



Al Abd 1970 datum, the author recorded 21° 30' 14"N centred on only two craters visible today of the eleven Philby recorded. On this and previous treks, points of his journey were found easily. Even those of no defined longitude can be located by running the latitude. (That is how Columbus progressed).

After some two and a half centuries of reliance on magnetic compasses and sextants as the primary navigation tools, the last eighty years have allowed desert navigators, borrowing nautical and air navigation practises, to move on from time, distance and direction dead reckoning using magnetic and sun compasses, to astronomical position fixing using nautical sextants, bubble sextants and theodolites, to the electronics of LORAN C and GPS.

Mapmakers use reference, or datum, points to provide a basis for horizontal measurements on their maps. Maps of Saudi Arabia variously display World Geodetic System 1984 (WGS- 84) Ain Al Abd 1970 (AAA-70) and Narwhan (Saudi Arabia) which is on the older maps. We decided to use our Confluence visit to illustrate the linear difference between the factory set default datum of all GPS receivers, WGS-84, the current "World Average" and the most commonly used local datum, AAA-70, the datum of the Kingdom's National Grid Network or NGN. Accordingly, having set some GPS's to WGS 84 and some to AAA-70 using Molodensky Transformation Constants* and having verified the expected consistency of within a radius of one second of arc, AAA-70 readings taken at an NGN survey point North East of Nadqan used as reference by the author over 14 years of GPS useage, we set off for 23° 00' 00"N 50° 00' 00"E.



The two groups ended up in a gypsum hollow 100m (approximately 3.5") apart, a typically small variation, the AAA-70 Confluence being to the North West of the WGS-84 Confluence. It is not a constant difference because of GPS satellite orbit variations, atmospheric layer induced errors, and linear variations at other latitudes. Larger and smaller offsets would have been observable at the same location at different times and at other locations in the Kingdom owing to these factors and the lack of repeatability of non-survey and non-military standard GPS receivers.

The landscape around was typical of a gypsum surfaced part of the rock desert. A gently undulating upper level of low flat tells or hillocks of mainly gypsum, being evaporite salt, interspersed with small depressions of mixed sand and gypsum surface soil, sparse plantlife and no surface dampness, a desolate spot. The photographs taken were unremarkable in their unremarkableness, apart from those showing the location difference between the two datums.



In the picture above, the author stands at AAA-70, a pair of vehicles at WGS-84.

Driving South, the party visited the area of the ancient well of Bir Al Bahath and further on the relatively recently dug government well named Lafit after the nearby ancient well of the same name, reminders that not far beneath the hostile and potentially deadly surface flows the essential fluid of life.

*** MOLODENSKY TRANSFORMATION CONSTANTS**

Entered in "User Datum" in the set-up menus of sophisticated GPS receivers. Low cost receivers may lack this facility.

AYN AL ABD 1970
International Ellipsoid
 $\Delta a(m)$ -251

$\Delta f \times 10^4$ -0.14192702
Transformation Constants
 $\Delta X(m)$ -150 ± 5 $\Delta Y(m)$ -251 ± 5 $\Delta Z(m)$ -2

NARWHAN, Saudi Arabia
(Narwhan displays considerable variance from WGS-84) Clarke 1880 Ellipsoid
 Δa -112.145 $\Delta f \times 10^4$ -0.54750714
Transformation Constants
 ΔX -231 ΔY -196 ΔZ +482

**FRGS -Fellow, Royal Geographical Society
MRIN -Member, Royal Institute of Navigation