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Tapping the sky's water reservoirs

B.C. firms lead the way in developing machines to pull moisture from air

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CREDIT: Jean-Marc Bouju, Assoicated Press

Nations such as Eritrea face regular catastrophic droughts, so water-vapour collectors would only be a small part of the solution.

In the search for new sources of water, everyone is looking down, to the sea or under the ground. But Roland Wahlgren is looking up -- to the vast, untapped fresh-water reservoir in the sky.

The dedicated North Vancouver researcher is one of a small band of scientists whose work has been largely ignored for decades. But these researchers say they've found hope for a world in which rivers and lakes are shrinking, water tables are dropping and contamination levels are on the rise.

With 1.5 billion people -- one in five -- parched, sick or dying for want of safe drinking water, says Wahlgren, it is an idea whose time should have come long ago.

Adapting simple dehumidifiers, scientists have designed machines that can pull water out of thin air, in amounts that could make the difference between life and death in many water-starved countries.

CREDIT: Peter Battistoni, Vancouver Sun

Researcher Roland Wahlgren says atmospheric water vapour has potential to end the world's shortage of clean, potable water.

The simplicity of the atmospheric water vapour processing unit belies its ponderous name. And the invention is surprisingly effective: A unit the size of a skyscraper or a low-rise plant as long as a city block can theoretically produce 5.8 million litres of water a day -- enough for about 387,000 people. Under the right atmospheric conditions, one water-cooler-sized unit can help provide cooking and drinking water for a family, simply by harvesting the water vapour from humid air.

In more than half the countries in the world -- some of them the poorest, most populous and most water-deprived -- the air is humid enough to yield huge amounts of precious water.

Even large-scale water-vapour extraction would have virtually no negative environmental effects, says Walgren, because of the sheer quantity of water vapour in the atmosphere. It contains four to 25 grams of water vapour per cubic metre, or 13,000 cubic kilometres of fresh water in total, scientists say.

Water-vapour condensers don't need much humidity: If the air has 10 grams of water per cubic metre, a unit can change 10 to 40 per cent of that water vapour to liquid. Most nations within 30 degrees latitude north and south of the Equator already have more vapour than they need -- an average 15 to 20 grams of water per cubic metre of air, year-round.

By contrast, Vancouver averages only 10 grams each in summer, and less as temperatures drop. The atmosphere over much of the relatively water-rich developed world is not ideal for optimum production, as cool air carries less moisture than the warm air that prevails in countries within 30 degrees latitude of the Equator.

But the technology would still be useful in North America's temperate zones, says Wahlgren, who holds a Master's degree in physical geography.

On an August day in Vancouver, a unit the size of a household dehumidifier would produce 35 litres of water a day -- only 15 litres short of the minimum daily amount for one person, according to the United Nations. In January, if kept from freezing, the water output from a unit in Vancouver would be 17 litres.

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Roland Wahlgren, 50, has been developing atmospheric water vapour processing units for three years, from his home-based business, Atmoswater Research company.

He tested two water-cooler sized prototypes -- one in his house and one outside -- during the spring and summer. His family of three used their 12-litre daily output for drinking, cooking and making tea, after carbon-filter and ultraviolet treatment to purify the water. "The tea tasted delicious," says Wahlgren.

He helped design another prototype that is now producing 70 litres a day in Florida's hot, humid climate.

Wahlgren is not alone. Canadian inventors are leading the race to develop "first-generation" commercial water machines, although inventors worldwide aren't far behind.

Jonathan Ritchey, from his Freedom Water Company, based in Vernon, is working with Okanagan University College in Kelowna and the federal National Research Council to perfect and market his solar-powered model.

And Keith White and Ray Anderson, from TTW International Ltd. in Vancouver, are already marketing Montreal-based Dectron Internationale's line of home, business and military units.

The stand-alone units, which they believe are the first in production worldwide, run on electricity or generators.

The question is: Why has it taken so long for scientists to invent a way of pulling water from the sky?

"Ninety-five per cent of people involved in water resources are still very much focused on ground and surface water," explains Wahlgren.

But the preoccupation with ground and surface water can lead to political conflict, even war, as countries vie for control of shared rivers and lakes and plummeting water tables.

Of the world's 200 largest river systems, 120 run through two or more countries. Even relatively water-rich Canada has come into conflict with its neighbour and ally, the U.S., over water.

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Wahlgren says his personal "point of distress" came in 1984, when crop failures due to drought triggered widespread starvation in Africa. He started to look for "something unconventional that other people hadn't thought of."

With an undergraduate degree in geography from the University of British Columbia and a Master's from Carleton University, he instinctively turned his attention to the interplay of earth, water and land.

"I was aware of water in the air and thought there would be a way to somehow transport it to places where it's needed," he says.

He found that other people had indeed thought about it -- hundreds of years ago.

The large-scale collection of dew -- nature's own method of recouping water vapour -- has long been ascribed to ancient Hebrews and Greeks, who are thought to have arranged stones to collect moisture from condensation as night temperatures fell.

Early in the 20th century, Russian engineer Feodor Zibold thought the ancient landmark stone piles around the modern city of Feodesia in Ukraine were the ruins of an enormous dew condenser. He saw them as part of a huge system of collectors that supplied that city's ancient predecessor, Theodosia, with its water supply.

Inspired, in 1912 he completed a huge beehive structure -- a 20-metre bowl of stones dug into the earth, and topped by a six-metre dome. It reportedly yielded 350 litres of water daily.

The famous French water researcher, Daniel Beysens, later argued that Zibold was mistaken: The stone piles were not dew condensers but ancient kourganes, the famous tombs the Scythians built between the 9th and 3rd centuries B.C. across southern Europe and the Asian sector of the former Soviet Union.

Historical miscalculations aside, the science itself had merit. Beysens set up modern-day condensers in Tunisia and France in 1995, with heartening results.

He found dew collectors can provide the equivalent of 0.1mm to 0.5 mm of daily rainfall -- one-third of Ottawa's daily summer rainfall.

This could lead, Mr. Beysens said, "to a new generation of condensers able to provide clean water wherever ordinary means cannot be used."

One tenacious Swedish researcher, Bo Hellstrom, professor of hydraulics at the Royal Institute of Technology in Stockholm, included this aside in an otherwise technical 1969 paper, Potable Water Extracted from the Air: "When visiting the Hydraulic Laboratory, the Minister of Health of this [Arabian] state said to the Author: 'I will give you as much oil as you want, free of charge, if you give me water.' "

The swap never took place. The identity of that country died with the researcher, whose quest had taken him to Egypt in 1953 to compare the dew-collecting qualities of different kinds of leaves. (Thin-leafed barley plants beat out olive trees as water collectors.)

Hellstrom's own experiments showed the "feasibility of the method has been fully proved." It would be an alternative source of water, he stated, where drinking water is expensive and needed in small quantities.

A colleague, H.E. Landsberg, was also enthusiastic about the potential of water condensers: "It is about time," he told a Washington, D.C., assembly of scientists in 1972, "that serious thought be given to the exploitation, by engineering methods, of that enormous water reservoir in the air."

And that was before the current crises over climate change, water pollution and water-table depletion. Once again, Ethiopia, Eritrea and much of southern Africa are facing catastrophe as a result of drought.

For such water-starved regions, water-vapour collectors will only be a small part of the solution, Wahlgren says. Desalination and distillation plants provide most of the purified water there, and will continue to be an important part of the picture, he predicts.

Water conservation is equally important, he adds. And that, for him, does not mean simply curtailing desert swimming pools and lawn watering. It also means halting wasteful irrigation practices and fixing leaky pipes, which account for a worldwide hemorrhage of some 60 per cent of the available purified water.

But, given the severity of water shortages and limits to expensive purification systems, he says, the world needs the flexibility of water-vapour collectors.

Strangely, though, the field remains relatively obscure, he says. Research results and patent information are scattered, with researchers and inventors working in semi-isolation.

"I could see that there had been so much work done on this whole topic, but no one was tying it altogether," says Wahlgren, who pulled together two years' worth of research in an exhaustive review that appeared last year in Water Research: A Journal of the International Water Association.

The biggest market for these devices, he says, lies in that crucial band of nations with enough humidity to generate water. They include Saudi Arabia, Yemen, Zaire, Uganda, Nigeria, Ghana, Mozambique, Tanzania, Kenya, Brazil, Indonesia, Malaysia and Myanmar, the Barbados and Haiti.

However, the drought on the North American Prairies, along with rising temperatures and the prospect of further dry summers and winters, he says, will make the problem more urgent for North Americans.

Last summer, drought ravaged the herds of Prairie cattle, and thousands of Alberta horses had to be slaughtered.

"With water shortages at this scale," he says, "you couldn't irrigate a field -- but you could set up cattle watering stations" using water-vapour condensers.

Within 10 years, Wahlgren predicts, large-appliance manufacturers will integrate these water machines into standard product lines.

"People are interested in security" when it comes to their water supply, he says. They don't want to worry about the contamination of centralized water supplies, such as the E. coli breakout in Walkerton in May 2000. Recent tests have shown water produced by vapour condensers in Vancouver, Florida and Texas is remarkably pure, with bacteria, nitrates, arsenic, organic chemicals, metals, pesticides and radioactive materials "below detectable limits."

The safety of the water supply will become an even greater concern in the wake of repeated warnings that terrorists might target drinking water, he adds.

But for the moment, he likens the development of water-vapour collectors to the early days of automobile production.

He hopes North Americans will raise money for the research and development of "really basic sturdy Model T type units that anyone could repair."

"If you have a source of water from the air, and only have to purify it," he asks, "why not use that?"