TELONICS QUARTERLY™

VOLUME 3 / NUMBER 1 / SPRING 1990

Down Under

A great experience!

Stan Tomkiewicz and I had the good fortune to visit with a number of people in Australia during early July 1990. To the old friends we visited and to the new friends we made, we would like to offer a sincere thank you for your hospitality. Australians are among the most friendly people I have ever had the pleasure to meet. From the professionals we visited to the waiters and clerks, each person we encountered was friendly and helpful.

The purpose of our trip was to meet the people with whom we work, and other interested persons, and conduct a series of informal discussions/workshops. Face-to-face meetings are very helpful from our perspective in that they enable us to more completely understand the requirements of the various projects in which we assist. From comments we have received previously, the meetings and workshops are appreciated by biologists because they are able to clarify questions regarding antennas, various types of power supplies and packaging available for transmitters, specialized attachment or sensing requirements, field techniques, etc.

We hit the ground running (well, more or less) in Brisbane after 23 hours of travel (including 14 hours non-stop from Phoenix to Sydney, and a loss of Sunday as we crossed the date line). I think the excitement of the arrival, and being able to do some echidna tracking that first afternoon, kept us on our feet and allowed us to avoid "jet lag". Despite Stan's admirable tracking, it took Lynn Beard's experience and excellent eyes to spot an echidna before we trampled it. We located three that afternoon - a feat that would have been nearly impossible without the use of telemetry. Each of the echidnas was equipped with a temperature sensitive implant, similar to those Dr. Gordon Grigg and Lynn have been using for several years to monitor body temperature and periods of hibernation. During the remainder of our stay in Brisbane, we were able to meet with a number of researchers and discuss a wide range of topics, from small implantable VHF transmitters to satellite PTT's for Magpie Geese and kangaroos.

From Brisbane we flew to Cairns, then drove to Townsville. Our timing dictated that the drive be at night, but we did see several wallabies, as well as some shm's (small hopping mammals) along the road. In Townsville, we visited with Dr. Helene Marsh and other researchers at James Cook University. Again, the topics of conversation varied considerably, ranging from gluing transmitters on the backs of small rain forest frogs to PTT's on dugongs. There are a variety of environments around Townsville. Thus, the dramatic effect of the environment on signal attenuation and bounce, and on transmitter packaging requirements was among the topics of discussion.

A free weekend in the middle of the trip allowed us to enjoy a small portion of northern Queensland. We visited Lake Etcham and listened to the "dawn chorus" of birds, one of the most diversified in the world. It was beautiful. We visited Mossman Gorge in Daintree National Park, and got a very nice taste of a tropical rain forest environment. On Sunday, we took a tour boat to the outer Great Barrier Reef and went snorkeling. The fishes and corals were indescribably incredible.

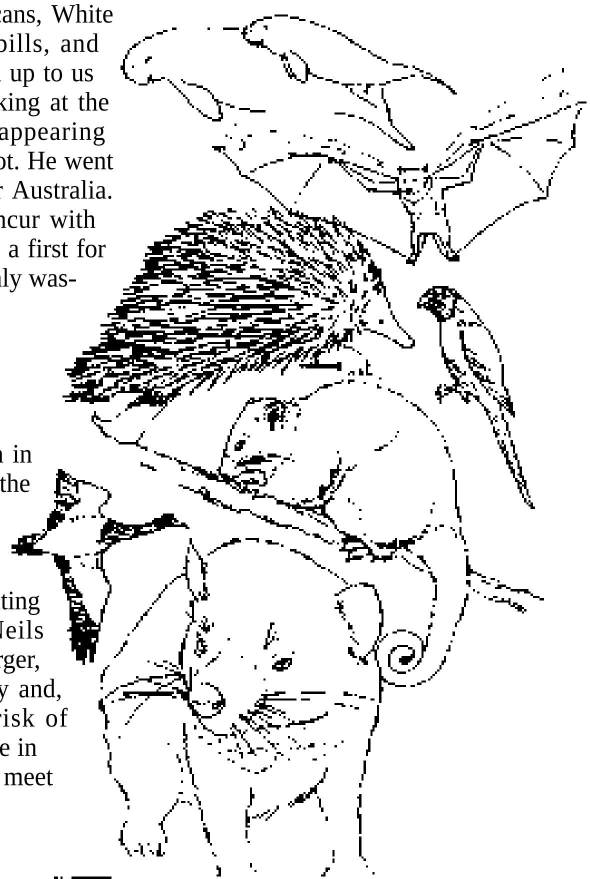
Our flight out of Cairns was two hours late (as it turned out, every one of our flights was late), so we squeezed in a walk along the waterfront. As luck would have it, this resulted in a notable bird sighting. As we were identifying Australian Pelicans, White and Glossy Ibis, Royal Spoonbills, and Silver Gulls, a gentleman walked up to us and asked whether we were looking at the Laughing Gull. At the risk of appearing ignorant, we admitted we were not. He went on to state that it was a first for Australia. We then saw the bird, and I concur with his identification. Whether it was a first for Australia I can't say, but it certainly wasn't in my Australian field guide.

Leaving the northeastern coast, our next destination was Hobart, Tasmania. Unfortunately, our delayed flight caused us to miss our connection in Melbourne and we had to spend the night there. That resulted in a room full of people waiting at the University of Tasmania when we arrived. We enjoyed visiting with Drs. Stewart Nicol and Neils Anderson (their echidnas were larger, more hairy as compared to spiny and, by some accounts and at the risk of offending anyone, cuter than those in Brisbane). We also were able to meet with other people from the University, the Antarctic Research Center, and other organizations. Hobart was cool and rainy, which was fine with us after leaving temperatures in the 120's in Arizona a week and a half before.

Our final stop was Sydney. There we presented a full day workshop at the Torongo Zoo, hosted by Dominic Fanning. Mike Orgy treated us to an informative tour of the city and we had time for a very enjoyable afternoon in the bush, tracking Ring-tailed Possums with Mike and Barbara Smith. We spent our final Saturday morning at the Zoo, and want to thank Geoff Ross for his informative and very enjoyable tour of the noctarium and Australian Mammal section.

The trip was great. It really is a pleasure to put faces with the voices (or the FAX's), and to learn in more depth the goals, needs and accomplishments of the various people and projects. I hope that we were able to help answer some questions. Once again, our sincere thanks to those we visited for your time and hospitality. For those we missed, we are sorry, but Australia is a big country and time, unfortunately, limited. We will be back!

Bill Burger



POLARIZATION

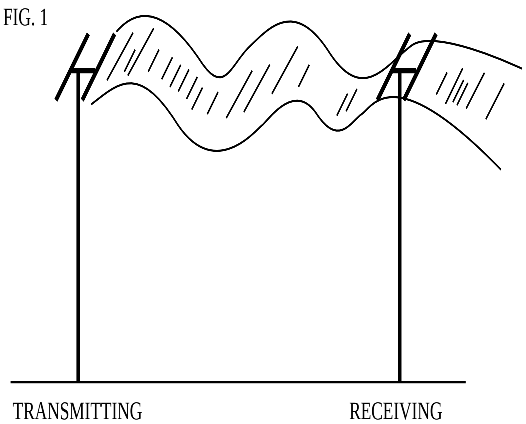
The effect on range performance

In the last Telonics Quarterly, the concept of antenna polarization and its impact on system range performance was briefly discussed and evaluated. This article attempts to explain in greater detail polarigation effects on range performance of practical telemetry systems. We will also examine the functional consequences of polarization changes in field applications.

To begin, we should review the definition of polarization. The plane of polarization of a “radio wave” can be formally defined as the direction in which the electrical vectors align during the passage of at lease one full cycle of a radio wave. If we project the electrical vectors of a wave onto a flattened surface perpendicular to the direction of the propagation, an ellipse is formed. This characterizes the plane of polarization of the radio wave. Have you got all that? This should certainly have cleared up everything—it is hard to imagine that there is anything more to discuss!

Now, let’s depart from theory for a moment and work our way from a precise definition of this phenomenon, through practical confusion, and on to a useful end. For

FIG. 1



illustration, we can mount two H-antennas about 12 feet above the ground in a horizontal plane relative to the Earth’s surface. Let’s define one of them as a transmitting antenna, and the other one a receiving antenna. Polarization of antennas is defined by the intrinsic design of the antenna; in the case of our H antenna, polarization is inherently linear (as opposed to circular, etc.). By mounting the two antennas as described, we have created an essentially optimum condition for energy transfer due to the following key factors:

• Both antennas are designed for the same polarization (linear).

• The directivity patterns (direction of maximum “gain”) of the two antennas are ideally aligned exactly toward each other. • The antennas are mounted a sufficient distance from the ground (and other intervening objects) that they actually achieve the directional characteristics which they were designed to provide.

• Since the two antennas are aligned in a like plane which is perfectly level (or horizontal, parallel to the plane of the Earth’s surface), we have an optimal condition.

A similar situation occurs if both antennas are mounted in a vertical plane with respect to the ground. In this case, the polarization is linear vertical and the transfer is, in general, equally efficient. If, on the other hand, the transmitting antenna is oriented in the vertical plane and the receiving antenna is mounted in the horizontal plane (or vice versa), in theory, the “cross-polarization” effect of this condition reduces the energy transfer to nothing, or O dB. This latter case assumes that there is no multi-pathing (reflected signals arriving over multiple paths), and that the test is being conducted in what the theoretician calls a “homogeneous isotropic medium”. Any time the two antennas are rotated such that their orientation is offset by 90°, minimum signal energy transfer will take place. In a practical sense, when the two antennas are completely cross-polarized, the signal loss is often on the order of 5 to 12 dB, but can be 20 dB.

The polarization of the transmitting antenna on the animal is virtually uncontrollable. In most wildlife applications, however, the polarization of the receiving antenna can be controlled by the researcher. Frequently, the orientation of the antenna on the animal will change and the polarization of the radiated wave will vary. In many instances when the receiving antenna is hand-held, the effects of the shifts in polarization can be compensated for by adjusting the orientation of the antenna. In the case of the H-antenna, we do this by simply moving off to one side or the other and turning it nearly vertical or keeping it completely horizontal by holding it above our heads. As is so often reported from the field, the result is that “...we sometimes hear a stronger signal when the antenna is near vertical.” In fact, in approximately 80% of the studies, the vertical polarization is the plane in which the strongest signal is achieved. However, there are also those environments in which horizontal antenna polarization provides the best signal reception.

One additional complexity must be added at this point. The polarization of radio waves emanating from transmitting antennas typically used in wildlife applications are largely linear. In the environment, however, radio waves emanating from their source (the transmitting antenna) encounter reflective surfaces such as wet snow and sheer canyon walls, wherein the radio waves are essentially bounced off reflective surfaces, changing the polarization. Such reflections impart a spiraling action to the reflected waves, which effectively causes them to “corkscrew” through the environment.

The apparent polarization (as perceived by the person holding the antenna) is ultimately the algebraic summation of the polarization vectors of all signals which are imposed on the receiving antenna at any instant in time.

In hand-held applications, we can compensate for the polarization by moving the receiving antenna somewhere between horizontal and vertical orientation. Unfortunately, this technique is not as easily applied to situations where antennas are mounted on fixed masts or on aircraft. The “best” orientation must be chosen in advance because orientation relative to the surface of the Earth normally cannot be conveniently adjusted to compensate for polarization shifts in most mast-mounted systems or once an aircraft is airborne. It is conceivable that an aircraft pilot could fly a continual series of loops, but this is not recommended. Because polarization is generally vertical, many mast-mounted applications utilize vertical polarization. However, in some systems such as the RA-NS null system, the vertical polarization may provide the strongest signal reception, but it allows the least immunity from signal bounce because the nulls inherent in the H-antenna pattern cannot be realized in the vertical mode. Therefore, in many precision null systems (such as the RA-NS systems), horizontal polarization is often chosen simply to increase immunity from reflected signals.

In aircraft applications, the limitation on mounting antennas is often associated with what hardware can be successfully installed on the strut of the aircraft. The optimum mounting procedure of the antenna on an aircraft strut, such as the Cessna series, would be in the horizontal polarization (refer to Telonics Quarterly, Vol. 2 No. 4 for a diagrammatic view of the aircraft mounting procedure). By mounting the antenna horizontally on the strut of the aircraft in the manner described, we minimize detuning the antenna and disruption of antenna pattern. It is possible to mount antennas vertically on aircraft which may provide the strongest signal. However, the effect of mounting the antenna vertically is that the antenna is badly detuned because of its close proximity to metal of the aircraft. Thus, the pattern becomes disrupted and unpredictable. Although we can sometimes hear the signal at greater range with vertical antenna orientation, a precise location of the signal may become more difficult to determine.

Generally, polarization represents a compromise situation. On the transmitting side, it’s controlled by the animal. Where possible, we compensate for polarization phenomenon on the receiving side of the system to achieve maximum range performance and a reliable antenna pattern.

Now you're probably feeling that's it's safe to go outside with your antenna. Not yet. The next article in our series on range performance will deal with phase cancellation and multipathing of radio waves.

Dave Beaty & Stan Tomkiewicz

Editor's Note: Penny and Trevor Austin became the new owners of PAXARMS in August 1989. They are committed to addressing the problems associated with remote injection technology, and have been able to make some major changes in the PAXARMS product line. We hope you find their report of interest.

Remote Injection Technology

Changes in design.

The basic features offered by the PAXARMS remote injection system have made the product an excellent choice for wildlife and zoo animal immobilization work. The soft injection system operates by air expansion, and is less damaging to animals than old-style burst or explosion injection systems. The PAXARMS rifle is also well designed; most researchers reporting from the field have been pleased with its handling and reliability.

As we know, the original PAXARMS dart has consistently presented some annoying problems. Over the course of the past year, a redesign of the dart has been in progress which involved working closely with the Department for Scientific and Industrial Research, as well as two outside consultants. The total system has been redeveloped and the purpose of this article is to detail the changes and improvements we've been able to make.

A modular design.

The original dart body often performed adequately if used properly, but it had a tendency to crack if the dart was stored for any period of time. The new PAXARMS body utilizes state-of-the-art molding technology, new materials, and it's been designed in modular components. The design eliminates stress points as well as any possibility of leakage.

During trial testing, PAXARMS darts have been fired repeatedly into a concrete wall without showing any signs of cracking. In fact, the bodies are still proving usable after 20 firings. In addition,

• all parts now separate for easy assembly and sterilization.

• A screw-in tail allows the dart to be filled directly from the drug bottle with a simplified filling unit.

• Tail plugs have been redesigned for easier insertion into the barrel.

• The darts have been flattened at the end for better flight trajectory.

• A gas check has been added between the needle and body. The dart seals tightly into the gun barrel, stabilizing it and creating a uniform resistance that allows pressure to build up consistently behind the dart.

A choice of calibers.

Available in both .465 and .509 calibers, the new darts come in a range of capacities. The .465 is available in 1.5, 2.0, 2.5 or 3.0 ml. The .509 comes in 3.0, 5.0 or 6.0 ml. Calibrations are printed on the outside of the dart body in half-ml divisions.

In general, it is recommended that users select one size dart, whichever best fits most of your needs, and use other sizes only as necessary. The .509 caliber, 5.0 ml dart, for example, delivers anything from 2.0 to 5.0 ml with equal accuracy. The .465 caliber, 1.5 ml dart is ideal for delivering .25 to 1.5 ml of drug in small animals at a medium distance, or 1.5 ml of drug in larger animals at a longer distance. Note: The .527 caliber equipment has been discontinued. U.S. researchers are encouraged to use the .509 caliber, and PAXARMS will do everything necessary to facilitate the adaptation.

Other improvements.

In engineering the new dart, we talked with a number of users and identified solutions to two other problems. First, researchers indicated that poor instructional guidelines were causing users to over-pressurize the darts. New guidelines have been established identifying the correct pressures. The charts are available from PAXARMS or Telonics, our U. S. distributor. A new users' manual is available.

A second improvement concerned the sights on the PAXARMS rifle. In our new design, open sights are connected to the velocity control valve. When velocity is increased, the sights automatically raise to point of aim. Designed as an attachment, the unit can be fitted to existing rifles.

Enhanced accuracy.

During trial testing, the new darts and modified rifles produced excellent results from 5-60 meters when darting small animals. Good accuracy is possible at up to 90 meters with larger animals, depending on wind and other conditions.

Modifying existing equipment.

Researchers who wish to modify their existing PAXARMS rifles to take advantage of new dart technology can do so easily. Full instructions and drawings are available and the modifications can be made by any responsible gunsmith. You may also return your rifle for factory modification, including range testing and calibrating.

While PAXARMS no longer supplies the old dart bodies, we are committed to helping researchers use up any existing inventory. Filling syringes, adapters, tail valve depressor pins, etc. will continue to be available for as long as necessary.

In conclusion.

PAXARMS is committed to providing the field with the finest remote injection technology possible. As users gain experience with the new darts, we hope you'll keep us informed about any problems or questions you may have. We want to work with you to ensure that our equipment is the most accurate and humane system available.

Penny and Trevor Austin

U.S. - Canada Trade Agreement

New savings on equipment

For years Canadian researchers have been paying high duty rates and Federal Sales Tax rates on equipment purchased from the United States. As of 1 January 1989, the U.S. Canada Free Trade Agreement went into effect. The FTA, over the next ten years, virtually eliminates the tariffs and trade barriers between the two countries. The changes greatly benefit the science community, and particularly those projects operating on limited budgets.

The tariffs are being eliminated in stages that began 1 January 1989 and end on 1 January 1998. All dutiable goods have been assigned to one of the following staging categories: immediate, five years (20 percent tariff cut per year), and ten years (10 percent tariff cut per year).

The duty rates on goods of U.S. origin will be phased out over a period of five to ten years, depending on the commodity. Until they are phased out entirely, the goods remain dutiable, but at increasingly lower rates. The intent is that duty will disappear on all goods, but a tax will still apply. On 1 January 1991, a Goods and Services Tax will replace the Federal Sales Tax. It will be set at a fixed 7% instead of the 13.5 % that Canadians have currently been paying.

Over the past two years, we have seen significant decreases in duty on Telonics' equipment.

ITEM	1988 % of duty	1990 % of duty
Antennas	10.2	5.7
Coaxial Cable	10.2	8.1
TR-2 Receiver	10.2	5.7
VHF Transmitter	10.2	0

Changes to date include the following:

• The decrease in duty on our VHF transmitter was accelerated as of 1 April 1990, leaving no duty on transmitters.

• Duty on most Telonics equipment has been reduced to 5.7% or less.

• Total tax and duty reductions range from approximately 24% to a fixed 7%, plus appropriate duty (when Goods and Services Tax goes into effect on 1 January 1991) .

• By 1 January 1998, there will be no duty, leaving only the 7% tax to pay.

It should be noted that equipment used in or on aircraft in a natural resource development is currently duty and Federal Sales Tax exempt.

In conclusion, Telonics appreciates the loyalty of Canadian researchers who have consistently used our products over the years. The new regulations will make things much easier for all of us. For further FTA information, Canadian customers should contact either Telonics Canada at (204) 269-7011 or your local customs broker.

Brenda Milam

Glossary of Terms

TRANSMITTERS

Hermetically Sealed Transmitting Subsystems: Transmitter subsystems which are constructed with the transmitter, battery, and sensors solder-sealed inside an air-tight and water-tight metal canister with a maximum leak rate of approximately 10-6 atmospheric CC per second .

Quiescent/Standby Current: The amount of current required by a transmitter to perform “housekeeping” chores between transmissions.

Peak/Pulse Current: The maximum amount of current drawn from the power supply by a transmitter during trans-mission.

Average Current: The average current required by a transmitter, including Peak and Quiescent modes.

Pulse Width: The amount of time a transmitter is “ON,” or transmitting.

Pulse Period: The amount of time from the initiation of one pulse to the initiation of the following pulse.

Duty Cycle: The ratio relationship between the length of time a transmitter is “ON” and the pulse period.

Compensated Transmitting Subsystems: Circuits which are more complex than a “one-stage or two-stage transmitter”, and are designed to create a more stable transmitter. These subsystems take into account battery voltage decay and component aging, thus substantially reducing the amount of “drift” in a transmitter’s electrical characteristics (with specific reference to short and long pulse periods and frequency stability). All Telonics transmitters employ compensation technologies.

EEPROM: An acronym for “Electrically Erasable Programmable Read Only Memory”. This device is used in some transmitters to allow users to modify the operational parameters. A program stored in this device remains unaltered when power is removed.

Downlinked Data: Data sent down from a satellite. This may include data which has been received by the satellite, processed, and then transmitted down to an earth station such as a Local User Terminal, ARGOS Data Processing Center, or NOAA CDA site.

ANTENNAS

Front-to-back ratio: The ratio of radiated power between the front and back of a directional antenna. For example, the RA-2A has a 10 dB front-to-back ratio.

Yagi antenna: A directional “ gain “ type antenna utilizing a number of parasitic directors in front of the “driven” element (the one you connect to your coaxial cable), and a reflector behind the driven element in a defined mathematical relationship. The name is derived from the surname of one of the inventors, i.e. Mr. Yagi. Our apologies to the co-inventor, Mr. Uda, who continues to go unheralded.

Gary Jones

TELONICS INC.
TELEMETRY-ELECTRONICS CONSULTANTS
932 E. IMPALA AVENUE
MESA, ARIZONA 85204-6699 U.S.A.
(602) 892-4444
FAX (602) 892-9139
TELEX 160231