



**NOAA Teacher at Sea
Dave Grant
Onboard NOAA Ship *Ronald H. Brown*
November 6 – December 3, 2008**

NOAA Teacher at Sea: Dave Grant

NOAA Ship *Ronald H. Brown*

Mission: VOCALS, an international field experiment designed to better understand the physical and chemical processes of the Southeast Pacific climate system.

Date: November 8-10

Science and Technology Log

Chile is due south of Portland, Maine; and Santiago, its capital, largest city and main gateway for international visitors is about 5235 miles from my home in New Jersey (By my crude flight calculations). Sometimes called the *London of South America*, it is as modern and upscale as some US cities.

Chile is huge and diverse; it's more than half the length of South America and bigger than Texas. Its 2666-mile (4300-Km) coastline stretches from the sub-tropical areas and deserts in the north, across the Tropic of Capricorn (The southernmost point where the sun reaches the Winter Solstice), through agriculturally important Mediterranean and Temperate climates at its middle, to the frigid tip of the continent at Tierra del Fuego.

Chileans are friendly, good natured and known for their hospitality towards visitors. Although the population is described as *mestizo* (A mixture of European and indigenous bloodlines) Aymara Indians in the North and Mapuche Indians in the South still follow many of their traditional ways of working the land.



From the top of El Morro, NOAA Teacher at Sea, Dave Grant, points to the Ron Brown anchored offshore.

After a short stay in Santiago, another 1,040 miles and two flights up the coast put us in the port of Arica, the capital of northern Chile, where we were to meet the NOAA Ship *Ronald H. Brown*.

Arica is squeezed between the nearly rainless Atacama Desert of Peru, one of the driest places on Earth, and one the widest and island-free portions of the South Pacific. It is a week's sail to "westernmost" Chile, Easter Island in the southwest; the home of the giant Moai statues and the most remote population of Polynesians. Arica is known as *La Ciudad de la eternal primavera* - "The city of the eternal spring" and is a busy but pleasant commercial center; the export/import hub for the region.



Arriving before the ship's departure allowed time for two worthwhile endeavors: sitting in on meetings with scientists who were reviewing their projects and exploring this fascinating part of the world.

Over 50 researchers and technicians met at the Hotel Arica, on the shore just south of the city. Discussed in detail were various aspects of VOCALS (VAMOS Ocean Cloud Atmosphere Land Study). VAMOS refers to Variability of the American Monsoon Systems - the seasonal changes of wind patterns. Atmospheric scientists presented overviews on large scale wind movements, rain and cloud-forming particles (nuclei) in the air. Oceanographers discussed the movement of rings (50-mile wide cores or eddies of circulating water bodies) in the

<http://www.eol.ucar.edu/projects/vocals/>

main study area designated ORS* - the Stratus Ocean Reference Station - a curious region hundreds of miles off of Chile with persistent stratocumulus cloud cover. Satellite images, radar, air samples taken by various aircraft and balloons, and water samples brought to the surface from hundreds of meters below are analyzed to study this expanse to better understand the interaction between the ocean and atmosphere, as well as influences on climate.

Meteorologists sometimes tease their colleagues that oceanography is a small aspect of weather science. The atmosphere and ocean are linked by exchanges of energy, and the currency for this interaction is water vapor. Major mechanisms for energy transfer in the ocean are exhibited by great water currents - "Rivers in the sea" as Mathew Maury described them - like the Gulf Stream of North America, and the Humboldt (or Peru) Current off of the western coast of South America.

Personal Log

Since the ship was not fully loaded, the galley closed and much of the crew on shore-leave, we were free to explore the town's small shops and restaurants at its center. My first stop is always

the outdoor markets to see what is being raised and caught locally, and there are some interesting choices here besides fishes, including: *muselina*, *cangrejo*, *limpa*, *percebe*. (Mussels, rock crabs, limpets and barnacles.)

Then, after enjoying a meal of this interesting nugget that I couldn't help copying verbatim from the local menu...*Pastel de jabus en su greda* ("Cake baked carb whit cheese in his clay pot")...it was off to explore the shore.

There are small pocket beaches here with ghost crab burrows; and I found a nice assortment of bivalves and univalves for my collection. There were also many empty squid egg cases that were as thin and white as tissue paper. In spite of the cool waters (60's), children don't hesitate jumping in the waves or sitting in the tide pools gouged in the rocks. These pools are a perfect spot for the budding marine biologist to study or play, and are filled with barnacles, pretty striped snails, and kelp. In the larger ones, small fish stranded by the tides dart for cover when they see your shadow; and other residents - little dark blennies, that match the color of the rocks and probably spend their lives in these havens, safe from bigger predators.



Mullet and mussels at the fish market



Tidepools at Isla de Alacran

Higher up the tideline where the wash of the waves – the life support of the littoral zone - diminishes, barnacles disappear and the main residents are durable little snails grazing on algae, and enduring harsher conditions of temperature and salinity that other creatures cannot. William Beebe wrote of his *little periwinkle*... "when a race of creatures develops an ability to clothe itself in impregnable marble palaces, immune to a host of dangers which threatens less armoured brethren, there is little need of their changing to meet new conditions."

The uppermost depressions in the rocks collect salt spray or ocean water during the spring tides which quickly turns to brine in the dry air and afternoon sunshine. I find the coast here reminiscent of Southern California in many ways.

Sturdy foot gear is in order since much of the coast is either eroding cliffs or rocky wave washed marine terrace. This is the realm of rugged creatures like limpets, snails and barnacles

that must hold or cement themselves to the rock face. It is also the haunt of the colorful Sally Lightfoot, a lively semi-terrestrial crab that darts into crevices as soon as it sees you move, or in anticipation of the next wave – whichever comes first.

Picking at whatever morsels they can catch among the rocks are groups of ruddy turnstones; tall, stately and wary curlews; and noisy and very nervous black oystercatchers. The oystercatchers have a loud squeak-toy call and announce their presence regularly to intruders like me and each other, so although discrete, they are easy to find. Grey gulls (Larus modestus) live up to their Latin name only when it comes to appearance.

Since this is the Autumnal spring, hundreds of them put on a continuous and raucous show along the shore, calling to each other in courtship pursuits, or in pursuit of any working fishing boat that passes.



Barnacles and a drill snail in a tidepool

Some birds like the striking band-tailed gull habituate to people and are common around the



Black Oystercatchers

docks and anywhere fishermen are cutting up their catch. Others, like the Peruvian booby, fly away whenever you approach them. The boobies and their cousins the cormorants, are responsible for the guano cliffs south of Arica, and a short trip to the end of the coast road brings you to a path that leads along the white-washed precipice through a series of caves.

The presence of seabirds is a clue to the productivity of ocean waters, and the legendary abundance of boobies, cormorants, pelicans and gulls (and their guano) along this coast and

especially across the border, confirms it. The *guano islands* of Peru that were mined for their rich fertilizer, harbor the world's largest colony of seabirds, some 10 million strong. The upwelling of nutrient-rich deep waters here helps produce perhaps one fifth of the world's annual fish catch.

By lunchtime the *camanchaca* (coastal fog) cleared "as it always does" and I negotiated a history and cultural tour with a very agreeable taxi driver named Federico. In spite of my poor

knowledge of Spanish, he was able to make it a very educational afternoon. First stop was inland to the Azapa valley and the Museo Arqueologico which specializes in cultural artifacts from the various groups that inhabited this harsh environment from the 7th Century BC until the Spanish “invasion” and colonial period. The earliest inhabitants fished and hunted fur seals and sea lions, and must have struggled constantly with their environment because of the lack of water and building materials. However they did leave behind evidence of their accomplishments: tools like fish hooks fashioned from cactus spines, weaved materials and most significantly (to the archaeologists) *cementerios* with clay-covered mummies – said to be the oldest in the world. Three are exhibited: a man, woman and child.



Geoglyphs on a hillside

They also invented and left behind their own brand of graffiti on the barren hills – *Geoglyphs*. By arranging dark stones on the light dusty hillsides, they created large and highly visible outlines of people and animals, especially llamas. South of Arica is the *Giant of the Andes* – said to be the largest in existence.

I was told these images are a type of ancient trailside billboard, which would have guided pack trains. Climbing up one steep hill to line up a photograph of a very distant condor geoglyph, I stumbled and fell flat on my back – much to the delight of Federico and a friendly dog hoping for a treat from picnickers. I wonder how long my dust angel, *The Gringo of the Andes(?)* will remain here, untouched by wind and rain.



Aduana – The old Custom house

On our way back to town we passed many farms where drip irrigation allows the cultivation of hedgerows of tomatoes, and of course, corn. Olives are an important crop too and the trees that the Spanish introduced are some of the largest and oldest plants in the valley. I made a mental note to pick up some of the local products to bring home to New Jersey as gifts: *Aceitede Olivia* (Olive oil) and a delicious *Mango Chutney*.

In town we visited the restored 1874 customs house (Aduana) which, to my surprise, was designed by none other than Alexandre Gustave Eiffel. Besides designing

the support structures for his famous tower in Paris and the Statue of Liberty, he is responsible for a number of buildings and bridges here in South America.

Looming over the city and harbor is El Morro. At 330 meters it offers an incomparable vista of the entire area, including a birds-eye view of surfers and windsurfers taking advantage of the consistent southeasterly breeze and swell. Birds are in constant motion too, benefiting from the updraft on the steep cliff and circling it effortlessly. Vultures are the most common, and I made eye contact with a large red-tailed hawk soaring directly in front of us. At one point three falcons of different sizes were engaged in aerial combat, diving upon each other and then wheeling high above; the smallest being the noisiest and most aggressive; perhaps defending an eyrie below us.



Puerto de Arica from El Morro

After a glorious sunset over the sea, the wind died down “as it always does” and the cool layer of marine air moved inland. Once it was dark, the park downtown erupted in music at several locations, including what I would describe as a *head-banger* concert that was loud enough to cause me to retreat back to the hotel to instead be sung to sleep (as the poets say) by the mewing of the nearby *gladness of gulls*.

*(ORS refers to a Woods Hole Oceanographic Institution (WHOI) buoy moored at 20° South/85° West, in the center of a vast region of cloud cover in the South East Pacific (SEP). Similar cloud regions occur off of the coasts of West Africa, California, the Western Atlantic and Western Australia, but this one is the largest and most important in modifying weather.)