

N76 14532

Kidson's Relation Between Sunspot Number and the Movement of High Pressure Systems in Australia

E. G. BOWEN
Embassy of Australia
Washington, D.C.

Anyone who looks for a simple relation between sunspots and elementary meteorological quantities like rainfall or pressure is most unlikely to find it. At best one might conceivably find a connection with one of the broader atmospheric parameters like the number of waves in the circumpolar pattern or the rate at which that pattern rotates.

One connection between sunspots and the movement of pressure systems has been in the literature for a long time, but it does not seem to be generally known in the United States. This

was published by Kidson (1925) and may be described briefly as follows.

A characteristic of Australian weather is the regular march of high pressure systems across the continent in the direction of New Zealand. They cross the east coast anywhere between latitudes 30° and 40° S as shown in figure 1, which is taken directly from Kidson's paper.

Kidson defined a quantity R as simply the north-to-south range of movement of the anticyclones in any one year. He showed that R is

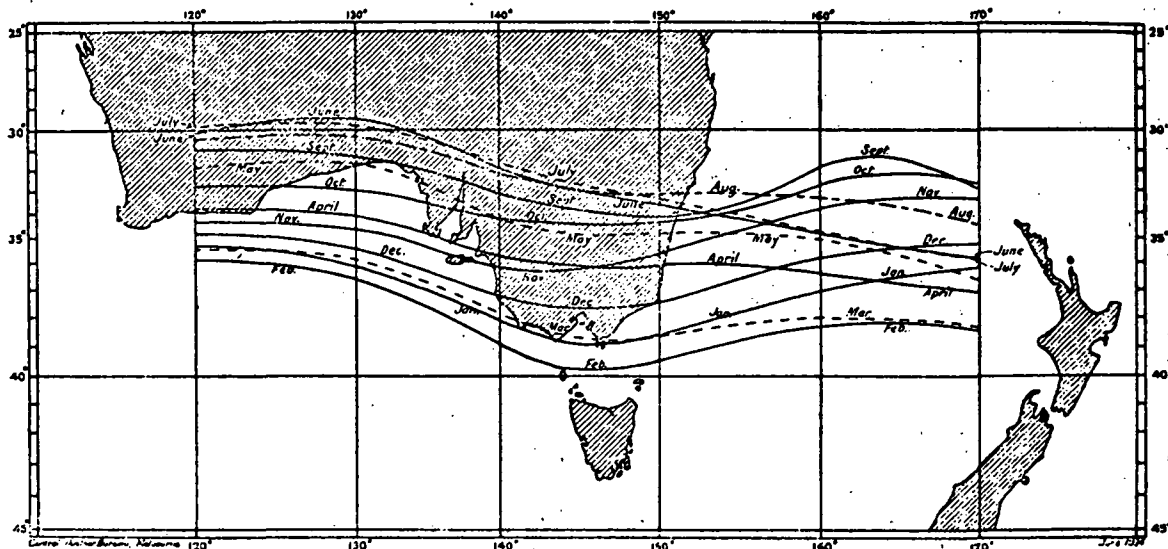


FIGURE 1.—Mean monthly tracks of anticyclones (Kidson, 1925).

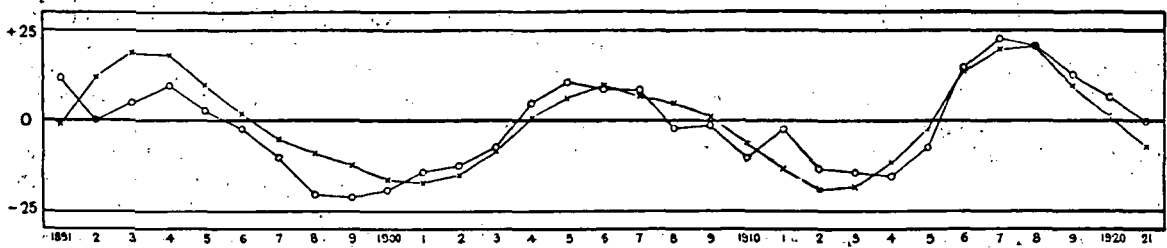


FIGURE 2.—Consecutive means of deviations from normal for 3-yr periods. (X = one-half the Wolf annual sunspot number; O = annual range in latitude in tenths of degrees of anti-cyclones across the 150° E meridian (normal = 4.0°).)

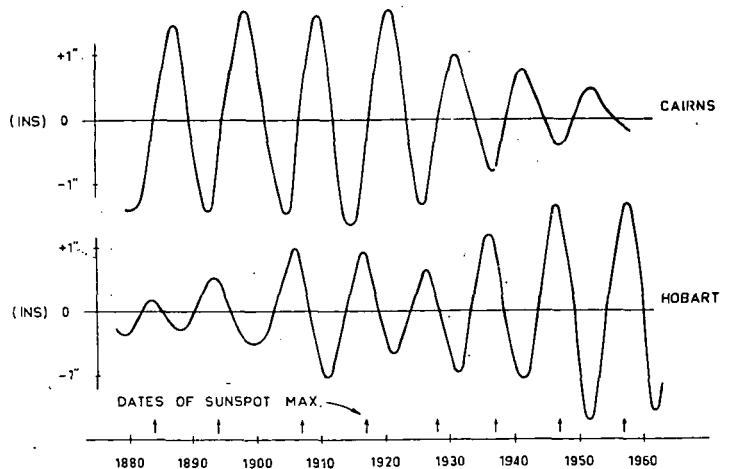


FIGURE 3.—Annual rainfall totals at Cairns and Hobart.

highly correlated and in phase with sunspot number as shown in figure 2.

Other workers (Deacon and Das, private communication) have since extended these data to the 1950's, that is, for another 30 yr, and the relationship stands up. An interesting consequence of this can be seen in rainfall, if one is prepared to dig for it. In the first place it is clear that if one looks for a 10- or 11-yr period in the rainfall of Australian stations within the 30° to 40° S latitude belt, one will find a very complex situation; on investigation this is indeed found to be the case. However, if one goes outside that range of latitudes, for example, Cairns at latitude 15° S and Hobart at 45° S, and applies a numerical filter (8- to 15-yr broadband filter) to the annual rainfall totals, the result shown in figure 3 is obtained.

That is, the 10- and 11-yr components are almost exactly out of phase. This is in spite of

the fact that within the year there is virtually no connection between Hobart weather and the weather of Cairns. The rainfall of Cairns is dominated by the southward movement of tropical cyclones down the Queensland coast and has virtually no winter rainfall. Hobart is influenced by low pressure systems off the southern ocean and has mostly a winter rainfall with a relatively dry summer. A few years ago a paper was published in the U.S.S.R. showing that an exactly similar antiphase relationship existed between the rainfall of Archangel and Athens.

In conclusion, if a relation is found between sunspots and weather, it is likely to appear in the march of high and low pressure systems around the poles.

REFERENCE

Kidson, 1925, "Some Periods in Australian Weather," Bull. No. 17, Bureau of Meteorology, Melbourne.

DISCUSSION

DESSLER: Can you describe the frequency response of the filter that you ran the rainfall data through?

BOWEN: It is essentially a bandpass filter without much flat top. The half values are at 8 and 15 yrs, respectively.

DESSLER: The comment I would make, and I would have to test it, is that I think if you ran white noise through a filter like that you would get something that was in the middle, something between 8 and 15,

close to 11-yr periodicity that was amplitude modulated; the amplitude would change with a periodicity of something like 7 cycles. Every 7 cycles you would go through a maximum or a minimum, and the data look consistent with running white noise through a filter like that.

BOWEN: A similar analysis of rainfall data for latitudes intermediate between Hobart and Cairns is indeed confused and might represent noise of low amplitude. However, at the northern and southern latitude extremes, the picture clarifies and two antiphase components stand out.