ENSO		El Niño		NE Brazil Drought	St Chile Anm (+)	Eq. Pac. Anm (+)Pcpn	E. Mons. Drought	Australian Drought	Defic. India Sum. Mons.	Weak Nile Flood		
Yr	Str	Yr	Str							Yr	Deg	Conf
1854-55	S	1854	M	-	1855-56	*	1855	1854	1855	1855	3	3
1857-E59	M+	1857-58	M	-	1858	*	1857	1857	-	1857	1	2
										1858	2	3
										1859	2	2
1860	M	1860	M	-	1860	*	-	-	1860	-		
1862	M-	1862	M-	-	-	*	-	1861-63	-	-		
1864	S+	1864	S	-	1864	*	1864	1864	1864	1864	4	4
L1865-E66	M+	E1866	M+	-	-	*	1866	1866	1865-66	-		
L1867-E69	S+	L1867-68	M+	1867	1868	M1868-E69	1868	1868	1868-69	1867	1	2
										1868	4	4
1871	M	1871	S+	-	-	*	-	1871	-	-		
1873-74	M+	1874	M	-	-	*	1873	1874	1873SBM	1873	2	3
L1876-78	VS	1877-78	VS	1877-79	1877	*	1877	1877	1876SBM, 1877	1877	4	4
1880-81	M+	1880	M	-	1880	*	1881	1880	1880SBM	1881	1	2
										1882	2	2
1884-85	M+	1884	S+	-	-	*	1884-85	1884	1885	1884	2	3
										1886	1	2
L1887-E89	S	L1887-E89	M-/ M+	1888-89	1887-88	*	1888	1888	1888 SBM	1888	4	3
1891	M	1891	VS	1891	1891	*	1891	-	1891SBM	-		
1896-97	M+	1897	M+	1898	-	1896	1896-97	1896	1896SBM	1897	1	3
1899-M1900	VS	1899-E1900	S	1900	1899-1900	M1899-1900	1899	1899	1899	1899	5	4
L1901-02	S+	1902	M+	1902-03	1902	M1902-E03	1902	1902	1901, 1902SBM	1902	2	4
1904-05	S	1904-05	M-	1904	1904-05	M1904-	1905	1905	1904SBM, 1905	1905	1	3
										1905	1	3
1907	M+	1907	M+	1907	-	-	-	1907	1907SBM	1907	2	2
1911-12	M+	1911-12	M	-	-	1911-12	1911	1912	1911,1912 SBM	1912	1	3
M1913-M15	S+	1914-E15	M+	1915	1914	L1913-M15	1913-15	1914	1913SBM, 1915SBM	1913	5	4
										1915	2	3
1918-E20	S+	1918-19	M	1919-20	1919	M1918-E20	1918-19	1918	1819,1920	1918	1	4
1923	M	1923	M	-	-	1923-E24	1923	1923	1923SBM	-		
1925-26	S	1925-26	VS	-	1926	M1925-M26	1925-26	1925	1925SBM	1925	2	3
L1929-E31	M+	L1930-E31	M	1930-31	1930	L1929-E31	1929-30	1930	1929SBM, 1930SBM	1930	1	3
1932	M+	1932	S	1932	-	E1932	1932	1932	1932SBM	-		
1939	M	1939	M+	1939	-	L1939	-	-	1939SBM	1939	2	4
1940-41	VS	L1940-41	S	1941-42	1941	1940-41	1940-41	1940	1941	1940	2	4
										1941	3	4
1943-44	M	1943	M+	-	1944	-	1944	1943	-	1943	1	2
										1944	1	2
1951-E52	M+	1951	M-	1951-52	-	M1951-L51	1951	1951	1951,1952 SBM	1951	2	3
										1952	1	2

ENSO		El Niño		NE Brazil Drought	St Chile Anm	Eq. Pac. Anm	E. Mons. Drought (+)	Australian Drought (+)	Defic. India Sum. Mons.	Weak Nile Flood		
Yr	Str	Yr	Str							Yr	Deg	Conf
1953	M	1953	M+	1953	1953	E1953-L53	1953	1953	-	-		
1957-58	S	1957-58	S	1958-59	-	M1957-M58	1957SBM	1957	1957SBM	1957	2	3
1965-66	S	1965	M+	1966	1965	M1965-E66	1965	1965	1965-66	1965	3	2
										1966	3	2
M1968-69	M-	1969	M-	1970	-	E1969	-	-	1968SBM	1968	2	2
										1969	2	2
1972-73	S+	1972-E73	S	1972	1972	M1972-M73	1972	1972	1972	1972	5	2
										1973	2	2
1976-77	M	1976	M	-	-	M1976-E78	1976	1976	-	-		
1979-80	M-	-		1979-80	-	L1979-80	1979	1980	1979	1980	1	2
1982-83	VS	L1982-M83	VS	1982	1982	M1982-M83	1982	1982	1982	1982	3	2
M1986-87	M	1987	M	-	1987	M1986-87	1987	1987	1987	1987	2	2
M1991-92	S	1992	S	*	1991	M1991-92	1991	1991	1991(Nw India)	1991	2	2

exceptionally strong 1782-84 ENSO (See Wood, 1984, concerning the unusual year of 1783.). The contents of Figure 1 and Table 4 provide verification for the relationship between the ENSO and the Nile River years of flood deficiency. In fact, the years of S, S+, and VS intensity ENSO's in Table 4 agree to the 100% level.

5. EARLY NILE RIVER RECORDS

History of the Nile River dates back to about 5000 B.C. and the record of Nile levels dates back to about 3000 to 3500 B.C. (Bell, 1970; 1971; Shahin, 1985). An historical overview covering nilometer development and information sources is provided in Quinn (in press). Problematic aspects such as variations with time in flood levels attributable to sedimentation, original source data in cubits and fingers, scales of measurement used, variations with time in the minimal level required for irrigation (plenitude) in Egypt, use by the Mohammedan chroniclers of the Mohammedan lunar calendar which rotates through all months of the solar year once in each cycle of about 33 of its years, and use of the skip year in the Mohammedan calendar which is the 33rd year of a cycle when equated with a cycle of 32 solar years, are discussed in Quinn (in press). Records on events (weak or excessive Nile flood years) as reported by the different chroniclers, may often differ by a year in the older records due to the recognition of different skip years. The following empirical formula which was obtained from Albert Galloway, a professional numismatist, was found to be very useful for converting the A.H. (anno Hegirae) dates of the Mohammedan era to A.D. dates:

A.H. date — (0 0303 x A.H. date) + 622 = A.D. date.

6. YEARS WITH LOW NILE MAXIMUM LEVEL FLOODS A.D 622-1991

Table 5 was constructed after considering tabulated data and textual information in Toussoun (1925) as modified by tabulated data, graphic plots, and corrections from Popper (1951). Popper's tables included data on the stronger developments from Ibn Taghri Birdi, Ibn al-Hijazi and Ibn Aibak. Table 5 lists the years of poor Nile floods, their degree of weakness (1-5) and a confidence rating (1-5). For about the first 460 years, the smallest flood deficiency level (1) was just below 16 cubits (cu), the original plenitude level [16 cu = 17.35 m above Mediterranean Sea Level at Alexandria in Toussoun's (1925) data, which is a little below normal for the period]. For the other degrees of weakness (2-5), the reduction values, based on 50-year averages for the annual Nile River maximum levels at Cairo, are as indicated in Table 3. After A.D. 1080, the degree of reduction, using the applicable 50-year average, pertains to all degrees as it did for Table 4 data. Also, the confidence level (1-5) is based on the number of sources of evidence [e.g., Toussoun, Popper, Popper's Arab sources (Ibn Taghri Birdi, Ibn al-Hijazi, Ibn Aibak)].

Table 5 shows a total of 179 weak Nile flood years with varying degrees of deficiency (1-5); during this 901-year period (622-1522) the figures on the average would indicate a weak Nile flood occurrence about every 5 years. However, the distribution of these weak Nile flood years makes it difficult to relate them to ENSO events during periods of extended weakness. Considering what we see in Table 4 and between applicable parts of Table 1 and Table 5, it appears possible that those extended weak Nile flood periods of 4-7 years in a row, that occur in the first part (based on the A.D. 622-999 record) of Table 5, may be associated with 2 or more ENSOs, with one setting in at the onset of the period and another 2 or 3 years later. There will be further discussion of these extended periods of activity in the following section. Out of the 901-year record with 179 years of weak Nile floods, there were 97 in degree 1, 33 in degree 2, 25 in degree 3, 13 in degree 4, and 11 in degree 5. Over the period A.D. 622-999 there were 105 years of weak Nile floods, occurring in approximately 27.8% of the years. Over the period A.D. 1000-1290 there were 24 years of weak Nile floods, occurring in about 8.2% of the years. For the period A.D. 1291-1522 there were 50 years of weak Nile floods, occurring in about 21.6% of the years. There were several cases of extended records during the earliest period but none in the other 2 periods of Table 5. It was now essential to tie in these earlier findings with the later records on the Nile; and although there were several breaks in the record between 1523 and 1823, it was possible to construct Table 6, despite breaks in the record, through the use of diagnostic interpretation as applied to data and anecdotal information obtained from Walford (1879), Lyons (1906), Toussoun (1925), Jarvis (1935), Hurst (1957), Popper (1951), Bell (1971), Shahin (1985), Le Comte (1980-1991), and many other authorities.

The available information for the years A.D. 622-1991 is broken down into 5 periods for considering the occurrence of those years with weak Nile River flood maximums, as shown in Table 7. Over the period 1523-1899 weak Nile floods occurred about 28.1% of the years. Also, several cases of extended weak Nile floods occurred over this period. During the recent period 1900-1991 weak Nile floods occurred about 29.3% of the years, but there were no periods of extended activity. Over the period 1525-1991 about 80.3% of the ENSOs were accompanied by weak Nile floods.

Table 5 - Years (Yrs), over the period A.D. 622-1522, with weak Nile floods (those below plenitude and/or specified average annual maximum flood levels) at Cairo, rated by degree (Deg) of deficiency (1-5) as noted in Table 3, with confidence (Conf) ratings based on the number of confirmation sources. (See text for details.)

Yrs	Deg	Conf	Yrs	Deg	Conf	Yrs	Deg	Conf	Yrs	Deg	Conf
629	4	2	759	1	2	828	1	2	941	1	1
									942	1	1
632	2	2	761	1	5	830	4	5			
			762	1	2				945	1	5
642	2	2	763	1	2	832	3	5	946	1	5
			764	2	2	833	2	2	947	1	5
650	5	3	765	1	2	834	1	2	948	3	5
									949	3	4
662	1	4	767	1	2	836	1	2	950	1	3
						837	2	2	951	1	3
678	1	2	769	2	2						
			770	2	2	841	4	5	963	1	2
683	1	2	771	1	2	842	5	4	964	2	2
			772	1	2				965	1	2
687	3	2	773	1	2	847	1	2	966	3	2
688	4	5				848	2	2	967	5+	5
689	5	5	776	2	2						
						850	1	2	977	1	2
691	1	4	779	1	2	851	3	2			
			780	1	2	852	1	5	981	2	3
693	3	5	781	1	2				982	2	5
694	5	5	782	3	5	860	1	2			
695	3	3							989	1	2
696	4	3	785	1	2	881	3	4			
									996	1	2
702	3	5	788	1	5	885	1	2			
			789	1	5				1007	3	5
705	4	5				887	1	5	1008	4	5
			791	2	2	888	1	5			
713	4	5	792	1	2				1023	3	5
						894	1	2			
721	1	4	794	1	5	895	3	5	1036	2	2
									1037	1	2
723	1	3	796	1	2	897	1	2			
			797	2	2				1057	1	2
726	1	4				903	5	5			
			799	2	2				1066	2	2
733	2	2				907	1	2			
			802	3	3				1072	1	2
735	3	3	803	4	5	917	1	4			
									1085	3	5
737	1	2	811	1	2	927	3	4			
			812	4	3				1096	5	1
740	1	2				931	2	2			
			817	2	2				1122	1	2
756	2	5	818	1	2	939	2	2			
									1124	1	2
1144	5	2	1313	1	3	1385	2	3	1459	1	3
1159	4	5	1321	1	3	1389	3	3	1461	2	3
									1462	1	3
1200	5+	5	1326	1	3	1393	2	3			
1201	1	2				1394	2	3	1466	1	2
1202	1	2	1334	1	3						
						1399	1	3	1468	1	2
1210	3	4	1337	1	3						
			1338	1	3	1401	2	3	1474	2	2
1219	3	4				1402	1	3			
			1340	1	3	1403	4	4	1484	1	2
1230	5	3									
1231	1	2	1348	1	2	1408	3	4	1490	1	2
1234	1	2	1350	1	2	1418	1	2	1492	1	2
			1351	1	2						

1244	4	4	1362	1	2	1420	1	3	1497	3	3
1290	1	2	1369	1	2	1424	2	3	1504	1	2
1294	3	4	1370	1	2	1427	3	3	1510	1	3
1297	1	2	1373	2	3	1433	2	3	1518	2	3
1298	2	2	1380	1	2	1449	1	3	1520	1	2
1309	1	3				1450	5	4			
						1451	1	3			

Table 6 - Years (Yrs) with deficient annual maximum Nile River heights at Cairo/deficient July-October Discharge levels into the Nile River system of Blue Nile and Atbara River water, resulting from deficient summer monsoon rainfall over the highlands of Ethiopia during the period 1523-1991; and ratings by degree (Deg) of deficienty (1-5) as noted in Table 3, with confidence (Conf) ratings (1-5) based on the number of confirmation sources.

Yrs	Deg.	Conf	Yrs	Deg.	Conf	Yrs	Deg.	Conf.	Yrs	Deg.	Conf
1525	1	2	1650	5	3	1762	2	2	1832	1	3
1531	1	2	1655	1	1	1765	3	2	1833	4	4
1540	2	2	1661	3	2	1766	4	3	1835	4	2
1541	1	2	1671	1	1	1769	1	2	1836	3	2
1544	2	2	1683	1	1	1772	3	2	1837	4	3
1553	5	2	1687	1	1	1773	1	2	1838	2	2
1559	1	1	1694	5	2	1776	2	2	1839	3	2
1567	3	1	1695	2	1	1782	4	4	1844	1	2
1578	3	2	1697	1	2	1783	5	4	1845	3	2
1582	1	2	1703	1	2	1784	4	4	1850	2	2
1589	2	2	1709	1	2	1785	3	3	1852	2	2
1596	1	2	1713	3	3	1790	1	3	1855	3	3
1600	4	2	1714	1	2	1791	3	4	1857	1	2
1604	4	2	1715	5	2	1792	3	3	1858	2	3
1607	3	2	1716	5	2	1793	3	3	1859	2	2
1614	1	2	1720	1	2	1794	3	4	1864	4	4
1618	2	2	1723	2	3	1795	2	3	1867	1	2
1621	3	2	1725	3	2	1796	2	3	1868	4	4
1624	1	2	1731	2	2	1797	2	3	1873	2	3
1630	4	2	1734	1	2	1799	2	2	1877	4	4
1631	3	2	1737	2	3	1803	3	2	1881	1	2
1635	2	2	1744	1	1	1806	2	2	1882	2	2
1640	4	3	1748	1	2	1807	2	2	1884	2	3
1641	5	3	1754	1	1	1812	1	2	1886	1	2
1647	1	1	1758	3	2	1814	1	2	1888	4	3
1905	1	3	1925	2	3	1824	4	2	1897	1	3
1907	2	2	1930	1	3	1825	4	3	1899	5	4
1912	1	3	1939	2	4	1828	2	2	1902	2	4
1913	5	4	1940	2	4	1830	2	2	1972	5	2
1915	2	3	1941	3	4	1951	2	3	1973	2	2
1918	1	4	1943	1	2	1952	1	2	1980	1	2
			1944	1	2	1957	2	3	1982	3	2
						1965	3	2	1987	2	2
						1966	3	2	1991	2	2
						1968	2	2			
						1969	2	2			

7. DISCUSSION

All available information and data have been carefully reevaluated and coordinated prior to entry into the various tables of this report. In addition to the sources referred to here and in prior work on this subject, the high index (anti-ENSO) features, that occurred between the 7th century and the present, were referred to as a further control on the ENSO event occurrences. In the studies of various portions of the record from 1523 up to the present, it was noted that about 80-81% of the ENSOs were accompanied by years with low Nile maximum levels However, this percentage of agreement increased for ENSO events in the S, S+, and VS categories. Information of this nature can be useful when relating event occurrence dates of this historical sequence to those estimated in the various proxy records. Based on the contents of Tables 1 and 5 there is a continuous record of low SOI-related climatic activity available for A.D. 622-1992. Considering the degree 5 Nile reductions (prior to 1523)/very strong ENSO activity (1523-1992), the years of extreme low SOI-related climatic conditions would appear to be A.D. 650, 689, 694, 842, 903, 967, 1096, 1144, 1200, 1230, 1450, 1661, 1694-95, 1782-84, 1791-93, 1844-45, 1877-78, 1899-M1900, 1940-41, and 1982-M83.

I have often been queried about using rainfall data to quantify the river data over northeast Africa. One must realize that it would take several thousand rainfall and evaporation stations to attempt to provide the excellently integrated data available through the river discharge systems.

I agree with Popper (1951) on his views concerning the sedimentary buildup of the Nile River bottom. There appeared to be very little buildup over the first 4 centuries. It is expected that average rainfall was less over this early cool period. And, of course, a cooler atmosphere would contain less precipitable water. It is expected that the rainfall amount was a little higher and less variable, in general, during the Little Climatic Optimum.

The extended periods of low Nile flood also appear to be a feature of the cooler ages. The 7-year period of plenty and 7-year period of famine, as referenced in the Bible no longer appears unusual when reviewing these long records. In fact, the low Nile flood period of 1790-1797 can be verified by 3 separate sets of data, Lyons (1906), Toussoun (1925), and Popper (1951). This extended weak Nile flood condition has been studied in more detail. Since the Ethiopian highlands are at the westernmost periphery of the summer monsoon system, a significant lag in the shifts in location, depth, and areal extent of the equatorial low from its low index (ENSO) phase position in the east over to its high index (anti-ENSO) phase position to the west could very well lead to an extension of the associated weak Nile flood (low summer monsoon rainfall over the Ethiopian highlands) condition; and, this in conjunction with successive ENSO's could bring about extended low Nile flood periods such as we see in 1790-1797.

A.D. 1525-1899, which would, in general, be considered the Little Ice Age (LIA), shows frequent occurrences of weak Nile floods and also shows several extended periods of weak Nile floods (Table 7); whereas, A.D. 1000-1290 which would be considered to represent the Little Climatic Optimum (LCO) shows a very low percentage of weak Nile floods and no extended periods for such floods. A.D. 1291-1522 was considered to be an interim period between the LCO and LIA. Based on the above findings it would appear that activity over A.D. 622-999 would be more representative of a cool period. This would be in agreement with Maejima & Tagami (1986) who noted a cool age during the 7th-9th centuries in Japan.

Moreover, the findings here would indicate that Joseph lived during a cool period (prior to and after 1700 B.C.), with his 7 years of famine setting in about 1708 B.C. (Walford, 1879; Biswas, 1970; Encyclopaedia Judaica, 1971).

Increasing SSTs, along with decreasing sea level atmospheric pressure were noted over the southeast Pacific in Quinn (1979). The temperature increases since mid-1976 over the tropics and lower subtropics were further discussed in Quinn & Neal (1984) and the extended effects can be seen in the generally lowered SOI values of Figure 2. Over the period April 1976-March 1988 the SOI anomalies averaged out to 1.5 mb below the mean. All other pressure indices showed a similar drop over this 12-yr period. It is interesting that one of the strongest recorded ENSOs (1982-1983) occurred in the midst of this significantly below-normal SOI period (Quinn & Zopf, 1984). Also, when we came out of that 12-yr period of below average SOIs, the plot moved up rapidly into the high SOI feature of 1988 (Fig. 2) and this was accompanied by a period of extremely heavy rainfall and flooding in the western sector of the SO. Le Comte (1989) reported that:

«Heavy rainfall in the Blue Nile's catchment basin in the Ethiopian highlands during late July and early August contributed to major flooding along the Nile in Sudan.»

An Egyptian newspaper *al-Ahram* in its 13 August 1988 edition stated that the two Nile tributaries the day before spilled across a region south of Khartoum «until only tree tops remained visible.» This was the first such period of flooding rains over this region in more than a decade. Since mid-1989 it appears that we have slipped back into the generally below normal index mode, and this continued indication of increased sea temperatures forewarns us of serious marine ecological consequences that may continue to arise in the global coastal zones of the tropics and lower subtropics. Over the past 12 years many of the global coral reef regions have been seriously threatened (Bunkley-Williams and Williams, Jr., 1990); and, in particular, the very strong 1982-1983 ENSO was disastrous to several coral reef areas (Glynn, 1990).

One of the interesting findings from this study is the fact that the large-scale ENSO developments often show up many months earlier in the regional features on the western side of the «see-saw» than they do on the eastern side. This was of course very clearly shown in the case of the very strong 1982-1983 ENSO.

Based on this study, it appears that the LCO and LIA may have caused some significant changes in the SO-related activity. In Quinn and Neal (1992) it was noted that the LIA caused an increase in the length and strength of subtropical Chilean droughts during the 17th, 18th, and early 19th centuries. In fact, during the peak drought period, 1770-1814, there was only one ENSO strong enough to bring about an above normal subtropical Chilean rainfall; this was the very strong ENSO of 1782-1784 that caused the heavy Chilean rainfall and floods of 1783 (1783 was a very unusual year for atmospheric phenomena, as reported by C.A. Wood in the 24 June 1984 EOS. The Laki volcanic eruption occurred in Iceland in 1783 along with other unusual phenomena.). I have often been questioned concerning the effects of volcanic eruptions on ENSOs and whether the El Chichon eruption caused the onset of the very strong 1982-1983 El Niño. As pointed out in Quinn & Neal (1983b) El Chichon occurred in April 1982, and by that time several of the ENSO-related developments were already underway, particularly those on the western side of the «see-saw.» In looking over past records I find as many or more cases where strong ENSO activity led volcanic activity. For

Table 7 - The years A.D. 622-1991 are broken into 5 periods for considering the occurrence of weak Nile River floods (WNRFs): 622-999, a relatively cool period; 1000-1290, representing the Little Climatic Optimum (LCO); 1291-1522, considered to be an interim period between the LCO and Little Ice Age (LIA); 1523-1899, representing the LIA, and 1900-1991, covering the recent period. The number of WNRFs by degree (as specified in Table 5) and total number are listed for each period, as are cases where extended (4 or more years in a row) of WNRFs occurred.

Period	Feature	Number of WNRFs by degree					Total number	Cases where WNRFS occur 4 or more years in a row
		1	2	3	4	5		
622-999	Cool period	55	20	15	9	6	105	693-696, 761-765, 769-773, 779-782, 945-951, 963-967
1000-1290	LCO	10	2	5	3	4	24	None
1291-1522	Interim period	32	11	5	1	1	50	None
1523-1899	LIA	34	27	21	16	8	106	1713-1716, 1782-1785, 1790-1797, 1835-1839,
1900-1991	Recent period	8	13	4	0	2	27	None

example there was no ENSO in 1815 or 1816 following the larger 1815 Tambora eruption, although there was a strong El Niño in 1814. However, after thinking about the reports of years without a summer over the New England states in 1816 and 1884 following the large Tambora and Krakatoa eruptions, I began to realize that when the two types of event occur near the same time, it might be the simultaneous occurrence of atmospheric warming over the tropical Pacific due to the ENSO and the cooling in higher latitudes as the optical depth of volcanic aerosols increased there, that caused the extreme weather activity of 1982-1983. I had checked with Dr. Kirby Hanson (then at ERL NOAA) and he reported that there were high turbidities in the polar atmosphere in spring 1983 and that it could also be assumed to be high there in the winter of 1982-1983. As an analogue, there was the great volcanic explosion of Krakatoa in August 1883 and the ENSO that set in early 1884; and it was in early 1884 that we had extremely heavy rainfall over the southwestern U.S. In fact, Los Angeles and San Diego received their greatest rainfalls in 1884.

For climatic trends Table 7 may be quite useful. Lamb (1977) indicates a warm dry time around 300 to 400 A.D. and a colder climate phase between A.D. 500 and 900 in Europe. The latter information like that from the Japanese (Maejima & Tagami, 1986) would tie in closely with our findings for East Africa. This study indicates that the most disastrous Nile flood failure occurred in A.D. 1200, and it is quite likely that the related large-scale ENSO was similarly unusual and may have caused the exceptionally strong El Niño that led to the cataclysmic «Chimu flood» in coastal Peru, which was reported in Nials *et al.* (1979).

The deficient summer monsoon rainfall over the highlands of Ethiopia and the El Niño along the coast of southwest Ecuador and northwest Peru are at opposite ends of the «see-saw» of ocean-atmosphere conditions, yet they are both integral features of the large-scale ENSO. However, as indicated by Griffiths (1972), the summer monsoon rainfall is primarily affected by the development and location of the equatorial low core of the SO; whereas, the winds, currents, SST conditions, coastal sea levels and weather conditions over the eastern tropical Pacific side of the ENSO depend greatly on the changes that take place in the southeast Pacific subtropical high.

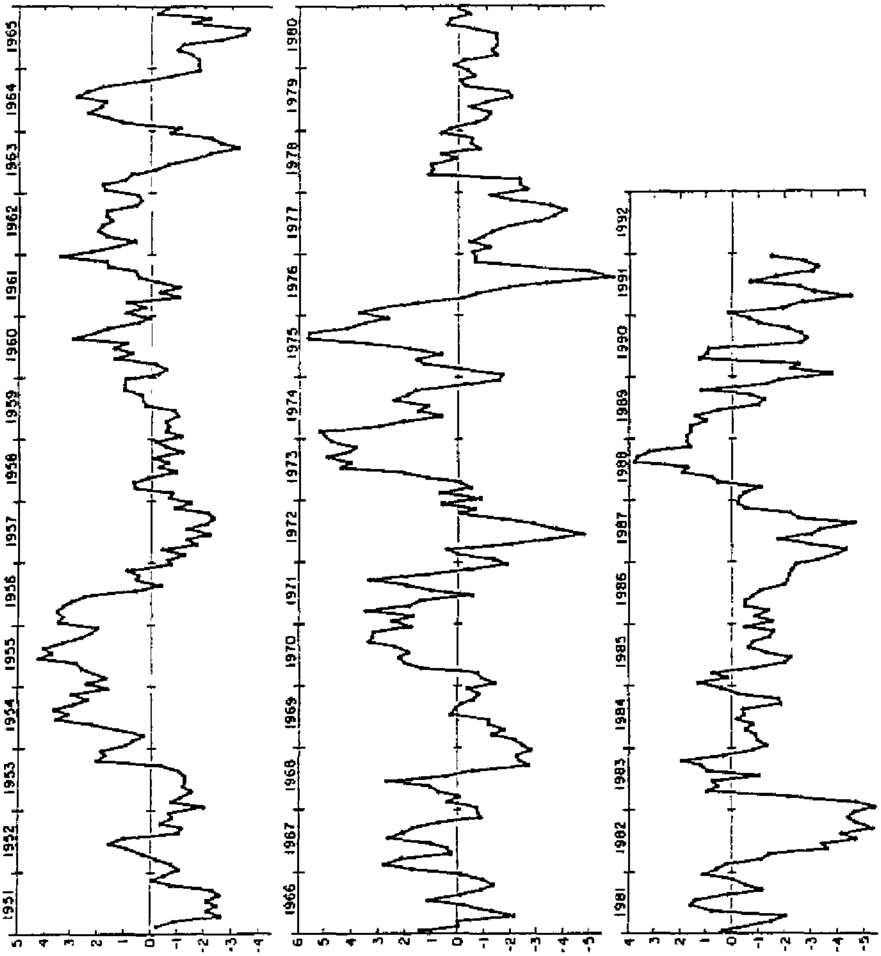

Fig. 2 -Three-month running mean plot of anomalies of the difference in sea level atmospheric pressure (mb) between Rapa Island (27o37'S, 144°20'W) and Darwin, Australia (12°26'S, 130°52'E). (Anomalies are based on data for 1951-1988.) (From Quinn, in press.)

Much more study is required to determine the cause of the significant differences between the SO-related climatic activity (as indicated herein) for the cool periods and the Little Climatic Optimum.

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