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Climatic changes in India—(III) Pressure

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1. Introduction

The authors (1953, 1954) have studied the changes in rainfall and temperature in India and the present note consists of a similar study regarding pressure. For this purpose, pressure data of the morning synoptic hour of 25 observatory stations distributed over India and neighbourhood, for which sufficiently long and continuous records are available have been selected after scrutiny of the periodical Inspection reports and other records. The stations selected for the purpose of the study have been shown in Fig. 1. In selecting the stations care has been taken to see that the exposure of the barometers have remained satisfactory throughout, and that wherever there has been any change in the location of the barometer, suitable corrections for the change in the location have been worked out; these corrections have been applied to the values to make the observations of pressure throughout the years comparable.

Table 1 gives the latitude, longitude, height, period of data utilised, the mean annual pressure and its standard deviation for the selected stations. It may be mentioned here that the morning observations were taken at 1000 LMT upto 1889, but in the succeeding years up to 1943, the observations have been recorded at 0800 LMT. From 1943 to February 1949, the observations were taken at 0800 IST, and from March 1949 to date, the observations have been taken at 0830 IST. In the first instance, the data prior to 1889 have been corrected for making them comparable with the data for 0800 LMT by applying suitable corrections (1904). These data up to 1942 were then corrected for the change in time from 0800 LMT to 0830 IST and finally all the data prior to March 1949 were corrected for the change from 0800 to 0830 IST. The values have been reduced to a standard temperature of 32°F and for standard gravity at 45° lat., and to the level of the barometer cistern equivalent to the present height of the barometer at each station. The final series of annual pressure values as utilised here can, therefore, be reasonably taken as a uniform series for the purpose of this study.

In addition to the series of mean annual pressures, certain aspects of the mean pressures for the months, January and July, which represent the winter and the monsoon conditions respectively have been studied in the following paragraphs.

The variations of the 0830 IST pressure at the different stations can be seen from the graphs in Fig. 2. Even though the standard deviations of annual means of pressure given in column 8 of Table 1 are a very minor fraction of the mean values of pressure (col. 7), it is well known that the variations play a very significant part in the control of weather. A statistical examination of the series of annual pressure data has been made with a view to find out whether any oscillatory changes or secular changes are present in the series. The methods used have been similar to those in our previous papers (1953, 1954) wherein we have studied the rainfall and temperature series.

2. Test for oscillatory changes

The mean daily values of pressure at the different stations vary from year to year. To test whether the variations from

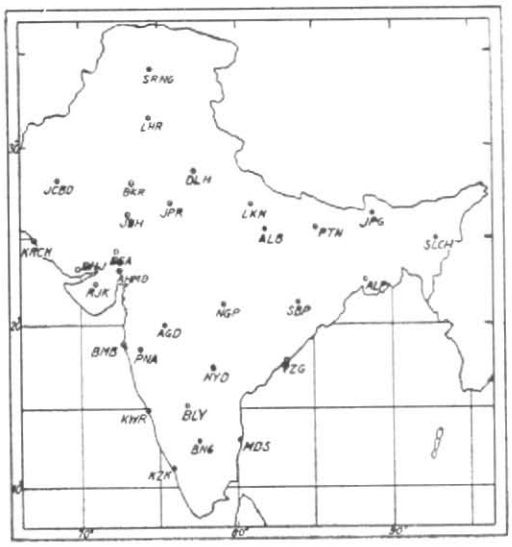

Fig. 1. Map of India and neighbourhood showing the position of selected stations

year to year are purely random or contain an element of related sequences in them, an examination of the 'peaks' and 'troughs' in the series (Kendall 1946) have been made. In Table 2 (a) are given the data in regard to the 'turning points', the actual number, the number expected on the hypothesis of randomness and their standard deviations. It may be seen that the number of turning points in the case of Allahabad, Bangalore, Bombay, Cochin, Hyderabad, Jaipur, Karachi, Madras, Mangalore, Nagpur, Rangoon, Tiruchirapalli and Visakhapatnam are significantly smaller than the expected number, indicating that the variations are not quite random, but they have a tendency to increase or decrease in the same way as in the previous year.

In Table 2(b) are given the actual and expected frequencies of phase lengths, the χ^2 and probability P for the occurrence of χ^2 greater than the ones observed. It is seen that the values of χ^2 for the stations—Allahabad, Bangalore, Bhuj, Bombay, Cochin, Dibrugarh, Hyderabad, Indore, Jaipur, Karachi, Madras, Mangalore, Multan, Nizamabad, Rangoon, Sambalpur, Tiruchirapalli and Visakhapatnam are high, and thus bring down the values of probability to less than 0·05, which may be taken as the limit for significance. This is due to the preponderance of phase length 2 and 3 or more years at the expense of 1 year phase lengths at Allahabad, Bangalore, Bhuj, Bombay, Cochin, Dibrugarh, Hyderabad, Indore, Madras, Nizamabad, Rangoon, Tiruchirapalli and Visakhapatnam, and preponderance of phase lengths of 3 years or more at the expense of 1 year ones in the case of Jaipur, Karachi, Mangalore, Multan and Sambalpur.

Thus in the case of pressure at Allahabad, Bangalore, Bombay, Cochin, Hyderabad, Karachi, Madras, Rangoon, Tiruchirapalli and Visakhapatnam, both the tests indicate the possibility of deviation from randomness and possibly some cyclical tendencies. The determination of which, however, requires further examination.

3. Tests for secular trends

The series of annual pressure values for the different stations have been fitted to orthogonal polynomials by the method developed by Fisher (1951). The co-efficients of the orthogonal polynomials and the square roots of the variances accounted for by the different degree polynomials are given in Tables 3(a) and 3(b) respectively. It may be seen that

(*i*) Bangalore, Jalpaiguri, Naya Dumka and Tiruchirapalli do not show any trend up to the 5th degree

(*ii*) At all the other stations with the exception of Cochin, Dibrugarh, Nagpur and Naya Dumka the co-efficients of the first degree terms are significantly negative indicating a decreasing tendency for pressure at these stations

(*iii*) Akyab, Alipore, Allahabad, Jacobabad, Multan and Naya Dumka indicate a 2nd degree trend suggesting one half oscillation over the whole period. Cochin, Dibrugarh, Jaipur, Lahore, Rangoon and Sambalpur show a 3rd

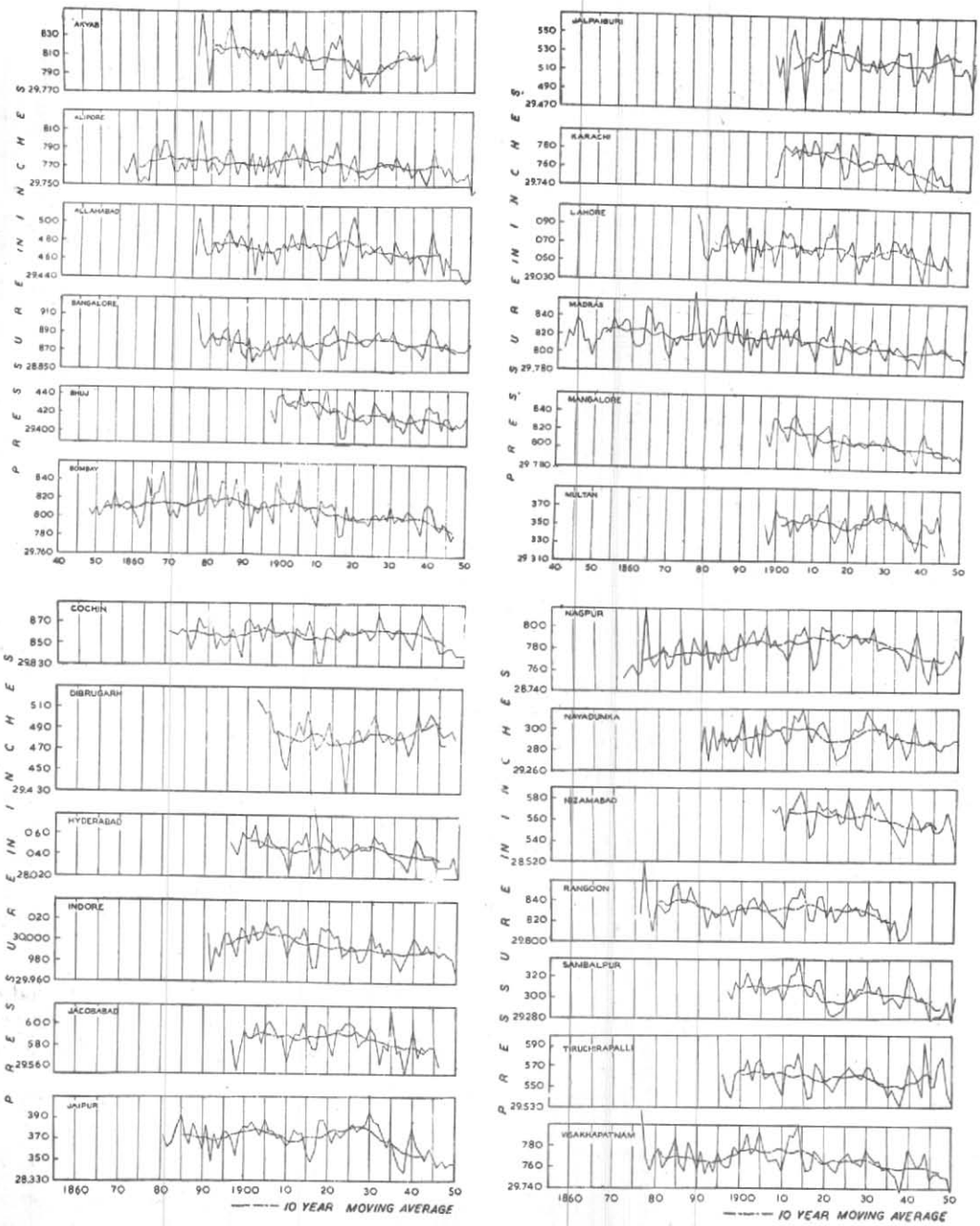

Fig. 2. Mean annual pressure year by year

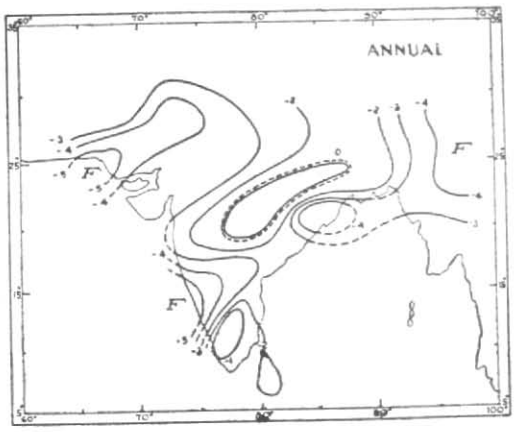

Fig. 3. Linear trend in mean annual pressure

degree trend suggesting a complete oscillation during the whole period. Bombay and Karachi a 4th degree trend and Indore, Nagpur and Visakhapatnam a 5th degree trend.

Even though all the co-efficients are not significant, the manner in which the values change from station to station, suggest that the occurrence of individual co-efficients are not entirely random but are to some exent dependent on their relative positions. In Fig. 3 the lines demarcating the different ranges of values of the 'linear trend' are shown. This diagram brings out the regions where pressure had a tendency to decrease and those in which pressure had a tendency to increase. It is interesting to note that there is a tendency for pressure to decrease over the major part of the country.

We now examine by the method of moving averages to see if the trends exhibited by the polynomial analysis were due to any systematic increasing or decreasing tendencies or to some unusually higher or lower values at certain particular periods. 10-year moving averages in respect of all the stations have been computed and plotted in Fig. 2. The features revealed by these are detailed below—

Akyab	Decreasing up to 1920 and increasing later
Alipore	Slight oscillating and decreasing tendency
Allahabad	Slight oscillating tendency with a period of about 30 years with a decreasing tendency since 1915
Bangalore	Oscillating tendency with a period of about 50 years
Bhuj	Decreasing since 1900
Bombay	Slight increase from 1850 to 1885 and decrease after 1905
Cochin	Slight oscillating tendency with a period of about 20-25 years
Dibrugarh	Decreasing up to 1923 and increasing later
Hyderabad	Decreasing since 1900
Indore	Decreasing since 1900
Jacobabad	Slight increase up to 1925 and decrease later
Jaipur	Oscillating with a period of about 25 years with a slight decreasing tendency
Jalpaiguri	Oscillating with a period of about 30 years
Karachi	Decreasing since 1900 with a slight oscillating tendency
Lahore	Decreasing with a slight oscillating tendency
Madras	Decreasing with a slight oscillating tendency with a period of about 20 years
Mangalore	Decreasing since 1900
Multan	Oscillating with a period of about 20 years superposed on a decreasing trend
Nagpur	Increasing from 1872 to 1920 and decreasing later
Naya Dumka	Slight oscillating tendency with a period of about 22 years
Nizamabad	Decreasing since 1900
Rangoon	Decreasing with an oscillating tendency

Sambalpur	Slight decreasing and oscillating tendency of period about 22 years
Tiruchirapalli	Slight oscillating tendency
Visakhapatnam	Slight oscillating tendency of about 25 years and decreasing tendency since 1910

As the nature of the oscillations are not consistent even over the same area, they have to be considered as transient and not presumably indicative of a general periodicity with periods comprised within the span of the available meteorological observations.

In Table 4 are given the decade averages of pressures. The significance of the differences of the different decade averages from the general mean pressures have been tested by the usual t-test and significant values have been indicated in the table. It will be seen that out of the 25 stations considered, 14 had pressures in some of the decades significantly higher than their respective means and in all these cases the higher pressures had occurred in one or two of the decades prior to 1930. In 16 of the stations the pressures in some of decades were significantly lower than their respective mean pressures, and in all these 17 stations the lower mean pressures had occurred in one or two of the last three decades.

The examination by ten year averaging process indicates that there has been a tendency to decrease at some of the stations.

4. Analysis of trend for the uniform period 1901 to 1950

It may be mentioned that in as much as the length of the series at the different stations are not all uniform, the feature revealed by Fig. 3 for the different stations cannot be treated as quite comparable. It was, therefore, considered desirable to examine the trend during a uniform period of 50 years for all the stations. The data from 1901 to 1950 were analysed by the method of polynomial analysis but only the 1st degree trend has been computed. The regression co-efficients of the linear term (b)

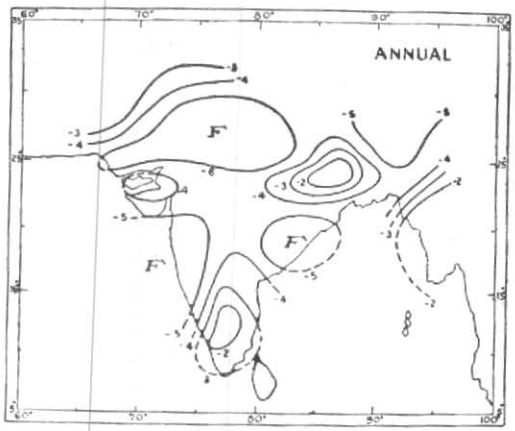

Fig. 4. Linear trend in mean annual pressure (1901-1950)

and their standard errors are given in Table 5. The co-efficients were plotted on charts and smoothed lines demarcating the values have been drawn in Fig. 4. It is seen that the pattern of changes indicated in Fig. 4 is similar to the one in Fig. 3. The tendency of the decrease of pressure is, however, slightly more over the country. Notable regions of tendencies for decrease of pressure are Sind, Rajputana, Uttar Pradesh, west coast of India, north Andhradesa, south Orissa and Assam.

5. Linear trends for the months January and July

Linear trends in January and July pressures for 50 years from 1901 to 1950 have also been calculated. The co-efficients and their standard errors are given in Table 6 and isopleths of the co-efficients are shown in Figs. 5 and 6.

January—It is seen that there is in general a tendency for pressure to decrease over the country and a tendency to increase over Burma and North West Frontier.

July—It is seen that there is in general a tendency for pressure to decrease over the country outside the south Peninsula and extreme northwest.

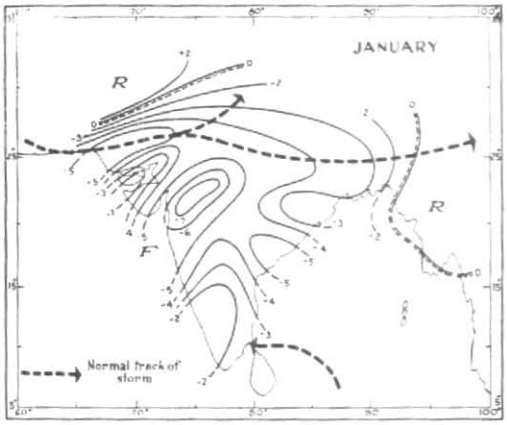

Fig. 5. Linear trend in mean January pressure (1901-1950)

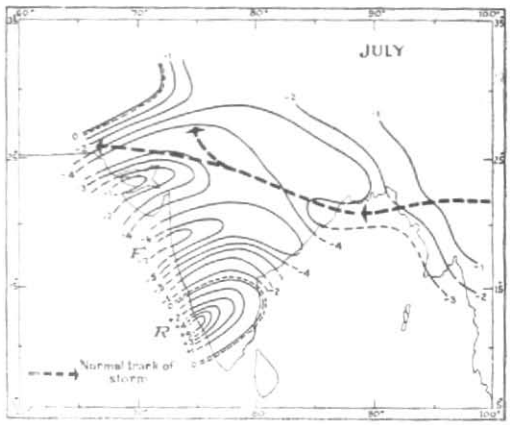

Fig. 6. Linear trend in mean July pressure (1901-1950)

The implications of these long period pressure tendencies and similar tendencies as regards rainfall and temperature in relation to general circulation will be discussed in a separate note later.

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TABLE 1

Station	Latitude (N)	Longitude (E)	Height of barometer a.s.l. (*ft*)	Period for which data available	Mean pressure (*inches*)	Standard deviation of annual pressure
1. Akyab	20° 08′	92° 55′	29	1876—1940	29·808	·015
2. Alipore	22° 32′	88° 20′	21	1856—1950	29·772	·013
3. Allahabad	25° 27′	81° 44′	322	1876—1950	29·471	·014
4. Bangalore	12° 58′	77° 35′	3021	1877—1951	26·880	·022
5. Bhuj	23° 15′	69° 48′	343	1897—1951	29·473	·014
6. Bombay	18° 54′	72° 49′	37	1848—1951	29·808	·014
7. Cochin	9° 58′	76° 14′	10	1881—1950	29·858	·011
8. Dibrugarh	27° 28′	94° 55′	348	1902—1951	29·481	·032
9. Hyderabad	17° 26′	78° 27′	1778	1896—1950	28·046	·011
10. Indore	22° 43′	75° 54′	1823	1891—1950	27·994	·013
11. Jacobabad	28° 17′	68° 29′	186	1897—1946	29·585	·013
12. Jaipur	26° 55′	75° 50′	1431	1881—1950	28·369	·014
13. Jalpaiguri	26° 32′	88° 43′	271	1897—1951	29·534	·022
14. Karachi	24° 48′	66° 59′	13	1897—1946	29·803	·015
15. Lahore	31° 35′	74° 20′	702	1877—1941	29·065	·016
16. Madras	13° 04′	80° 15′	67	1848—1951	29·814	·014
17. Mangalore	12° 52′	74° 61′	72	1897—1951	29·789	·013
18. Multan	30° 12′	71° 31′	413	1897—1946	29·355	·019
19. Nagpur	21° 09′	79° 07′	1022	1872—1951	28·779	·014
20. Naya Dumka	24° 16′	87° 15′	489	1890—1949	29·292	·013
21. Nizamabad	18° 40′	78° 06′	1250	1907—1950	28·561	·013
22. Rangoon	16° 46′	96° 11′	18	1876—1940	29·831	·013
23. Sambalpur	21° 28′	83° 58′	486	1897—1951	29·303	·014
24. Tiruchirapalli	10° 49′	78° 42′	255	1891—1950	29·558	·013
25. Visakhapatnam	17° 42′	83° 18′	126	1877—1951	29·768	·014

TABLE 2

Distribution of turning points and phase lengths in the series of mean pressure values

Station	No. of turning points			Phase lengths						χ^2	P
				$D=1$		$D=2$		$D=3$			
	A	E	SD	A	E	A	E	A	E		
1. Akyab	40	42·0	3·25	23	24·6	11	10·6	5	3·0	2·20	·40
2. Alipore	62	61·9	4·06	36	38·3	20	16·7	5	4·7	2·04	·43
3. Allahabad	41*	48·6	3·61	17*	25·2	15**	10·9	8**	3·1	12·68*	·005*
4. Bangalore	35*	48·6	3·61	13*	21·4	13**	9·3	8**	2·6	16 33*	<·001*
5. Bhuj	31	35·3	3·07	13*	18·9	12**	8·2	5**	2·3	7·39*	·043*
6. Bombay	57*	67·9	4·26	22*	35·2	26**	15·3	8**	4·4	16·53*	<·001*
7. Cochin	37*	45·3	3·48	12*	22·6	19**	9·8	5**	2·8	16·08*	<·001*
8. Dibrugarh	27	32·0	2·93	11*	16·4	9**	7·1	6**	1·8	12·64*	<·001*
9. Hyderabad	22*	35·3*	3·07	7*	13·3	9**	5·7	5**	1·6	10·35*	·01*
10. Indore	38	38·6	3·21	20**	23·3	13**	10·1	4**	2·9	16·73*	<·001*
11. Jacobabad	31	32·0	2·93	17	18·9	8	8·2	5	2·1	5·02	·12
12. Jaipur	35*	45·3	3·48	17*	21·4	8	9·3	9**	2·6	17·18*	<·001*
13. Jalpaiguri	33	35·3	3·07	18	20·2	10	8·7	4	2·5	2·02	·37
14. Karachi	26*	32·0	2·93	12*	15·8	8	6·8	5**	1·7	7·84*	·035*
15. Lahore	42	45·3	3·48	24	25·8	11	11·2	6	3·2	1·47	·54
16. Madras	54*	67·9*	4·26	22*	33·2	19*	14·5	12**	4·1	20·27*	<·001*
17. Mangalore	25*	35·3	3·02	10*	15·1	7	6·5	7**	1·8	16·66*	<·001*
18. Multan	27	32·0	2·93	11*	16·4	9	7·1	6**	1·8	12·64	<·001*
19. Nagpur	44*	51·9	3·73	22	27·1	15	11·7	6	3·3	2·81	·30
20. Naya Dumka	35	38·6	3·21	16	21·4	13	9·3	5	2·6	5·72	·09
21. Nizamabad	23	28·0	2·74	10*	14·6	9**	6·1	3**	0·6	14·12*	·002*
22. Rangoon	32*	42·0	3·35	10*	19·5	14**	8·5	7**	2·4	15·78*	·009*
23. Sambalpur	30	30·5	3·07	14*	18·3	9	7·9	6**	2·2	8·12*	·03*
24. Tiruchirapalli	22*	35·3*	3·07	4*	13·3	12**	5·7	6**	1·6	25·69*	<·001*
25. Visakhapatnam	41*	48·6	3·61	15*	25·2	18**	10·9	7**	3·1	14·37*	·002*

*Lower values (significant at 5 per cent level)

** Higher values (significant at 5 per cent level)

TABLE 3 (a)

Co-efficients of orthogonal polynomials

Station	Mean pressure (P_m)	$D_1 \times 10^6$	$D_2 \times 10^7$	$D_3 \times 10^8$	$D_4 \times 10^9$	$D_5 \times 10^{10}$
1. Akyab	29·808	—25·88	+116·6	+ 53·60	+ 14·58	— 4·33
2. Alipore	29·772	—12·97	— 52·15	— 1·45	— 5·25	— 0·02
3. Allahabad	29·471	—26·90	—131·04	— 8·83	— 9·41	— 0·61
4. Bangalore	26·880	— 6·72	— 19·73	— 54·40	— 8·95	— 0·90
5. Bhuj	29·473	—37·62	+ 75·19	+ 55·05	— 43·05	+ 34·99
6. Bombay	29·808	—22·66	— 5·72	+ 4·72	+ 13·84	— 1·36
7. Cochin	29·858	— 9·64	— 60·40	— 53·48	— 19·15	— 5·52
8. Dibrugarh	29·481	—46·18	—150·90	—517·34	—156·60	—190·37
9. Hyderabad	28·046	—33·53	— 71·22	— 62·55	— 17·78	+ 22·41
10. Indore	27·994	—30·46	—114·42	+ 66·63	— 51·63	— 17·31
11. Jacobabad	29·585	—25·12	—256·70	+ 24·30	— 26·83	+ 55·57
12. Jaipur	28·869	—27·28	—159·48	— 58·25	— 4·17	+ 7·45
13. Jalpaiguri	29·534	—12·25	—142·00	+ 65·15	— 50·68	— 48·37
14. Karachi	29·803	—59·98	—219·1	+ 60·62	—106·23	+ 73·37
15. Lahore	29·065	—23·14	— 34·37	— 35·75	+ 5·69	— 9·59
16. Madras	29·814	—21·08	— 25·12	+ 7·24	— 0·41	+ 0·71
17. Mangalore	29·789	—50·86	+ 0·83	— 15·81	— 36·55	+ 31·99
18 Multan	29·385	—37·10	—274·30	— 32·65	+ 4·29	+122·55
19. Nagpur	29·779	+ 5·74	—143·52	— 1·00	+ 6·38	+ 9·49
20. Naya Dumka	29·292	— 3·79	—151·32	+161·04	— 3·40	— 3·71
21. Nizamabad	28·561	—57·24	— 86·83	—102·96	— 13·28	—138·10
22. Rangoon	29·831	—23·18	— 49·79	— 57·56	— 12·04	+ 13·24
23. Sambalpur	29·303	—42·02	— 54·22	— 17·65	— 52·85	+ 34·36
24. Tiruchirapalli	29·580	—14·30	— 13·62	+ 57·29	— 42·90	— 10·83
25. Visakhapatnam	29·768	—26·86	— 92·52	— 27·31	+ 14·56	— 12·96

TABLE 3(b)

Square roots of variances accounted for by the polynomials

Station	X_2	X_3	X_4	X_5	X_6	Polynomial as a whole	Residual
1. Akyab	39·14	29·58	22·38	9·95	4·81	24·62	13·64
2. Alipore	34·67	34·41	2·30	19·85	15·30	24·45	11·87
3. Allahabad	50·43	47·56	11·54	12·24	4·03	31·93	12·17
4. Bangalore	12·61	7·16	37·50	11·62	2·91	18·73	22·76
5. Bhuj	44·28	12·53	12·81	13·86	15·46	23·30	12·15
6. Bombay	69·37	4·71	10·25	78·51	20·22	32·89	12·65
7. Cochin	16·31	18·44	27·28	18·25	9·24	18·80	9·64
8. Dibrugarh	47·94	19·87	86·17	32·76	49·79	52·29	29·68
9. Hyderabad	39·47	11·89	14·56	5·72	9·92	20·21	9·21
10. Indore	25·88	20·42	21·05	24·58	39·14	30·55	9·17
11. Jacobabad	81·05	33·79	4·04	5·61	14·53	26·29	12·36
12. Jaipur	46·12	45·04	29·71	3·96	12·45	32·28	11·00
13. Jalpaiguri	14·42	23·73	15·16	16·39	21·41	18·59	22·69
14. Karachi	60·79	35·42	10·09	22·22	19·18	33·80	10·39
15. Lahore	39·11	10·48	57·66	5·42	16·03	32·40	10·77
16. Madras	64·54	20·64	15·68	2·35	10·63	31·48	12·28
17. Mangalore	59·87	0·13	3·67	11·74	14·00	28·03	9·56
18. Multan	57·84	36·11	5·44	0·28	32·05	18·03	18·02
19. Nagpur	11·83	61·22	0·86	11·09	33·00	31·94	11·87
20. Naya Dumka	5·08	31·43	5·00	1·61	2·65	14·49	12·46
21. Nizamabad	48·21	8·30	10·95	1·56	17·80	23·79	10·05
22. Rangoon	35·05	12·61	24·04	8·22	14·73	21·21	11·83
23. Sambalpur	49·41	90·58	41·05	17·03	15·20	24·76	12·20
24. Tiruchirapalli	16·82	2·27	13·30	13·78	4·78	11·61	13·23
25. Visakhapatnam	50·36	33·57	18·84	18·96	31·73	32·82	11·36

TABLE 4

Decade averages of 8 A.M. pressure

	Station	1851-1860	1861-1870	1871-1880	1881-1890	1891-1900	1901-1910	1911-1920	1921-1930	1931-1940	1941-1950	General mean
1.	Akyab				29·818**	·810	·801	·806	·795*	·809		29·808
2.	Alipore		29·777	·777	·773	·774	·777	·774	·770	·768*	·761*	29·772
3.	Allahabad				29·479	·479	·477	·487**	·469	·466	·456*	29·471
4.	Bangalore				26·881	·874	·877	·886	·885	·879	·878	26·880
5.	Bhuj						29·482**	·476	·472	·466	·465*	29·473
6.	Bombay	29·812	·814	·814	·820**	·813	·812	·805	·801	·801	·789*	29·808
7.	Cochin				29·861	·856	·860	·857	·862	·861	·849*	29·858
8.	Dibrugarh							29·485	·481	·483	·471	29·481
9.	Hyderabad						28·053**	·049	·047	·043	·036*	28·046
10.	Indore						28·006	27·998	·991	·988	·987	27·994
11.	Jacobabad						29·590	·690	·591	·580		29·585
12.	Jaipur				28·373	·370	·376	·371	·379**	·365	·351*	28·369
13.	Jalpaiguri						29·540	·544	·532	·531	·530	29·534
14.	Karachi						29·814**	·810	·804	·794*		29·803
15.	Lahore				29·070	·066	·067	·069	·061	·061		29·065
16.	Madras	29·826**	·819	·819	·821	·817	·814	·812	·807	·803*	·804*	29·814
17.	Mangalore						29·798**	·792	·788	·783	·777*	29·789
18.	Multan						29·363	·359	·362	·352		29·355
19.	Nagpur				28·776	·777	·786	·789**	·789**	·780	·765*	28·779
20.	Naya Dumka					29·291	·293	·301	·292	·292		29·292
21.	Nizamabad							28·569**	·563	·558	·553*	28·561
22.	Rangoon				29·840**	·827	·830	·836	·831	·819*		29·831
23.	Sambalpur						29·315**	·313**	·297	·302	·299	29·303
24.	Tiruchirapalli						29·562	·562	·559	·550*	·558	29·558
25.	Visakhapatnam				29·770	·767	·776	·777**	·767	·760	·757*	29·768

*Lower values (significant at 5 per cent level)
**Higher values (significant at 5 per cent level)

TABLE 5

Linear trend of pressure—Annual (1901-50)

Station	Mean	SD	$b \times 10^3$	$SE \times 10^{+3}$	Station	Mean	SD	$b \times 10^3$	$SE \times 10^{+3}$
1. Akyab	29·805	·013	—·14	·1073	14. Karachi	29·803	·014	—·60	·1167
2. Alipore	29·770	·013	—·40	·1076	15. Lahore	29·063	·011	—·31	·1143
3. Allahabad	29·468	·014	—·67	·1225	16. Madras	29·763	·011	—·31	·1143
4. Bangalore	26·879	·010	—·16	·0983	17. Mangalore	29·787	·011	—·51	·0912
5. Bhuj	29·473	·026	—·39	·0617	18. Multan	29·355	·018	—·37	·1833
6. Bombay	29·801	·011	—·59	·0979	19. Nagpur	28·782	·014	—·44	·1159
7. Cochin	29·857	·011	—·21	·1013	20. Naya Dumka	29·332	·013	—·20	·1225
8. Dibrugarh	29·481	·033	—·47	·3137	21. Nizamabad	28·561	·013	—·57	·1211
9. Hyderabad	28·045	·011	—·37	·0971	22. Rangoon	29·828	·011	—·17	·0784
10. Indore	27·994	·012	—·49	·0983	23. Sambalpur	29·302	·013	—·48	·1256
11. Jacobabad	29·585	·011	—·25	·1275	24. Tiruchirapalli	29·558	·012	—·23	·1275
12. Jaipur	28·368	·013	—·56	·1196	25. Visakhapatnam	29·766	·014	—·63	·1055
13. Jalpaiguri	29·537	·015	—·52	·1275					

TABLE 6

Linear trend of pressure (1901—50)

Station	JANUARY				JULY			
	Mean	S.D.	$b \times 10^{+3}$	S.E. $\times 10^{+3}$	Mean	S.D.	$b \times 10^{+3}$	S.E. $\times 10^{+3}$
1. Akyab	29·969	·029	+·19	·27	29·601	·031	—·29	·29
2. Alipore	30·009	·044	—·38	·44	29·499	·034	—·37	·33
3. Allahabad	29·727	·038	—·43	·33	29·179	·028	—·34	·27
4. Bangalore	26·979	·025	—·07	·23	26·780	·018	+·21	·19
5. Bhuj	29·634	·024	—·18	·23	29·142	·031	—·08	·29
6. Bombay	29·936	·024	—·58	·23	29·625	·025	—·79	·23
7. Cochin	29·919	·025	—·05	·23	29·820	·021	+·06	·21
8. Dibrugarh	29·690	·035	+·01	·35	29·246	·025	—·05	·25
9. Hyderabad	28·188	·010	—·39	·10	27·880	·026	—·17	·27
10. Indore	28·150	·032	—·88	·29	27·764	·020	—·41	·63
11. Jacobabad	29·887	·031	+·28	·10	29·230	·025	—·04	·26
12. Jaipur	28·576	·010	—·44	·10	28·097	·025	—·49	·23
13. Jalpaiguri	29·740	·034	—·30	·32	29·280	·029	—·13	·27
14. Karachi	30·019	·028	—·64	·23	29·453	·029	—·49	·27
15. Lahore	29·132	·032	+·21	·30	28·760	·028	—·22	·23
16. Madras	29·959	·030	—·31	·29	29·675	·018	+·03	·19
17. Mangalore	29·862	·025	—·02	·23	29·715	·021	+·55	·20
18. Multan	29·643	·028	+·33	·27	29·090	·027	+·03	·27
19. Nagpur	28·974	·031	—·43	·10	28·554	·027	—·53	·27
20. Naya Dumka	29·532	·033	—·36	·32	29·266	·035	—·33	·33
21. Nizamabad	28·711	·042	—·23	·39	28·364	·043	+·17	·39
22. Rangoon	29·948	·031	+·07	·29	29·704	·021	—·17	·20
23. Sambalpur	29·533	·033	—·21	·32	29·044	·033	—·29	·30
24. Tiruchirapalli	29·678	·033	—·24	·34	29·460	·013	—·01	·17
25. Visakhapatnam	29·974	·031	—·59	·10	29·546	·025	—·50	·23