Mean High Waters and Extreme Sea Levels at Liverpool since 1768: The Work of William Hutchinson 1716–1801

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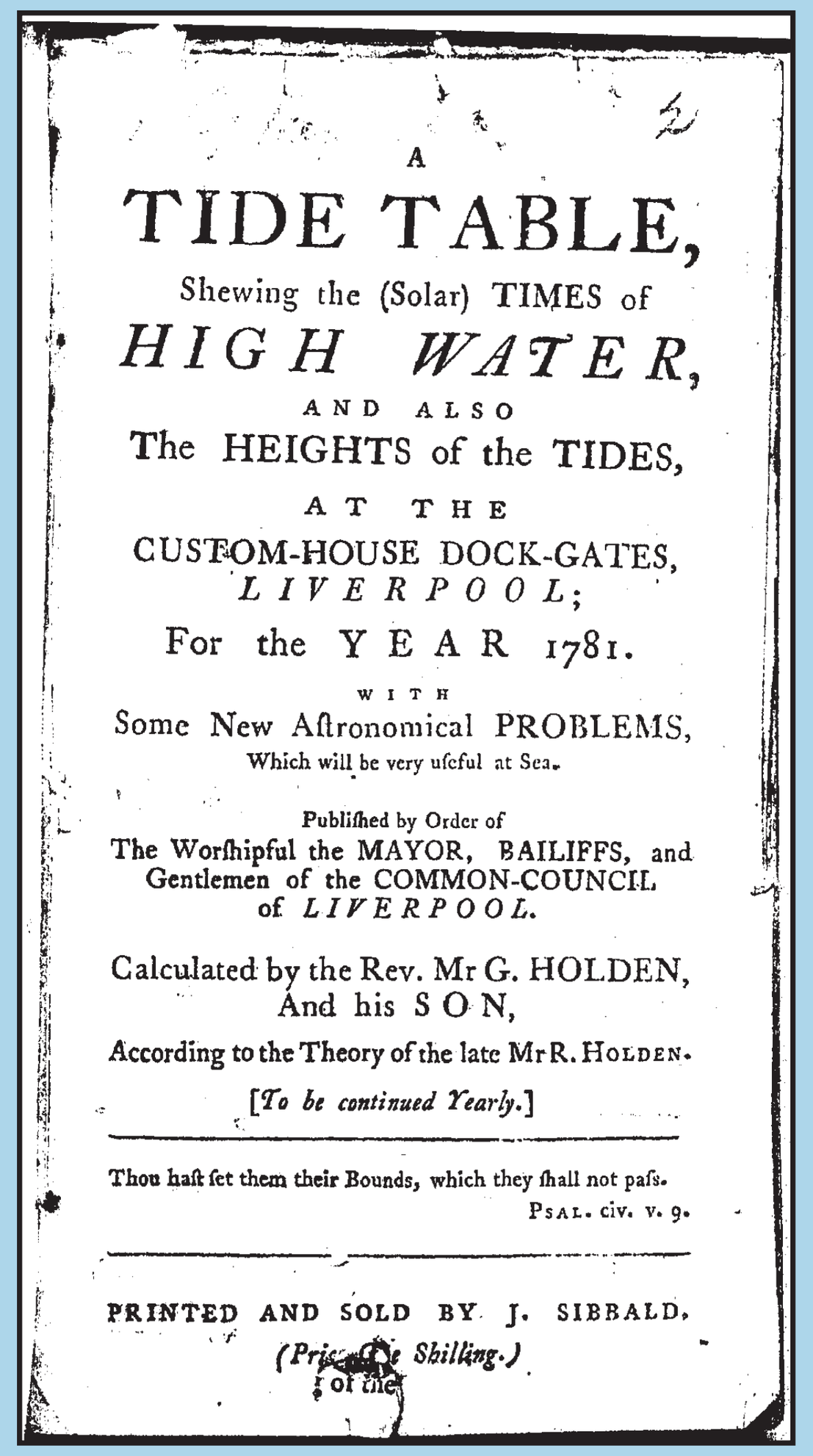
William Hutchinson 1716–1801

William Hutchinson was a former privateer (pirate) captain who became Dockmaster at Liverpool in 1759. His measurements of the heights and times of high water spanned 1764-1793 (the 1764-1767 data are now lost) and provided the first extended set of UK tidal information, other than those in the 17th century also at Liverpool by Jeremiah Horrocks which are also lost. The data have been used in studies of changes in mean high water (a proxy for mean sea level) and extreme sea levels at Liverpool over the past two and a half centuries and are some of the longest records in Europe. Hutchinson also compiled a complete set of meteorological measurements including air pressures, and his data set was (arguably) the first in which the 'inverse barometer effect' was identified – the Swede Nils Gissler sometimes gets the credit as does, incorrectly, James Clark Ross. This poster gives an idea of recent use of Hutchinson's data.

First Public Tide Tables



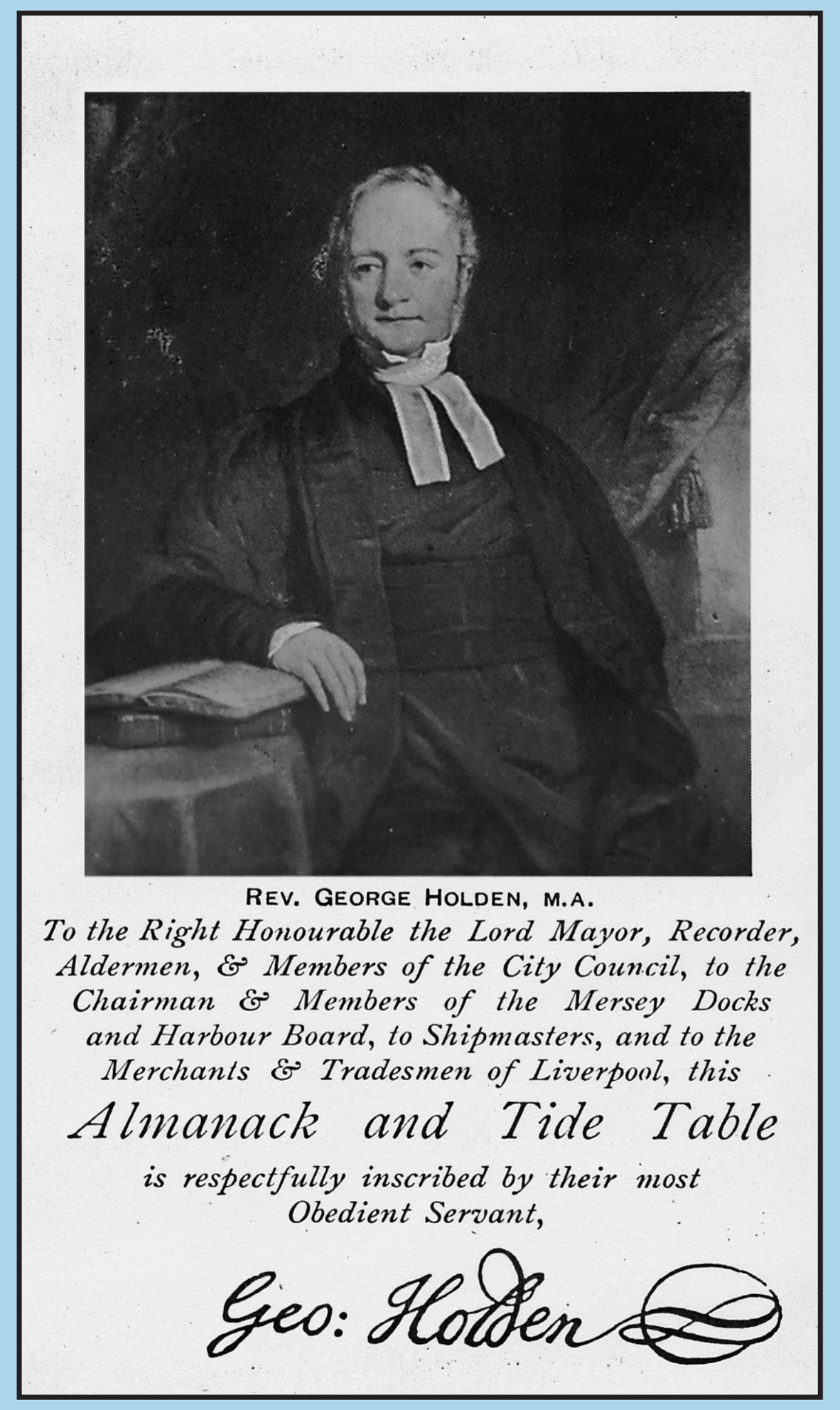
A
TIDE TABLE,
Shewing the (Solar) TIMES of
HIGH WATER,
AND ALSO
The HEIGHTS of the TIDES,
AT THE
CUSTOM-HOUSE DOCK-GATES,
LIVERPOOL;
For the YEAR 1781.
WITH
Some New Aſtronomical PROBLEMS,
Which will be very uſeful at Sea.

Publiſhed by Order of
The Worſhipful the MAYOR, BAILIFFS, and
Gentlemen of the COMMON-COUNCIL
of *LIVERPOOL*.

Calculated by the Rev. Mr G. HOLDEN,
And his SON,
According to the Theory of the late Mr R. HOLDEN.
[*To be continued Yearly.*]

Thou haſt ſet them their Bounds, which they ſhall not paſs.
PSAL. civ. v. 9.

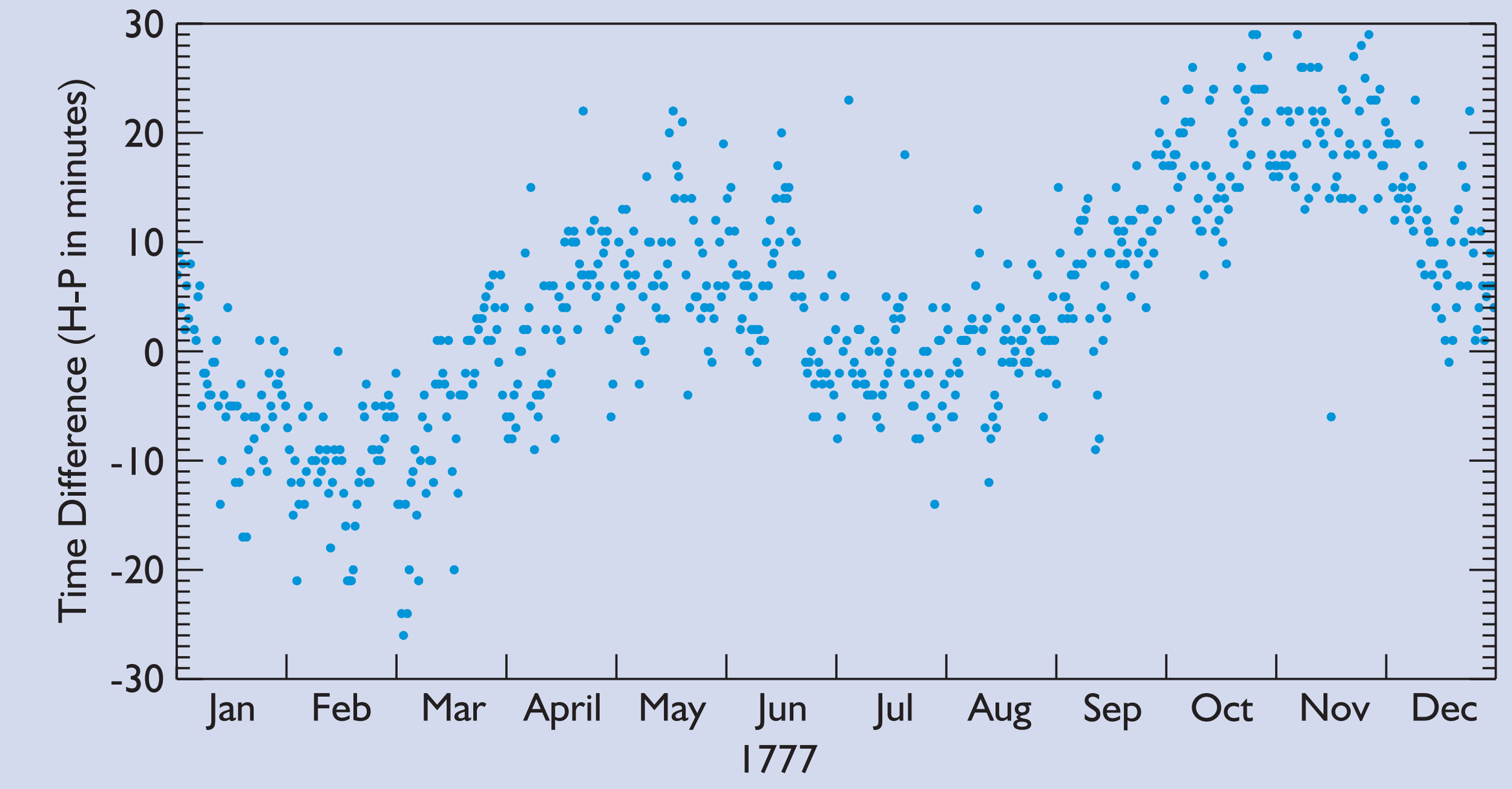
PRINTED AND SOLD BY J. SIBBALD.
(*Price One Shilling.*)



REV. GEORGE HOLDEN, M.A.
To the Right Honourable the Lord Mayor, Recorder, Aldermen, & Members of the City Council, to the Chairman & Members of the Mersey Docks and Harbour Board, to Shipmasters, and to the Merchants & Tradesmen of Liverpool, this
Almanack and Tide Table
is respectfully inscribed by their most Obedient Servant,
Geo: Holden

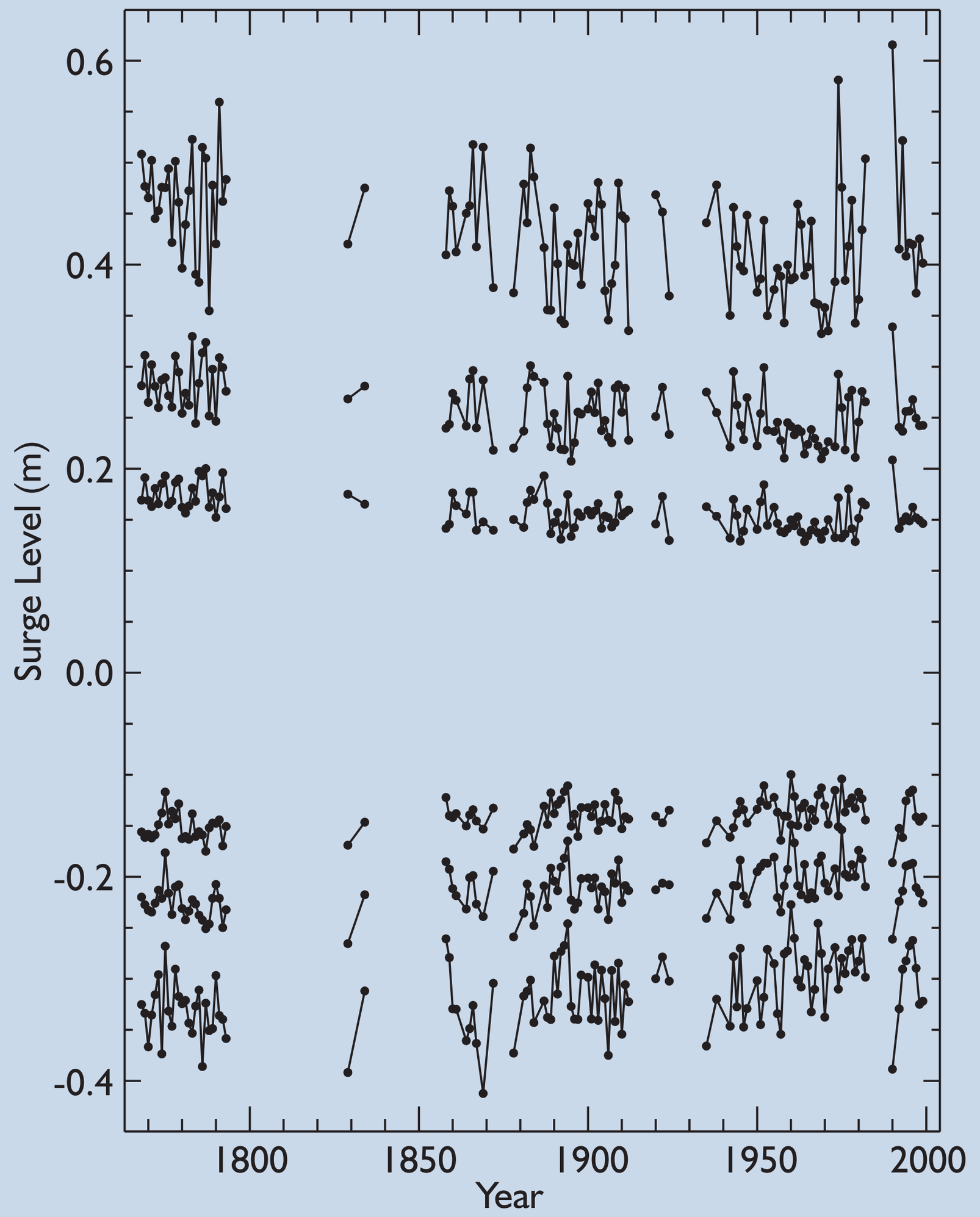
Hutchinson's measurements of the tides during 1764-1767 were used by Richard and George Holden to derive the first reliable publicly-accessible tide tables in the UK. They first appeared in 1770 and were published for over 200 years.

Comparing Hutchinson's Measurements



The difference of the time of high tide measured by Hutchinson and that 'hindcasted' by POL. The S-shaped time-difference through the year is because Hutchinson used a sun dial next to his house to measure time (i.e. he recorded apparent solar time), no doubt supplemented by a mechanical clock for night time observations. Apparent solar time differs from Greenwich Mean Time by a fixed offset (due primarily to the difference in longitude of Liverpool and Greenwich) and by the 'Equation of Time' through the year which arises from the slightly non-circular orbit of the Earth around the Sun.

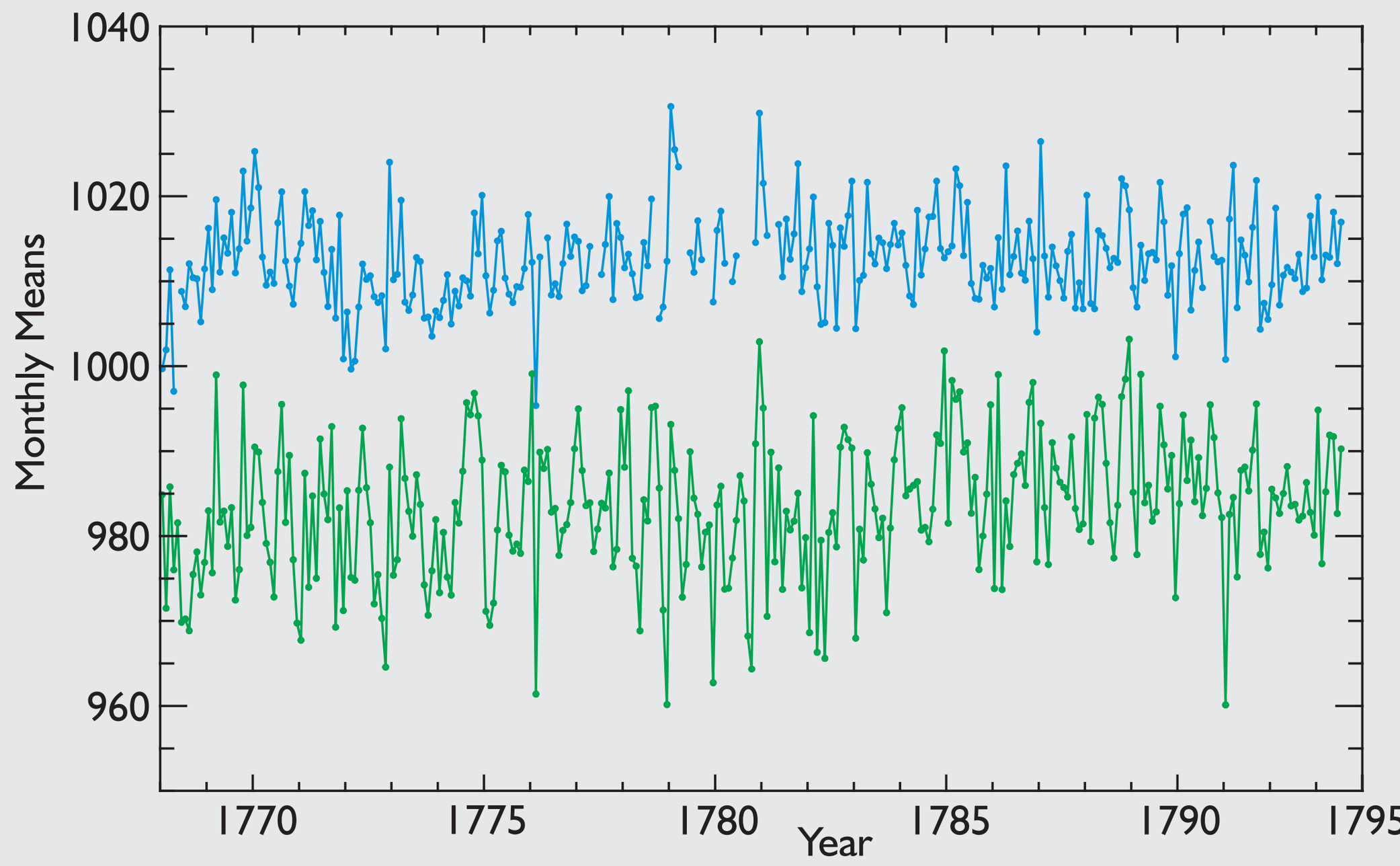
Long Term Changes in Surges



Percentile levels (3, 10, 20, 80, 90 and 97) for surges at high water at Liverpool for each year with the corresponding median surge value (percentile 50) for the year subtracted. The plot suggests that the distribution of surges has been similar at Liverpool through the years, although the size of the largest surges may have decreased slightly since Hutchinson's time.

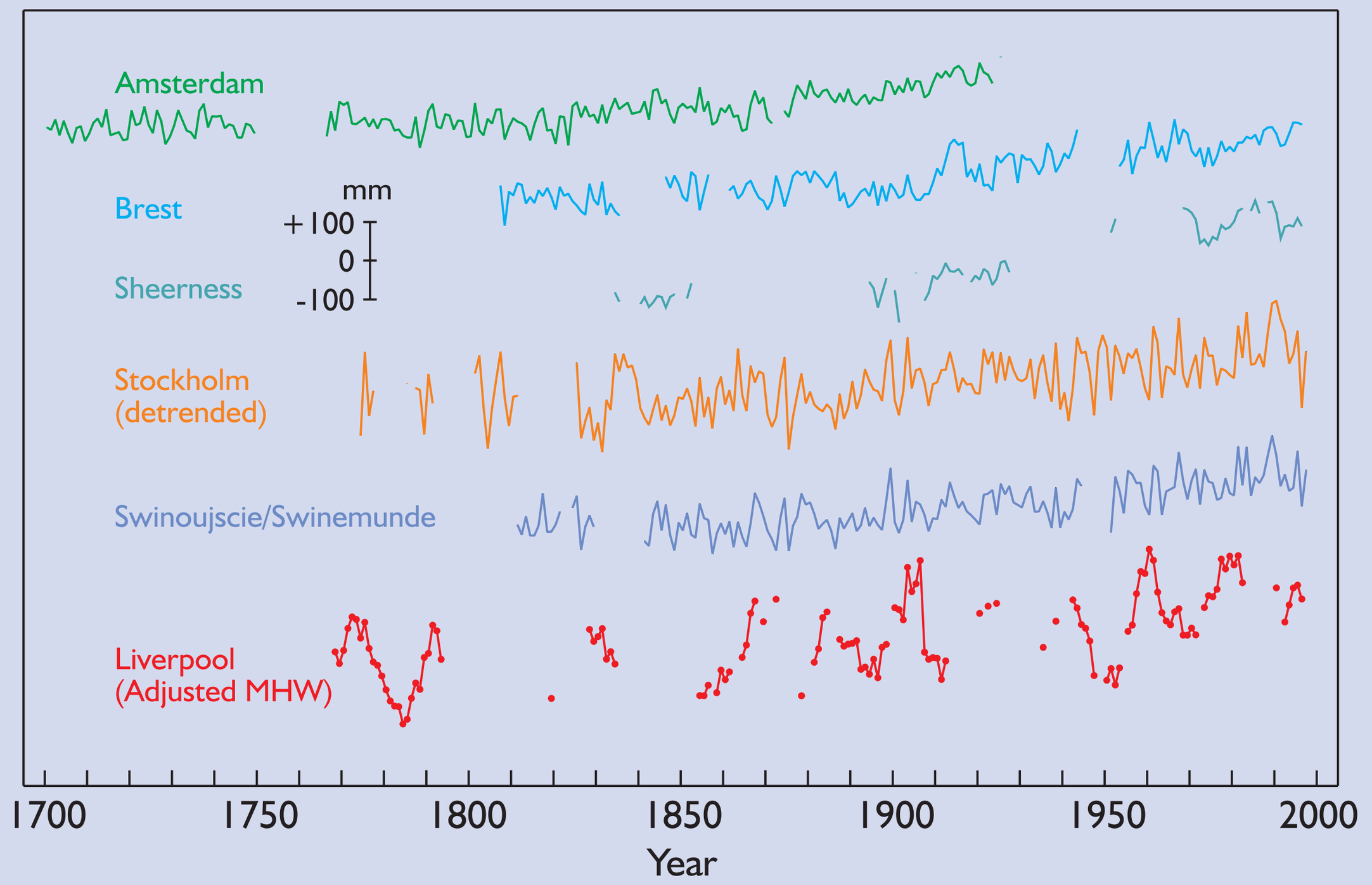
Inverse Barometer Effect

Time series of monthly mean air pressures obtained by Hutchinson at Liverpool (top, mbar) together with his monthly mean high waters (MHW) over the same period (bottom, cm). The latter has been inverted for comparison to the former and is expressed relative to an arbitrary reference level. Both series have been deseasonalised and an additional nodal term has been removed from the MHW record. The local inverse barometer coefficient is -0.89 +/- cm/mbar.



Long Term Sea Level Change

Time series of 'Adjusted Mean High Water' from Liverpool compared to sea level data from other parts of northern Europe.



The first 30 years of the Liverpool record were from Hutchinson's efforts. Later ones were by Jesse Hartley - who constructed many of Liverpool's docks - the Mersey Docks & Harbour Board, and POL. The collected data show evidence for relatively recent (20th century) sea level rise due to climate change. (Note that as the Liverpool data are MHW they contain a nodal (18.6 year) term and so appear 'noisier'). The scale bar indicates +/- 100 mm.

More 'Data Archaeological' Research

- A paper describing Hutchinson's extensive meteorological data set has been published (International Journal of Climatology 2006).
- A CD has been produced containing all Hutchinson's tidal and meteorological data, relevant biographical details and scientific papers for Liverpool 'European Capital of Culture' in 2008.
- We want to compare Hutchinson's 18th century sea level measurements at Liverpool with those taken at almost the same time at Brest in France, presently being 'data rescued' by Guy Wöppelmann and colleagues.
- We want to go back another century and find the tidal measurements made around 1640 at Liverpool (Toxteth) by the astronomer Jeremiah Horrocks in 1640. Horrocks (or Horrox) was the first person to predict and observe the transit of Venus. His tidal records were believed to have been lost in the Civil War, but maybe they weren't!

Historical datum of the Liverpool Old Dock Sill, the datum with respect to which Hutchinson made his measurements.