rate data and currently are adding it to our computer data base.

Although transporting eggs from Antarctica is still experimental, the encouraging results suggest that this is a viable alternative to capturing and transporting live birds. The logistics requirements are considerably less, and the negative impact on wild populations is minimal.

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Neogene fossiliferous deposits in southern Chile

Nearly 150 years have passed since Charles Darwin visited South America and the Chilean islands of the Chonos Archipelago (Darwin, 1962). Noting the close similarity of fossil and recent molluscan faunas in the region, he suggested that the Chonos Islands with fossiliferous outcrops were remnants of recently uplifted marine sedimentary basins (Darwin, 1897, p. 232-236). Although he correctly deduced the broad outlines of the region's geological history, he was unable to provide a convincing tectonic mechanism to explain the uplift.

In a modern context, we recognize the island sequences as portions of an uplifted Neogene forearc basin. From data obtained in an ongoing study we eventually will provide a detailed analysis of the paleontology and sedimentology of the Neogene marine sequences, taking into account the geometry and bathymetry of the basin, sediment provenance, oceanic conditions, and evolution and biogeography of the fauna.

Between 26 September and 14 October 1983, U.S. and Chilean geologists completed a survey of fossiliferous Neogene strata in southern Chile.[1] By using the R/V *Hero* (cruise 83-6), we were able to reach otherwise inaccessible islands with Miocene and Pliocene clastic sedimentary exposures (figure 1).

[1] *Hero* cruises in Chile's 200-nautical-mile zone are conducted with the assistance and permission of the Chilean government. In June 1983 representatives of the U. S. and Chilean governments signed an agreement that outlines a cooperative plan for research conducted aboard the *Hero*. To fulfill one requirement of this agreement, NSF publishes the final reports of these cruises in the *Antarctic Journal*.

Field studies

In this region rock outcrops are exposed only along wave-cut cliffs and intertidal benches. We successfully inspected much of the outcrop along the eastern side of Guafo Island but were able to reach only limited exposures on Ipun and Lemó. These three islands are composed entirely of Cenozoic sedimentary rocks. Stokes Island, however, is composed of crystalline basement rock with Tertiary sediments covering only 2 kilometers of the western end. The contact between the two rock types is overlain by a conglomeratic sequence that upward becomes finer into sandstone with interbedded tuffs. To the west, Stokes sandstones rapidly become finer grained. Beyond Stokes, sandstone and siltstone beds with a range of thicknesses alternate in vertical sequence and become thinner and more regular on the eastern shores of Ipun. The stratigraphic continuity of outcrops on Stokes, Lemó, and Ipun islands and the thickness of the tertiary deposits have yet to be proved.

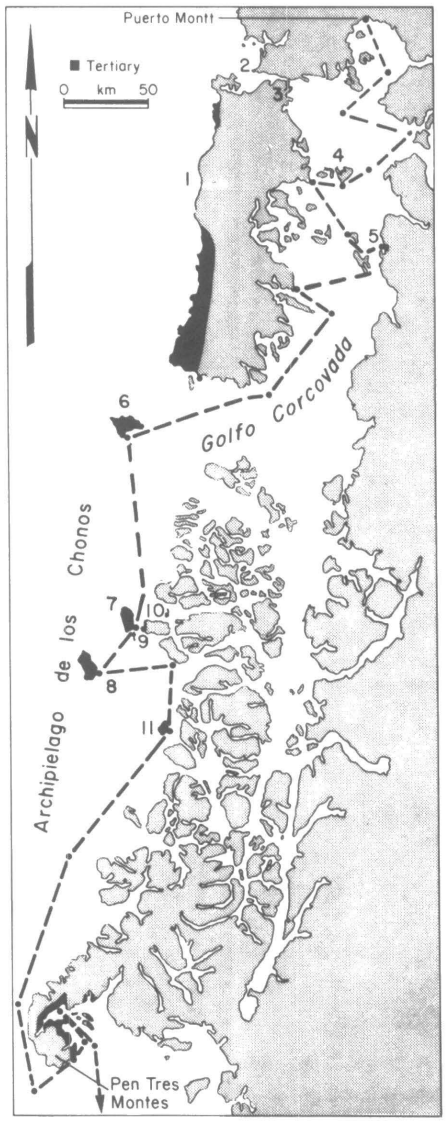
Similar depositional sequences are present on Guafo Island and the islands within the hook of Peninsula Tres Montes. We also saw evidence of soft-sediment deformation and slumping on Guafo Island.

Macropaleontology

Darwin (1897) was the first to collect and describe (with G. B. Sowerby) the Neogene molluscan fauna of the Chonos Archipelago and Chiloe Island. Because of the insularity and vegetative lushness of the region, paleontologists subsequently forsook those remote outcrops for the amply exposed Neogene beds of central and northern Chile (Philippi, 1887; Herm, 1969; Tavera, 1979).

The outcrops that we visited on each island south of Chiloe can be assigned to the Miocene or Pliocene on the basis of their molluscan fauna. For both epochs we can further identify faunas associated with coarser clastic (midshelf?) and finer clastic (outer shelf to upper slope?) sediments (table 1). Newly documented coarse-clastic faunas can be correlated more easily with shelf faunas of the mainland Chilean Navidad Formation than the fine-clastic faunas previously known from Darwin's (1897) collections.

The presence of *Distorsio*, *Cassis*, and *Terebra* at Stokes Island shows that middle Miocene tropical faunas extended at least as far south as 45°S. We cannot yet attribute the lack of the same tropical forms at Tres Montes to a higher latitude (47°S), younger age (late Miocene), or incomplete sampling. A similar impoverishment, however, is noted in late Miocene (9-million-year-old) faunas of south-central Peru (DeVries and de Muizon, in preparation).



Locality map of southern Chile with cruise track of R/V *Hero*, cruise 83-6. The numbers indicate the following sites: (1) Chiloe; (2) Punta Chocoi; (3) Punta Puihuil (Chiloe); (4) Lemuy; (5) Llahuen; (6) Guafo; (7) Ipun; (8) Guamblin; (9) Lemó; (10) Stokes; (11) Lemu.

Molluscan faunas from Guafo Island differ markedly from those on Ipun, Lemó, and Stokes islands and at Tres Montes. *Turritella chilensis*, common to both fine and coarse facies on Guafo, is quite like *T. cingulata*, a recent Chilean species. This, together with the presence of *Chorus* spp., *Argobuccinum*, and the absence of "tropical" species, indicates a Pliocene age for Guafo strata.

Small collections of mollusks made at Llahuen, Punta Puihil (Chiloe) and Chocoi Peninsula reiterate previously reported Pleistocene and Neogene ages.

Micropaleontology

Preliminary results reveal an abundance of well preserved Miocene and Pliocene foraminifera in many horizons throughout the region. Samples from Lemó contain a diverse assemblage of outer-shelf to middle-bathyal benthic foraminifera. Many of the key taxa recovered from these samples are found today on the shelf and slope of Chile (Bandy and Ruolfo, 1964; Ingel *et al.*, 1980). These include

- *Uvigerina peregrina* group
- *Pullenia bulloides* (d'Orbigny)
- *Martinottiella communis* (d'Orbigny)
- *Pyrgo depressa* (d'Orbigny).

The stratigraphic correlation between islands has not yet been worked out. On the basis of tentative identifications of planktic foraminifera, we believe the entire sequence is limited to the early Miocene to early Pliocene.

Darwiniana

We have been able to clear up some confusion regarding Darwin's localities in the Chonos Archipelago. In his original field notes (available to us on microfilm), Darwin refers to a Tertiary molluscan fauna from sandstones at Lemuy Island. The island (spelled Lemus) is mentioned in connection with Ipun in *Geological Observations* (Darwin, 1897, p. 389). Subsequent geologists (including ourselves) have searched in vain for these fossiliferous beds among the Quaternary glaciofluvial sediments of Lemuy Island (east of Chiloe) and the Precambrian-Paleozoic crystalline rocks of Lemu Island. Darwin's site was actually on Lemó Island. Situated between Ipun and Stokes, Lemó is separated from Ipun by a shallow strait and is little more than extension of the other island.

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We would like to thank Captain Pieter Lenie and the crew of the R/V *Hero* for their unstinting support of our research efforts. The scientists who participated in the cruise are listed in table 2.

Also participating were two official Chilean observers, Contraalmirante Carlos Quinones L. and Teniente Marcelo Asenjo Boegel.

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Table 1. Selected Neogene fossil invertebrates from southern Chile.

Island	*Fine clastic facies*	*Coarse clastic facies*	*Estimated Age*
Guafo	*Turritella chilensis* *Bella cosmophila* *Pleurotoma* spp. *Cardita volckmani* *Dentalium majus*	*Turritella chilensis* *Chorus* cf. *doliaris* *Argobuccinum* new sp. Venerid spp. *Panopea vetala*	Pliocene
Crosslet, Hereford, (Tres Montes)	*Trochus laevis* *Polincies pachystoma* *Cassis monilifera* *Fusus* cf. *pyruliformis* *Oliva dimidiata* *Cancellaria* aff. *medinae* *Aturia* sp. *Panopea* cf. *ibari*	*Turritella* cf. *affinis* *Nucula* spp. Inarticualte Brachiopoda *Flabellum* corals.	?late Miocene
Ipun-Lemo-Stokes	*Sigaretus subglobosus* *Cassis monilifera* *Cassis tuberculifera* *Distorsio decussata ringens* *Bursa verruculosa* *Monoceros labialis* *Olivancellaria tumorifera* *Cucullaea* sp. *Pinna* cf. *semicostata* *Pecten simpsoni* *Dentalium sulcosa*	Trochid sp. *Turritella* sp. *Monoceros labialis* *Terebra undilifera* *Flabellum* corals.	?middle Miocene

Table 2. Participants on R/V *Hero* cruise 83-6.

Name	*Discipline*	*Affiliation*
Thomas J. DeVries	geologist (chief scientist)	Ohio State University
Lowell Stott	geologist (graduate student)	Ohio State University
Jennifer Chambers	geologist (graduate student)	Ohio State University
Marijke van Heeswijk	geologist (graduate student)	Ohio State University
Vladimir Covacevich	geologist	Servicio Nacional de Geologiá y Mineriá
Daniel Frassinetti	paleontologist	Museo Nacional de Historia Natural, Santiago
Soledad Valdivia	geologist (graduate student)	Departamento de Geologiá, Universidad de Chile, Santiago

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