AN ANALYSIS OF THUNDERSTORMS AT SYDNEY.

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ABSTRACT.

R. Scherhag (1948) in "New Methods of Weather Analysis and Forecasting" gives a graph showing the thunderstorm probability at Potsdam as a function of air pressure.

The chief aim of the present analysis was to find if some useful relationship could be found between air pressure and subsequent thunderstorm activity in the Sydney Metropolitan Area. A probability curve could be used as an additional aid in forecasting these events, preferably the day before.

The occurrence of thunderstorms was analysed for the last 41 years. The M.S.L. atmospheric pressures at 9 a.m. on the days of thunderstorms were tabulated and grouped into pressure intervals. From these a graph of thunderstorm occurrences was plotted against M.S.L. pressure. For comparison, the normal pressure distribution at 9 a.m. was extracted and plotted. Curves were prepared for the months of November to January inclusive. Finally a set of probability curves were prepared from these two graphs. Air pressure is of course only one of the factors involved in the thunderstorm mechanism, and the method is tested merely as an additional aid, as stressed above.

Diagrams were prepared for the occurrence of hail in the Metropolitan Area during the same period.

When thunderstorms occur in or about a large city, considerable disruption may result to tramways, electric railways and electricity supply networks as a result of lightning strikes. The various public utilities can make arrangements for additional maintenance staff to be on duty if they can be forewarned of the likelihood of thunderstorms. For obvious reasons the general public, aviation interests, and so on, are also concerned with these storms, and any additional clue the meteorologist can use as a means of forecasting them is welcome. It should be pointed out that the graphs and tabulations were compiled for such a purpose.

The months of greatest thunderstorm activity in the Sydney area are November, December, and January.

In the discussion, a meteorological "day" is taken as the 24 hour period following 9 a.m. E.S.T., to enable the 9 a.m. pressure to be used as the indicator.

In order to include all thunderstorms which occurred in the Metropolitan area, and not only those which occurred at the Sydney Weather Bureau, all instances of "thunder head" (from the Bureau and elsewhere in the Area) and all "distant lightning" observed in the western half of the sky were grouped as actual thunderstorms. In some cases, there were records of distant lightning at night, and no mention was made of the direction. As the majority of such instances would be lightning at sea, these observations were rejected for the purposes of the graphs.

Hence, the term "thunderstorms" hereinafter refers to all reports of thunder, and also to lightning seen on or west of the coastline (but not lightning to the east of it). Most thunderstorms move into the Metropolitan Area from westward, and when such phenomena are observed to the west, they ultimately affect some part of the area. The exception is the rare occurrence of thunder and lightning of the "stream" type, moving in from the eastward, in conjunction with east coast cyclones.

The various journals, day-books, and field books were examined for the years 1912 to 1952 inclusive and tabulations of thunderstorms made of the whole period. A note was made of the time of occurrence, and then the M.S.L. pressure at 9 a.m. on the same day was listed. The M.S.L. pressure at 3 p.m. on the preceding day was also noted.

Then the relevent 9 a.m. pressures were grouped into class intervals of 1 millibar, and the number of thunderstorms in each interval plotted. This procedure was carried out for the months of November, December, and January over the 41 years. The resulting plots and curves are shown in figure 1, 11, and 111.

In order to discover how these curves corresponded to the average 9 a.m. pressure distribution for the months concerned, every 9 a.m. pressure for the 41 years was grouped into the same class intervals and plotted. This resulted in the plotted points and curves superimposed on figures 1, 11, and 111.

Features which emerge from these results are:-

(a) The peak or peaks in the thunderstorm/pressure curves are to the left, i.e. at a lower pressure than, the peak of the pressure distribution curves.

(b) The thunderstorm/pressure curves show a tendency towards more than one maximum. The significance of this is doubtful in the absence of an even larger record, particularly those maxima at lowest pressures. Here both the number of thunderstorms and pressure frequencies are small.

As mentioned above, the same data was extracted for 3 p.m. the day preceding the occurrence of thunderstorms. This curve again showed major and minor peaks, but the major peaks coincided with the mode of the normal pressure curve. Thus it was immediately concluded that pressure so far in advance was of little significance as an aid in forecasting thunderstorms. The result for January is shown in figure 1V.

Scherhag derived his probability curve from "the quotient of the number of thunderstorm days and frequency of days in which the mean pressure lies within certain ranges of pressure, in summer, as a function of pressure reduced to M.S.L. at Potsdam".

In the present work, probability curves were obtained by dividing the thunderstorm-pressure curve by the normal pressure distribution curve. The results and curves obtained are shown in Figure V.

As can be seen from figures 1 to 1V, the population of both elements is so small below 1000 millibars that the probability curves (figure V) showed frequent fluctuations and are unreliable to the left of this point.

CONCLUSION. For the months of greatest thunderstorm frequency in Sydney, i.e. November, December, and January, thunderstorms have rarely been observed following a 9 a.m. pressure above 1020 millibars. Also, above 1015 millibars the probability of thunderstorms is less than 10 per cent for the months of December and January. Between 1015 millibars and 1000 millibars the probability rises to above 20 per cent and at times above 30 per cent, the maximum probability in each case occurring well below the mode of average 9 a.m. pressure. The probability curve for November as a function of 9 a.m. pressure is a much broader one.

Hence, although some useful relationship can be obtained between 9 a.m. pressure and thunderstorm activity during the ensuing 24 hours, the relationship is not a spectacular one and there are limitations in its use for forecasting. It is again stressed that in order to use these curves the occurrence of thunderstorms must be already favoured by other meteorological considerations.

HAIL.

The number of reports of hail in the Metropolitan Area from all available sources were tabulated over the 41 years. Diagrams relating hailstorms and preceding 9 a.m. pressures were constructed for November, December, January, and February, in the form of histograms, and these are shown in Figure V. In these four months 63 reports of hail were noted over the 41 years.

In figure VI the 9 a.m. pressure intervals (in millibars and tenths) are again the abscissae, and the number of occurrences of hail for each individual month, and for the whole group of four months, shown as the ordinates.

Hail, though an important phenomenon, is not a frequent one, and perhaps because of this nothing very conclusive can be drawn from the results from the point of view of the forecaster, except to say that, other things being equal, hail is most likely to follow 9 a.m. pressures above 1002 millibars and below 1015 millibars in the months dealt with. In January it is most likely to follow 9 a.m. pressure in the range of 1002 to 1010 millibars.

The following table gives a summary for each of the four months for the period 1912-1952 inclusive, of:-

(1) The total number of reports of "Thunder heard" in the Metropolitan Area. Column 1.

(2) The total number of reports of "Thunder heard" PLUS those of lightning seen west of the coastline (Metropolitan Area). (i.e. the thunderstorm occurrences used in the graphs). Column 2.

(3) The total number of reports of hail (Metropolitan Area). Column 3.

The 41 year monthly averages are taken out for items (1) and (2).

November			December			January			February		
(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
Totals 41 years											
160	171	24	164	196	11	143	168	22	110	136	6
Average											
4.0	4.2	--	4.0	4.6	--	3.5	4.1	--	2.7	3.3	--

Although data was extracted for all other months over the 41 year period, it was decided that it was insufficient to justify analysis, occurrences of electrical storms and hail being so much less frequent.

REFERENCE

SCHERHAG, R. 1948 "New Methods of Weather Analysis and Forecasting" (roneoed extracts from an English (translation, distributed by (C.W.B. Melbourne 1952

SOCIAL ITEMS (continued)

Since the last number of A.M.M., C.W.B. has lost two of its most charming adornments in the persons of DOROTHY ROYLE, of Drafting Section, who became Mrs. Michael Parkes in November 1953 and DOROTHY BURKE of Typing whose marriage will be celebrated at the end of January. Though he doesn't quite qualify for the role of charming adornment, and in any case will not be lost to C.W.B., HUGO CARRIGG of Staff Section is another who will be plunging into the matrimonial seas in January, following in the wake of CEDRIC FOSTER whose wedding took place in December.

The stork has not been inactive during the last few months of 1953 and congratulations are due to the following members of the staff on the acquisition of children of the sex specified :- ARTHUR WOOLCOCK (daughter) VIN PYE (daughter) TONY POWELL (son) JULIAN CLIFFORD (son).

Figure I - 9 A.M. PRESSURES IN RELATION TO THUNDERSTORM ACTIVITY DURING THE FOLLOWING 24 HOURS.
November 1912 - 1952.

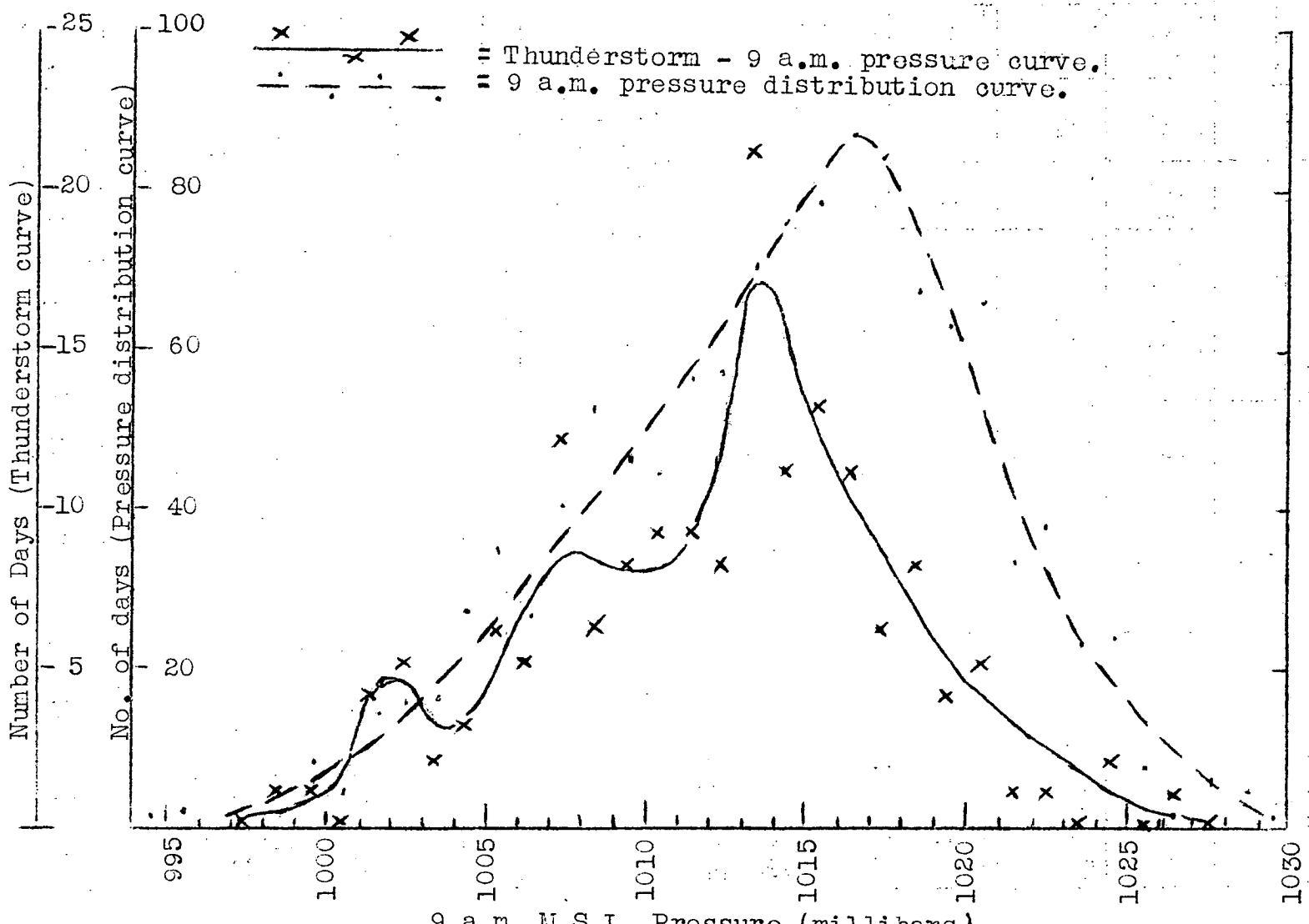


Figure II - 9 A.M. PRESSURES IN RELATION TO THUNDERSTORM ACTIVITY DURING THE FOLLOWING 24 HOURS. December 1912 - 1952.

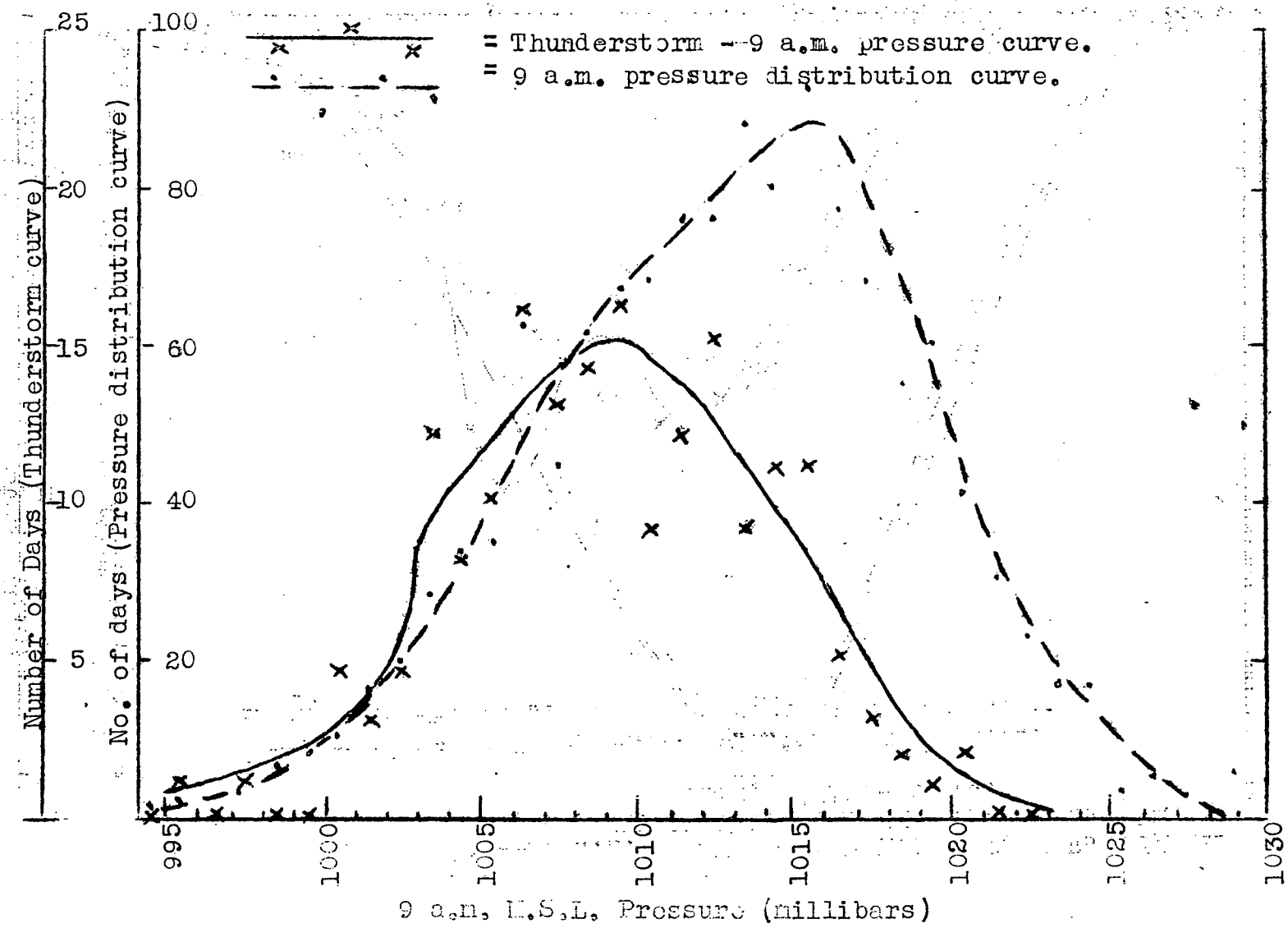


Figure III - 9 A.M. PRESSURES IN RELATION TO THUNDERSTORM ACTIVITY DURING THE FOLLOWING 24 HOURS.
January 1912 - 1952.

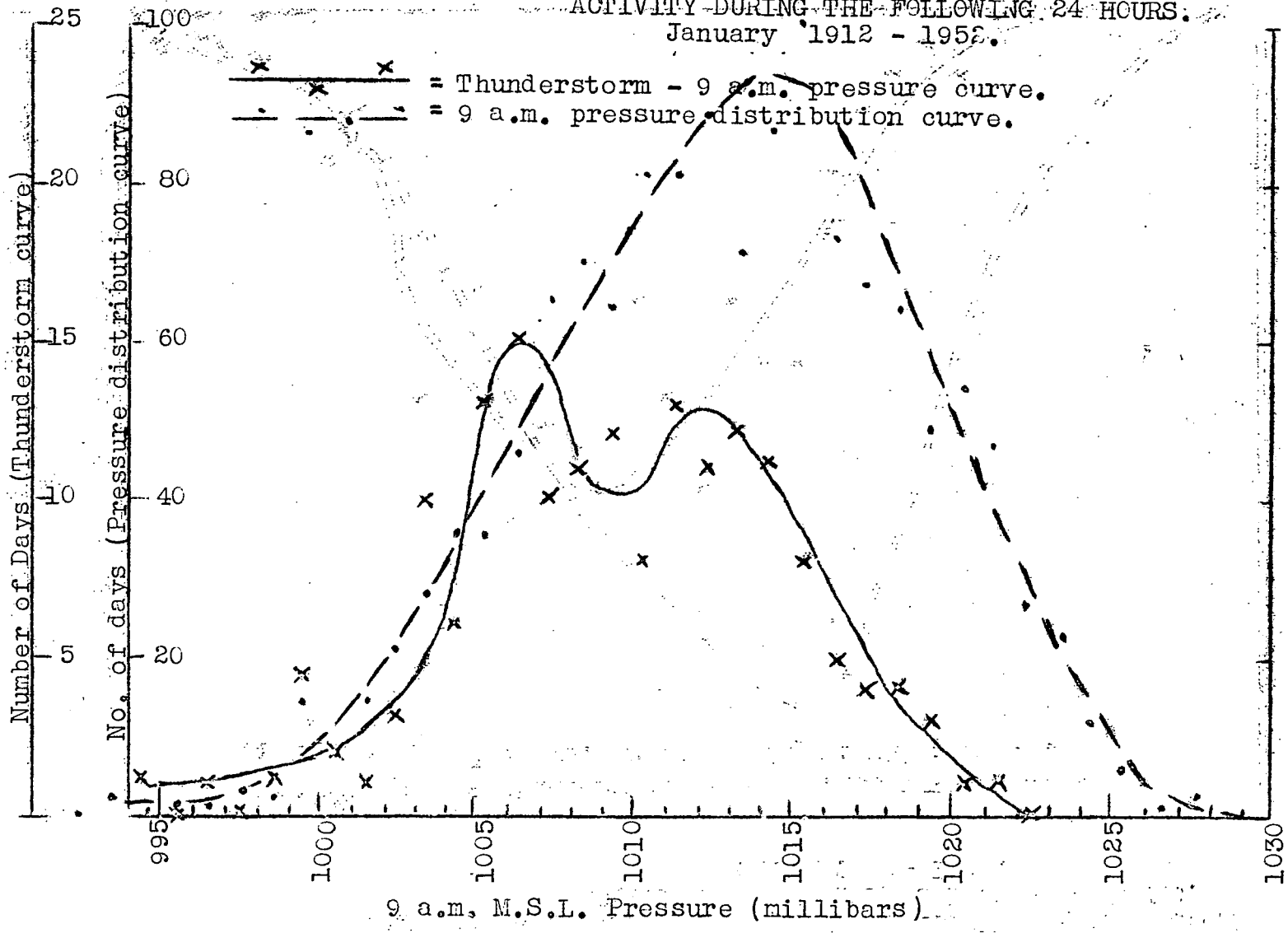
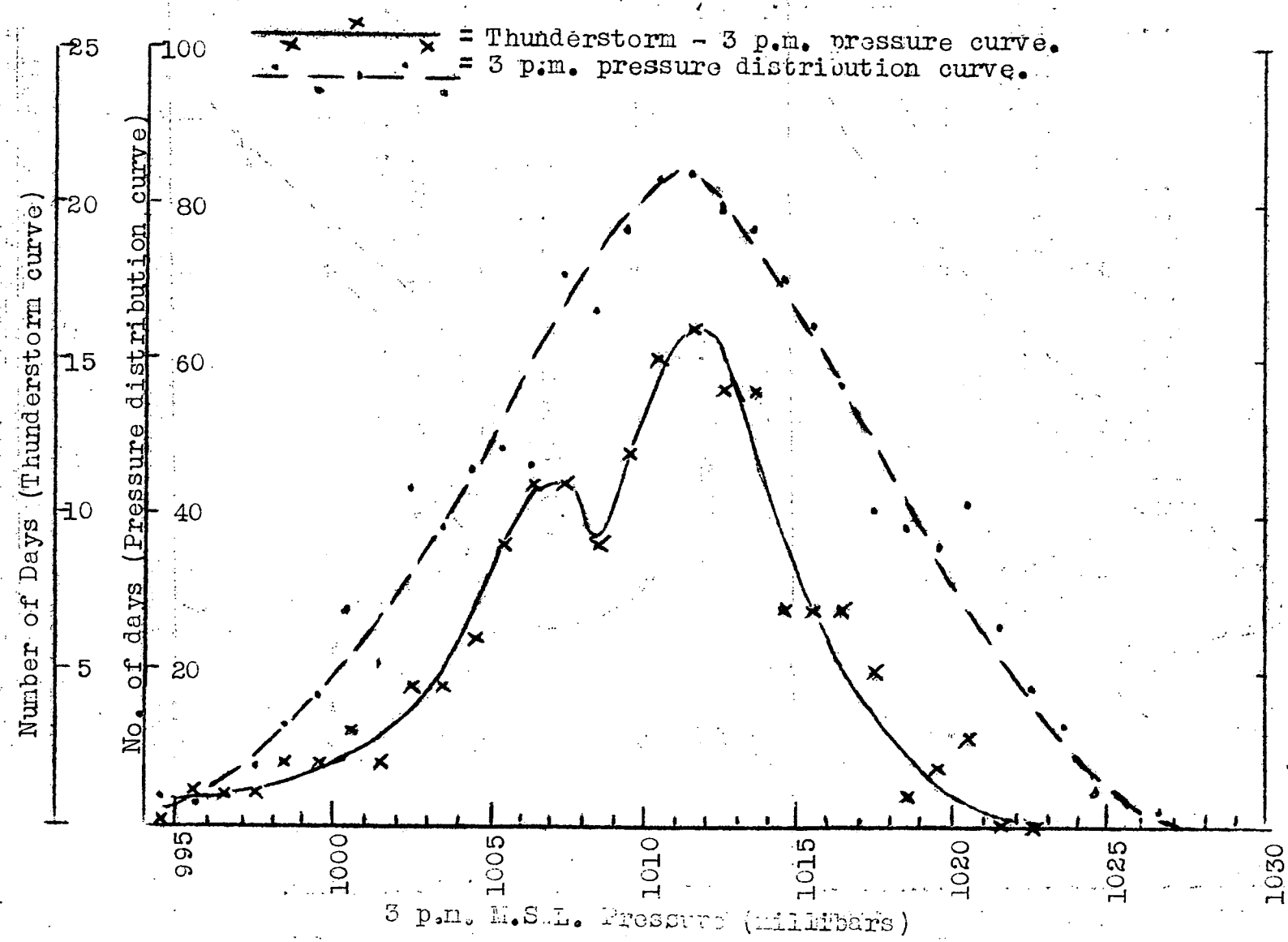


Figure IV - 3 P.M. PRESSURES IN RELATION TO THUNDERSTORM ACTIVITY DURING THE FOLLOWING 24 HOURS.
January 1912 - 1952.



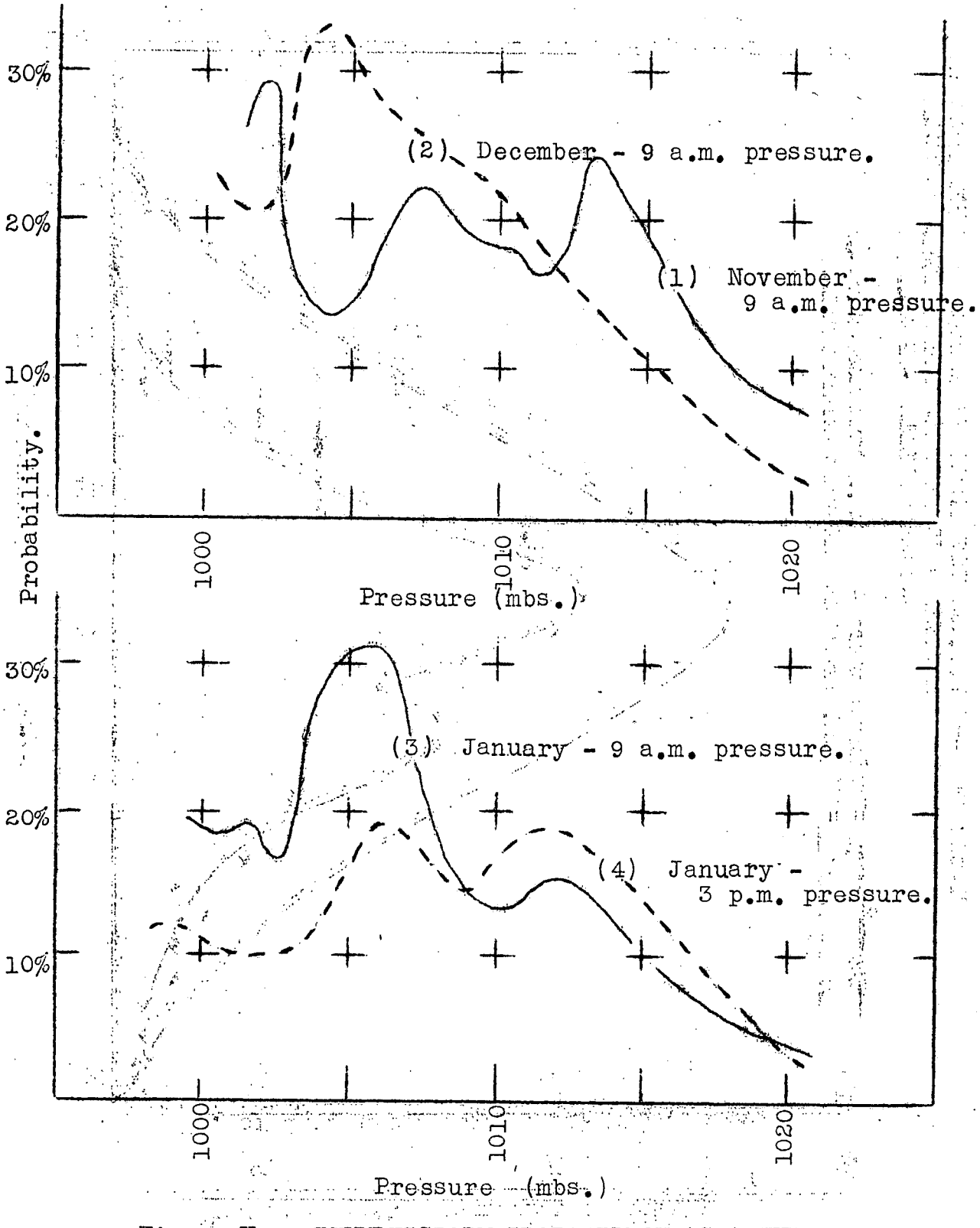


Figure V - THUNDERSTORM PROBABILITY AS A FUNCTION OF M.S.L. PRESSURE.

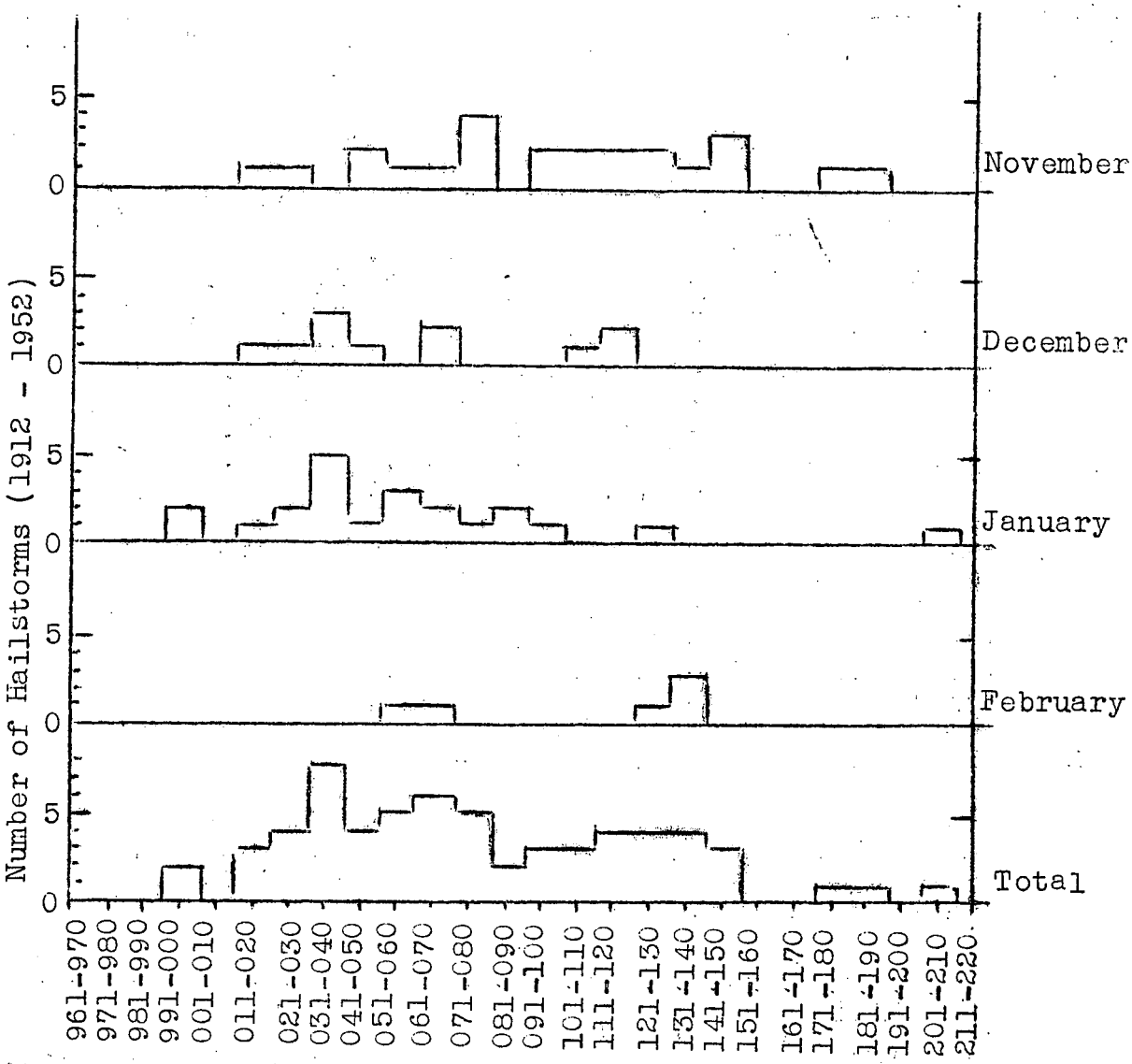


Figure VI - HAILSTORM - 9 A.M. PRESSURE DISTRIBUTION.