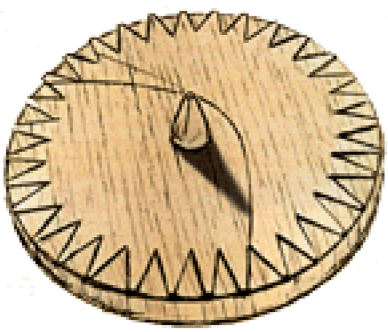
Back to sundials

French version

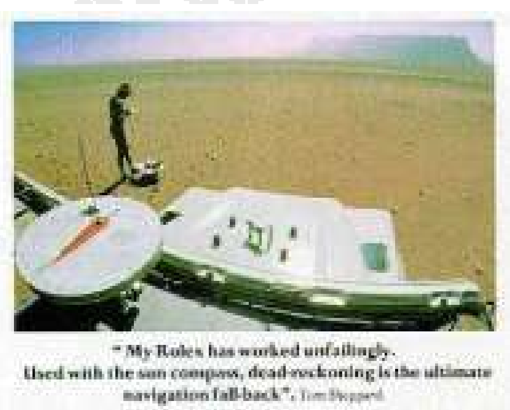
FIELD NAVIGATION

One of the possible uses of sundials is to help navigation on land. The armies of several countries as well as various scientific expeditions have used instruments derived from the sundial for navigation in desert regions.



The sun compass would be used by Vikings. This sun compass is delightfully simple. You take a small disc of wood with a short pin in the middle, make sure it is level, and spend the day before sailing marking, at regular intervals, the end of the shadow cast by this pin from the sunlight. Join up these points and you have a gnomon curve, which passes closest to the pin at north. The next day all you have to do is line up the shadow of the pin with this curve at any time and the north point will point to north. Obviously this curve has a limited life as it will change as the sun's declination changes, but in mid June the declination is changing very slowly, so a curve drawn at this time will be accurate enough for orientation for a couple of weeks. In any case, if the curve is slightly out, an error in the morning will be reversed in the afternoon.

The information below (dating from the winter of 94-95), which was passed to me by Jean-Paul Cornec, proves that sundial were already in use some years ago.



A BIT OF HISTORY

In 1701, the mathematician Antoine Parent described in a paper addressed to the Academy of Sciences the possibility of constructing, based on the analemmatic sundial, a universal instrument for measuring time. In practice, it only partially deserved the title 'universal', since its use in northern latitudes was rendered impossible on account of its cumbersome dimensions. This dial had every chance of being forgotten, precisely because of its universal nature, only a limitation of its latitude range made it re-appear. In 1920, we find the same type of dial, described in a USGS (United States Geologic Survey) bulletin. This device, Baldwin's sun graph, was used for direction finding. It was also a multi-latitude analemmatic dial (covering latitudes from 30 degrees to 70 degrees) but which differed from Parent's in that the latitude ellipses all have the same major axis. In order to position the gnomon correctly for a given date and latitude, it is necessary to use a special graph built into the dial plate. It seems that Parent's dial is easier to use and it is doubtless for this reason that twenty years later someone decided to use this somewhat forgotten man's dial.

There is evidence that sun compass was used in different places and at different times. It was used in the Philippines by the U.S. Army. The British and Australian Armies also used the Sun Compass. There is some evidence, not definitive, that the German Army also used a similar instrument. In addition, some polar expeditions used it up to the 70's. ANARE (Australian National Antarctic Research Expeditions) used American Army surplus sun compasses.
Several accounts confirm that a Sun Compass was still used on expeditions in the Sahara at the end of the 70's. The device was different from the 1943 one. It was made of transparent plastic so that it could be read from underneath and installed on the top of the windscreen of an open Jeep. In this way, the driver could easily follow his course.

I intend to show you different models of these instruments:

ABRAM'S SUN-COMPASS

COLE'S SUN-COMPASS

BAGNOLD'S SUN-COMPASS

HOWARD'S SUN-COMPASS

THE ASTRO COMPASS

THANKS
I would like to thank Claude Guicheteau , without whom this web page would not have existed. In fact, it was at his request that I undertook some research on the Sun Compass on the Internet. It has been quite a long story because, to start with, it was I who wrote a few lines about this Sun Compass in the ATCO revue. M. Guicheteau contacted me for more information and succeeded in finding an example of the Sun Compass.
Thanks too to Phil Walker, from Great Britain, who helped out with the English translation.
And finally, thanks to Larry MacDavid, from the Los Angeles area, Bill Walton from Plymouth USA, Jean-Paul Cornec from Lannion, Karl Schwarzinger from Austria, Tom McHugh from Fort Fairfield USA, and the imperial war museum from London for help.

Back to sundials

French version

French version

Thanks to Phil Walker and Liz Berzins, who helped out with the English translation.

SUNDIALS

By François PINEAU, (ATCO)

When a sundial is not a sundial : FIELD NAVIGATION

Have a look to JAIPUR OBSERVATORY

Two sundials in SAINT-SYR SUR LOIRE

SOME LINKS to sites devoted to sundials.

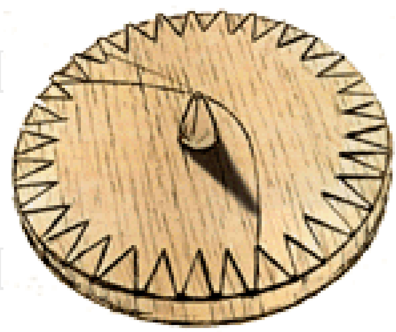
Home page

Retour sommaire des cadrans

Version anglaise

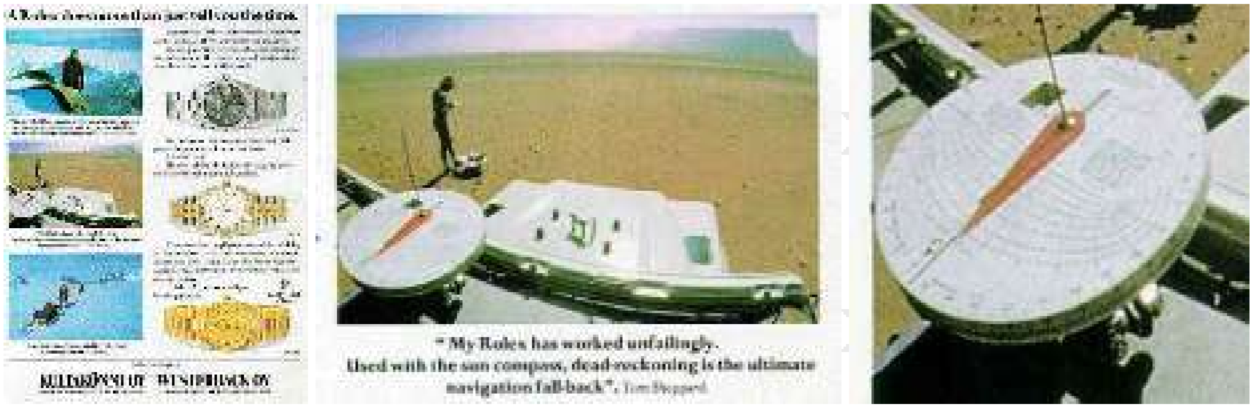
NAVIGATION TERRESTRE

L'une des utilisations possibles des cadrans solaires est l'aide à la navigation terrestre. Les armées de différents pays ainsi que diverses expéditions scientifiques ont utilisé des instruments dérivés du cadran solaire afin de se diriger dans les régions désertiques.



Le compas solaire aurait été utilisé par les Vikings. Ce compas solaire est extrêmement simple. Vous prenez un petit disque en bois avec un petit axe planté au centre. Assurez vous qu'il soit de niveau, et passez la journée précédant le voyage en mer à marquer, à intervals réguliers, l'extrémité de l'ombre de l'axe éclairé par la lumière du Soleil. Joignez ces points ensemble et vous obtenez une courbe qui passe au plus près de l'axe dans la direction du nord. Le jour suivant, il ne vous reste plus qu'à faire cincider l'ombre de l'axe avec la courbe en fonction de l'heure, et le "point nord" indiquera le nord. Evidemment, cette courbe a une vie limitée puisqu'elle change en même temps que varie la déclinaison du Soleil, mais à la mi-juin la déclinaison varie très lentement, aussi une courbe déssinée à cette époque restera suffisement précise pour s'orienter durant une quinzaine de jours. Même si la courbe est légèrement fausse, l'erreur du matin sera compensée par celle de l'après-midi.

La publicité ci dessous (datant de l'hiver 94-95), qui m'a été transmise par Jean-Paul Cornec, prouve que les compas solaires étaient encore utilisés il y a quelques années.



UN PEU D'HISTOIRE

En 1701, le mathématicien Antoine Parent exposa dans un mémoire adressé à l'Académie des Sciences, la possibilité de construire sur la base du cadran analemmatique un instrument universel de la mesure du temps. En fait, celui-ci ne méritait cette épithète que partiellement car son emploi dans les zones boréales était rendu impossible par les dimensions encombrantes que prenaient alors ces éléments. Ce cadran avait donc toutes les chances d'être oublié du fait même de son universalité, seule une restriction de capacité en latitude l'a fait réapparaître. En 1920 on retrouve ce même type de cadran, décrit dans un bulletin de l'USGS (United States Geologic Survey). Ce dispositif, le graphique solaire de Baldwin a été utilisé pour l'orientation. C'est aussi un cadran analemmatique multi-latitudes (de 30° à 70° de latitude) mais qui diffère de celui de Parent dans le fait que les ellipses de latitudes ont toutes le même grand axe. Pour placer correctement le gnomon en fonction de la date et de la latitude, l'utilisation d'un graphique spécial, incorporé à la table du cadran, est nécessaire. Il semble que le cadran de Parent soit plus facile d'utilisation et c'est sans doute pour cette raison que vingt ans plus tard quelqu'un se résolut à utiliser le cadran de cet homme quelque peu oublié.

Des témoignages montrent que le sun-compass fut utilisé en différents lieux et à différentes époques. Il aurait été utilisé aux Philippines par l'armée US. Les armées Britannique et Australienne se sont aussi servies du Sun compass. Un témoignage, mais incertain, indique que l'armée allemande aurait utilisé un appareil semblable durant la seconde guerre mondiale.
Par la suite, des expéditions polaires l'ont utilisé jusque dans les années 70. L'ANARE (Australian National Antartic Research Expéditions) a utilisé des compas solaires provenant des surplus de l'armée américaine.
Plusieurs témoignages montrent que le Sun compass était toujours utilisé lors d'expéditions dans le Sahara à la fin des années 70. L'appareil était différent de celui de 1943. Il était en plastique transparent afin de pouvoir le lire par en dessous et installé sur le haut du pare brise d'une Jeep sans toit. Le conducteur pouvait ainsi suivre facilement sa route.

Je vous propose de découvrir differents modèles de ces instruments:

LE SUN COMPASS MODELE "ABRAMS"

LE SUN COMPASS MODELE "COLE"

LE SUN COMPASS MODELE "BAGNOLD"

LE SUN COMPASS MODELE "HOWARD"

L'ASTRO COMPASS

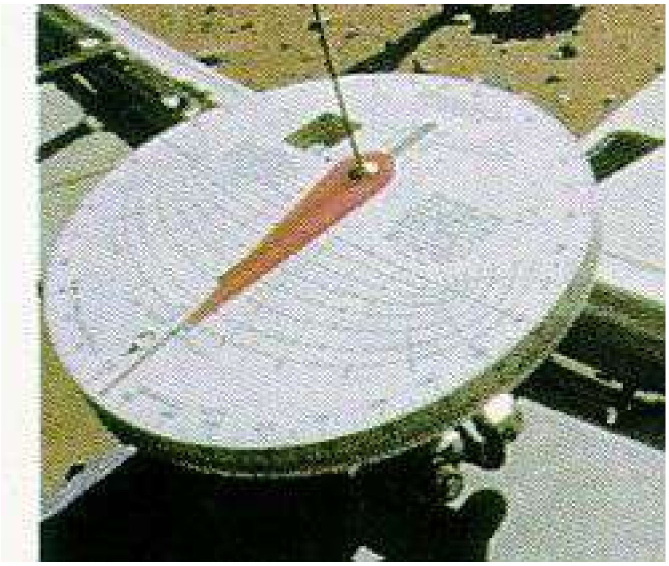
REMERCIEMENTS
Je tiens à remercier Claude Guicheteau sans qui cette page WEB n'aurait pas existé. En effet c'est à sa demande que j'ai effectué des recherches, au sujet du Sun Compass, sur internet. Ce fut même une longue histoire car pour commencer c'est moi qui écrivit quelques lignes au sujet de ce cadran solaire dans la revue d'ATCO. M. Guicheteau me contacta pour avoir plus de renseignements et réussit à trouver un exemplaire de ce Sun Compass.
Je remercie aussi énormément Phil Walker, de Grande Bretagne, qui a permis de réaliser la traduction anglaise.
Et enfin, je remercie Larry Mac David de la région de Los Angeles, Bill Walton de Plimouth USA, Tom Mac Hugh de Fort Fairfield USA, Jean-Paul Cornec de Lannion, Karl Schwarzinger d'Autriche et l'imperial war museum de Londres, pour tous les documents qu'ils m'ont envoyés.

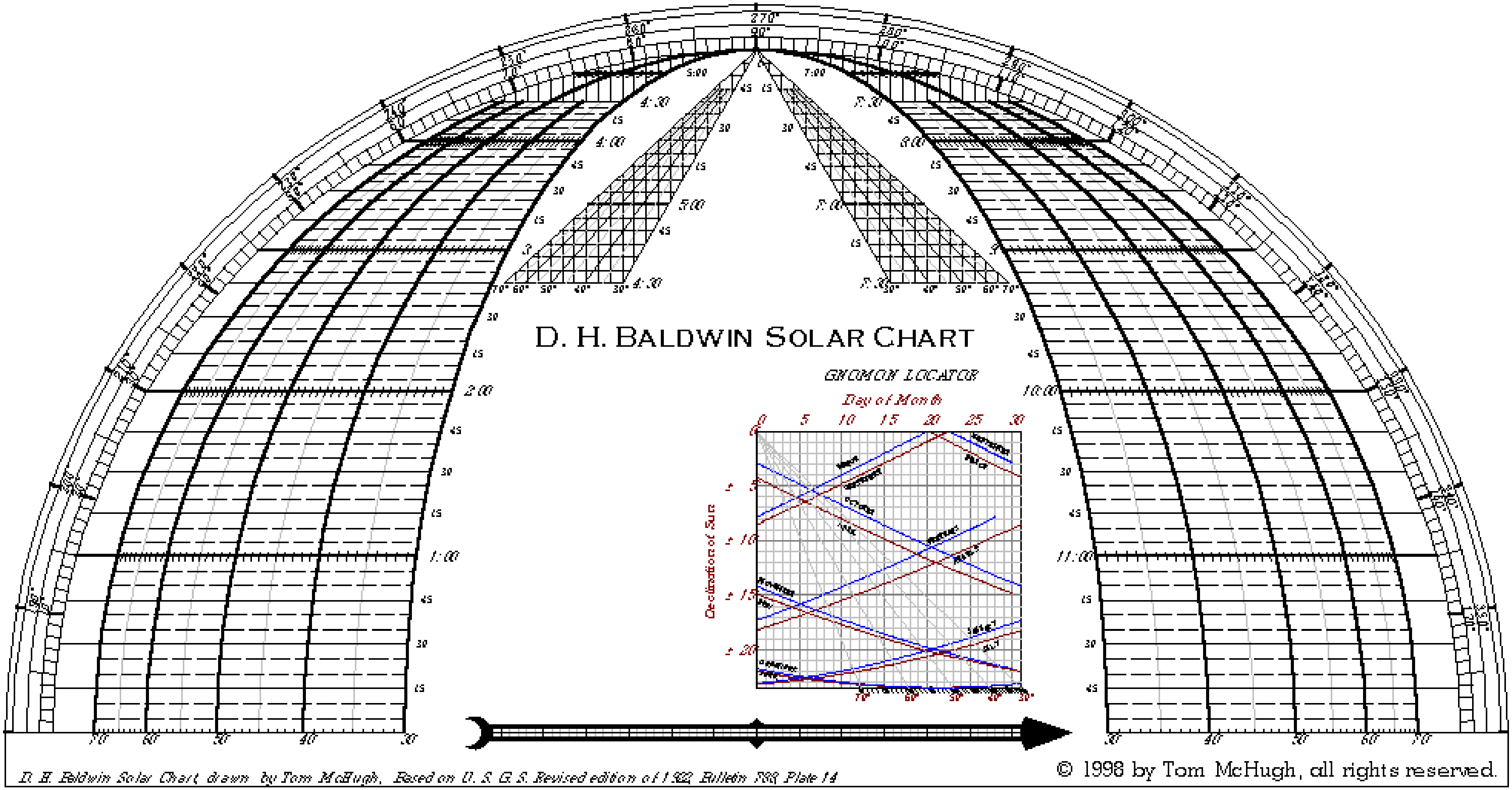
Retour sommaire des cadrans

Version anglaise


A Rolex does more than just tell you the time.
on this planet, will be venturing into the unknown.
A Rolex Oyster.
The sheer ability of a Rolex to keep going under the most severe conditions is legendary.
Where in the world will you be taking yours?
ROLEX
Authorised import:
KULTAKÖNNI OY
WESTERBACK OY

" My Rolex has worked unfailingly.
Used with the sun compass, dead-reckoning is the ultimate navigation fall-back". Tom Sheppard.




D. H. BALDWIN SOLAR CHART
GNOMON LOCATOR
Day of Month
Declination of Sun
D. H. Baldwin Solar Chart drawn by Tom McHugh, Based on U. S. G. S. Revised edition of 1922 Bulletin 788 Plate 14
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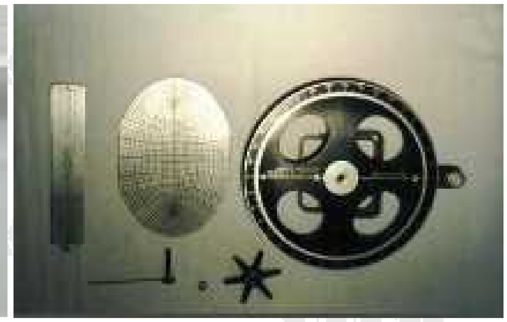
[French version]

ABRAM'S SUN COMPASS



From left to right :
1) A Sun Compass belonging to Claude Guicheteau,
2) A Sun Compass belonging to Larry Mac David,
3) Sun Compass mounting, detail,
4) Different parts of Sun Compass.

The Sun Compass was used as a navigation aid by the American Army in the North African desert during the Second World War. It is basically an analemmatic sundial. but, whereas we normally know the location and orientation of a sundial and we use it to determine the time, in this case, we know the location and the time and we use it to determine a direction we want to follow.
According to the Manual, 'the Universal Sun Compass is a mechanical device which utilizes the azimuth of the sun to obtain true direction .' It was intended to be used on vehicles such as lorries and tanks and 'has many definite advantages over the magnetic compass' . In particular, it 'is not affected by any local magnetic attraction such as electrical circuits or metal as is the case with the magnetic compass. However, the Manual does concede ' The sun compass can only be used when the sun is shining, so it is the complement of, and does not replace the magnetic compass."

PRINCIPLES

The sun compass looks very like an 'analemmatic' sundial and indeed it makes use of the same principles. For an given latitude and time (date and local apparent time), the direction of the sun, its 'azimuth', is known. In an analemmatic sundial, which is located in a fixed position and accurately oriented, the shadow cast by the vertical gnomon on the dial plate is used to determine the sun's azimuth and, for the current date, the local apparent time. With the sun compass, the dial plate is not fixed in position but can be rotated around the gnomon. The user needs to orient the sun compass accurately so that he can set a course from a map over featureless terrain. Since he knows his location, in terms of latitude and longitude, and also the local appparent time, if he rotates the dial plate until the shadow of the gnomon falls in the direction indicated for the current date and latitude, then the sun compass is correctly oriented and the required bearing can be determined.

PARTS OF THE COMPASS

The compass is mounted on the outside of the vehicle in full sunlight. It is provided with a gimbal mounting and a built-in spirit level . The circumference of the protractor is marked off, anti-clockwise, in 360 degree graduations and is fixed so that the 0 -180 degree line is parallel to the centre line of the vehicle. The gnomon is a six inch vertical rod which screws into the top of a pivot bolt in the centre of the protractor. The remaining functional parts, the date bar, the solar plate and the shadow bar can all rotate around the pivot bolt, which can be slackened off to allow rotation and then tightened again after the instrument has been set up.
The date bar has a centre line terminating in an arrow head, which is used to point to the required bearing on the protractor. Along the length of the date bar there are a series of marks against which dates within the year are

engraved. These are used to position the solar plate, which, in addition to rotating around the pivot bolt, can also slide along the date bar.
The solar plate is the key element in the operation of the sun compass. Elliptical in shape, it is engraved with a series of concentric ellipses, each marked for a specific latitude, between 45 degrees north and 45 degrees south,.and a series of intersecting time lines, indicating local apparent time (sun time.) from 6 a.m to 6 p.m.
The shadow bar also rotates around the pivot bolt and is used in conjunction with the solar plate to indicate where the shadow of the gnomon should fall for the current time and latitude.

HOW TO USE THE SUN COMPASS

Determine the Bearing Required

The first step is to determine the bearing which you want to follow with your vehicle. This is usually done by using a protactor to read off the azimuth of a line linking your present position and the desired position on a map. The bearing must relate to true North, not magnetic North. For example, a north-easterly direction on the map will give a bearing of 45 degrees

Orient the Date Bar

Now rotate the date bar until the arrowhead points to the required bearing on the sun compass protractor.

Adjust the Solar Plate

Rotate the solar plate until the flat outside edge is aligned with the date bar and now slide the solar plate along the date bar until the flat outside edge coincides with the line on the date bar for today's date.

Determine Local Apparent time

The next step is to determine Local Apparent Time. This involves making the necessary adjustments to Clock Time to allow for longitude difference from the Clock Time Meridian , the Equation of Time and, if necessary, Daylight Savings.

Adjust Shadow Bar

Rotate the shadow bar until it coincides with the intersection on the solar plate of the lines for your latitude and the local apparent time. The sun compass is now correctly set and to prevent unwanted movement, a nut on the pivot bolt is tightened to lock date bar and solar plate in position relative to the protractor and each other.

Adjust Heading of Vehicle

When the sun compass has been correctly set up as described above, in order to proceed on the required bearing, the vehicle driver has to steer the vehicle so that the shadow of the gnomon always coincides with the shadow bar. As long as the vehicle is on course, the arrowhead on the date bar is pointing true north.
The manual recommends that ' the shadow bar should be reset to a new local apparent time at regular intervals of 15 minutes. On long East-West journeys, the manual comments that the user may have to take into account the change in longitude in calculating Local Apparent Time.

HISTORY

The Sun Compass was manufactured by the Abrams Instrument company in Lansing, Michigan, USA. The company is still in operation today but it has not made this instrument for a long time. Abrams Instrument specialised in instruments for the aviation industry and made the Sun Compass under contract for the American government during the Second World War. (The manual in our possession is dated 1943)
The Sun Compass seems to have been used mainly in the North African desert by the American Army. B24 Liberator bombers were equipped with this instrument so that, in case of a crash, the survivors could orientate themselves in the desert.

REQUEST FOR INFORMATION

If you have any information about this sun compass (photos, written material or personal experience), we would be very pleased to receive it at the following address : francois.pineau2@wanadoo.fr

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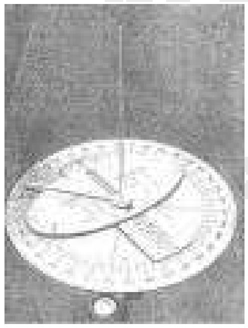
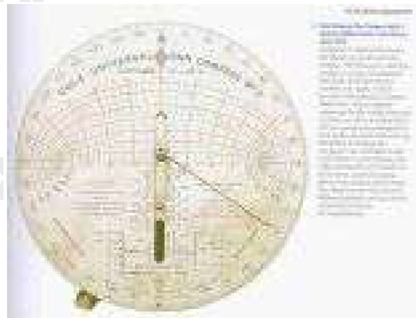
French version

COLE'S UNIVERSAL SUN-COMPASS

photo 1   photo 2

It will be clear that on any given latitude and for any given period of the year, true north will be given by the sun at any time throughout the day if we mark on the compass plate the position got from Davis' tables (azimuth tables), in wich the shadow should fall at each hour or half-hour. We have only then to turn the plete round till the shadow actually does fall on the spot marked for the particular time of day, and the plate will then be correctly oriented. We can have a separate set of graduations for each latitude.

WORKING

In the universal compass each set of graduations is arranged in the form of an ellipse. Each ellipse corresponds to a particular latitude. To use the compass, the shadow must be kept on the time of day, from one hour graduation to the next, allong the correct ellipse for the latitude of the place. As long as this is done, the arrow wich is in line with the figure XII on the compass plate remains pointing to the true north. For convenience in keeping yhe shadow on the right point on the right ellipse a white pointer is attached to the base of the needle, and can be moved by hand every half hour or 15 minutes along the time scale. The shadow can be kept on the pointer, so avoiding continuous reference to the graduations.

The variations of the azimuth from week to week is catered for very simply by sliding the whole plate north or south with reference to the needle. The correct position for the plate is given by a date scale engraved along the slide-way.

The plate and the slide-way with its north-pointing arrow can together be rotated over a circular plate wich is graduated into 360 degrees. The circle is fixes to the vehicle so that the 0°-180° lubber line is truly for-and-half, with the 0° mark towards the front. If the aroow is set to any given bearing on the circle, (41° in the setting shown in photo 1) and is kept on the meridian by the shadow and pointer, the vehicle is kept on the required heading.

SETTING

In order to set the lubber line accurately for-and-half on the vehicle, the needle is removed from the central position and inserted in a hole on the 0° circle graduation. A second needle is provided, and this is inserted in another hole on the 180° graduation. The two can be used as sights.

LIMITS OF THIS COMPASS

For use, the Universal Sun Compass needs only a watch set to local solar time. The compass carries on it all the information required to operate it. Since, however, the shadow indicates directly a time and not a bearing, and since it must be re-set by hand in order to read any new bearing in which the vehicle may happen to head, this type of compass is not suitable for continuous navigation. It is nevertheless a usefull and simple instrument for keepind a vehicule on a straight pre-ordained course.

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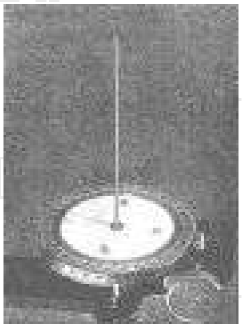
French version

BAGNOLD'S NAVIGATING SUN-COMPASS



This is a small instrument of great precision. It has the great advantage that the shadow plate itself is graduated into 360 degrees of bearing, so the shadow shows directly and continuously the actual true bearing in wich the vehicle is heading. Hence the heading can be read off at a glance and logged at any moment without re-setting the instrument.

PRINCIPLE

The 360° shadow circle is movable. When set with the 0° mark towards the front of the vehicle,making an angle of 180° with the tail of the vehicle, the sun at noon will cast a shadow on the mark wich will give the true heading, whatever that may be. At other times of the day the shadow will give the true heading if the 0° mark makes the same angle with the tail of the vehicle as the sun's azimuth at that time. In other words, the 0° mark must must be made to move round with respect tothe lubber line (the for-and-aft axis of the vehicle) at the same rate as the sun's azimuth changes through the day with respect to the meridian.

An azimuth scale is therefore marked on the side of the shadow plate, and the lubber line is shown by a fixed indes set accurately towrds the tail of the vehicule. The shadow plate is rotated by a thumb screw so arranged that one complete turn changes the azimuth of the plate by exactly 2°.

The sun's azimuth, cast and west for every half hour 'and for every 15 and 10 minutes when the sun is very high) is given for each latitude by a separate card which contains all the necessary figures for the whole year.

The azimuth figure on the card for any given half or quarter hour period is computed for the middle of the period. So there must be a certain small error in the bearing towards the beginning and end of the period. But since these errors are in opposite sences they cancel out exactly over the whole period. The year is divided into calendar periods, and the figures are again computed for the mean date in each period. The period are so arranged that the error due to the change in the sun's declination between the ends and the middle of a period is never more than 2°. For very accurate work the correct figures for the sun's azimuth can be interpolated for any given date.

A separate card is provided for every three degrees of latitude between Lat 36° and Lat 15° N. By a suitable change of dates the cards can be used for the same latitudes in the southern hemisphere.

The change of azimuth per degree of latitude is given against the azimuth figures, so accurate corrections can be made for changes of latitude during a journey.

The only disadvantage of the Navigating Sun-Compass is that it requires separate cards which may get lost. Since however this compass is intended for the use of trained navigators, who should be intelligent and responsible men not given to losing things, this disadvantage is not serious.

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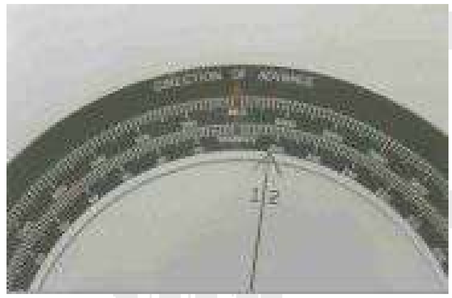
French version

HOWARD'S SUN-COMPASS

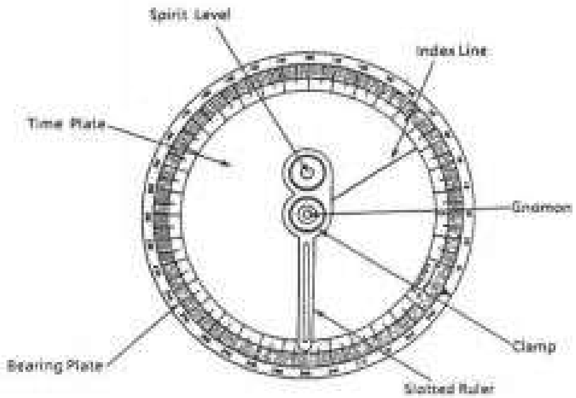


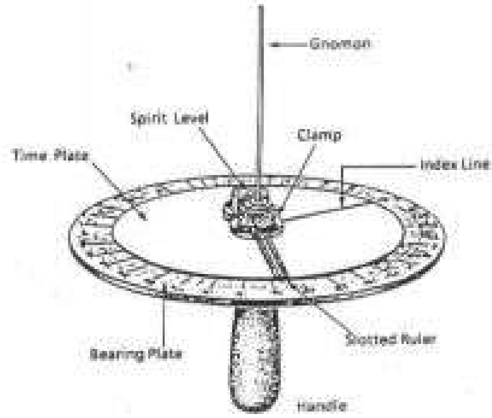


Following my research on the Web, I was able to acquire a solar compass of this type, thanks to Tony Payne of the UK. This compass was bought in a second-hand store and comes from the surpluses of the British army. It carries an inscription " BTO/3/91 " which seems to be the date of manufacture. The plate is made out of an aluminum alloy and the transparent discs out of plastic. It is a model MKIII, and thanks to the Imperial War Museum of London, we were able obtain a copy of the instruction manual of the model MKII from which the following information is drawn.

DESCRIPTION

The Instrument consists of:
A Circular Bearing Plate, engraved anti-clockwise in degrees from 0° to 360°. The plate also has an inner circle graduated from 0° to 360° clockwise but this is normally covered by
A Circular Time Plate, a white plastic disc, which revolves independently on the circular bearing plate. Usually, it has an index line, marked '12' and drawn as a radius from the centre. The index line is used as a 1200 hours (midday) baseline for drawing other lines to represent times of the day. If the index line is not engraved on the plate it can be drawn in with a pencil.
A Slotted Ruler, pivoting on the centre of the circular bearing plate to form a radius. When clamped down it holds the circular time plate (plastic disc) in position.
Spirit Level. In some models the spirit level is incorporated in the pointer, on the opposite side of the gnomon to the slotted ruler, as shown in the illustrations. In other models it is fitted on the outside edge of the bearing plate.
A Gnomon, mounted vertically in the centre of the circular bearing plate around which the slotted ruler and time plate can revolve.
Mountings. The instrument can be mounted on a vehicle or hand held. Its box, which contains spare gnomons, may be screwed on to the vehicle for better security.





SETTING UP

The Howard's sun compass must be correctly oriented and secured to the vehicle for use when mounted. Although the Howard's compass is easier to set up than the Cole's, shadow angle lines must be redrawn on the circular white plastic time plate at fortnightly intervals. Dismounted, orientation is even simpler.

Shadow Angle Table. Choose the table at the end of this Appendix appropriate to the latitude and date.

Index Line to 0°. Turn the circular plastic time plate so that the 12 Index Line points to the 0° mark and the Red Directional Arrow on the outside rim of the bearing plate. If no lndex Line has been marked on the plate, pencil it in.

Draw the Shadow Angle Lines on the circular plastic time plate using the slot in the compass pointer as a ruler. With the Index Line pointing away from you, pencil the morning Shadow Angle Lines in to the left of the Index Line and the afternoon lines to the right of it. The table gives the bearing for each half-hourly Shadow Angle Line to the east or west of true north, 0° on the bearing plate.

Equation of Time. Note the figure, in minutes, for the appropriate latitude and date shown in the second column of the Shadow Angle Tables. This figure must be added to or subtracted fro m the halfhourly Shadow Angle Lines when setting the compass to march or drive on a bearing to allow for the discrepancy between Local Apparent Time and actual sun time.

Clamp the sun compass to the hole in the vehicle bonnet using the spirit bubble to level it.

Align the 0°-180° axis of the sun compass with the axis of the vehicle with tlne 6° and Red Directional Arrow pointing to the front. In models which have holes at 0° and 180° on the bearing plate, two gnomons can be screwed in to make the fine adjusiment, lining up the gnomons and the side of the vehicle by eye or by magnetic compass. dn models which do not have the extra gnomon holes, one gnomon can be screwed into its usual place in the central clamp and the other can be hand held in the end of the slotted ruler pointer at the 0° mark.

Re-set one watch to Local Apparent Time (LAT) and the other to GMT or LMT (for radio time signals).

TO DRIVE ON A BEARING.

Setting a Course. Rotate the circular plastic Time Plate until the Index Line points to the bearing on the rim of the Bearing Plate and clamp it. The compass is now set for 'Index on Course'. Turn the vehicle (or, if dismounted, just the compass) until the gnomon's shadow coincides with the local apparent time on the circular plastic Time Plate. The compass is now set for 'Shadow on Time'.

Driving or marching on a course

a. The 0° mark and Red Directional Arrow now point on the bearing required for the move. Pick up a feature along the bearing and drive towards it. If it is possible to line up two features, one behind the other, keeping direction will be much easier, particularly if minor detours round patches of bad going are necessary.

b. On arrival at the first steering mark, line up the gnomon 'Shadow on Time' again, pick out another steering mark in line with the gnomon and Red Directional Arrow, 0° mark, and drive on.

c. In featureless country where there is no convenient steering mark the navigator and driver must keep direction by keeping the gnomon's shadow along the Slotted Rule Pointer. The Pointer should be moved round the circular plastic Time Plate once every 15 minutes to keep the shadow in step with the navigator's LAT (sun time) watch.

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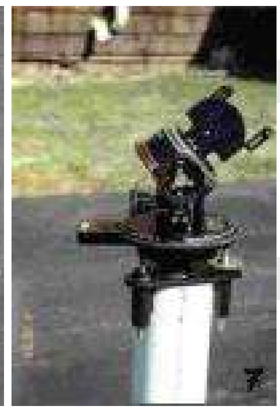
French version

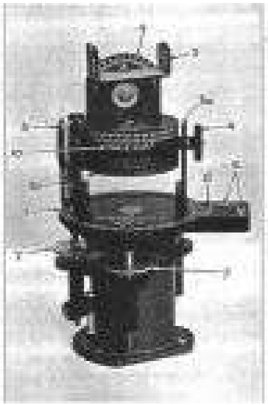
THE ASTRO COMPASS

The astro compass is not a sun compass, but it too is an instrument which is used for finding one's position thanks to the sun, moon or stars. This instrument was used by the Royal Air Force during the Second World War. All the information below is extracts from an instruction manual on air navigation, dating from 1941, which was supplied to me by the Imperial War Museum in London.



The photos above were kindly supplied by Bill Walton of Plymouth (USA)

The astro-compass consists of a bearing plate (1) with a movable sighting device (2) attached to it. The sighting device is set relative to the bearing plate so that the angle between its line of sight and a north mark on the plate is equal to the azimuth of an observed heavenly body.
Now the azimuth of a heavenly body depends of three factors:
- The local hour angle of the body (3).
- Its declination (4)
- The latitude of the observer (5).
The instrument is so constructed that when these values are set on the astro-compass (the scale for each being clearly marked), and the sighting device is aligned on the body, the bearing plate will be properly oriented and the north-mark upon it will indicate true north.



CONSTRUCTION

The astro-compass may be levelled by means of cross-levels (6) and adjusting screws (7). Its base consists of a bearing plate (1), free to rotate against a lubber line (8). Two graduated hour angle scales are mounted above, one in white (3a) for north latitudes and one in red (3b) for south latitudes. These scales are locked together and are rotated by a spring-loaded knob (9).

Attached to the top of the hour angle scales is a sighting device (2), which has a shadow bar and screen for use with the Sun or Moon and a prismatic str-sight for use on other occasions. Although aligned permanently with the 0°-180° line of the hour angle scales, the sights can be tilted for any declination between 64° N or S. The declination is read against an arc (4), engraved in white (for north latitudes) or red (for south latitudes).

The latitude scale (5), white for north and red for south, is adjusted by a knob that indicates single degrees to be added to the tens of degrees marked on the scale itself.

When usig the Sun or a bright Moon, the bearing plate is rotated until the shadow from the shadow bar falls between the parallel lines on the shadow screen.

OPERATION

The astro-compass helps the air navigator in three important ways:
1- It provides a rapid check on the true course.
2- It enables a required course to be steered independently of the magnetic compass.
3- It can be used for taking accurate visual bearings.
When using heavenly bodies, those having low altitudes give the most accurate results, particularly in low latitudes.

CHECKING THE COURSE

1- Place the instrument in its standard and level each bubble in turn with the appropriate screw.
2- Set the latitude (nearest degree).
3- Calculate L.H.A body.
4- Set L.H.A. on the appopriate hour angle scale.
5- Set the declination.
6- Rotate the bearing plate until the sights are aligned on the body.
7- Read the true course of the aircraft against the lubber line.

STEERING A COURSE

1- Set the true course required against the bearing plate lubber line.
2- Set up the instrument for latitude, declination and hour angle as described above, and level.
3- Instruct the pilot to turn the aircraft until the selected body comes on to the sights.
4- Maintain the course by the directional gyro.
5- Check course with the astro-compass at intervals of not more 15 minutes, altering the course steered on the directional gyro if necessary.

IDENTIFYING A STAR

1- Place the instrument in its standard and level.
2- Rotate the bearing plate until the true course registers against the lubber line.
3- set the latitude.
4- Turn the hour angle scale and adjust the declination scale until the star is on the sights.
5- Read off the L.H.A star and the declination.
6- Calculate the S.H.A. star.
First calculate

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