Feature — Science and Technology

The Way Animals Communicate

by Jamal Arsalan

IN Aesop fables and the ancient folk tales of every country animals are depicted as being able to talk among themselves and with human beings. The reality of their communicative ability has long been under study not only to know if they do communicate but also to learn the various forms of communication possible and what it means to different species.

Communicating with animals for commercial benefit is not anything new. Shepherds have been using sheep dogs for ages. Certain breeds show themselves to be more adept than others. Talking to the dog, whistling or using hand signals is not always necessary. Sometimes the master and the dog — though working at a distance with the herd of sheep scattered between them — perform so harmoniously, it would seem they were in telepathic communication. At other times the sheep dog works independently but just as its master would have desired. This tendency can also be seen among cow ponies or horses used to herd cattle. A good horse does not always have to be led by the reins or knees. Sensing the rider's commands, it can anticipate the bull or the cow's probable movement and act accordingly.

Communication occurs at various levels from a mental communion to recognition of oral instructions. Those who bring up 'free moving hens' in their yard know how hens come running when one makes a particular noise. Sometimes the sound of the back door being opened is sufficient to send them scurrying up. While there is no doubt as to the ability of animals to comprehend communication cues, some human researchers try to relegate such behaviour to low key intelligence level. There seems to be a fear that human superiority will evaporate if other beings are shown to have a modicum of communicative ability.

Events experienced by many persons testify to the competence of animals to convey their wants or needs. A dog with a beef bone stuck in its throat was not allowed to have it extracted by the mistress of the house when the son came to know of it. She feared the animal would sink its fangs into the teenager's hand. But when the youth was alone, the dog came to him with its eyes left no doubt as to the relief being sought. The teenager put his hand into the affected throat and tugged out the bone.

A famous Austrian naturalist was at a railway station. Hearing a familiar honking he looked up at the sky. A flick of wild geese were in flight. He seemed to recognize one which he had brought up. Without thinking, he raised his head and let out a piercing yell corresponding to the summons of such a bird, as he had often done when the goose was staying with him. The sudden ear-splitting incoherent shout caused immediate consternation at the station. Men jumped, women fainted or fell into the arms of their escort. Officials were just wondering if this was an escaped asylum inmate and they would have to 'secure' him. Mercifully though the naturalist was a rather large individual just then the embarrassed scientist found to his intense relief that the bird halted in mid-flight, gave a cry of recognition and folding both wings dived into his arms to nestle against him fondly. Terror among the naturalist's neighbours now gave way to understanding and wonder. The naturalist was most pleased by the fact that the bird had remembered him and been able to recognize his voice and person.

Farley Mowat, another naturalist, reports the intensive "Variety and range" of sounds made by the wolves he was studying in the wilds of the Canadian icy north. Only human beings have such a wide vocabulary; in his experience actually elephants and dolphins are among several species which rival the wolves. The wolves communicate with 'words' beyond the range of human hearing as well as "howls, wails, quavers, whines, grunts, growls, yips and barks." As is known 'soundless' whistles pitch calls only one's dog can tune on to and bats use calls too low for human ears as radars to guide them to fruit trees and the delectable fruits.

Farley's investigations were aided by Ootek, and Eskimo, who understood wolf talk. At first, Farley with all of a 'civilised' man's skepticism did not believe in any wolf language. One clear, calm day Ootek told Farley joyfully the caribou or reindeer were returning south as reported by a wolf from hills five miles to the north. The wolf had not seen the caribou himself, he was relaying another wolf's sighting. Farley's study wolf listened then passed on the message: "a long, quavering howl..." Farley believed the wolf was saying something after having heard the other wolf but he could not accept Ootek's explanation. To his amazement the hard-headed trapper Mike, who was part Eskimo, set off on a two to three day walk through the Tundra on Ootek's words. It must be mentioned that at this stage of Farley and Ootek's relationship, neither knew enough of the other's language for adequate conversation. Mike was their interpreter. Farley tried to stop Mike from a pointless journey into the cold. Mike heard him but did not answer. He came back three days later with venison and a pot of caribou tongues to announce the caribou herd had been exactly where described! Farley regarded the incident as a coincidence.

The next occasion Ootek reported, via Mike, that the previous day when Mike had been absent, the study wolf had called his wife early in the night to tell her the hunting was unsatisfactory. He would return about the middle of the next day. Farley was fairly shaken by this for when the wolf returned at 12:17, very exhausted, Ootek was fast asleep. The next incident brought conviction. Farley during his observation saw the wolf listening to a message that did not appear to interest him. He did not reply or pass the news. But Ootek was highly exited. With Mike absent he could not make Farley understand. Exasperated he left the surprised naturalist and went off north-west. That evening the wolves instead of their usual hunting route went off exactly opposite to Ootek's route. Ootek turned up later with three "bashful friends, all grinning" and shy at their first meeting with this white stranger who was interested in knowing about wolves. On Mikes' return, the naturalist learnt that Ootek had heard the wolf on the five mile Hills report the "passage" of these Eskimos through his territory. Ootek had gone to meet them alone being unable to make Farley understand.

Among other Nature's creations, it is thoroughly documented how a worker bee 'dances' to let other workers know when a treasure trove of flowers has been found. Vervet monkeys when sounding a leopard alarm call causes the tribe of monkeys to take to the tree tops.

Communication with dolphins or killer whales may allow the harvesting of fishes in the seas and oceans of the futures like sheep or cattle on land. Feeding the dolphins would be a lot easier than sheep dogs or horses experts opine, since one could simply give them a share of the harvest from the seas. Today the mass of research on animal communication is so voluminous, it is no more a matter if they do communicate among themselves but whether they can perceive of themselves as individuals — ample evidence support this fully — and whether they can shape their environment to make living more comfortable. Carrying out and action in the present to reap benefits in the future is present among animals, not on an instinctive species basis but individual-wise. So a sea otter may carry a rock under its arm pit for future use having found by the (very human) trial-and-error process that a particular rock is better than other rocks to dig up clams from sea bottoms — here the rock works as a crow bar. The same rock is used to crack open the clam shell: now the rock is a hammer. As a naturalist wryly remarked that one should try telling any member of the cat family, from domestic cats to a tigress or a lioness, that they cannot 'communicate' and all one would get would be a haughty stare, while they carried on with their task of teaching or training their offsprings to hunt! Hunting is not natural to cats as other predators. The young ones have to be taught, or some of them may starve and die.

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Sheep need dogs to keep them in order

Francis Perrin: A Pioneer in Atomic Research

by Jean Chabrier

FRANCIS Perrin was born in Paris in 1901. He was the son of Jean Perrin, winner of the Nobel Prize in physics in 1926. With such a father, from his childhood he frequented Marie Curie, the Joliot-Curies and all the greatest scientific minds of the century.

At the age of 17, he won a place at the prestigious "Ecole Normale" school for teachers, where he was the youngest student, and, following in his father's footsteps he gained his "aggregation" teaching qualification and then his doctorate in science (physics and mathematics) at the age of 27. In 1933, he was appointed senior lecturer and then professor at the Sorbonne in 1935 at the age of 34.

Surrounded mostly by left-wingers (his father was a minister in the Popular Front), he was a socialist militant and a down and out atheist, but he soon gave up politics. However, in the 30s, with his father, he was part of the very closed group of French atomic scientists. He took part in the research carried out by this group of physicists who revolved around Frederic Joliot-Curie in the cramped precincts of the laboratories of the Sorbonne and the College de France.

The close cohesion between these researchers and their families should be noted, and to such an extent that many of them met up again on holiday in the same part of Brittany, in Paimpol. He thus knew Marie Curie's two daughters and married P Augier's daughter.

In 1939, together with the team, he drew up the texts of five fundamental patents covering all kinds of applications for nuclear energy, from the reactor to the bomb. It was he who, in May 1939, discovered the notion of "critical mass", that is to say the amount of fissile matter necessary and sufficient to start a chain reaction. He humorously recounts how all this took place in a Jules Verne-like atmosphere and how, ecstatic over the enormous power that they could create, they imagined digging a canal to irrigate the Sahara.

Watchfulness

In 1940, several of these scientists went into exile both out of conviction and also not to have to disclose their secrets to the Nazis freely or by force. In the United States, Francis Perrin held the chair of physics at Columbia University. Then he was appointed to the Consultative Assembly in Algiers, by General de Gaulle. In 1946, he obtained the chair of professor of atomic and molecular physics at the College de France.

In 1951, he took over from Frederic Joliot-Curie as the High Commissioner for atomic energy, a post he was to hold until 1971. He thus contributed to setting up Euratom, to developing the first nuclear reactors and then to the creations of nuclear power stations such as Pierrelatte and research centres such as Saclay and Marcoule.

This shy, gentle and affable man, with his clear eyes, who was a philosopher in his free time, believed in the peaceful application of the atom. He was one of the rare pioneers to have seen his dream come true. He very well knew the demons that he had contributed to taming and was scrupulously watchful. It is no doubt partly thanks to him that France is one of the rare atomic powers which has not had to deplore an accident in its nuclear power stations, making her the largest producer of civil nuclear energy.

If he has acquired international renown as an atomic physicist, it should also be pointed out that he has distinguished himself in many other fields such as the fluorescence of solutions, the duration of elementary light emissions, the Brownian rotation movement of spherical and ellipsoidal particles, the dielectric dispersion of solutions of large molecules, the diffusion of light in an opalescent environment, etc ...

His death, at the age of 91, marks the disappearance of one of the last atomic physicists of the heroic era.

— L' Actualite En France

Francis Perrin, a pioneering personality in atomic research.

One Antenna Gives Multi-cover

TELEVISION viewers would be incensed if, to gain access to the programmes of all available stations, they had to buy individual receivers for each channel.

It is a situation faced worldwide by those needing to communicate with satellites — a single dish antenna provides access to only one individual satellite.

Australia's national science agency, CSIRO, is about to change that with the launch of its multi-beam antenna which can track up to 20 satellites at once.

In a recent demonstration in Sydney, the revolutionary antenna, which was developed with the support of the Australian Department of Defence, simultaneously tuned into two television stations beamed down by Optus satellites, and a third beacon signal from an Intelsat satellite.

CSIRO Division of Radiophysics researcher and team leader Dr Trevor Bird described the multi-beam antenna as completely new.

"As the world telecommunications market continues to expand, it is becoming increasingly impractical for users to have a separate dish for each satellite they need to communicate with," he said.

"What we have here is like having one television set for all five local channels, instead of having to buy a different set for each channel.

"Using one multi-beam antenna means you can send and receive signals to and from up to 20 satellites. These signals might include television broadcasts, telephone calls, scientific data or other information."

An example of its value in an everyday situation would be in a block of apartments where many residents might want to watch pay TV, but not all would choose the same programme. The new antenna would provide the variety of selection needed.

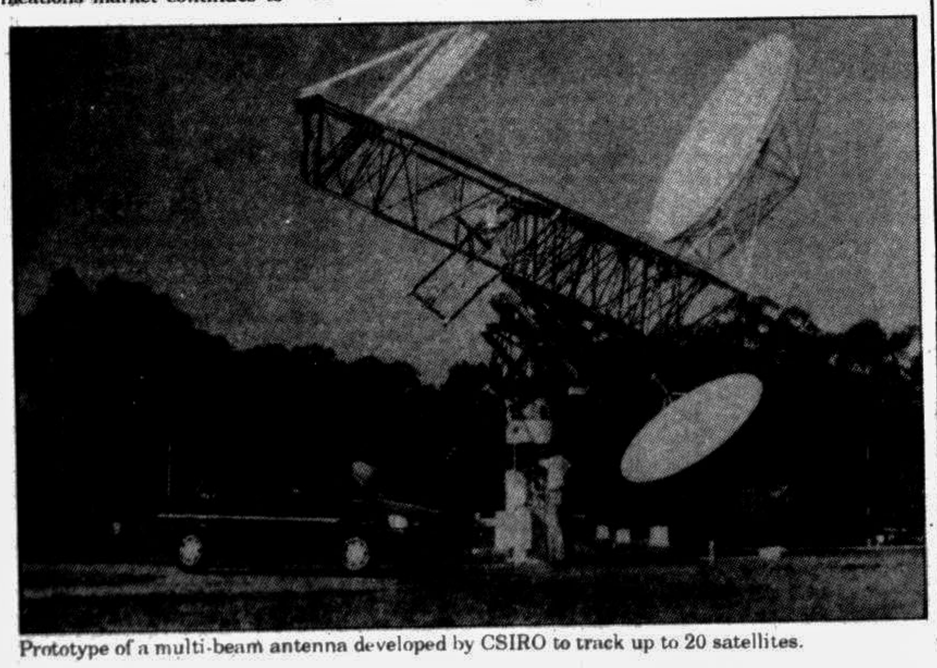
Dr Bird said the multi-beam antenna had a separate feed unit for each satellite. These were able to keep track of their own satellites, so that the main reflector or dish on the satellite did not need to move. All that was needed to gain access to another satellite was another feed unit. With conventional systems, the large reflector had to move to track each satellite, limiting each antenna to only one satellite.

The satellite signal is sampled as the antenna is rotated on a spherical grid, enabling the antenna's radiation pattern to be obtained. The satellite signal is recorded by another fixed antenna. The resulting data allow application of holographic techniques, including assessing the reflector surface accuracy.

This is repeated for several selected feed locations in the focal region of the antenna. Results obtained show antenna efficiencies have registered better than 65 per cent.

The system is flexible and reliable. Networks can be reconfigured to optimise transponder usage. Stand-by links to an alternative satellite also may be activated if one link fails.

— (Australian Science & Technology Newsletter)



Prototype of a multi-beam antenna developed by CSIRO to track up to 20 satellites.

Major Success in Fighting Rust

by T.V. Padma

INDIAN scientists are launching an all-out offensive to lay all rust to rest.

Undeterred by the site of the rust — be it in oil pipelines deep in the ocean or skyscrapers in cities, a small jetty bobbing in the sea or a massive petroleum refining complex — scientists have armed themselves with an array of inhibitors, alloys, jellies, primers, paints and oils to assault rusty and corroded structures.

The battle against corrosion is being chalked out in the laboratories of the Central Electrochemical Research Institute (CECRI), Karaikudi, whose new anti-corrosion technologies to protect vital installations such as bridges and offshore pipelines and platforms for oil drilling are expected to save over a hundred million rupees every year.

Annual losses due to corrosion mount to 3 to 5 percent of a country's gross national product (GNP) and 10 percent of the annual metal output invariably goes into replacing corroded materials.

Some of the CECRI processes, already made mandatory by the Ministry of Surface Transport, are being used in several places, including the Mandovi bridge in Goa, the Pamban bridge near Rameshwaram, port trusts, thermal power stations, and the Oil and Natural Gas Commission's offshore pipelines, CECRI Director Prof S K Rangarajan says.

Corrosion manifests itself in different forms: there can be uniform corrosion of the metal surface leading to an average reduction in thickness, or a localised form of failure like pitting or cracking which is sudden and unpredictable.

The danger comes mainly from pre-stressed concrete bridges which face considerable damage due to sudden snapping of corroded pre-stressed wires.

High strength prestressing steel, which is held in permanent tension, is increasingly used in bridge constructions. The steel is highly sensitive to environmental cracking and snapping due to corrosion and hydrogen embrittlement.

It is also vulnerable to severe corrosion due to time lag between insertion in the cable duct, stressing and final cement grouting.

CECRI's protection package consists of surface modification of prestressed steel, temporary protection during transit and storage, temporary protection while laying in cable duct and adding an inhibitor admixture to cement grout.

CECRI is tackling the problems on four fronts — it has developed suitable coatings for rebars, for concrete surfaces, corrosion control measures for pre-stressed steel wires during transport, laying down and actual service, and ways to modify existing concrete composition.

CECRI's anti-corrosion treatment on steel rebars consists of four steps subsequent to bending and shaping. Scientists first derust steel rods by dipping them in a derusting solution to obtain a bright surface, and then apply a phosphating jelly as a coating.

Two more coats of inhibited cement slurry, followed by a sealing coating and the treatment is over in about three days to give a chloride-free protective environment around the steel bars.

The treatment which can be done on site and costs less than one percent of the total cost of construction, enhances the durability of RCC structures by nearly five times in marine climates. It does not affect the bonding between steel and concrete, extensive tests have shown.

The institute has developed a package of technologies to protect pre-stressed steels at all stages, right from manufacture to grading coatings for steel-rebars and the concrete surfaces, as well as corrosion-resistant concrete mixers.

The new treatments to protect both the concrete structures and steel reinforcing bars (rebars) inside are vital for India where at least 700 bridges need either replacement or improvement at an estimated cost of Rs 10,000 crores.

Another CECRI technique is cathodic protection, which involves application of an external negative voltage to protect steel rebars in marine structures such as offshore platforms, jetties and ships as well as buried structures such as underground pipelines. The structure to be protected is converted into a cathode relative to an external anode.

The method uses galvanic or sacrificial anodes based on metals which have more negative electrode potentials than the structure. A second method is the impressed current anode technique in which the current is impressed from and external source.

Earlier India imported thousand-million rupees worth galvanic anodes to offer this protection, but now CECRI has the know-how for aluminum alloy anodes incorporating mercury or indium, zinc alloy and magnesium anodes.

Aluminium alloy anodes can be used in shiphulls, barges, dock structures, jetties, submarine pipelines and ballast tanks. Magnesium alloy anodes find use in pipelines, storage tank bottoms and towerfooting of overhead power lines, while zinc alloy anodes have potential application in water boxes, condensers and fresh water tanks.

CECRI's titanium substrate insoluble anode (TSIA) is currently being used for cathodic protection of jetties, marine structures and interiors of pipelines.

Cathodic protection stops corrosion even in salt-contaminated concrete and strikes at the root of corrosion, unlike currently used patches, sealers and membranes which treat the symptoms only.

To ensure that their protective measures are working, CECRI scientists have developed a hi-tech SCADA — acronym for supervisory control and data acquisition — as a next generation monitoring system for the marine structures.

SCADA, which monitors from a control room, ensures adequate and continuous protection of the structure.

Another major development is water repellent polymer coatings to protect the marine structures.

Research on water-borne paints is receiving attention, more so because of severe restrictions imposed in developed nations on the use of harmful organic solvents-based paints.

Organic coatings to protect structures and equipments account for 30-40 percent of the total cost of corrosion.

CECRI has made rapid advances in the field of high-build paints, water-soluble paints that minimise pollution and the less toxic anti-fouling paints.

The institute's epoxy polyamide coating which can be applied over moist surfaces and prevents fires is expected to find extensive use in bridges, ONGC and chemical industries.

It has also synthesised a few water-soluble resins based on alkyd and epoxy resins that give highly corrosion-resistant electrocoatings for automobiles and appliances.

Its polycrystalline phosphate coatings can be also used as a pretreatment for automobiles, household electrical gadgets and appliances and steel furniture.

A water-based rust converter has been developed, which converts surface rust into a protective film in a three-in-one process that combines surface preparation, pretreatment and primer application.

The universal rust converter for marine and industrial structures can be used on any rusted surface without the usual treatment procedures.

Other measures to tackle rust in bridges, towers and tanks include inhibitors and jellies that remove rust from steel structures, primers based on zinc silicate, and rust preventive oils.

Similarly, the institute's calcium chromate pigment may be a boon to the paint industry as a substitute for costly zinc chromate pigments.

CECRI has established an off-shore laboratory at Tuticorin to develop techniques to control marine corrosion and biofouling, a phenomenon in which marine organisms attach themselves to ships and pipelines and damage them.

CECRI's Offshore Platform and Marine Electrochemistry Centre (OPMEC) at Tuticorin is studying the mechanics of barnacle corrosion and collecting data on biofouling by marine species, and atmospheric corrosion of steel and copper in coastal regions.

Biofouling is a major problem in power-generating plants which use sea water for cooling. In the worst case fouling can reduce the diameter of intake pipes by almost half.

So enormous is the problem that a 15 cms thick growth of marine micro-organisms on structures needs an additional 50-mm thick steel for offshore platforms.

Water used in heat exchangers, boilers and secondary oil wells causes problems of deposit formation, fouling due to bacteria and corrosion of materials.

CECRI has developed less toxic inhibitors to control corrosion, a package of oxygen scavengers, antiscalants and corrosion inhibitors for secondary oil wells, and special inhibitors for acid and alkaline media.

The institute's experts and experience are being increasingly used by both private and public sector undertakings in India in the form of sponsored projects and consultancies. It is also solving some specific problems faced by defence and space organisations.

—(PTI Science Service)

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