SEAFLOOR SPREADING AND OCEAN BASINS

g1 Jigsaw puzzle fit of the continents < 500 fathom contour >

'How many arbitrary parameters did you use for your calculations?' I thought for a moment about our cut-off procedures and said, 'Four.' He [Enrico Fermi] said, 'I remember my friend Johnny von Neumann used to say, with four parameters I can fit an elephant, and with five I can make him wiggle his trunk.' —Freeman Dyson.[1]

The temptation to fit the continents together, as in a jigsaw puzzle, was probably there as soon as the first, passably, accurate maps of the New World were published (an "atlas" was the name that cartographer Gerardus Mercator (1512-1594) gave to bound folios of these).[2] So then, in *Thesaurus Geographicus*, Abraham Ortelius (1527-1598) posits that "torn away from Europe and Africa ... by earthquakes and floods" were the Americas: "The vestiges of the rupture reveal themselves, if someone brings forward a map of the world and considers carefully the coasts of the three."[3] However, English philosopher Frances Bacon in 1620 finds noteworthy only that Africa and South America both have a southward tapering shape.[4] To the south was *Terra australis nondum cognita* (L. for *Southern land not yet known*). Buffon's 6th epoch (of 7) of his *Earth history*, 1788, is of continental rending which produced the Atlantic.[5] After mid-1800s expeditions to Antarctica (reviving the Greek name *Antarktikos*) beyond the edging ice visited by sealers,[6] cartography improves. The wonderment of the match of the Atlantic coasts of Africa and South America was noted by Snider in 1858 (*see* Topic *i3*). This goodness of fit is no illusion and this datum improved as maps improved. But for long stretches of the adjacent coastlines the fit is *not* there. Finally, it was realized that coastlines (which delineate the seaward edges of coastal plains) are not the true edges of a continent. Continental shelves are but the flooded continuations of gently seaward-sloping coastal plains. Consequently, small changes of sealevel cause coastlines to shift greatly. During the Great Ice Age, a *eustatic* (eustasy pertains to evidence of worldwide changes in sealevel) fall in sealevel of some 130 meters (due to the accumulation of ice on the land) allowed rivers to erode seaward continuations of their valleys across much of what is now continental shelf (then coastal plain). In the present interglacial, the sea has flooded back. The present coastline was established about 6000 years ago. River valleys that cross the coastal plain have their continuation across the continental shelf as submarine valleys. Bathymetry reveals that the fathomable (shallow enough for weighted-line soundings) continental shelf lies at a depth of 150 -700 meters at its outer edge. Here, there is a break in the slope from that of the shelf to an abruptly steeper 3º-8º slope, called the *continental slope*. This leads down into the unfathomable (deeper than the reach of simple weighed-line soundings) abyssal depths of the oceans. The shelves, which are the flooded edges of the continents, measure in their widths from zero to 1000 kilometers.[7] *The outer margin of the continent is the continental slope.* To test the goodness of continental fit, Edward Bullard in 1965 showed that the 500-fathom (equals a depth of a little over 900 meters as one fathom equals six feet) contour on the continental slopes on each side of the Atlantic Ocean can be fitted (***Figure g1.1***) (are conjugate) with a mismatch of less than one degree over most of their lengths.[8] This snug fit far exceeds mere chance as an explanation. ❑

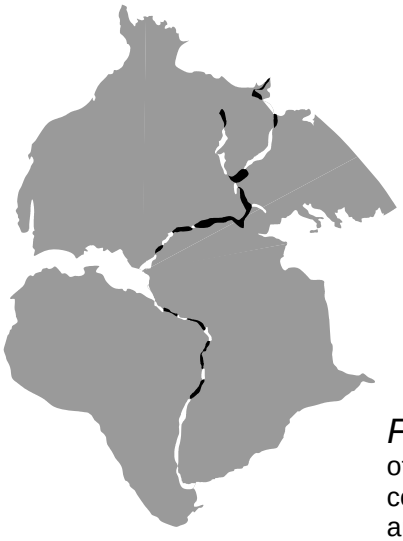

Figure ***g1.1*** [9] Bullard's computer-generated 'best fit' reconstruction of part of Pangea. A closed Atlantic ocean results in residual continental margin-contact mismatches that are the minor gaps (white) and overlaps (black). (Spain is rotated separately from Europe).