

-5 JAN 90 12 50z

R/V Cory Chouest Telecopy Cover Sheet
Telecopy Number 011-872-150-5225

Date: 05 Jan 1991

To: Name: APL Comm
Company: JHU/APL
Fax Number: 301-953-1093

From: Name: Cory Comm
Company: SEES

Total number of Sheets, including Cover Page: 1

APL Comm Please route this SITREP to distribution

From: SE Government Services 05 Jan 1991
To: Distribution
Subj: Dockside SITREP #4, Fremantle, WA (Western Australia)

1. Members of the scientific party are still arriving.

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 HAI - Tom Judd, Dan McCloskey - Hand delivered ✓
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 Sea World Research Institute - Dr. Ann Bowles - Hand delivered ✓
 APL, University of Washington - Dr. R.C. Spindel 206-543-8785 ✓
 Scripps Institution of Oceanography - Dr. W. Munk 619-534-6354 ✓
 University of Michigan - K. Metzger - Hand delivered ✓
 Amy Chouest - Captain Joe Borkowski - Hand delivered ✓
 Master R/V Cory Chouest - Hand delivered ✓

**HEARD ISLAND SCIENCE DAILY
9 JANUARY 1991**

TO ROBERT SPINDEL FAX 206-543-6785

1. This is the first issue of HISD, giving a summary of the daily acoustic and biological activities. Bob will routinely fax HISD to Briscoe, DeMaster, Wursig, and Munk (at SIO), and from time to time to anyone else who he thinks should be informed about a particular item. The purpose is to keep the PI's informed so that we can take speedy action when necessary, and to raise issues which require action and clarification.
2. If you wish, we could prepare a weekly summary for a wider distribution. Please advise.
3. Please note change in area code for Cory from 872 to 873. Telephone 873-150-5224 and 5235, FAX 873-150-5225.
4. Cory Chouest departed Fremantle at 1400 local and is going 9.5 knots direction 232T. Winds 25 knots from 210T. Marine mammal observers started operations. Many birds have been sighted, no mammals so far.
5. Amy traveling 8 knots in 5-10 ft swell, wind 30 knots from SE. Amy is riding smoothly with observers on flying bridge all day using 25x150 binoculars (Big-eyes). Marine mammal observers began their watch (2 hrs on, 2 off) at 1330 local. Whales sighted at 1700 local at 35 15S, 109 52E. The best news today was the observation of at least 5 Barau's petrel (Pterodroma barau), a species known from Le Reunion and environs, but not known down here (per Bob Pitman and Richard Rowlett).

9. 91 09:19 PM *CORY CHOUEST

P02

6. Art will be pleased to learn that his signal analyzer was badly damaged in transit, but has been repaired and now looks as if someone shot it with a semiautomatic pistol. (Walter's misplaced humour.)

7. Would Doug please respond as soon as possible to two modifications: (i) the request to change the wording of the permit from "dead marine mammals" to "dead cetaceans"; and (ii) the request for modification of the number of harassed animals.

Walter Munk
Ann Bowles
Andrew Forbes

01. 10. 91 11:34 PM *CORY CHOUEST

P01

FAX TO
SPINDEL

14

HELDON ISLAND SCIENCE PARTY
10 JANUARY 1991

TO ROBERT SPINDEL FAX 206-543-6785

Cory Chouest is progressing at 9 knots into SE winds. Further west, Amy is travelling at 7 to 8 knots into a 10' swell and 30 knot winds. The schedule for completing the 4 day survey prior to transmission is somewhat tight. Weather has been pleasant, partly cloudy. Observers are on station from sunrise to sunset at both stations.

Amy sightings to date are as follows.

- 1 beaked whale (*Mesoplodon* spp.) on 9 January
- 30 pilot whales (*Globicephala* spp.) 10 January
- 1 unidentified beaked whale
- 1 Australian sea lion (tentative id.) not usually found here

Cory sighted an unidentified small cetacean (dolphin) this morning. Great winged Petrel was the most frequently seen seabird.

Amy conducted two test deployments with sonobuoys. Receiving equipment functioned well, although noise levels are still too high, probably as a result of weather conditions. The APL pinger is working properly, but the transducer needs to be lowered to greater depth. John Hunter has devised a neat method for paying out the 60m length of string to adjust sonobuoy depth.

Cory conducted a brief source test in air, and we have learned how to measure source intensity in situ. Range to Scott's sonobuoy will be determined using Andrew's acoustic release pinger. Matthew Dzieciuch is devising a method for recording

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HEARD ISLAND SCIENCE DAILY
11 JANUARY 1991

TO ROBERT SPINDEL FAX 206-543-6785

At 1300Z Cory is at 36S, 108 1/2 E, going about 9 knots toward south-west in 15-20 knot winds. Amy is about 300 miles ahead, encountering 30 knot winds and 10-15' swell (she seems to be soaking up the weather for the Cory). As things stand for the moment, both ships will get to Heard Island on the 20th.

Amy sighted no marine mammals today but had four species of albatrosses follow them, thus compensating for the windy weather. They saw a Japanese long-liner heading north-east. Bob Franklin devised a handy brick pinger-sinker which made it possible to deploy both the APL pinger and the sonobuoy (and you thought there was no use for bricks on a boat). Returns from the sonobuoy were strong to 3 nm and detectable out to 6 nm. A modem link is being established between Amy and Cory.

On the Cory marine observers maintained a sunrise to sunset watch in good weather, using 25x and 7x binoculars. A group of 8-10 common dolphins (*Delphinus delphis*) was encountered in the late morning. The observers now have wooden benches on top of the wheelhouse, so their task is made a bit easier. Clocks will be retarted one hour tonight and one hour tomorrow night, and from then on we will be on Heard time, Z + 5. A daily meeting has been started at 1245 in the conference room.

Today we discussed array deployment, current meter recovery (set by Andrew last June) and sound speed profiling. Tom Judd is hesitant to deploy sources if the weather is worse than state 3

or 4. So we welcome a 4 day "weather window" at the source site.

You will recall that we responded to a critical Greenpeace Australia press release. We received the following encouraging reply:

"Thank you for your FAX of the 10th. I have passed your comments and questions on to our scientific advisors, and I hope to reply to you and clear the air between us at the beginning of next week. I hope the weather is fine for you. (I've crossed those seas many times!)

Regards, David Iggulden."

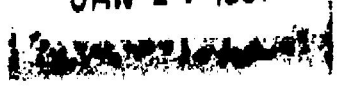
Walter Munk
Ann Bowles
Andrew Forbes

SPINDEL 20

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**HEARD ISLAND SCIENCE DAILY
12 JANUARY 1991**



TO ROBERT SPINDEL FAX 206-543-6785

Amy is now well into the roaring forties, with 10 to 20 foot seas (and a number of 30 footers). They are bucking 30 knot winds, and the observers are beginning to look like old salts from Gloucestershire. Sighting conditions are rotten, no cetaceans today, but an entourage of a dozen albatrosses all day. There was one young Wanderer with distinctive spots on his wings that followed Amy all day.

On the Cory seeing conditions were fair to poor, with a 10 ft swell and occasional rain squalls. A small pod of unidentified cetaceans was encountered midday.

Ann has connected a modem to send data back and forth between the two Chouests. Scott, Rick Ray and Andrew tested the sonobuoy launch and receiver/recording system. It operated quite well for 30 minutes at a ship's speed of 8 knots.

This morning Andrew and Walter spent some time going over Doug deMaster's suggested simplified protocol for what to do should dead cetaceans and pinnipeds be encountered. We suggest that Doug contact Aleta and ask her to get a SKY PAGE (like Mel and Bob) so that if necessary there can be a direct contact between Ann and Aleta (or possibly Scott and Aleta) for the critical period 20 January till 6 February. Doug please respond.

Matt, George and Walter have been playing with GPS data to see whether one can measure the unsteady component of ship's motion (for Doppler correction).

Walter Munk, Ann Bowles, Andrew Forbes.

*1/4 Faxed Copy to: Munk (file), Briscoe, Wursig, deMaster,
Church, Woodward*

(1/4)

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JAN 14 1991

HEARD ISLAND SCIENCE DAILY 13 JANUARY 1991

Bob, please send this on to Ted and Kurt. Matt produced the plots on the next page. Satellite fixes during one hour, one for every ten seconds or so, were fitted by least square to produce the mean velocity. Departures of individual GPS fixes from the mean progress are shown for the foreward component, and the port component. Duration one hour.

1. The two component look very different. The foreward component is oscillatory with 4 wiggles during the hour and an amplitude of 20m. The port component looks like an accelerating current in the starboard direction. Both are adequately sampled.
2. Both are too big to permit coherent processing for a constant time compression for the entire hour. But they would permit coherent processing of 10 minute chunks.
3. One would suppose the ideal processing is to apply the measured component of acceleration along the geodesic at Heard to the signals received at the fixed stations. Any ideas?

The weather was kinder today, calm and sunny for the Cory and down to 30 knot winds for the Amy. The Amy is half way to Heard, and the injection temperature has dropped from 13 C yesterday to 12.2 C today. The entourage of birds were about the same as yesterday. On the Cory the following were seen:

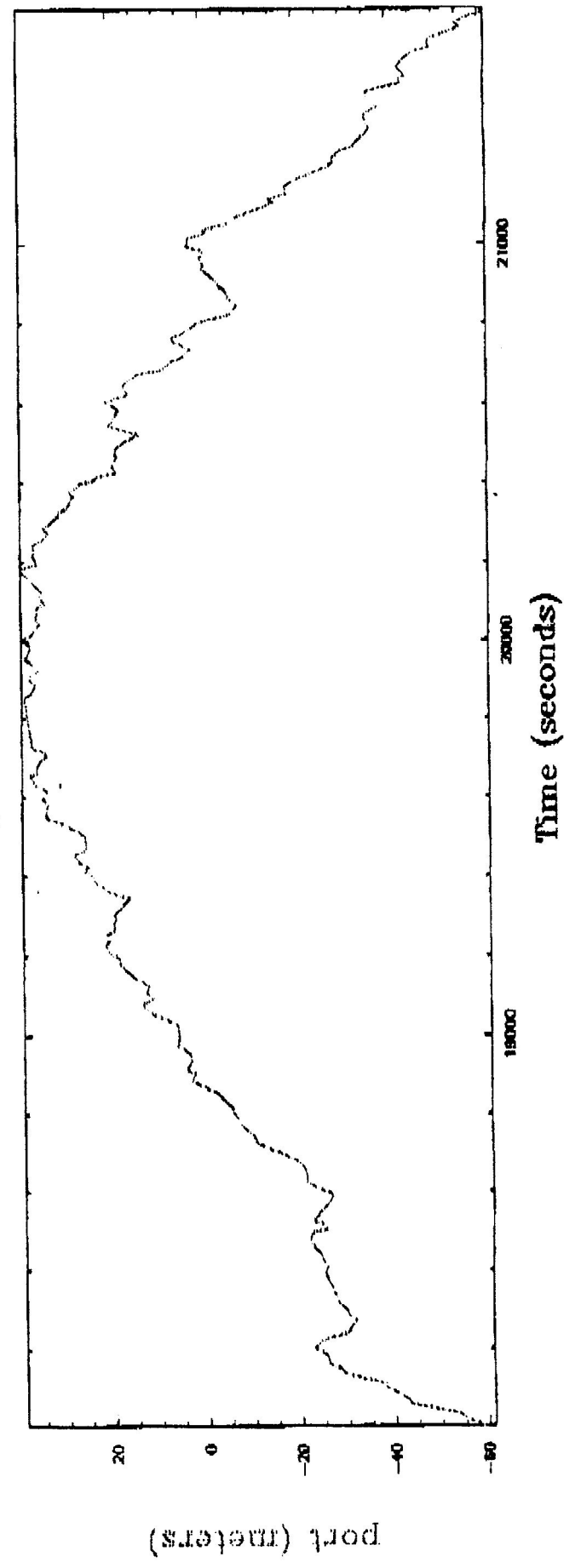
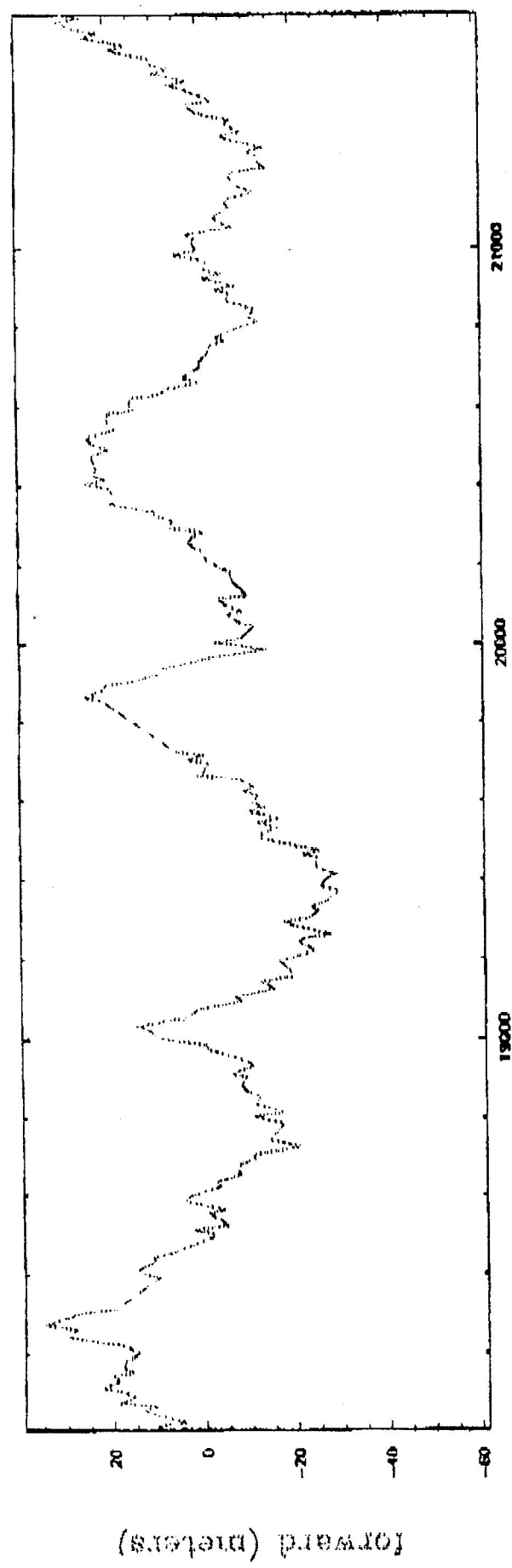
Unidentified rorqual (twice)
Unidentified meaplodon Spp
Unidentified small whale and unidentified dolphin
Globicephala Spp.

It was a relaxed Sunday.

Walter Munk, Ann Bowles, Andrew Forbes.

*Y14 Faxed Copy to: Munk (file), Briscoe, Wursig
Demaster, Church, Woodward
(A) Birdsall, Metzger*

R/V Cory Chouest Wobble



01. 15. 91 12:38 AM *CORY CHOUEST

P02

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JAN 14 1991

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HEARD ISLAND SCIENCE DAILY**14 JANUARY 1991**

Amy is at 45°S with 20 - 30 ft seas on her beam, and 35 - 40 knot winds, gusting to 48 kts. Water temperature is down to 10.6 C. Everyone agree that Amy is riding this weather remarkably well. The only concession came from the galley - Chef Bear put away the bottles of salad dressing, which have set out unrestrained since leaving Perth. No marine mammal watch was maintained.

Cory encountered 30 knot winds and a 10 ft swell from the starboard beam. Sighting conditions were poor and the binoculars could be used only intermittently due to sea spray. No marine mammals were encountered.

An SVP profile gave an axial soundspeed of 1482 m/s at 1100 m depth, very much in accord with the climatological expectation. We had a protest from the Director of the Australian Bureau of Mineral Resources, stating that our transmissions might interfere with geophysical work on the continental shelf off Perth.

We have good news coverage from the Persian Gulf via the Armed Service Station.

Walter Munk
Ann Bowles
Andrew Forbes

*Y14 Faxed Copy to: Munk (file), Baiscoe, Wursig, demaster,
Church, Woodward*

HEARD ISLAND SCIENCE DAILY
15 JANUARY 1991

Sunny and cool for both vessels. The water temperature on the Amy has dropped to 8.3 C, and the first giant petrel was sighted, a sure sign that the convergence is close. No marine mammals were seen on the Cory despite continuous efforts with 25x and 7x binoculars.

Amy acoustics team deployed a final test sonobuoy today. John Hunter's patented Finger-crochet Sonobuoys Launching System worked better than expected for deploying the hydrophone to the correct depth. The signal was strong to at least 5.5 km. Amy makes quite a racket, even to that distance:

The Cory acoustic team tested out Andrew's system for measuring the distance of the Sonobuoy with the recall pinger. Daily sound velocity profiles will give a nice trans-Indian Ocean vertical section, and ought to be useful in working up the transmissions. We are anxiously awaiting news for permits modified and granted from U.S. and Australia alike. And we are hoping that by tomorrow this time the world will not be at war.

Walter Munk
Ann Bowles
Andrew Forbes

R/V CORY CHOUSET TELECOPY COVER SHEET

FAX NUMBER 011-873-150-5225

APL DIRECTOR'S OFFICE RECEIVED

DATE: 1.16.91

JAN 16 1991

TO: NAME: R. Spindel

FROM: NAME: W. Munk

COMPANY: APL

COMPANY:

FAX NUMBER: 206-543-6785

NO. PAGES: 2

**HEARD ISLAND SCIENCE DAILY
16 JANUARY 1991**

We feel the need for some feedback from the home front. During the last week we have made a number of enquiries and don't know whether they were received and acted upon. Foremost was the question of what happened to the request for modification of the Permit. (Today we sent some Faxes asking for the proper version of the Permit to be faxed to Gordon Anderson.) There was also our request to get Aleta a SKYPAGE for direct emergency communication with Ann. Bob, could you help get some of the information back to us.

One reason for this need is Andrew's continuing contacts with Australian authorities and societies. Andrew talked to David Iggulden of Greenpeace, Sydney today. David was the nominal author of the Press Release that went out the day before we sailed (some or most of the material came from their London office) to which we replied in some detail. The intention of the call was to keep the dialogue going so that we can deal with any concerns Greenpeace might have, well before the Australian Whale Permit deadline on January 21. The exchange of information between Andrew and David was productive and quite friendly and David will let us know the outcome of



tomorrow's meeting in London at which the experiment is again an agenda item for discussion.

Mate Warren of Cory sighted an Orca whale at 3 AM much to the chagrin of the sleeping observers. Watch all day with 7x and 25x binoculars. Calm Seas. Rewarded at end of day with the sighting of a pod of 30 Orca and stayed with them for about 45 minutes. An attempt to listen with sonobuoy failed for unknown reasons.

Amy has reached 48 N in good weather. The convergence must be getting very close now. The engine intake temperature dropped to 6.1 C by midafternoon. The air temperature was 11 C at noon and dropped to 9.5 C by evening.

A southern bottlenose whale (Myperoodon planifrons) and a school of unidentified dolphins were sighted this afternoon.

By an ingenious set of measurements and deductions John Hunter and Ann postulated that at 57 Hz an output of 1.0 Vrms must be equivalent to 127 dB. Now very fortunately this agrees with existing calibration charts (TRANSDEC, 20 Mar. 1986). Therefore the existing calibration charts will be accepted for determining intensities.

Walter Munk
Ann Bowles
Andrew Forbes

FAXED VIG: Munk (file), Briscoe, Ursig, demaster
Church, Woodward.

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JAN 17 1991

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R/V CORY CHOUEST TELECOPY COVER SHEET**FAX NUMBER 011-873-150-5225****DATE: 1.17.91****TO: NAME: R. Spindel****FROM: NAME: W. Munk****COMPANY: APL****COMPANY:****FAX NUMBER: 206-543-6785 NO. PAGES: 2 3****HEARD ISLAND SCIENCE DAILY**

The Amy, ever leading, crossed into the fifties. Her present position is 50° 24' South, 80° East. Some poet aboard the Cory left the following lovely quote from Shackelton's Boat Journey by F.R. Worsley:

In the afternoon the swell settled and lengthened out - the typical deep-sea swell of this latitudes. Offspring of the westerly gales, the great unceasing westerly swell of the Souther Ocean rolls almost unchecked around this end of the world in the Roaring Forties and Stormy Fifties. The highest, broadest and longest swells in the world, they race on their encircling course until they reached their birthplace again, and so, reinforcing themselves, sweep forward in fierce and haughty majesty. Four hundred, a thousand yards, a mile apart in fine weahter, silent and stately they pass along. Rising forty or fifty feet from crest to hollow, they rage in apparent disorder during heavy gales.

Amy had a fine day. It was sunny and calm. Sighting conditions were perfect. The species composition of birds has changed dramatically since yesterday. Today, Amy sighted many Antarctic prions (Pachyptila desolata), diving petrels, Wilson's storm petrels (Oceanites oceanicus), southern giant petrels (Mascronectes giganteus); a few Wandering Albatrosses, and some blue petrels.

Marine mammals (and pseudo-mammals) sighted today include King penguins (at least 13 birds, mostly adults), Hourglass Dolphins (7 schools sighted averaging 6 - 12 animals), Southern bottlenosed whales, an unidentified whale and Antarctic fur seals.

Cory is at 47° 17' South, 87° 40' East. Light rain and strong winds prevented any searching for marine mammals during the morning hours. However, by noon the skies had cleared and the wind decreased to a Beaufort 5. A watch with 7x and 25x binoculars was rewarded with a close encounter with a small group of Hourglass dolphins (Lagenorhynchus cruciger) in the late afternoon.

We attach an interesting plot generated from GPS positions by Matt Dzieciuch. It shows the offsets in meters of Cory from a point traveling with absolutely uniform speed and direction. The mean values are an hourly average. The rms offset in the for-and-aft direction is 21m, the port-and-starboard component is 13m. It is not clear whether the departure from constant velocity is geophysical or navigational (the ship was on automatic pilot). It is important to us for the following reason. The speed of the ship (source) introduces a doppler shift in the CW tone; as long as the doppler is constant it is corrected for by a procedure introduced by Birdsall and Metzger. A non-constant doppler of sufficient amplitude would prevent coherent processing. (We estimate that coherent processing is limited to about a half hour.)

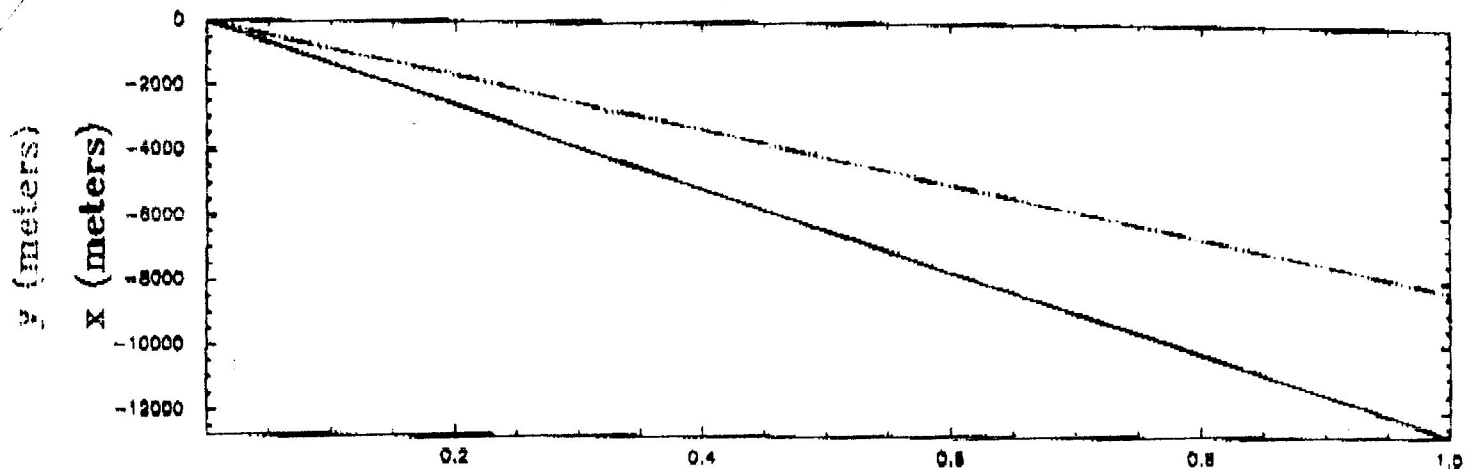
The sound axis has been steadily rising, from 1100 m to 625 m. At an XSV drop just completed it fell again to 975m, demolishing George's plan for an CTD survey of the convergence zone tomorrow. We must have encountered an eddy displaced from the north by 200 miles.

Walter Munk
Ann Bowles
Andrew Forbes

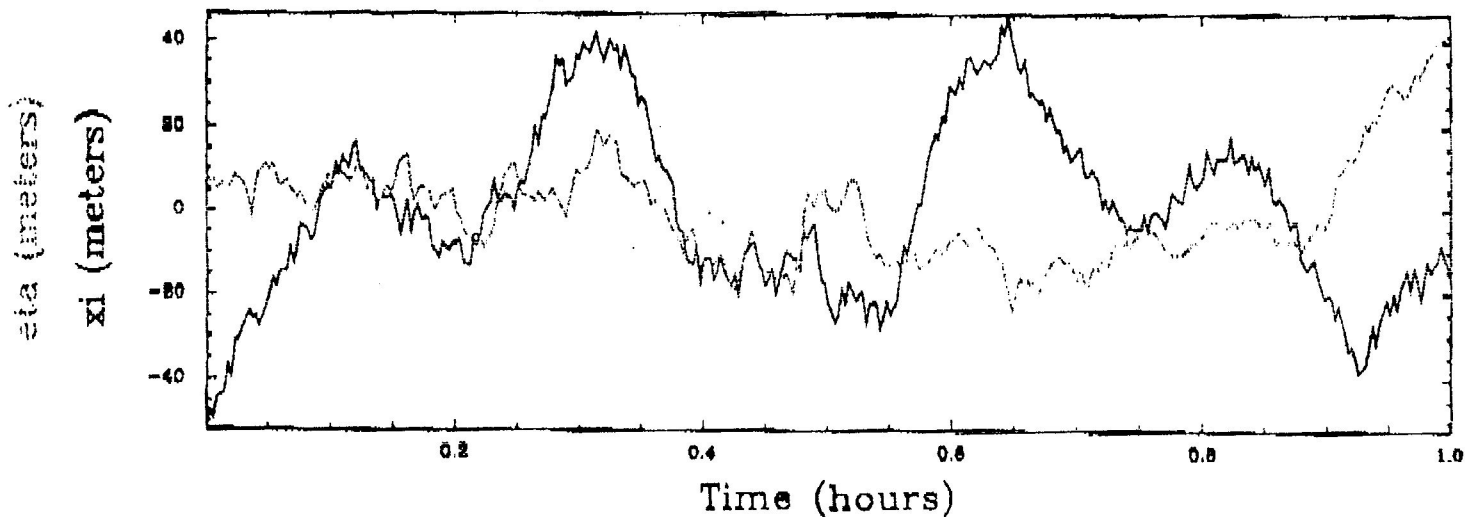
1/17 Faxed: Briscoe, deMaster, Church, Wursig, Woodward, Munk



R/V Cory Chouest Position



R/V Cory Chouest Wobble



start julian day: 16
start time (hours): 0.00
start latitude: -44.295112
start longitude: 93.584851
ls velocity (knots): 8.20
ls course (degrees true): 236.89

ls x velocity (m/s): -3.53
ls y velocity (m/s): -2.30
ls velocity (m/s): 4.22
rms(x'): 19.83
rms(y'): 13.65
rms(xi): 20.54
rms(eta): 12.54

DATE: 18 January 91

TO: NAME: R. Spindel

FROM: NAME: W. Munk

COMPANY: APL

COMPANY: SIO

FAX NUMBER: 206-543-6785 NO. PAGES: 4

HEARD ISLAND SCIENCE DAILY

Amy is now at 52° 06' S, 76° 03' E, due to arrive at Heard Island shelf at late tonight. Cory is at 49° 16', 83° 31' and due at the site on the 20th at 0630Z. The sea is relatively calm; we rather fear that we have used up our supply of good weather before going into action acoustically.

At the Amy location the temperature has dropped to Antarctic levels, the water has stabilized at 3.6 C. A different assortment of birds was sighted, including the first light-mantled sooty albatross. The concentration of marine mammals has declined considerably, indicating that the convergence zone has been crossed and that Amy is indeed in Antarctic waters. The marine mammal observers did sight a large school of pilot whales (Globicephala melaena), consisting of 60 to 80 animals in two groups. They were milling at the surface, possibly feeding. A sonobuoy was deployed, engines were shut down for 30 minutes and 60 minutes of recording were taken. Although a sea state 4 made the recordings noisy, they may be useful for future analysis. Observers practiced making behavioral observations.

The Cory was blessed with light winds (Beaufort 2) and overcast skies which created optimal conditions for marine mammal observations. The following were encountered:

Lagenorhynchus cruciger (Hourglass dolphin)

Balaenoptera physalus (Fin whale)

Mesoplodon Spp. (Unidentified beaked whale)

Our first King Penguin was seen this afternoon.

Roy Carter and Richard Neville are taking daily sound velocity profiles (XSV) to yield vertical sections for the westward and eastward acoustic paths. These have been augmented by frequent XBT's and George Dworski's occasional CTD's. The plan was to take 3 closely spaced CTD's in the Convergence Zone. But there was to be a surprise.

The traditional picture is that the the sound axis rises continuously from about 1200m at 40° south to near the surface at 60° south. Figure 1 shows some selected profiles, with latitude marked at the depth of the axis. From 45° 44' S to 46° 38' S the axis rose from 900m to 700m, pretty well as expected. We stopped for a CTD cast at 47° 18' where we had projected an axial depth of 550m (the casts are limited to 600m). To our surprise the axis had deepened, to about 1000m (!), beyond the reach of the our cast. Going further south to 47° 49' it deepened even further to 1100 m. But at the next station 48° 26' the axis was precipitously higher at 350m but in accordance with the traditional picture. The results are consistent with a hundred mile eddy from the north having penetrated southern waters.

Fig 2 shows two XBT profiles taken only 3 miles apart.

We understand that no comments have been filed concerning the amendment to the U.S. Permit and that it should be signed soon. As of Friday 1600 East Australian Time there have been no comments on the Australian Permit application (fax from John Church). The cut-off time is end of business on Monday. Aleta is in touch with Gordon Anderson in an effort to make U.S. and Australian Permits compatible.

*1/18 FAXED: Munk, Woodward, Briscoe,
Wursig, de Master, Church*

HIFT (approaching convergence zone)

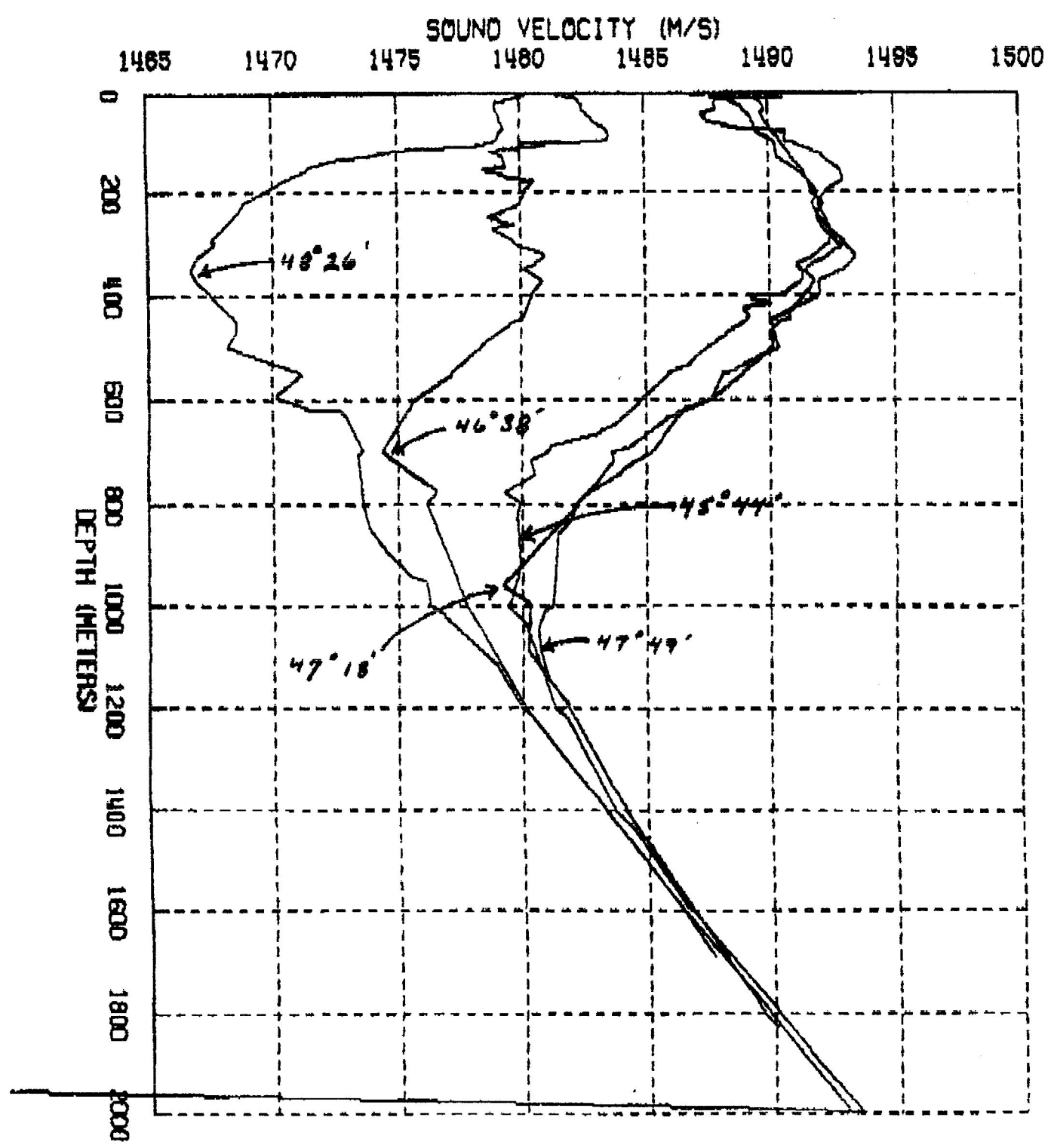


FIG 1.
(A)

HIFT (48-26')

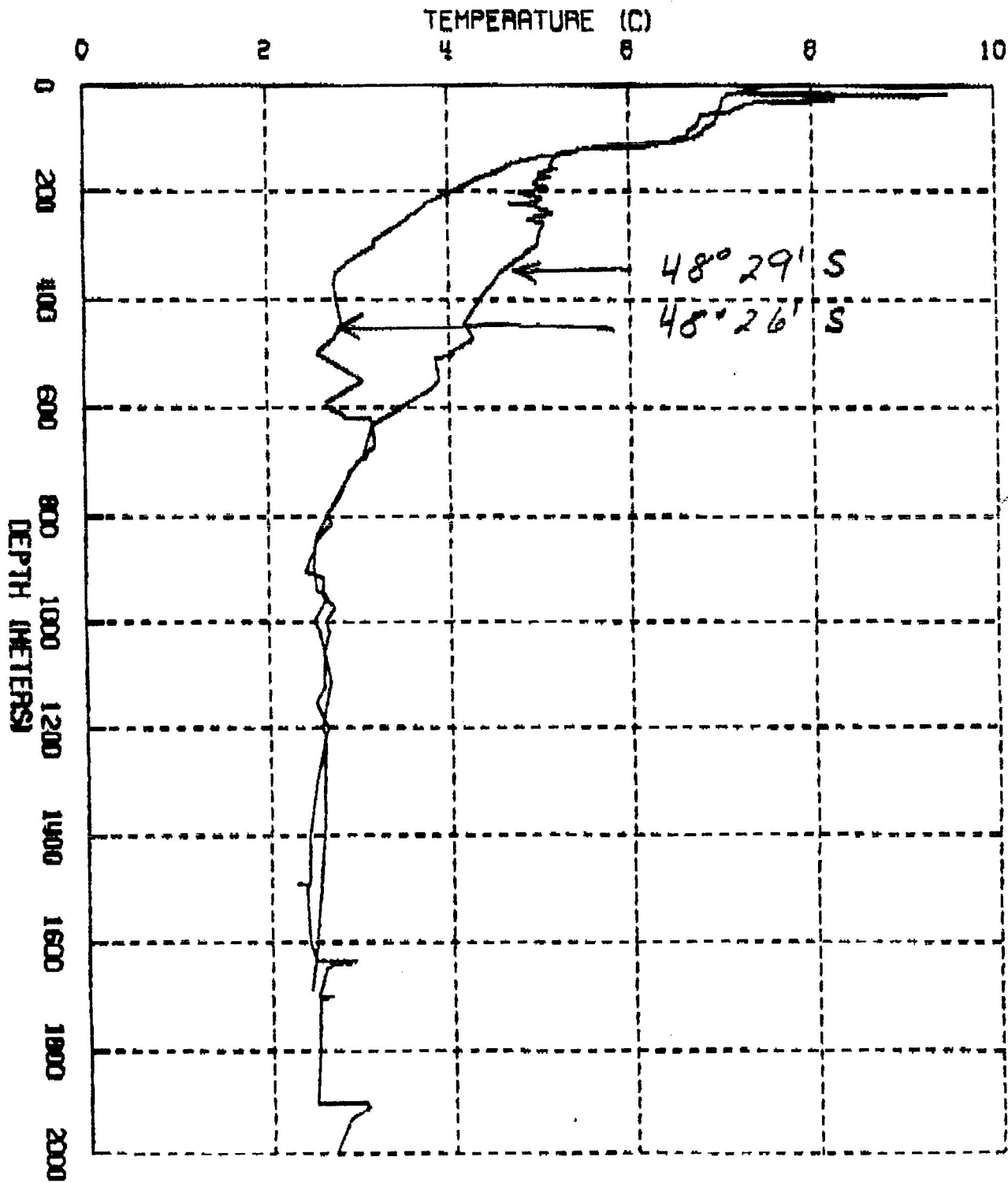


Fig. 2

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JAN 21 1991

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TO: R.Spindel. APLFROM: W. Munk. SIOFAX NUMBER: 206-543-6785 NO. PAGES: 3

20 January 91

HEARD ISLAND SCIENCE DAILY

We made this a weekend issue, 19th and 20th January. Amy has started her transect, Cory arrived at the transmission site at 1300 ZULU on 20 January. It is rainy and overcast; Heard Island did not put on her most sunny face to welcome us.

We were buoyed by messages from home. Roger Revelle fax'ed: "YOUR MESSAGES FROM DOWN UNDER ARE WONDERFULLY INTERESTING. WISH I WAS WITH YOU BUT GLAD I'M NOT"

We are trying to visualize how people are now departing for the various receiver sites in all of the World's oceans. According to Bob's messages, things are ready to go with the possible exception of Ascension Island which might be a war casualty, due to non-availability of military transport aircraft.

The attached figure is the first indication of what this year's summer sound channel looks like. The station at 52°50' S is very close to our area of operation; the axis is at 160m and the surface to axis contrast is 7 m/s. Only 1 day prior and 2° further north we had gotten our hopes up with a much better wave guide: a 200m axis with a 13 m/s surface to axis contrast. We have taken many soundspeed profiles during the last few days, and the axis varies irresponsibly between 100 and 200 m at close intervals.

Amy started the last leg of her transit to Heard Island on 19 January at 0500 Z (1000 local), running south along the shelf break in search of pinnipeds and other marine mammals. Unfortunately the sighting conditions were poor to awful all day, with the occasional doze of haze and wind-

driven snow. Amy vainly ran two transect lines in the hopes of finding better weather further out to sea.

Despite the bad weather, she did get a glimpse of the picturesque skirts of the Island from beneath the clouds. Captain Joe was careful not to approach too closely because when the long spit is submerged at high tide it does not show on radar. A few fur seals and a possible minke whale were seen during the shelf survey. In the vicinity of the island, however, things were livelier. The air was filled with swarms of Antarctic and narrow-billed prions, Wilson's and black-bellied storm petrels, Cape pigeons, skuas (Catharacta lonnbergi), black-browed albatrosses and giant petrels. Fur seals and three species of penguins, the Gentoo, Macaroni and Rockhopper, were seen porpoising away from the ship in all directions. Together the island and the birds made a wonderful scene after all these days of travel.

Meanwhile on the Cory, the marine mammal observers were forced to don their Mustang suits as the Cory officially crossed into the Southern Ocean. Cold and windy conditions prevailed and intermittent fog greatly reduced visibility. Despite the lousy conditions, a small group of Lagenorhynchus cruciger (Hourglass dolphin) and a small pod of unidentified small whales were encountered. Both abundance and diversity of seabirds increased dramatically. Prions, Diving-petrels and Black Browed Albatross were the most obvious.

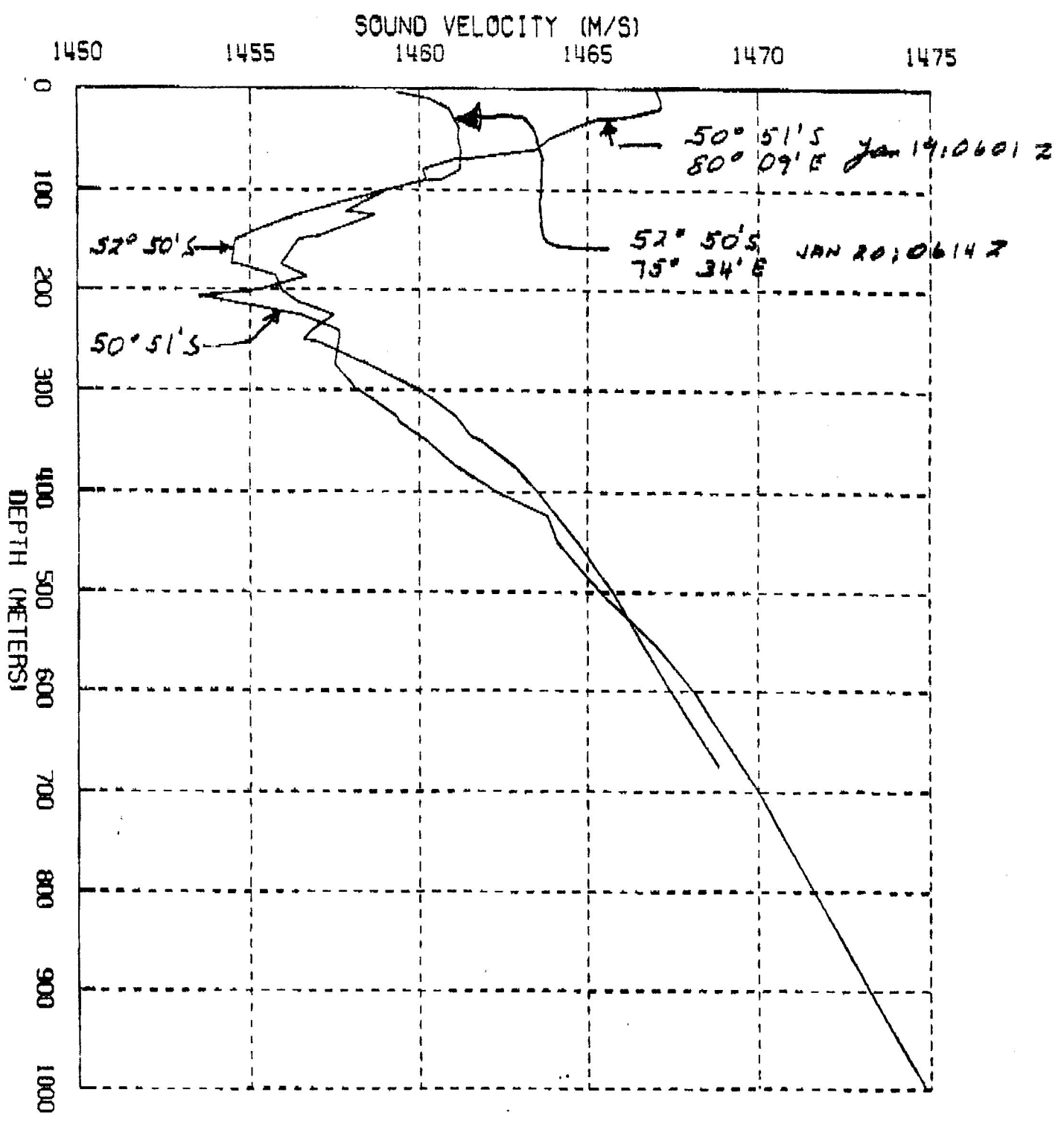
On the next day (20 January) sighting conditions became worse, with heavy fog decreasing visibility to less than one mile for much of the day. A small group of Hourglass dolphins found us in the morning and played in the bow wake for about twenty minutes, much to the delight of the few hearty spectators that braved the very cold and damp Antarctic air. A large unidentified whale was seen in the afternoon.

At 0920 Z, Radar picked up the top of Big Ben at 50 miles bearing 270°.

Walter, Ann & Andrew

1/22 Faxed: Munk, Woodward, Briscoe,
Wursig, deMaster, Church

HIFT (1061 & 1066 XSV's)



TO: R. Spindel, APLFROM: W. Munk, SIOFAX NUMBER: 206-543-6785 NO. PAGES: 22

21 January 91

HEARD ISLAND SCIENCE DAILY

Cory woke up to brilliant sunshine and her first look at Big Ben. After seeing a two-dimensional world for 15 days (2.1 fractional dimensions on rough days) Big Ben made a profound impression.

Immediately after breakfast, Andrew Forbes made a smart recall of the current meter mooring he had set in June 1990. The enable signal was transmitted at 0152 Z, the response was heard at 0155, and the two current meters were on deck by 0250. Not a sign of corrosion, and the workings looked in perfect shape. Andrew had obtained a one month record in 1990 prior to departing, and found a predominantly diurnal tidal current, with a residual current of 15 cm/sec setting towards ENE. The two 8-months records will be a significant addition to current measurements in the Southern Oceans.

The weather was good, so it was decided to put down the sources. This is a major operation and it was beautifully performed by the technicians aboard. The array axis was placed at 175 m, the center of the sound channel. (The array cannot be lowered in bad weather, and we had dreaded the possibility of four consecutive bad days which would make us miss our start date.) We will now drift with the array down until transmissions start in 4 days.

The marine mammal observers settled into drifting mode today, maintaining a continuous watch for animals that might approach the Cory during her drift. Two separate incidents of curious fur seals, within 100 meters of us, were noted. In addition, a small group of Hourglass dolphins lingered on our bow for about five minutes before disappearing.

01.21.91 10:46 PM *CORY CHOUEST

P02

9

Amy is well on her way to carry out the pre-transmission transect survey required by the Permit. This involves a 75km by 75km square to the south and east of Heard Island, centered on the transmission point. During the four days Amy is to run 16 parallel north-south transects at 5 km separations, for a total of 1200 km.

The survey commenced yesterday (20 Jan). Observers saw minke whales three times (5 whales) hourglass dolphins twice, and one southern bottlenosed whale. Whales were scattered up and down the survey lines. Observers also saw some king penguins, although certainly not in the number they found in the convergence zone.

The survey continued all day today. The deep waters south of Heard Island have an abundant marine mammal fauna, consisting of species that feed on squid, and a somewhat smaller number of krill feeders. Observers saw southern bottlenosed whales at least four times, in small groups (1-3 animals). This afternoon the sighted an enormous pod of pilot whales., estimated at over 250 animals of all ages, mixed with a small scattering of 30 or so hourglass dolphins. They were first sighted in a state of high excitement dead ahead of Amy, spyhopping and jumping and breaching, with swarms of birds all around them. A close look at the fish-finder fathometer showed a concentration of targets at 60 m and smaller balls at 20 m or so. Amy was shut down and a sonobuoy thrown over the side. A long series of sharp knocks heard underwater suggested that the animals were indeed feeding (these sounds are associated with feeding pilot whales off California). They were whistling loudly and well.

After hanging around Amy for 15 minutes, the school swam slowly down the sides of the boat, rounded her back quarter, and headed east with the prevailing current, calling constantly as they went. Observers listened to them go until their calls were lost in the background of wind noise.

Walter, Ann & Andrew.

TO: R.Spindel, APLFROM: W. Munk, SIOFAX NUMBER: 206-543-6785 NO. PAGES: ~~1~~ 2

22 January 91

HEARD ISLAND SCIENCE DAILY

Tuesday, January 22

Today we received a letter from David Iggulden, Greenpeace and he has countered some of our criticisms of his press release by basically repeating his earlier statements. He did apologies for one or two errors, though, and his covering note was friendly. I am glad they did not object officially to ANPWS. His letter was actually written in time to do that, but not sent until today.

Today we are going to practice maneuvering the ship for one of our transmission runs. We will see how good our navigation is. Roy Carter fixed the wind direction sensor so now we have a check on the bridge's estimate of the best direction to steam.

We actually did three practice runs and the navigation procedure worked well, even though the wind direction sensor does not work after all. Matt generated the appropriate waveforms so it almost seemed like a real run. The M4 sequence sounds very pleasant through the speaker, the pentaline has a harmonic beat to it, but the CW sounds dull.

Matt and Bill Perris spent the afternoon rigging up a sonobuoy hydrophone so we can use the ship's sounder to range to Scott's sonobuoys. We will try it tomorrow.

Cory biological observations were relatively sparse on account of the navigational practice runs. Like yesterday, two separate sightings of single fur seals were made, and

(147)

there was one encounter with a solitary Mesoplodon spp. All were seen within 50 meters of the vessel.

Amy is running up and down near the transmission site, surveying for the third day. At 1130 local they spotted a fin whale hanging around the surface about 1 nm from the ship. Mari Smultea was finally able to collect some behavioral data, as the whale meandered around at the surface for about 1 hour. A sonobuoy drop showed that the animal was not vocal. The fish-finder indicated concentrations of potential prey at 100 and 250 m.

At 1630 local a large bull sperm whale was sighted blowing at the surface, and the observers were able to follow him for 15 minutes. He disappeared thereafter, but he did not leave the area. One animal's worth of sperm whale clicks were clearly audible for 1 1/2 hours after the whale was sighted; he was still clicking when the sonobuoy went out of range.

Three small fin whales were sighted at 1700. They stayed at the surface for over an hour, with Amy following at a discrete distance. A sonobuoy failed to detect any calls.

The rest of the sightings were the usual fare of the last two days: two southern bottlenosed whales and some unidentified dolphins (almost certainly hourglass).

Wasta, Ann & Andrew

*has Faxed: Munk, Briscoe, Woodward
Wursig, demaster, Church*

(Handwritten mark)

TO: R. Spindel, APL FROM: W. Munk, SIO
 FAX NUMBER: 206-543-6785 NO. PAGES:

23 January 91

HEARD ISLAND SCIENCE DAILY

Today's Science Daily has little science. We managed in two days to get our official response to Canberra concerning the comments by Project Jonah and by the Australian Conservation Foundation. DeMaster prepared his excellent response, using also material by Spindel, Wuersig, Bowles, Forbes and Munk. Spindel kept things moving back and forth. As we write this, the complete document has been on the desk of Gordon Anderson ANPWS for three hours. Transmission is to start in 70 hours.*

(A third responder, the DEPARTMENT OF FOREIGN AFFAIRS AND TRADE, responded positively: "...In view of this commitment for Australia to contribute actively to international efforts to find solutions to the problem of climate change activities, this Department supports the conduct of this experiment.")

Bob Spindel faxed today:

1. Baggeroer is in Monterey and everything looks good
2. Mikhalevsky reported late last week that Bermuda vertical array looks good
3. Ross Chapman is on shakedown cruise with Canadian array. So far so good.
4. Ted and Kurt are right now setting up the West Coast stations.
5. Japanese are at sea, on way to listening site
6. Dan Walker, Hawaii, is able to listen to H.I. frequencies with hydrophones On north side of Oahu.
7. Woodward believes equipment has already left for Ascension, and that personnel left yesterday. Am still trying to confirm.

All other sites appear to be on track.

John Church faxed today:

1. Bob Edwards has left for Christmas Island
2. Kevin Miller hopes to get the equipment in the water before (or on) Saturday 26 Jan. (Tasmanian receiver).
3. Andrew plans to telephone Louise Crossley at Mawson Station, Antarctica, tomorrow.

* The process of preparing and submitting Environmental Assessment Reports, Marine Mammal (US) and Whale (AUS) Protection Permits has been a long and complex task in both The US and Australia. One of the critical points on the timeline occurred in December when ANPWS finally insisted that we apply for a Permit to interfere with cetaceans under the Whale Protection Act. I was required to place an advertisement announcing our application for a Permit in the Public Notices section of an Australian newspaper with national circulation. I first learned of this requirement from Gordon Anderson (ANPWS Marine section) on Friday, December 21 at about 5 pm.

We drafted an advertisement over the phone and I then rushed to our library to get the phone number of the classified ads department of the Australian Newspaper, the best recognized paper for such national notices. I phoned immediately and was told that the deadline for the Saturday edition has passed at 4 pm but they would be pleased to publish the Notice on Monday, December 24. However, that would mean that the statutory period of 30 days for public comments on the Application would not expire until January 23, impossibly close to our start date of the 26th.

I made another quick trip to the library and found the number for the Melbourne Age (one of the three papers nominated by ANPWS). With some anxiety now, I called and to my great relief, was greeted by the most charming Kiwi accent (New Zealanders pronounce "i" like "u", so fish becomes fush) of a girl whose mission in life was clearly to help "harassed" oceanographers place vital ads at the last minute. She patiently and carefully transcribed every detail including the text of the ad onto her computer, read it back word for word, made meticulous corrections, then went through it once again. Perfect! She then asked how I wished to pay the \$208 cost - I clearly couldn't send a cheque before Saturday morning so she graciously suggested that I might like to charge it to CSIRO's account - what wonderful service! I practically hugged the phone. With a cheerful cheerio! she sped the ad on its way.

The next morning, Saturday, I drove into the city to buy a copy of the Age, and there was the ad! I love you, New Zealand and the Age too! Andrew Forbes.

(13)

Amy finished her third set of survey legs. Air temperature was a balmy 6C, winds 10 knots or less. In the afternoon the fog rolled in, reducing visibility to less than 1 nm. Richard Rowlett, one of our most experienced observers, prophesied before we left that we would have either good sea state and fog, or howling winds and sun. He is a sage indeed.

Cory made four navigational practice runs, now being able to keep on track within about 10 m. The biggest event of the day was a close pass of Amy by Cory to calibrate the reticles on the "Big-eye" spotting binoculars. Cory observers and their retinue of floating albatrosses, with no wind to keep them airborne, waved Amy by.

In terms of sightings, it was back to the usual. Amy's observers made several sightings of southern bottlenosed whales and one of hourglass dolphins. Cory's watch turned up the usual small assortment of pinnipeds and cetaceans. Three Antarctic fur seals were seen, one of which lingered near the Cory for over a half hour, and two cetacean sightings were made, one small group of hourglass dolphins and one unidentified small cetacean. Sighting conditions were very good until the late afternoon when a thick fog rolled in.

25. 91 11:16 AM *CORY CHOUEST

P 01

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TO: R.Spindel, APL FROM: Walter, Ann & Andrew
FAX NUMBER: 206-543-6785 NO. PAGES: 1

25 January 91

HEARD ISLAND SCIENCE DAILY

We were busy yesterday and missed the Science Daily. Fortunately we don't have paying customers.

First we continue latest word from receivers:

1. Louise Crossley called Cory from Mawson Station. They are ready for the first transmission. There is a bit of a problem as to what to do if the battery is discharged before the ten days are up. (The battery lasts more than 10 days in temperate climates.)
2. W.M. received message from K.S.Yajnik in India confirming that Dr. P.S. Kanya is participating on board SAGAR KANYA. Presumably this means that things are going ahead.
3. Word from Don Betts at SIO that Chris Winther, Todd Johnson and equipment has boarded aircraft to Ascension Island. Further, Chris Palmer and Todd are there already setting up equipment. Later word from Gordon Glass (APL) of progress at Ascension.
4. From Spindel that Geoff Brundit, Cape Town has equipment checked out
5. Word from Spindel that New Zealand is on schedule.
6. Baggeroer has left Monterey.

We calibrated the 10 sources. Their average level at 57 Hz is 208.0 dB (rated at 209), which give a 160 dB contour at 1.1 km from source. This is the radius within which cetaceans at start of transmission will delay transmissions.

We have received Australian Permit at the 11th (actually 21st) hour.

VOR FAX: Munk Demaster Church, Wursia, Woodward, Briscoe

TO: R.Spindel, APL

FROM: Walter, Ann & Andrew

FAX NUMBER: 206-543-6785 NO. PAGES: ~~4~~ 5

26 January 91, Australia Day

HEARD ISLAND SCIENCE DAILY

This is the first transmission day. It really started the evening of the 25th while doing a transmission loss (TL) experiment. Ann had completed the required 4 day survey, and permitted us to transmit test signals (in her words once the area was ensonified the animals loose the "naiveté"). We turned on each source one at a time for a few minutes. The sonobuoy source level was then recorded by a sonobuoy launched off Amy at 31 nm. Transmission losses are proverbially hard to measure but we got enough information to choose a non-absurd propagation loss model. At the end we fired up sources 1,3,5,7,9 at 1059 Z for perhaps 8 minutes, and then sources 2,4,6,8,10 at 1107 Z for about 5 minutes. (This will turn out to be crucial information).

In the process of listening to our 57 Hz calibration signals, Ann was bothered by some intermittent 30 Hz stuff. Andrew came up with the answer immediately. The R.V. Marion Dufresne was doing seismic work near Kerguelen (it is in fact one of the receiving stations for our transmission tomorrow).

25:1630 Z Gordon Glass (standing in for Bob Spindel) telephoned from APL to record that Kurt had picked up some 57 Hz at Bermuda starting near 1400 Z. This is precisely when the 1059 TL test firing of sources 1,3,5,7,9 should have reached Bermuda. Computed travel time is $10805s = 3.001$ hours. Gordon also reported that we had been received off Nova Scotia.

25:2330 Z Gordon called again, reporting that Ted has picked up the TL test signal at Whidbey Island

BS

PG 1

(presumably a Tasman Sea path). Thus Heard had been heard to both sides of North America the day before before the feasibility test actually commenced.

At just about this time we received a most appropriate fax from Mel Briscoe:

*By the rude bridge that arched the flood,
Their flag to April's breeze unfurled,
Here once the embattled farmers stood,
And fired the shot heard round the world.*

From the Concord Hymn by Ralph Waldo Emerson, an inscription on a granite marker in Concord, Massachusetts. I was reminded of Sir Edmund Hillary's diary entry when he realized that he had gotten to the top of Mount Everest:

"... I became aware that we were no longer going uphill"

25:2300 Z Roy Carter started his run to be close to the shot site at midnight.

26:0000 Z minus 5 minutes. Forsyth reports from the bridge that two Fur Seals had been sighted near the vessel. (Thank God that under the revised terms, this is no longer a condition for suspending transmission.)

26:0000 Z minus 1 minute. Clock signal interruption to computer causes start delay by 51 sec.

26:0000 Z + 51s. Sources 1,3,5 are on.

26:0002 Z Sources 1,3,5,7 now going. Source 9 not transmitting. (Source 9 has been lost for the duration of the experiment).

26:0045 Z Louise Crossley called from Mawson Station, Antarctica. They have not been able to see the signal on their spectral display.

26:0050 Clock problem turns off sources

0225 Gordon Glass reports Ascension is "booming in" at 38 dB S/N !

0230 John Hunter (Australian biologist/acoustician) aboard Amy) report 40 minute "afterglow following end of transmission, evidently due to scatter from Antarctic continent.

0245 Winds pick up 25 to 30 knots from 285 T.

0300 to 0400: Second run, eventless. Winds continue 25 to 30 kn.

Louise called again; no signal. Andrew advised making noise outboard motor near sonobuoy (motor could be heard yesterday). Louise is to call Ron Stein at APL for guidance.

0437 Gordon Glass reports Ted picked up signal at Widby Island.

0300, 0600, 0900 Z Runs went smoothly. Almost dull

1030 Z call from Mawson. The 19 day sonobuoy is lying on the bottom at 900'. To see what the problem might be, they took out a helicopter during our 0600 run and dropped a sonobuoy in 1200 feet of water. As the sonobuoy was sinking and at some shallow depth (say 60') the radio receiver apparently received a loud signal. This implies that at 900' on the bottom is the wrong geometry. Accordingly they will drop another sonobuoy to reach 60 ft depth, and if this works they will raise the 10 day sonobuoy mooring, and move the receiver up the line so that it is at 60' depth (say) but still moored in 900' of water.

1200 Z Good CW transmission. Some fluctuations of drive pressure are rather large, and these are attributed to large departure of the array from vertical, due to high swell.

1235 Z Amy which is 23 nm to the northwest located a dead elephant seal, badly decomposed. We do not abort for

01. 27. 91 03:49 PM *CORY CHOUEST

P01

26

three reasons: it is not within 10 km from source, it is not a cetacean, and it is not a fresh carcass.

1500 Z Pentaline sequence. Good start

1525 Source 2 dies, and we continued with 4 sources.

1800 Z M1 sequence, sources 1,4,6,8,10, #3 idling as spare.

1819 Z #1 shut down, #3 energized. Completed run with 3,4,6,8,10

2000 Z Bob Spindel telephoned, confirmed good results from Kurt from a number of stations, Birdsall good S/N, Ascension now 35 dB S/N, and new result: Baggeroer is hearing us weakly with Packard array (Pt. Sur vertical array), with 8 out of 32 hydrophones not working. He will attempt repair. We will have no word from the SAIC Bermuda vertical array until after recovery.

2100 Z M4 sequence with sources 3,4,6,8,10. All ok.

.....

In the meantime the Marine Mammal Observers continued their activities. Amy spent the day censusing rainbows in blowing foam under Beaufort 8 conditions. There was no opportunity to measure behavioral response of marine mammals to the acoustic transmissions. No whales today - observers saw a few hourglass dolphins. At dusk Amy found the carcass of a bull elephant seal a few miles off Spit Point. Bob Pittman estimated the time of death within the last 24 to 48 hours. Beaufort 8 conditions precluded bringing the carcass aboard. Several seal-salvaging devices are now being designed to make the next attempt more successful.

We have given today's events in more detail than we shall do henceforth, to give you a sense of our activity. Our spirits are high and we would all have joined in a toast if it were not for the damned dry rules aboard these vessels.

TO: R.Spindel, APL FROM: Walter, Ann & Andrew
FAX NUMBER: 206-543-6785 NO. PAGES: 3

28 January 91

HEARD ISLAND SCIENCE DAILY

This weekend issue has to report some setbacks. By the morning of the second transmission day sources 2,8 and 9 are out, and #1 is overheating. We kept losing sources, and by 1535 Z we were down to 4 working sources.

The failure rate is worse than expected. Tom Judd believes it is the result of two things: (i) the lower than standard frequency for which there is little experience, and (ii) the rough weather. There is some talk of inter-element reaction, one source driving neighboring sources into violent resonance. The last time the sources transmitted at low frequency was in Scotland in 1988, and 6 out of 10 sources failed, bolts were sheared off.

The decision was made to pull up and repair. This is a major task, at least 3 hours up, 3 hours down, an unknown amount of time for repairs, followed by 8 hours to fill the capsules with Nitrogen. It means around-the-clock for the technicians and for some of the others. I telephoned Spindel who supported the decision and went to work to notify receiving sites. Bob had some news: Bermuda vertical array could not be launched on account of bad weather. Monterey vertical array receives us, but weakly.

The technicians worked since midnight, and all sources were aboard by 0400 Heard Island Local Time (HILT).. Things look bad. The clamping ring and associated bolts are irreparably broken on sources 1,7,8,10; Tom believes that the bolt failure is a fatigue failure, because fatigue failure gives a clean break as found. Sources 2 and 8 have electric failures, probably from violent oscillations. Sources 3,4,5,6 look good.

We set around the table and decided to go for broke. That is, to repair the two repairable sources, on the good sources replace every

other bolt with a new bolt, lower the array with six operational sources, and then transmit 5 at a time as long as possible, then 4, then 3, till we are down to zero.

1100 Z Called Kevin Miller at Maatsuyker Island (Tasmania) receiving station. The 10-day sonobuoy was deployed at local noon (0100 Z). It has been re-configured as a moored buoy and the receiver/data logger set up on the island which lies 12 miles south of Tasmania. Kevin reported the delay in deployment was due to strong gales, which may last another couple of days. Despite this, he believes he is getting a reasonable signal from the buoy although the spectrum is dominated by a 50 Hz mains frequency. He is in the process of isolating that problem and will get in touch with us when he has positive news.

Bob Spindel has contacted all but one of the receivers. Cape Town is delayed but now ready. New Zealand is delayed but will be ready by 30 January. Ted has gotten perfect results with Pentaline code, but sees some interference with the M codes, like 0.2 Hz lines. Andrew suggests that this might be due to mechanical oscillations of the failing sources.

Ann reports with great satisfaction that interference from the Marion Dufresne has ceased. Could this be an indication that the Marion Dufresne has stopped seismic shooting and is now listening for our signals?

The marine mammal team is keeping a round the clock vigil for animals that might appear near the Cory during transmissions. They were rewarded today when during the 27:0000 Z transmission one small group of Hourglass dolphins was encountered when they approached the bow of the ship. This group was seen riding the bow wave and frolicking next to the ship for about a half-hour. Another group was seen briefly during the 0300 Z transmission. A fur seal was spotted near the ship during the 1200 Z transmission. No unusual or peculiar behavior was noted from either the dolphins or the fur seal.

Amy quartered up and down the survey area looking for whales. The weather has improved overnight, dropping to Beaufort 4 - 5 with chilly 15-20 knot southerly winds and light rain. The air temperature is down to 3.6°C.

*Spindel note
This is incorrect.
all but one of the
receivers
transmissions
see file.*

Today was a read letter day for the biologists. At 0730 HIST (Heard Island standard time) observers encountered a small blue whale (Balaenoptera musculus) and followed it. They were able to take continuous behavioral observations until 1000 HIST, spanning the 0300 Z (0800-0900 HIST) transmission. Amy was then 17 nm at 295°T. The small blue whale was joined by several other whales (at least one large blue whale) at around 0830 HIST. This is our first opportunity to observe cetacean responses to the Cory sources, and particularly valuable because the blue whale is one of the more seriously endangered species we are likely to encounter.

There was nothing really remarkable about the focal animal's behavior at any time during the observation. (Our transmission model yields 127 to 139 dB for 25' to 100' depths.) It had several hourglass dolphins riding the whale's bow (actually, its nose). The whale lunged out of the water a short way several times, dragging along the hourglass dolphins which became briefly visible to the observers. Eventually the dolphins (and Amy) let the whale go about its business. Later analysis will show whether the whale's behavior was affected in subtle ways by the acoustic source.

Several sonobuoys were dropped in the vicinity of the whales, one to 50m and one to 20m. So far, none of the rorquals we have encountered have been vocal.

The rest of the day was not as interesting. A few hourglass dolphins were sighted and possibly a southern bottlenose whale.

TO: R.Spindel, APL

FROM: Walter, Ann & Andrew

FAX NUMBER: 206-543-6785 NO. PAGES: 1

30 January 91

HEARD ISLAND SCIENCE DAILY

We are halfway through the Feasibility Test, and only 3 sources are still working. As we write this, we are on our 25th transmission.

We have removed one source for a spare. We will go back to our full compliment of 3 available sources in 6 hours. By then the New Zealand vessel Tui will be ready to listen for transmission through the Tasman Sea. (Previous claims for a Tasman Sea transmission are premature.) Tasmania station has been delayed by gale winds for 4 days, and may be ready in 6 hours as well..

Louise finally picked us up at Mawson station. And according to Bob, the Canadian towed array gave a 20 dB S/N off Los Angeles.

The ANARE vessel Icebird has tied up at Atlas Cove. It is fortunate that the sources are still working to allow the scientific party from Icebird to make some shore-based biological observations. Amy had planned to assist by measuring acoustic intensity at the north side of the island but this had to be canceled for safety reasons.

Matt Dzieciuch and John Hunter have been listening to our sonobuoys after the transmission stops. They record 40 minutes of diminishing reverberation above noise level. Some of it might be scatter from Antarctica.

Walter lost \$20 in a bet of how long the sources would last.

TO: R.Spindel, APL

FROM: Walter, Ann & Andrew

FAX NUMBER: 206-543-6785

NO. PAGES: 2

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JAN 31 1991

31 January 91

SEASIDE ISLAND SCIENCE DAILY

Amy reports Beaufort 10 seas, and their wind guage pegged out at sixty knots. They have contributed a companion piece to Mel Briscoe's contribution of last week. It goes like this:

A capital ship for an ocean trip
Was the Walloping Window Blind
No gale that blew befuddled the crew
Or troubled the Captain's mind

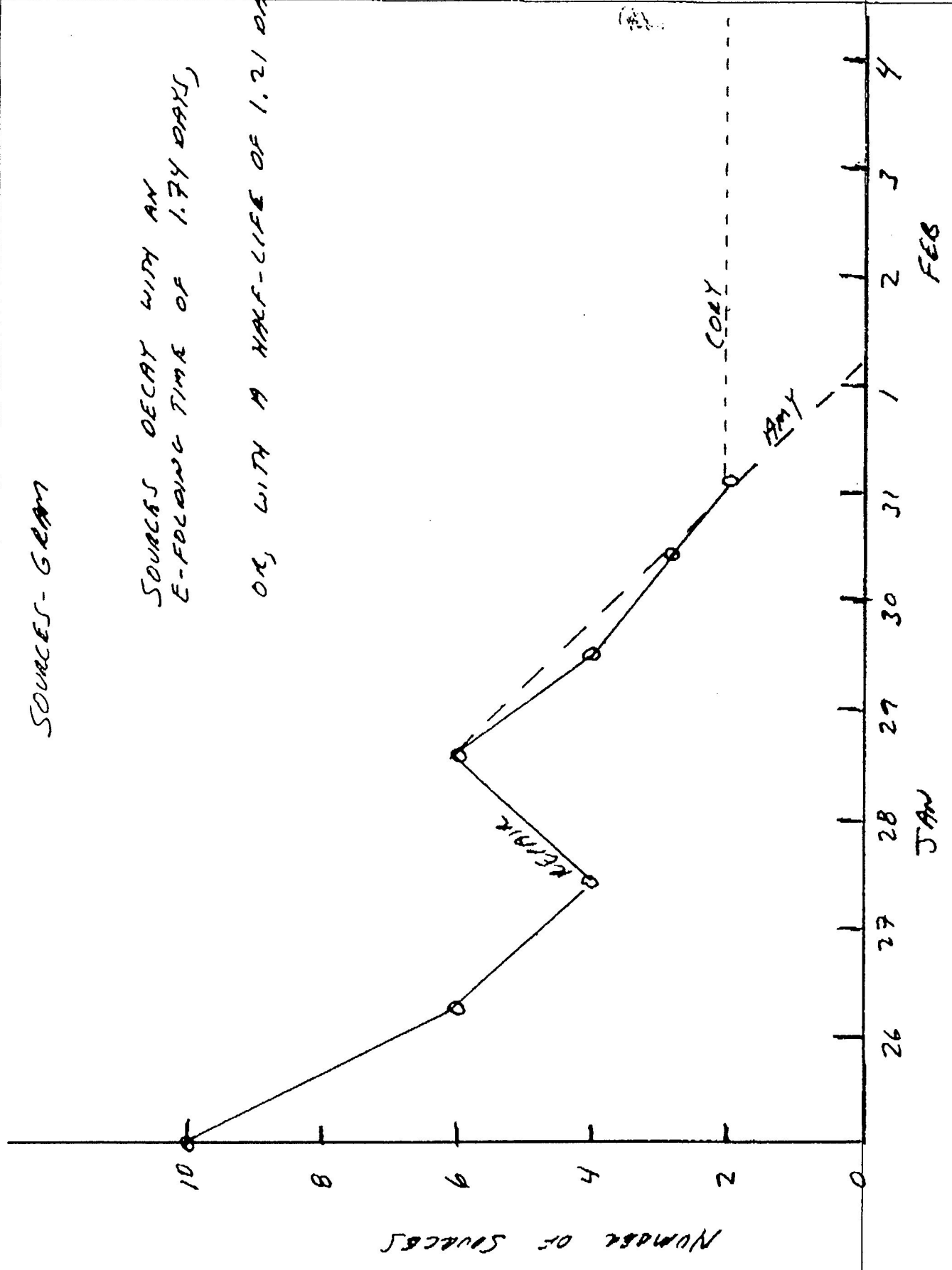
Their scientific contribution for today is the attached Sources-Gram. Note the least-squares prediction (dashed line marked Amy) stills the Cory voices by tomorrow afternoon. The Cory prediction, on the other hand, is based on the higher order theory of least-likelihood as implemented by Robert Spindel.

The Spindel strategy for today (31 January GMT) consists of transmitting-with one source for one half hour during each 3-hour period; tomorrow with two sources for one half hour each 3-hour period. The goal is to give Art Baggoreor the best possible chance after he has steamed south from Monterey. Cory is implementing that strategy!

SOURCES - GRAM

SOURCES DECAY WITH AN
E-FOLDING TIME OF 1.74 DAYS,

OR, WITH A HALF-LIFE OF 1.21 DAYS



The last acoustic transmission from Heard Island was at 2100 Z January 31. Severe weather conditions and electrical problems forced early termination of transmissions (which were scheduled to continue through 4 February). It appears that most, if not all, receiving sites acquired excellent data sets. A brief summary of what we know at the moment is provided below.

With strong acoustic signals received in all oceans, the acoustic experiment was a great success. My assumption is that the marine mammal observation program was similarly successful. Whether acoustic signals can be used to measure ocean warming is still an outstanding question, pending detailed data analysis.

I have not heard from the ships since early this weekend, but I assume they are enroute to Capetown.

I will continue to try to keep everyone informed of progress.

Heard Island Experiment Status Report February 1, 1991 - 2200Z

Weather conditions and electrical problems have forced termination of acoustic transmissions from Heard Island pending recovery of acoustic sources and possible repair. The last transmission was at 2100Z 31 January. We expect to know whether redeployment is possible by about 1800Z 2 February. Under favorable conditions transmissions could resume at 0000Z 3 February. Redeployment depends on repairs required, weather conditions, and desire of receiving stations to acquire additional data.

All receiving sites have been advised to use their own judgement regarding termination of their operations. If they feel they have enough data, they should feel free to stop listening. They have been asked to notify us of their intent.

Bermuda, DREP and Ascension have already advised that they are terminating at this time. Expect Whidbey Island to do likewise. Will advise of others as they inform us.

There follows a synopsis of the reports we have received so far.

Bermuda - excellent data, SNR very high, 30 to 40 dB with all sources, less with fewer sources and less when local ship noise is high

Ascension Island excellent data, SNR very high. Single phone SNR of 30-35 dB

Capetown Receiving signals at 36S 17E . Reported conservatively, 20 dB SNR. Expected better when seas calm. Top and bottom arrays were giving comparable results.

HMNZS Tui Receiving signals at 33.32S, 158.27E in Tasman Sea in deep shadow cast by Tasmania at 17dB SNR averaging 30 frames.

DREP Pacific Received CW with 25-30 dB SNR on array with approximately 16 dB array gain. Has taken data up and down the West Coast, Mexico to Canada.

Goa Received only 2 receptions, 0000 and 0300Z 26 January, on deep hydrophone before it failed. Have been listening with 1000 ft deep sonobuoys. With 3 frame incoherent averaging are getting SNR in low 20 dB range.

Xmas Island Reports 35 dB SNR

USSR Atlantic Have received no report.

Japanese Near Samoa. Have not heard signal. However, I am uncertain about their receiving system.

DREA Atlantic Reported 10dB SNR off East coast of US about 40N 70W. while steaming.

Tasmania Reported weak signal on Jan. 28. Suspected bad hydrophone.

Whidbey Good data recorded. SNR higher to the South.

Mawson Station Antarctica Is receiving transmissions. No qualitative information is available.