SECTION F, GEOGRAPHY

Relation of High-Sun Season Precipitation in Tropical Savanna (Aw) Climates of the Southern Continents to Sun-Tides

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The Solar System, viewed in the tradition of Copernicus, Kepler, Newton, Euler, and Laplace (Truesdell, 1960) is a heliocentric, perpetual motion mechanism in which it is reasonable to assume that the planets, through their gravitational attractions on the sun, cause direct equilibrium sun-tides analogous to the tides in the oceans and atmosphere caused by the gravitational attractions of the moon and sun (Barlow and Bryan 1901; Chapman 1951). Planetary sun-tide indices, calculated according to generally accepted mechanical principles, vary up to 30%, above and below mean values (Bollinger, 1960a) and hence should influence the pressure and stability of the solar gases and hence radiation and the climates of the planets.

The tide raising force of a single planet varies directly with mass and inversely as the cube of distance or as m/r^3. When two or more planets are in alignment, their tide forces are added. The constituent tide force of a planet not in the principle alignment varies as the cosine of its heliocentric angular difference. Thus a resultant "Solar Index" can be computed for any given configuration for which the heliocentric longitudes and radius vectors are known (Barlow and Bryan 1901). The corresponding "Global Index", a theoretical expression for the intensity of insolation on the earth hemisphere facing the sun, can be derived from the Solar Index by multiplying by $1/r^2$ earth (r=distance from center of sun to center of earth).

Seven-planet Solar and Global indices, calculated at 8-day intervals for the years 1900-1959 and at 5-day intervals for 1960, were given by Bollinger (1960a). Indices for 1961 are now in Press (Bollinger, 1961). Indices for years 1960-1980 are in process. A flow chart for calculating sun-tide resultant indices from XYZ coordinates of Jupiter, Saturn, Uranus and Neptune has been prepared by Melton (1961). A project for calculating outer planet sun-tide indices, at 40-day intervals, based on U.S. Naval Observatory punch card records of XYZ coordinates for the years 1653-2060 is being prepared for submission to the National Science Foundation. If approved, it is hoped that the data will be found to have a significant bearing on long period climatic trends and cycles.

Solar and Global Indices, because of inequality of revolution periods and the eccentricity of the planetary orbits, exhibit very complex cyclic variations. Eccentricity of the planetary orbits makes orientation as well as degree of alignment important. Jupiter and Venus, the two planets having the strongest tide forces, 2.233 and 2.1333 respectively, in a system where the tide force of earth at mean distance = 1.0, have recurrent alignment with the sun at a little under four months (the average period is 118.4 days) (Bollinger, 1960a). The phases of this fundamental cycle recur about nine and one-half days earlier on successive years. Venus and Earth have recurrent orientation alignment at 4-year intervals. At 12-year intervals Earth and Venus have approximately recurrent orientation and alignment with Jupiter. At 83-year intervals Jupiter, Venus and Earth

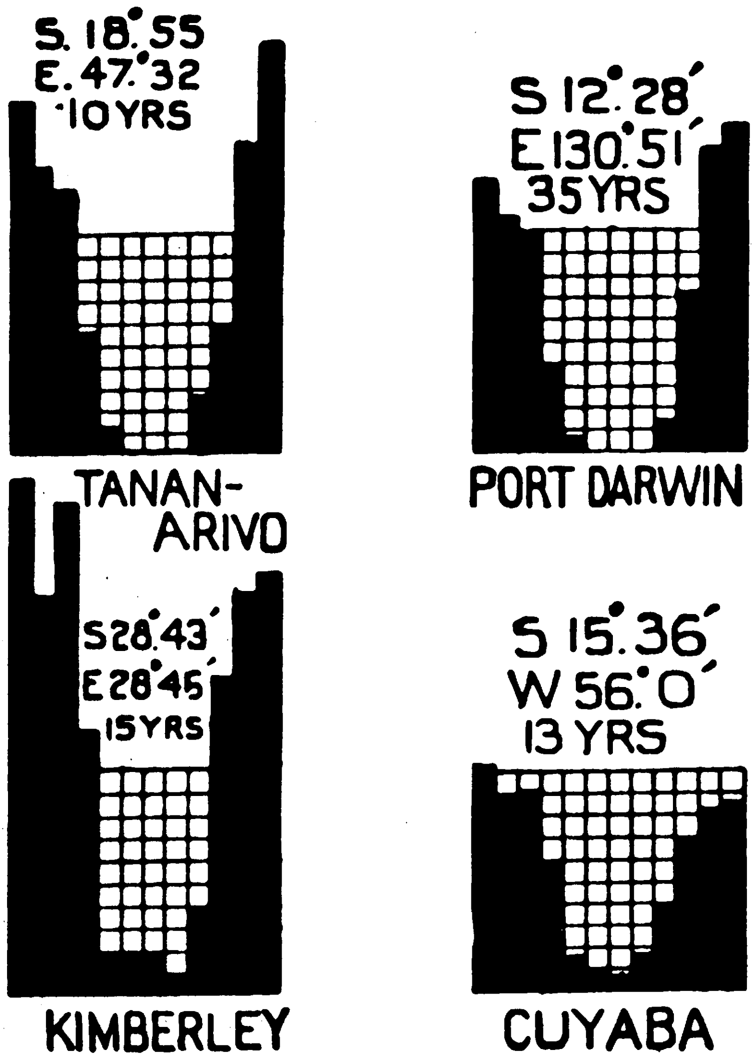
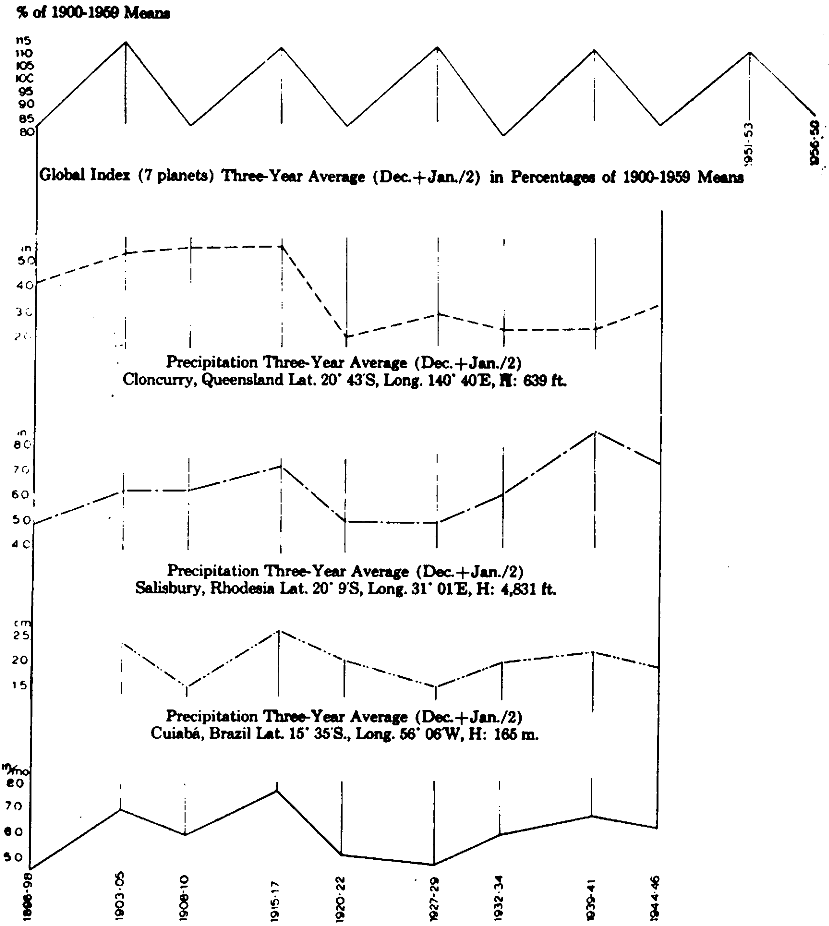

S. 18°55
E. 47°32
10 YRS
TANAN-
ARIVO
S 12°28'
E 130°51'
35 YRS
PORT DARWIN
S 28°43'
E 28°45'
15 YRS
KIMBERLEY
S 15°36'
W 56°0'
13 YRS
CUYABA

Figure 1



Precipitation, Average of Three Stations: Cloncurry, Salisbury and Cuiabá, in High-Sun Seasons on High and Low Sun-Tide Cycle Phases

Figure 2

have almost precise recurrent orientation and alignment. At 59-year intervals Mercury and Saturn both with very eccentric orbits and with apse lines only 15° apart add strength to the fundamental Jupiter-Venus-Earth suntide cycle. These and other suntide indices thus far calculated are only first approximations of suntides, since planetary declination from the plane of the solar equator has been neglected. However, they provide a firm theoretical frame of reference for solar and climatic cycle analysis.

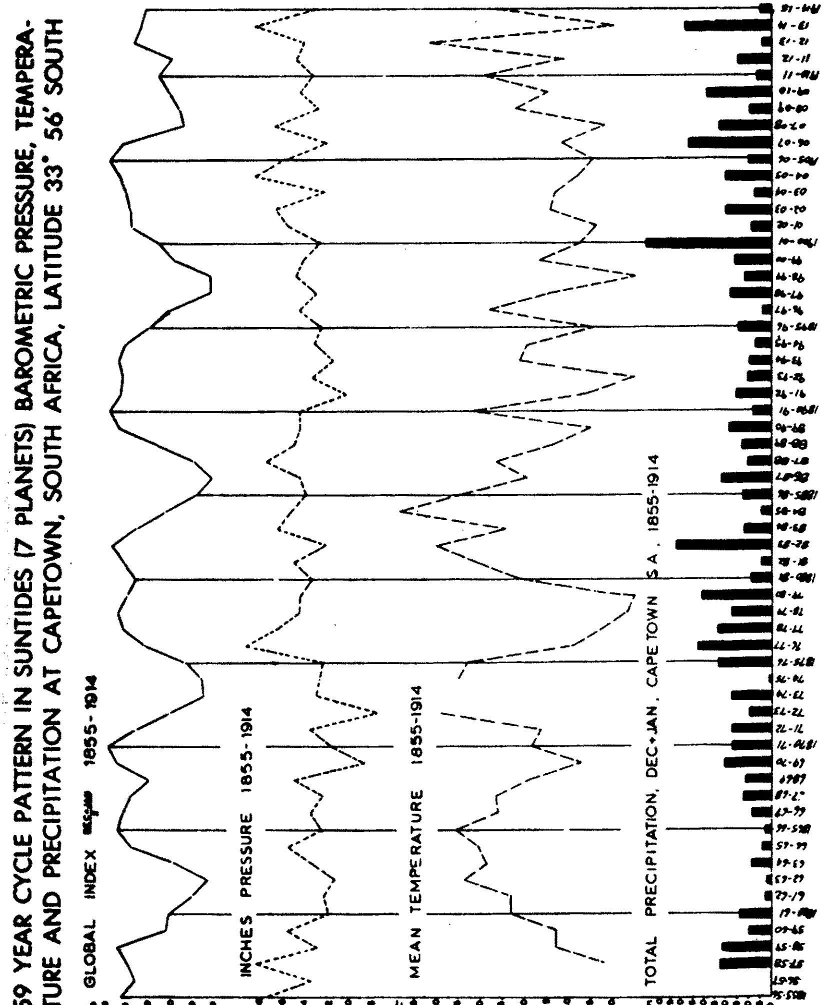


Figure 3-A

Uniform measurements of incoming and outgoing radiation needed to demonstrate the validity of the sun-tide climatic cycle theory are not now, but perhaps soon will become available. Also the present lack of regionally representative climatic data tabulated at short 5-, 7-or 10-day intervals is needed.

The sun-tide and global index patterns have been found to be significantly related to spring and summer rainfall in the Great Plains and Prairie triangle and at a few other stations in the Northern Hemisphere. Similar relationships are to be expected in the tropical continental Aw climates of the southern continents, as shown by graphs of thunderstorm frequency at representative stations, (Fig. 1), after Shaw (1933). Rainfall is most abundant in the high sun season. The monthly December-

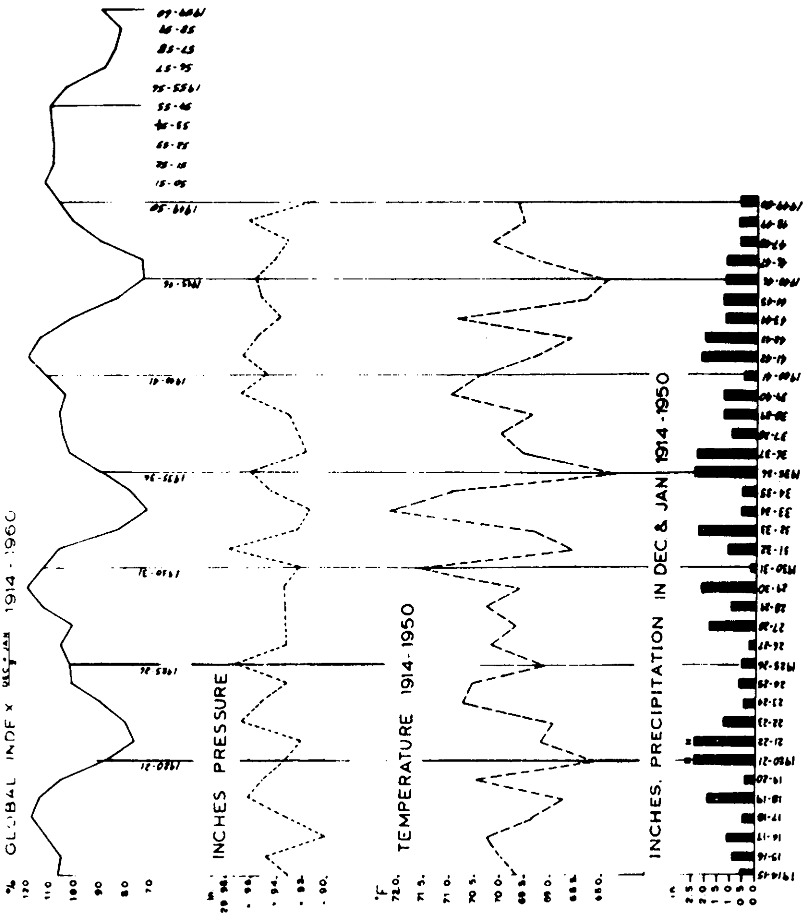


Figure 3-B Cape Town

January rainfall at Cloncurry, Queensland; Salisbury, Rhodesia and Cuiaba, Matto Grosso, at high and low index phases of the 12-year cycle, are given in Figure 2. Single station data may not be representative of true regional values and more climatic data is needed. However, it should be noted that three-year averages of December-January precipitation at the high index phase was recorded at all three of these widely separated stations in 1903-05, 1915-17; and in 1939-41 at Salisbury and Cuiaba. The low index phase was accompanied by drought at the three stations in 1896-98 and 1920-22. The high December-January indices in 1927-29 are not expressed in December-January precipitation at Salisbury and Cuiaba. However it should be noted that the summers of 1927 and 1928 were abnormally wet in the interior of the United States.

The 59-year Global Index patterns and December-January pressure, temperature and rainfall at Capetown, where the high sun season is normally dry, are given in Figure 3. (Anon., 1950).

This is an inviting field for research in which young geographers should participate.

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