WORLD POLITICAL MAP

CAHILL-KEYES PROJECTION

Atlantic-centred "W"

KEY

INDIAN OCEAN ocean
Bellingshausen Sea bay, bight, gulf, sea
DAHLAK ARCH. island group
Zanzibar island or separate land mass
Huron lake, area >15,000km²
Lake Chad lake, area until recently >15,000km²
Fimbul Ice Shelf antarctic ice shelf, area >15,000km²
Pearl major river, centreline
SWEDEN sovereign state
Juba capital city, city-state, sovereign principality/duchy
grids: 1000km, 5000km graticules: 1°, 5°, 10°

Scale 1:27million

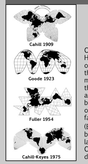
Elevation

To display relative altitude (~400m to 8000m above sea level) and ocean depth (down to 10,000m below sea level), a range of colours and shades is used. Although the human eye and brain (and the world) is smoother than a powerful (and literal) rule-but, as such shading needs to be exaggerated to be effective, and so, to make the most of the data as clear as possible, higher/shallower areas are also shown lighter than lower/deeper ones.

Abbreviations

Arch.	Archipelago	Neth.	the Netherlands
Aus.	Australia	NZ	New Zealand
B. & H.	Bosnia & Herzegovina	Pen.	Peninsula
Is.	Island	Port.	Portugal
Fr. Poly.	French Polynesia	Sp.	Spain
Fr. S. & Ant.	French Southern & Antarctic	UK	United Kingdom
Isl.	Islands	U.S.	United States of America
Lux.	Luxembourg		
Mac.	Republic of Macedonia		

WHAT IS UNIQUE ABOUT THIS MAP?



THE PROBLEM

"Try to cover a baseball with a square piece of cloth and leave nothing over. It can't be done." — B.J.S. CAHILL

Conventional world maps – Mercator, Mollweide, Homolosine, Gall-Peters, &c. – greatly distort shapes of continents, which bear little overall resemblance to those on a globe. In 1909 B.J.S. Cahill invented a world map which divided the globe into eight equal pieces with three cuts: one at the Equator and two more at right angles through the poles. The resulting **octants** could be individually flattened with minimal distortion and laid out to provide a whole Earth map which is a reasonable facsimile of an entire globe.

(Buckminster Fuller's 1954 Dymaxion Map was a worthy but inferior attempt; among various flaws, its 22 pieces lacked Cahill's symmetry both outside and inside. Every Cahill octant is identical; every Fuller triangle has a disparate graticule – meridians and parallels.)

The essence of Cahill-Keyes is total comparability of map to globe: not only every continent (like Cahill), but also every single 1° or 5° **goocell** (a Keyes refinement).

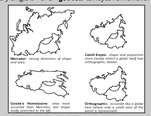


Figure 1 — Four Profiles of USSR & China (1969)

USE & CONSTRUCTION

How do I find north?

As in most maps, north is the top edge of a Cahill-Keyes. However, to keep shape, distance and area as close to a globe as possible, meridians don't go top to bottom: they bend to converge at the poles. Instead, north is towards Earth or South Poles Meridians longitude/and parallels latitude form the **graticule**, shown in grey, which resembles a spherical version of a supermarket bag.

I need to find latitude & longitude

These are marked by the grey graticule mentioned above. Lines of latitude are labelled, and, in addition (The 'Construction' section below is a starting point for those interested in how and why the graticule lines bend slightly at key points.)

How do I measure distance?

Global distance is a complex and controversial subject. However, to keep shape, distance and area as close to a globe as possible, meridians don't go top to bottom: they bend to converge at the poles. Instead, north is towards Earth or South Poles Meridians longitude/and parallels latitude form the **graticule**, shown in grey, which resembles a spherical version of a supermarket bag.

I need to find latitude & longitude

These are marked by the grey graticule mentioned above. Lines of latitude are labelled, and, in addition (The 'Construction' section below is a starting point for those interested in how and why the graticule lines bend slightly at key points.)

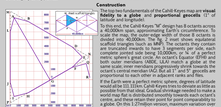
Construction

The core fundamentals of the Cahill-Keyes map are visual **fidelity to a globe** and **proportional goocells** (1° of latitude and longitude).

To achieve this, Cahill-Keyes "W" design has 8 octants-octo is Greek for eight, hence octagon, octahedron, &c.-to scale the map, the outer edge width of those 8 octants is 8 equal-length 180° arcs. The 8 octants are composed of scaffold triangles (such as **left**). The octants they contain are truncated inwards to have 3 segments per side, each segment being a 60° arc of a great circle. The 24 resulting metric spheres great circle: for octant's Equator (EPM) and both outer meridians (MEM, ULM) match a globe at the equator, and, in addition, for each octant's Equator and octant's central meridian (MC). But at 17° and 51° goocells are proportional to each other in adjacent rows and files.

Cahill-Keyes is not equal-area, but, at least, at latitude equal-all for 101.101m. Cahill-Keyes tries to stream as little as possible from that ideal. Gradual shrinkage needed to make a single unified world map with all continents whole, in place, and contiguous, and these retain their point for point comparability to a globe. On this 1.27million version, maximum variation over the Equator, 0km-4.4km, and for neighbouring goocells, rendering 18km and 4km.

Detailed specifications of the Cahill-Keyes design, including the graticule shifts at Polar, Middle and Equatorial zones, are at geodesyca.com.



B.J.S. CAHILL

In 1909 Cahill, an architect by training, published his Butterfly Map in response to the lack of an appropriate, undistorted global map for a modern age, and having a stated goal:

> *"... to accustom the sub-conscious mind of the next generation to a planetary rather than the parochial outlook and its intolerant arrogance, which today, in many lands, so threatens the peace of the world."* — 1939

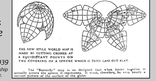


Figure 3 — The relationship of the octants to a globe.

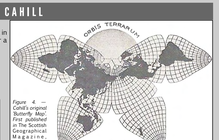


Figure 4 — Cahill's original Butterfly Map. First published in The Scottish Geographical Magazine, *1909.*

Despite his hopes and long term promotion of the invention, and of its obvious advantages, Cahill's Butterfly Map was not widely adopted.

GENE KEYES

In 1973, political scientist Gene Keyes wanted a better world map to view the almost-nuclear-war between Russia and China in 1969 — as well as their joint history over 3,000 years — on a single map. But he was stymied by the notorious distortions of customary world maps, and incoherence of piecemeal world-history maps.

While admiring Buckminster Fuller's 1954 Dymaxion map, Keyes's detailed study led him to conclude it had too many flaws, and that B.J.S. Cahill's 1909 octohedral design was far preferable as an all-encompassing global base map, at any size, small to giant.

Unable to find a sufficiently large scale Cahill world map, he set about producing his own "Cahill-Keyes" version. By 1975 he had constructed a first draft, with the following modifications, which overcame some shortcomings of the Cahill original:

1) Change to the principal format, from a "Butterfly" to an M-shape, joined at the south Atlantic (to ensure contiguity of place names).
2) Change the central dividing meridian from 22.5° to 20° West, to facilitate easy comparability with globes and orthographic maps.
3) Change in the depth of incisions at the equator and poles to 17°, to avoid rents in Canada and Russia.
4) Strive for proportionality of goocells. (Not perfectly, of course; squashing a sphere demands compromise. Inner goocells of a Cahill-Keyes octant are smaller than outer ones. But the change is gradual, and no goocell is grossly out of proportion to its neighbours.)
5) Use Cahill's octant layout for Arctic regions. (Cahill had omitted Antarctica, and his flattened polar arcs would produce a rounded square, out of keeping with the rest of the map.)
6) Re-assembly and attachment of Antarctica, to have a single unified world map with all continents whole, in place, and contiguous.

Figure 5 — Gene Keyes' first draft of the Cahill-Keyes "Real World" map, 1975.

By 1980 he had made all the calculations for a hand-drawn 1° resolution prototype at 1:1 million scale & below. From 2010 the huge task of Perl and OpenOffice.org Basic programming by Mary Jo Graça enabled, amongst other things, wider publication of versions of the map.

"Something Nearer to What Looks and Feels Like a Ball" – Robert Frost

Many thanks to: Jon Harris for his Original Inspiration, Cahill's Map & Tom Sandy (Tom Sandy's Map Site) for Advice

Cahill-Keyes "Real World" Map projection (graticule designed and constructed by Gene Keyes ©1975, 1980, 2011. Original version of graticule with coordinates programmed in Basic in Kaypro DOS, 1981. Revised version of graticule with coordinates programmed in Perl & OpenOffice.org Basic, Linux, 2010. Cahill-Keyes "Real World" Map projection (graticule designed and constructed by Gene Keyes ©1975, 1980, 2011. Cartographic design & all other features © Mary Jo Graça 2010-2011. Cahill-Keyes "Real World" Map projection (graticule designed and constructed by Gene Keyes ©1975, 1980, 2011. Cartographic design & all other features © Mary Jo Graça 2010-2011. Cahill-Keyes "Real World" Map projection (graticule designed and constructed by Gene Keyes ©1975, 1980, 2011. Cartographic design & all other features © Mary Jo Graça 2010-2011.

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