suggestion that can easily expand into a significant educational exploration. The Astrolabe is an ancient instrument, and at the same time, very modern, deserving to be known and disseminated. Therefore, I wish our patient readers good work.

Giovanni Paltrinieri

ESSENTIAL BIBLIOGRAPHY "ASTROLABE"

The bibliography on this subject is quite extensive: the most interesting works are listed below:

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Egnazio Danti, *Dell'Uso et Fabbrica dell'Astrolabio*. Firenze, appresso i Giunti, 1578.

G. P. Gallucci, *Della Fabrica et uso di diversi stromenti di Astronomia et Cosmo grafia*. In Venezia presso Meietti, 1598.

G. P. Gallucci, *Margarita Filosofica.* In Venetia, 1600.

AA. VV. *The Planispheric Astrolabe. National Maritime Museum,* Greenwich, 1989

R. and M. Webster, *Western Astrolabes. Adler Planetarium & Astronomy Museum,* Chicago, 1998.

Jean Noel Tardy, *Astrolabes, Cartes du Ciel.* Edisud, Aix en Provence, 1999.

Raymond D'Hollander, *L'Astrolabe, Histoire, Theorie et Pratique.* Institut Oceanographique, Paris, 1999.

Pierluigi Pizzamiglio, *Astrolabi per misurare Cielo e Terra.* Editrice La Scuola, Brescia, 2007.

A. Gunella – J. Lamprey (Transl. and Edited), Stoeffler Elucidatio, *The construction and use of the Astrolabe.* 2007.

Paolo Trento, *L'Astrolabio: Funzioni, Storia, Costruzione.* Stampa Alternativa/Nuovi Equilibri, Viterbo, 2011.

GIOVANNI PALTRINIERI

For fifty years, Giovanni Paltrinieri has been dedicated to the measurement of time, writing articles, publishing books, giving lectures, and organizing exhibitions. He has numerous gnomonic achievements to his credit, which have earned him significant recognition. Among these is the monumental solar group in Bologna's Savena district, mentioned several times in the Guinness World Records, with a Sundial 36 meters in diameter. In Riccione, he built the large Sundial adjacent to the Agolanti Castle.
Equally important is the large gnomonic complex in Abano Terme, beside the Cathedral. He has worked with Tonino Guerra for the Sundials in Pennabilli and with Remo Brindisi for a marble Sundial in Bagnacavallo. In Lourdes, one of his Sundials is just steps away from the Basilica. Recently, in Isnello (PA), he created a series of monumental Sundials in the square in front of the Planetarium of the Astronomical Center. Paltrinieri collaborates with Superintendencies and Museums: he restored twelve Sundials in Mondovì on a single wall, made in the mid-18th century in what was then the Jesuit College.
He has conducted extensive research on the large meridian of San Petronio in Bologna, also producing popular publications to introduce this fascinating subject to schools. Giovanni Paltrinieri is a Master of Work, a Corresponding Member of the Deputation of National History for the Provinces of Romagna. He is the curator of the "Sezione Meridiane e Orologi Solari" of "AISOR – Associazione Italiana Studiosi di Orologeria."

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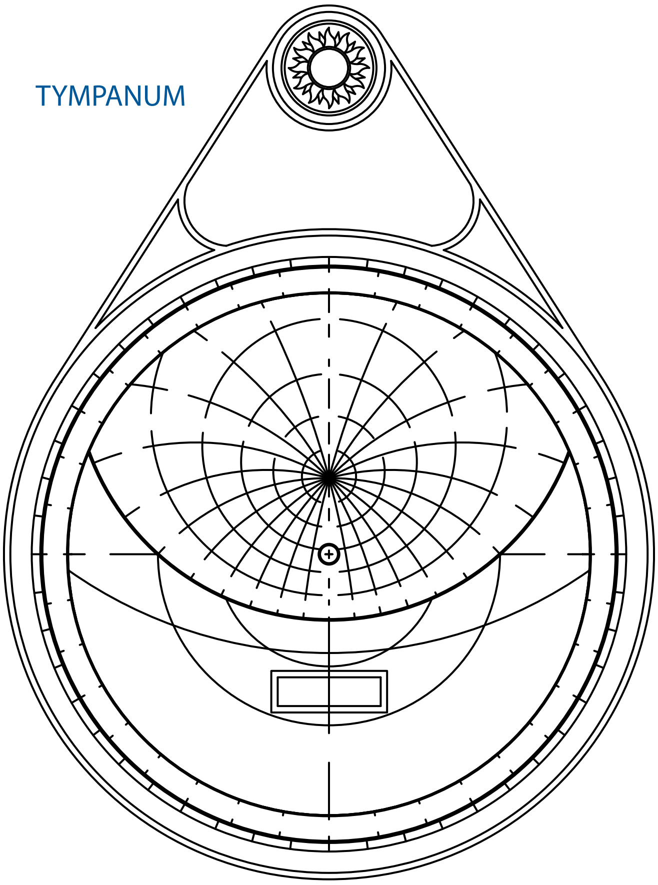
CONTENENTS OF THE BOX

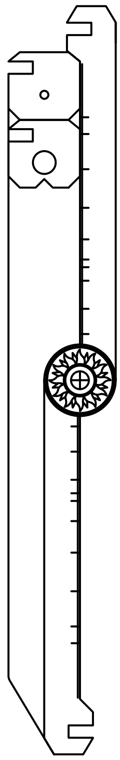
Birch plywood, 6 mm

TYMPANUM



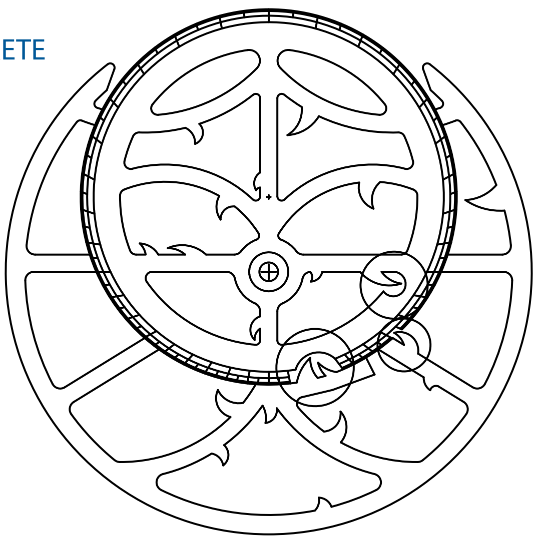
Birch plywood, 4 mm

ALIDADE



Birch plywood, 4 mm

RETE

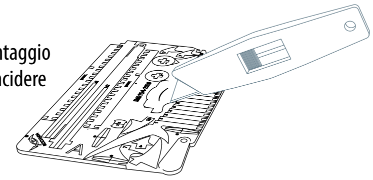


Basswood rod, 6mm

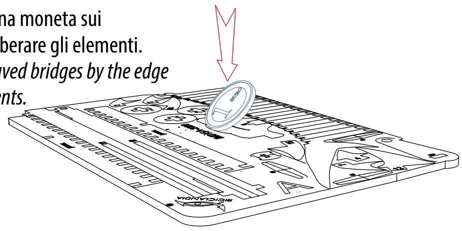
Pin, 2mm (wicker) 5 cm

Cord, 2/3mm, 30 cm
in lenght

COME PROCEDERE / *HOW TO ASSEMBLE*



Liberare gli elementi necessari al montaggio via via che servono. Per farlo, prima incidere i ponticelli che tengono l'elemento sull'insieme, da ambo le parti.
Release the elements necessary for assembly as they serve. To do so, first engrave the bridges that hold the element on the whole, on both sides.



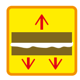
Premere con il bordo di una moneta sui ponticelli già incisi per liberare gli elementi.
Press on the already engraved bridges by the edge of a coin, to free the elements.

IMPORTANTE ! Seguire le istruzioni punto per punto e nella giusta sequenza. Prima di incollare gli elementi eseguire sempre un montaggio a secco delle varie parti. Scegliere sempre la parte migliore da mettere in vista.
IMPORTANT ! Follow the instructions in detail, step by step the right sequence. Always dry-assenbly the various parts before gluing the elements Always choose the best part to put in view.

Nel caso di errore di incollaggio usare del solvente per sciogliere la colla, poi ripulire ed asciugare gli elementi e quindi incollare in modo corretto. *In case of error of gluing use nail solvent to dissolve the glue, clean and dry the elements concerned, glue everything again, in the right way.*

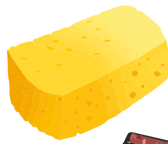
LEGENDA / *LEGEND*

Incollare (se seguito dall'identificativo di un elemento, incollare solo quell'elemento).
Glue (if it is followed by the identifier of an element, glue only that element).

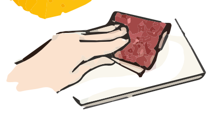


Accertarsi che la colla sia secca prima di procedere ad altre fasi con lo stesso aggregato.
Make sure that the glue is dry before carrying out other phases with the same aggregate.

Pazienza, ordine, pulizia…
e una buona dose di manualità
Patience, order, cleanliness…
and a good dose of manual skill

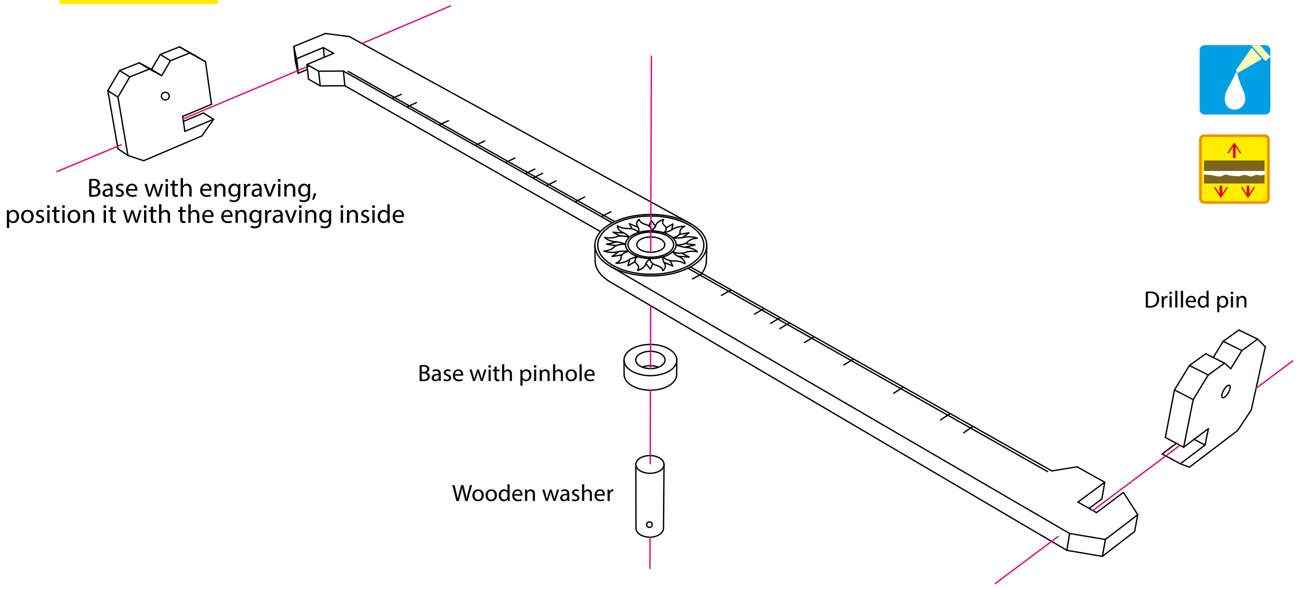


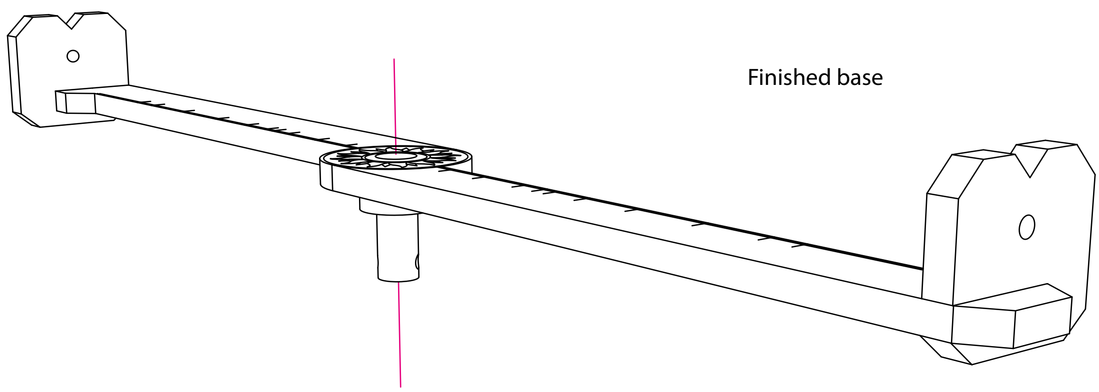
Spugnetta inumidita di acqua per pulire la colla in eccesso.
Wet sponge for cleaning excess glue.



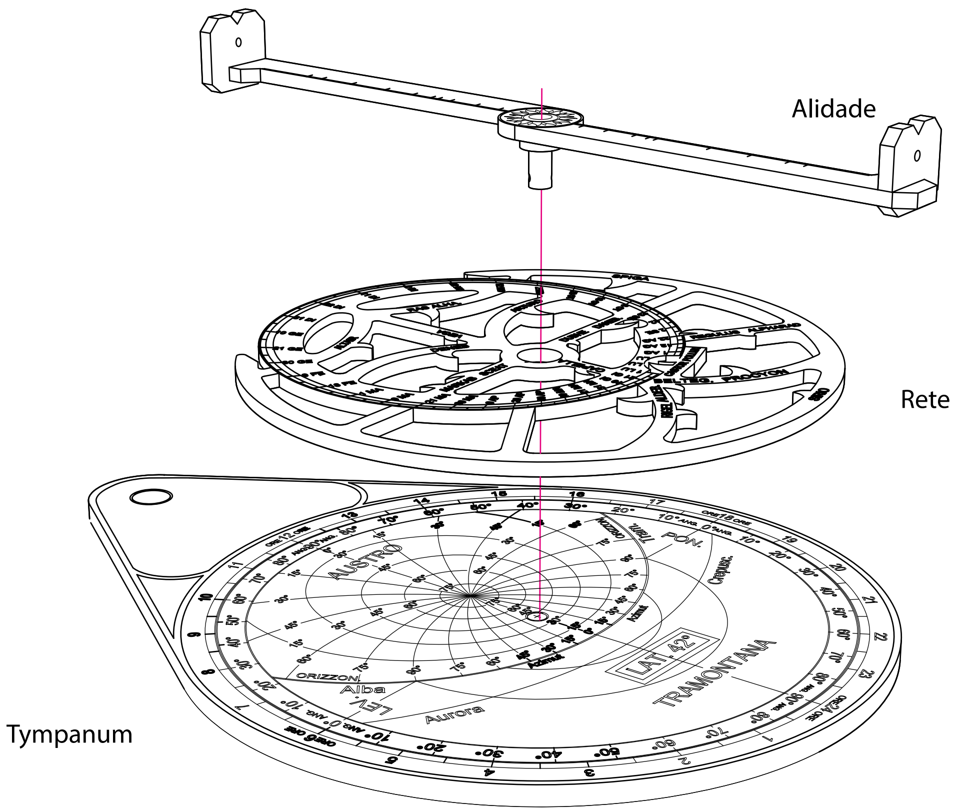
Piccolo pezzo di carta vetrata titolo 80/120 per pulire i pezzi incollati e asportare eventuali inperfezione.
Small piece of 80/120 sandpaper to clean the glued pieces and remove any inperfection.

step # 01



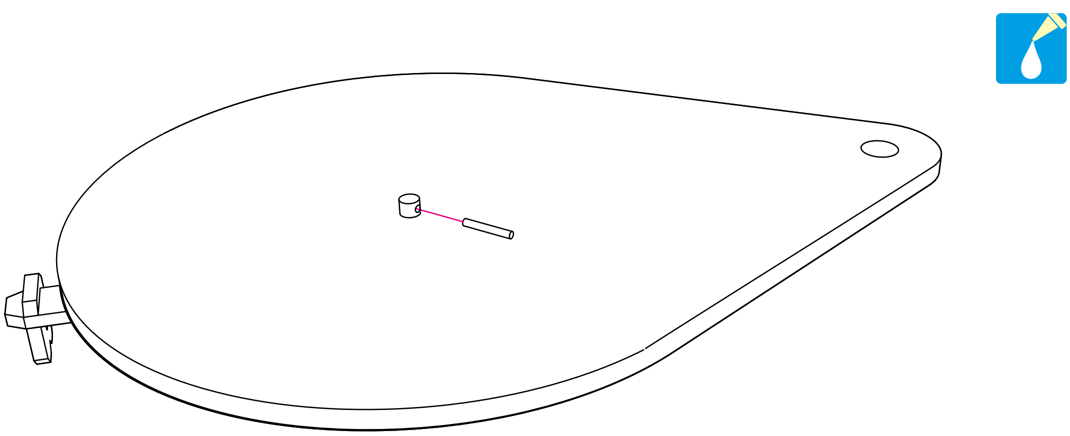


step # 02



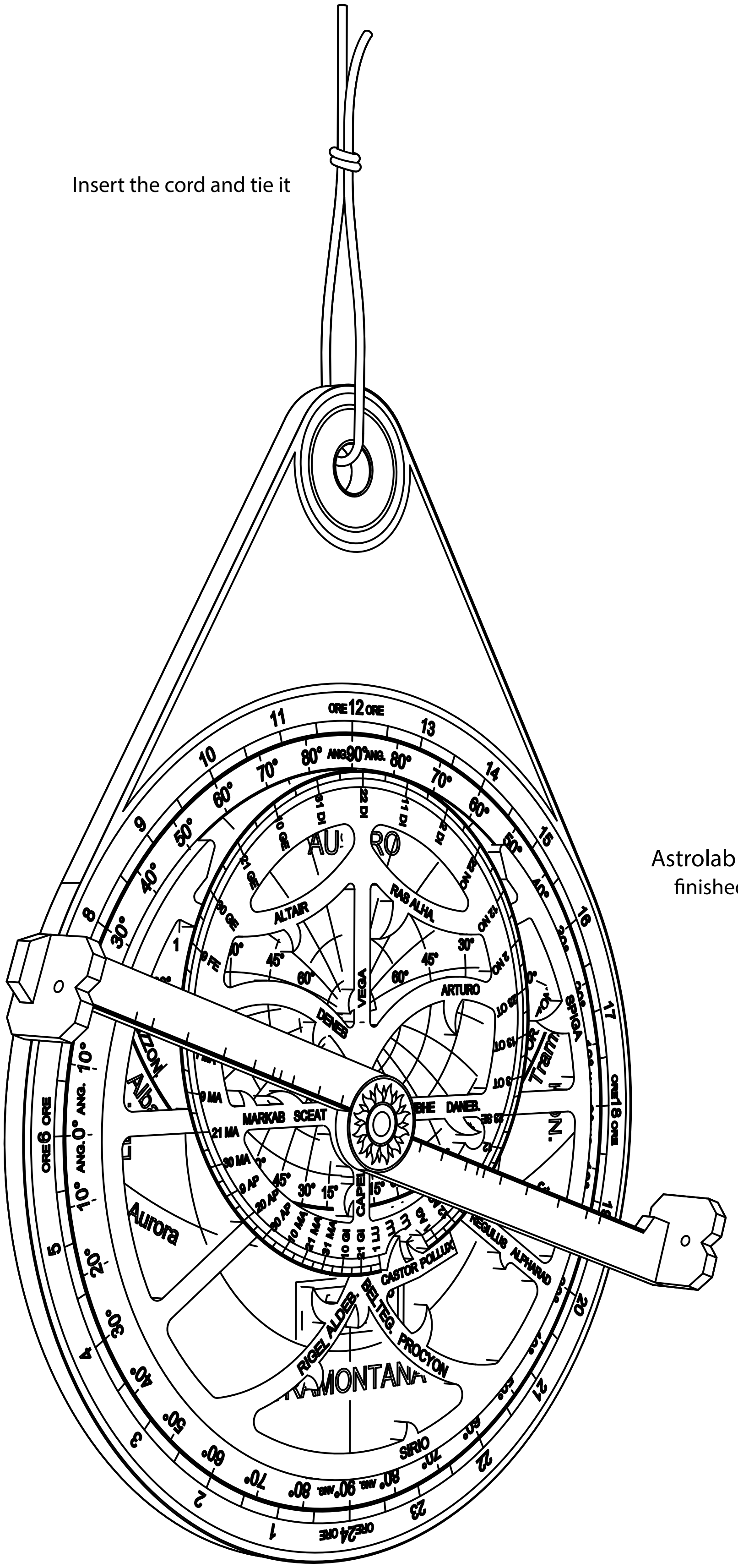
step # 03

on the back insert 1.5 / 2 cm of 2 mm wicker
to block the Alidade (a toothpick will also work)



step # 04

Insert the cord and tie it



Astrolab 42
finished

For use, carefully read the Astrolab-42 operating manual.
Improper use can cause permanent damage to the eyes.

PULIZIA Durante il montaggio è possibile che gli elementi si possano macchiare, ed è possibile che i pezzi pretagliati (di legno grezzo) presentino qualche asperità. Per risolvere questi problemi si consiglia di effettuare una pulizia locale con carta abrasiva fine (grana 80/100). *Questa operazione deve essere eseguita sotto il controllo di un adulto, data la potenziale nocività delle polveri inalabili*.

CONSERVAZIONE Una volta montato l'oggetto non necessita di manutenzioni particolari: spolverare di tanto in tanto con un pennello morbido per evitare l'accumulo di polvere.

COSA FARE SE

- Durante lo "smontaggio" degli insiemi e la liberazione degli elementi pretagliati si rompe o si danneggia o si scheggia un pezzo necessario al montaggio:
  – Non gettare i pezzi danneggiati ma incollarli subito con colla vinilica ripristinando l'elemento (il materiale del quale sono fatti è realizzato a strati. Una possibile discontinuità del materiale può determinare piccole rotture).
- Durante il montaggio viene erroneamente sbagliata un'operazione di incollaggio:
  – Se l'incollaggio è fresco e le parti si separano, ripulirle la superficie di contatto con carta vetrata e/o con solvente per unghie (*vedi istruzioni di sicurezza*), poi procedere nuovamente con il montaggio seguendo le istruzioni. Se l'incollaggio è secco e le parti non si staccano procedere allo scollamento con l'ausilio di un batuffolo di ovatta imbevuta in solvente per smalti da unghie (*vedi istruzioni di sicurezza*), tamponando più volte le parti interessate fino a che le parti si staccano, poi procedere come sopra.
- Risultano mancanti o danneggiati uno o più elementi (*Attenzione: la confezione all'acquisto dovrà essere integra e completa dell'involucro sigillante*):
  – richiedere via e-mail a posta@riciclandia.it i pezzi mancanti indicando: modello e lotto di produzione (*Lot*), allegare lo scontrino di acquisto, indicando nome, cognome e indirizzo per la spedizione, n. di telefono per contatti.
- Se l'oggetto già montato si danneggia in maniera lieve:
  – Procedere come ai punti 1 e 2. Se vengono danneggiate altre parti o se serve la sostituzione del pezzo richiedere a posta@riciclandia.it il disegno e la sagoma per ricostruire autonomamente il pezzo, oppure fare una richiesta con le stesse indicazioni di cui al punto 3 precedente, indicando come oggetto: "Richiesta materiali per sostituzione".

CLASSIFICAZIONE In base al cap. 10 dirett. Giocattoli 2009/48 il presente oggetto è assimilato ai prodotti destinati a collezionisti adulti di età pari o superiore a 14 anni (10.1.2 punto 2). Non necessita di marchio CE, ma sottostà alle regole del Codice di Consumo (dcl. 206/2009 e agg.).

SMALTIMENTO Il prodotto è formato da materiali non classificabili come rifiuti speciali e/o pericolosi, pertanto i rifiuti sviluppati sia in fase di montaggio che a fine vita del prodotto possono essere trattati come normali rifiuti domestici. Si consiglia comunque di informarsi presso gli uffici territoriali competenti per lo smaltimento consapevole.

GARANZIA Il prodotto è coperto dalla garanzia legale, prevista dalla legge vigente al momento dell'acquisto, di 2 anni. Eventuali usi impropri(*) o danneggiamenti del prodotto non dipendenti da trasporto o da rottura di pezzi dentro la confezione (*che dovrà essere integra e sigillata al momento dell'acquisto*), non sono coperti da garanzia. (* ***Si intende:*** *Uso continuo dei meccanismi. Mancata lubrificazione. Montaggio eseguito male. Uso eccessivo di collante. Altro uso non espressamente considerato nelle presenti istruzioni ed avvertenze*).

MANUALE Aggiornamenti nel sito web: www.riciclandia.it
e-mail: posta@riciclandia.it

CLEANING During assembly it is possible that the elements can get stained, and it is possible that the pre-cut pieces (of raw wood) show some roughness. To solve these problems it is recommended to carry out a local cleaning with fine abrasive paper (80/100 grit). *This operation must be performed under the supervision of an adult, given the potential harmfulness of inhalable dust*.

STORAGE Once assembled, the object does not require special maintenance: dust from time to time with a soft brush to avoid the accumulation of dust.

WHAT TO DO IF

- During the "disassembly" of the assemblies and the freeing of the pre-cut elements, a piece necessary for assembly breaks or is damaged or chipped:
  – Do not throw away the damaged pieces but glue them immediately with vinyl glue restoring the element (the material they are made of is made in layers. A possible discontinuity of the material can cause small breaks).
- During assembly, a gluing operation is mistakenly mistaken:
  – If the bond is fresh and the parts separate, clean the contact surface with sandpaper and / or nail polish remover (*see safety instructions*), then proceed with the assembly again following the instructions. If the gluing is dry and the parts do not come off, proceed with the detachment with the aid of a cotton swab soaked in nail polish remover (*see safety instructions*), dabbing the affected parts several times until the parts detach, then proceed as above.
- One or more elements are missing or damaged (*Attention: the packaging upon purchase must be intact and complete with the sealing wrapper*):
  – request the missing pieces by e-mail to posta@riciclandia.it indicating: model and production lot (Lot), attach the purchase receipt, indicating name, surname and shipping address, n. phone for contacts.
- If the object already mounted is slightly damaged:
  – Proceed as per the previous points 1 and 2. If other parts are damaged or the damage is such as to consider it right to replace the piece, ask posta@riciclandia.it for the drawing and details of the shape of the piece to be reconstructed independently, or request with the same indications as in point 3 above, indicating as object: "Request for replacement materials".

PRODUCT CLASSIFICATION According to chap. 10 direct Toys 2009/48 this object is similar to products intended for adult collectors aged 14 or over (10.1.2 point 2). It does not require the CE mark, but is subject to the rules of the Consumer Code (dcl. 206/2009 and adj.).

DISPOSAL The product is made up of materials that cannot be classified as special and / or hazardous waste, therefore waste designed both during assembly and at the end of the product's life can be treated as normal household waste. However, it is advisable to inquire at the competent local offices for responsible disposal.

WARRANTY The product is covered by the legal warranty, provided for by the law in force at the time of purchase, of 2 years. Any improper use (*) or damage to the product not dependent on transport or breaking of pieces inside the package (which must be intact and sealed at the time of purchase), are not covered by warranty.

(* ***We mean****: Continuous use of the mechanisms. Lack of lubrication. Bad assembly. Excessive use of glue. Other use not expressly considered in these instructions and warnings*).

MANUAL Updates on the website: www.riciclandia.it
e-mail: posta@riciclandia.it

Astrolab 42
Il presente strumento, considerato nella sua essenza basilare, così da renderlo di facile utilizzo anche per chi non ha alcuna dimestichezza con il mondo dell'astronomia e della strumentazione celeste, è calcolato per la Latitudine di 42°
Completamente in legno, ASTROLAB-42 Può essere montato con facilità grazie alle istruzioni illustrate. Il suo uso è facilitato da un manuale competo di esempi scritti da un esperto del settore: Giovanni Paltrinieri.

Astrolab 42
This instrument, considered in its basic essence, so as to make it easy to use even for those who are not familiar with the world of astronomy and celestial instrumentation, is calculated for the Latitude of 42°
Completely made of wood, ASTROLAB-42 can be assembled easily thanks to the illustrated instructions. Its use is facilitated by a manual complete with examples written by an expert in the sector: Giovanni Paltrinieri.

Manual in English at the web address

Il Genio in Bottega, è una linea di Riciclandia in collaborazione con ideedileonardo.it nella quale convergono tutte le idee geniali che scaturiscono dall'aria che si respira negli ambienti dove si realizzano cose complicate scherzandoci sopra, e dove gli artigiani lavorano gomito a gomito con artisti, inventori, pensatori… ***Il logo*** con il quale si identifica questa linea indica chiaramente che si tratta di una Bottega Toscana, come quelle del medioevo che si sono rinnovate, aprendosi a idee e nuovi mezzi, cambiando poco o punto nella sostanza.

***Il Genio in Bottega** is a Riciclandia line in collaboration with ideedileonardo.it in which all the ingenious ideas that arise from the air you breathe in environments where complicated things are created by joking about them converge, and where artisans work side by side with artists, inventors, thinkers... **The logo** with which this line is identified clearly indicates that it is a Tuscan workshop, like those of the Middle Ages which were renewed, opening up to ideas and new means, changing little or nothing in substance.*

Astrolab 42
7 426813 525647

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