

LONDON WEATHER CENTRE MEMORANDUM No.16

Decrease in the Frequency of Fog in Central London

by

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In a previous paper⁽¹⁾ it has been shown that there was an increase in the averages of duration of bright sunshine in Central London over the 10 years ending in 1967. Several authors^(2,3,4) have shown that there has been a decrease in fog at London/Heathrow Airport in recent years. The papers by Kelly⁽⁵⁾ and Brazell⁽⁶⁾ on fog in Central London were both completed just after the implementation of the Clear Air Act (1956). Smoke pollution figures during Winter (October to March) for Central London⁽⁷⁾ show a steady decrease over the last ten years (Figure 1) and it was decided to try and find if there was a similar decrease in the number of days with fog.

Although the site of London Weather Centre has changed during the period examined, the sites are all within about 200 yards of Lincolns Inn Fields (Annex 1).

The number of occasions when fog occurred at fixed three hourly intervals were extracted from London Weather Centre (Table 1) and visibilities of less than 500, 200 and 100 metres (550, 220 and 110 yards) were used. These values were chosen as it was thought that visibilities below 200 metres would begin to affect road traffic, while those below 100 metres would hinder it.

It is suggested that if there were a thick fog (less than 200 metres visibility) this would be mainly due to water droplets so that any decrease in smoke pollution would not be expected to cause a marked decrease in the number of occasions of thick fog. However, visibilities between 200 and 500 metres would probably have a significant number of occasions which were caused or aided by smoke and therefore a decrease in the number of occasions with these visibilities would be expected.

The period used was July to June the following year so that any foggy winters would remain intact. Five year running means of the number of occasions with fog were prepared and then plotted against the middle year of the five year period (Figures II-IX).

Monthly Maxima

Three fundamental patterns were found according to the time of year.

December - March In these months the warmest area lay from Central London along the south bank of the Thames to the Kent coast. The coolest area was in the northwest where the Chiltern Hills rise to over 500 ft. The greatest temperature contrast (1.0 to 1.5°C) was between this area and Central London.

April - September During these months the sea caused lower maxima to be recorded on the coast, with the highest temperatures in the region from Central London to Gillingham. The Chiltern Hills remained the coolest area with maxima typically 1.5°C lower than Central London.

October and November Although the highest temperatures were recorded in Central London and along the Kent coast, London was cooler by a few tenths of a degree. Presumably at this time of year when solar radiation was weak the relatively warm sea was more important. Temperature contrasts were slightly reduced from the summer values, and the Chilterns were 1.0 to 1.5°C cooler than London.

It is reasonable to assume that at the time of day when the maximum temperature occurred, the lapse rate in the lowest few hundred feet approached the dry adiabatic value. Temperature differences between Bovingdon in the Chilterns and nearby stations at lower elevations agree reasonably well with this assumption. In general, the broad scale features of the pattern away from the coasts are produced by altitude. This can also be checked for the urban area of London by using the elevated site at Hampstead which is relatively free from urban influences and nearby urban sites (Camden Square, Regent's Park, Kensington Palace and St. James Park). The temperature difference calculated from the height difference and assuming a dry adiabatic lapse rate was added to the Hampstead figure and compared with the temperatures recorded at the urban sites (table 2).

The figures for Camden Square (2.25 miles from Hampstead) are in close agreement with the 'corrected' Hampstead values. The relation for the other sites is not as good and indicates lapse rates less than the dry adiabatic, except Regent's Park which shows the reverse. These small variations are probably due to peculiarities at each site.

The conclusion from this is that the urban area itself seems to have made very little impression on the maximum temperature.

Monthly Minima

Three basic patterns can be recognised.

November - March In these months Central London and the coast near Isle of Grain and Shoeburyness recorded the highest minima in the area, and were approximately equal. These two areas were about 2.0°C warmer than the surrounding rural districts. Note that in January the mean minima in most rural areas was below 0°C . This is probably not a very good indication of average conditions since it includes the exceptionally cold January of 1963; similar conclusions can also be made for February.

April - July and October Central London together with the Kent and Essex coasts, particularly the former, still record the highest minima, but there is a tendency now for the lowest minima to be found in the Weald. The rural/Central London temperature difference was about 2.5°C for the Weald, but only 2.0°C for the area to the north of London.

August and September During the late summer, minima were highest in the Isle of Grain area of the Kent coast with Central London about 0.5°C less. There was still a tendency for Wealden stations to record slightly lower minima particularly in September. The rural/Central London difference was again about 2.0°C .

According to these figures the intensity of London's heat island (at least for minimum temperature) is about 2.0° - 2.5°C throughout the year, the latter figure applying to the months April to October when Wealden minima were the lowest in the area. This difference is less than those which have been measured on particular evenings with clear skies and light winds, when 4.0°C or more is quite usual. The difference is less here because minimum temperature is used (when rural/urban differences are not at their maximum) and also because means have been presented.

The presence of the sea had much the same effect on minima as the urban area. Considering that the sea has a greater heat capacity this may seem surprising, but of course the means would average out instances with wind blowing on and offshore. Warming by the sea was greatest in late summer.

On the maps, the town of Reading is shown as having a heat island. It was possible to do this since an urban site was available. Other towns such as Slough and Watford would no doubt show similar features, and some indication of this is shown by linking the isotherms around urban areas.

London's heat island was not circular, but elongated approximately along the River Thames. This is based on readings at Kew whose minima were unusually high due to the siting of the screen on the north wall. However, the readings have not been neglected. Other readings are also somewhat unusual. The Isle of Grain record has very high minima, often 0.5°C higher than Shoeburyness on the opposite side of the Thames Estuary. Although the site is shown as being rural, large oil refineries are situated close by and extra warming due to this is possible. Some sites are in the bottoms of valleys (Mickleham and Finchampstead) and the minima were unusually low. No allowance has been made for these site peculiarities.

Monthly Means

Five patterns are described.

October to February The highest temperatures are found over Central London and the Isle of Grain area of the Kent coast. Rural districts to the south and west of London were about 1.0°C cooler than Central London, but the Chilterns were about 1.5°C cooler.

March This month is distinguished from the October to February set since Central London is the warmest area. This is probably due to the cooling effect of the sea on the coast. Means in rural areas were generally 1.0°C below Central London and again the Chilterns were 1.5°C lower.

April to June During Spring and Early Summer the Kent coast was about 0.5°C cooler than Central London. The rural Chilterns and Weald had almost the same mean temperature, about 1.5° - 2.0°C lower than Central London, but the rural area to the west of London, approximately coincident with the Thames Valley, was only 1.0° - 1.5°C cooler than London.

July and August The general pattern mentioned for October - February was established again with the coolest region in the northwest (Chilterns). However, the April - June tendency for higher mean temperatures in the rural region to the west of London also occurred.

September This month has been distinguished as the only one when the mean temperature in London was exceeded by that on the Kent coast, though the difference is marginal. Again the coolest rural areas were the Weald and Chilterns, with the Thames Valley rural area slightly warmer.

A Comparison between London Weather Centre and Other Stations in Central London

Temperatures have been recorded at the London Weather Centre since 1958. This record has not been included in drawing the maps since it is a roof top site. A comparison between this record and those from nearby surface stations is in table 3. London Weather Centre has occupied three sites during the ten years, all of which are close to one another, but the heights differ (189 ft., 167 ft., 172 ft. above sea level). The mean height has been used and assigned to the record. On table 3 the differences between mean maxima and minima are shown for each month of the year and for each surface station, with the surface station value being subtracted from the Weather Centre reading. Estimated values for the surface stations have not been used here.

Mean Maximum

During the months May to September the Weather Centre is about 0.3° - 0.5°C cooler than surface stations, with the higher figure corresponding to May and June. Camden Square and Regent's Park this corresponds to a gradient of temperature about three times the dry adiabatic, falling to twice that value in July and August. The trend for Kensington Palace is similar though the July - August gradient is more nearly dry adiabatic. For St. James Park, gradients are closely dry adiabatic in June and August. These results are to be expected since it is quite normal for superadiabatic lapses to occur near the ground on sunny days in summer. Such an effect would be less well developed on a roof since convection can remove the superadiabatic layer more easily. During the winter months November to March the sign of the difference is reversed with the Weather Centre about 0.2°C warmer. Heating from the building at the Weather Centre seems to have made a small difference. April and October are transitional when small differences of either sign can occur.

Mean Minimum

The detailed situation is more complex but in general Weather Centre minima are higher. The months November to March show the greatest differences, while those for May to August are less than the winter figures. April shows the smallest difference during the year while September and October are transitional between the summer and winter regimes.

All the sites except Camden Square, which is a small grassed area, are in large parks within the city, and a surface nocturnal inversion over the vegetated surface is to be expected with clear skies. This inversion is normally absent over a built up area as previous work in urban meteorology has shown, but it gives a good reason for local urban temperature differences. On the basis of this theory of nocturnal temperature differences, the trends in local urban differences ought to be similar to the heat island as a whole. So we should expect the largest heat island in winter, a minimum value in April and medium values in summer. The maps show that this is not the case, and special effects at the Weather Centre have to be considered. Extra warmth would come from artificial heating from November to March and from stored solar heat from May to August. April would then be a minimum since solar heating is not yet strong, while the artificial heating has been turned down.

It may be necessary sometimes to consider what the representative surface temperature would be in Central London. For maximum temperature, values measured at the climatological stations in the parks appear to be the best. The minima there would seem to be too low while those at the Weather Centre are too high. An average of the two seems the best compromise which is equivalent to adding about 0.5°C to the minima measured at the park sites.

A similar study by T Kelly (London Weather Centre Memorandum No. 3) discusses the temperature differences between London Weather Centre and Heathrow. Maximum temperatures show similar trends to those presented here and although the difference in minima takes the same sign, the magnitude is constant throughout the year. However, comparison is difficult since only the years 1960 and 1961 are considered. This gives some support to the view that effects at the Weather Centre are of greater importance in determining the small monthly variations.

Variations of London's Heat Island with Time

The temperature data presented here for 1958/1967 have been compared with similar data for the period 1931/1960 for 8 stations in the London Area. Four rural stations were used (Wisley, East Malling, Addington and Rothamsted) together with four stations in Central London (Camden Square, Kensington Palace, St. James Park and Regent's Park) and the differences in monthly mean maximum and minimum between the rural and urban stations were calculated.

Changes in the heat island intensity are due to the different responses of urban and rural environments to regional changes. While a regional warming may produce an increase in maximum temperature, the increase at one station may not be so large as those at others so that the temperature difference between them changes with time.

Regional Trends

The records were first examined for regional temperature trends. For maximum temperature February, September and October show recent (i.e. 1958/1967) marked warming while most others show cooling, especially January, March, April and May, July, August and December. With minimum temperature February and October also showed a warming trend, together with April, May and to a lesser degree March. Cooling is pronounced for January, July, August and December, while other months have generally small changes.

Each site has its own response to these regional changes and broadly speaking, the urban stations have a different response compared to the rural sites. Table 4 gives the magnitude of these changes (1931/1960 value minus 1958/1967 value) for some important months. Taking maxima first, the urban sites have a slightly smaller increase than the rural sites in warming months. Months with regional cooling have urban/rural responses dependent upon season. In December and January cooling is greater in rural areas, but in July and August this is reversed. The situation for minimum temperature is more complex. In months with cooling, Wisley, Addington and East Malling cooled less than urban sites, but Rothamsted cooled more. Months with a warming were characterised by greater warmings in rural districts. Again Rothamsted had a reverse trend with its warming less than the urban warmings. In addition the warming in April for Rothamsted was less than for the other rural sites, but for this month the urban changes were less than all the rural changes.

On this bases it is possible to estimate the changes that occurred. Graphs showing the changes schematically are in fig. 2 while the actual graphs are in fig. 3.

Maxima

Warmings which occurred in February and September/October have reduced the temperature differences and produced small troughs in the graphs. Some Spring troughs occurred in March and April and fig. 2 represents a mean of the data. The major summer peak on the 1931/1960 curve has been flattened by the recent July/August cooling. In winter, the relatively greater rural cooling has increased temperature differences somewhat. In this respect the recent increases of winter sunshine in Central London (see I Jenkins, Weather, 24, 2, 1969) may have been important.

The graphs for each station are drawn in fig. 3. In general the basic pattern described above is present, though with some departure as well. The relation is poorest for Rothamsted where the early Autumn trough is now in August.

Minima

The 1931/1960 pattern is rather complex, but the broad features are a late Winter/early Spring trough (February to April) followed by a rise to a peak in June. Temperature differences were then almost steady until October, though a second peak in August was shown in some cases. From October to December East Malling and Wisley showed a sharp fall while Rothamsted and Addington fell at first, but later rose in November and December.

Changes in regional minimum temperature would be expected to cause a reduction in temperature differences. In general this is true. The 1958/1967 curve has the same shape as the one for 1931/1960, but is displaced roughly 0.2°C below it. The Rothamsted curve is quite different. This shows a trough in April followed by a peak in July/August and a less well defined Autumn trough. Moreover, temperature differences in general are unchanged between the two periods and have been larger in recent summers. This is because the response at Rothamsted is different to the other rural stations. For example in July and August the minima were less in recent years, but all rural stations except Rothamsted cooled less than the urban sites. This caused an increase in temperature difference for Rothamsted, but a decrease for the other three rural stations. The

behaviour was reversed in months showing recent warmings, for example, in October Rothamsted's warming was only half of the warmings at the other rural sites and also was less than the urban warmings. This increased the temperature differences for Rothamsted. To complicate the picture further, all rural stations behaved similarly in response to the April warming and show decreases in temperature differences. The Wisley curve was also unusual in showing a trough in August. This is seen to be produced by the small cooling there compared with other stations.

April 1970

Table 1

List of Stations Ten Year (1958-1967) Monthly Mean Temperatures
 Figures in Brackets have been Estimated

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
STATION MAX. MIN. MEAN												
BOVINGDON	4.44	6.16	8.81	11.81	15.45	18.93	19.76	19.52	(17.76)	(13.74)	(8.52)	(5.81)
	0.05	1.09	1.70	4.03	6.57	9.48	11.01	10.82	(9.50)	(6.92)	(3.31)	(1.13)
	2.25	3.65	5.27	7.93	11.02	14.18	15.41	15.16	(13.64)	(10.34)	(5.92)	(3.46)
EASTWICK LODGE	5.55	7.40	9.99	13.08	16.94	20.40	21.29	21.18	19.56	15.28	9.71	6.94
	-0.24	1.08	1.63	4.02	6.27	9.08	10.81	10.56	9.05	6.71	2.87	0.48
	2.66	4.23	5.81	8.55	11.63	14.73	16.05	15.89	14.31	11.02	6.30	3.69
GARSTON	5.42	7.15	9.71	12.76	16.49	19.85	20.69	20.45	18.82	14.69	9.40	6.76
	0.01	1.30	1.96	4.46	6.94	9.80	11.39	11.21	9.55	7.01	3.21	0.76
	2.70	4.23	5.86	8.62	11.72	14.85	16.07	15.84	14.17	10.84	6.29	3.75
ROTHAMSTED	4.76	6.52	9.01	12.26	16.05	19.38	20.25	20.11	18.33	14.06	8.82	6.20
	-0.53	0.80	1.41	3.97	6.50	9.24	10.65	10.55	9.26	6.62	2.74	0.26
	2.12	3.66	5.23	8.11	11.29	14.30	15.46	15.34	13.80	10.34	5.76	3.22
ST. ALBANS	5.30	7.03	9.46	12.62	16.35	19.82	20.77	20.60	18.75	14.56	9.28	6.66
	-0.32	1.07	1.70	4.20	6.67	9.50	11.1	10.92	9.38	6.84	2.94	0.44
	2.49	4.04	5.58	8.39	11.51	14.64	15.94	15.77	14.06	10.70	6.12	3.55
MALDON	5.43	7.16	9.52	12.65	16.46	19.90	21.16	20.96	18.96	14.88	9.81	7.04
	0.19	1.39	2.09	4.65	7.17	10.19	11.98	11.69	10.25	7.26	3.47	1.12
	2.83	4.28	5.79	8.64	11.81	15.03	16.54	16.31	14.58	11.09	6.63	4.06
SHOEBURYNESSE	5.43	7.04	9.29	12.12	15.71	19.10	20.59	20.46	18.59	14.79	9.86	6.88
	1.69	2.62	3.15	5.40	8.23	11.28	13.03	13.18	11.72	9.10	5.31	2.97
	3.56	4.85	6.23	8.77	11.99	15.19	16.81	16.82	15.16	11.97	7.58	4.93
SOUTHEND	5.52	7.34	10.04	12.90	16.77	20.22	21.51	21.18	19.34	15.12	9.97	7.04
	0.78	2.08	3.01	5.33	8.30	11.26	12.94	12.90	11.56	8.69	4.68	1.98
	3.16	4.72	6.53	9.10	12.52	15.75	17.22	17.04	15.45	11.91	7.34	4.50
WRITTLE	5.58	7.27	9.73	12.95	16.68	20.06	21.06	20.90	19.07	14.88	9.71	6.97
	0.05	1.21	1.79	4.18	6.47	9.14	11.02	10.87	9.24	6.87	3.26	0.96
	2.81	4.25	5.78	8.56	11.58	14.58	16.06	15.88	14.16	10.89	6.50	3.97
CAMDEN SQUARE	6.19	7.69	10.16	13.35	17.31	20.82	21.69	21.38	19.55	15.28	10.16	7.56
	1.37	2.63	3.46	5.74	8.60	11.42	13.15	12.98	(11.42)	(8.76)	4.82	(2.42)
	3.78	5.12	6.80	9.55	12.94	16.10	17.42	17.17	(15.49)	(12.02)	7.49	(4.99)
GREENWICH	6.22	7.79	(10.31)	13.29	17.13	(20.52)	(21.53)	21.06	19.37	15.38	10.24	7.60
	1.07	2.38	(2.94)	5.43	8.08	10.96	12.61	12.56	10.84	8.09	4.40	1.95
	3.66	5.09	(6.63)	9.37	12.61	(15.74)	(17.07)	16.81	15.10	11.72	7.32	4.79
HAMPSTEAD	5.19	6.73	9.23	12.41	16.20	19.74	20.71	(20.25)	18.55	14.33	9.18	6.59
	0.36	1.69	2.38	4.93	7.90	10.49	12.14	12.05	10.59	7.84	4.01	1.44
	2.78	4.23	5.80	8.66	11.94	15.11	16.44	(16.15)	14.56	11.09	6.60	3.99
KENSINGTON PALACE	6.14	7.81	10.33	(13.50)	17.30	20.72	21.65	21.22	19.53	15.35	10.15	7.53
	1.30	2.50	3.37	(5.76)	8.36	11.30	12.87	12.75	11.20	8.46	4.56	2.27
	3.53	5.13	6.87	(9.63)	12.83	16.03	17.25	16.98	15.37	11.90	7.36	4.91
REGENT'S PARK	6.12	7.81	10.35	13.49	17.34	20.82	21.69	21.35	19.69	15.46	10.27	(7.48)
	1.19	(2.48)	(3.40)	5.71	8.41	11.22	12.83	12.63	11.08	8.51	4.61	(2.23)
	3.65	(5.14)	(6.88)	9.58	12.88	16.02	17.26	17.00	15.39	11.98	7.43	(4.86)
ST. JAMES PARK	6.34	7.99	10.33	13.44	(17.29)	20.74	(21.66)	21.29	19.51	(15.41)	10.29	7.80
	1.71	2.95	3.80	6.13	(8.98)	11.71	13.38	13.04	11.41	9.22	5.12	2.57
	4.02	5.47	7.07	9.78	(13.13)	16.19	(17.52)	17.07	15.45	(12.31)	7.71	5.22
HAMPTON	6.02	7.71	10.13	13.14	16.80	20.42	21.26	20.90	19.35	15.28	10.19	7.39
	0.90	2.22	2.98	5.48	8.32	11.19	12.88	12.75	10.98	8.18	4.32	1.77
	3.46	4.96	6.55	9.33	12.57	15.80	17.07	16.82	15.16	11.74	7.26	4.57

Table 1 Continued

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
HEATHROW	5.76 1.11 3.44	7.55 2.40 4.96	10.27 2.83 6.55	13.26 5.34 9.29	17.08 8.04 12.57	20.71 11.01 15.86	21.59 12.61 17.09	21.18 12.36 16.76	19.41 10.79 15.09	15.18 8.07 11.66	9.86 4.44 7.15	6.98 2.16 4.56
SOUTHGATE	(5.78) (0.52) (3.15)	7.45 1.84 4.63	9.93 2.71 6.33	13.06 5.09 9.08	16.84 7.71 12.28	20.29 10.62 15.46	21.19 12.26 16.70	20.92 12.05 16.49	19.19 (10.56) (14.88)	(15.03) (7.83) (11.43)	9.84 3.95 6.89	7.18 1.56 4.32
ADDINGTON	4.90 0.43 2.66	6.62 1.55 4.08	9.18 2.44 5.82	12.34 4.71 8.52	16.12 7.44 11.79	19.57 10.18 14.85	20.51 11.92 16.26	20.13 11.87 16.02	18.46 10.56 14.52	14.25 7.93 11.08	9.01 4.04 6.51	6.34 1.48 3.91
KEW	5.84 2.09 3.95	7.48 3.18 5.33	9.87 3.66 6.75	12.94 6.01 9.47	16.77 8.66 12.70	20.33 11.50 15.92	21.25 13.16 17.21	20.72 12.87 16.80	18.81 11.22 15.03	14.81 8.72 11.76	9.79 5.29 7.54	7.09 3.13 5.12
MICKLEHAM	(5.66) -0.42 (2.62)	7.57 0.83 4.20	9.94 1.36 5.66	13.03 3.76 8.40	16.43 5.81 11.15	(19.90) (8.43) (14.17)	(21.14) (10.23) (15.69)	20.77 10.34 15.56	19.01 8.75 13.87	14.82 6.19 10.55	9.72 (2.41) (6.07)	(6.98) 0.31 (3.65)
WISLEY	5.68 0.36 3.04	7.49 1.73 4.60	10.17 2.34 6.27	13.31 4.74 9.05	16.90 7.11 11.99	20.47 9.71 15.10	21.31 11.48 16.39	20.74 11.48 16.11	18.99 9.63 14.30	14.87 7.16 11.03	9.64 3.62 6.62	7.02 1.34 4.19
BROMLEY	5.96 0.83 3.39	(7.56) 2.00 (4.78)	(9.99) (2.94) (6.47)	13.03 5.15 9.10	16.92 7.92 12.42	20.24 10.65 15.44	21.35 12.40 16.88	(20.85) (12.22) (16.54)	(18.97) (10.60) (14.79)	(15.04) (7.91) (11.48)	(9.87) (4.15) (7.01)	(7.31) (1.70) (4.51)
DARTFORD	6.22 0.61 3.41	7.93 1.90 4.90	10.40 2.39 6.40	13.32 4.96 9.15	17.04 7.42 12.22	20.49 10.21 15.35	21.47 11.95 16.72	21.42 11.69 16.58	19.65 10.04 14.85	15.56 7.37 11.35	10.37 3.79 7.08	7.66 1.35 4.50
EAST MALLING	5.88 0.14 3.01	7.53 1.41 4.49	9.90 2.02 5.96	12.94 4.36 8.64	16.68 6.57 11.63	20.08 9.23 14.65	21.24 11.05 16.13	21.07 10.83 16.03	19.30 9.27 14.28	15.31 6.62 10.98	10.04 3.25 6.65	7.32 0.92 4.13
GILLINGHAM	6.05 0.92 3.48	7.74 2.09 4.95	10.11 2.84 6.48	12.93 5.38 9.16	17.07 8.04 12.56	20.61 10.91 15.69	21.71 12.83 17.27	21.47 12.62 17.03	19.52 11.15 15.65	15.46 7.84 11.66	10.28 4.14 7.27	7.62 1.86 4.75
GOUDHURST	5.41 -0.27 2.58	7.13 0.85 4.01	9.69 1.60 5.65	12.82 3.72 8.27	16.40 5.97 11.19	19.58 8.62 14.07	20.66 10.56 15.04	20.37 10.53 15.45	18.77 8.98 13.88	14.82 6.52 10.65	9.62 2.84 6.31	6.96 0.48 3.72
ISLE OF GRAIN	6.25 1.95 4.09	7.75 2.76 5.27	10.00 3.77 6.88	12.81 6.15 9.47	16.31 9.08 12.68	19.81 11.96 15.89	21.14 13.59 17.35	21.01 13.70 17.34	19.11 12.35 15.72	15.31 9.31 12.28	10.54 5.42 7.98	7.84 2.74 5.29
SWANLEY	(5.66) (0.22) (2.94)	(7.41) (1.62) (4.52)	9.92 2.15 5.04	13.07 4.36 8.73	16.83 6.62 11.71	20.19 9.46 14.80	(21.21) (11.15) (16.18)	(20.19) (11.03) (15.97)	(19.07) (9.21) (14.14)	(14.97) (6.8) (10.89)	(9.86) (3.51) (6.69)	(7.10) (1.07) (4.09)
ALICE HOLT LODGE	5.25 -0.03 2.60	7.04 1.22 4.12	9.52 1.75 5.67	12.57 4.20 8.39	16.11 6.54 11.32	19.61 9.25 14.43	20.46 10.96 15.73	20.08 10.92 15.50	18.40 9.32 13.87	14.39 6.36 10.58	9.30 3.25 6.28	6.73 0.76 3.73
SOUTH FARNBOROUGH	5.57 0.50 3.03	7.37 1.78 4.58	9.97 2.06 6.02	12.89 4.58 8.73	16.52 7.08 11.80	20.12 9.97 15.04	21.10 11.66 16.37	20.66 11.35 16.01	19.00 9.63 14.31	14.91 7.00 10.96	9.66 3.79 6.73	6.97 1.33 4.15
SHINFIELD	5.64 0.16 2.91	7.46 1.60 4.53	9.89 2.17 6.04	12.93 4.00 8.75	16.43 7.03 11.72	20.08 9.54 14.80	20.99 11.35 16.19	20.63 11.16 15.89	18.89 9.47 14.19	14.84 7.03 10.98	9.69 3.40 6.55	7.10 1.00 4.04
READING	5.86 0.66 3.27	7.65 2.06 4.84	10.25 2.71 6.48	13.24 5.32 9.29	16.91 7.80 12.35	20.42 10.68 15.55	21.28 12.12 16.70	20.84 11.90 16.37	19.15 10.24 14.68	15.01 7.64 11.32	9.85 3.92 6.87	7.23 1.52 4.36
FINCHAMPSTEAD	5.61 -0.36 2.61	7.50 1.07 4.30	9.96 1.39 5.69	12.86 3.92 8.38	16.28 6.26 11.28	19.93 8.91 14.44	20.84 10.64 15.74	(20.55) (10.59) (15.57)	18.86 8.61 13.73	14.82 6.16 10.48	9.71 2.69 6.19	7.06 0.42 3.73
HURLEY	5.76 -0.11 2.83	7.43 1.32 4.36	9.98 1.88 5.93	13.00 4.31 8.65	16.54 6.67 11.62	19.99 9.50 14.74	20.93 11.14 15.99	20.52 10.82 15.67	18.88 9.25 14.10	14.89 6.69 10.79	9.73 3.01 6.38	7.18 0.62 3.90
GATWICK	(5.52) (0.21) (2.87)	(7.35) (1.35) (4.35)	(9.99) (1.48) (5.74)	(12.96) (3.80) (8.38)	(16.55) (6.14) (11.35)	20.01 (8.84) (14.43)	21.19 10.70 15.97	20.71 10.40 15.56	19.14 8.74 13.94	15.01 6.32 10.66	9.74 3.24 6.49	6.83 1.11 3.98

Table 1 Continued

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
FERNHURST	5.80	7.50	9.75	12.78	16.25	19.79	20.57	20.26	18.73	14.80	9.95	7.38
	0.08	1.32	1.90	4.25	6.49	9.06	10.82	10.75	9.13	6.65	3.24	0.77
	2.93	4.42	5.81	8.52	11.35	14.40	15.70	15.50	13.93	10.73	6.60	4.07

Table 2

Hampstead and Camden Square monthly mean maxima.
Height difference = 100 m.

	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.
HAMPSTEAD (ADJUSTED VALUES)	6.19	7.73	10.23	13.41	17.20	20.74	21.71		19.55	15.33	10.18	7.59
CAMDEN SQUARE	6.19	7.69	10.16	13.35	17.31	20.82	21.69		19.55	15.28	10.16	7.56

Hampstead and Regent's Park monthly mean maxima
Height difference = 98 m.

	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.
HAMPSTEAD (ADJUSTED VALUES)	6.17	7.71	10.21	13.39	17.18	20.72	21.69		19.53	15.31	10.16	
REGENT'S PARK	6.12	7.81	10.35	13.49	17.34	20.82	21.69		19.69	15.46	10.27	

Kensington Palace and Hampstead mean maximum
Height difference = 113 m.

	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.
HAMPSTEAD (ADJUSTED VALUES)	6.32	7.86	10.36		17.33	21.07	22.04		19.68	15.66	10.51	7.92
KENSINGTON PALACE	6.14	7.81	10.33		17.30	20.72	21.65		19.53	15.35	10.15	7.53

Hampstead and St. James Park mean maximum.
Height difference = 120 m.

	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.
HAMPSTEAD (ADJUSTED VALUES)	6.39	7.93	10.43	13.61		20.94			19.75		10.38	7.79
ST. JAMES PARK	6.34	7.99	10.33	13.44		20.74			19.51		10.29	7.80

Table 3

Temperature differences between London Weather Centre and nearby surface stations ($^{\circ}\text{C}$).
In all cases the surface station value is subtracted from the Weather Centre reading.

	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.
<u>MEAN MAXIMUM</u>												
London W. Centre- St. James Park. (1 mile apart)	0.06	-0.09	0.07	-0.14		-0.44		-0.39	-0.41		-0.11	0.0
London W. Centre- Camden Square (2 miles apart)	0.21	0.21	0.24	-0.05	-0.51	-0.52	-0.39	-0.48	-0.45	0.02	0.24	0.24
London W. Centre- Kensington Palace (3.2 miles apart)	0.26	0.09	0.07		-0.50	-0.42	-0.35	-0.32	-0.43	-0.05	0.25	0.27
London W. Centre- Regent's Park (1.8 miles apart)	0.28	0.09	0.05	-0.19	-0.54	-0.52	-0.39	-0.45	-0.59	-0.16	0.13	
<u>MEAN MINIMUM</u>												
London W. Centre- St. James Park	1.09	0.85	0.80	0.47		0.69	0.72	0.76	1.09	0.68	1.18	1.43
London W. Centre- Camden Square	1.43	1.17	1.14	0.86	0.90	0.98	0.95	0.82			1.48	
London W. Centre- Kensington Palace		1.3	1.23		1.14	1.1	1.23	1.05	1.3	1.44	1.74	1.73
London W. Centre- Regent's Park	1.61			0.89	1.09	1.18	1.27	1.17	1.42	1.39	1.69	

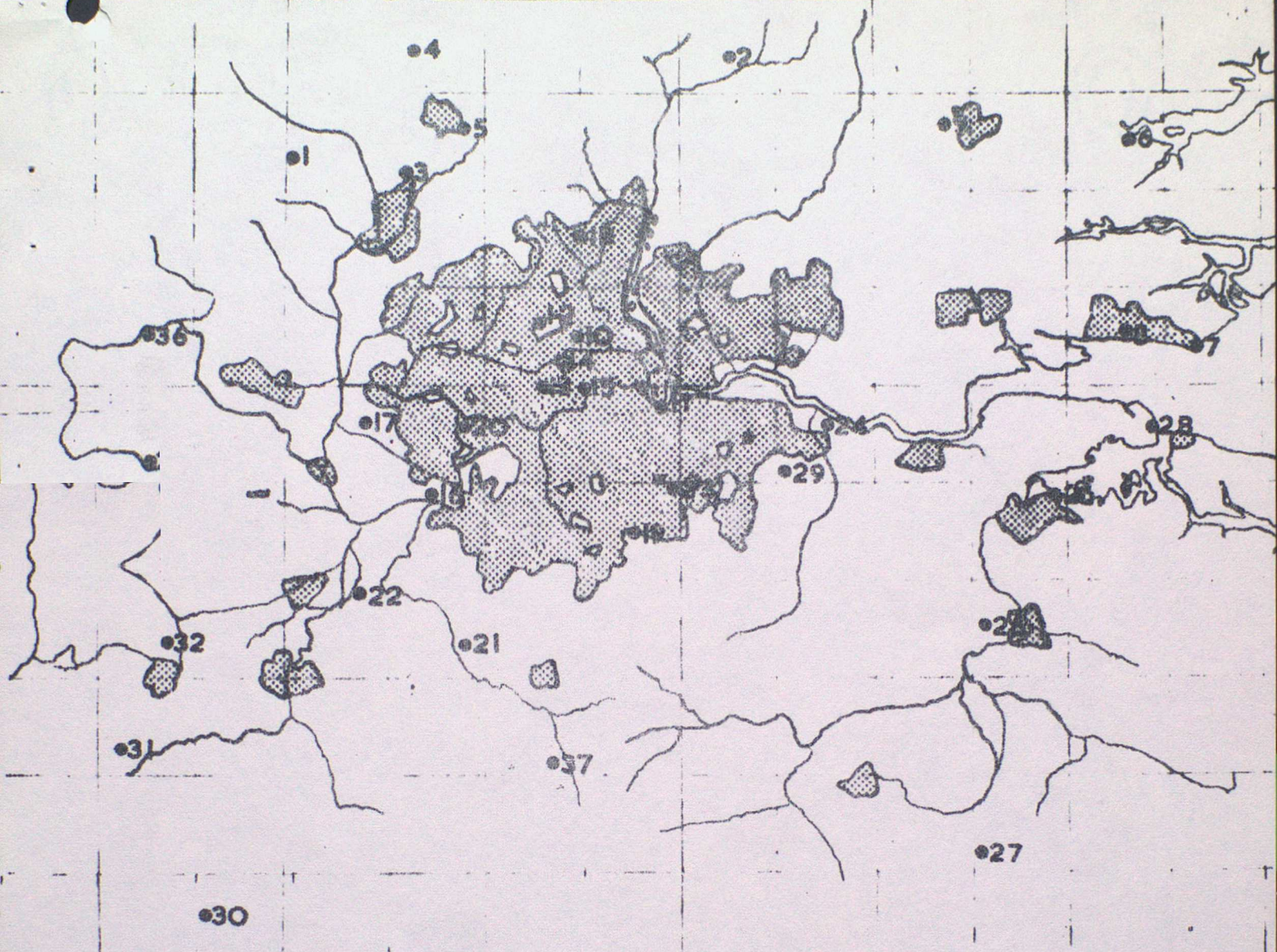
Table 4

Temperature differences: 1931/60 value minus 1958/67 value, °C

MINIMA	JULY (COOLING)	AUGUST (COOLING)	FEBRUARY (WARMING)	OCTOBER (WARMING)	APRIL (WARMING)
CAMDEN SQUARE	0.55	0.52	0.73	0.66	0.04
KENSINGTON PALACE	0.73	0.55	0.40	0.46	0.16
ST. JAMES PARK	0.52	0.66	0.85	0.82	0.13
REGENT'S PARK	0.67	0.57	0.58	0.51	0.20
WISLEY	0.42	0.12	0.93	0.86	0.74
EAST MALLING	0.55	0.27	0.81	0.82	0.46
ADDINGTON	0.28	0.33	0.75	0.83	0.31
ROTHAMSTED	0.85	0.75	0.5	0.42	0.27

MAXIMA	FEBRUARY (WARMING)	OCTOBER (WARMING)	JULY (COOLING)	AUGUST (COOLING)	JANUARY (COOLING)	DECEMBER (COOLING)
CAMDEN SQUARE	0.29	0.38	1.11	1.12	0.51	0.14
KENSINGTON PALACE	0.41	0.55	0.85	0.98	0.56	0.27
ST. JAMES PARK	0.29	0.51	0.54	0.91	0.76	0.40
REGENT'S PARK	0.51	0.56	0.81	0.85	0.58	0.22
WISLEY	0.19	0.57	0.49	0.86	1.02	0.48
EAST MALLING	0.50	0.71	0.46	0.63	0.62	0.08
ADDINGTON	0.32	0.55	0.69	0.87	1.00	0.56
ROTHAMSTEAD	0.42	0.66	0.55	0.59	0.74	0.30

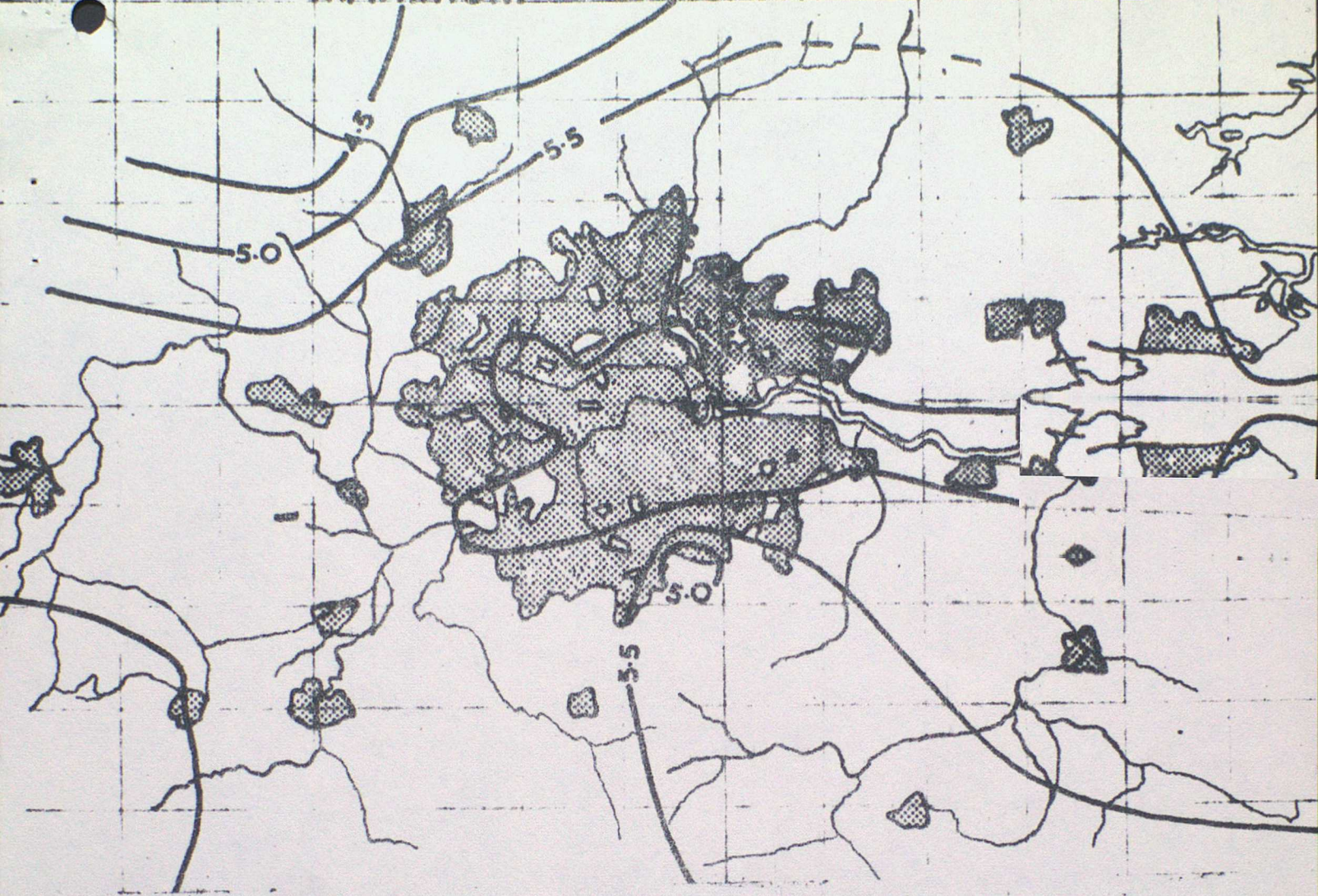
FIG. 1 STATIONS



LIST OF STATIONS AND NUMBERS

1	BOVINGDON	20	KEW
2	EASTWICK LODGE	21	MICKLEHAM
3	GARSTON	22	WISLEY
4	ROTHAMSTED	23	BROMLEY
5	ST. ALBANS	24	DARTFORD
6	MALDON	25	EAST MALLING
7	SHOEBURYNESSE	26	GILLINGHAM
8	SOUTHEND	27	GOUDHURST
9	WRITTLE	28	ISLE OF GRAIN
10	CAMDEN SQUARE	29	SWANLEY
11	GREENWICH	30	FERNHURST
12	HAMPSTEAD	31	ALICE HOLT LODGE
13	KENSINGTON PALACE	32	SOUTH FARNBOROUGH
14	REGENT'S PARK	33	SHINFIELD
15	ST. JAMES'S PARK	34	READING UNIVERSITY
16	HAMPTON	35	FINCHAMPSTEAD
17	HEATHROW	36	HURLEY
18	SOUTHGATE	37	GATWICK
19	ADDINGTON		

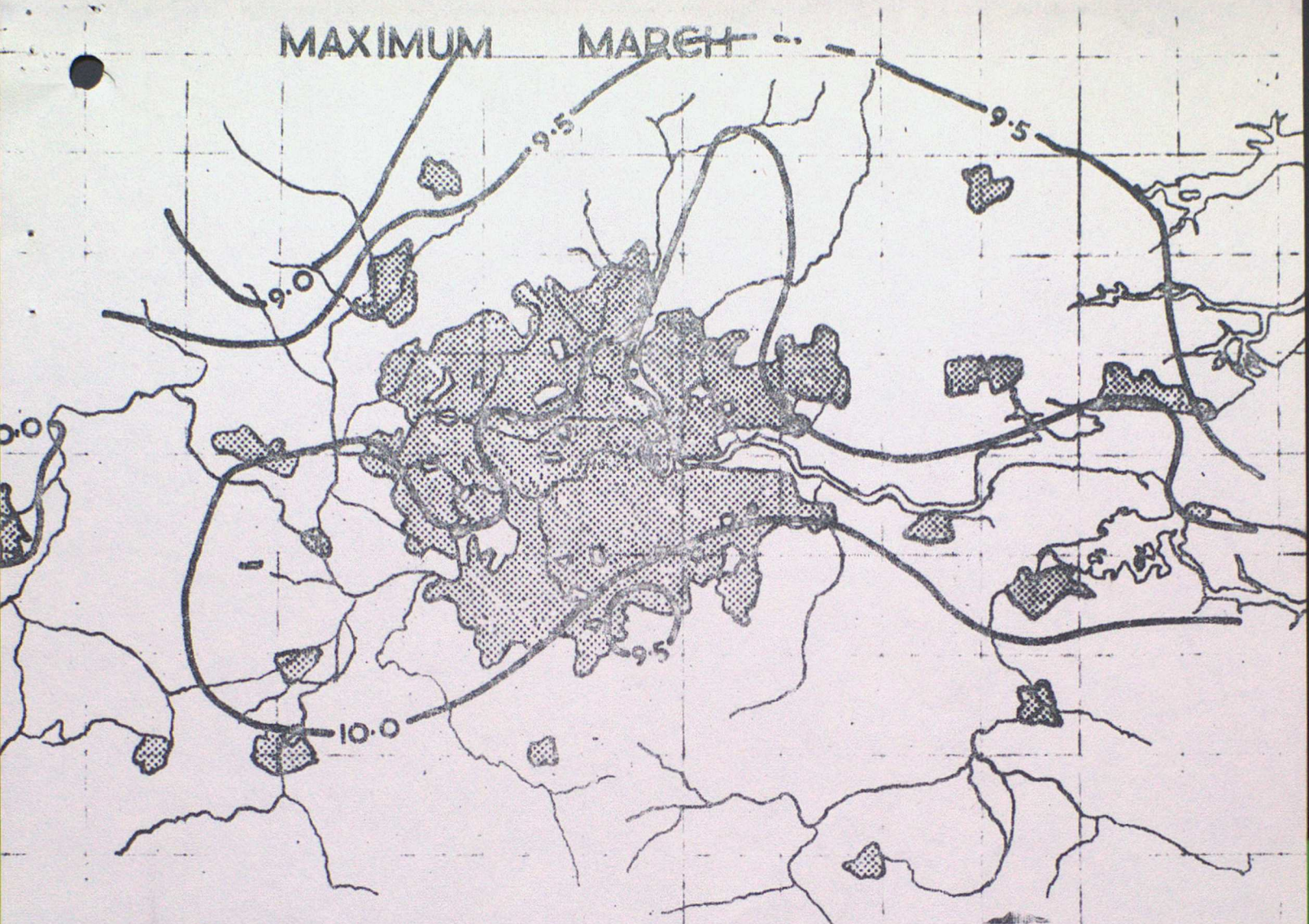
MAXIMUM JANUARY



MAXIMUM FEBRUARY



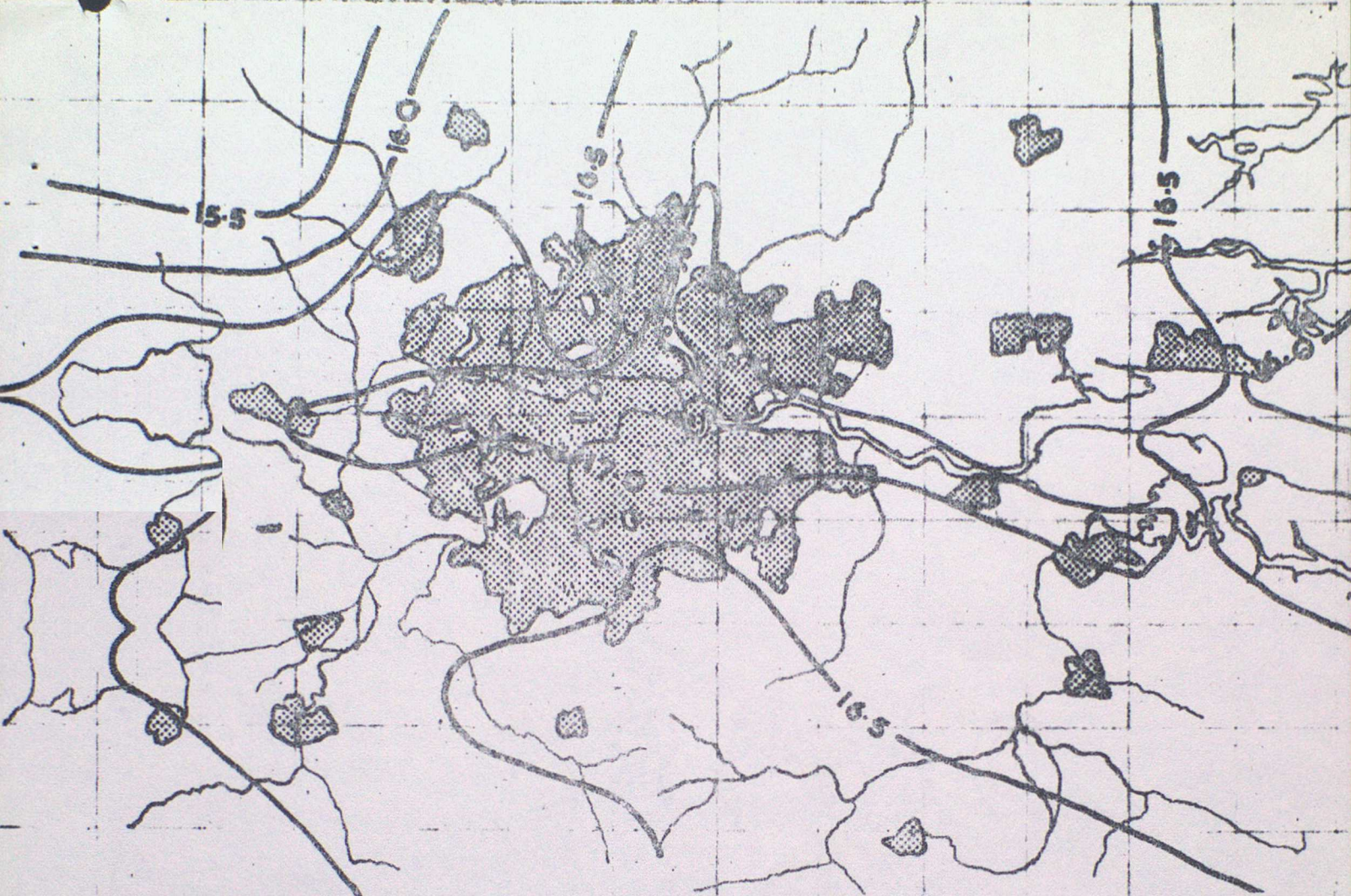
MAXIMUM MARCH



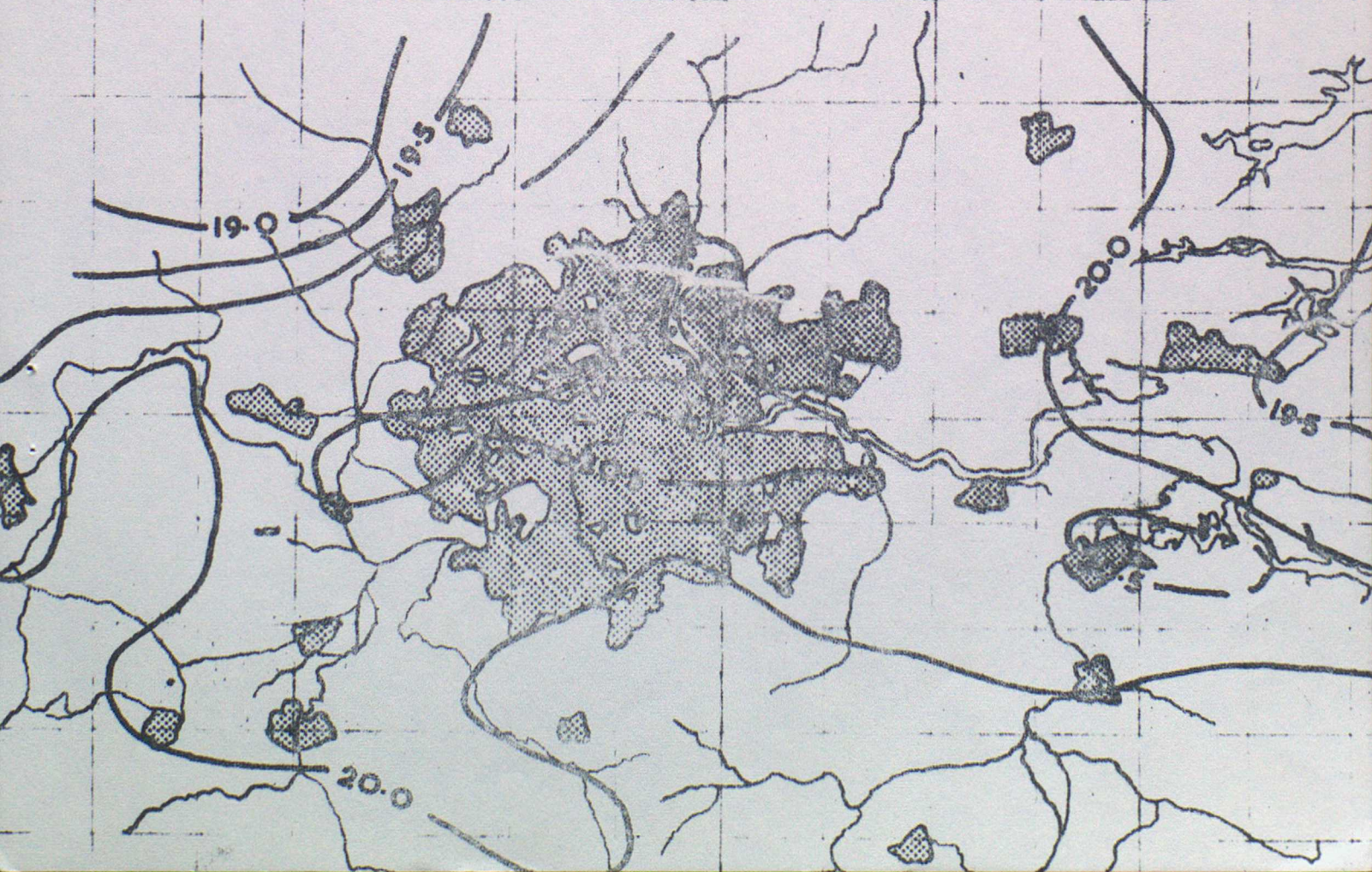
MAXIMUM APRIL



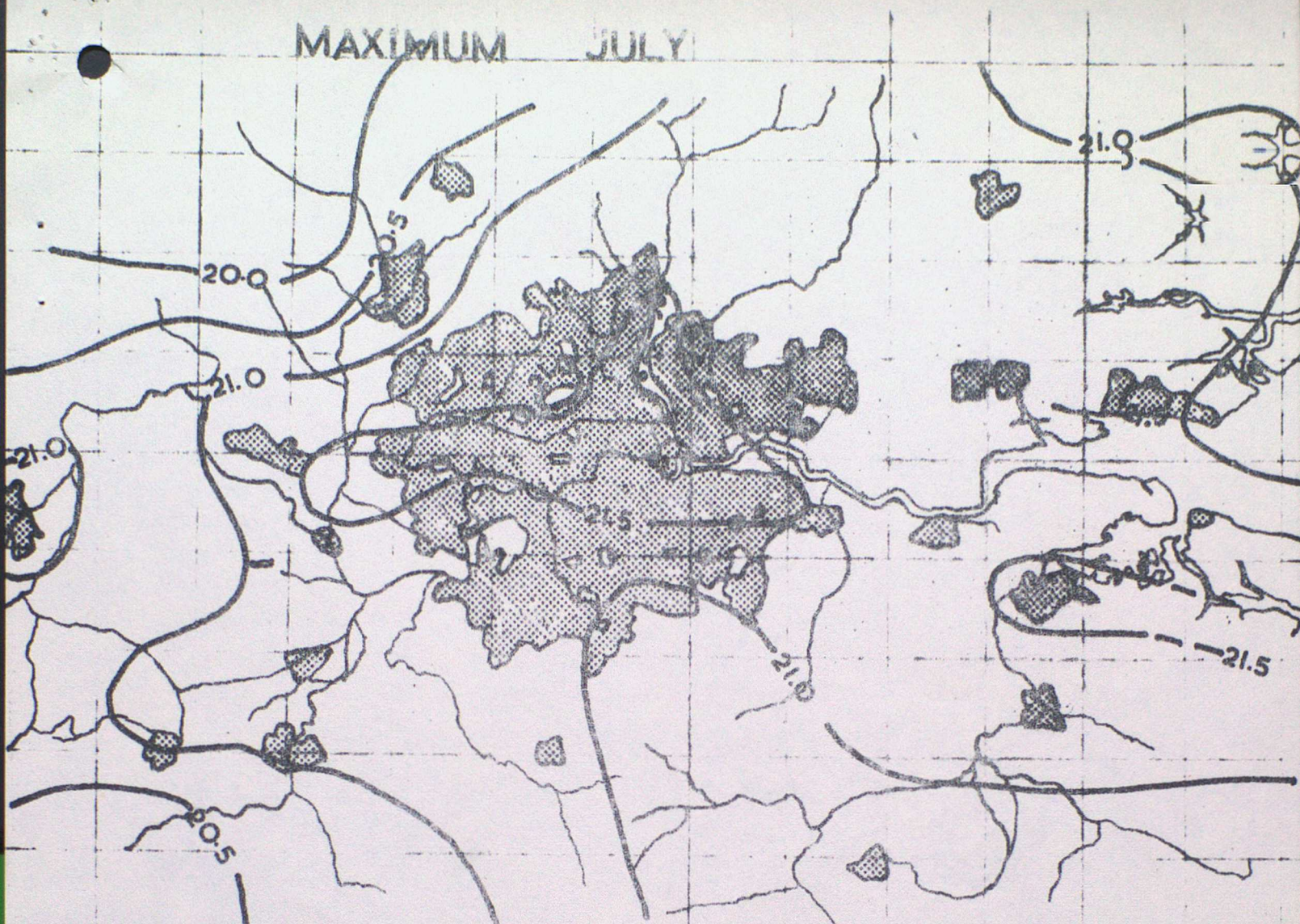
MAXIMUM MAY



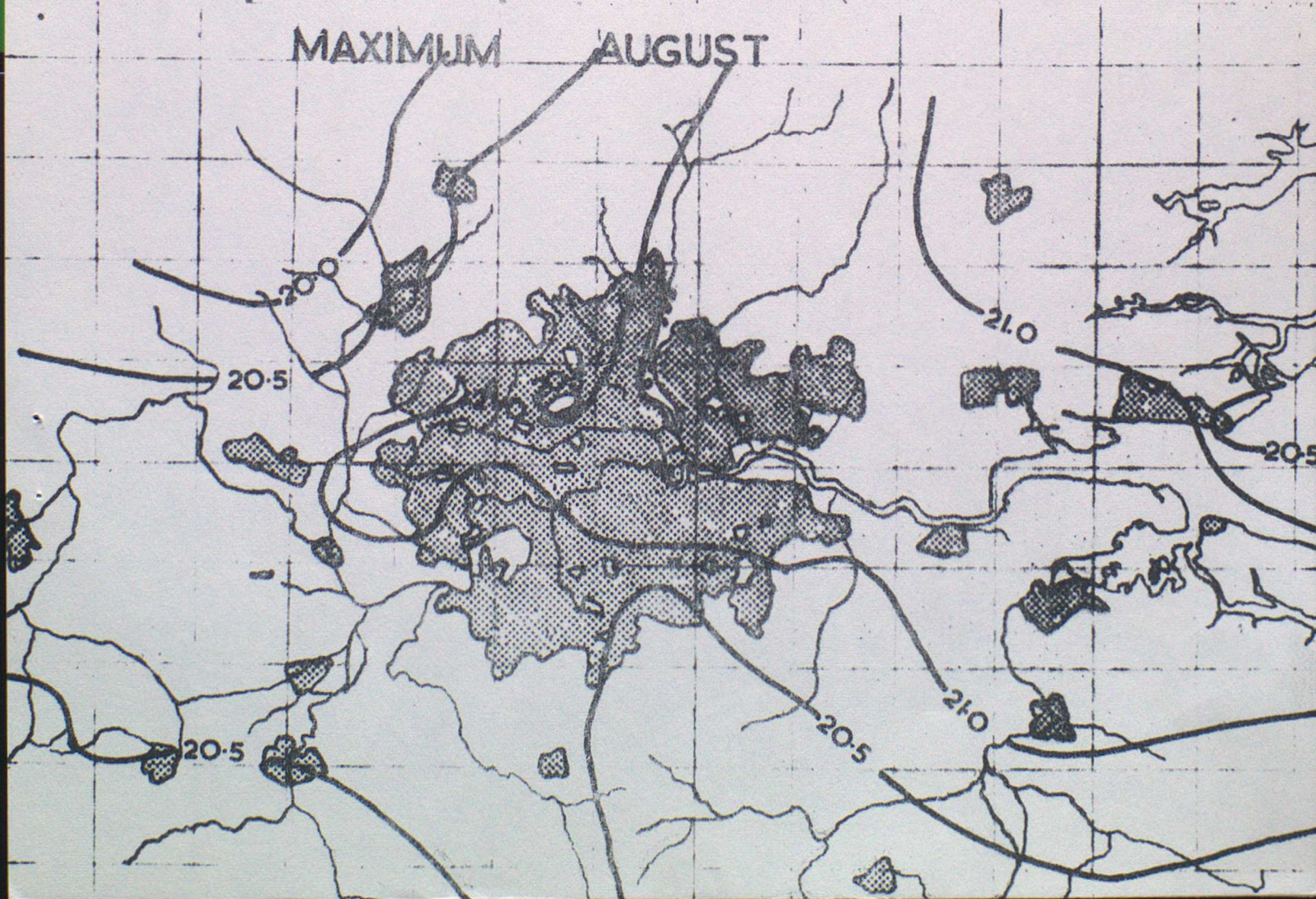
MAXIMUM JUNE



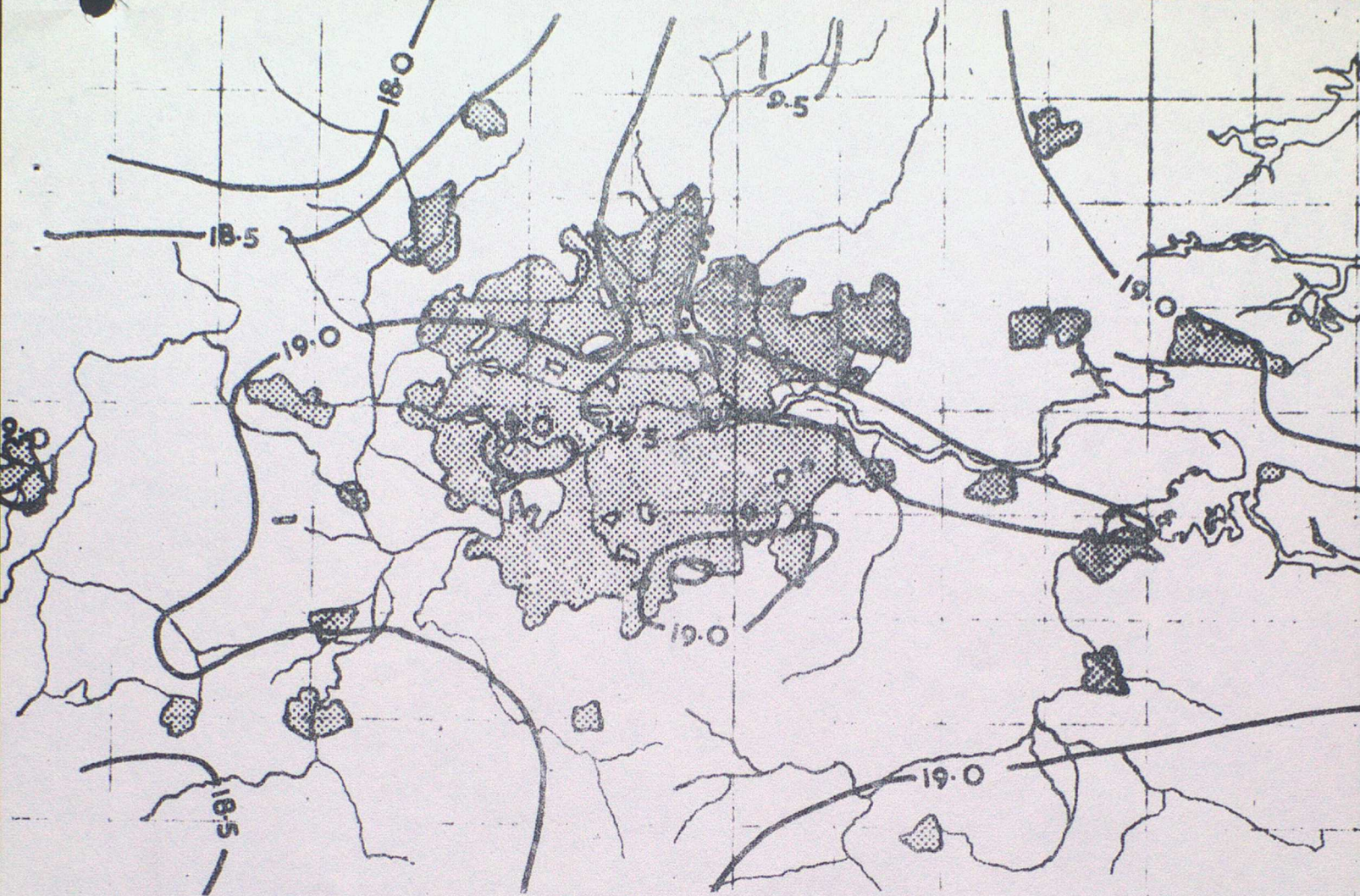
MAXIMUM JULY



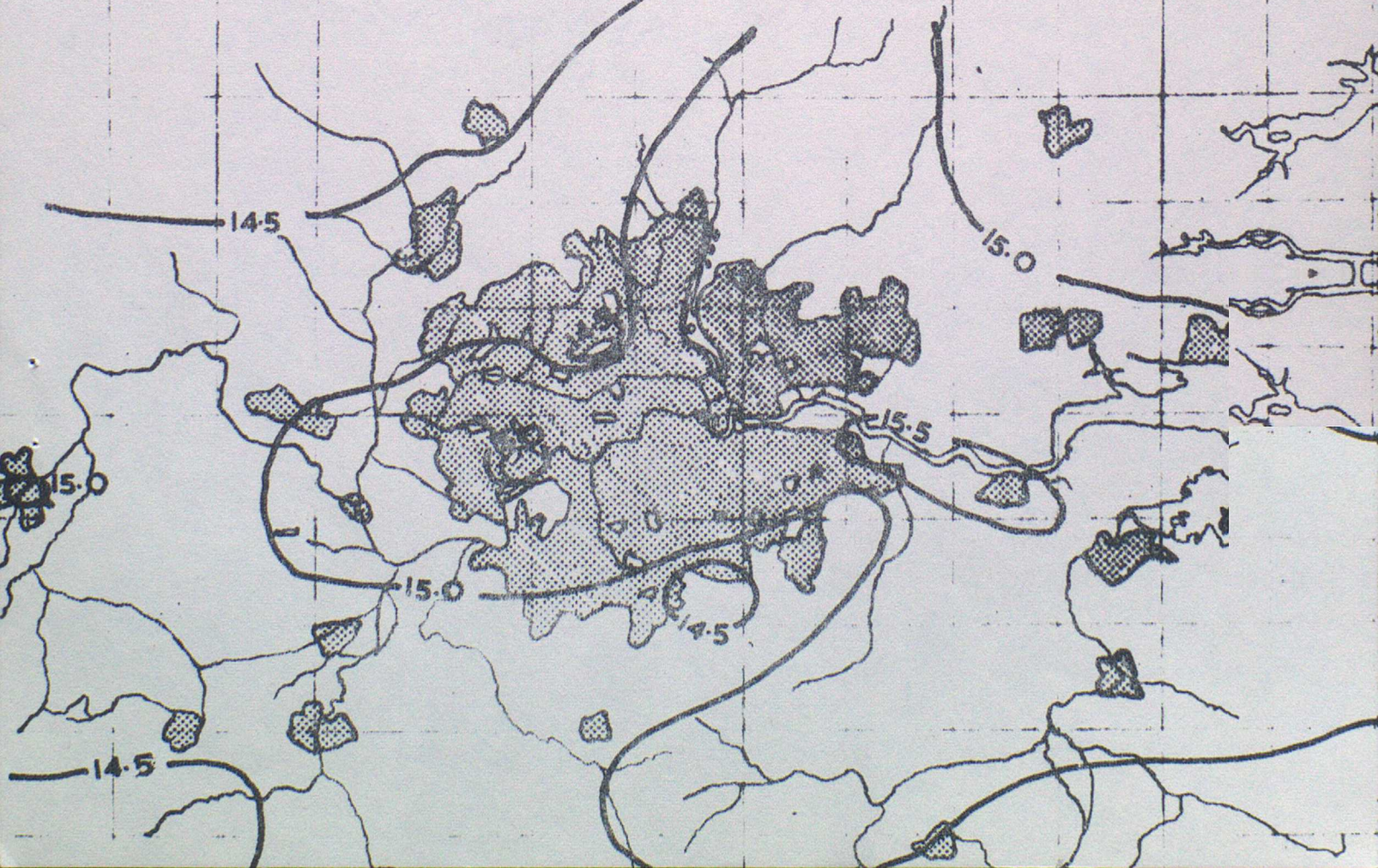
MAXIMUM AUGUST



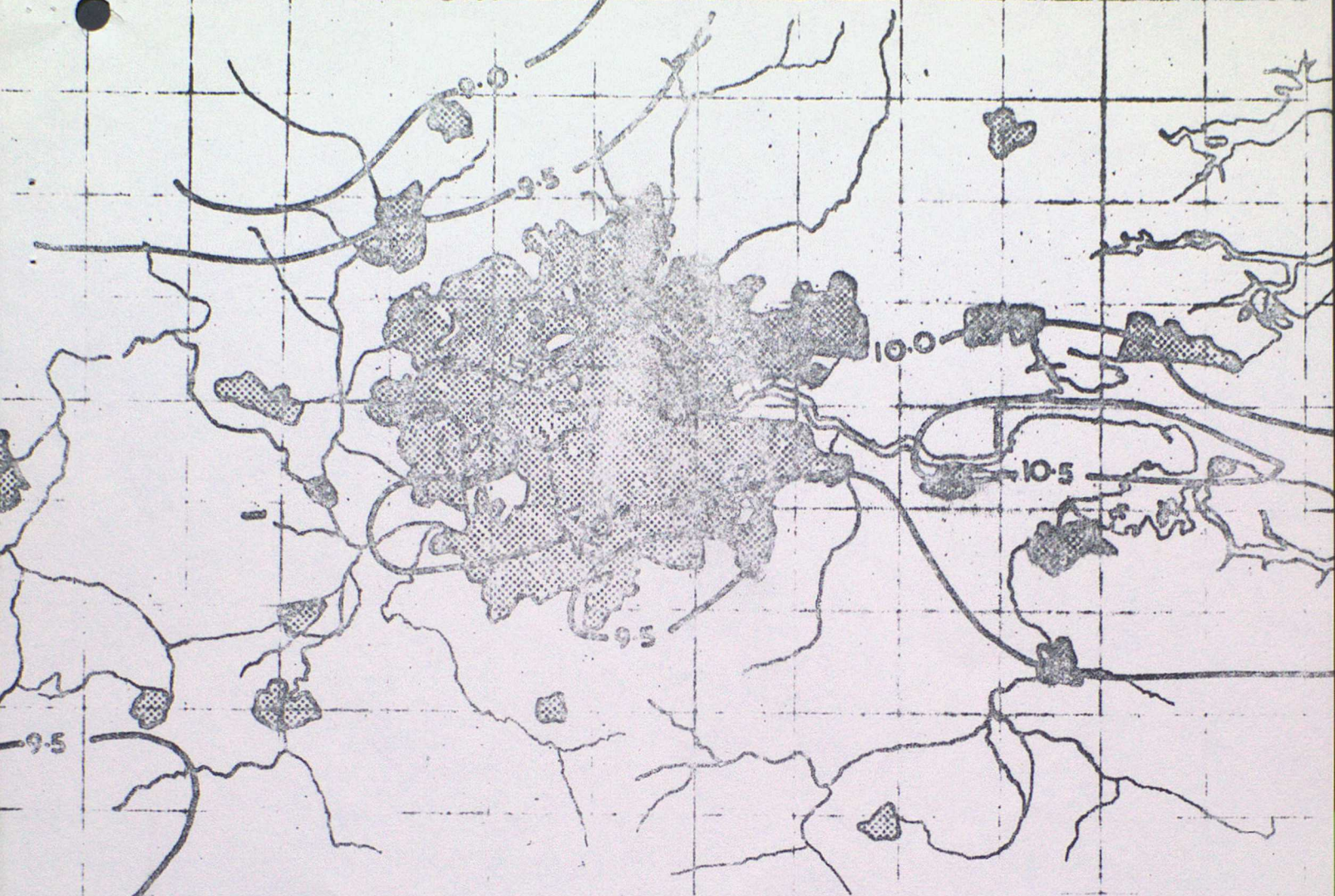
MAXIMUM SEPTEMBER



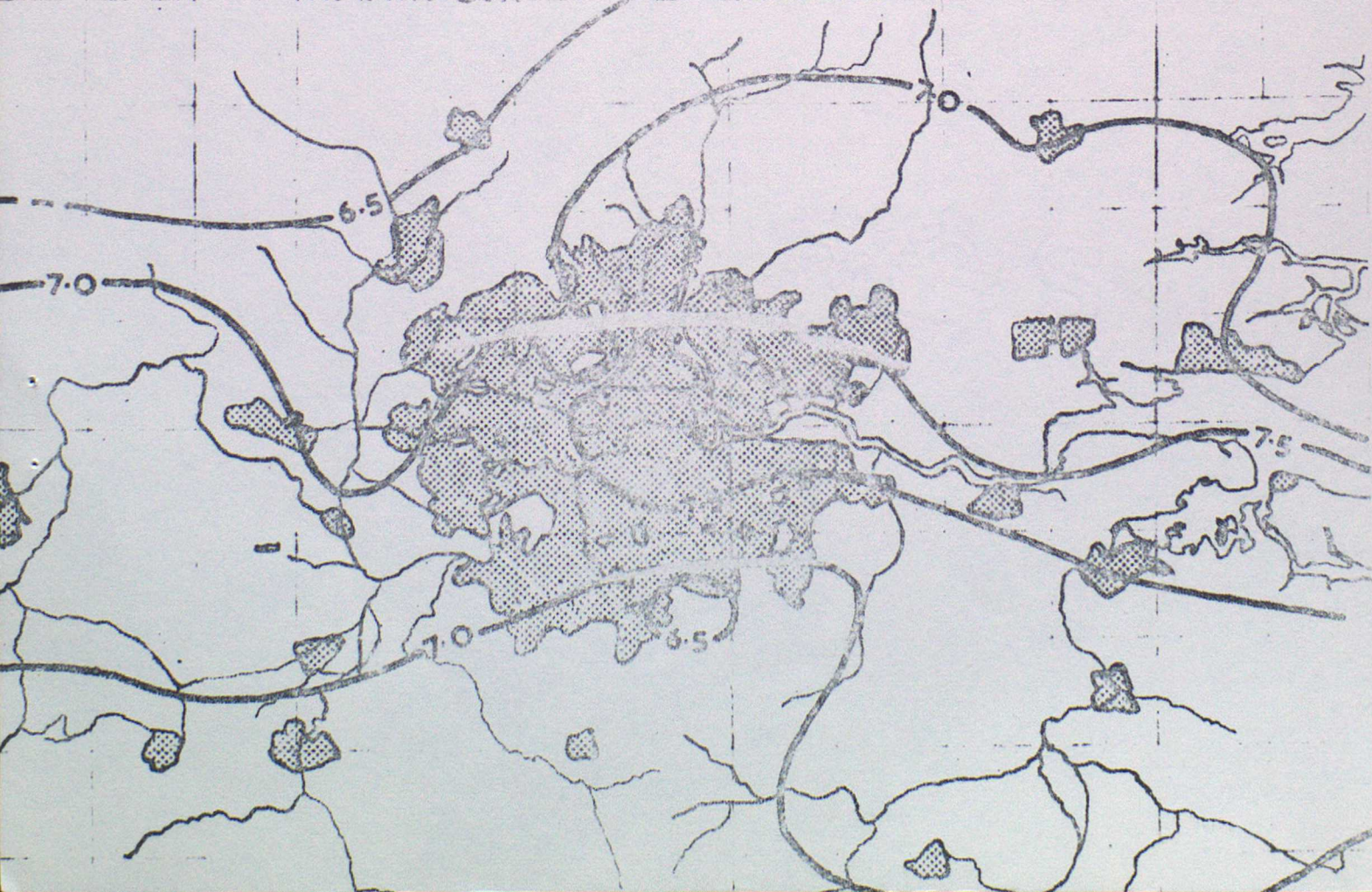
MAXIMUM OCTOBER



MAXIMUM NOVEMBER



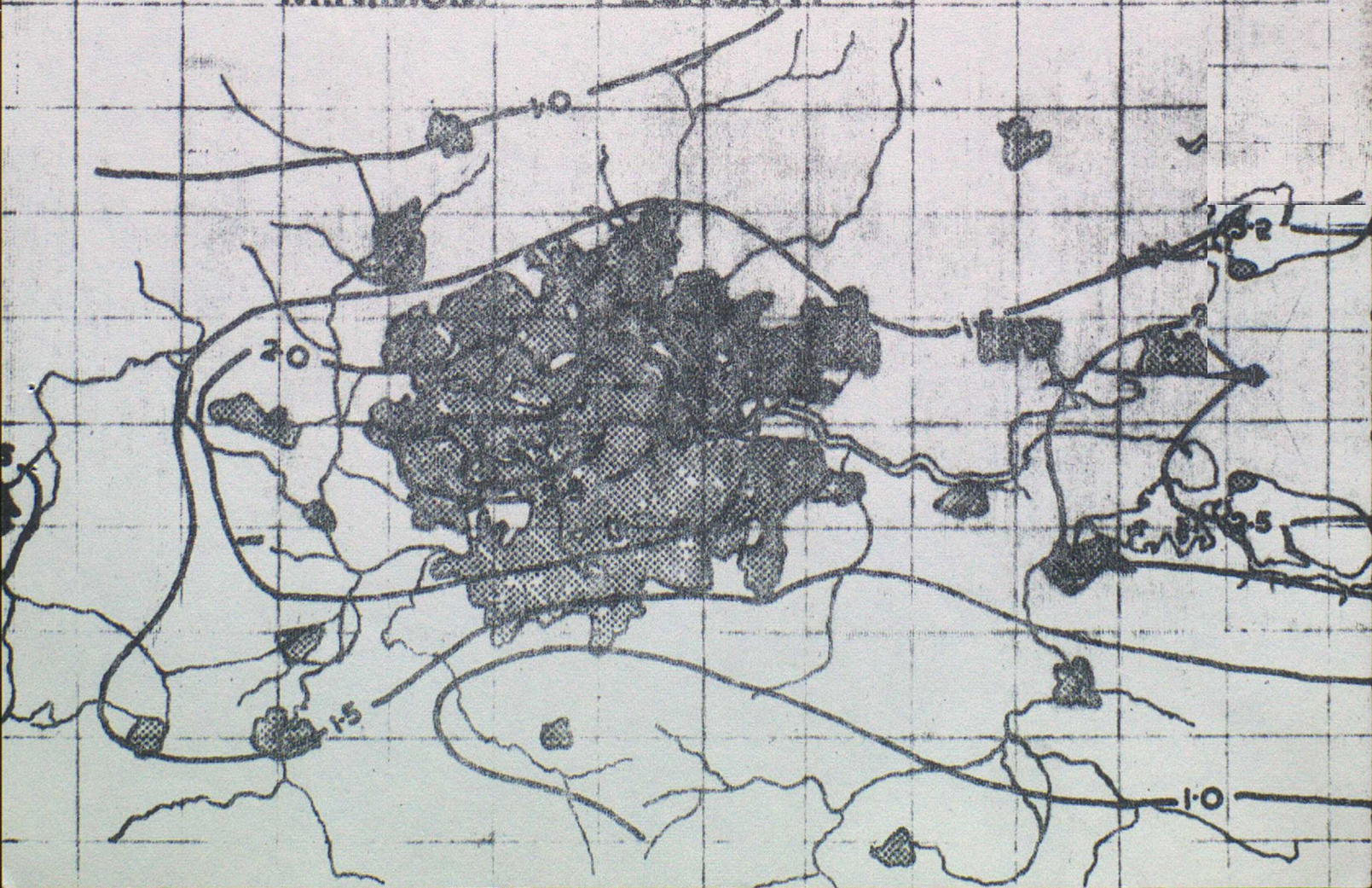
MAXIMUM DECEMBER



MINIMUM JANUARY

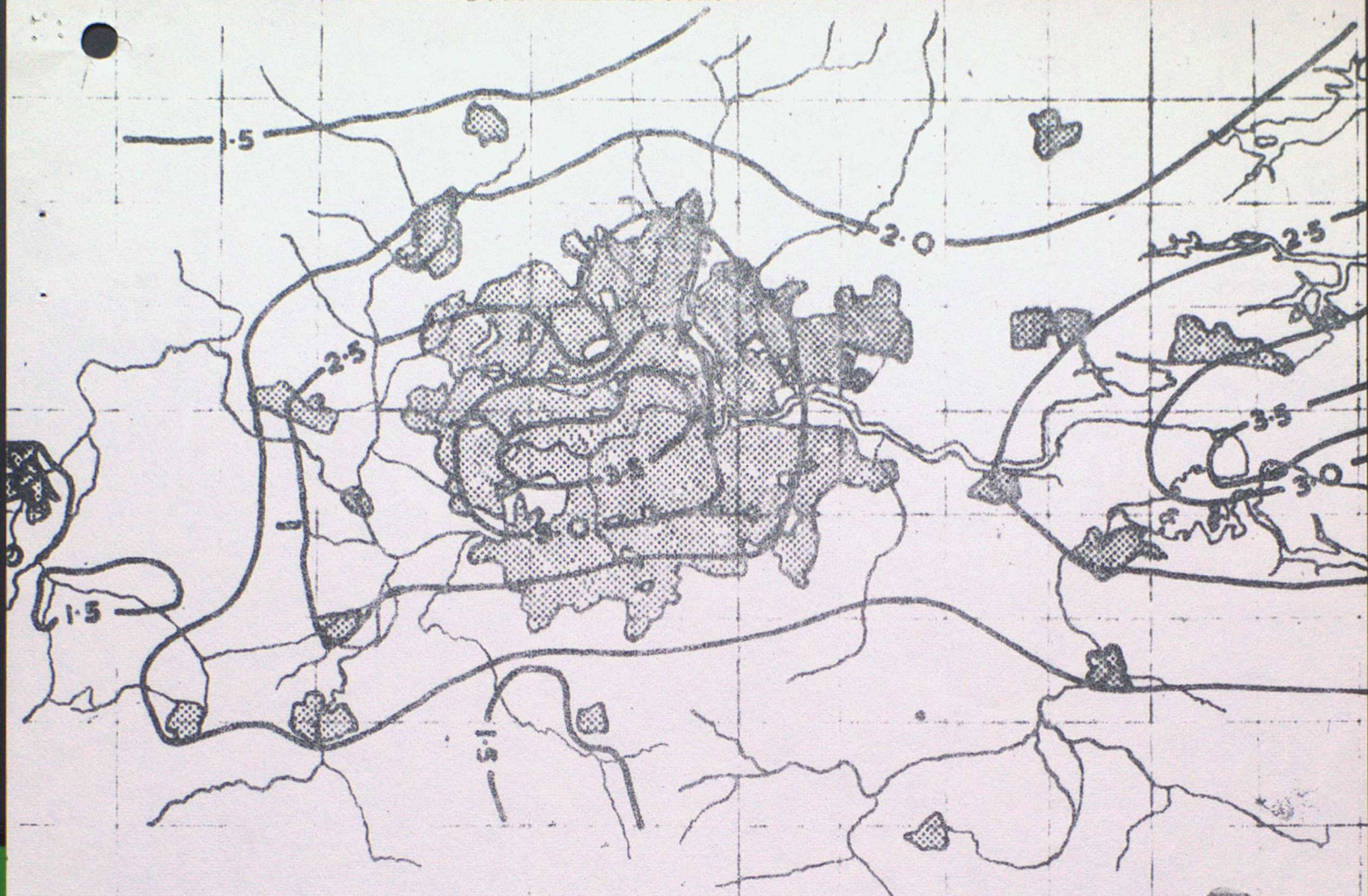


MINIMUM FEBRUARY



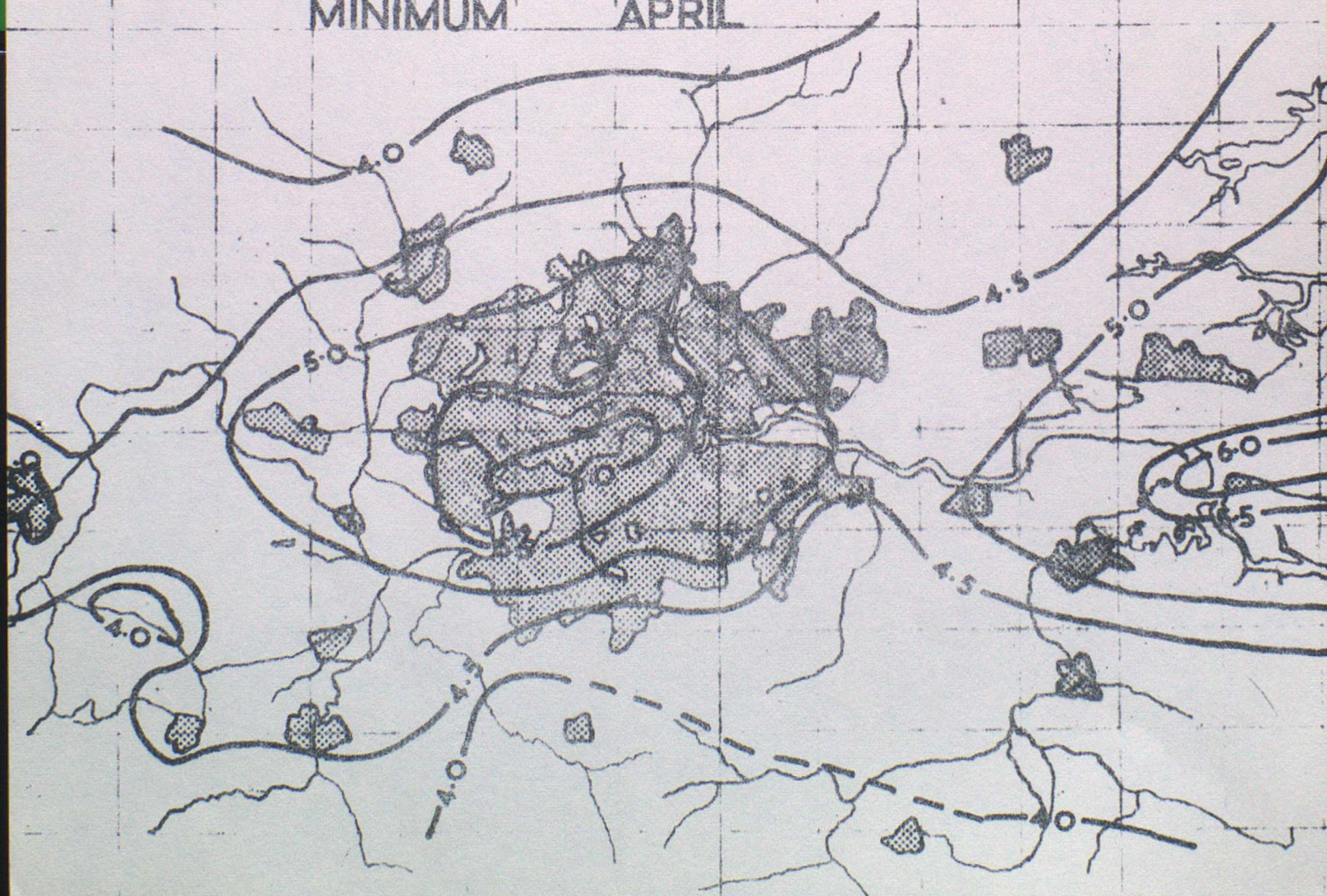
MINIMUM

MARCH

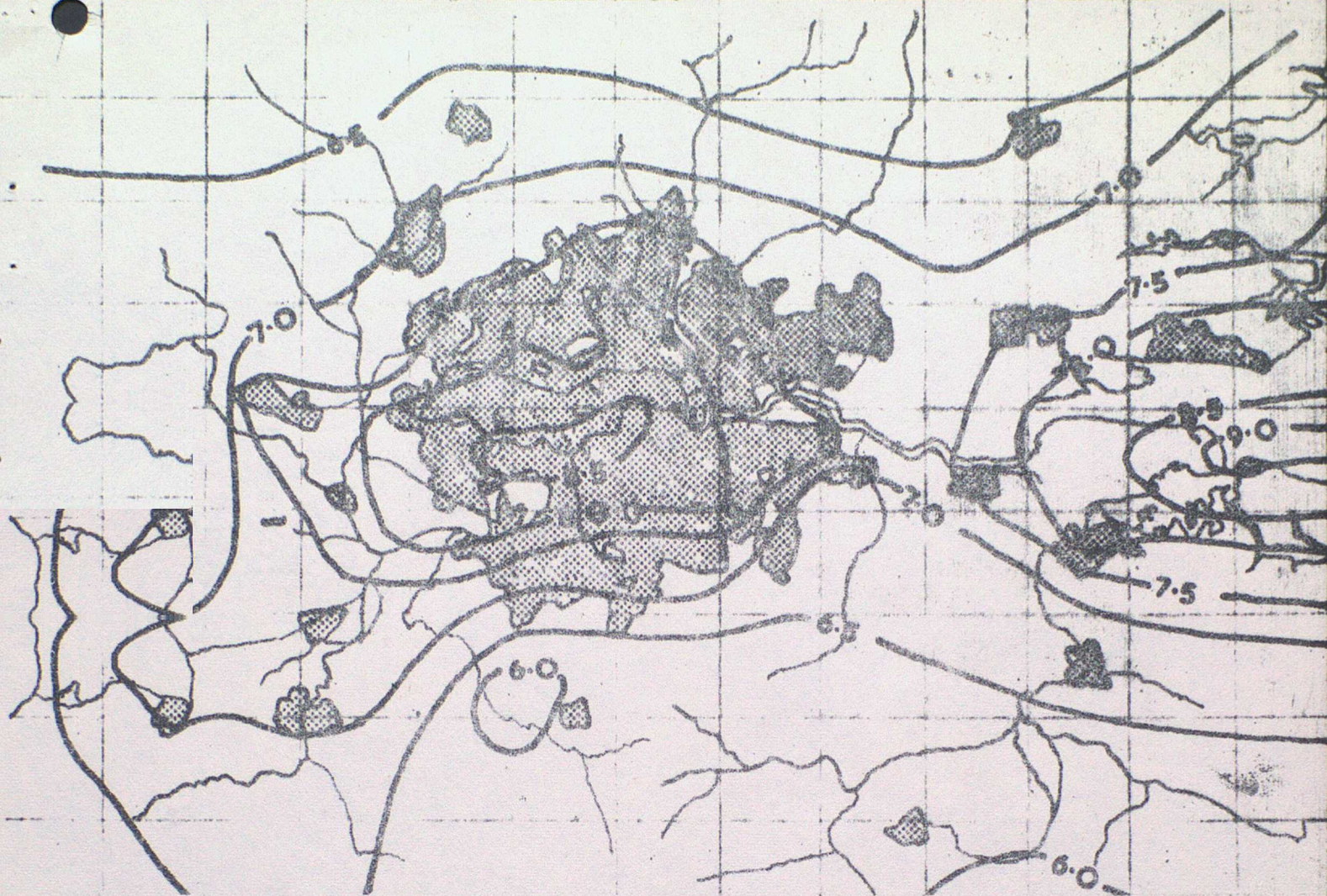


MINIMUM

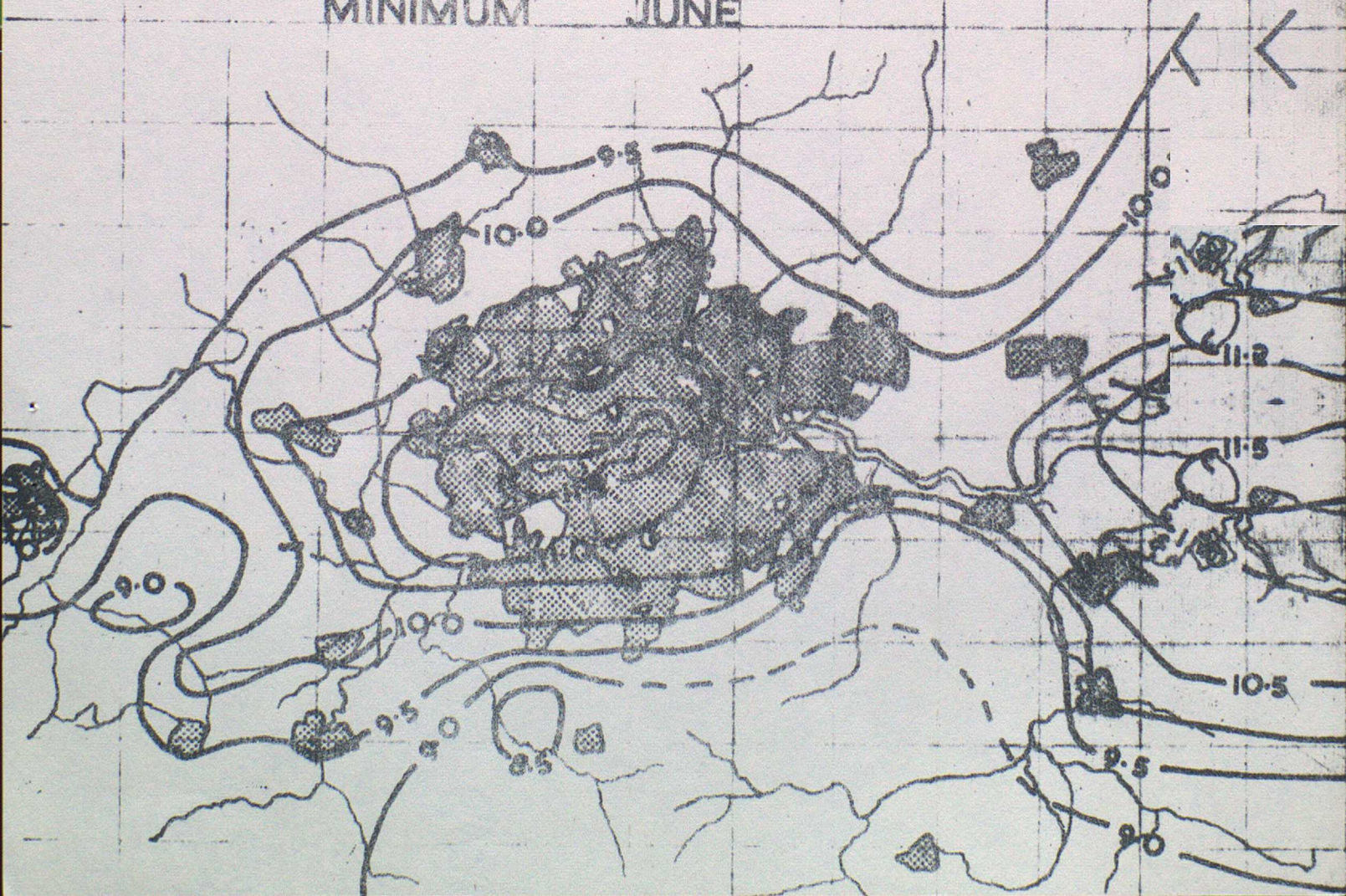
APRIL



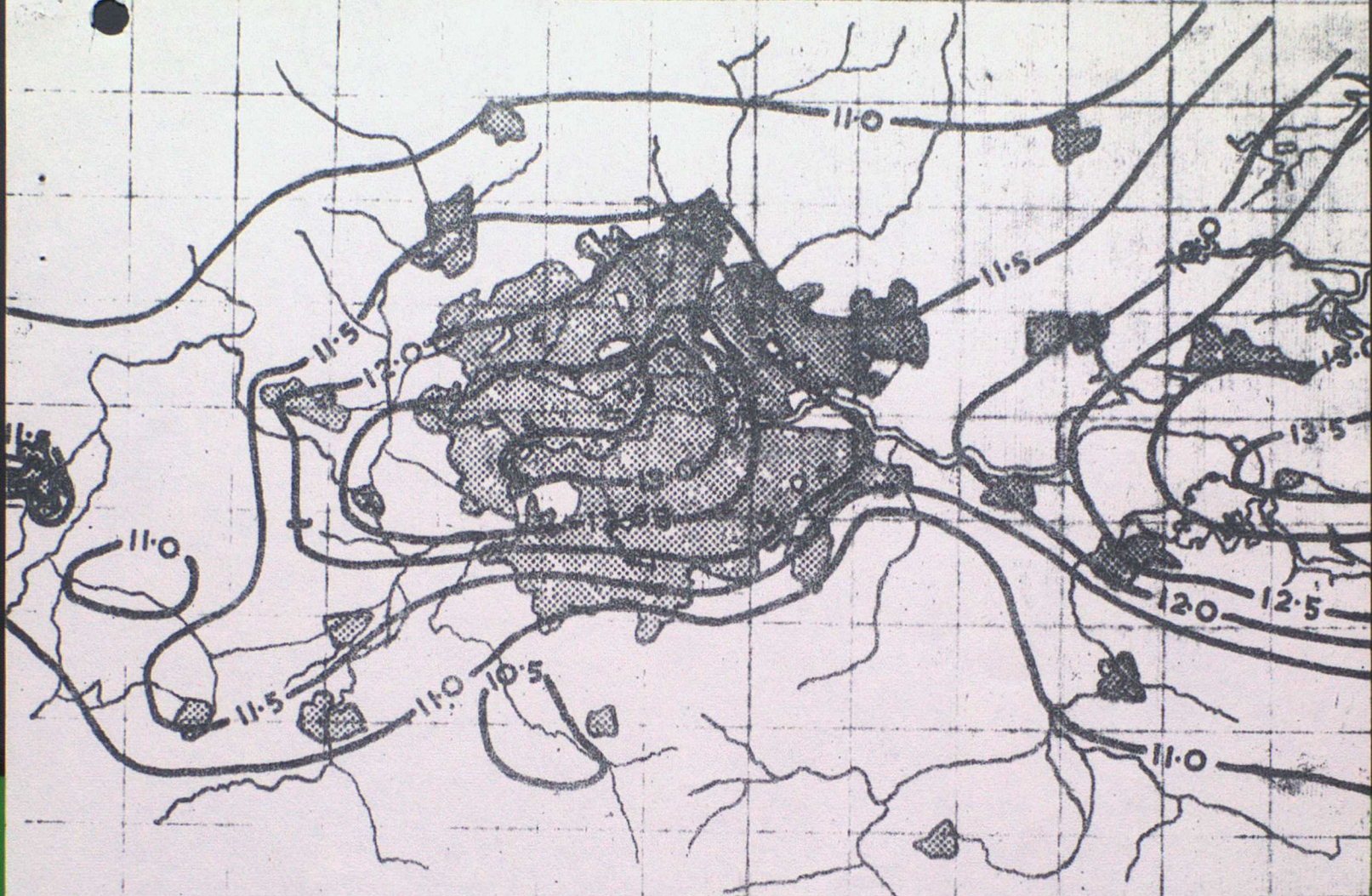
MINIMUM MAY



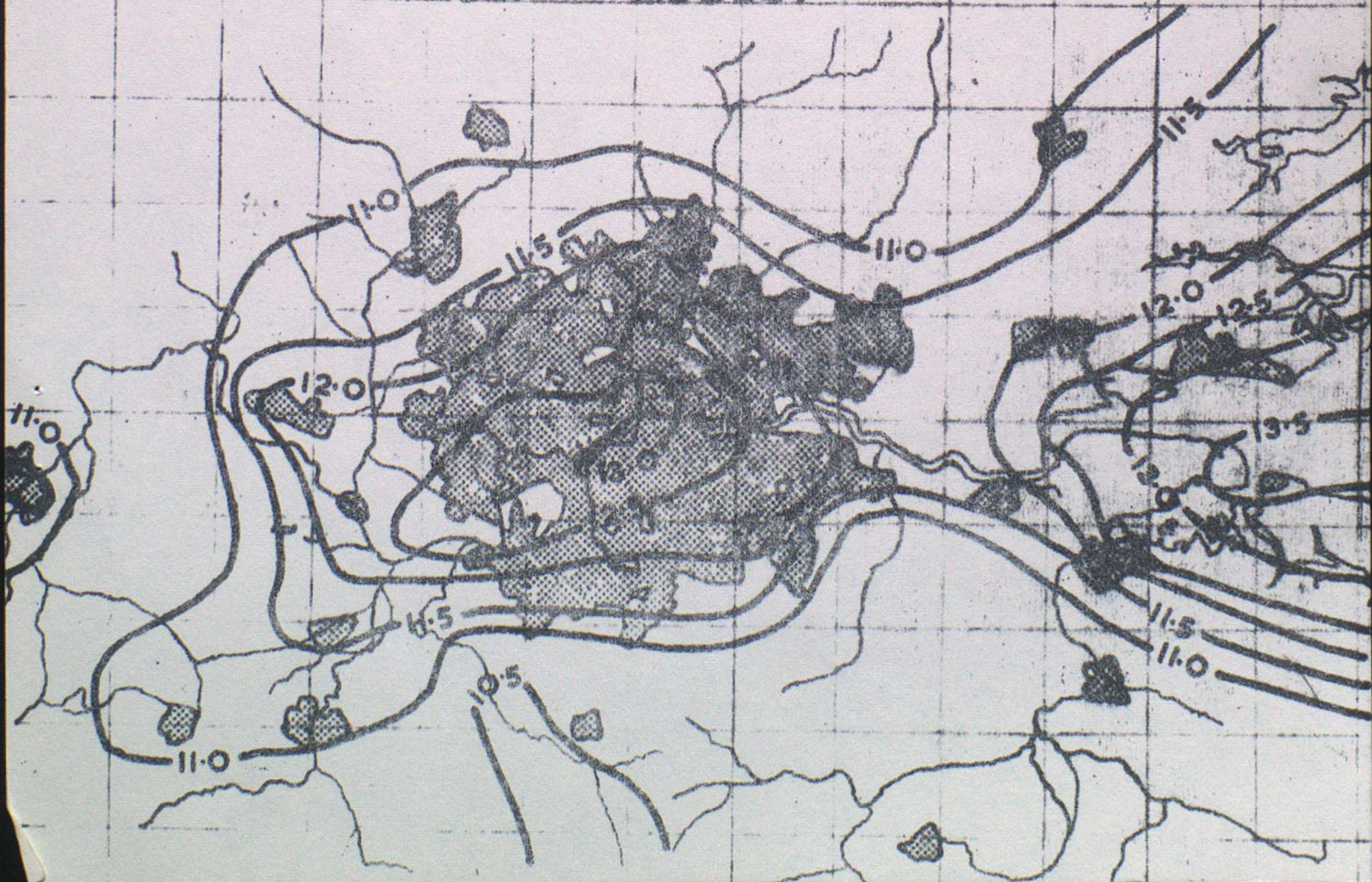
MINIMUM JUNE



MINIMUM JULY

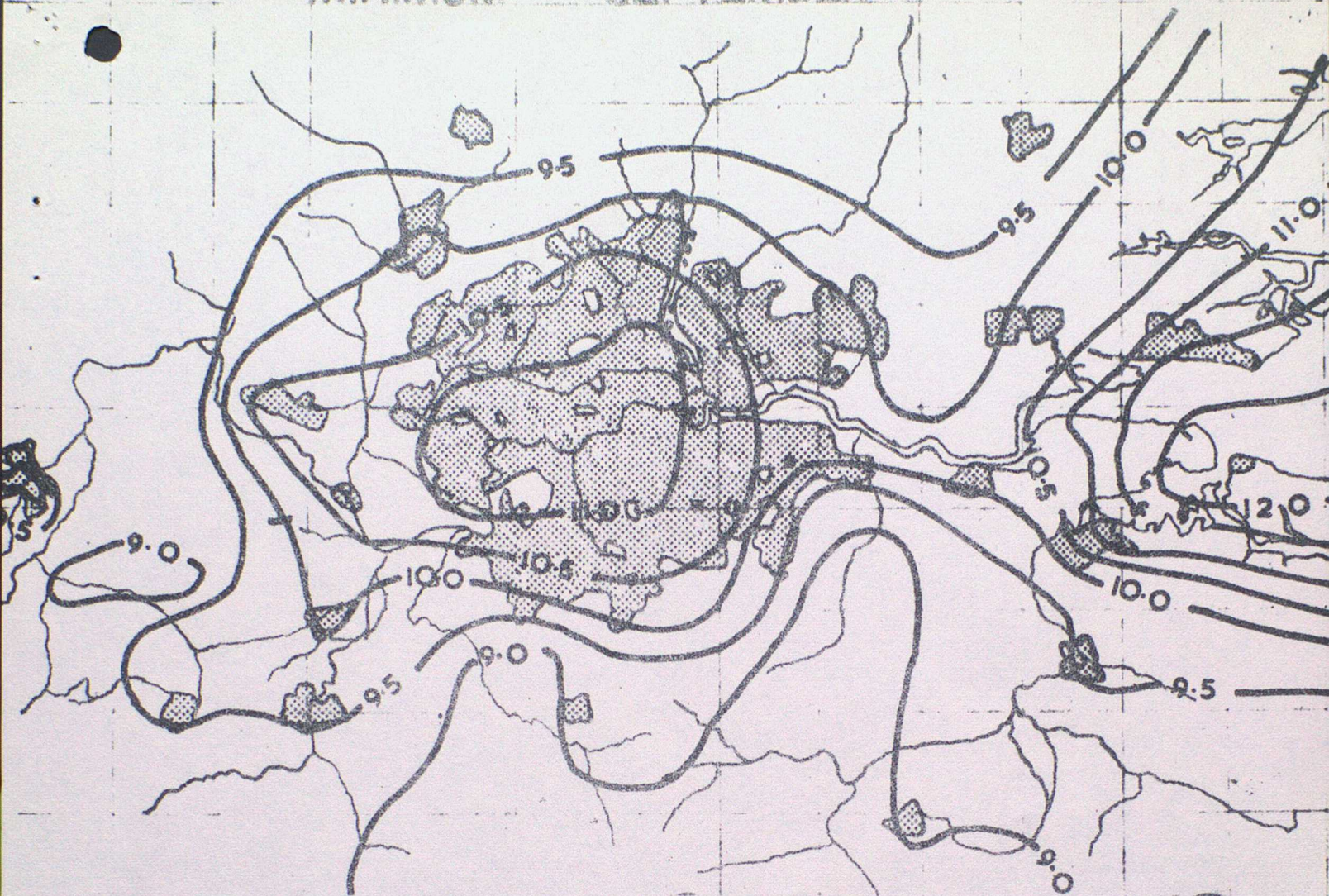


MINIMUM AUGUST



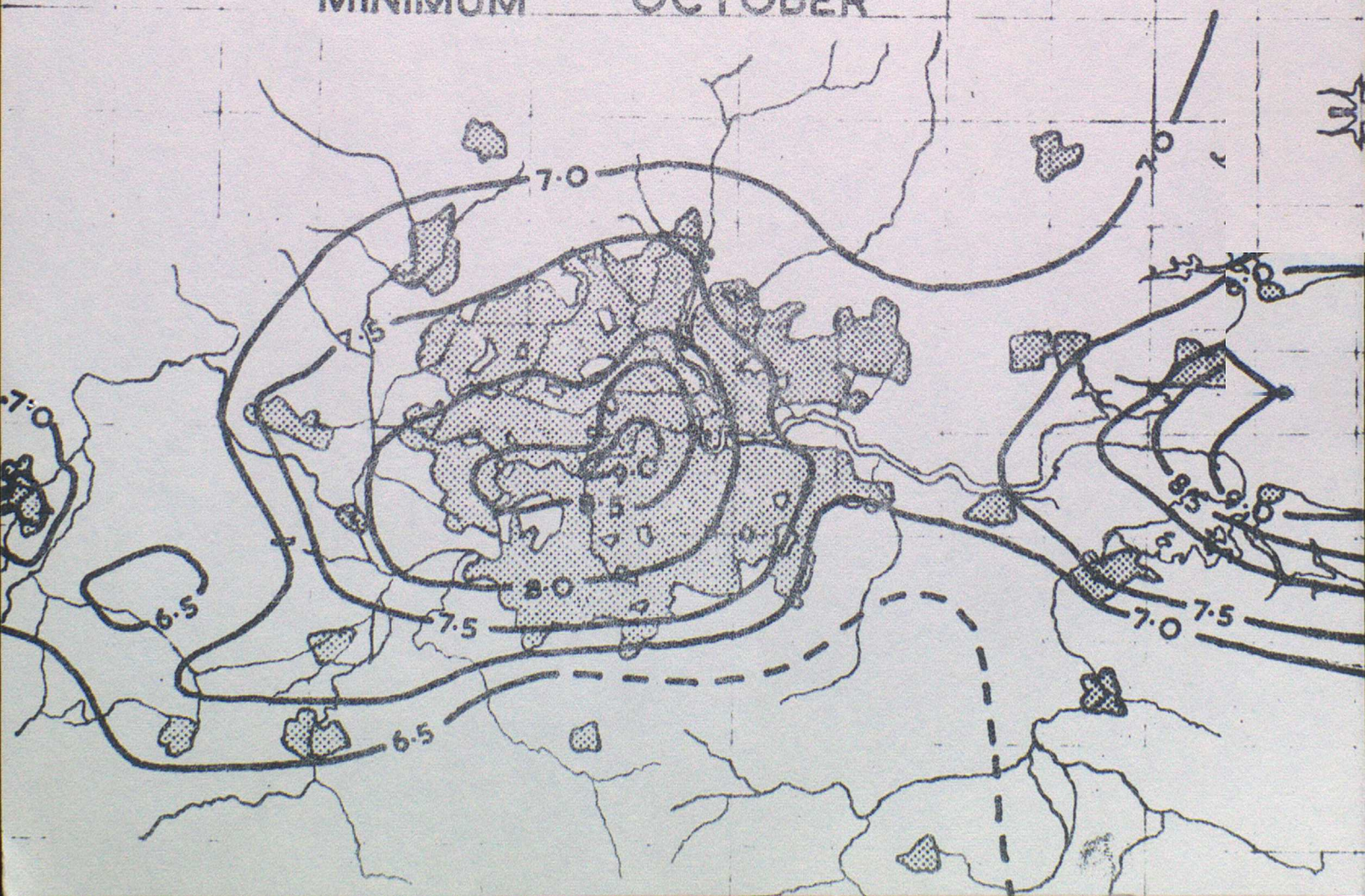
MINIMUM

SEPTEMBER

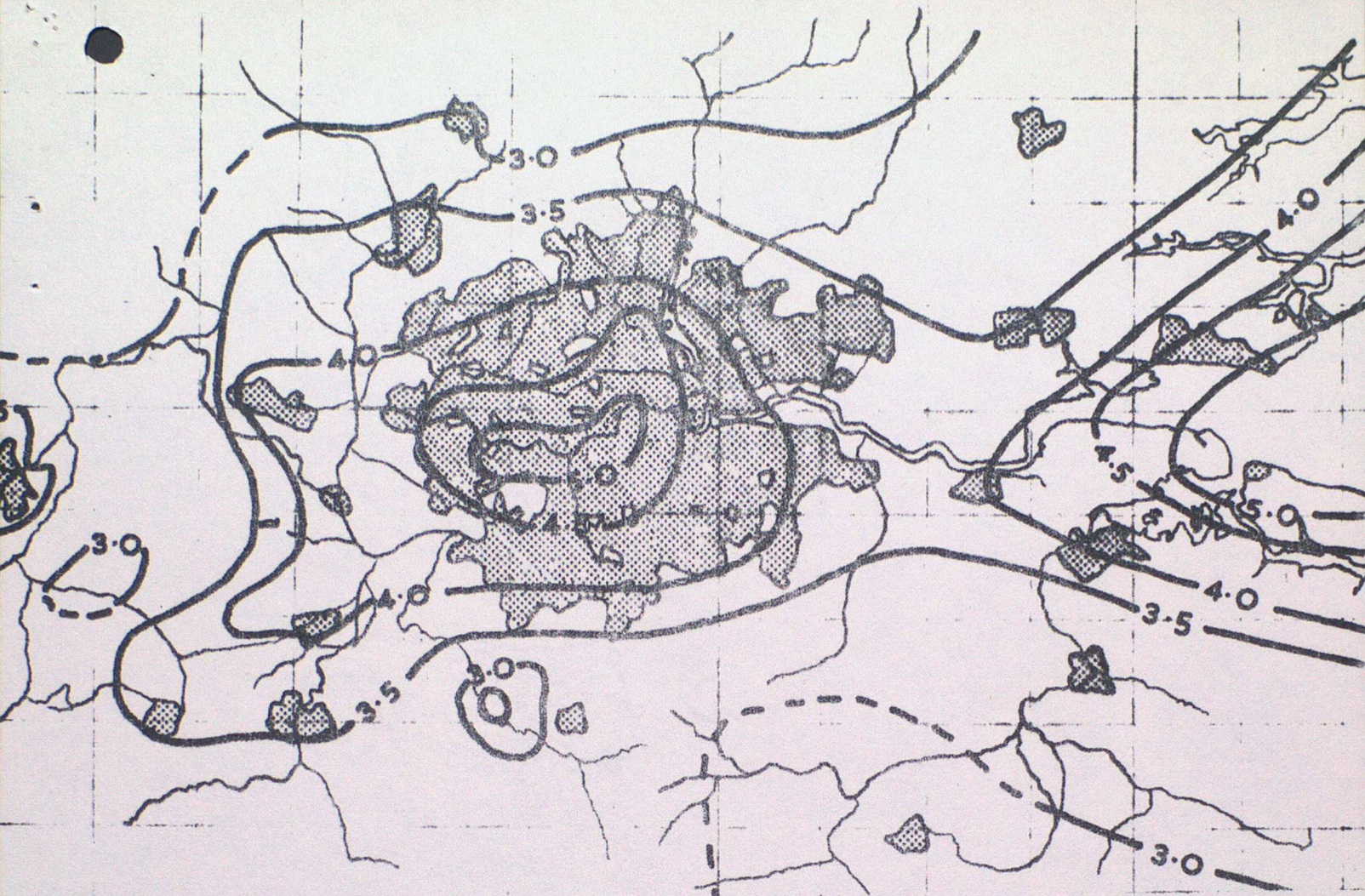


MINIMUM

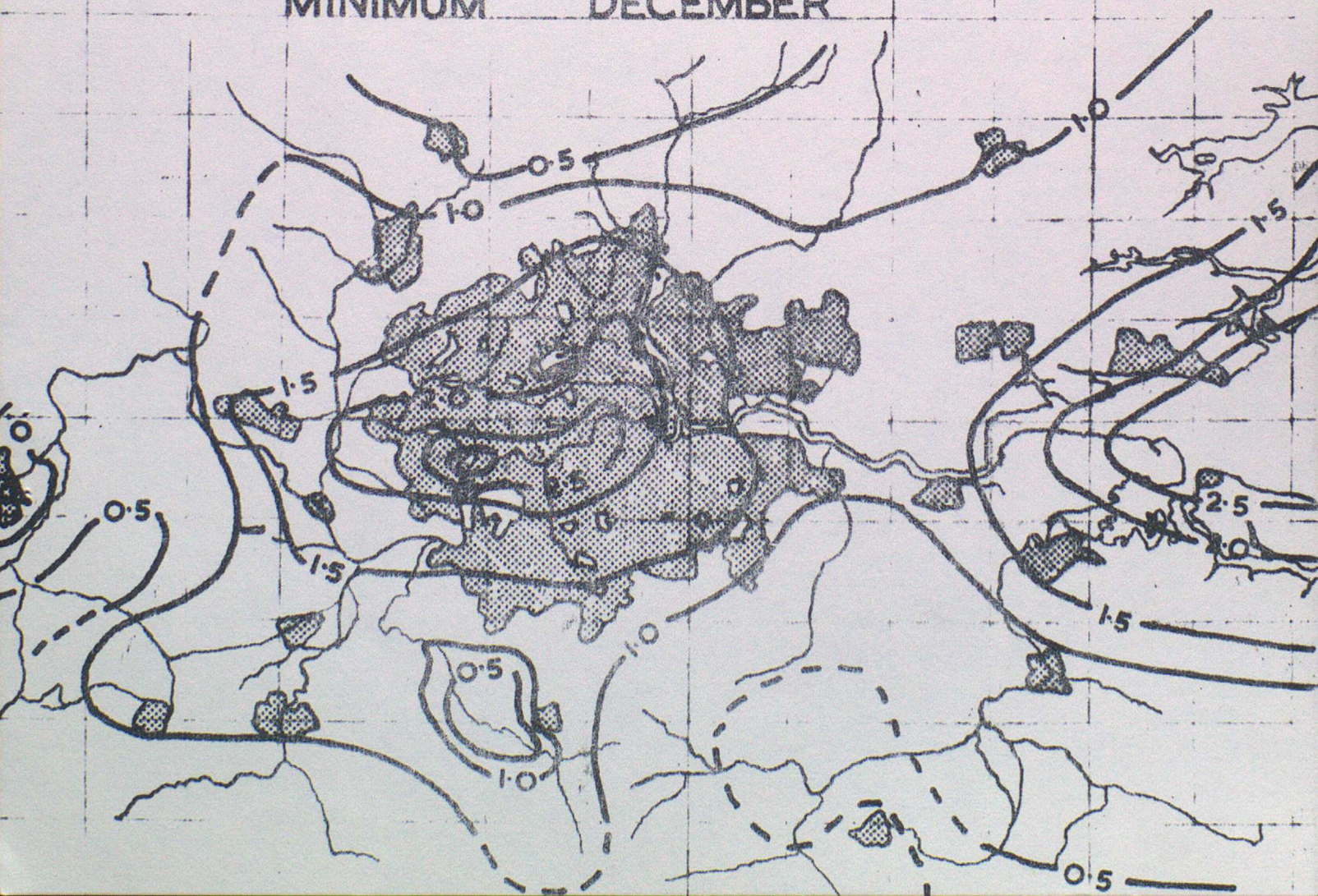
OCTOBER



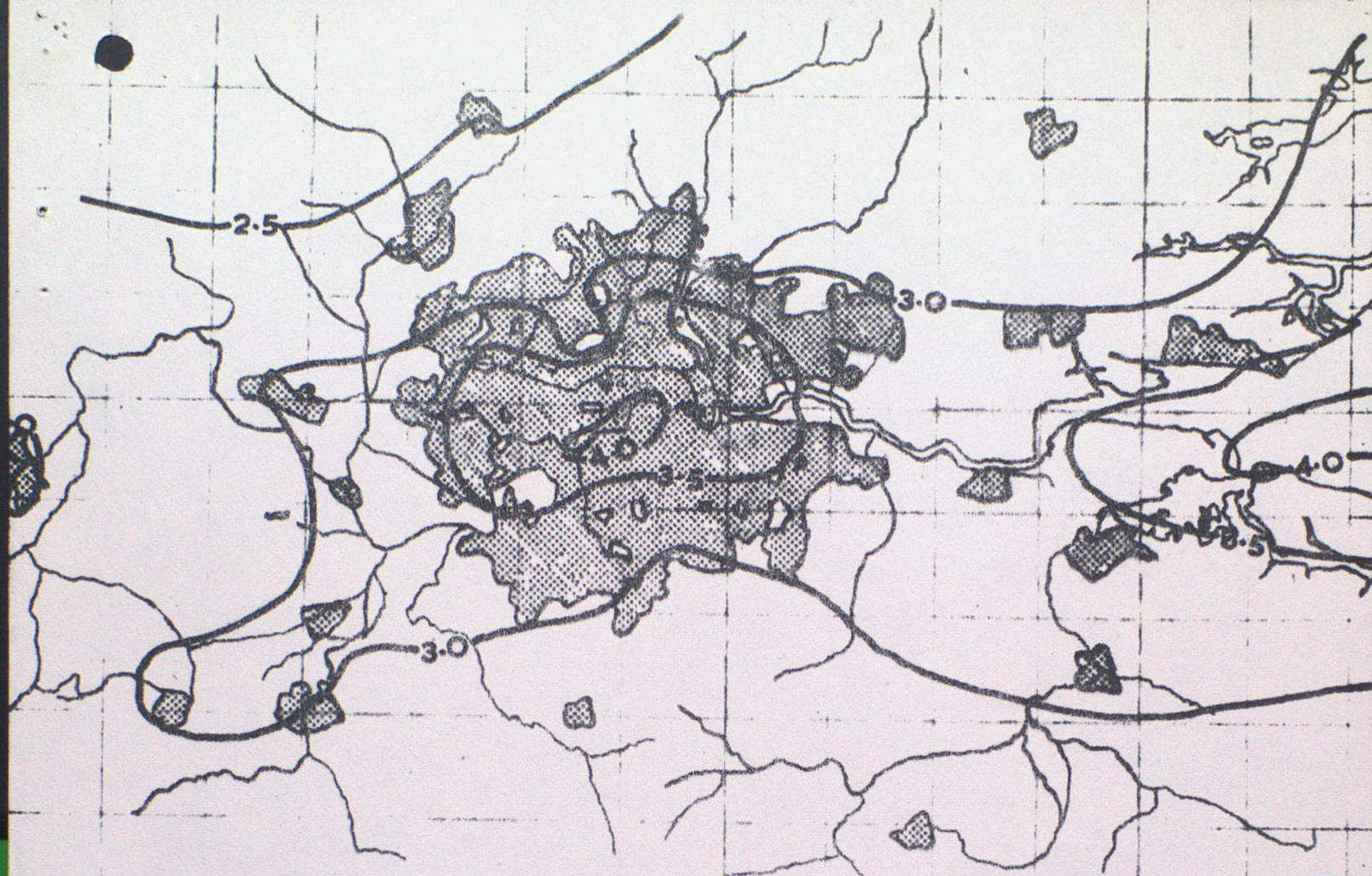
MINIMUM NOVEMBER



MINIMUM DECEMBER



MEAN JANUARY



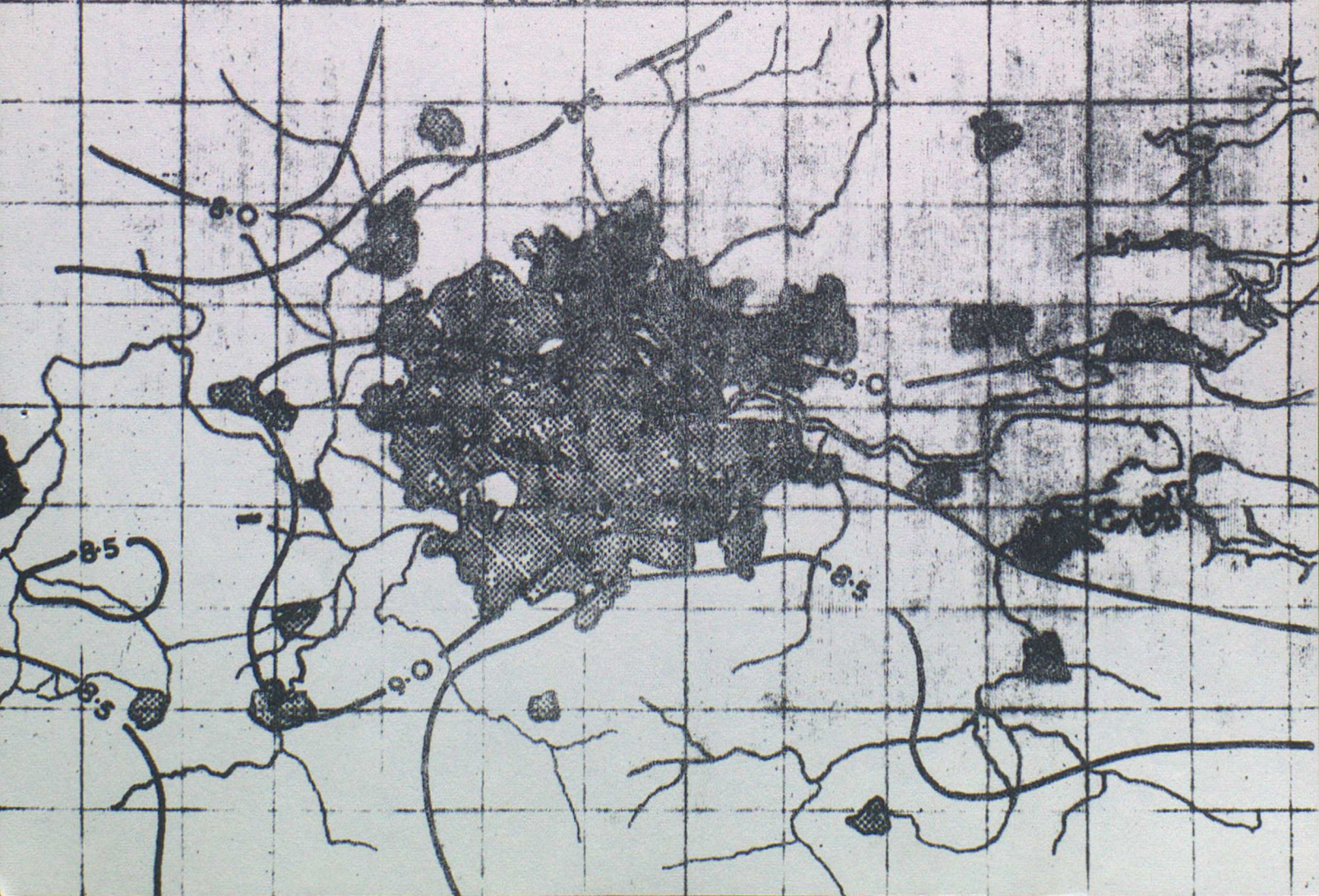
MEAN FEBRUARY



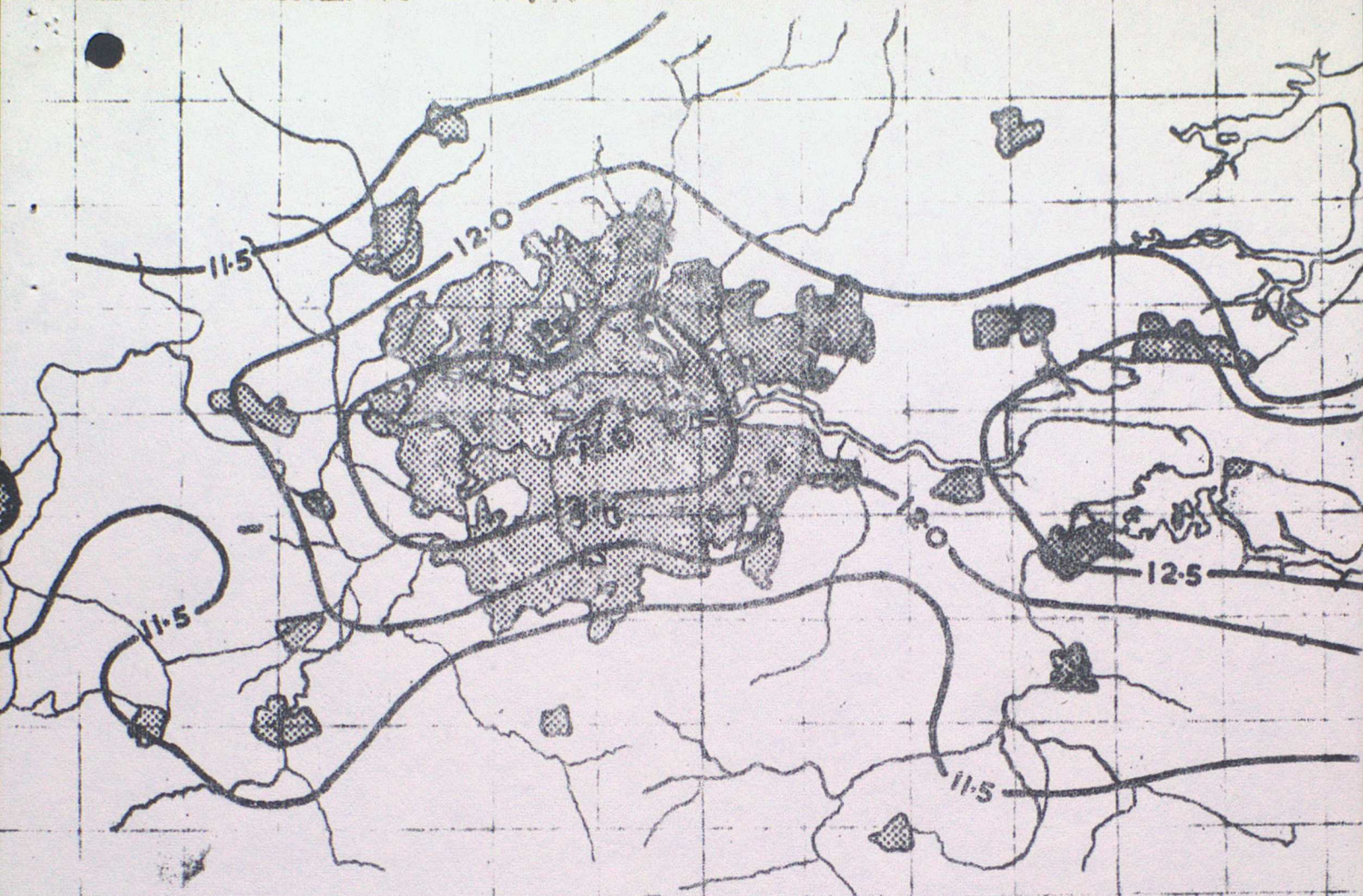
MEAN MARCH



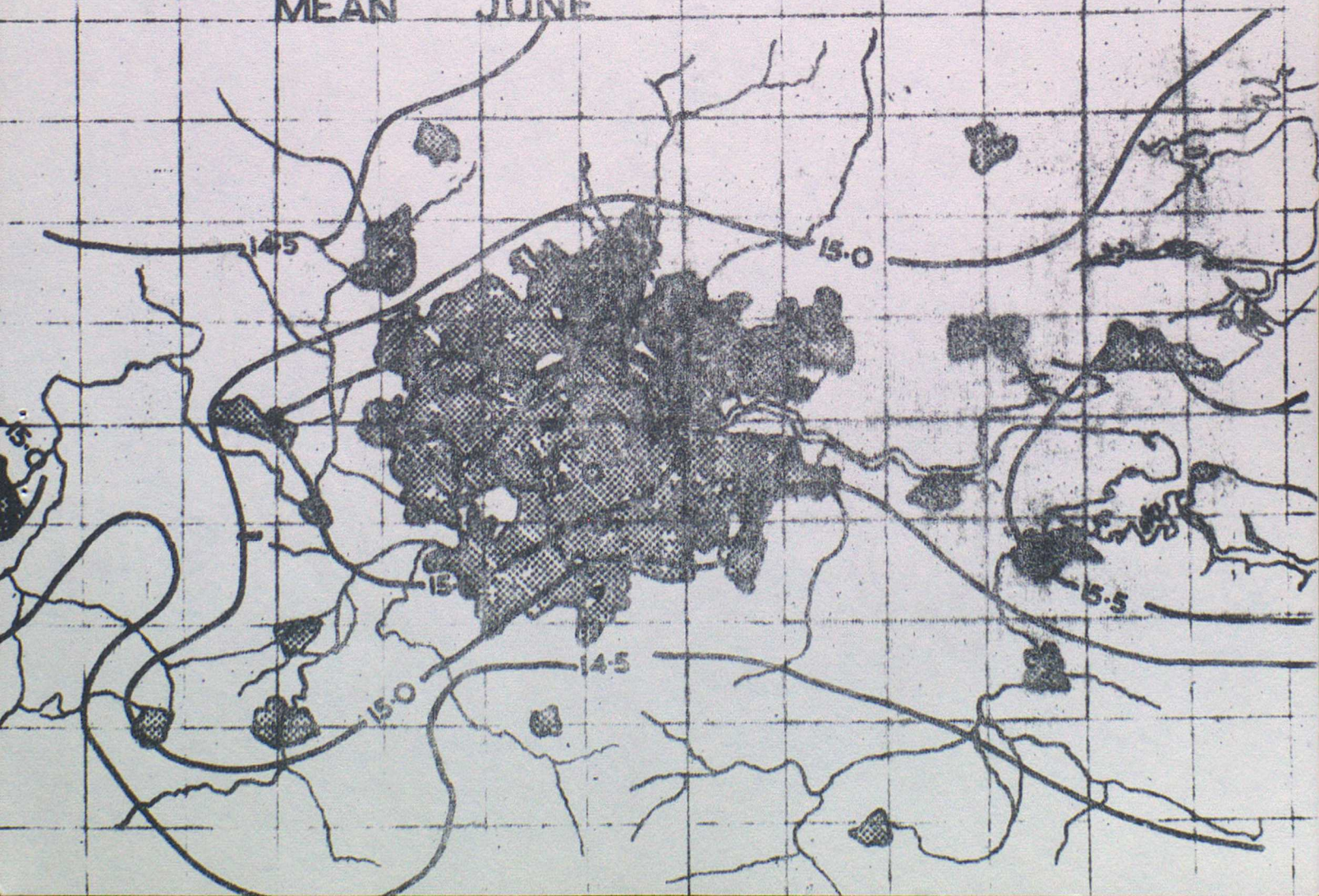
MEAN APRIL



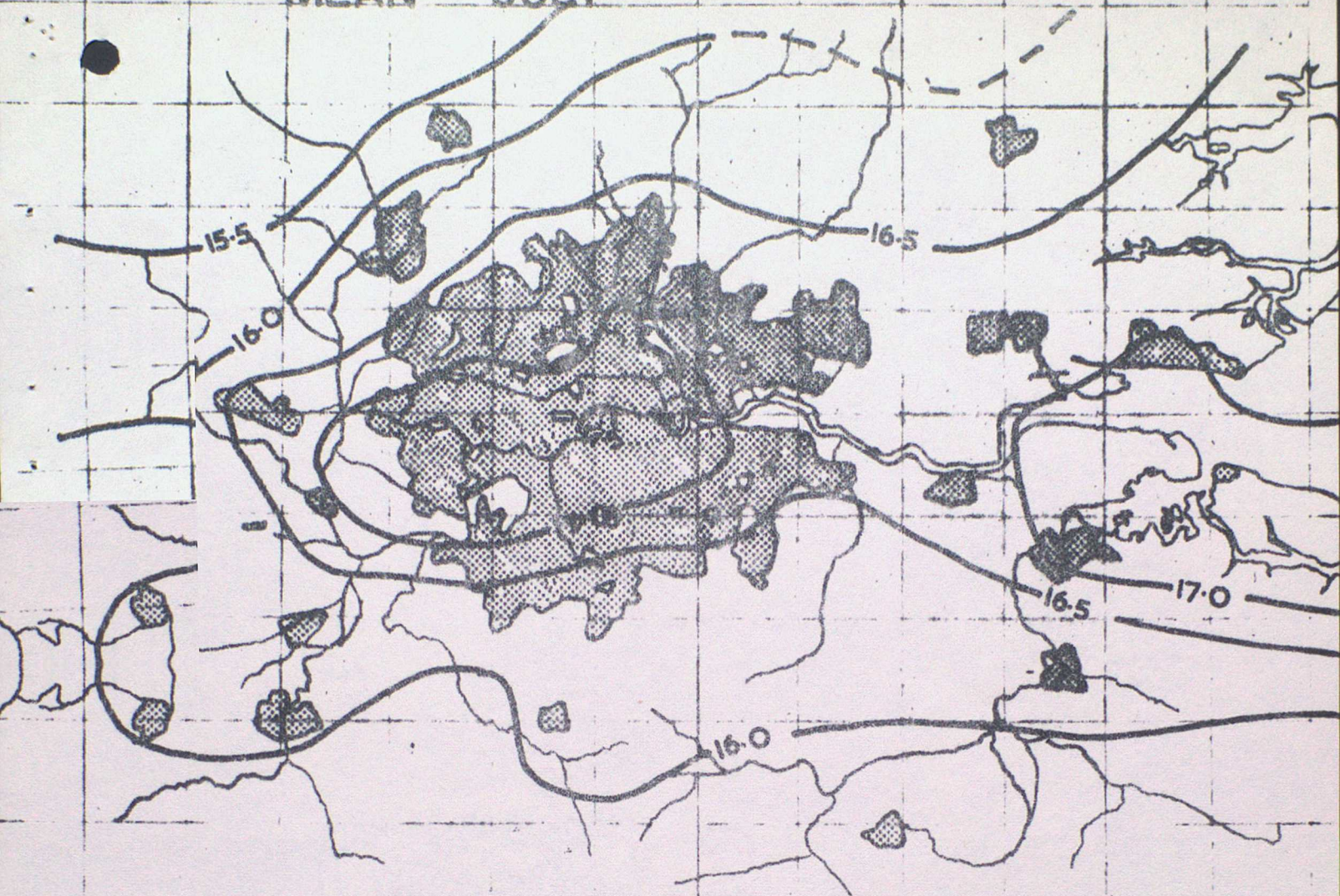
MEAN MAY



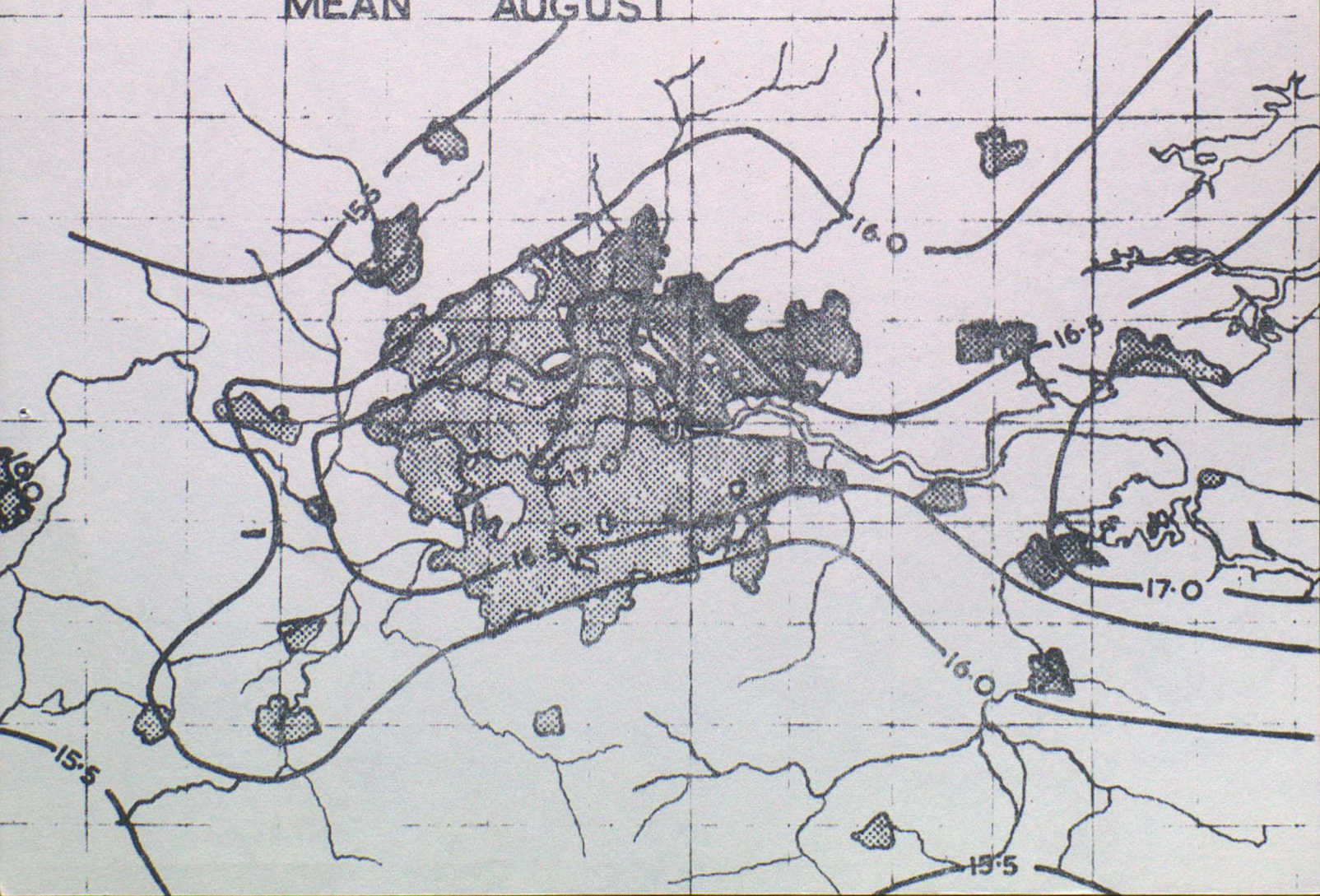
MEAN JUNE



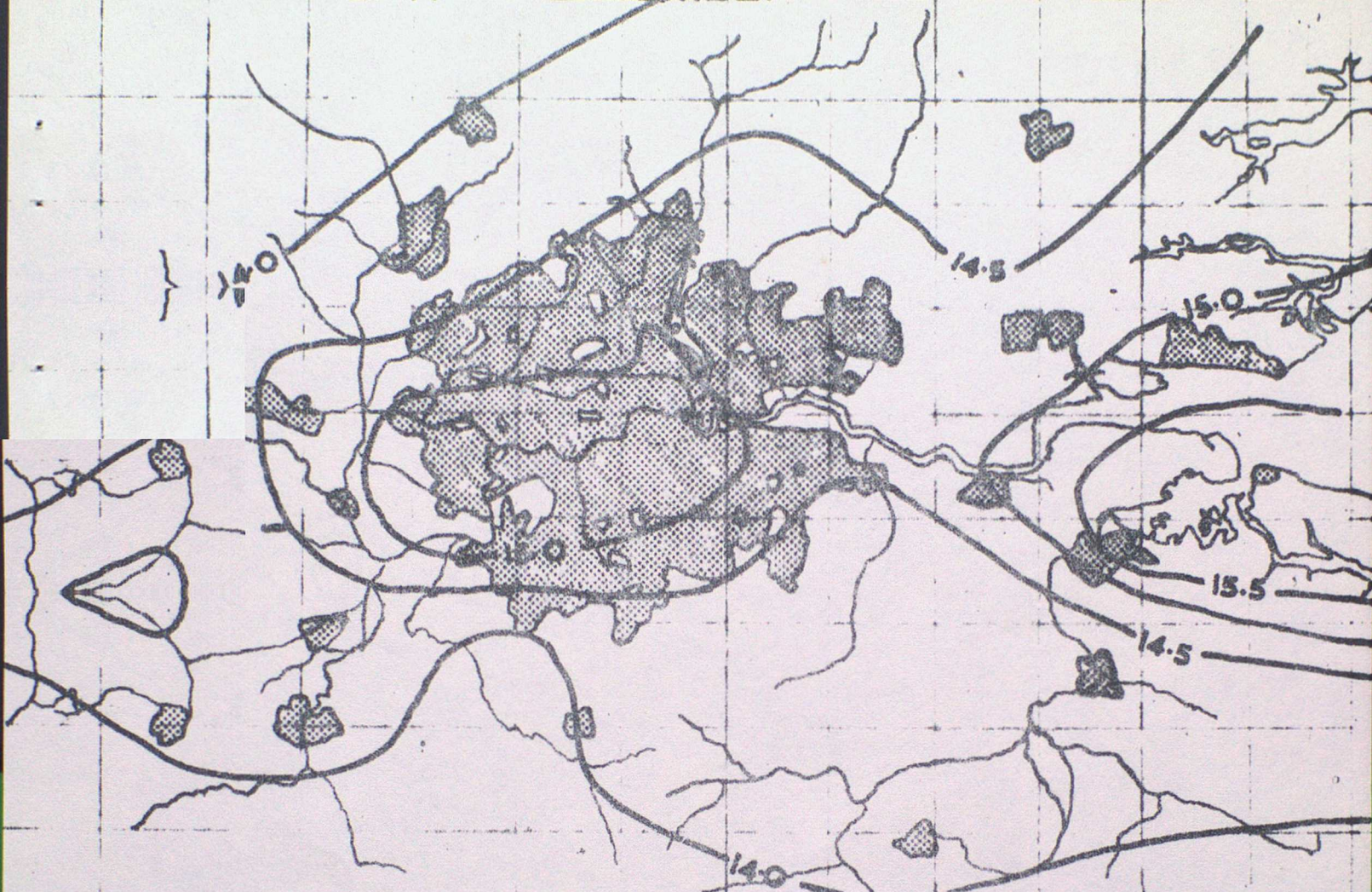
MEAN JULY



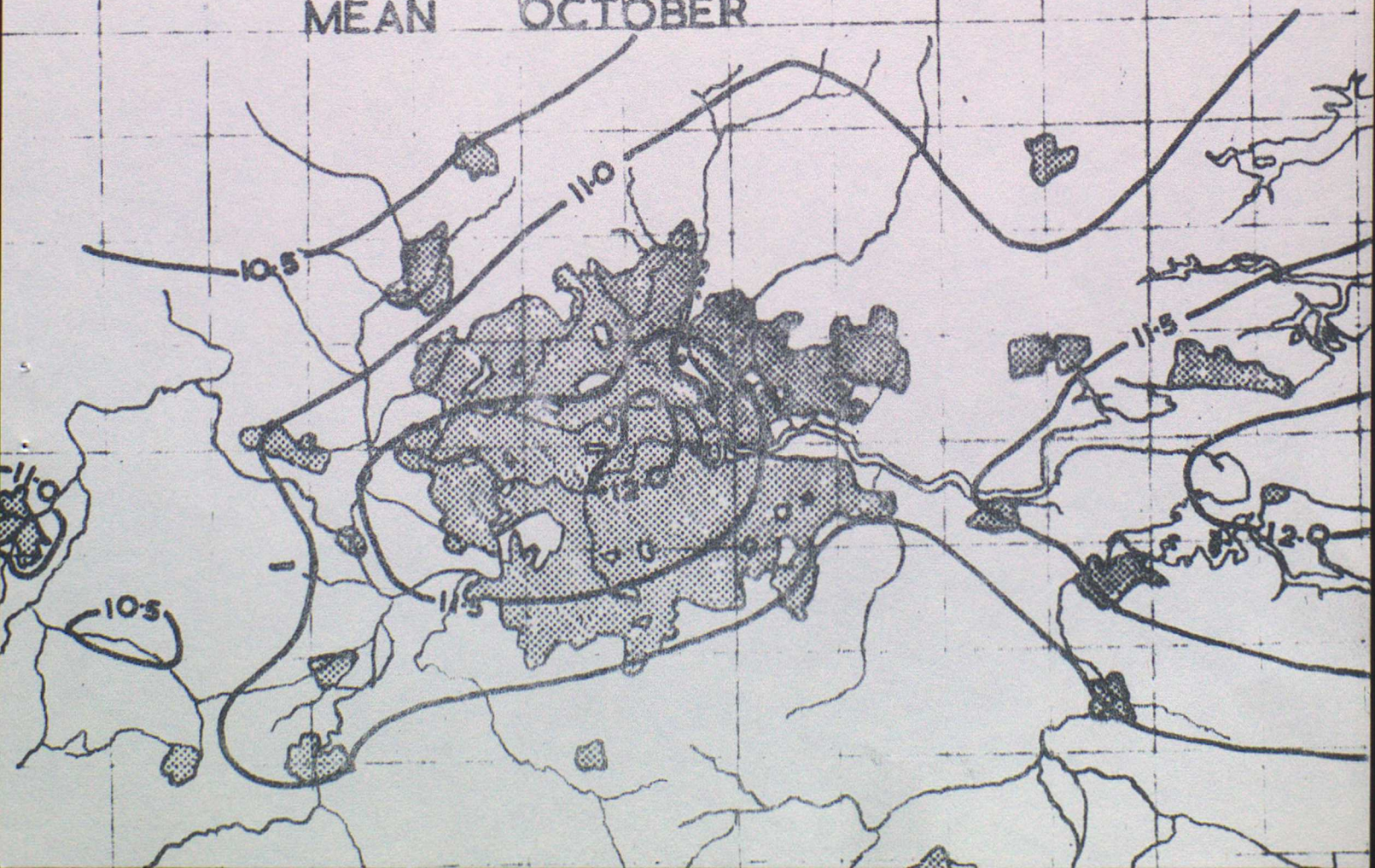
MEAN AUGUST



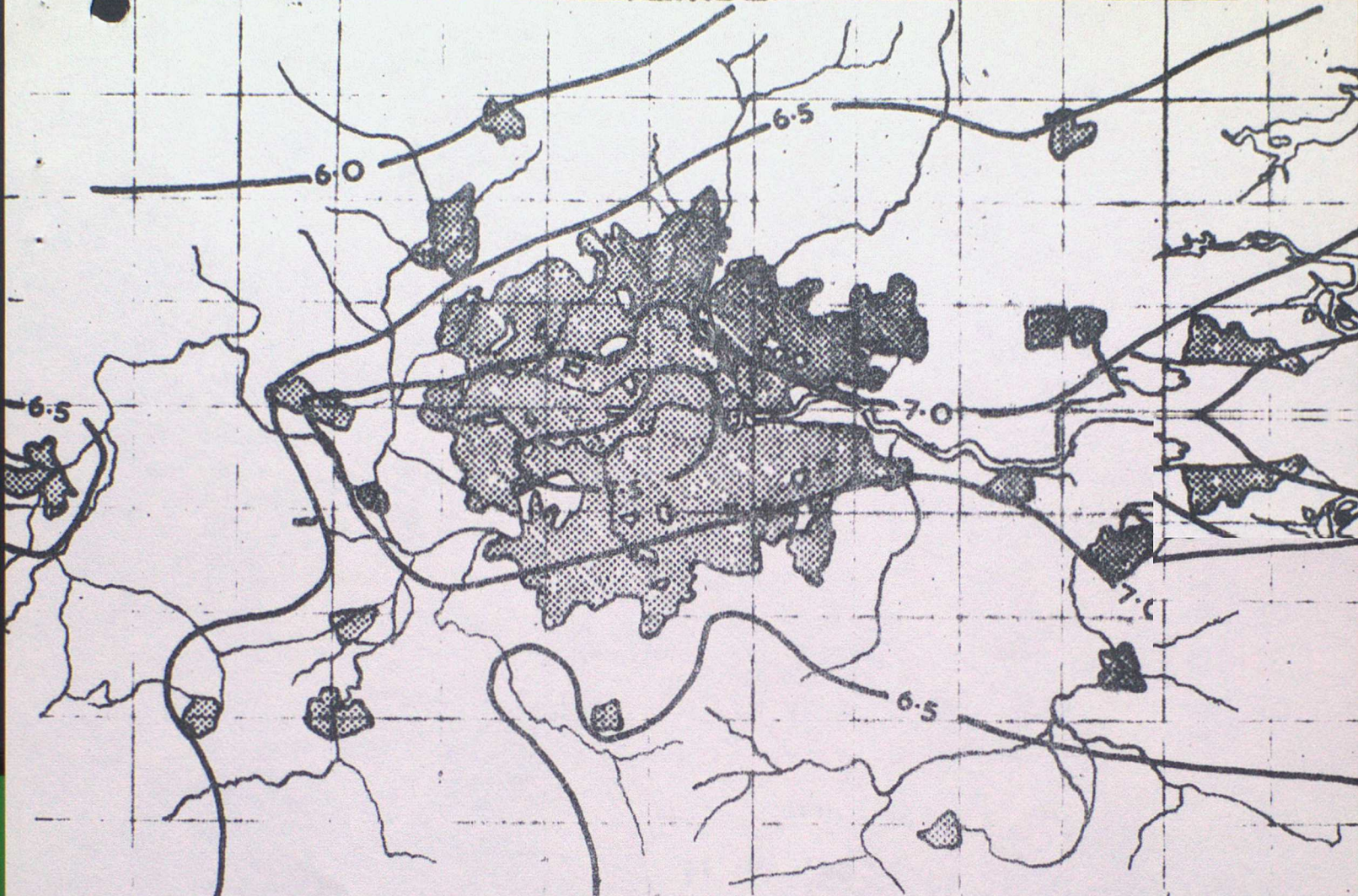
MEAN SEPTEMBER



MEAN OCTOBER



MEAN NOVEMBER



MEAN DECEMBER

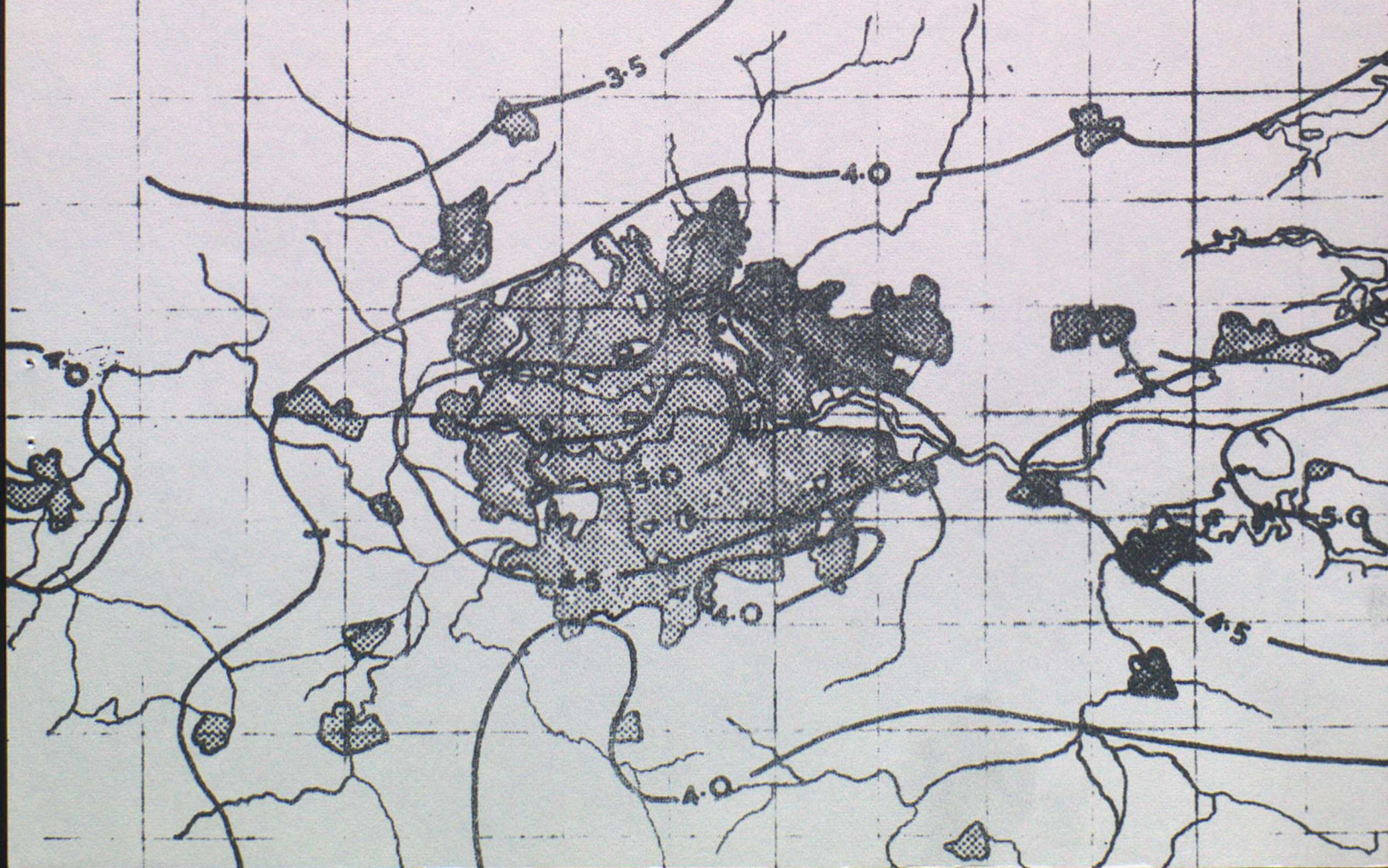


FIG. 2 SCHEMATIC TEMPERATURE DIFFERENCES.

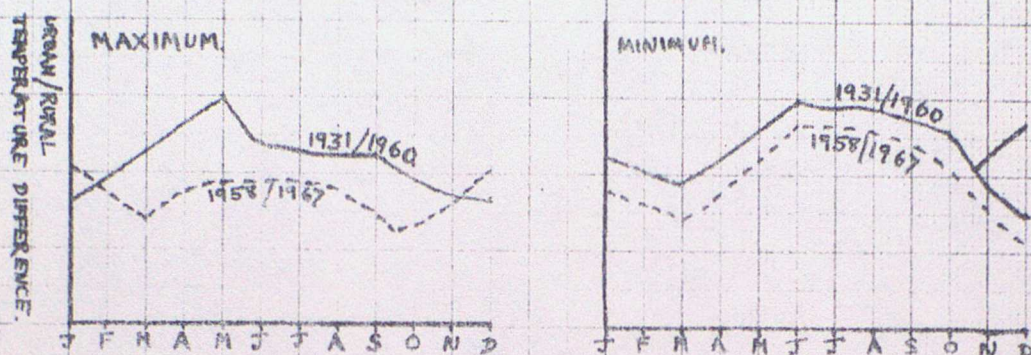
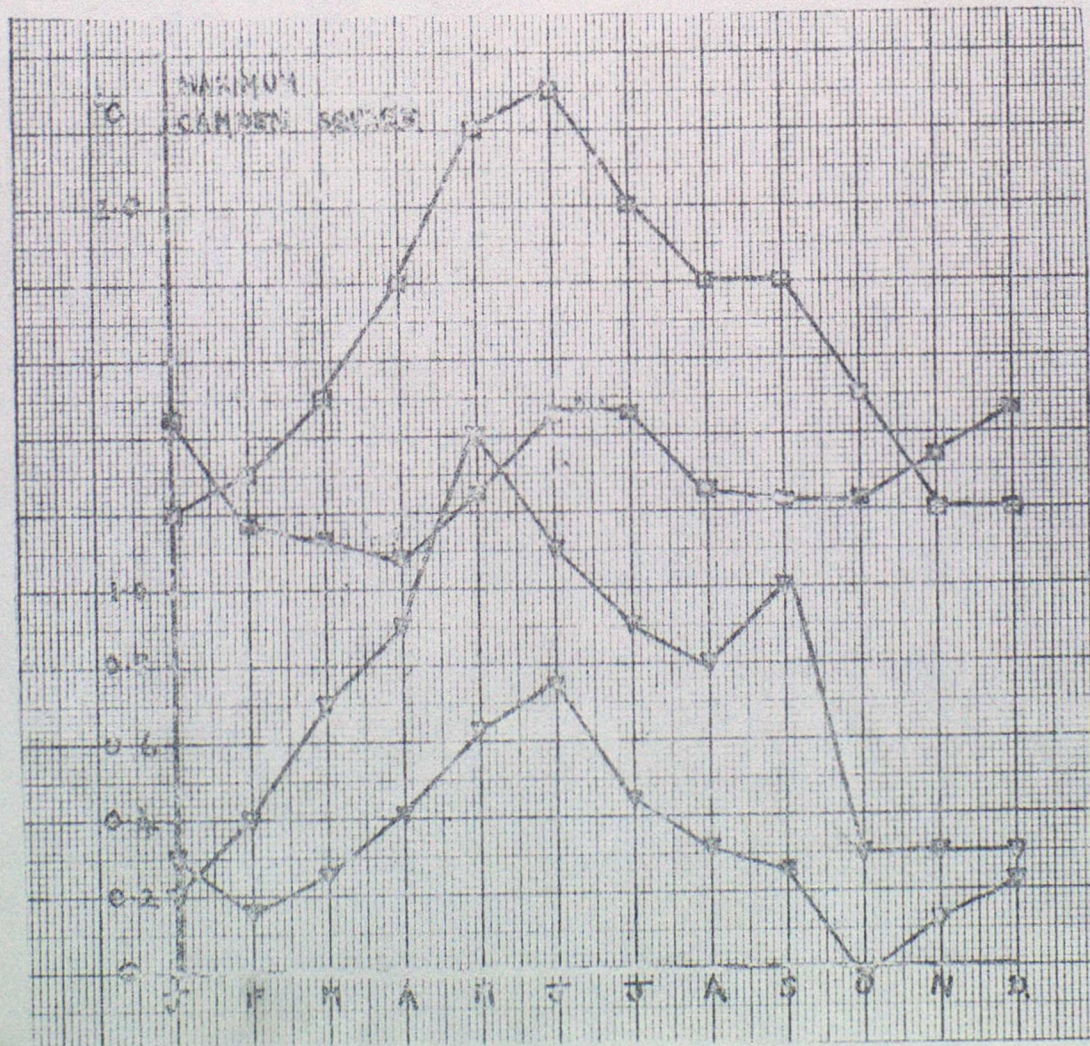
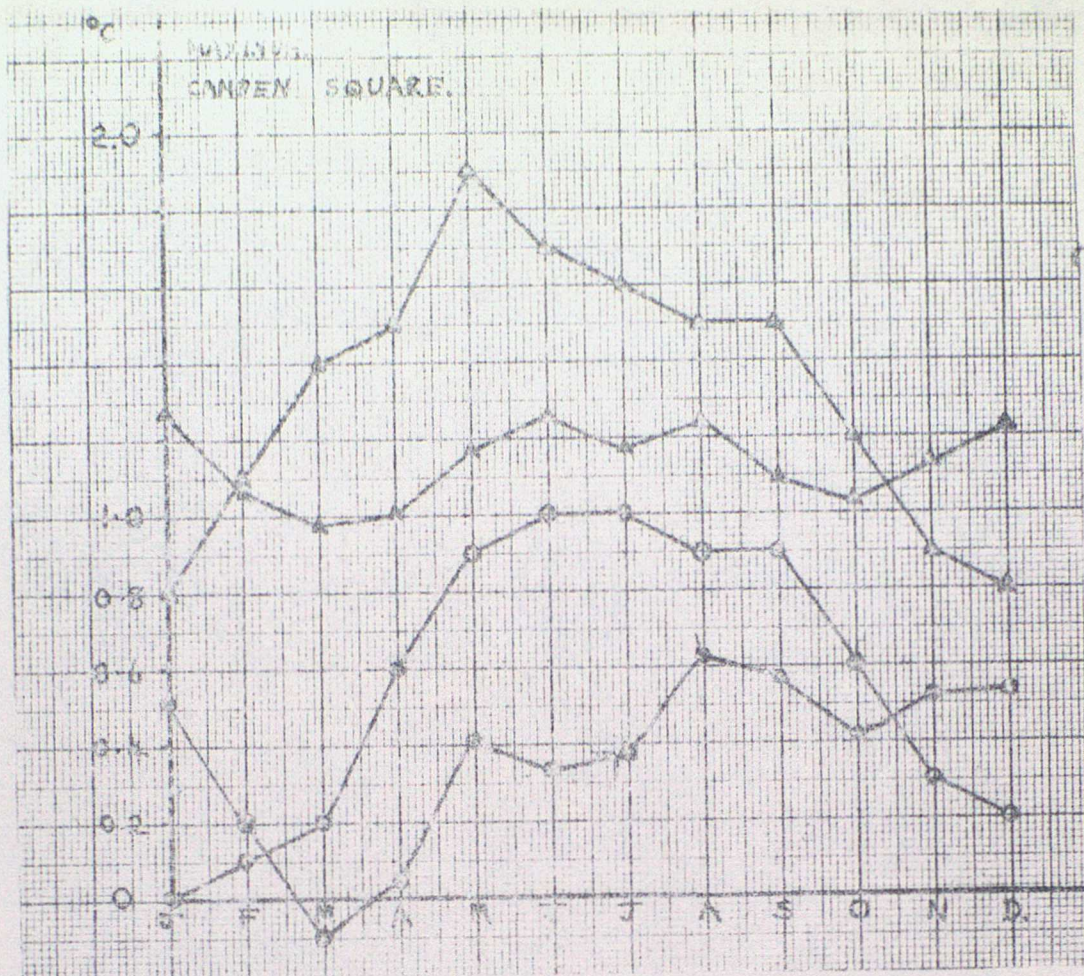


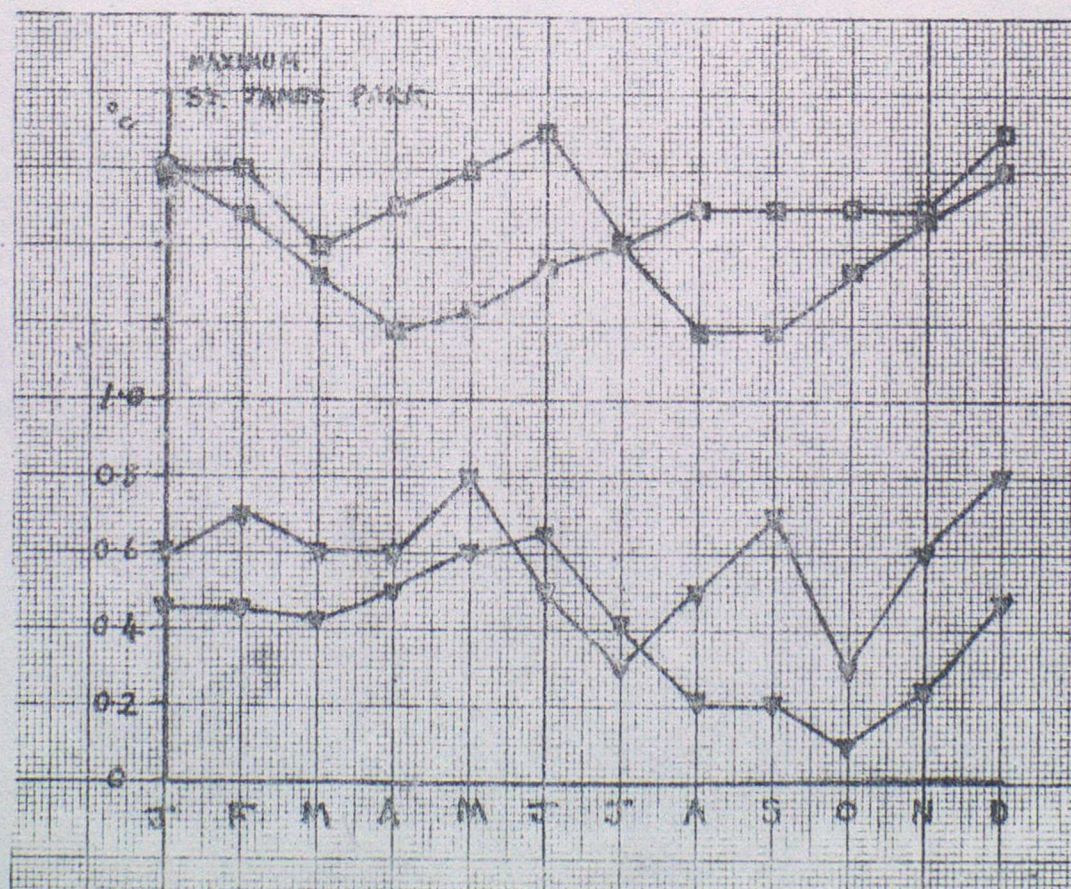
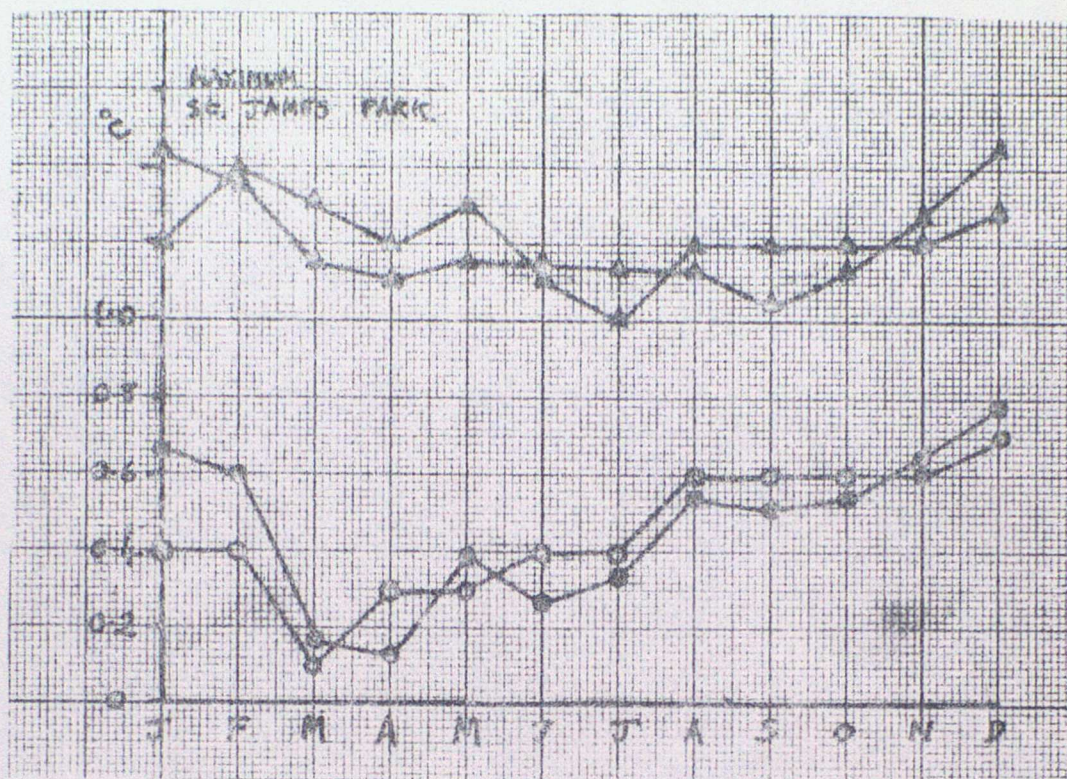
FIG. 3 GRAPHS OF TEMPERATURE DIFFERENCES.

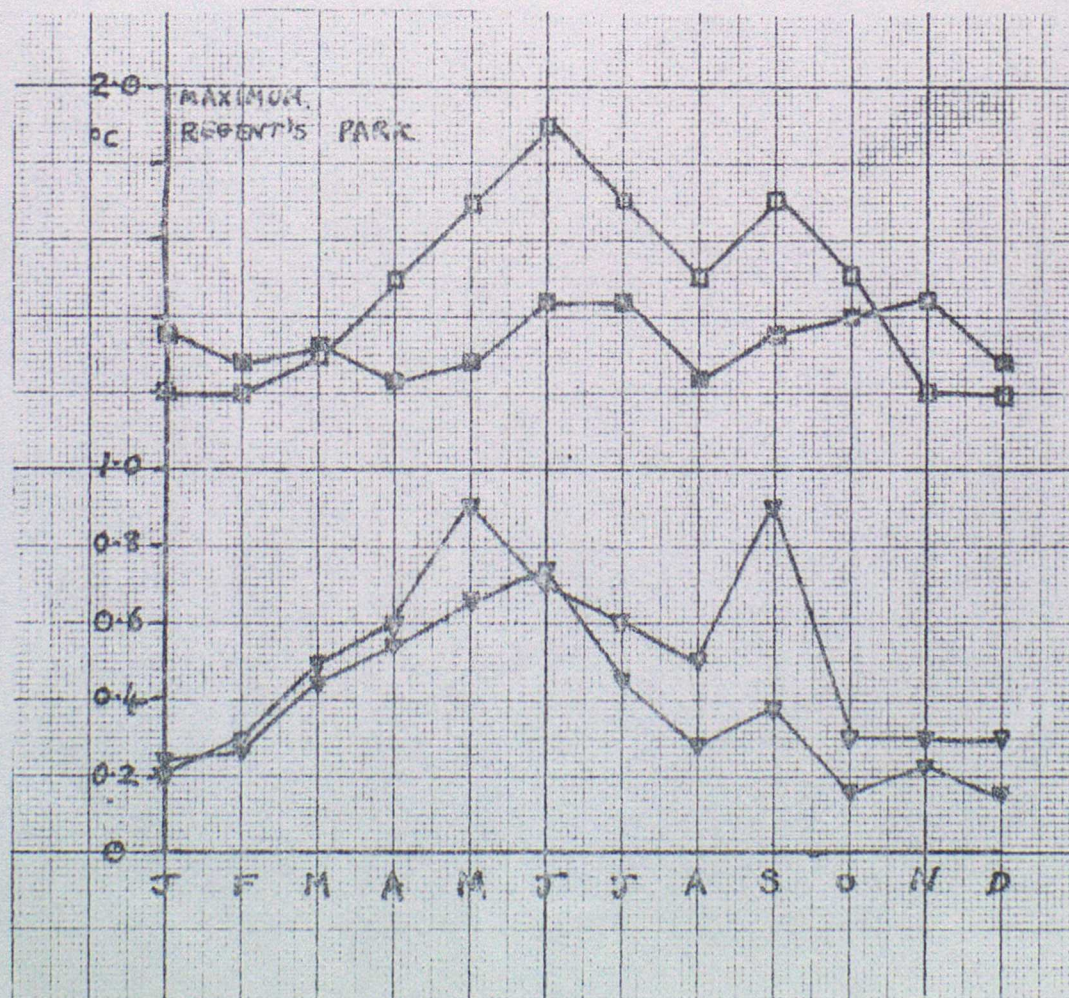
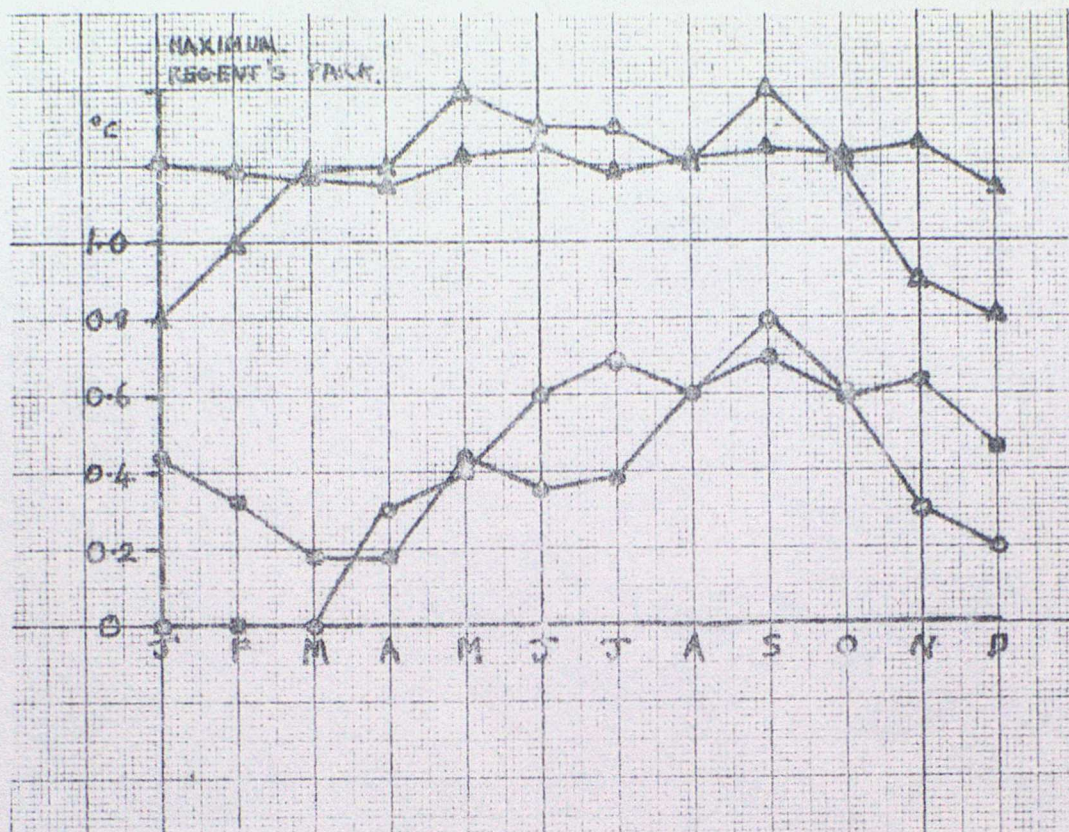
SYMBOLS USED.

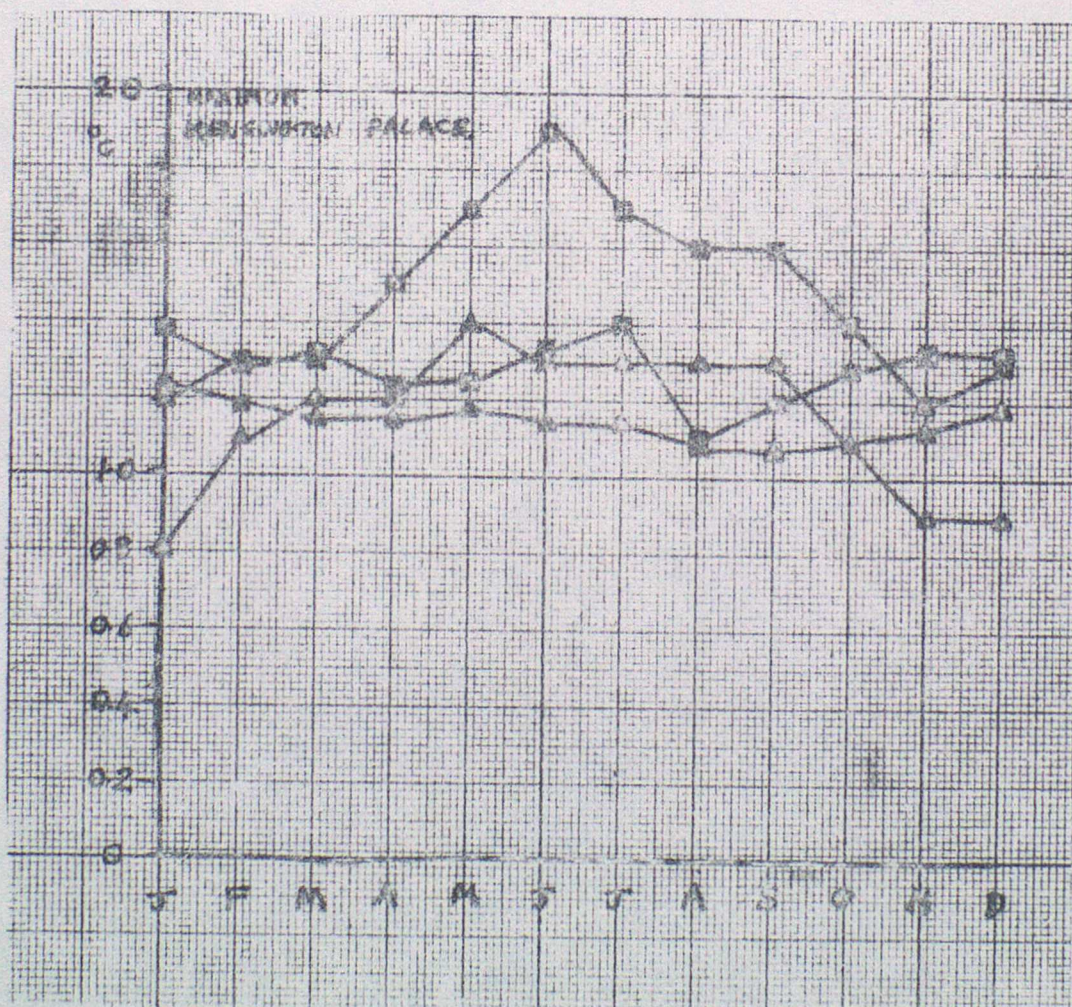
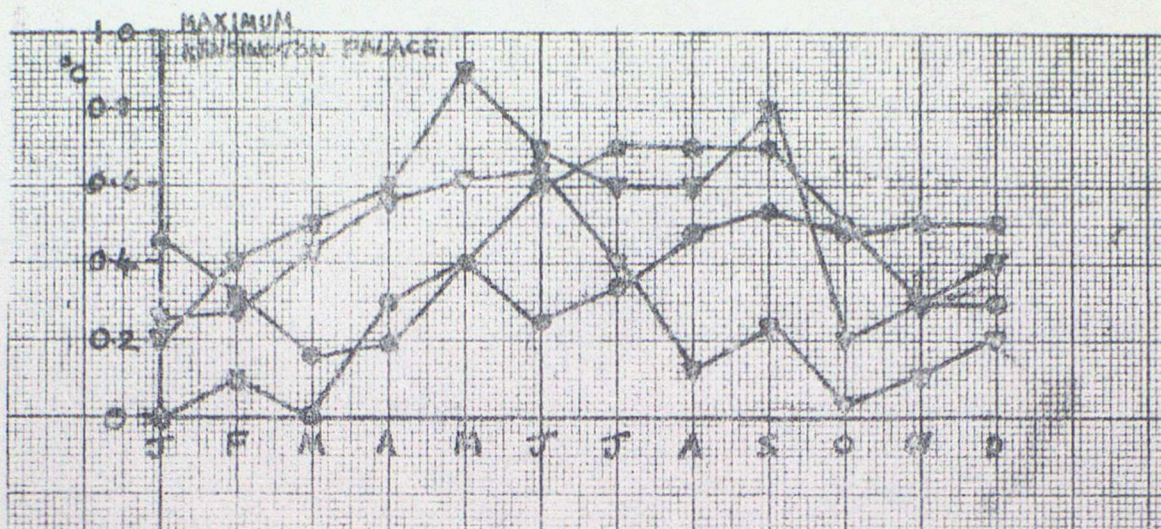
- WISLEY. 1931/1960.
- WISLEY. 1958/1967.
- ▽ EAST MALLING. 1931/1960.
- ▼ EAST MALLING. 1958/1967.
- △ ADDINGTON. 1931/1960.
- ▲ ADDINGTON. 1958/1967.
- ROTHAMSTED. 1931/1960.
- ROTHAMSTED. 1958/1967.

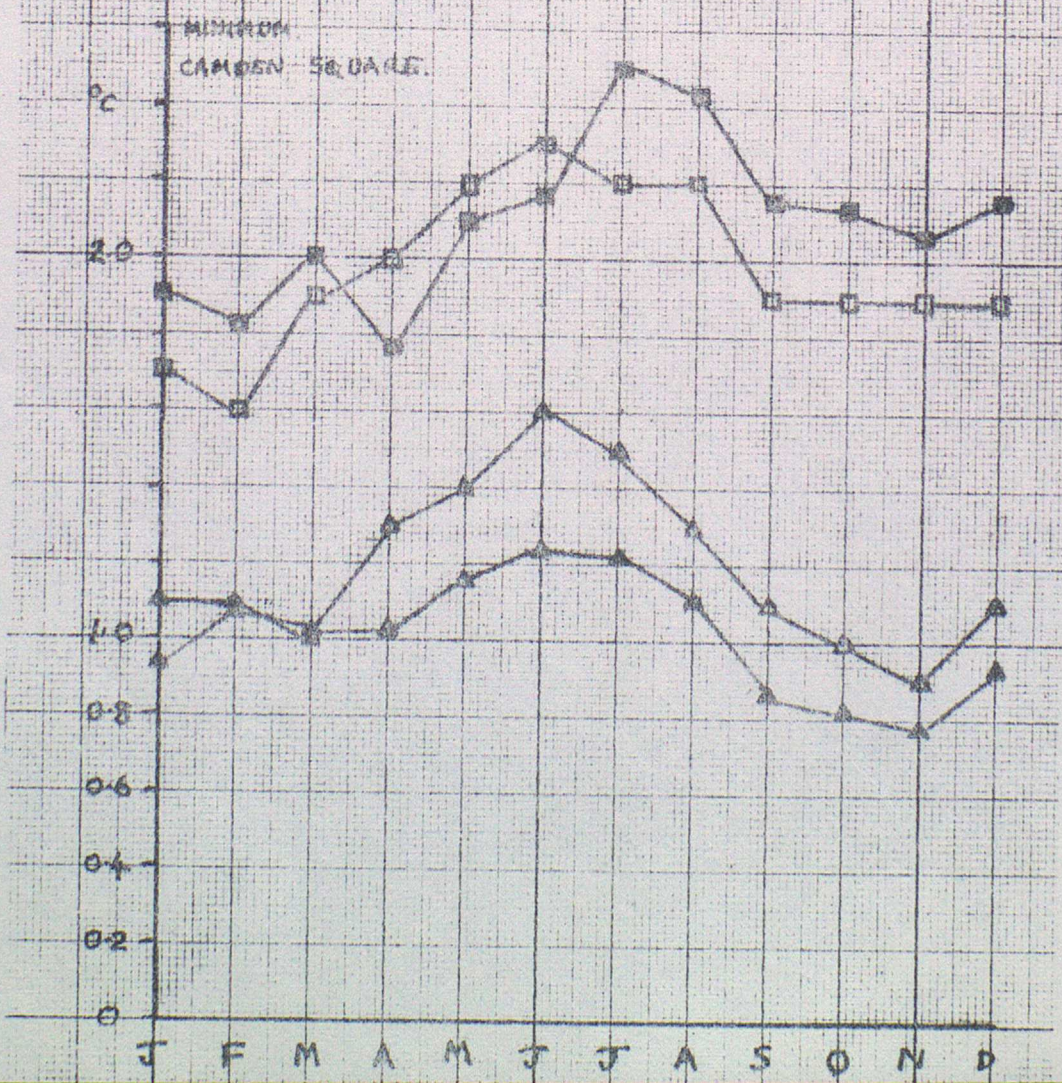
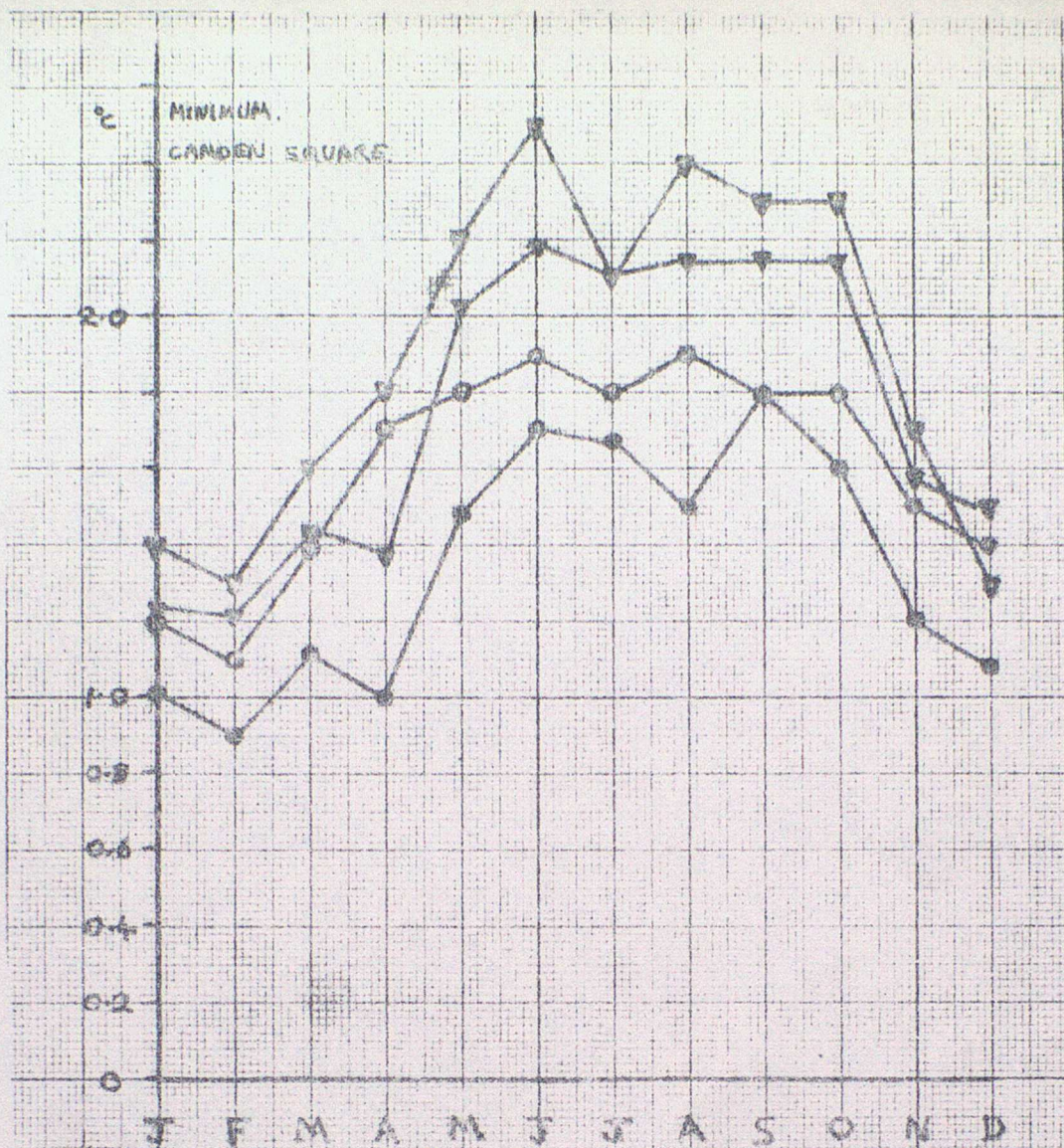
FOR EACH URBAN SITE THE TEMPERATURE DIFFERENCE (URBAN MINUS RURAL) IS PLOTTED FOR THE FOUR RURAL SITES.

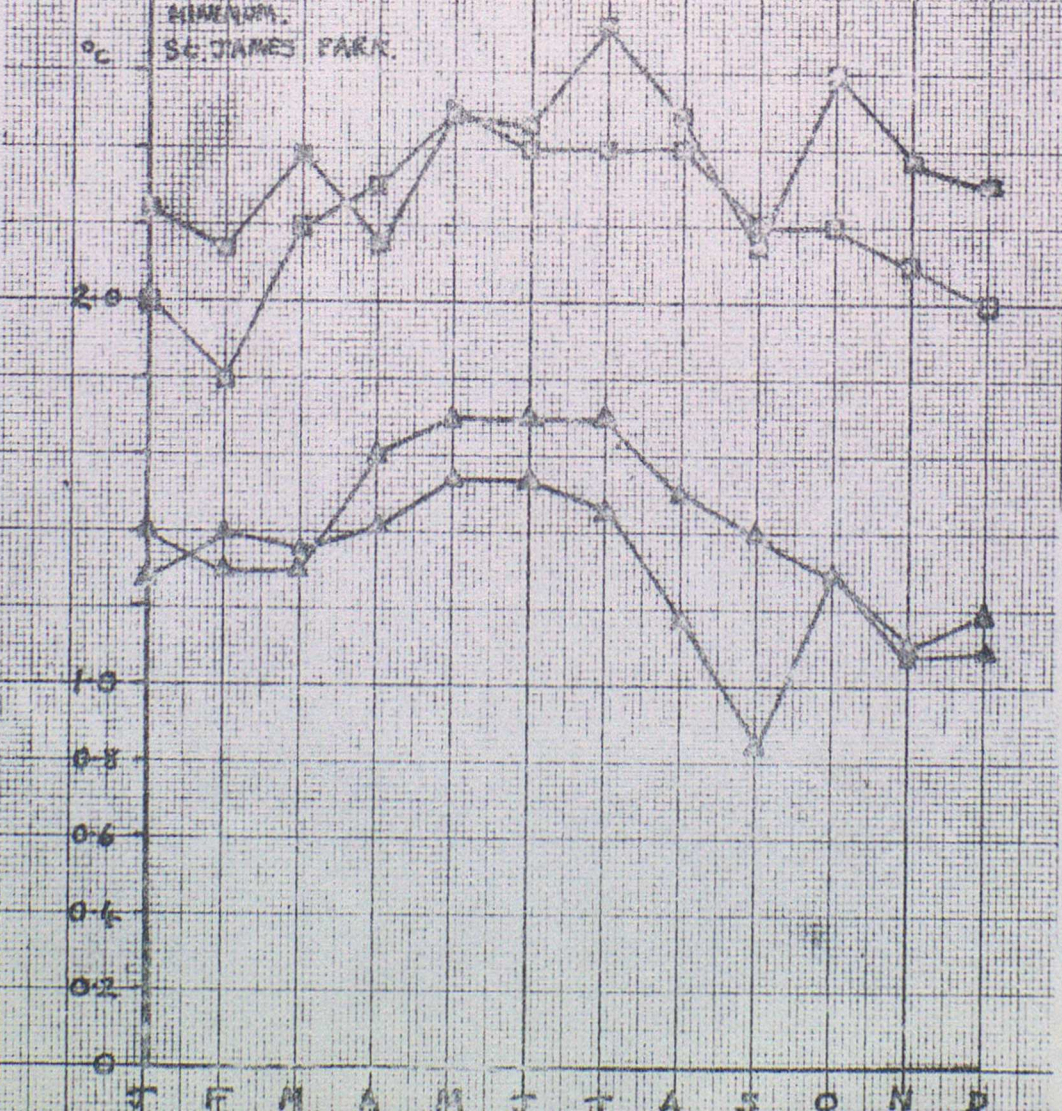
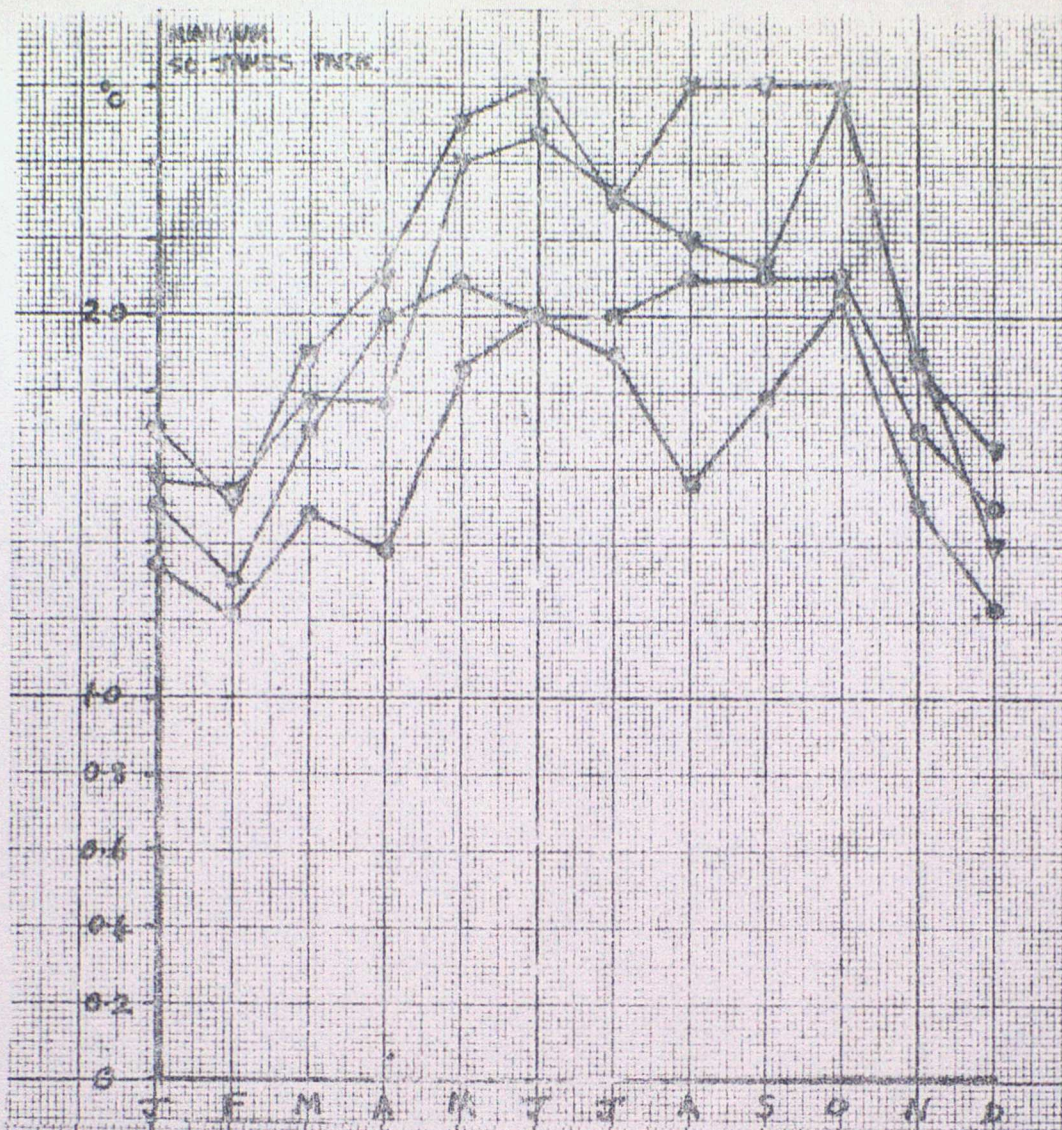


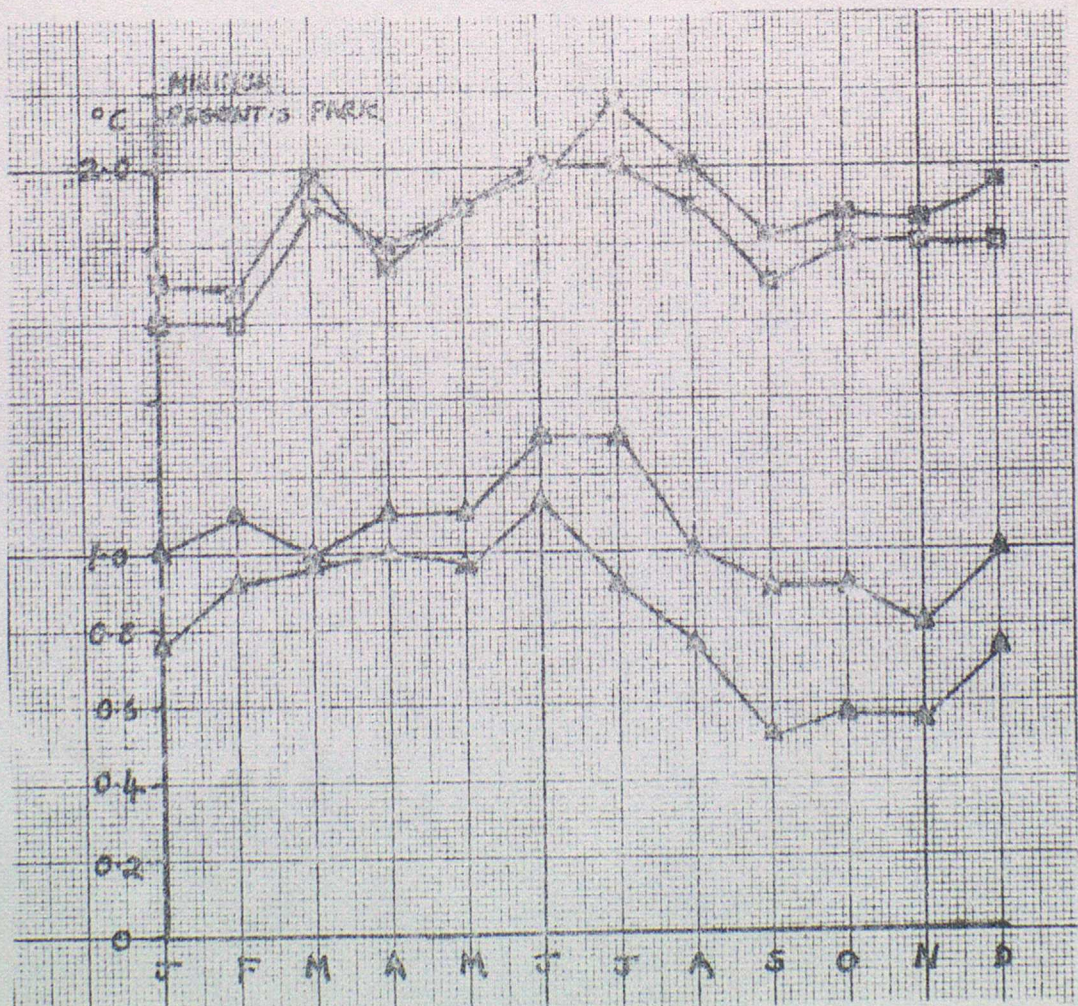
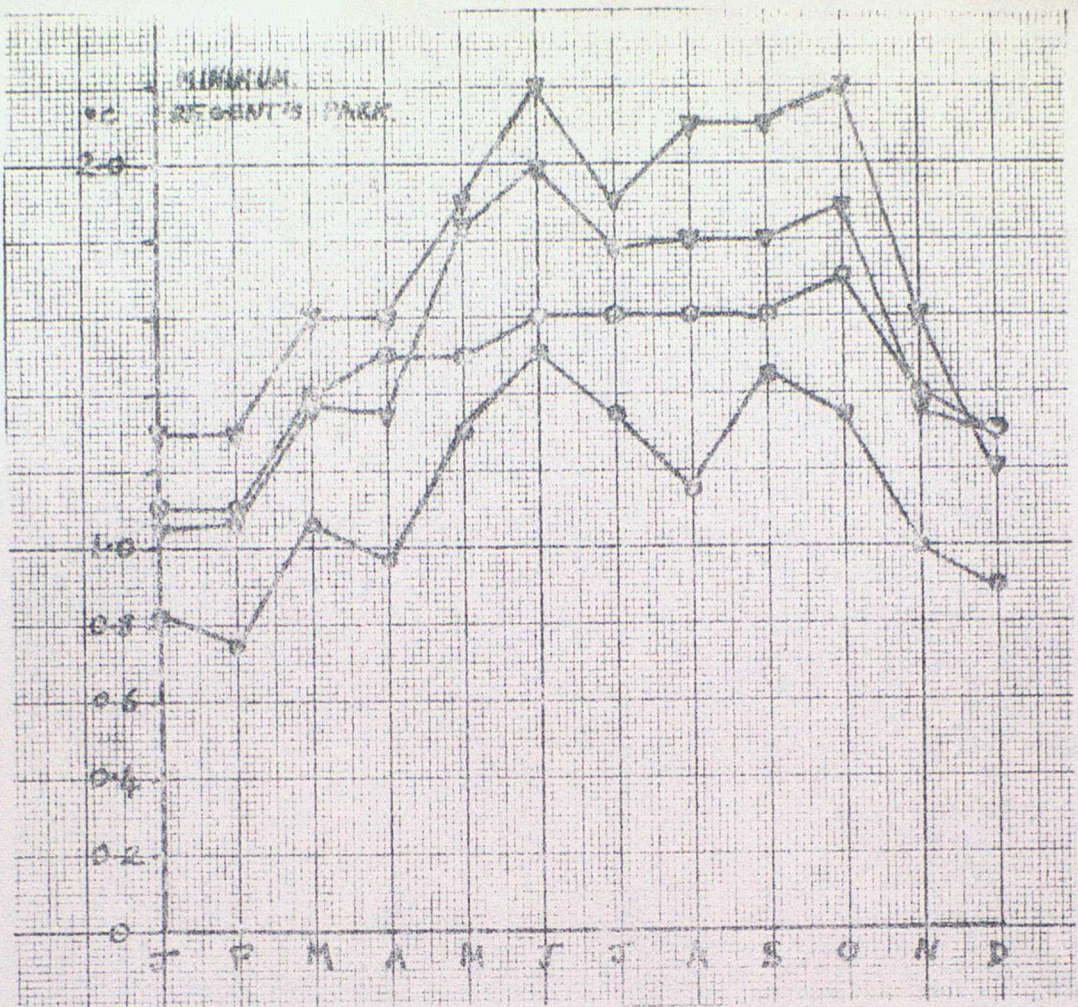


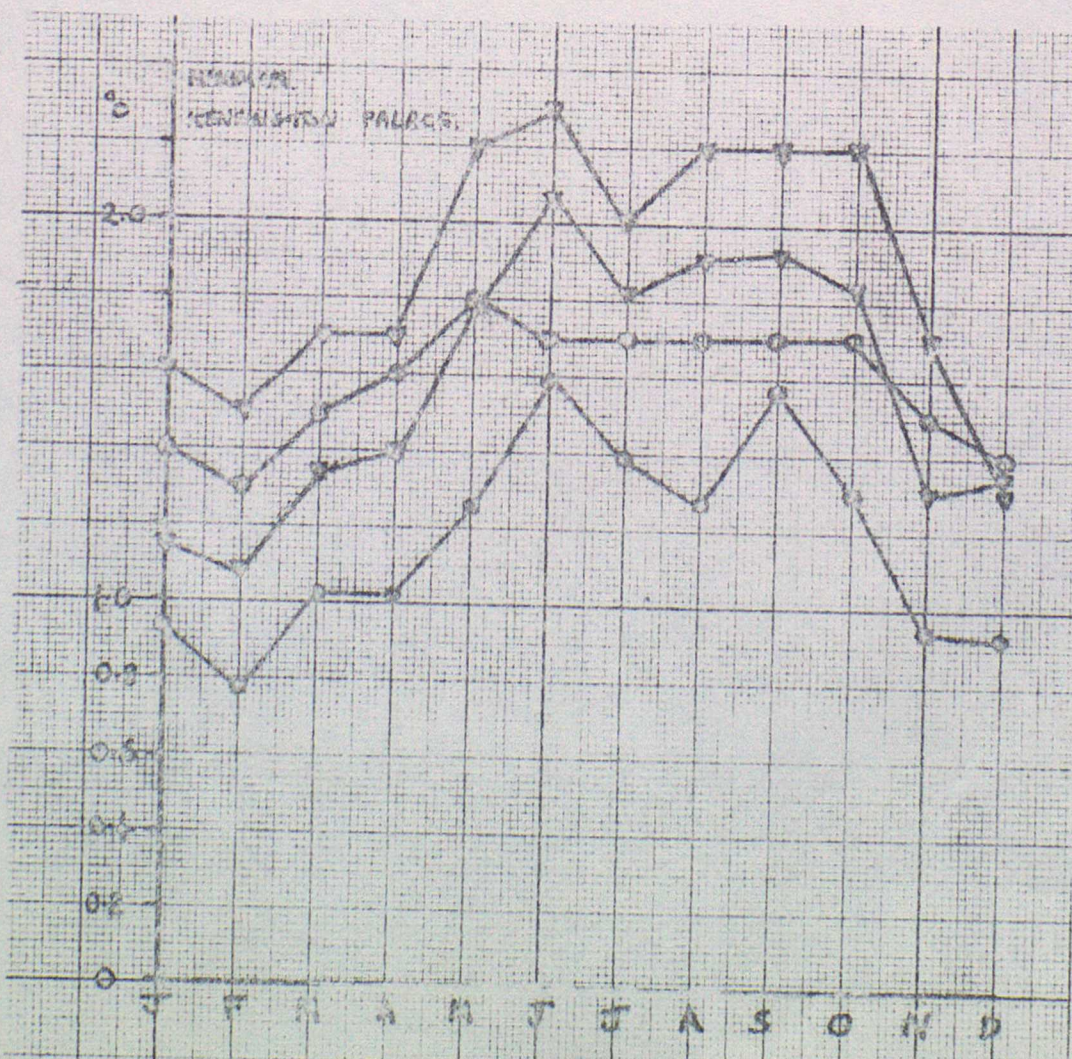
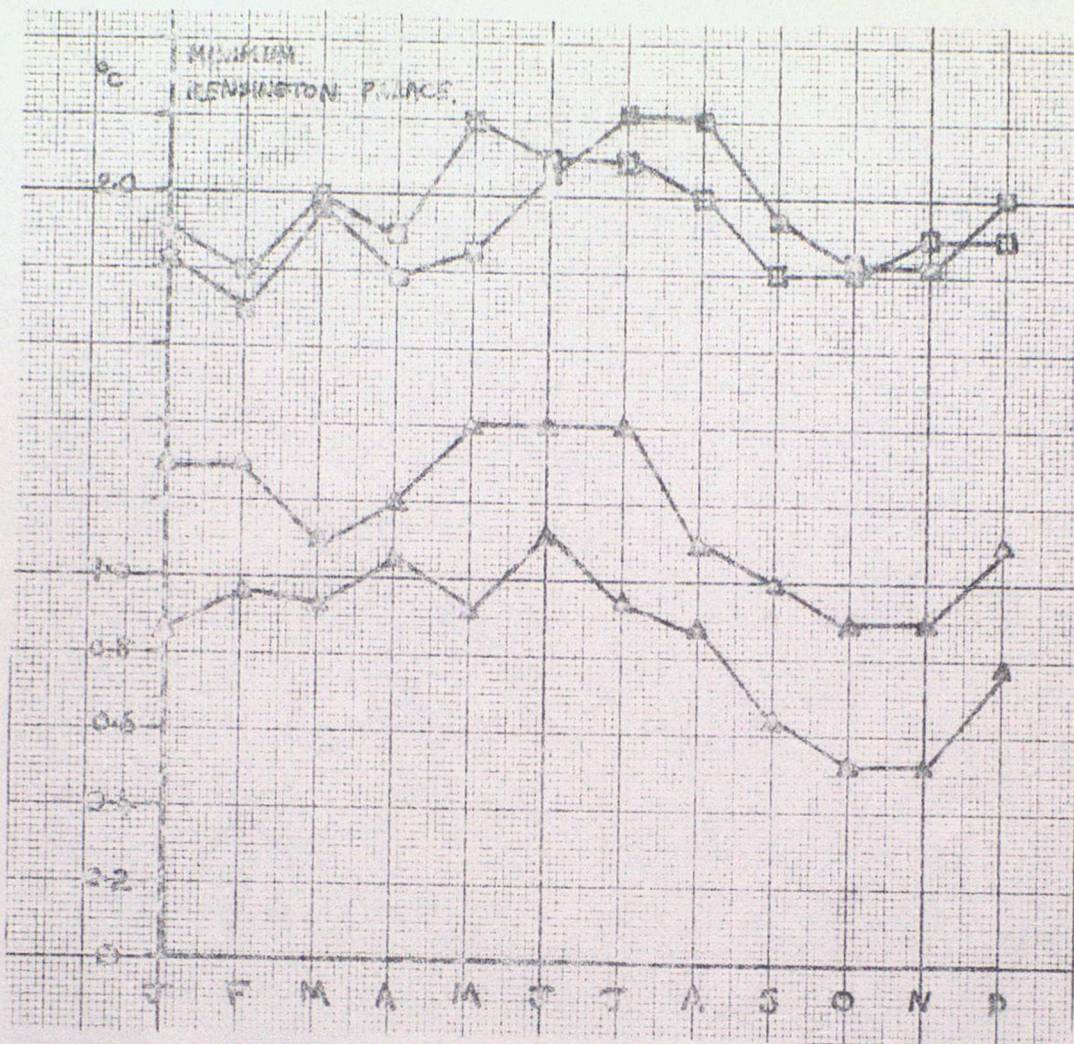












London Weather Centre Memorandum No. 17

Amendment No. 1

Please correct the following -

Page 2 line 4 for 'temperature contract' read 'temperature contrast'.

Page 4 line 3 for 'shown by linking' read 'shown by kinking'.

Page 5 line 11 for 'On table 3' read 'In table 3'.

line 17 for 'to May and June. Camden' read 'to May and June.
For Camden'.

Page 6 line 12 for 'similar to the head' read 'similar to the heat'.

Page 7 line 14 for 'marked warning' read 'marked warming'.

Page 8 line 1 for 'bases' read 'basis'.

Table 1

Swanley August maximum to read '20.91' not '20.19'.

Shinfield April minimum to read '4.60' not '4.00'.

LWC
May 1970