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THUNDER DAYS IN AUSTRALIA

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Abstract: A thunder day map of Australia, based on five years (1954-58 inclusive) of record, shows peak incidence of 80 days per annum in the Darwin area with a secondary peak of 60 in the south-east corner of the Gulf of Carpentaria. High incidence is noted from this area southeastward, where an isobaric trough is a common feature of daily weather maps. In the tropics incidence is much higher on the western coasts than in the east, but south of the tropic this is reversed.

Approximately 700 of the 1000 stations supplying data were considered reliable enough for use in preparing the map.

Superimposed histograms for a selection of longer term records show that summer is the main thunderstorm season, except in the southwest corner of the Continent where winter fronts and troughs lead to approximately twice as high an incidence in winter as in summer.

1. INTRODUCTION

In 1953 the Insulation Co-ordination Committee (Technical Committee No. 8) of the Electricity Supply Association of Australia requested the co-operation of the Bureau of Meteorology in preparing an up-to-date thunder day map of Australia.

Although a variety of stroke counters has been designed, as yet no reliable instrumental measurement of the frequency or intensity of lightning strokes to ground is available. Also, although it is well known that there are marked differences in the intensity of thunder-storms, no simple observational procedure by which storms can be classified has been devised. Isoceraunic level, or days per annum of audible thunder, is the accepted basis for determing protective design against lightning strike for high tension transmission lines. With the rapid expansion of grids in Australia, such information is becoming of increasing economic importance.

It was also considered that some indication of seasonal distribution would be valuable as maintenance and servicing procedures are planned to aim at a minimum of loss through weather effects. Monthly histograms for selected stations with longer periods of reliable record than five years were considered a satisfactory means of presenting this information.

PLANNING REPORTS

To ensure as wide a cover of observing points as possible and maximum reliability, willing observers were obtained through a number of sources. The Bureau of Meteorology circularised voluntary rainfall observers whose returns were of high standard and obtained thunder day reports from the gratifying number who were willing to undertake this five year commitment. The Electricity Supply Association of Australia, through State Committees, obtained reports from Electrical Authority employees, Forestry Department employees and other Governmental and private workers. The number who faithfully sent in returns each month for the full five-year period was very pleasing and their co-operation evidences a high measure of public-spiritedness. Returns from Bureau of Meteorology staffed stations and from allowance stations were also used. By the end of the period between 900 and 1000 records were available and of these all except approximately 200 were deemed useful. Even so, this represents only one observing point per 4000 square miles.

PROCEDURE

Bureau of Meteorology data was collated in the Statistical Section of the Bureau and results passed to State E.S.A.A. Committees who collected other reports direct and each year arranged tabulations of all data for their State. At the end of 1954 a thunder day map for that year was drawn at the Bureau and it was evident that a most useful product would eventually be forthcoming.

In 1959 each State Committee prepared and forwarded to the Bureau its completed five year tallies, with comment where possible on the quality of data, and a draft thunder day map was drawn. This was discussed fully at the 1959 meeting of Committee No. 8 and the most effective presentation decided. At the same time each State Committee took a map for study and later forwarded comment from local experience and consideration of incomplete but valuable data. This purely constructive criticism was received during early 1960 and used in revising the draft map. The final thunder day map is shown in Fig. 1 and monthly histograms for selected stations in Fig. 2 and 3.

AVERAGE ANNUAL THUNDER DAY MAP OF AUSTRALIA

(Means based on 5 years 1954–8 inclusive)

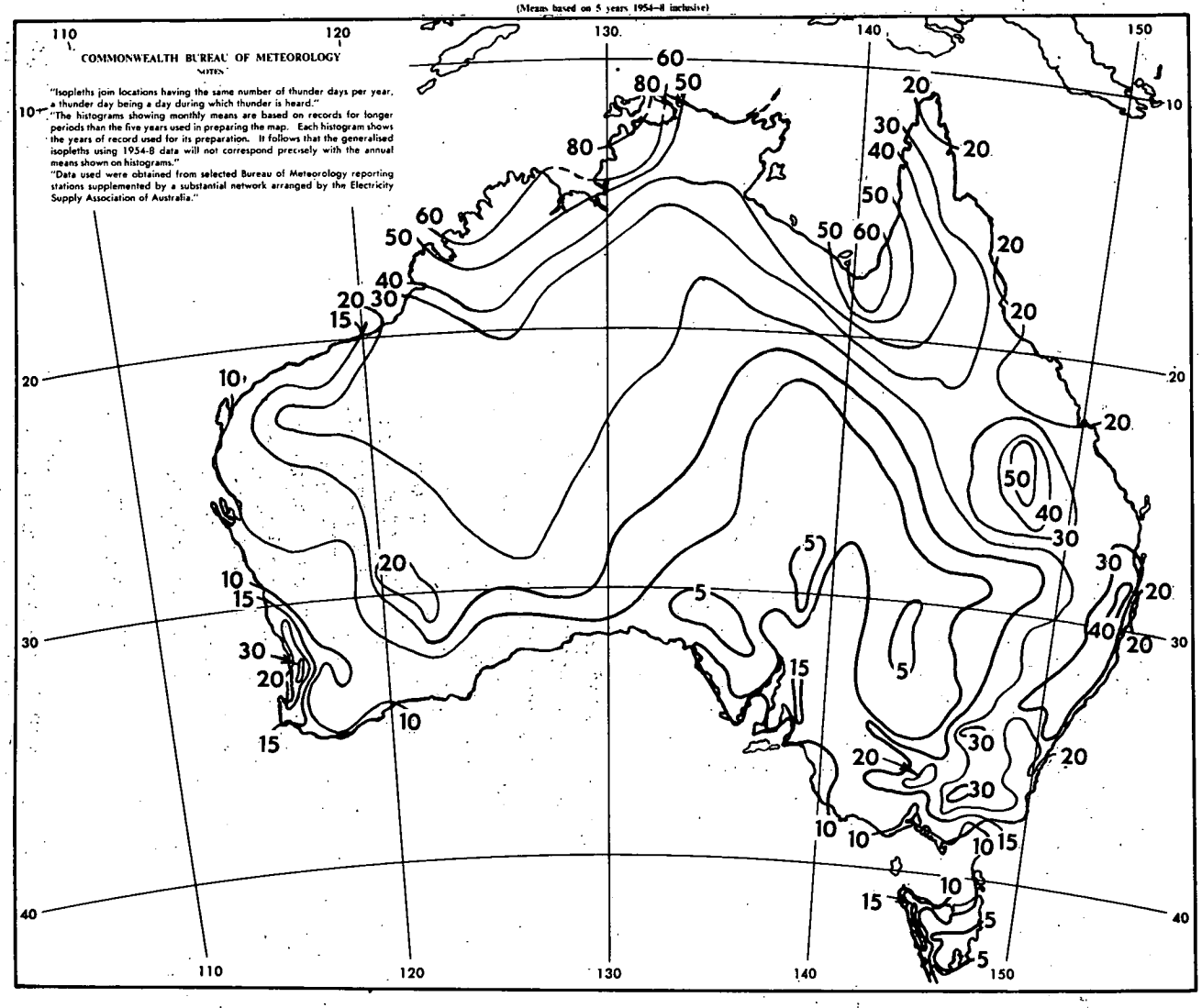

Fig. 1

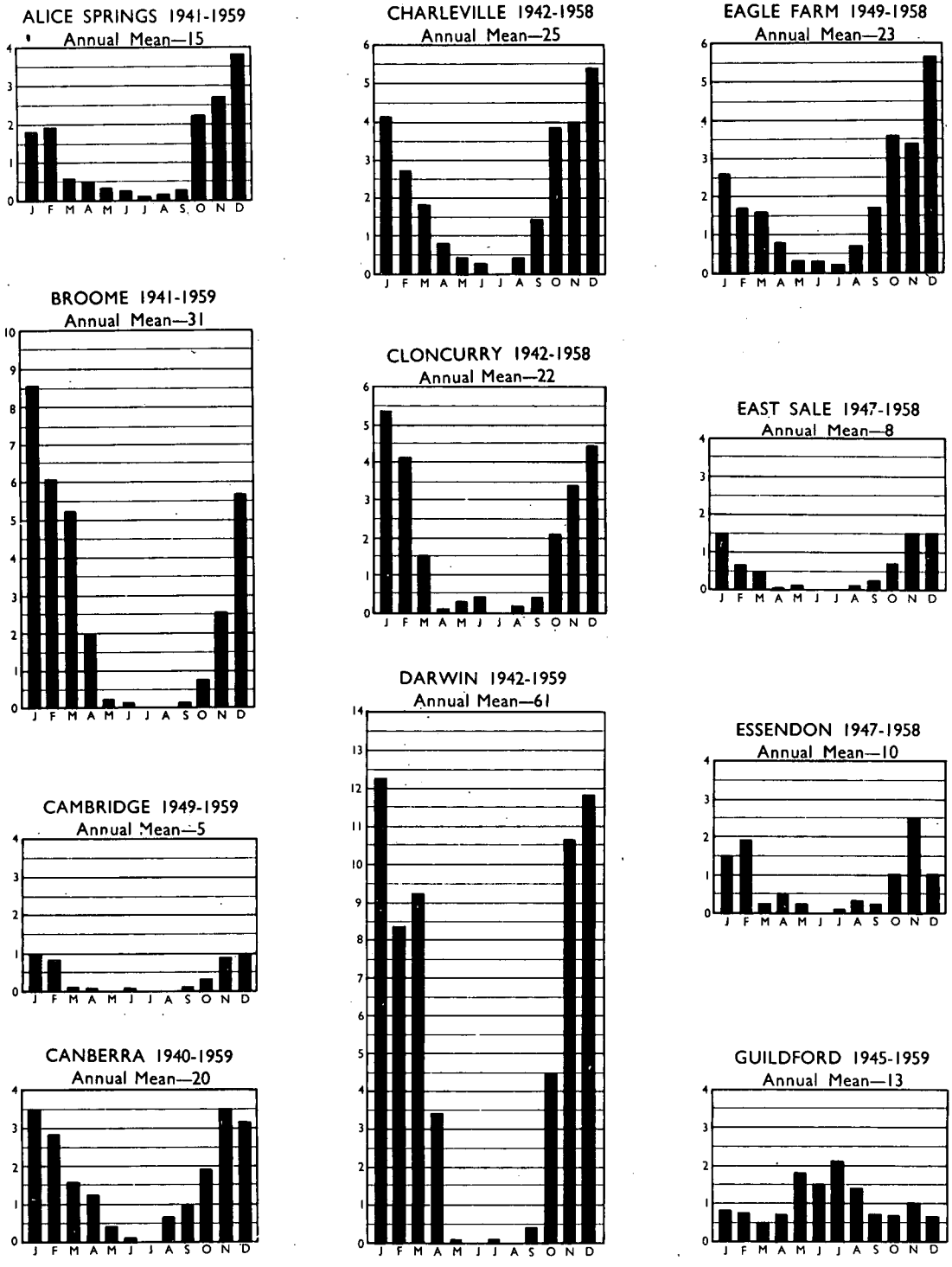

Fig. 2 Histograms of Thunderdays

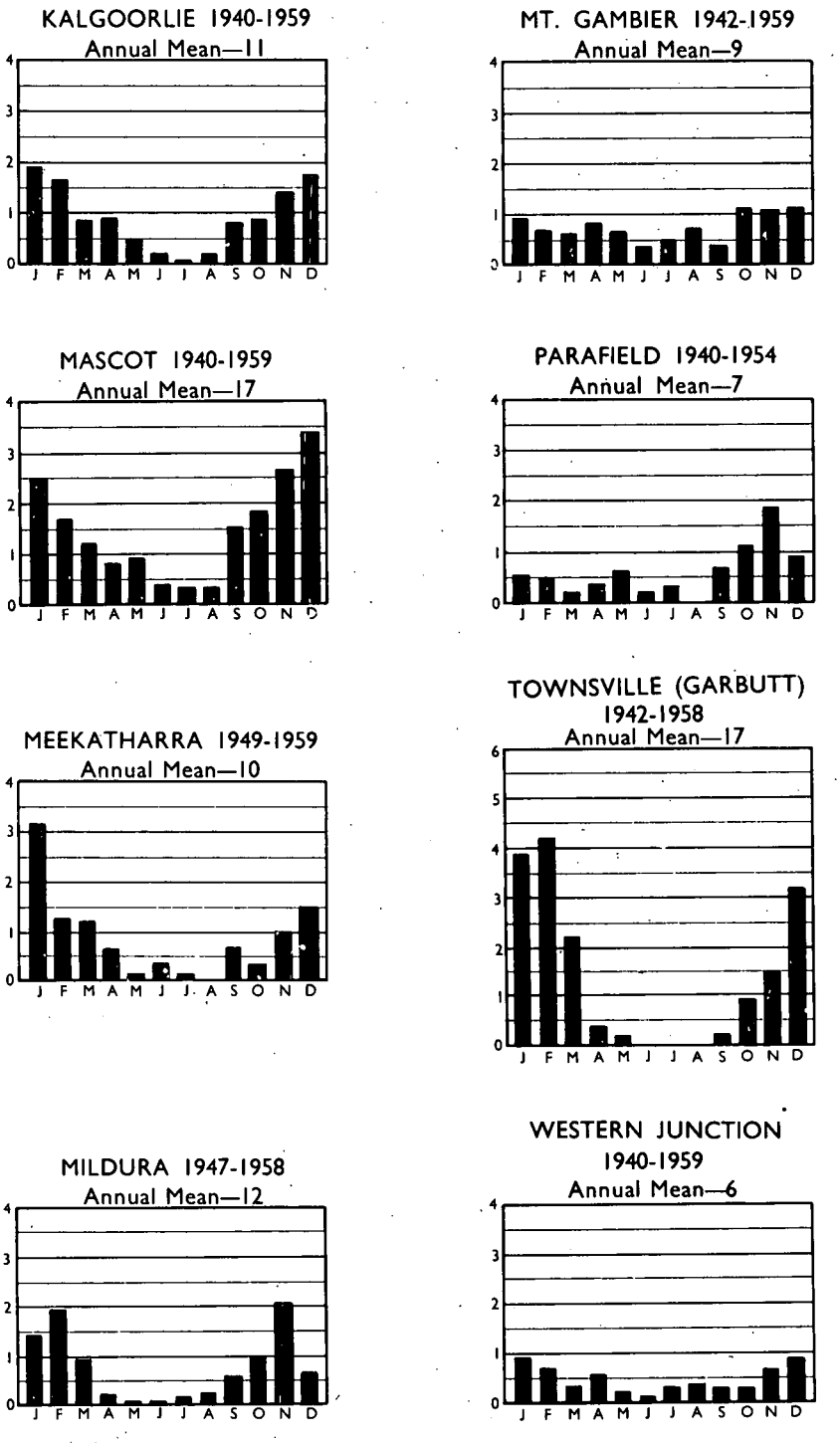

Fig. 3 Histograms of Thunderdays

DISCUSSION OF MAP

A peak in excess of 80 thunder days per year occurs in the vicinity of Darwin and a similar but smaller peak southeastward from the Gulf of Carpentaria. In both these areas the thunder days are confined to summer months, virtually none occurring from May to September inclusive. The highest incidence occurs during December and January in the Darwin area, but in February in the Gulf Country.

It is notable that there is a belt of country where incidence is high, extending southeastwards from the Gulf of Carpentaria almost to the Queensland-New South Wales border. This is an area of converging surface winds where an isobaric trough is a semi-permanent feature of weather maps, particularly in summer. The centre of relatively high frequency in the Goldfields area of Western Australia can likewise be related to a summer trough commonly extending down from a north to north-west direction.

The influence of mountainous country is evident in a number of ways. Over the southwestern corner of the Continent, the Darling ranges cause with the westerlies of winter a well defined seasonal maximum. There may be a similar effect in parts of rugged western Tasmania, but from the limited data for that area there was no evidence to draw any isopleth of greater value than fifteen. Undoubtedly the pattern from southeastern Queensland to the Victorian border is quite complex, and the pockets of country shown with more than thirty thunder days annually can only be considered as roughly delineating areas reporting high incidence over a generally mountainous terrain.

RELIABILITY OF RECORDS AND ISOPLETHS

It must be accepted that as a rule the average observer is much more likely to report too few than too many thunder days. Therefore giving extra weight to two or three high values against an equal number of lower ones in a restricted area is justified. The audibility range for thunder is generally about ten miles, the consistency of this making thunder a much more acceptable indicator of electrical storms than lightning. Wind in general has a self-compensating effect, increased range downwind being counteracted by a decrease upwind. Nevertheless, experience suggests strongly that there are locations favourably situated for hearing thunder over greater distances than is usual, but allowance for this is not possible in using data.

A certain amount of use was made of other information than direct reports of thunder in sparsely populated areas. In Western Australia the elongation of the twenty isopleth north from Perth over rising ground of the Darling Ranges is based on observer's comments

rather than actual observations of thunder in the ranges themselves. A similar reason justifies the twenty isoline of the Hamersley Ranges east from Onslow.

The method of drawing such a generalised map assumes comparatively slack gradients of thunder activity, i.e. no running together of isopleths is attempted. On national maps of mean rainfall the same principle is adopted and is justified even though it is known that local orography and other factors can cause marked differences in thunder incidence, as in rainfall, in distances of a few miles.

COMPARISON WITH BARKLEY'S 1934 MAP

It is not quite certain whether Barkley's contours are based on thunderstorms per annum or thunder days per annum, so the map is best regarded as a guide only to relative activity. Certain points of difference between Barkley's and the present map warrant mention.

Over the southwest corner of Western Australia, Barkley shows a frequency of five to ten only. Meteorological considerations, as well as current data, confirm that this is a serious under-estimate. On the other hand, the small area of very high frequency, over one hundred, in the northwest of that State may be correct, as observations were not available in this location during 1954-58.

Over the Eastern States, Barkley's figures are generally lower than those available now. Almost certainly this results from better and more reports during 1954-58. An exception is the Mount Tamborine area of Queensland. Present evidence points to a much more extensive area, from southeast Queensland to the Gulf of Carpentaria, having a high incidence of thunderstorms, but the peak about Mount Tamborine being less marked than shown earlier.

Hollerith data for up to twenty years, based on records from stations manned by trained Bureau of Meteorology staff, were used for histograms to show the monthly distribution. It is a reasonable assumption that, although over areas for some distance around these locations the annual total may vary considerably, the seasonal distribution will be similar, so these diagrams superimposed on the map should be quite useful.

ACKNOWLEDGEMENTS

The co-operation of E.S.A.A. Committee No. 8 through its convener Mr. E.D. Howells, of the SEC Victoria is greatly appreciated, as is that of Professor S.A. Prentice, Department of Electrical Engineering, University of Queensland.

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Prentice, S.A.	1955	Thunderstorm in relation to Electricity Supply in Queensland. I. of E. Journal, April-May 1955, p.99-107