AN INTERESTING CASE OF RAPID FRONTOGENESIS IN A TROUGH

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The object of this paper is not to present a new theory or describe a unique or unusual situation but to give an account of frontogenesis followed by cyclogenesis in a trough during a period when aircraft reports were available over the Indian Ocean between Perth and Cocos Island.

Winter time depressions off the W.A. coast usually follow one of two patterns -

(a) A cyclone with well defined fronts which has originated well to the west of the W.A. coast; or

(b) a depression which forms as a wave on a frontal line in a trough adjacent to the coast.

It is this latter situation which is occasionally the cause of forecast failures due to the difficulty in assessing the rate of development and subsequent depth of the cyclone.

At 2200Z on the 16th July, 1952, the synoptic chart over W.A. was a typical early morning winter time situation with a weak high pressure cell over the Eastern Divisions. Fig. (1). The intensity of this high is usually spurious owing to the low temperatures at high level stations.

The trough inside the coast was extremely weak and appeared to have little significance at the time and outside the coast there was evidence from Leeuwin and Naturaliste reports of another weak trough. There is a tendency for these weak troughs to be discarded because they are so indefinite and are of no immediate importance. However, they upset the normal pattern of S.W. isobars in the wake of a cyclone and create a suspicion of a secondary development, which plays an important part in longer range forecasting.

The 700 mbs. chart for 171000Z followed the normal pattern of a ridge in the wake of a depression with SW winds gradually backing to the SE. Fig.(2). On the 172200Z surface chart, Fig. (3), there is slight evidence from the south-westerly and westerly cloud directions from Naturaliste and Leeuwin respectively that the trough may have passed through these stations. However, the south-westerly from the "Napoli" appears to confirm the presence of the trough between it and the coast with a suspicion of a wave on a weak front in the trough.

The most interesting transformation at this stage was in the 700 mbs. chart for 171800Z, Fig.(4), which showed a rapid backing of winds on the coast at nearly all levels to 1000 feet but even this was not indicative of the change which was taking place seawards where the aircraft reported winds which were unpredictable from the evidence available 12 hours previously. On the assumption that these winds were correct an effort was made to reconstruct the 700 mbs. chart for 171800Z. The winds and contours were changing so rapidly at the time that it was impossible to draw even a stream line chart to conform accurately to the winds reported from the aircraft at hourly intervals. However, there was evidence of a wind discontinuity across front "C" between Carnarvon and Onslow and its position seaward was fixed on a sharp temperature rise of 5° C. between two successive observations from the aircraft at 9500'. The position of a front further north was based on similar observations together with an almost unbroken layer of Ac As in the area.

By 181000Z there was a considerable fall in pressure on the lower west coast and a report from the "Napoli" at 181200Z with a sharp fall in pressure but still wouth-westerly winds appeared to confirm the idea of a wave development on the surface front in the trough east of the "Napoli".

By 182200Z, Fig.(5), a depression was located off the south west coast with rain over the south of the State.

It is suggested here that the depression actually originated as a wave on a front which developed in the trough, but the cause of the wave may be attributed to either

(a) a depression on a trailing front in the upper levels with front "B" connected directly to front "C", or

(b) the front "B" was a continuation of front "A", as shown in Fig.(4), and that "C" was the influencing factor causing the wave development along A B.

In the latter case the difference in trajectory and density of air on either side of "C" would naturally cause a retardation of the approaching front to the south of "C" to a much greater extent than it would to the north where the air is moister and warmer.

nd so provide a situation which would facilitate wave development. lthough there has never been sufficient data available for proof t is the writer's contention that this is the mechanism which auses most of the waves on fronts off the west coast.

In a previous paper on this subject I referred to a ront "C" as a pseudo warm front having the properties of a cold ront on the surface and a warm front aloft, and it is understood hat a front having similar properties is frequently located off he west coast of Africa. It usually moves through the lower .A. coast preceded by NNE/NNW winds and followed by NW/WNW winds hich are conditionally unstable and produce showers along the oast.

The difficulty in forecasting from this situation ies in the fact that without an adequate network of ship reports r upper air data from aircraft, it is impossible to locate the railing front either on the surface or aloft unless it passes nside the northwest coast, when by extrapolation to the west it s possible to estimate approximately where the wave development s likely to occur.

However, until more frequent aircraft and ships rep-rts over the Indian Ocean are received, it is my opinion that his situation will continue to be responsible for the majority f forecast failures over South Western Australia.

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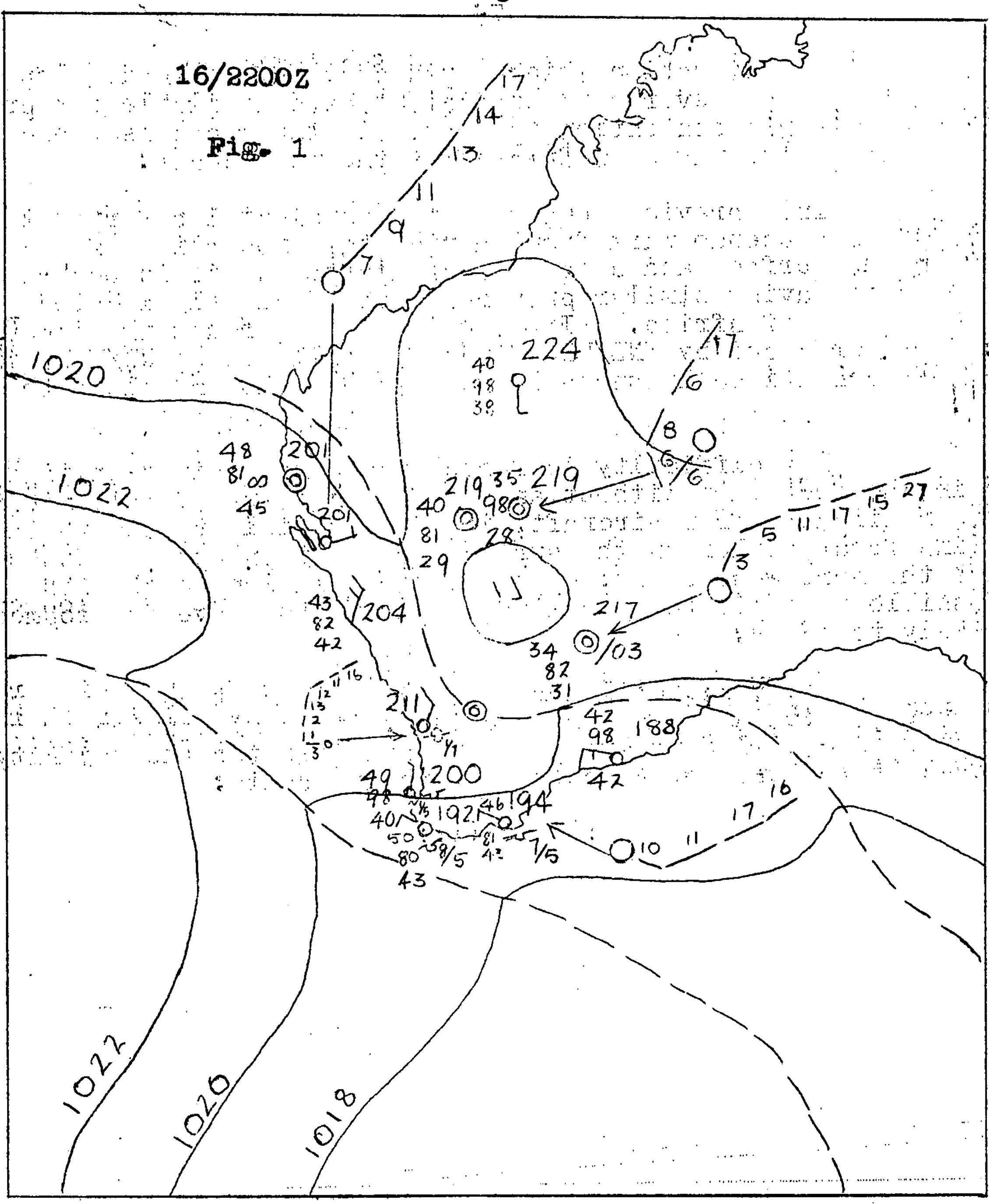
16/2200Z
Fig. 1
1020
1022
1022
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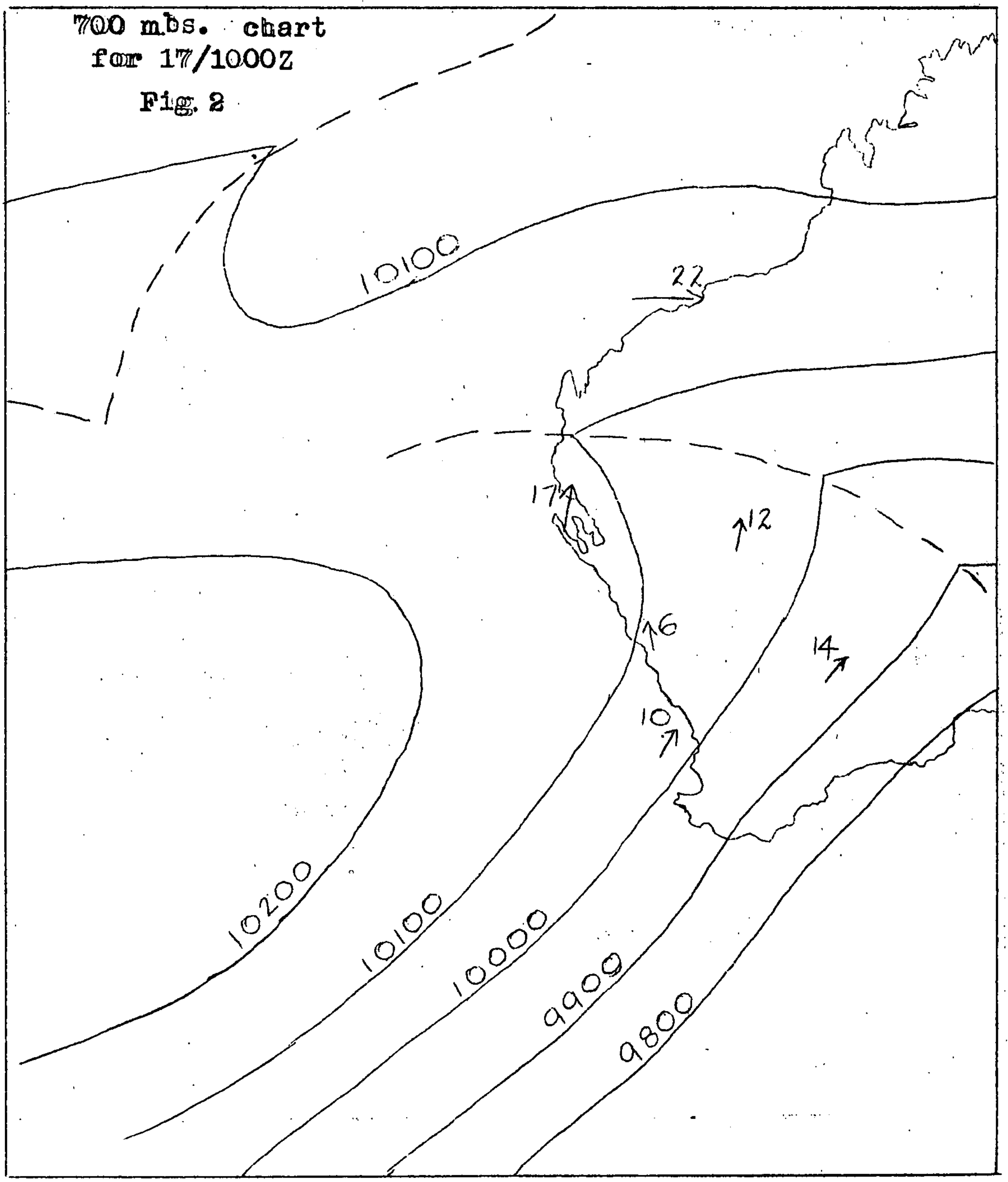
1018


700 mbs. chart
for 17/1000Z
Fig. 2
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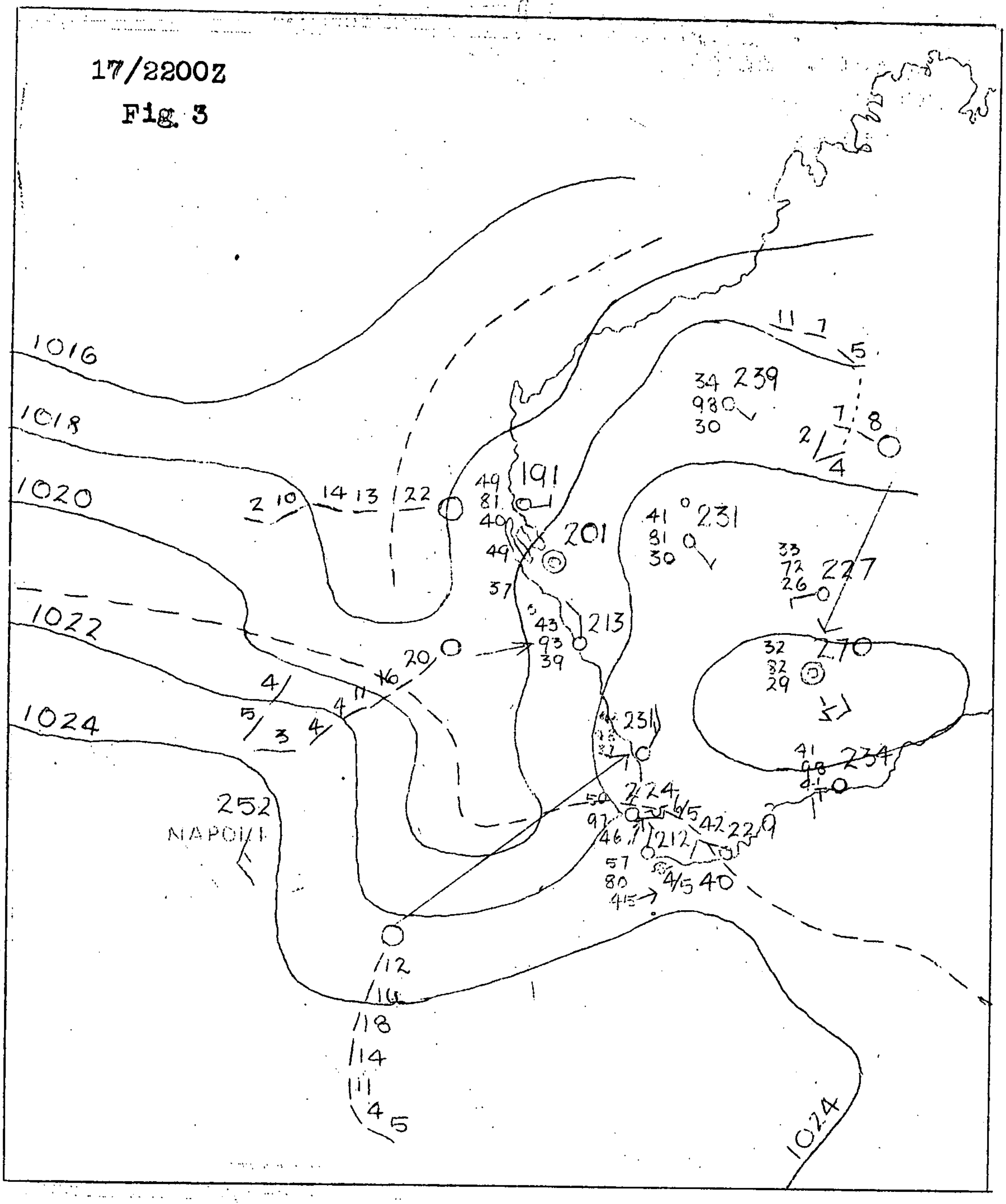
17/2200Z
Fig. 3
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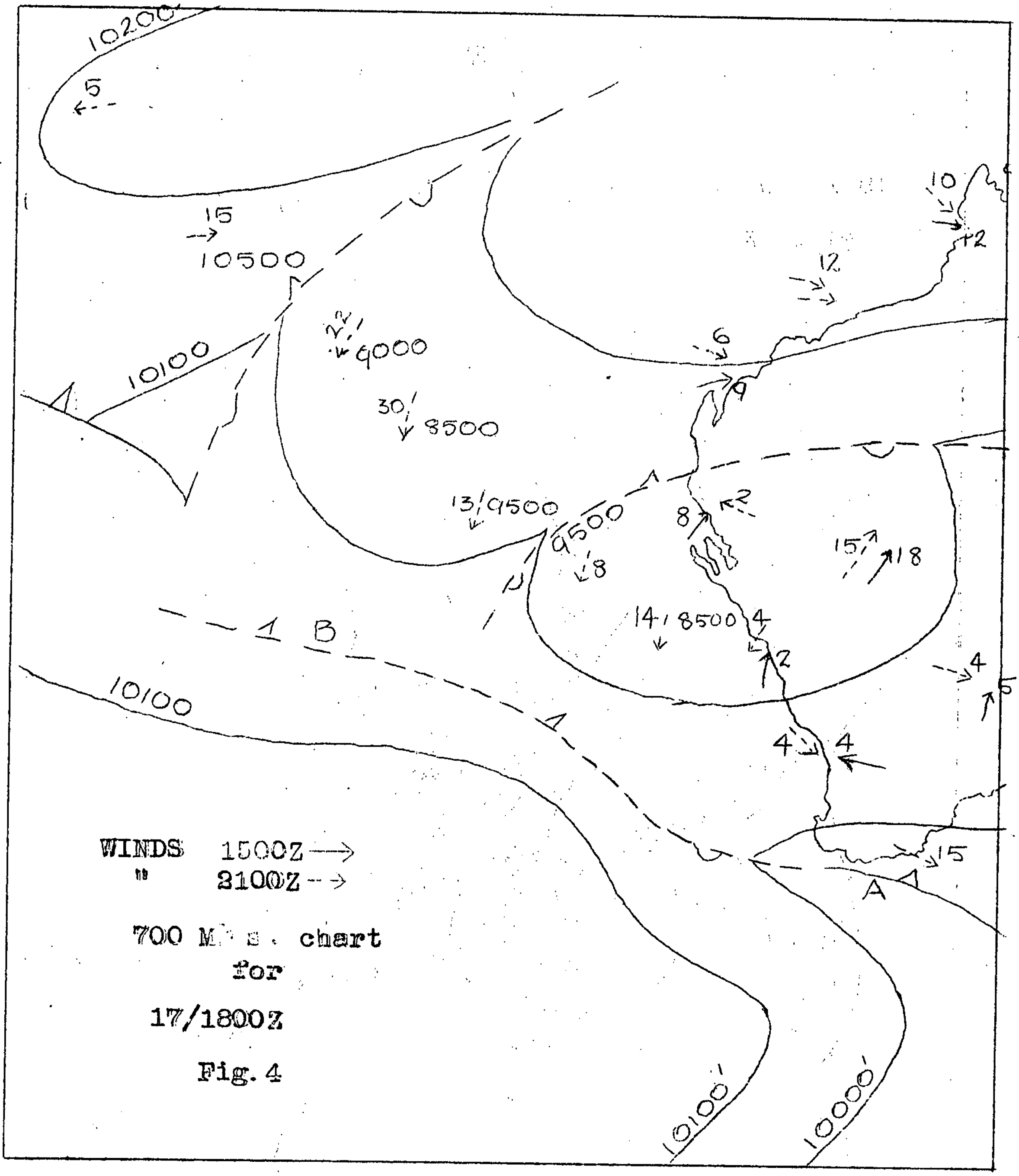

700 Mbs. chart
for
17/1800Z

Fig. 4

18 / 2200 Z

Fig. 5.