Bulletin 01.1 English summary
R. Hooijenga, T. Brandsmastraat 42, 1964 BV Heemskerk, The Netherlands
Email: r.hooijenga@rhayward.demon.nl (home) or r.hooijenga@lvnl.nl (office)

Contents of the January 2001 Bulletin, nr. 75

01 Account of the September 2000 meeting — Secretariat

Twenty members and one guest attended. Fer de Vries showed his Sawyer Dialing Prize, an equatorial dial by Tony Moss. Later, many gnomonic topics were debated, many of which are also mentioned in this Bulletin. Ton vd Beld made a beautiful universal ring dial. Fer made a bifilar dial out of two matchboxes, a ruler, two pieces of wood and two beer mats. He used it to check a computer program. The *Chronomium*, a permanent exhibition on Time, was started. Mr. Holman is looking for better accommodation; for the time being, Chronomium is on Oostwal 8, Ootmarsum.

02 Agenda annual meeting and Chronicle of 2000 — Secretariat

In 2000, there were three meetings and a trip to Leiden. Members helped with two exhibitions. Fer de Vries received the Sawyer Prize. On 1 December, there were 165 members. Over the year, W. Coenen reported all changes in the sundial files.

02 Account of the Treasury — Treasurer

03 Meetings in 2001 — Secretariat

Vredenburg 19, 3511 BB Utrecht; on 13 January, 17 March, 23 June (sundial trip), 22 September.

03 Astronomical data 2001 — F.J. de Vries

Start of the seasons in UTC and local Dutch times, according to the Meeus algorithms.

03 Members: four resignations, four new members, three address changes. — Secretariat

03 Meetings abroad: three important ones are listed. — Secretariat

And a mention of the nice Internet site by member Frans Maes: www.biol.rug.nl/maes. See also the /genk page.

04 Sawyer Dialing Prize — J.A. Sassenburg

Frederick Sawyer III founded the North American Sundial Society NASS in 1994. In a short time, NASS has grown large and successful. Fred Sawyer is still president, and following his professional retirement in 2000 he conceived the idea of an annual prize, consisting of a specially designed sundial and a sum of money to be donated to a cause of the winner's choosing.
Fred Sawyer and NASS finance the Prize. A committee of three choose the winner. Fer was the first one on 18 August 2000. He gave the money to U of California, Berkeley, for a student's sundial project. His thank-you letter to NASS was in the September Bulletin.
The ancient Greeks used letters to indicate the hours on their dials. These were Α, Β, Γ,Δ, Ε, F, Ζ, Η, Θ, Ι, ΙΑ, ΙΒ. The 7th through 10th spell ΖΗΘΙ, which means "life". This could constitute the first use of a motto (Gatty, "The Book of Sundials"). "ΖΗΘΙ" is also on Fer's Sawyer dial, which was made by Tony Moss of England.

05 Correction B00.3 p24 "From the Rojas astrolabium to sundials" — F.J. de Vries

In this article, fig. 5 was missing. You will find it here. Also missing is a footnote *mentioning "Universal Card Dials with Nomograms for Babylonian, Italian, and Antique Hours"* in Compendium, vol 5 nr 4, Dec 1998.

06 Sundial calculations using spherical trigonometry — H.W. van der Wijck

The author is wondering why spherical trigonometry is not used more often in relation with sundials. He knows of only two treatises: J. Drecker's "Sundial Theory" of 1925 and R.R.J. Rohr's "The Sundial" of 1982, and finds that both give erroneous outcomes because of incorrect diagrams. Van der Wijck then proceeds to derive the method from the ground up, taking knowledge of certain terms for granted.
We start with the celestial sphere with its polar axis; a horizontal plane; and the dial face, an arbitrary plane through the centre. Polar axis and dial face form a pole style dial. Our aim is to find the lines on the dial face that coincide with the shadow of the pole style. By definition, all these lines meet where the pole style intersects the dial face, and they can be described by the angle between them and a reference line.
Because these angles are equal to corresponding arcs on the sphere, they can be found using spherical trigonometry. Angles that are not in the centre of the sphere cannot be found by this method, which is therefore limited to pole style dials, the reading of which does not depend on the declination of the sun.
The author now introduces the meridian plane (perpendicular to the horizontal and containing the polar axis) and the style plane (perpendicular to the dial face and containing the polar axis) in addition to the horizontal plane,

He further needs co-ordinate axes, X along the horizon and Y along the meridian. Choosing their northern intersection as the origin and the direction toward zenith as positive, the polar altitude is positive and less than 90°. The positive X direction will be the sun's motion from North over East, so that the hour angle t is positive from the origin. Now inclination i and declination d of the dial face are defined, after which several arcs and angles are drawn in the figure (see p7).
The definitive derivation is shown in full. The result is an equation that gives the angle between noon line and hour line as a function of all the variables. The formula looks unwieldy, but the author warns against attempts to simplify it by using trigonometrical substitutions. Experience shows that you will not always get valid results after that, and besides, programmable calculators can handle the full form without difficulty.

The author derives the remaining angles in part 2, immediately following the above. In the last paragraph, he shows how to use the method in the southern hemisphere. This is accomplished by having the origin in the south. Choose Y positive towards zenith, choose X positive from S to E (again following the sun) and use the altitude of the south celestial pole.

10 A wide style

F.J. de Vries

It is usual for the style triangle on a sundial to look like fig. 1. The straight edge is parallel to the axis of the earth and casts the shadow that shows the hours on the dial face. Rarely, the style is made to look like fig. 2. The photo of fig. 3 shows an historical example, an 18th century horizontal dial engraved by David Coster of Holland.
Neither of the styles poses any difficulty in drawing the hour lines when their thickness may be neglected. If the style does have an appreciable thickness we actually have two styles and two dial centres.
Considering a style as in fig. 1, one might at first think it is sufficient to cut the dial face along the noon line and separate the halves by the style thickness. Many beautiful dials were in fact done this way, but it is wrong. While the hour lines from 6h to 18h (apparent local) do have to be moved outward, the early morning and late evening lines have to be moved in. Fig. 4 shows from which dial centre each hour line should be drawn.
With a style like the one in fig. 2, the hour lines have to be moved the opposite way, as is shown in fig. 5.
The photo in fig. 6 shows a dial of this type where the hour lines were moved in the wrong direction. A correct example is fig. 7, a detail of the Coster dial face. The 6h-18h lines are moved in, showing an overlap around 12h.
In general, then, the dial face should be cut in four pieces: along and at right angles to the substyle. Depending on the type of style, two pieces should be moved in, and two out.
Other lines on the dial face use a nodus on the style. Now that we have two, all these other lines will have to undergo the same treatment. Fig. 8 shows a clear example of this (20° and 23½° declination lines).

13 Asteroid Louwman

Secretariat

It has again been the pleasure of the International Astronomical Union to name a number of minor planets after Dutch persons and a Dutch object. Among the chosen ones are: science reporter George Beekman, also the "Zenit"-editor longest in function; Mat Drummen, president of "De Koepel" ("The Dome") and co-author of the annual star guide "Sterrengids"; Peter Louwman, one of the moving forces behind the NVWS committee Moon and Planets; Nobel Prize winners Crutzen and Van Der Meer; and the artificial satellite ANS.
Dutch astronomers Van Houten and Van Houten-Groeneveld of Leiden and Dutch-North-American astronomer Tom Gehrels discovered all of these asteroids. For a complete list see www.astro.uu.nl/~wwwzenit.
"Louwman" was discovered using the Mt. Palomar 48" Smith Camera. Its orbit is between those of Mars and Jupiter, and its diameter is five to eight kilometres.
We congratulate Peter cordially with the honour bestowed upon him.

14 Self-orienting sundial

A. van der Hoeven

One of the attendants of the September meeting raised the issue of the self-orienting nature of a combination of two different sundials. The author remarked that as this nature comes from the properties of a nodus dial, these should be considered when discussing accuracy or best combination.
He distinguishes between dials where the angle between style shadow and reference plane is a measure of time, and those were the shadow position on a plane of a point in space has that function.
Fig. 1 shows how the second type is turned around until the point shadow intersects the curve for the known date. It follows that this dial really measures solar altitude, and is therefore inaccurate around noon.
Van der Hoeven now proposes to align a horizontal and an analemmatic dial so that their noon lines coincide. To adjust the analemmatic dial, the date should be known. The intersection of the pole style with the vertical gnomon depends on the date. In the course of the day, the shadow of this point moves along a hyperbola. Because the intersection of the styles changes with the date, these hyperbolas are not the same as the date curves of the point dial.
What the author finds essential is that, turning the combined dials, we do not observe the intersection of the two shadow lines, but rather the angles they make with the noon plane. "With the hour alignment correct and equal,

the noon plane of both dials will coincide with the local meridian plane". In fig. 2 this would mean that angle α (3h on the analemmatic) and angle β (3h on the horizontal) together mark point S on the date curve.
In conclusion, the author states that we can see the self-orienting property as the result of a solar altitude referenced to the horizontal (or vertical) plane, transformed to an azimuth referenced to the meridian plane.

16 Sunsphere by Randy Hess F.J. de Vries
In principle, this is an opaque, matted sphere [hollow, presumably] with an aperture in the south. The light patch on the north surface is easily visible. Instead of hour lines drawn directly on the sphere, this design has an epoxy and quartz sand coating in which the hour lines are left open. A choice of different pedestals (by artists Mulder and Stoopman) and coating colours are available. Member Jan Kragten gave extensive advice during the preparation of the design.
The manual has the owner adjust for local meridian by turning the entire sundial around its vertical axis. Strictly speaking, this is not correct: the sphere should be turned around the polar axis. In our small country, however, the resulting error is small enough to be of no practical concern.
Fer wrote a computer program that will draw Sunspheres for any latitude and show them from any direction.

18 Nieuw & St.Joosland 2 J.T.H.C. Schepman
The author describes the estate "Hof Nieuwlands Rust" from 1787. It is still in its original form. The neatly maintained garden is home of an armillary sphere. The ring diameter is 23cm (9") and the pedestal is 94cm (3') high. The enormous trumpet playing angel serves as a weathercock. This is a simple sundial, but the lady of the house told the author that her father-in-law, born 1904, and his father, of 1860, have always seen it in that place. This is really an old sundial.
In a second part, the author gives many more details about the estate. It was first built in 1648 and renovated in 1787. Ferdinandus Ferdinandusse (1786-1844) was a surveyor, and so was his grandson Ferdinant Pieter. The sundial in the garden is no surprise - Ferdinant must have known exactly where North was.

21 The Mercator Projection Mystery J.A.F. de Rijk
We all know the Mercator projection: the world maps decorating schoolroom walls are of this type. It is not a proper projection at all, even if some books show pictures like fig. 1 and 2.
The shortest route from A to B on the globe is along a section of a great circle or orthodrome. Mariners had no way of doing this; but using a compass, they were able to hold a constant course. On the globe, this is not a great circle but a line intersecting the meridians at a constant angle: a loxodrome. If followed, we find that a loxodrome "spirals" toward the pole without actually getting there at all. Although the loxodrome is the longer route, the difference is not too large for reasonable distances.
Mariners wanted charts that represented loxodromes as straight lines, but at the beginning of the era of the great discovery voyages, these were not available. Mercator first accomplished it in his 1569 world map.
Before that, he was manufacturing globes, made of papier-mâché covered in plaster on which he glued paper segments of the chart, with meridians and parallels. In 1541 he finished a 41,5cm (16") globe for Charles V's Chancellor. A few globes identical to this remain today. Remarkably, Mercator already drew a rose of loxodromes on several points of his globe. In 1569, Mercator published his large world map. Again, some copies still exist, the one in Basel being the best kept. Rotterdam has an atlas made from three copies of the map.
The Latin motto states the map is especially useful for mariners. Mercator had succeeded in making a map on which one could lay a course using a ruler.
The mystery is: how did Mercator do this? He never explained his method. A legend on the map seems to point to the construction of fig. 8. Because DC is stretched to EF, lengths AD and BC are stretched to AE and BF.
Mathematically we get $\Phi_\varphi = \ln(\tan(\pi/4 + \varphi/2))$, found by Wright (1599) and Oughtred (1632), but it is highly unlikely that Mercator knew this. The map legend could be just a description of the result.
Fig. 9 shows how Mercator could have constructed loxodromes on his globe. Using, for example, a strip of paper, he could have drawn an approximation of a small segment of the loxodrome of 60°, AB'. This was repeated from point B', etcetera. This method required craftsmanship rather than mathematics.
Once a loxodrome was drawn, the intersections with the parallels were determined. Fig. 11a/b shows how from this the parallels on the Mercator map were drawn. In short: construct a loxodrome of, say, 60°; observe where it intersects the parallel of, for example, 30°N; using the same meridians on the map, find the intersection with the corresponding (straight line) 60° course; this shows where the 30°N parallel should be drawn on the map.
The fact that the relevant dimensions on globe and map are precisely 2 to 3 seems evidence that Mercator really may have used this method.

28 The Keelven project horizontal sundial D. Verschuuren
The forests and fens south of Someren, near the Strabrecht moors, are opened up for day tourism. The author was asked to design a sundial that would fit the educational recreation concept.

As a slanting style would not fit in with the upright trees, he decided to go for a shadow plane dial. A post of 2m, 1.6m from the dial centre, would make the (invisible -) style angle arctan 1,25 = 51°20'25", not far from the 51°20' on the map. The hour markers could be anywhere as long as they were somewhere on their hour lines, so a spiral arrangement seemed appealing, with 20cm diameter hour markers. The plan was approved.
The post supplied was rather too long; driven as deeply as possible its height over ground was still 2.3m. Yet, the rope that is part of the shadow plane design should go on top of the post. - And when the hour markers arrived, they were 1m long posts of 40cm diameter, fitted with 30x30cm square yellow synthetic numberplates. Apparently, the municipal surveyor did not want them to be strewn about the woods.
That was the end of the spiral. The author placed the dial centre post, with a height difference with the first post of 2m, and determined the positions of the hour markers, now on a circle of 7m diameter
Checking the finished dial later, he discovered that - of course - his own shadow fell on the last bit of rope and on the hour marker. Extending an arm and stepping to the side solved that. A bigger shock was that his watch was an hour slow compared with the sundial. Fortunately, the informative sign reads "the dial shows DST..".

30 Sundials in The Netherlands W. Coenen

Bellingwolde: The globe dial of B85.4.27 mention is no longer here. It has moved to Assen, where it is on top of a cupboard in the house of the former owner's grandson.
Amersfoort 9: The SunPointer was out of order due to a technical problem, which was fixed a few days later.
Den Dolder, mail order company Overtoom: A black metal horizontal dial, circular dial face in a crescent shape with the pole style between the horns. Close to the building, it will only see some sunlight in summer. Motto: Where Sun shines, Time shows.
Utrecht 20: Uithof, a horizontal dial of 5m diameter, 16 four-sided pyramids for hour markers, one pyramid as south-marker. On the Utrecht "Introduction Time" exhibit of 14-18 August 2000. Some 1500 freshmen of U. of Utrecht, in one day, decorated the markers and the 2m-diameter brick centre with coloured mosaic. All freshmen received a paper sundial, an EOT graph and a sundial manual (see p33).
Leiden 15: A slightly unsightly armillary sphere of 1924 in the garden of the 1683 Jan Pesijn almshouses. Described by M. Hagen in 1987 as having a shiny black hour band, it is now rusty and bent over. Author Coenen has offered the help of the Society to the Leiden Almshouses Foundation.
Mesch 2: vertical dial on the Mesch watermill chapel from 1699. Restored using data from our secretary, who subsequently heard nothing, until word came that all work was finished!

34 Literature 1383..1394 D. Verschuuren, A. van der Hoeven

1381 Hidokei. The Japan Sundial Society was founded 25 March 2000 in Minami-mura. The official name is Nihon Hidokei no Kai; the name of the bulletin is Hidokei (Sundial). **1386 BSS Sundial Glossary**. Just in case you missed it, find this on the Net or order the printed version. [I am referring to it as I type this summary.]
1388 Zonnetijdingen. 1388.4 "De bezonningstijd van vlakke zonnewijzers" (R.J. Vinck) finds the duration of irradiation of plane dials, using stereographic projection of the solar path. **1389 La Busca de Paper**. 1389.1 Problema de Gnomònica, a translation (by Vallhonrat) of the De la Lande work on analemmatic, azimuthal, horizontal and elliptical [projection?] dials. **1391 In Tijd Gemeten**, a book on several aspects of time measurement, calendars, holidays, Saint's days; with background information, tables, lists. **1392 Deutsche Gesellschaft.. Jahresschrift.** (53pp on sundials). 1392.3 Über das Analemma, from the *αναλεμμα* of ancient Greece and Vitruvius to more modern meanings of the word, concluding with some analemmatic sundials. 1392.4 Anpassung einer Sonnenuhr; two wedges in the Bernhardt dial pedestal allow it to be used "anywhere".

40 Extra book review J.T.H.C. Schepman

H.C. Pouls, *Een nuttig en profijtelijk boekje voor alle geografen*. ("a useful and profitable book for all geographers"), by Gemma Frisius, Delft; published by NCG(Dutch Geodesic Committee) with De Hollandse Cirkel Foundation. ISBN 90 6132 268 5, approx. $10.
Frisius adapted Petrus Apianus' *Cosmographia Liber* of 1533 and added an appendix, *Libellus de Locum describendaria Ratione* (the Zeeland Library in Middelburg owns a 1564 copy). One Gregorius Bonte published a Dutch edition of the appendix, *A useful and profitable book, ... done by Gemmas Frisium* (the Rotterdam Maritime Museum owns a copy). The Pouls work, again, is based on this.