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NUCLEAR SUBMARINE COMMUNICATIONS TESTED ON THE ICE

The accompanying article by Robert Aldridge and William Whistler alleges that a civilian research station in the Antarctic has been used for a number of years for military research on very low frequency radio communications. If the military use can be proven beyond doubt, a not-so-simple task in the far reaches of the ice, the fact of military research would be a serious indictment of United States Antarctic operations. It would prove deliberate American violation of the Antarctic Treaty.

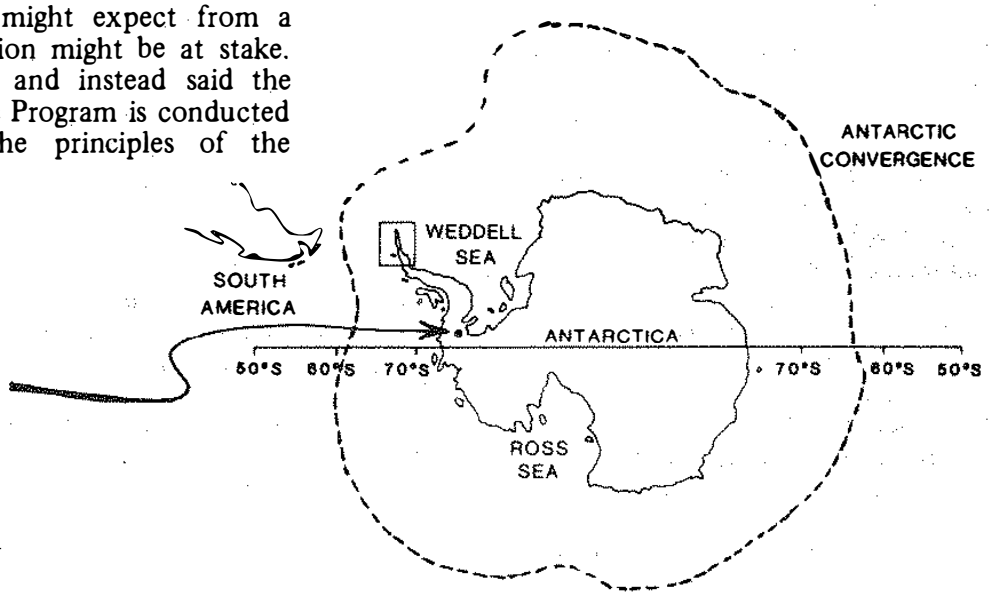
In June, at the time of the mid-winter supply drops at McMurdo, the director of the National Science Foundation Division of Polar Programs, Dr Peter Wilkniss, visited Christchurch. An item in the local press quoted Dr Wilkniss as saying that the Siple station would be opened this summer. That is the station having the VLF facility of concern to Aldridge and Whistler. We wrote to Dr. Wilkniss in late June and asked two simple questions: Is the Siple facility strictly for civilian research? Is the facility used for submarine communications?

The response came back about a month later from the head of the information section, not from Dr Wilkniss. Curiously, the questions were not answered with simple denials as one might expect from a civilian agency whose reputation might be at stake. They dodged direct answers and instead said the following: "The US Antarctic Program is conducted in full compliance with the principles of the Antarctic Treaty, and there is absolutely no research or other activity of a classified nature involved."

So we tried again. In August we wrote back to NSF and repeated the same two questions. We emphasized that we wanted direct answers to the questions, and we also mentioned the obvious, that just because research is not classified does not mean that it is not directly relevant to military applications. We received a two-sentence reply in which we were referred back to previous correspondence. No answers were forthcoming.

Our interpretation of the course of this investigation to date in combination with the following article, is that there is much to be concerned about at Siple. The research station is supported by the civilian National Science Foundation via Operation Deep Freeze based at Christchurch. The NSF is trying to avoid answering difficult questions about an Omega-type facility similar to that rejected by New Zealand 15 years ago.

– Bob Leonard



Siple Station

Critical to developing U.S. First Strike Capability

2 A WHISTLE FROM SPACE TO TRIGGER TRIDENT

By Robert Aldridge and William Whistler

Of the hundreds of human-made satellites spinning about the earth, over three-quarters are for military purposes. But the so-called "civilian" spacecraft often have military utility. Such may be the case with an experiment which began when a mighty roar split the pre-dawn hours of August 3, 1981. A Delta rocket lifted off from Vandenberg Air Base in California carrying two Dynamic Explorer satellites into orbit – ostensibly to monitor auroral processes. But a prominent aeros ace journal revealed that "one satellite also will participate in tests in which an Antarctic-based transmitter will send a powerful signal into the magnetosphere, forcing changes in the space environment that will be detected by the spacecraft over the equator at the time." [1] What is not apparent is that this experiment may be tuning a future trigger finger to fire Trident missiles from submerged submarines. The first strike nature of these weapons could make this the signal that touches off World War III. Let us look closer at what led to this experiment and the military interest behind it.

During the 1950s an interesting phenomenon was observed. The Naval Communications Station at Annapolis, Maryland broadcast a very low frequency (VLF) radio signal that was picked up at Cape Horn, way down in the southern hemisphere. Closer attention revealed that other signals transmitted in the VLF band from one hemisphere were received in the other.

In 1958 a Geiger-counter in Explorer-1, America's first satellite, discovered the Van Allen radiation belt composed of protons and electrons trapped in a doughnut-shaped pattern about the equator. These charged particles are blown in by the solar wind which reaches greatest intensity during solar flares. This wind is composed of charged particles and gases – ionized hydrogen and other atoms, or protons – which reach hundreds of thousands of degrees temperature and are accelerated to more than a million miles per hour by the tremendous magnetic fields from the sun spots.

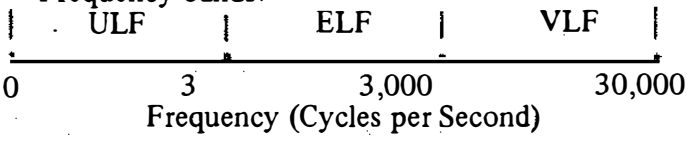
When these particles, particularly the protons, strike the earth's magnetic field they are forced into a corkscrew motion about the lines of flux, generating millions of electron volts which play in important role in such geophysical activities as auroras and communications blackouts. But these spiraling protons are also the means by which radio waves can be amplified and new waves of a different nature can be generated.

The earth's magnetic field is graphically illustrated as curved north-south lines of flux through space which contact the earth near the poles (Fig. 2 illustration). The closer to the poles they touch, the farther out into space they curve. It can therefore be determined where flux lines of a given altitude will meet the earth. These imaginary lines are identified by numbers which correspond to the number of earth radii they are from the earth's center, measured through the equator. This magnetic field of the Van Allen radiation belt is now called the magnetosphere, which extends out about nine earth radii.

Circularly polarized VLF radio waves called whistlers will follow the magnetic lines (which meet the earth at the transmitter's location) as if they were duct tubes. When broadcast, a whistler will travel along the flux line into the magnetosphere and then back down to a corresponding point in the opposite hemisphere. That is how the Annapolis signal was picked up at Cape Horn. The more extreme north or south the radio wave source is located, the farther out into space their magnetic duct will go.

It has been discovered that VLF radio waves (Fig. 1) traveling in the whistler mode are amplified a thousand or more times through interaction with the spiraling protons in the same magnetic duct tube. In addition, investigators have found that pulsing VLF transmitters at an ultra-low frequency (ULF) rate–

Figure 1.
Frequency bands:



that is, in the neighborhood of one pulse per second – creates a new radio signal in the ULF band of 0.2 to 3 cycles per second. This new ULF wave is in turn amplified by cyclotron resonance with these high energy protons. The spiraling protons most likely to generate such a wave are trapped in the radiation belt between the altitudes of 2.6 and approximately 6 earth radii. The new ULF wave then travels both north and south along field lines until it reaches the ionosphere – a shell of charged particles extending from approximately 60 to about 1,250 miles above the earth. While passing through the F2, F1, E and D layers of the ionosphere, the ULF wave spreads out to cover much of the earth's surface. (Fig. 3, Fig. 4, Fig. 5, Fig. 6)

To investigate this phenomenon the National Science Foundation sponsored Stanford University's radioscience laboratory in setting up a transmitter at Byrd Station, Antarctica in 1965. A 20-mile long antenna was laid out on the ice. Transmissions from that location, however, went up over 7 earth radii and thus missed the concentration of spiraling protons which produce the best results. The induced ULF wave was very weak.

In 1969, with the help of the U.S. Navy, the station was moved to Siple where the transmitted whistlers would travel along a flux line passing

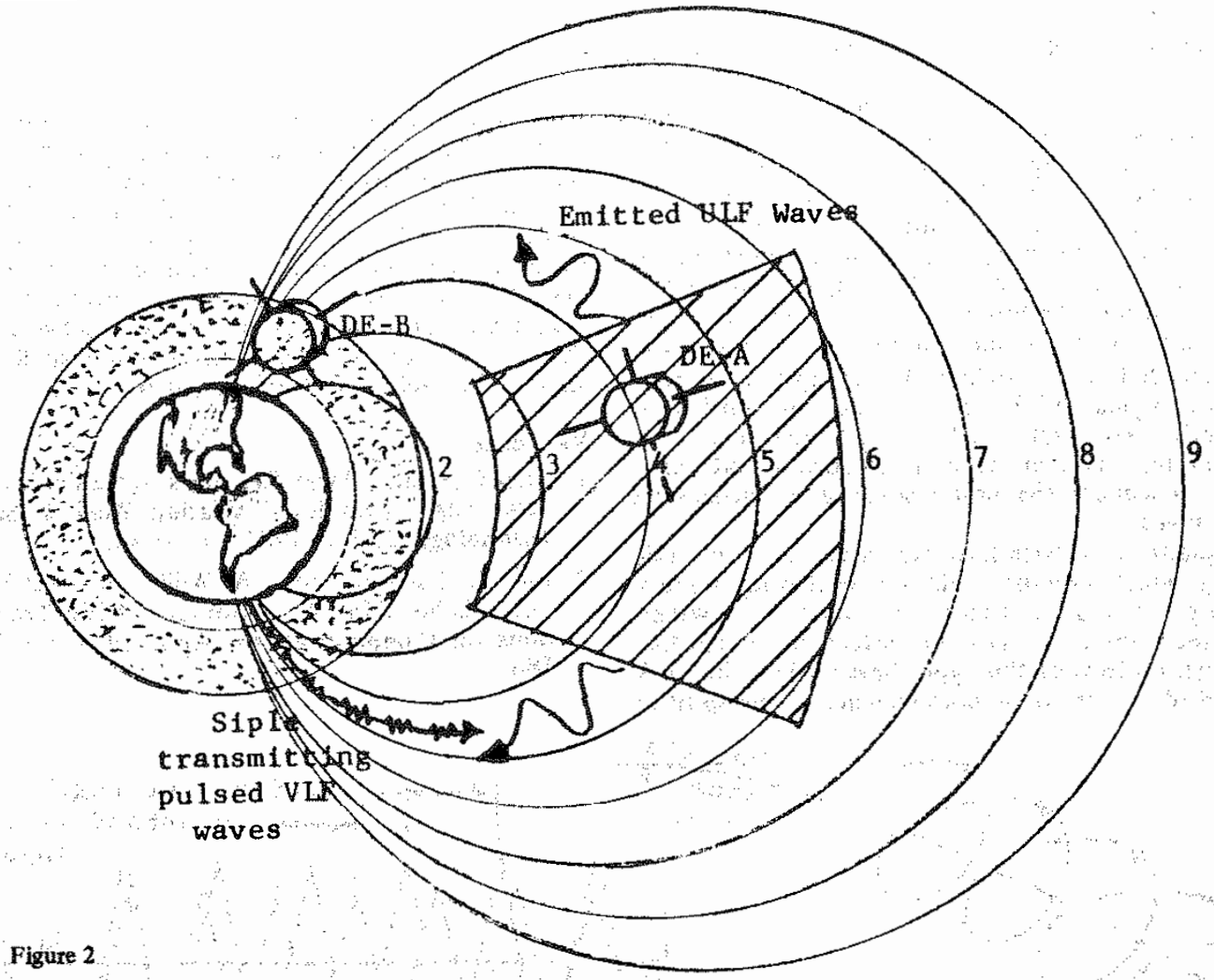


Figure 2

Ionosphere – starts at approx. 60 miles altitude and extends to about 1,250 miles altitude.

Trapped proton belt in Magnetosphere – extends from 2.6 approx. 6 earth-radii above the centre of the earth. rejected.

Numbers next to earth's magnetic field lines indicate the number of earth-radii above the center of the earth that each line crosses the equator.

through the center

Navy-furnished transmitter was installed and a double (dipole) 13-mile long antenna was laid out on a thick ice sheet. The first experiment commenced early in 1973 and demonstrated a definite relationship between pulsed VLF signals and generated ULF waves. In 1979 a stronger and more versatile transmitter was furnished by the Navy. Siple is now the most powerful station in the world capable of transmitting at the very bottom of the VLF band.

The U.S. Navy's interest in VLF/ULF interaction appears to run deeper than loaning equipment and providing support forces. In 1973 the Naval Research Laboratory used its Cutler, Maine communications center to broadcast VLF whistlers into the magnetosphere. First results were disappointing but, taking note of Siple's apparent success with pulsed signals, the Naval lab changed to that mode. More promising results then occurred but not as good as Siple's because of latitudinal location differences.

ULF apparently appeals to the Navy as a means of communicating with submarines. After a newly-generated ULF signal reaches down to the ionosphere, it fans out parallel to the earth's surface for thousands of miles. During the Cutler, Maine tests there were magnetometers (magnetic sensors to pick up ULF waves) placed in various locations to determine the superconducting magnetometers placed on the ocean floor. It is expected that ULF waves will penetrate seawater to more than a thousand feet deep.

Why is the Navy interested in ULF when it hopes to construct a 72-80 cycle per second extreme low frequency (ELF) transmitting antenna in Michigan and Wisconsin for submarine communication? One reason could be that the ELF system has had stiff public opposition. But in addition, ULF signals of one cycle per second or less have much better water-penetrating capabilities. At a thousand foot depth it would be like listening to a large truck rather than a whisper. An IEEE research report states that "for receivers at (approximately 1,000-foot) depth, which may well be reasonable for foreseeable submarine technology, this advantage would be nearly 70 decibels . . ." [2]

There are also times when ELF signals have a difficult time getting through at all. Several hours of early morning null have been periodically experienced at the Wisconsin ELF test transmitter. These disturbances seem to occur for several days following magnetic storms – during the conditions when VLF whistlers have the best chance of generating ULF signals. It is expected that a nuclear war environment would create similar problems. The above mentioned

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scientific report points out that "under the conditions of geophysical variability which follow large solar eruptions and high altitude nuclear explosions, communications via ELF may be significantly disturbed. Under these conditions a ULF system may be capable of restoring partial communication." [2]

Before ULF can be used to signal submarines, however, it must be better understood and controlled. That appears to be the purpose of the Dynamics Explorer-A (DE-A) satellite. As the Siple transmitter sends its signal, DE-A will be in the radiation belt to instantly play back what is happening. The Siple transmitter can then tune its frequency and pulsations to achieve the best resonance for generating ULF waves.

Against this backdrop we have the Antarctic Treaty which everyone thinks is outlawing military activity on that continent. In practice, however, the treaty does not have any effect on "scientific" research projects of this type. Nevertheless, the work described in this article does violence to the spirit of that agreement and demonstrates a lack of good faith.

A whistle from Antarctica may well be what signals the submarine-launched Trident missiles to execute their first strike role. The Dynamics Explorer spacecraft, under the classical guise of conducting basic research, will tune that whistle to shrill readiness. Clearly, this is another covert project leading America closer to the nuclear brink. Corrective action through the exercise of democratic responsibility by an informed public is urgently needed.

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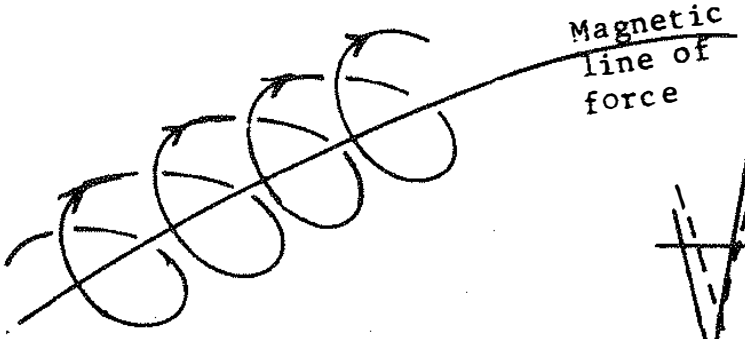
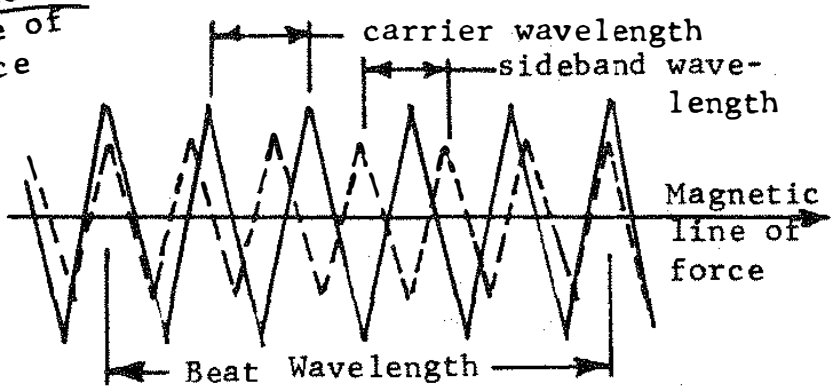


Figure 3

Amplification: A slow Alfven wave is a left hand circularly polarized wave which is guided into the proton belt along a line of the earth's magnetic field. Protons in this wave take the same helical path around the line of force that is taken by the trapped solar protons in the proton belt, and the amplifying transfer of energy takes place from the proton belt to the VLF Alfven wave.



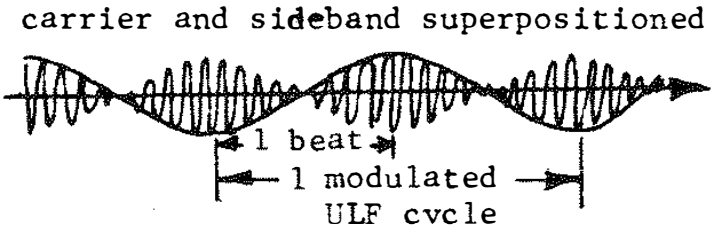


Figure 4

Mode Conversion: The sideband components of a VLF wave modulated at ULF frequency travel at different velocities through the proton belt.

When superpositioned, their combined helix radius around the line of flux has a slowly varying amplitude which create beats at twice the modulated ULF frequency (beat wavelength equals one-half the ULF wavelength).

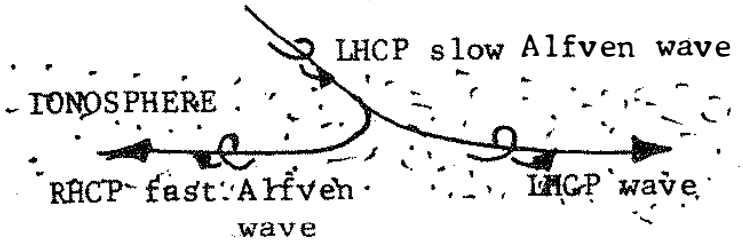


Figure 5

Mode Changing: The left hand circularly polarized Alfven waves (VLF or ULF) re-enter the ionosphere where they break into several components, among them the fast Alfven wave (right hand circularly polarized).

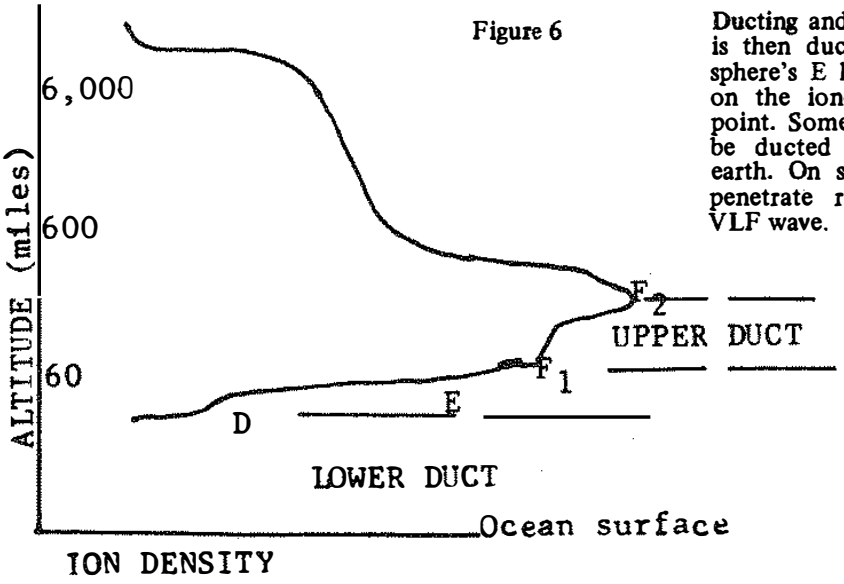


Figure 6

Ducting and Striking the Earth: The fast RHCP Alfven wave is then ducted horizontally in the region above the ionosphere's E layer with little attenuation. The wave impinges on the ionosphere at large distances from the generating point. Some energy passes through the lower ionosphere to be ducted horizontally between the ionosphere and the earth. On striking the ocean's surface this ULF wave will penetrate roughly 100 times deeper than the generating VLF wave.

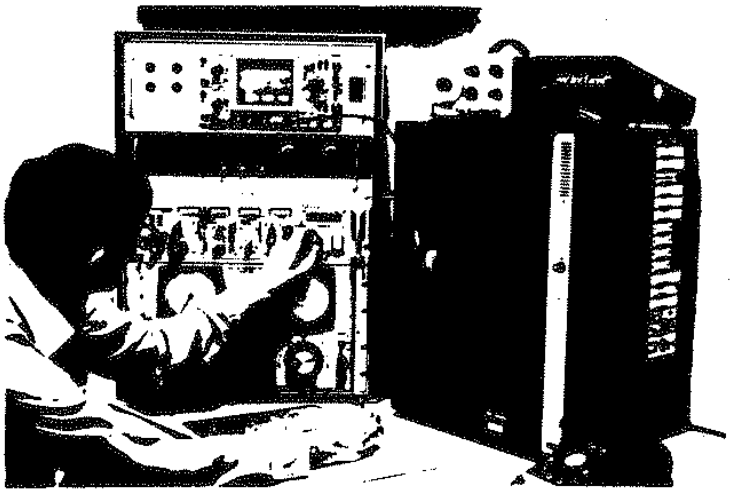
BIOGRAPHIC NOTES:

ROBERT ALDRIDGE, an aerospace engineer, was a design specialist on Trident missiles at Lockheed. He resigned that position in 1973 in protest to Trident's first strike capability and is now engaged in private research aimed at better public understanding of military programs. He is the author of **First Strike: The Pentagon's Strategy for Nuclear War** (Boston, South End Press; 1983).

WILLIAM WHISTLER, an electrical engineer and former designer of radar and satellite antennas, is currently employed by the University of Pennsylvania. He has written articles on precision tracking antenna design and holds two patents on microwave devices. He has been active in resisting the nuclear arms race since resigning from General Electric in 1980, in protest to their nuclear war-making contribution.

THE NAPIER GEODETIC SATELLITE TERMINAL (1975-1978)

New Zealand's secret contribution to improved ICBM accuracy.



by **Keith Burgess**

Introduction

In July 1975 Prime Minister Bill Rowling made a general public accouncement that the New Zealand Government had approved a joint project with the United States in carrying out a satellite observation programme. The announcement emphasised the major purpose of the project – experiments aimed at demonstrating the usefulness of satellite-borne altimeters for measuring the geometry of the ocean surface and improving scientific calibration systems. It spoke of the role of the National Aeronautics and Space Administration (NASA) and the intended scientific applications of data to be gathered from the experiments.

The announcement, however, made no mention of the fact that the U.S. Defence Mapping Agency (DMA) was to play a major part in the programme and that civilian staff belonging to that U.S. military agency were to be stationed in New Zealand for the purpose of monitoring the experiments.

Nor was any mention made of the military applications to which data resulting from the experiments would be put including the use of data for the enhancement of the accuracy of the Poseidon and Trident SLBMs (Submarine Launched Ballistic Missiles) – approximately a 100ft enhancement of the Trident accuracy representing a significant advance in the counterforce capability of the missile.

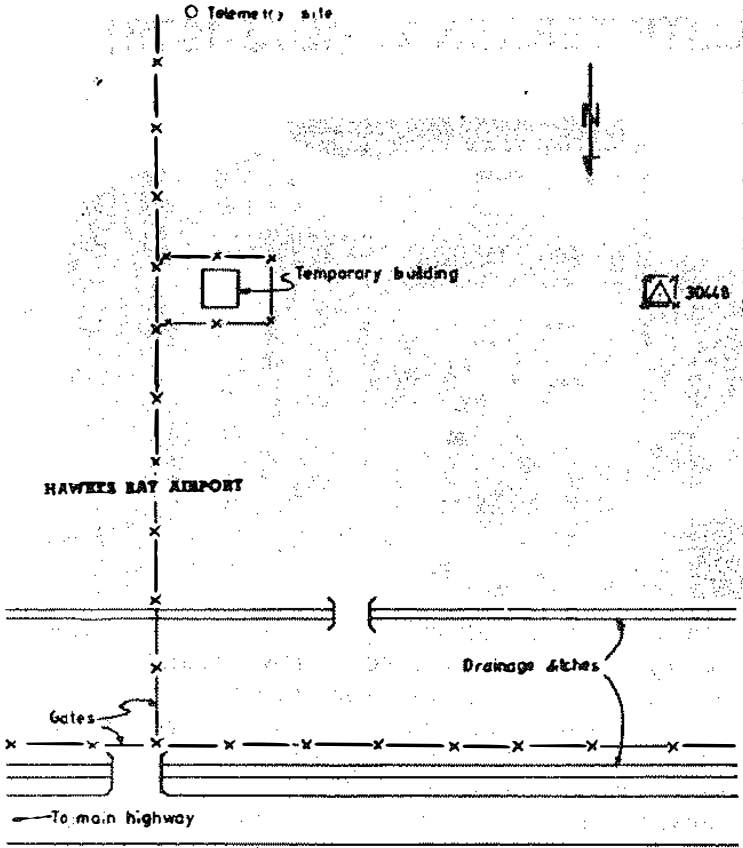
Today the New Zealand Ministry of Defence and Department of Lands and Survey prefer to stress, in their descriptions of the joint New Zealand/United

States project, the value of the data in standard geodetic and mapping terms. The pure military role of the DMA is ignored, as are the military uses to which data gathered from the experiments were put.

NAPIER, U.S. SATELLITE DOPPLER STATION No. 30448

The geodetic satellite terminal known as the U.S. Doppler station No. 30448 was established in August 1975 at a point just north of the Hawkes Bay Airport at Napier. This point is recorded on a Lands and Survey office plan as GEOS-3 and GEOS-3 No. 2, referring to two of the experiments undertaken there. Just prior to the commencement of the programme portable telemetry equipment to be used for the experiments arrived under diplomatic pouch. At about the same time civilian staff employed by the U.S. Defence Mapping Agency arrived to set up the equipment. A building owned by the New Zealand Post Office and close to the site was taken over by the DMA staff for a "peppercorn" rental of $1. According to information provided by the Department of Lands and Survey and confirmed by DMA, the station at Napier was operated between August 1975 and January 1978 in support of the GEOS-3 (the Geodynamics Experimental Ocean Satellite Project). The same station was occupied by DMA personnel and operated for the period June–October 1978 in support of the SEASAT (Sea Satellite) programme.

Station site sketch (supplied by DMA).



Besides Napier, two other sites were being considered by NASA immediately after application had been made to the New Zealand Government. These were the D.S.I.R.'s field station at Slope Point near Invercargill, thought to be the most likely site at the time by Prime Minister Bill Rowling, and alongside Highfield Road, Courtenay, in Malvern County near Christchurch. According to the Chief Surveyor of the Lands and Survey Department in Christchurch at the time, Mr R.A. Innes, the two nine to ten foot towers (one a receiver and one a transmitter) to be used had to be manned whenever the satellites were overhead. For this reason a site near a town was sought and the Napier site selected as the least remote.

The work undertaken at Napier between 1975 and 1978 was part of a NASA observation programme for DMA to demonstrate the utility of a satellite-borne radar altimeter. The programme required the location of Doppler tracking the telemetry equipment [1] at specific locations to fill gaps in the existing NASA tracking and telemetry networks, to provide a world-wide network. The purpose of the Napier terminal was to facilitate coverage in the Southern Hemisphere. The satellites used were GEOS-3 (1975-1978) and SEASAT (1978).

Although, to put things in perspective, Napier was just one of forty sites spread over eighteen countries used to complete the experiments, it was important that at all times the satellites involved remained 'in the line of sight'. The nearest sites to New Zealand were positioned at Melbourne and Easter Island. The Napier terminal, then, functioned as a vital the experiments.

The Napier terminal was operated by Civilian staff of the United States DMA. Station occupation-reports reveal that the two personnel involved were solely responsible for operating and overseeing the terminal during the entire length of the programme.

THE DEFENSE MAPPING AGENCY

The U.S. Defense Mapping Agency which acknowledges its participation in the GEOS-3 and SEASAT experiments at Napier is also candid about its overall military responsibilities within the United States Defense establishment.

The DMA's annual report for 1984 states that its efforts must be 'directed towards maintaining and increasing the accuracy and currency' of military systems and that its work encompasses the development of 'new and improved operational weapon systems with increased accuracies, faster speeds, longer ranges, better penetration capabilities'. This aptly describes the nature of the DMA's work and the integral part it plays in developing the United States offensive nuclear weapon systems.

The fiscal 1984 DMA report states also that the 'largest segment of the DMA production effort is dedicated to strategic systems including all elements of the TRIAD. DMA is supporting land and off-shore gravity data acquisition efforts for testing and operational deployment of the TRIDENT II.'

Director of the DMA, Vice Admiral Shannon D. Cramer Jr., said at the hearings before the Senate Committee on appropriations for fiscal '77, in his description

single major weapons system that does not have its effectiveness predicated on the skill and expertise of the 8,000 people within DMA'.

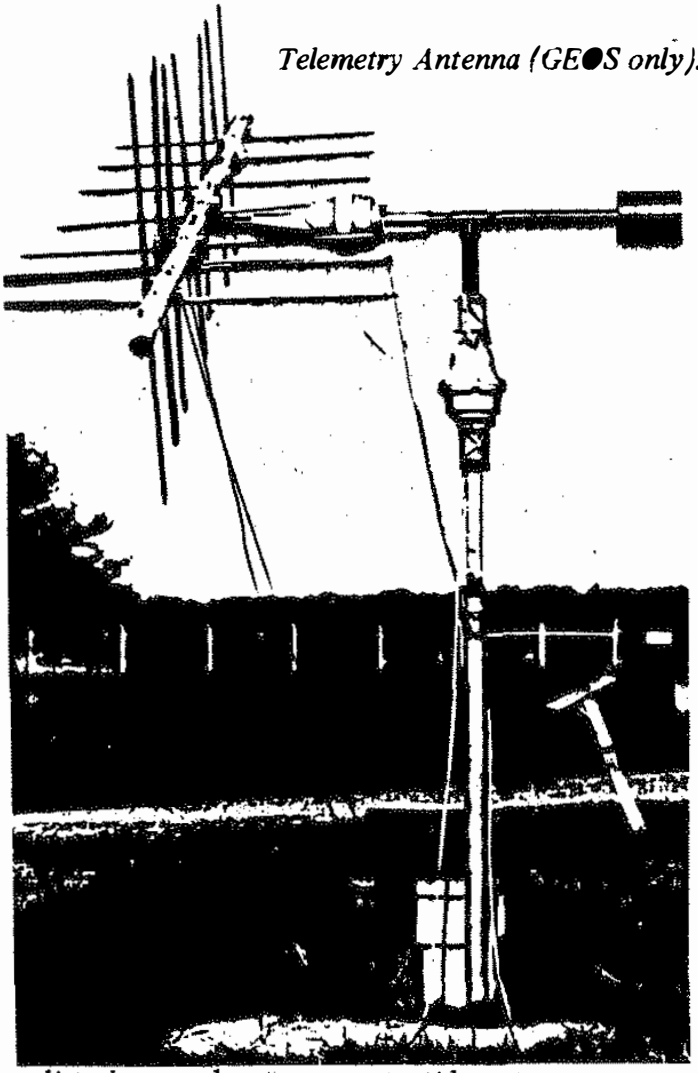
But the most significant revelation in that set of hearings was DMA's request for '$2.1 million to reimburse the National Aeronautics and Space Administration (NASA) for increased satellite radar altimetry data acquisition, handling and distribution'. 'This includes', the report goes on, 'an extension of the Geodynamics Experimental Ocean Satellite (GEOS-3) mission for an additional six months to

support very critical Department of Defense (DoD) requirements'.

This establishes that the DMA is the principal user of the GEOS-3 and hence of the Napier station. The Lands and Survey claim that NASA was the principal user as did the New Zealand Government at the time. It establishes also that the data gathered from the radar altimeter experiments was vital for the enhancement of missile technology, i.e., the accuracy of ICBMs and the ability of the United States to wage nuclear war.

THE USE OF RADAR ALTIMETER DATA FOR IMPROVING THE ACCURACY OF ICBMS

The radar altimeter part of the SEASAT and GEOS-3 satellite experiments had two objectives – to measure very precisely the altitude between the satellite and the ocean surface and to measure the significant wave height of the ocean surface at the subsatellite point. The altitude measurement when combined with the precision ephemeris gives sea surface topography, which can be further analysed to determine the marine geoid or shape and sea surface



Telemetry Antenna (GEOS only).

disturbances due to currents, tides, storm surges and, most notably, gravitational anomalies.

If the earth were a perfect sphere of uniform density there would be no difficulty in predicting the magnitude and direction of gravity. But the earth is somewhat irregularly shaped, an ellipsoid, of varying density. This gives rise to a gravity vector that varies from place to place, in both magnitude and direction.

7 The inability of the accelerometers of an ICBM's inertial guidance system to, measure the force of gravity leads to a potential source of errors that would cause it, the ballistic missile, to miss its target. However data gathered from the GEOS-3 and SEASAT satellite experiments improved the use of radar altimeters for sampling, in detail, by satellite gravitational field strengths at 200 to 1500 km above the earth – the usual apogee for a ballistic missile. Thus, mid-course corrections can be made to ballistic missiles. There is no doubt that the DMA valued this data and thought it essential to efficient ICBM targetting.

A further DMA report states 'DMA R & D (Research and Development) efforts have been successful in determining gravity measurements to support existing and emerging weapon systems such as the Pershing, Lance, Minuteman, Trident and advanced ICBM. The radar altimeter placed on board NASA's GEOS-3 satellite [2] will measure the distance to the sea surface with a precision of about one metre. By combining this data with a carefully determined satellite orbit, the fluctuations of the sea level will permit the determination of variations in the pull of gravity at sea level. This data will in a very short time provide the equivalent of decades of traditional shipboard gravity measurements.'

Experiments undertaken in the GEOS-3 and SEASAT programmes can be specifically related to United States development of ICBMs known to be integral parts of first-strike strategies. The Napier geodetic satellite terminal, although only one link in a very long chain, was in turn integral to those experiments.

IN CONCLUSION

It is accepted as traditional now that any U.S. military activities, especially in the area of research, are down-played with only the beneficial Civilian by-products mentioned and not the prime military purposes. The outstanding examples, of course, are Omega VLF stations and the Mt. John, and Black Birch Ridge observatories.

The Napier geodetic satellite terminal is one more example. Whether the Labour Government at the time was fully aware of the part DMA was to play, or the military nature of the experiments, is almost impossible to ascertain. It is certain however that the New Zealand Ministry of Defence was at least aware of the military aspect of the experiments. A copy of a 1978 memo from Defence Department head Mr J.F. Robertson to the Secretary of the New Zealand Foreign Affairs acknowledges that the tracking team had a connection with the United States Department of Defense. However Prime Minister Bill Rowling in public statements made at the time made no mention at all of U.S. department of Defense involvement. Whether this was a case of the concerned Government Departments (Foreign Affairs and Defence) not fully informing the Government or whether the Prime Minister made a conscious decision to conceal military aspects of the joint project is difficult, if not impossible, to ascertain.

However, at the very least, we can say the Government at the time failed to find out itself the nature of the experiments and their importance to the continuing development of first strike nuclear weapons.

The Napier geodetic satellite terminal, in hindsight, was another Mt. John or another Omega. Obviously data gathered from Napier by DMA cannot be retrieved, but we can demand with this disclosure more frankness from our Government and a closer examination in future of other proposed joint projects before they go ahead.

Earlier this year experiments were recommenced by NASA to duplicate and expand radar altimeter experiments originally undertaken within the GEOS-3 and SEASAT programmes. A recently released report of the U.S. Defense Marketing Service (DMS) says the new experiments are part of an ongoing and extensive effort required to reduce all error sources restricting the accuracy of Submarine Launched Ballistic Missiles. This time around, Australia has been involved again having been asked to provide an Orion aircraft for surveillance purposes. The Government there has consented to the request although there has been open public debate in parliament on the nature of the project.

Whether New Zealand would have been asked to provide assistance if the current rift over the nuclear warship ban had not developed is open to question. The experiments are expected to have completed the data acquisition stage by April 1986 so that there is little chance that New Zealand might be invited or would consent to become involved.

However such experiments are expected to be ongoing in order to refine, and refine again, data that would enhance ICBM and SLBM accuracy. **Peace Researcher** will monitor future experiments. In particular we will be looking for announcements about the planned future use of portable geodetic satellite terminals in New Zealand.

1 The portable telemetry equipment used at the Napier satellite terminal was comprised of a telemetry receiver and recorder, a geoceiver and antenna. The receiver was a Doppler radio tracking device. The Doppler tracking and telemetry equipments operate in a completely passive mode. The Doppler equipment listens to a precise oscillator signal from the GEOS-3 and SEASAT satellites and compares it against an internal oscillator of the same frequency as the satellite-borne oscillator. The difference in frequency represents the Doppler shift which would have been recorded on paper tape and transmitted to the applied physics laboratory of Johns Hopkins University. At the laboratory these data would have been combined with the data from as many as 40 Doppler tracking stations located in eighteen different countries to produce precise position coordinates of the satellites.

2 The SEASAT also had on board a precise radar altimeter with significantly better performance than previous instruments.

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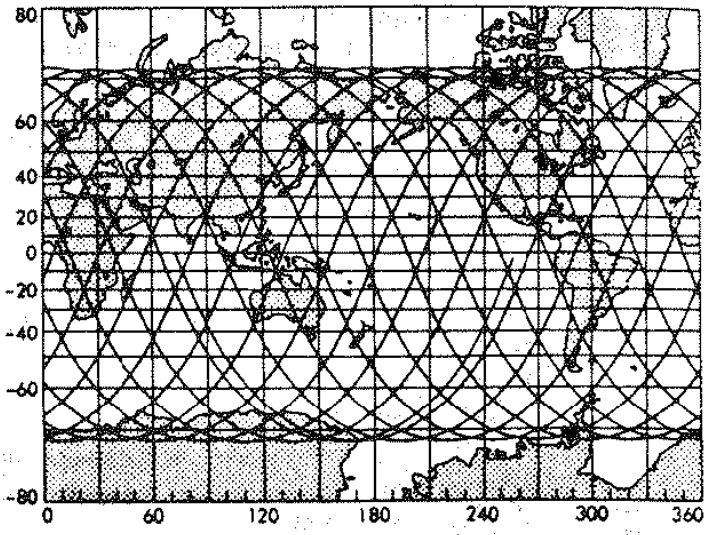

Tasmanian test linked to MX, say Democrats

CANBERRA. — The Australian Democrats have claimed that Australia is helping test a US satellite which has links with the controversial MX missile.

The Democrats spokesman on nuclear issues, Senator Sanders, yesterday challenged the Defence Minister, Mr Beazley, to deny main purpose of the Geosat satellite — being tested off Tasmania — is to increase the accuracy of submarine-launched nuclear missiles.

Mr Beazley announced last week that Australia would host flights by a US P-3 Orion aircraft over the next fortnight which will check the performance of the US navy's Geosat satellite. The aircraft will fly from Sale in Victoria over an area south of Tasmania and its readings of wave height, windspeed and gravitational field will be checked against those from the satellite.

Senator Sanders said: "The Geosat satellite is to collect gravitational data about the Earth, which will increase the accuracy of submarine-launched ballistic missiles, in particular the Trident II missile. The Trident II is merely the navy version of the land-based MX.

"The data collected from these Trident II missile tests will also be used for the MX," Senator Sanders said.