Spectrum

Leeuwin Current revealed

Look up the world's ocean currents in an atlas, and you will probably find a northward-pointing arrow indicating the West Australian Current flowing up the Western Australian coast. Look further, and you will observe the Benguela and Humboldt Currents, which also flow northwards, up the western coasts of Africa and South America respectively.

Maps of the Atlantic, Indian, and Pacific Oceans show that the waters of these seas generally move with a circular motion in an anticlockwise direction. The 'Roaring Forties' propel the waters of the Southern Ocean eastwards as the West Wind Drift around the southern part of the globe. Each of the three southern continents deflects parts of the West Wind Drift northwards to form the northward-flowing currents.

Just south of the equator the South-east Trade Winds move the South Subequatorial Currents westwards, and the waters of these in their turn become deflected southwards down the eastern coastlines of the southern continents to rejoin the West Wind Drift.

This circulation pattern looks delightfully neat, and certainly it explains the Benguela and Humboldt Currents. It also helps explain why the system of eddies known as the East Australian Current moves southwards down the coast of New South Wales (see *Ecos* 3). Unfortunately, for much of the year, the West Australian Current doesn't seem to exist.

Confusing things happen in the waters off the Western Australian coast. Dr Loisette Marsh of the Western Australian Museum has found that each autumn, for example, large numbers of marine animals of the type normally found in tropical waters north of the Exmouth Gulf suddenly appear off Rottnest Island. They disappear again about 3 months later.

Individuals of a marine turtle species that is normally found near Broome have also occasionally turned up on the western coast of Tasmania. To have got there, they would have had to swim thousands of miles, nearly half of which should have been against the West Australian Current — an astonishing feat.

Dr John Andrews, an oceanographer with the Department of Defence, has recently shown that, during summer at least, the West Australian Current does exist after all, but it is hundreds of kilometres out to sea. Part of it flows in towards the coast at 30°S latitude (Perth is located at 32°), before doubling back on itself to meander southwards, forming a series of eddies about 100 km in diameter as it goes.

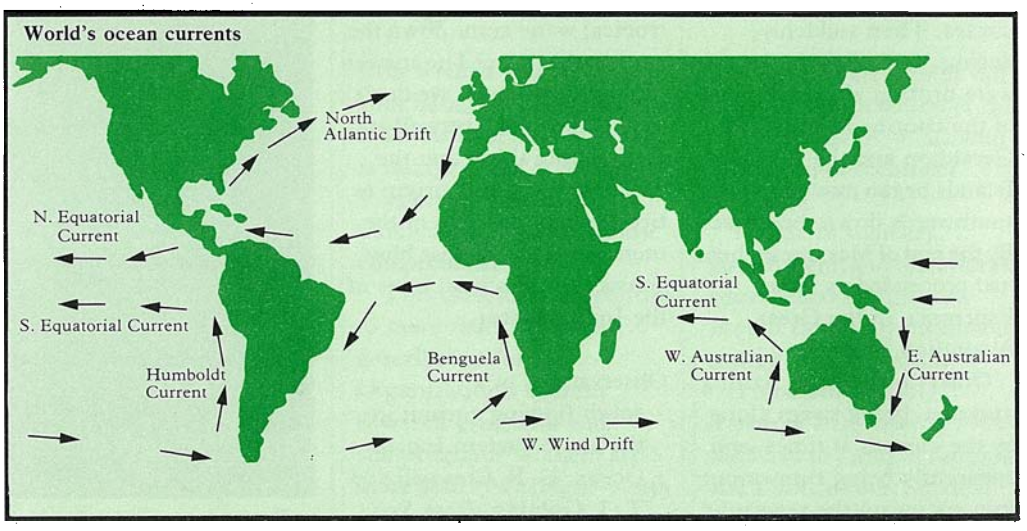
Using a combination of free-drifting radio buoys that were tracked by the American Nimbus VI satellite and observations made from the research vessel the R.V. *Sprightly*, Dr George Creswell and Mr Terry Golding, of the CSIRO Division of Fisheries and Oceanography, have added yet more to our knowledge of the circulation patterns off the Western Australian coast. They gathered this information as a part of the Division's investigations into the life cycle and migration patterns of the western rock lobster — that gourmet's delight that forms such a profitable fishery in the area (see *Ecos* 9).

These studies confirmed that no less than three different sets of currents move up or down the southern half of Western Australia's coast at various times of the year.

Firstly, there is the southward-moving system that Dr Andrews described. But other currents that vary in direction with the season also move along the continental shelf. They flow southwards in summer and northwards in winter, driven by the prevailing northerly and south-westerly winds.

Superimposed on these movements is a third current, which can best be described as a body of water from the tropics that during autumn and early winter surges round the south-western corner at Cape Leeuwin into the Great Australian Bight.

Oceanographers have been aware for many years that tropical water moves down



Typical map showing the world's currents. Arrows indicating the West Australian Current are misleading.

the coast and into the Great Australian Bight. What caught everybody by surprise was the rate at which it does so. The drifting buoys and the ship-borne studies showed that between April and July it forms a current some 20 km wide that may reach nearly 4 km per hour (2 knots).

This current, which Dr Cresswell and Mr Golding have named the Leeuwin Current, flows along the continental slope.

The two scientists began releasing their transmitter-equipped buoys at various locations off the southern half of the Western Australian coast during the latter part of 1975. They released 12 in all.

Between October 1975 and March 1976 most of these buoys remained not far from the coast, apparently moving at random and often around in circles. Then suddenly, during April, three buoys that were drifting along the edge of the continental shelf off Geraldton and the Abrolhos Islands began moving rapidly southwards down the coast. By the end of May one of them had proceeded as far as Esperance in the Great Australian Bight.

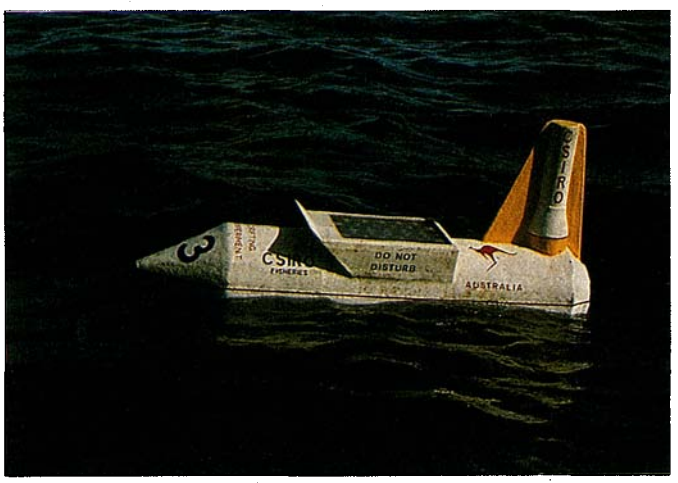
Others made more halting progress, being swept along by the current at times, and apparently being thrown out into eddies on the seaward side at others before being carried back in again.

The current continued to flow through much of June, but by July the buoys appeared to be moving at random once more.

Between March and July 1976, the crew of the *Sprightly* mapped the width and the rate of the current's flow by steaming back and forth across it and measuring the ship's drift. The crew also took sea-water samples, which revealed that the water in the current was about 2°C warmer than that in the surrounding local sea, and also that it was less salty.

These two facts indicated that the waters of the current derived from the warmer, less saline, tropical seas to the north — and the appearance of tropical marine animals around Rottnest Island during autumn confirms this.

But why should a surge of tropical water come down the coast at that time? The answer to that question is: we don't really know. Dr Creswell and Dr Golding think that the Leeuwin Current's origin is tied up with changes of the monsoonal winds that blow across the equatorial parts of the Indian Ocean.



The Nimbus VI satellite tracked solar-powered buoys like these off the Western Australian coast.

Observations of a south-flowing current in the south-eastern Indian Ocean. G. R. Creswell and T. J. Golding. *Deep Sea Research*, 1980, 27 (in press).