6.3 CASE III - CAPE ROLLERS (ABNORMAL WAVES) (21 - 26 SEPT. 1973)

6.3.1 General Discussion

With increasing shipping traffic, primarily super tankers too large for the Suez Canal, considerable interest has been generated in the unusually high swells, sometimes in excess of 40 feet, in the area off southeast Africa from Durnford Point to Port Elizabeth (see Fig. 6.16). These huge swells have been named "Cape Rollers" by the seamen who sail around the African Cape. Ships returning from the Persian Gulf/ Indian Ocean take advantage of the rapid southwest flowing Agulhas Current (4 to 5 kt) to shorten their travel time. The course of the Agulhas Current runs "head on" into large swells from the southern ocean during the austral winter.

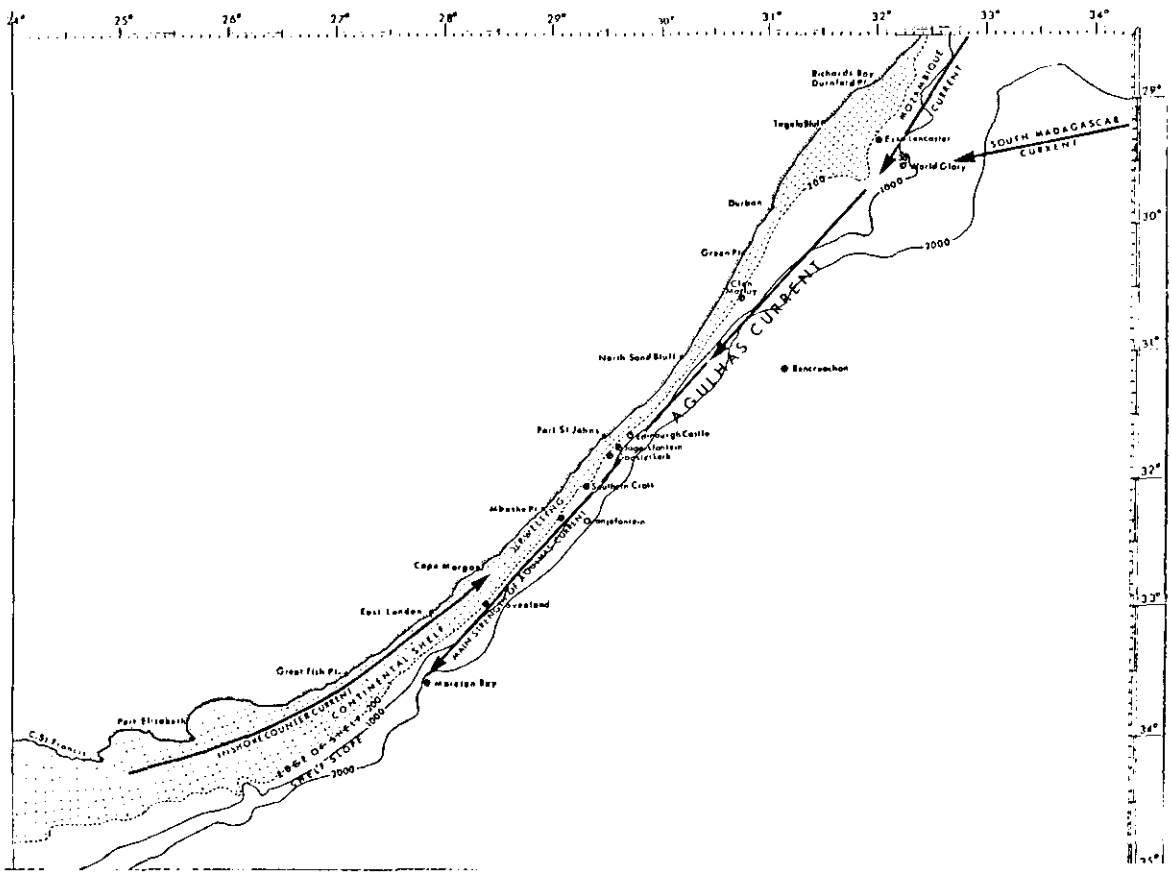

Fig. 6.16. Chart of southeast coast of the Republic of South Africa showing the continental shelf, shelf edge and continental slope, Agulhas Current and coastal upwelling, with positions of ships which have encountered an abnormal wave (depths in meters) (Mallory, 1974).

Davies (1972) computed Fig. 6.17 which depicts trajectories of swells generated at 55°S. These large swell trains can be generated by more than one source, each swell group having its own wavelength and frequency. These northeast traveling swells are affected by the counterflowing Agulhas Current off southeast Africa which shortens the wavelength, raises the height of the swell waves and steepens their slope. Locally produced wind waves can momentarily superimpose themselves upon these swell thereby increasing the height. Mallory (1974) determined the typical incoming northeast moving swell arriving along the southeast coast of Africa from the southern ocean as having a wavelength of 660 ft (201 m) and a steepness of .08 in the open ocean. Using these figures, Smith (1976) calculated the crest to trough wave height as high as 52.8 ft (16.1 m) with the possibility of wind waves superimposing another 16.5 ft (5 m) on the giant swell. Obviously, such giant waves are extremely dangerous to shipping and the task force meteorologist must be aware of the synoptic situation that generates them.

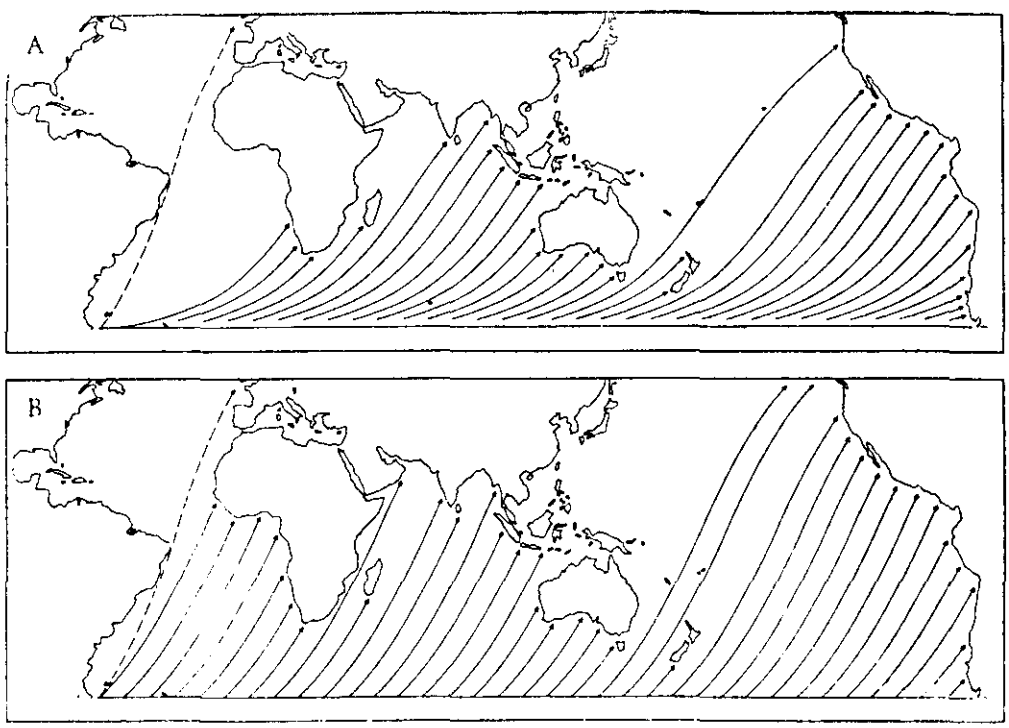

Fig. 6.17. Typical great circle paths followed by swell generated at Latitude 55°S by (A) Westerly and (B) Southwesterly gales, according to J. L. Davies. Note the paths parallel to the southeast coast of Southern Africa.

6.3.2 Geophysical Background

Further description and statistics concerning Cape Rollers are given in paragraph 7.4 under Coastal Oceanographic Influences. Because of its depth, the main core of the Agulhas Current is found outside of the continental shelf but within 100 n m of the shoreline (see Fig. 7.24).

During the austral winter (May - October), cyclones following the normal storm track usually pass near Marion Island (47°S, 38°E), creating a southwesterly fetch of over 1200 miles behind the front (see Fig. 6.18). Hence, the swell generated by the southwesterly winds behind the front will be fully developed and will have reached maximum height and length when they reach the southeast African coast. It must be remembered that even if the coastal winds are light, the southerly swell is nonetheless fully developed. The local wind however may superimpose wind waves over the fully developed swell. These abnormally high waves will be preceded by correspondingly deep troughs described by the expression "a hole in the sea". The effect of the Agulhas Current is much weaker as the large swells encounter lower current speeds. Mallory (1974) speaks of the current as being strongest near the 100 fathom line where the maximum height and steepness of the giant waves are found during the austral winter. In Mallory's investigation of 10 ship disasters caused by the giant waves none occurred shoreward of the 100 fathom line.

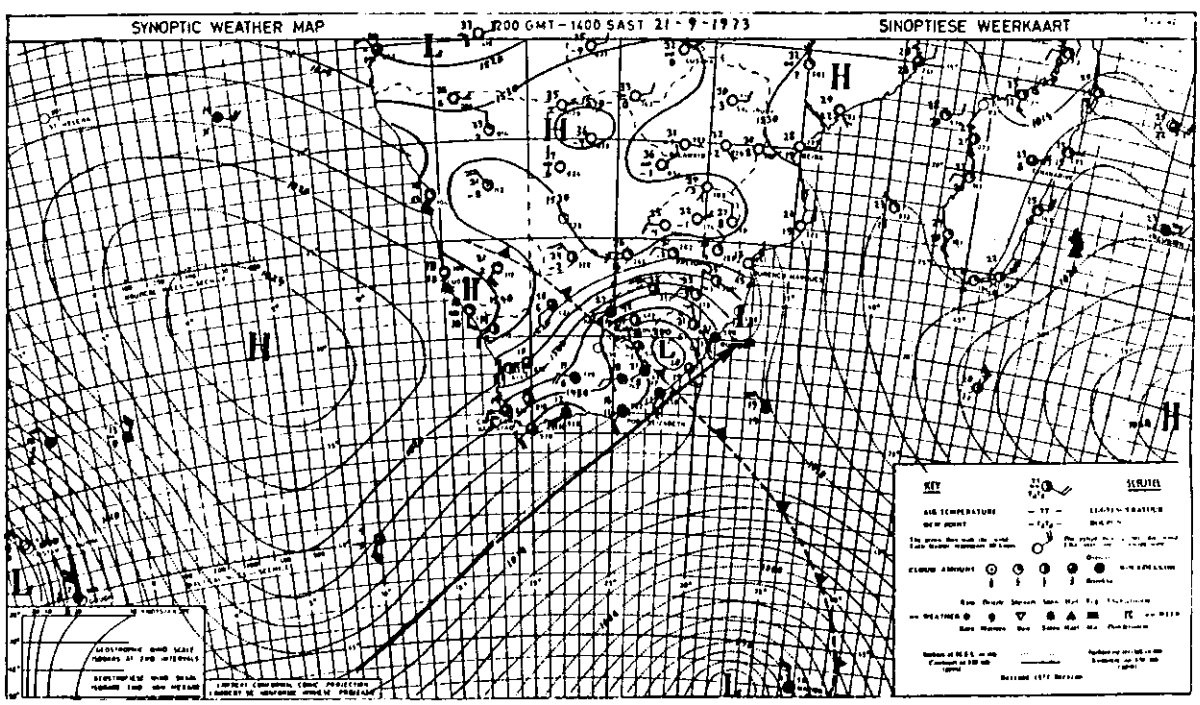

Fig. 6.18. Republic of South Africa Weather Bureau Surface (over Ocean) and 850 mb (over Continent) Analysis: 1200 GMT 21 September 1973

6.3.3 Case History

At 1647 L, on 25 September 1973, the 258,000-ton tanker SVEALAND, fully loaded, steaming southwestward suffered damage and casualties when she plunged into a long deep trough which appeared ahead of the ship. The ship reported 30-40 ft (6-13 m) waves with gale force winds prior to the mishap. SVEALAND was steaming one mile seaward of the 100 fathom line, 23 miles east from Hood Point, South Africa at a reduced speed. SVEALAND's position at the time of encountering the giant waves is plotted in Fig. 6.16, east of East London.

The Republic of South Africa Weather Bureau 1200 GMT surface charts from 21 September 1973 through 26 September 1973, encompassing the time of SVEALAND's calamity, are reproduced as Figs. 6.18 - 6.23.

On 21 September (see Fig. 6.18) a cold front is moving northeast along the southeastern coast of Southern Africa with southwesterly gales in the cold air mass. The long arrow marks the fetch from which the large swell waves propagate. The fetch is approximately 1200 miles long.

At 1200 GMT on 22 September (Fig. 6.19) the cold front has penetrated north of Lourenco Marques. The fetch is reduced to 800 - 900 miles as an anticyclone follows the cold front around the cape.

By 1200 GMT 23 September (Fig. 6.20) the anticyclone is dominant over the coastal waters of southeast Africa. The associated northeasterly winds produce a reduced fetch from the opposite direction and accentuate the Agulhas Current. A second cold front is approaching Cape Town from the southwest.

Near Port Elizabeth on 24 September (Fig. 6.21) a sudden change of wave direction takes place ahead of the cold front. The 989 mb low tracks eastward toward Marion Island.

The surface weather chart of 25 September (Fig. 6.22) shows the cold front north of Durban with an unlimited fetch behind it. Southwesterly winds continue through 1200 GMT on 26 September (Fig. 6.23). The anticyclone following the cold outbreak is centered further south than the anticyclone of 22/23 September. The SVEALAND suffered damage and casualties on 25 September.

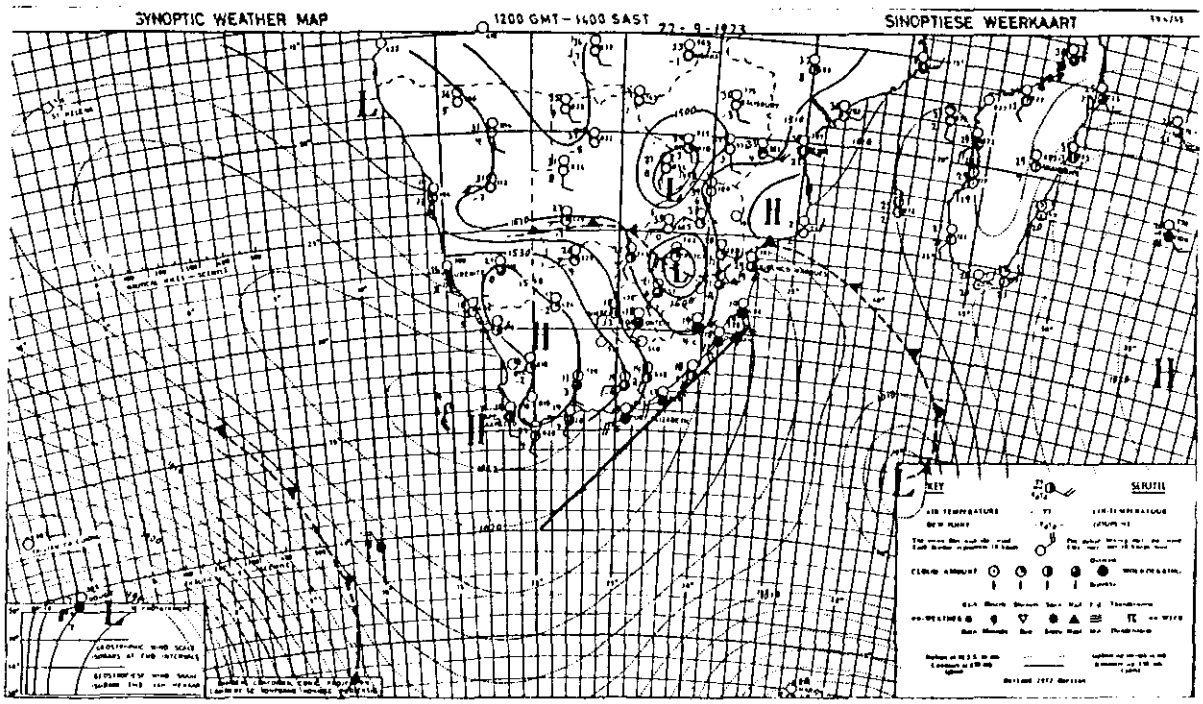

Fig. 6.19. Republic of South Africa Weather Bureau Surface (over Ocean) and 850 mb (over Continent) Analysis: 1200 GMT 22 September 1973

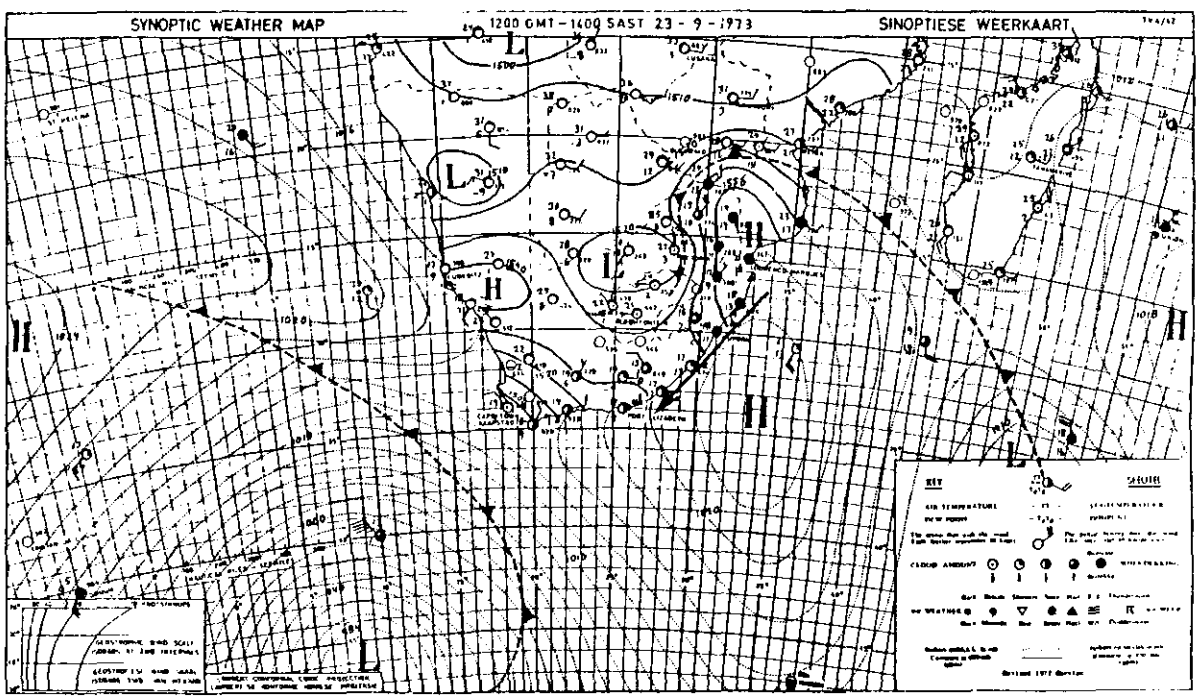

Fig. 6.20. Same as Figure 6.19 except for 1200 GMT 23 September 1973

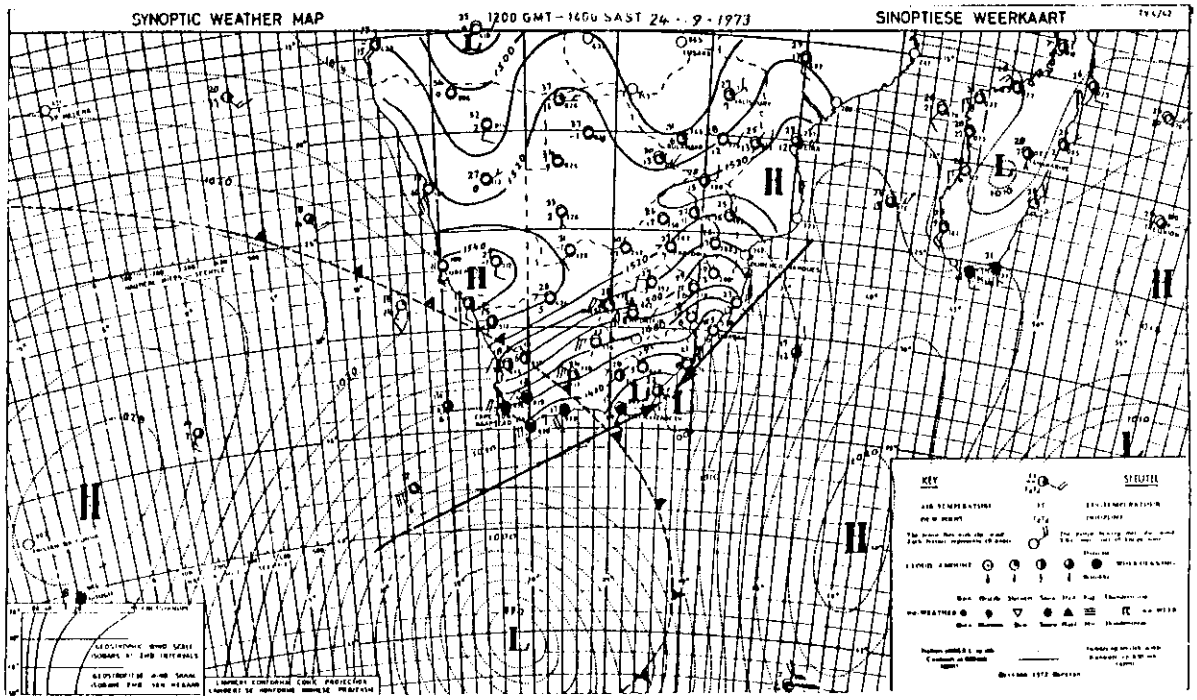

Fig. 6.21. Republic of South Africa Weather Bureau Surface (over Ocean) and 850 mb (over Continent) Analysis: 1200 GMT 24 September 1973

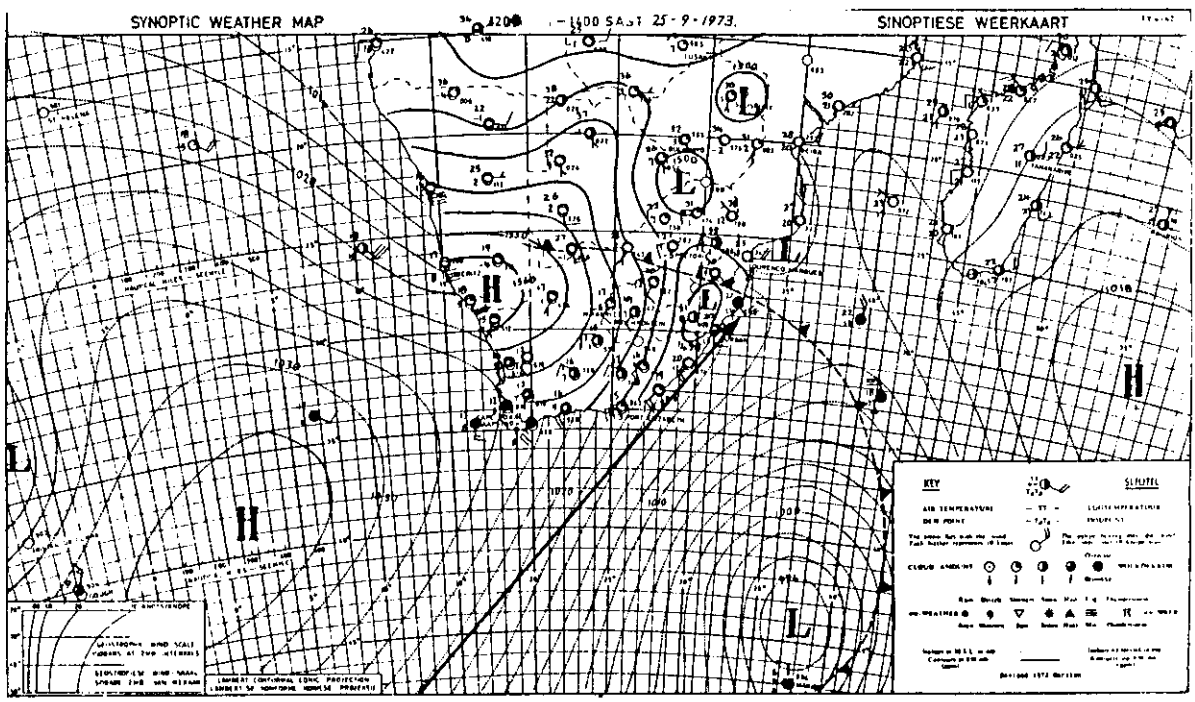

Fig. 6.22. Same as Figure 6.21 except for 1200 GMT 25 September 1973

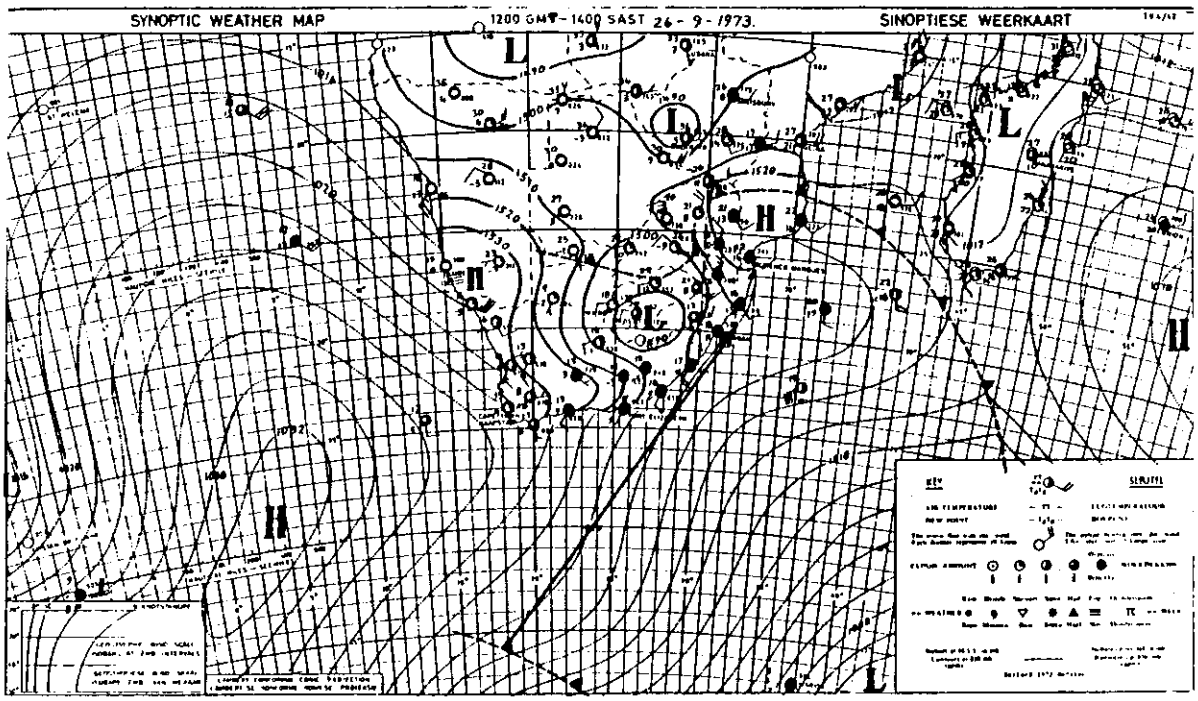

Fig. 6.23. Same as Figure 6.21 except for 1200 GMT 26 September 1973

6.3.4 Forecast Rules

1. If strong southerly waves/swell are expected,[10] recommend a track as close to the RSA shore as safe navigation permits, especially if the ship is on a southerly heading. If not feasible, stay well offshore (outside the 100 fathom line) (Hubert et al., 1983).

2. If expected waves are slight to moderate from any direction, the effect of the Agulhas Current on speed made good is probably the most important factor in track selection (Hubert et al., 1983).

3. Prior to passages of cold fronts along the southeast African coast, northeasterly winds accentuate the speed of the Agulhas current.

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[10] See Subsection 7.4 for additional recommendations concerning avoidance of Cape Rollers by ships proceeding in the Agulhas Current.

4. A rapid change of wind direction occurs with frontal passage over these coastal waters, backing from NE Force 6 (22-27 kt) to SW Force 6/7 (22-33 kt) in about 4 hours.

5. The effect of southwesterly winds is immediate, creating local rough seas. These rough seas occur within one hour and create 10 ft (3 m) waves with lengths of 200 ft (60 m) and a 6-7 second period. The Agulhas Current shortens the wavelength to 175 ft (53 m) with a height of 12 ft (4 m).

6. Fully developed swells from the southwest accentuate the height of the locally generated waves.

7. A correspondingly abnormally deep trough occurs ahead of the giant wave.