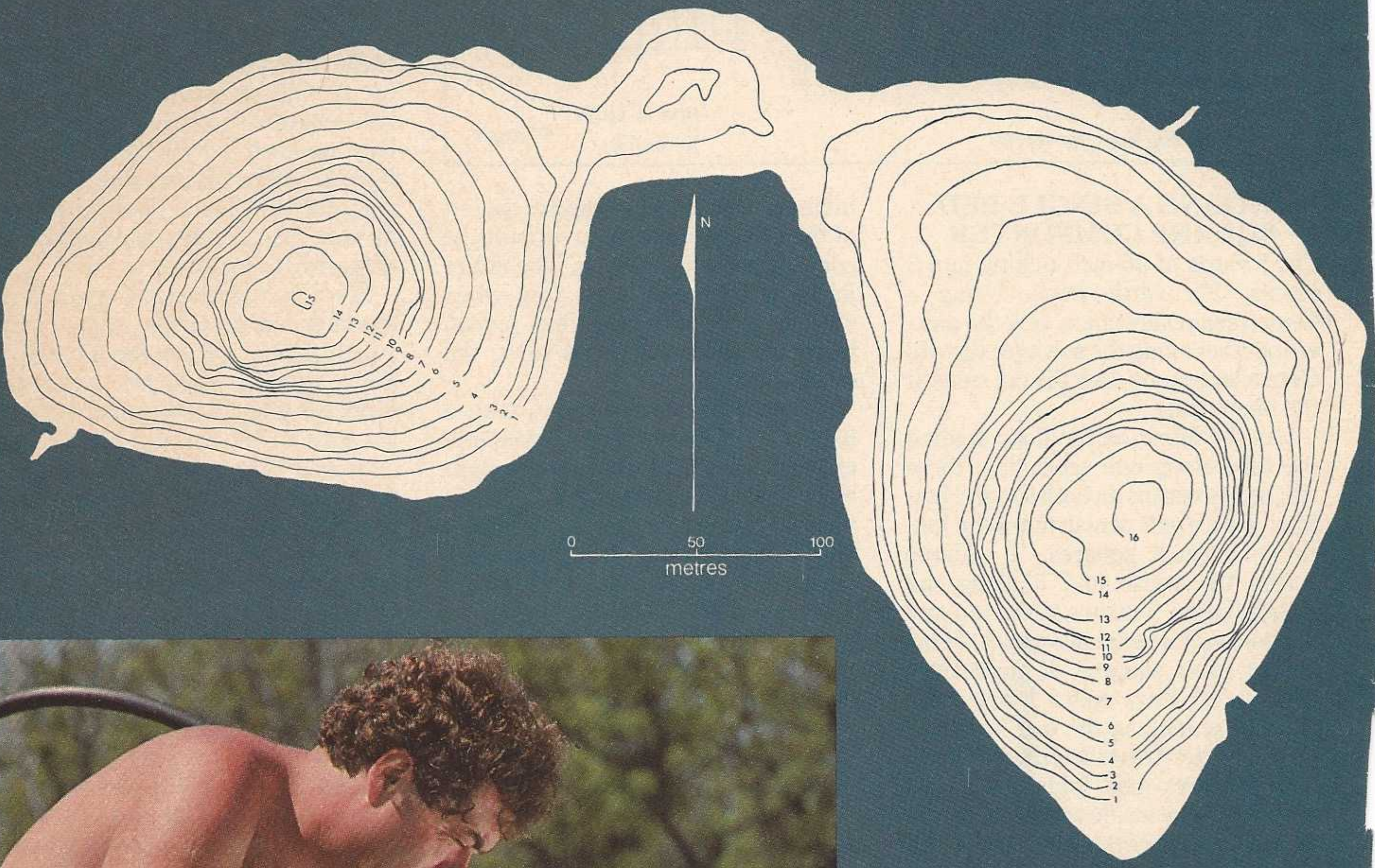
New Hope For the Dead

One Canadian lake in four is eutrophic, oxygen-starved and algae-strangled. But with a machine to do the breathing revival is at hand

By Rhonda Birenbaum



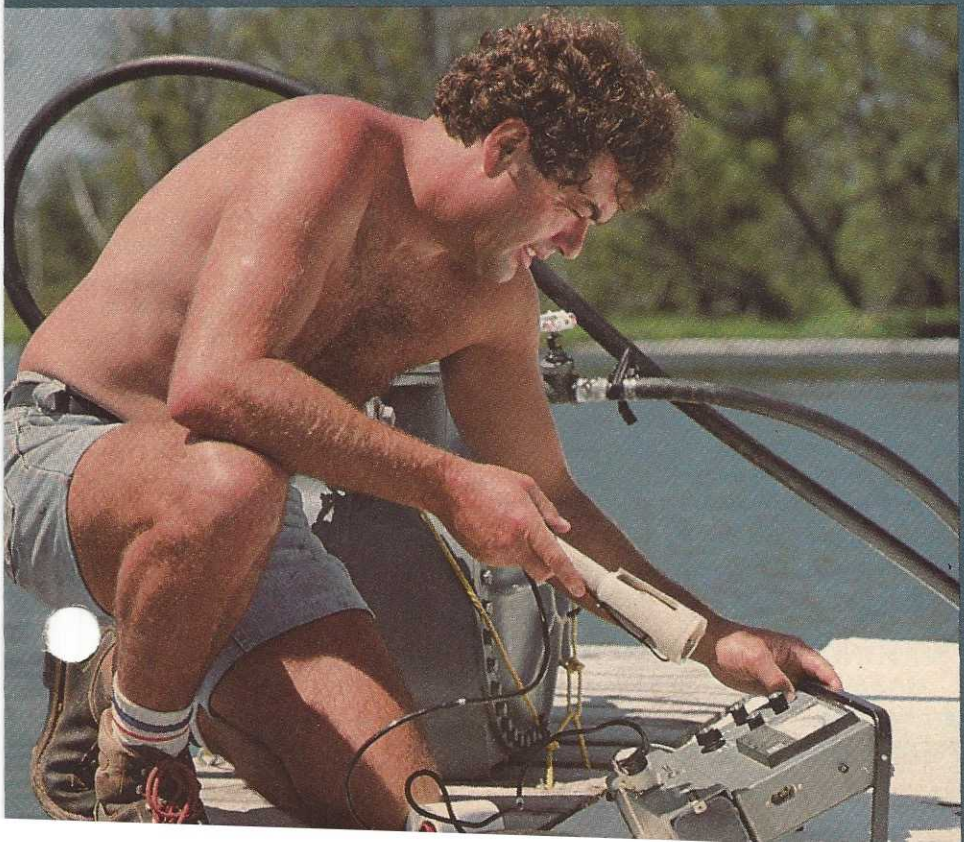


FIGURE 2

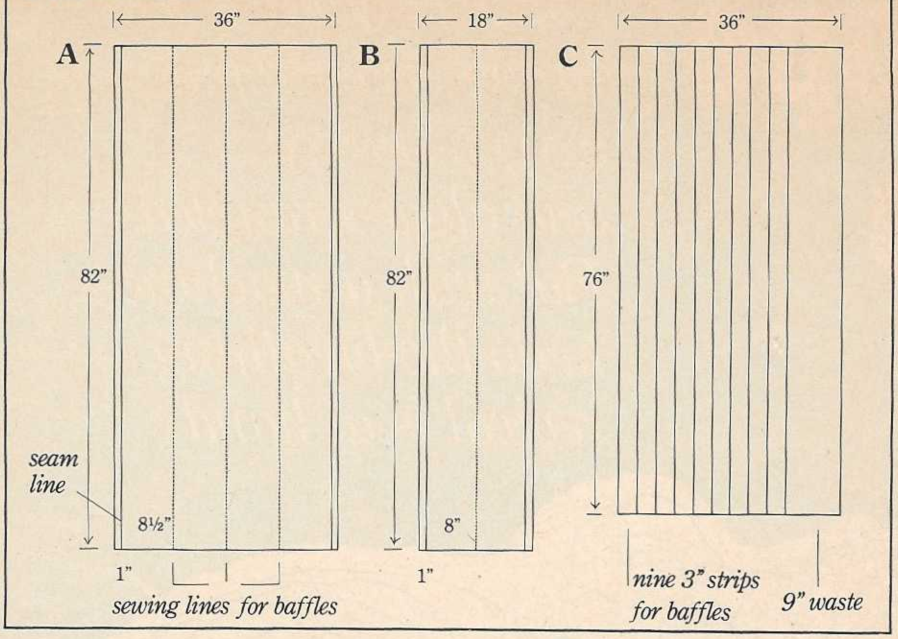
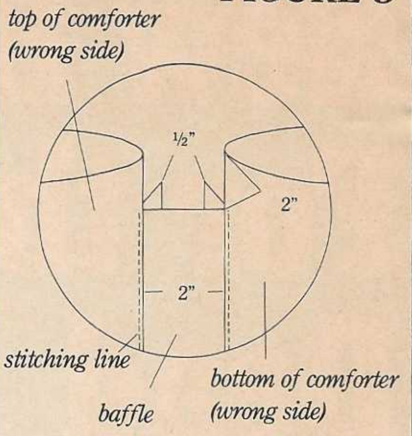


FIGURE 3



MAKING A SINGLE BED SQUARE COMFORTER

Cut 7 yards of 36-inch ticking into 3 pieces, 2⅓ yards each. Using a ⅝-inch seam allowance, sew the pieces together along the selvage edges to form a large tube with the cut sides at the open ends.

Lay the fabric on the floor, folding the tube along one seam line; there will be 1½ widths on both top and bottom. With a soft pencil, mark the fabric in 13-inch squares, 4 squares across the width and 6 along the length. Leave 3 inches at the top and the bottom for seam allowance. (This makes even squares; if uniformity isn't crucial, leave only a 1-inch seam allowance, making the end "squares" a little longer than the others.)

At the open ends, fold the seam allowance to the inside and press. Carefully pin together the 2 layers of cloth across the centre width line and along the 3 lengthwise lines. Sew along the pinned lines. You now have 4 tubes open at each end, with a seam across the middle (see figure 1).

Because the comforter must now be alternately stuffed and sewn, special facilities should be prepared. Down is like quicksilver – it escapes at the slightest opportunity. Your work area will become covered with fine plumules despite the greatest of care, and working outdoors is not advisable except in dead calm. It's best to arrange a clean working surface in a spare room or even a shed.

Sewing the down-filled squares is an awkward job. If possible, place a table at the same height and to the left of the sewing machine to support the comforter during sewing. The entire job is easier (and more fun) when shared with a friend. One person holds the tubes open and sews, the other stuffs.

To stuff the first square, take a handful of clean down. With your other hand, press the down into a tight ball. Pick the excess from between your fingers so the ball is as compact as possible. Plunge your hand deep into the first square and gently let go. The down will expand to fill the square. Quickly pin the 2 layers of cloth together along the drawn line to close the square. Continue to fill the 4 squares across that row, pinning each as it is filled. Then sew along the pinned line to complete the first row.

Only experience will ensure even stuffing; one ounce of the very best goose down will fill 500 to 600 cubic inches and will compress to 15 cubic inches, or about one handful. A down-feather mix will not have the same loft or compressibility. To fill a 13-inch square with a blend will require 1½ or 2 handfuls.

When all 4 rows in one half are filled, close the end with a seam ¼ inch from the edge, then edge stitch to finish. Repeat this procedure to fill the 4 rows in the other half, then fluff the comforter, encase it in a slipcover, lie back and enjoy it.

MAKING A DOUBLE BED BAFFLE COMFORTER

Cut 13½ yards of 36-inch ticking into 5 pieces 82 inches long and one piece 76 inches long. With a soft pencil, mark four of the 82-inch pieces with baffle lines as indicated in A (see figure 2). Cut the fifth 82-inch piece in half lengthwise and mark the baffle lines on each half as indicated in B. For the baffles that separate the channels, cut the 76-inch piece lengthwise into nine 3-inch strips (leaving 9 inches of waste), as indicated in C.

Sew two A panels and one B panel together along selvage edges, using 1-inch seams. This is the top side of the comforter, 90 inches across and 82 inches long. Turn a 1-inch seam allowance to the wrong side on both ends and both sides. Press. Repeat the entire procedure with remaining A and B panels to form the underside of the comforter.

To attach baffles, fold the top side of the comforter along the first baffle line, right sides together. Pin to the baffle, starting 2 inches from the top and overlapping ½ inch as shown (see figure 3). The baffle will end 2 inches short of the bottom. Stitch through all 3 layers close to the folded edge.

Attach all the baffles to the inside of the comforter top. Then fold the comforter bottom along the first baffle line, right sides together. Attach to the first baffle as above. Continue attaching the baffles, beginning at one side and working across to the other.

Pin the side edges of the comforter together, seam allowances to the inside. Stitch together ¼ inch from the edge, then edge stitch to finish. Close one of the ends of the comforter in the same manner.

The comforter with its 10 channels is now ready to stuff. Lay it out lengthwise on a working surface at least 10 feet long. The clean filling should be in a bag with a small opening. Pin or baste stitch the bag open-

(Continued on page 103)

The lake is calm and quite beautiful, its surface rippled only occasionally – and respectfully – by the morning breeze. There is another distance, also small, a few yards offshore: a boat with two occupants, easily mistaken at first glance for fishermen observing age-old custom. But they are not, because this lake has no fish – at least none worth eating. Nor does this lake's beauty extend more than a few feet below the surface.

Lake St. George is a dead lake, strangled by its own plant life, overfertilized and virtually uninhabitable. One of the men in the boat is biology professor Don McQueen, the other, one of his students. They are here to breathe life back into Lake St. George. With them in the boat is an aerator, a bubble machine that McQueen has designed himself. With a minimum of effort they hoist it over the side and watch as various plastic tubes drop and disappear into the green algal stew. A third man, unseen in the forest, throws a switch and the vague rumble of an air compressor begins. The lifeline has been extended.

After 20 years of urban pollution and agricultural runoff, this 10-hectare lake near Oak Ridges, Ontario has become chronically eutrophic. About 25 per cent of all the lakes in Canada also suffer from eutrophication, a condition characterized by too much algae and too little oxygen. It kills lakes as surely as acid rain does but, in recent years at least, without the attendant publicity.

Normally a lake is a neat ecological organization. Algae flourish and, as they die, drift through the lake's warm upper water layer to its colder bottom, where they become food for bacteria. The bacteria devour the oncoming algae and the water stays clear. In a eutrophic lake, excess nutrients – the result of man's sewage, agriculture, even road paving – encourage the algae to take over the surface. The bacteria consume to excess, depleting the lake's supply of oxygen. Algae eventually dominate the local ecosystem, and the result is an opaque mass of living and dead matter.

The chemical villain that drives lakes to this murky death is phosphorus. A crucial element in plant and animal metabolism, it flows into lakes via runoff water and can reach tremendously high proportions, causing the suffocating algae bloom. Ultimately the lake dies as fish, such as trout and whitefish, are replaced by carp, perch and bullheads that can tolerate low levels of oxygen. Phosphorus-loading makes the water more alkaline, killing certain kinds of plants and promoting overgrowth of others. The overall effect, as numbers and kinds of various predators and prey alter, is a drastic upheaval in the food chain.

Lake St. George, charted on the facing page, was given up for lost. Then Don McQueen and his bubble machine gave it a lease on life

At last count (in 1978), 320,000 square kilometres of Canadian lakes had gone the route of Lake St. George. What's more, virtually all of these lakes are in populated southern regions, where people rely heavily on water for drinking and recreation. Thus, the problem of eutrophication is more serious than even the bare statistics suggest. Moreover, it is steadily intensifying. As long as populations and farming activity increase, there will be more sewage and fertilizer pouring into lakes. Many lakes now sit on death row with little chance of reprieve. In another decade hundreds more will have died.

Eutrophication is not new and in the past many methods of alleviating it have been attempted, including the use of chemicals, pH neutralizers and pesticides. All, unfortunately, had the habit of killing more than just the algae, and ultimately did more harm than good. Previous attempts to aerate eutrophic lakes have also failed. The first aerator worked like an egg-beater, whipping air into the water. However, it disrupted lakes by unnaturally mixing their top and bottom layers and raising overall temperatures. As a result, lakes aerated in this manner remained inhospitable to cold-water fish and many aquatic insects. Scientists in Sweden, where lake aeration began, conducted experiments as ear-

Photos by Peter Emmerson

ly as 1960. They placed an elevated platform on a reservoir and as water tumbled over the platform it picked up oxygen from the air. Once again, however, the water warmed. It became less potable and its wildlife structure changed drastically.

Not until Don McQueen, who teaches at Toronto's York University, developed his "hypolimnetic aerator" did hope for restoring the ecosystems of eutrophic lakes revive. Recognizing the shortcomings of previous attempts, McQueen has concentrated on designing a machine that pumps oxygen into the water without disturbing its natural stratification and wildlife composition. Unlike the units of his predecessors, McQueen's aerator pumps oxygen directly into the choked lower layer of water, the hypolimnion – thus hypolimnetic aeration. Other experts consider it the best method around.

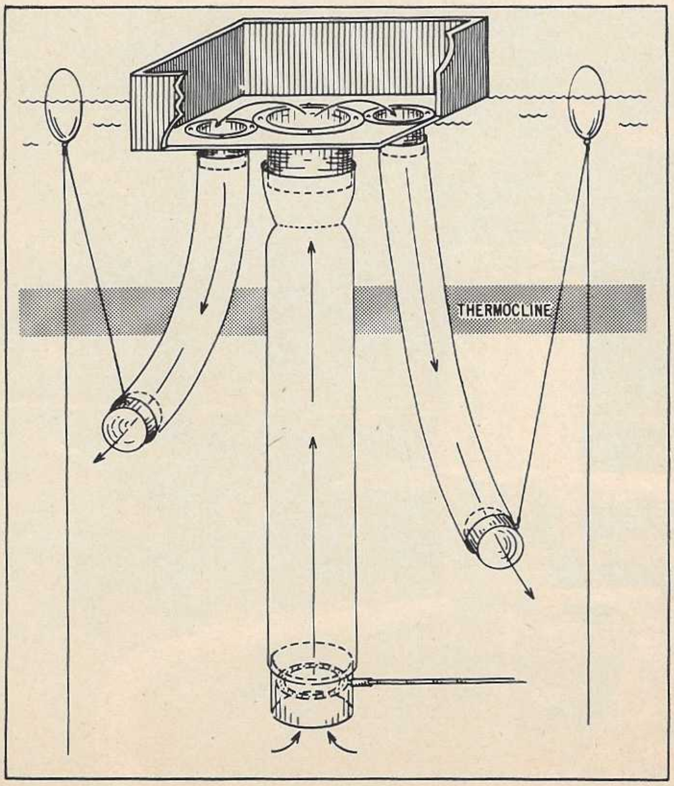
Since 1978, McQueen and his students have been familiar sights on Lake St. George, preparing for its rehabilitation. And, daily since they first installed the aerator this year, at least one of them has been seen on its surface, collecting water for microscopic evaluation and chemical analysis, checking turbidity or watching for fish-population changes. A graduate of the University of British Columbia's Institute of Animal Resource Ecology, McQueen seems right at home collecting samples. Before arriving at York, he did all his work in the field, and has been working on and teaching about lakes since 1970. Lake St. George has been eutrophic as long as McQueen has known it, well before 1979 when he began work on its resuscitation. Since then, however, it has become increasingly uninviting to both wildlife and people. McQueen attributes its decline to an adjacent farm. In the same few years that Lake St. George has rapidly deteriorated, the neighbouring farmer has increased his cattle herd. Consequently, water destined for the lake has recently contained much higher concentrations of phosphorus and other nutrients from manure. Without that extra farm runoff, McQueen maintains, Lake St. George could have held its own. Every sample bottle he draws from the lake is testimony to the nutrient overload.

Yet McQueen remains excited about the prospects of his experiment. As he explains it, the mechanics of hypolimnetic aeration are really rather simple. An onshore compressor supplies air through a hose resting on the lake bottom. The air is mixed with water and bubbles up a riser tube where oxygen dissolves in the water. Poisonous methane and hydrogen sulphide gases are vented at the surface, then two manifold tubes direct the purified and aerated water back to the lake depths. The added oxygen revives bacteria rendered inactive by the air deficit, enabl[illegible] them to feed on the overabundant [illegible]gae pouring down from above. The bacteria clear the water and leave enough oxygen in it once again to support fish life.

In the summer of 1978 a prototype hypolimnetic aerator began pumping air into Tory Lake, 25 kilometres north of Toronto. After two years of aerating this small, half-hectare lake, McQueen and his team achieved dramatic results. Oxygen rose from zero to four milligrams per litre. Colour and turbidity improved, while 17 kilograms of phosphorus were removed from the water and rendered inactive in the sediment on the lake's bottom. Now, at Lake St. George, McQueen is achieving the same effects. The aeration has revived the bacteria and significant changes in the clarity and colour of the water have become evident. Hopeful that there is now enough oxygen in the lake to support some of the fish species that have been choked out over the years, McQueen plans to stock the lake with pickerel (walleye) before the ice sets in this winter to t[illegible] their survival potential.

But there is no doubt that one year's aeration has not purified Lake St. George. Because of the enormous and continuing pollution influx,

McQueen's machine and its maker manning it on Lake St. George. Life is returning again but full recovery is at least 10 years away



David Lean, research scientist at the Canadian Centre for Inland Waters, Burlington, estimates it will take 10 seasons of daily aeration before the lake becomes clear once more. And, despite his hopes, McQueen is even less sanguine about his early successes. Clearing polluted lakes with hypolimnetic aeration can only be a short-term answer, he says, a stopgap operation effective only until other, long-term solutions are worked out. Success will be limited as long as fertilizer and other sewage continue to pour into the water. Only modified agricultural practices and the construction of more sewage treatment plants will give eutrophic lakes a real fighting chance. Both reforms are under way in certain regions, but progress is slow and the political obstacles considerable. McQueen, however, considers reform inevitable. "We're getting into a situation where our population is forcing us to manage almost every aspect of nature and, whether we like it or not, I think we're going to have to comply," he says. "It simply cannot manage itself, not with the amount of pressure we put on it."

In the absence of more farsighted policies, however, the best lake-management technique seems to be hypolimnetic aeration. Since it promotes restoration of an ecosystem to a former state of balance, it may prove the only safe rehabilitation available for these dying lakes. That is why the Lake St. George experiment is so significant. McQueen and Lean agree that over 50 per cent of eutrophic lakes in demand as sources of water or recreation would benefit immediately from the procedure.

In that light, there appears to be a huge commercial potential for the new bubble machine. But its inventor remains uninterested in exploiting it. "I'm a scientist, not a salesman," he says. What is more, no Canadian patent has been issued for the device and McQueen has no plans to seek one. "Anyone could build the aerator," he says. "I'm publishing all the details in the scientific literature. The components for our aerator were purchased in a building-supply store and from a sailmaker who supplied the polyvinyl tubing. Nothing came from a scientific-supplies outlet." It cost $2,000 to build the hypolimnetic aerator, a one-time expense. Most of its operating budget is spent to power the air compressor that must run continuously until the lake is cleared. The electric bill for Lake St. George this year totalled about $2,400.

Paul Leich, renewable-energy coordinator at the Kortright Conservation, Interpretation and Education Centre north of Toronto, has devised a plan to free McQueen from his dependence on electricity. "On top of a 14-metre tower we plan to build a four-blade wind-conversion system," he explains. "A four-metre windmill will turn a one-piston air compressor capable of compressing up to 100 psi of air. This air will be stored in a reservoir and bled slowly into the lake." Leich compares the system to a bagpipe: air, as required, flows into and out of a storage receptacle that is kept full at all times.

Ideally, Leich says, the windmill would float directly above the aerator on the lake, "where the wind blows undisturbed by trees." But for its trial run it will stand on shore where the scientists can monitor its performance. A hose will carry oxygen out to the bottom of the lake. Leich estimates that $5,000 will pay for all the components, including a $2,000 compressor, the most expensive part. "But after that there are no more hydro costs and very little maintenance." Not only will the wind system provide the cheapest possible air, it will also allow lakes that aren't near a power grid to be aerated. Lean calls it "the aerator of tomorrow."

Meanwhile, Lake St. George remains polluted. Every new water sample is clearer than the last and McQueen's journal notes become progressively more optimistic, but it will take years of daily aeration before the lake thrives as it once did. The reward McQueen is demanding for his painstaking labour is a simple one. "Someday," he says, "I'd like to dip into Lake St. George and come up with a clean glass of water." Perhaps, thanks in no small part to his efforts, someday he will.

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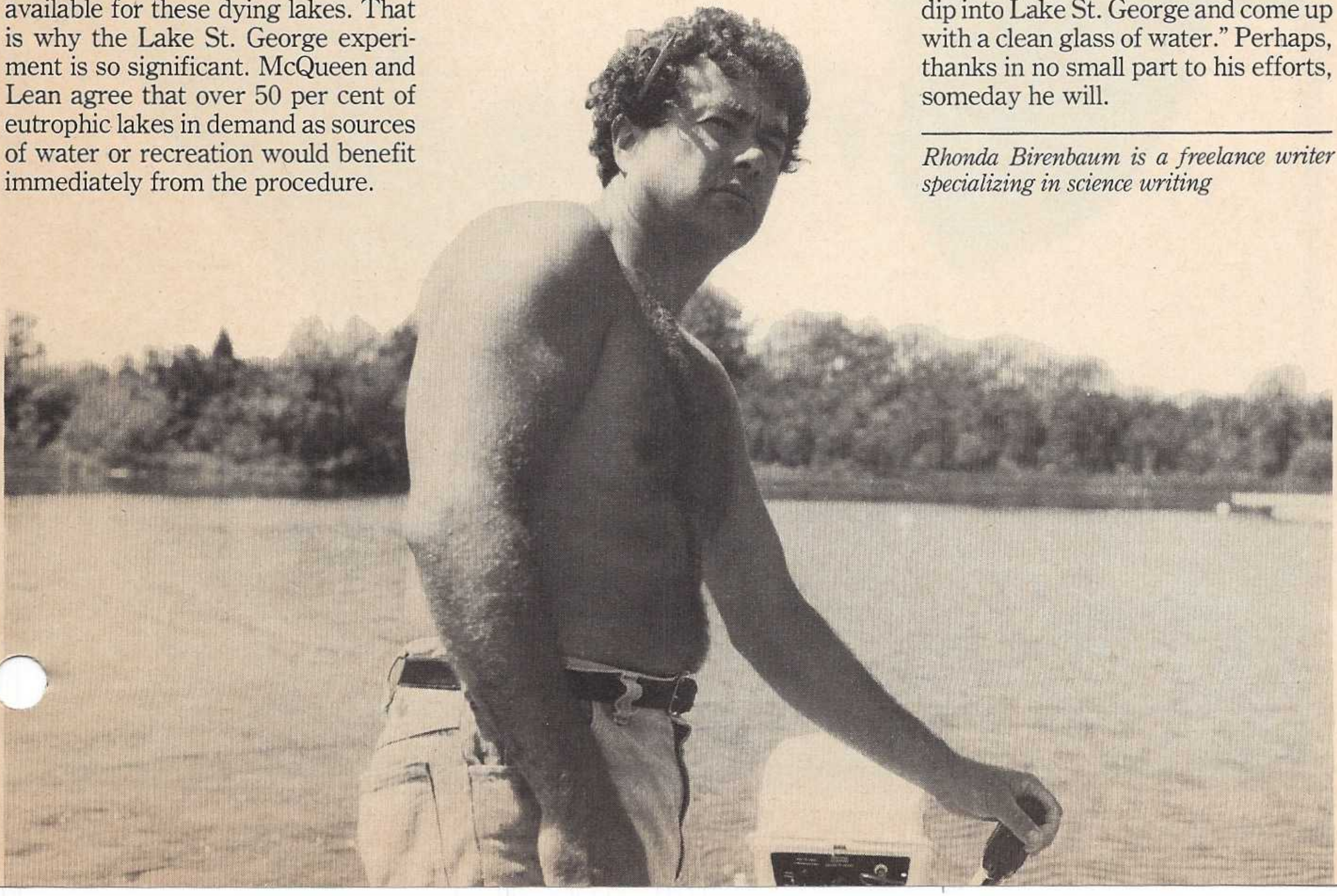


For Don McQueen, his system is no more than a short-term solution. Ultimately, he says, man will be forced to manage almost every aspect of nature, whether we like it or not

Pork Storkery

By Michael Webster

A piglet's progress

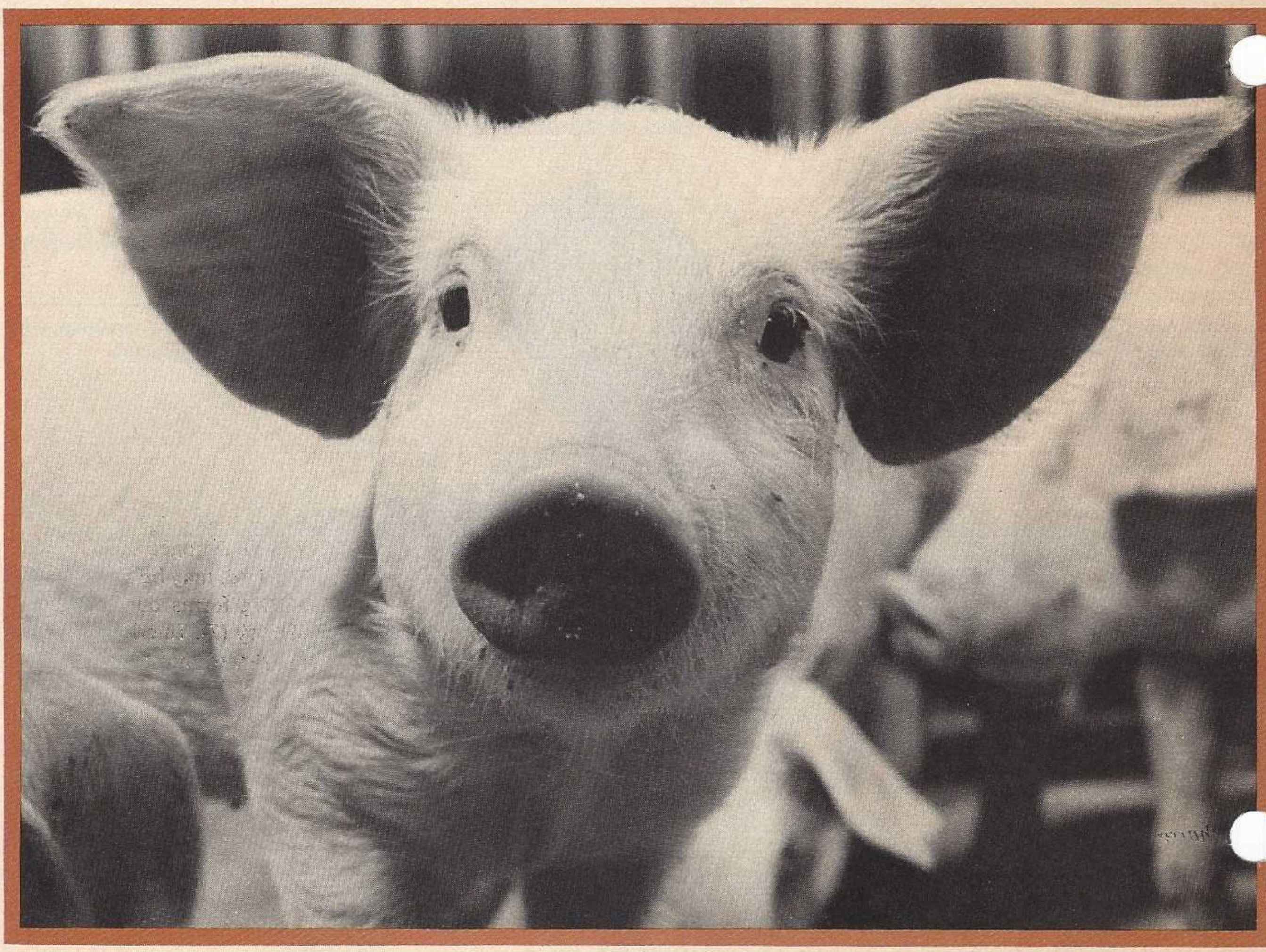
Squatting on clean straw in the warm red glow of a heat lamp, I cast a sleepy eye at my 500-pound companion. Stretched out beside me in all her porcine splendour lies my favourite momma pig, about to give birth. I affectionately scratch her pink rump and she grunts in response: She and I have been through this before. Shortly, her sides quivering in contraction, she delivers into the world what appears to be a Chihuahua tied up in a plastic bag.

This impression fades, however, as the young pig struggles out of its natal sac, sneezing the mucus from its nose, then staggers to its feet and totters off in search of nourishment. When it makes a wrong turn I nudge it onto a correct course and soon it is nosing along its mother's belly while I determine that "it" is, in fact, "he." By the time a sibling joins him, he has latched onto a spigot and been dried by the heat of the brooder bulb.

In the space of two hours the birthing is complete and I count 12 squirming pink bodies. Through a combination of their lack of muscular control and their incessant jockeying for position, it seems none of them are getting the colostrum they so desperately need; but their momma is announcing her satisfaction with a wonderfully maternal low grunting so I leave the new family to its own devices and make my way to my own warm bed.

With the pig population in Canada running close to 10 million animals, my 12 additions will not greatly affect the national economy. They do, however, play an important part in the finances of my homestead, where this twice-annual event offers stability and – a word so seldom heard in agriculture these days – profit. The pioneers, in fact, referred to reproducing sows as "mortgage busters." As with generations of small landholders before me, generations dating back some 7,000 years to ancient China, my homestead sow is an essential part of my agrisystem.

A SOW IS A STRAIGHTFORWARD creature, with predictable needs and a common-sense regimen: adequate diet, clean water, a draft-free enclosure in winter and shade in the summer. When one adds some thoughtful



John Colwell from Grant Heilman