THE BRUNSON UNIVERSAL SUN COMPASS

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Malcolm Barnfield's interesting articles on sundials used in wartime[1] reminded me of an elaborate army surplus instrument which I acquired in America in the 1960s: the Universal Sun Compass, model number 7637B, manufactured for the United States Army by Brunson Instrument Company of Kansas City, Missouri. The Company, which still exists, was founded in 1927 and specialises in precision engineering, especially of calibration and surveying equipment.[2] It claims that it is in a 300-million year old building, being buried in a 200,000 square foot limestone cave, free from traffic vibrations, and where temperature and humidity stability is easy to maintain.

The US Army Engineer Research and Development Laboratories (ERDL), based at Fort Belvoir, Virginia, was responsible for the development of topographic instrumentation. In 1947 it developed lensatic compasses, experimental models of which were produced by two companies, that of the Brunson Company faring better in tests. The Company went on to produce experimental models of wrist compasses for the Army in 1950. Following cold weather tests at Fort Churchill in Manitoba, Canada, large quantities of these compasses were provided to the Army in 1951.

Simultaneously with these developments the Company was engaged by the Army to produce experimental and test service models of "*an improved sun compass that could be used in all latitudes, as opposed to the instrument suitable only between latitudes 45° north and south.*" Arctic winter tests were again conducted at Fort Churchill in February 1950, and desert tests were carried out at Yuma Test Station in Arizona in August 1952. The project was closed by the Army laboratories in June 1954.[3]

Nevertheless, production of the sun compass appears to have continued for some years. Company President Deighton Brunson has advised me that, although it now has little information about the compass, its serial number (61231) indicates that it was probably made in 1961. In the early 1960s the Company was contracted to supply the US Army with a number of items, including lensatic compasses, M2-type compasses, theodolites, and solar-reading devices that attached to theodolites.

The major innovation of the Brunson Universal Sun Compass, in addition to being usable at all latitudes, was the incorporation of a clockwork mechanism to counteract the Earth's rotation.

The comprehensive operations manual describes it as "*a mechanical device for obtaining true azimuth with the aid of changing but easily calculated directions of the sun or stars with relation to the time and place of observation*", which "*can be used for navigating predetermined courses; for determining the azimuth of required directions of travel; and for intersection or resection of topographic or man-made features by azimuthal plotting of rays from known points on or within sight of the course.*"

The compass is housed in a substantial metal box, and weighs 6 Kg, including the box base. In operation it was fixed to a military vehicle or tank, either directly using a trivet ring or by bolting the base of the box onto the body of the vehicle. Although it had the advantage of not suffering from magnetic effects, it was not intended as a replacement for the magnetic or gyro-compass, but as a complement to them.

Figure 1 is a general view of the instrument. Figure 2 identifies its various parts. Figure 3 shows the compass mounted on a US Army amphibious cargo carrier.

The heart of the instrument is a 24-hour clock, rotatable to display one of two faces. One face is for use in the northern hemisphere, and is graduated clockwise; the other, for the southern hemisphere, is graduated anti-clockwise. A micrometer adjustment allows the clock face to be tilted to correspond to the observer's latitude, to an accuracy of about 0.2°.

From the centre of each clock face protrudes a gnomon rod, to which various sighting assemblies can be attached. Three such

Fig. 1. The Brunson Universal Sun Compass.

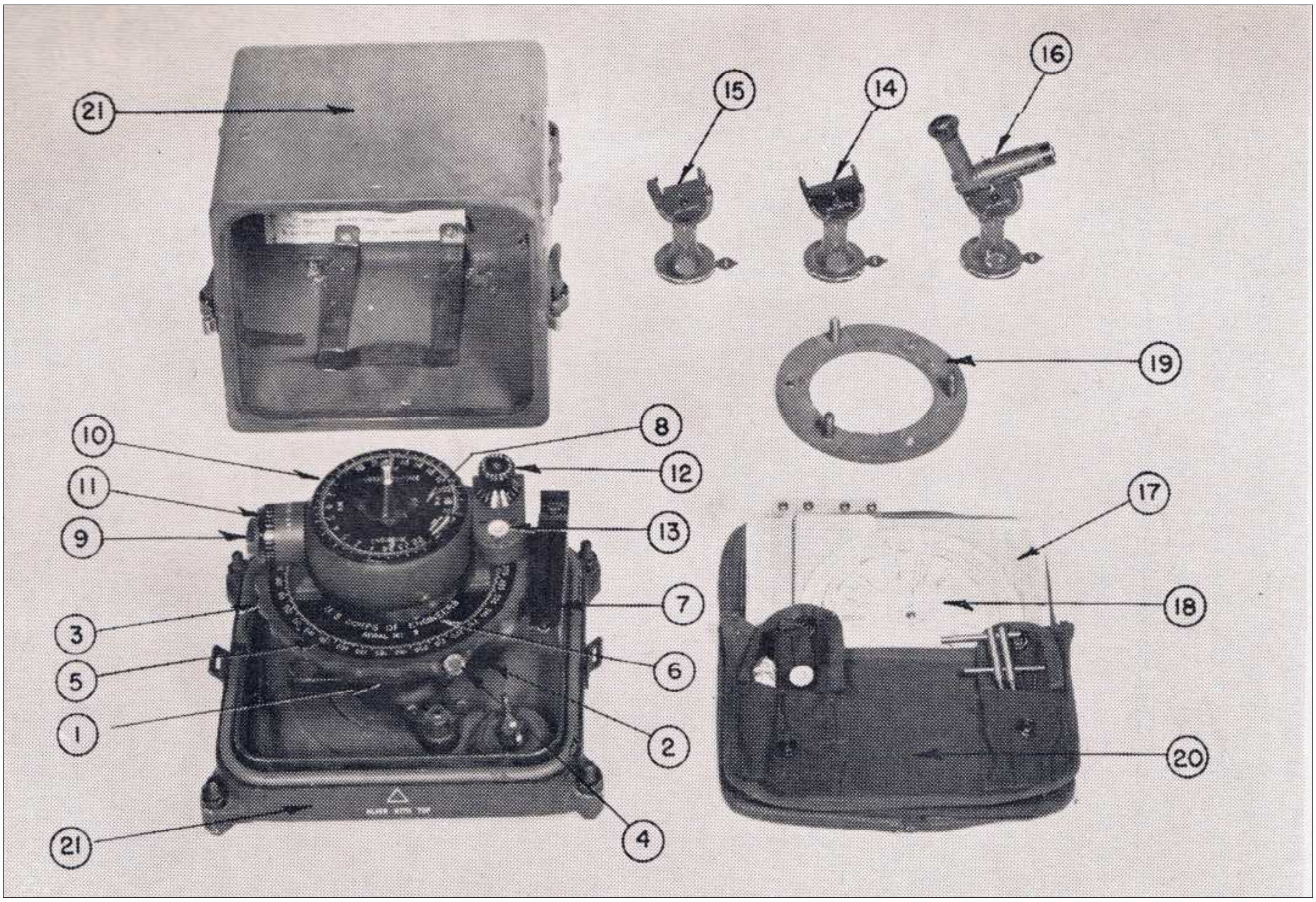


Fig. 2. The parts of the compass:

1. Base housing assembly
2. Levelling clamp
3. Lower motion housing assembly
4. Lower motion clamp
5. Azimuth circle
6. Upper motion index plate
7. Object sighting device (alidade)
8. Mean time 24 hour clock
9. Winding key
10. Clock hands
11. Latitude scale
12. Latitude micrometer
13. Circular level bubble
14. Gnomon assembly
15. Alternative gnomon assembly
16. Star sight assembly
17. Sun time correction chart
18. Hour angle star chart
19. Trivet (mounting) ring
20. Canvas accessory case
21. Metal carrying case.

assemblies are provided: one with a graduated frosted shadow screen (for observing the shadow cast by a slotted bar), one with an opaque shadow screen and prismatic sighting device (for sighting the Sun directly when it is not bright enough to cast a shadow), and a non-magnifying elbow tube (for observing stars).

Once it is levelled, the clock wound, the latitude and zone time set, and the appropriate sighting device mounted, the sun's declination and the time adjustment for longitude are determined by the 'Sun Time Correction Chart' (Fig. 4), one side of which is for East longitudes, the other for West longitudes. The sliding part of the chart is set so that the closest date appears in a window. The sun's declination is then directly read in an adjacent window, and is set on the sighting device.

The time correction combining the Equation of Time and that due to the longitude difference from the time zone meridian is read on the same line on the chart. The gnomon assembly is offset by this amount on the 'Time Correction' scale on the clock hands. The result, although not referred to as such in the manual, is the Local Apparent (Solar) Time.

If it is desired to follow a route determined by a particular azimuth, the north index line on the Azimuth Circle is set to that azimuth. The instrument is then unclamped and rotated to align the gnomon assembly with the sun. A distant object can be sighted with the alidade, and the vehicle driven towards it. The clock drive ensures that the correct orientation is maintained with respect to the sun.

Fig. 3. The Brunson compass mounted on a US Army amphibious cargo carrier.

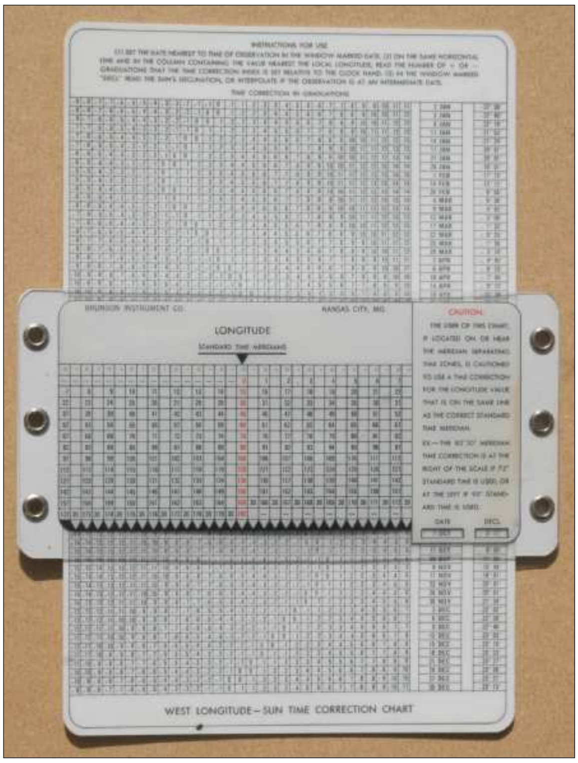
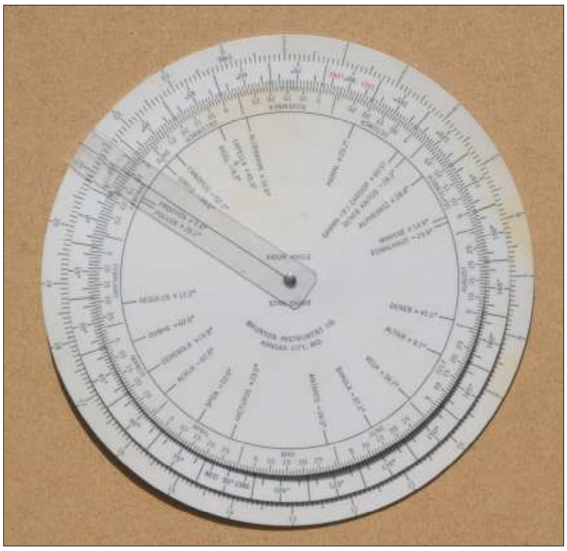


Fig. 4. 'Sun Time Correction Chart'.

Fig. 5. 'Hour Angle Star Chart'.



Alternatively, the instrument may be used to determine the azimuth of a direction, by lining up the alidade with a distant object, and reading the azimuth against the north index mark.

For navigation by the stars the Star Sight Assembly is attached to the clock shaft. Any one of two dozen navigation stars are identified on north and south star charts provided in the manual. Reference is then made to the Hour Angle Star Chart (Fig. 5), which consists of three co-axially mounted plastic discs, with scales for: (a) standard time and hour angle, (b) longitude, and (c) date, with a transparent pointer pivoted on the chart centre.

The star's declination is listed on the chart, and this is set on the declination scale of the Star Sight Assembly. The hour angle of the star is then determined by aligning the time, date and longitude scales, then, using the transparent pointer, reading the hour angle on the time scale against the position of the star. The index line on the Star Sight Assembly is set to the hour angle on the clock face. The star is centred in the star sight's field of view, and the north index line is aligned as for solar observation.

The manual (which seems to lack only a glossary) includes a description of its operation in considerable detail, instructions for its care and adjustment, disassembly and reassembly, a complete parts list, and a map of world time zones. The instrument was supplied with a basic tool kit, a bubble level, and a 4× magnifier for reading the scales.

I have used the sun compass to determine the direction of true north when researching the design of the Guernsey Liberation Monument.[4] It was not difficult to use and gave reliable results at the reduced scale needed for the experiments. The clockwork system was particularly beneficial as the compass essentially looked after itself after initial setting up. I have been unable, however, to determine the extent of its military use. The results of an Internet search implies that it is probably now quite rare. While the Company has one, and there is another at the US Army 1st Infantry Division Museum at Cantigny in Illinois, I know of no others.

REFERENCES

1. M. Barfield: 'The Sundial Goes to War: Part 1', *BSS Bull.* 23 (ii), pp. 20-25 (Jun 2011), and 'The Sundial Goes to War: Part 2', *BSS Bull.* 23(iii), pp. 10-15 (Sep 2011).
2. Brunson Instrument Company, 8000 E. 23rd Street, Kansas City, Missouri 64129. *www.brunsonkc.com.*
3. John T. Pennington: *History of U.S. Army Engineer Topographic Laboratories (1920 to 1970),* Topographic Laboratories, Fort Belvoir, Virginia, (1973).
4. D. Le Conte: 'The Guernsey Liberation Monument', *BSS Bull.* 97.3, pp 43, (July 1997).

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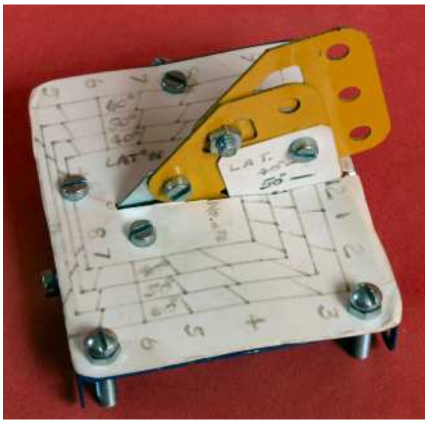
Meccano Butterfield Dial



This working Butterfield dial was made from the components of a Pocket Meccano set as a challenge issued to the late Noel ta' Bois when he was in hospital.
The item is currently held by the BSS, courtesy of another Meccano enthusiast, member Pat Briggs.