The decrease of magnetic horizontal force from 1919 to 1920 was noticeably smaller than for the previous year, during which it was 24γ, or very nearly the average yearly decrease from 1902 to 1920. Similarly, from 1902 to 1904 the decrease was 25γ for each year, and for 1904 to 1905 the amount of decrease diminished to only 16γ. The provisional value of H for 1912 shows that a similar diminished decrease occurred from 1911 to 1912 (18γ).

Preliminary Analysis of Apparent Annual Inequalities of H.F. in successive Years.

It was felt desirable, in view of the relationship shown in last year's report to exist between the annual variations in 1905, 1910, 1914, and 1919, that some investigation should be made of the apparent inequalities in various years. It is fairly evident that some relationship existed between the inequalities in years 5 or 9 years apart, or both, independently of any direct connection with position in the sun-spot cycle, and that if the data in every available year were analysed in the same manner, treating it provisionally as entirely cyclic within the twelve months, some indication of periodical order at least might be obtained.

The following table gives the results of the analysis for the first four harmonic terms. Correction for secular change was applied to the apparent inequalities according to the known amounts at the time. The phase angles, of course, are given for January 0d.

It must not be forgotten that the analysis is really a measure of conditions existing over the whole year, and in some degree an averaging of those conditions. If conditions changed very slowly we would expect a progressive change of the phase angles. Rapid changes in periods other than the year would make these angles appear to vary irregularly.

At the right-hand side of the table are given some results of similarly analysing the *average* annual marches in the stated groups of years.

During the period including the years treated of, the years 1905, 1907, and 1918 were years of sun-spot maximum; 1901 and 1913 were years of sun-spot minimum. The years 1905 and 1915 were years of maximum solar constant, as observed elsewhere; 1912 was a year of secondary maximum of solar constant; 1910 and 1913 were years of solar constant minimum.

Analysis of Successive Annual Marches of Magnetic Horizontal Force at Christchurch

(Treated as entirely cyclic within the year; 0°=January 0d.)

	Years.												Averaged Marches.					
	1902.	1903.	1904.	1905.	1910.	1913.	1914.	1915.	1916.	1917.	1918.	1919.	1920.	1902, 1903, 1904.	1914 to 1919.	1914, 1919.	1916, 1917.	1905, 1910.	1915, 1920.
	γ																		γ
P_1 ..	2·77	7·5	4·87	3·13	8·47	1·03	0·43	3·05	7·99	3·05	4·37	3·63	9·09	3·96	2·77	0·80	4·41	3·72	4·6
P_2 ..	4·04	5·5	3·36	5·88	7·57	3·61	2·37	1·88	7·24	6·22	5·09	6·94	8·74	4·25	4·59	6·20	5·12	7·07	5·3
P_3 ..	4·66	4·4	2·28	1·20	2·86	0·32	1·83	1·92	2·87	1·70	2·56	2·32	2·86	2·48	1·34	0·34	1·99	1·35	1·5
P_4 ..	2·95	3·2	3·20	1·44	1·06	2·70	0·36	0·44	2·11	2·49	1·26	1·69	1·44	2·24	0·42	0·92	0·50	0·79	0·9
A_1 ..	314°	276°	194°	257°	123°	227°	240°	66°	88°	67°	98°	170°	165°	255°	101°	360°	81°	142°	145°
A_2 ..	39	39	48	124	109	83	72	87	84	168	64	104	73	38	98	90	58	119	71
A_3 ..	18	28	253	172	243	364	52	56	26	302	353	231	310	369	349	354	340	221	350
A_4 ..	45	119	151	55	197	206	200	358	322	128	343	64	296	148	22	55	81	96	308

Looking at the amplitudes of these first four components, we see that P_1 is large in the years 1903, 1910, 1916, 1920, and small in the year 1913, of sun-spot minimum, and the following year 1914. P_2 is largest in 1910, 1916, and 1920, the year 1910 being a year of maximum of solar constant and of sun-spottedness, and 1920 being possibly a year of maximum solar constant, but the solar constant data for 1920 are not yet all available. P_2 is generally large from 1916 to 1920 inclusive. P_3 is largest in 1902 and 1903, diminishing to 1905.

The constancy of P_3 at 2·86γ in 1910, 1916, and 1920 is as remarkable as the largeness of P_1 and P_2 in those years. P_4 is large in 1902, and slightly larger and constant in 1903 and 1904. The equality of P_4 at 1·44 in 1905 and 1920 is noteworthy, and also the fact that it is almost exactly one-half of 2·86, the value for P_3 just noted above. Since P_4 in 1905 = P_4 in 1920, it is probably not mere coincidence that P_2 in 1905=P_2 in 1920—P_3 in 1920 [5·88=8·74—2·86], but that systematic effects are responsible. It was found that the value 1·44γ for P_4 (1905 and 1920) also occurred thus: a_3 in 1914 = + 1·44; a_3 in 1917 = − 1·44. And two numerically equal values of b_4 occurred thus: b_4 in 1917 = − 1·21; b_4 in 1918 = + 1·21. These are further evidences of systematic effect.

Other indications exist, but enough is pointed out to show that the curve representing the march of H.F. throughout the years is a true periodogram involving other periodicities than the year, and that it is worth while investigating it by the regular methods. This work will be proceeded with; it is probably a more difficult undertaking than ordinary tidal analysis, but no accurate prediction of future magnetic values can be made without it. Work of that kind may be expected to throw light upon the relationship between the annual and diurnal variations, and it may eventually enable the solar constant curve to be obtained from the results of magnetic observation alone: such would be the ideal result.

As was to be expected, the analyses of the march of H.F. for the years 1905, 1910, 1914, 1920 shows in each case striking characteristics. It must be the case that when two melodies played simultaneously yield almost the same symphony as two other melodies played simultaneously, each melody of each pair must be principally a simple composition, or at least they must all differ simply. The table shows the results of the analysis for the four presumably chief harmonic components in these years, and we see that the sum of the phase angles A_2+A_4=180° in 1905, and=271° in 1914;