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LIFE DEPENDS ON WATER

WE can live without house or clothing for months, we can live without food for days, but to live without water is figured in terms of hours and minutes.

It is something we seldom think about. Water is common, easily accessible, and cheap. It is cheaper than dirt; you can buy water in our cities, delivered by tap to your bath and sink, for about a nickel a ton, while just ordinary dirt fill costs from a dollar up, and topsoil comes at around $10.

It is only when a crisis occurs that we realize our dependence upon water. Even then we mostly take stopgap measures such as prohibiting the watering of lawns or shutting off the supply for a few hours a day, or, as in New York recently, going without shaving on one day a week.

In a paragraph, here are ten of the most important uses of water, every one of which has been the basis of hundreds of volumes of technical writing: moisture in the air makes organic life possible; drinking water is our greatest physical need; plants, from lowly lichens in Niagara Gorge to giant Douglas firs of British Columbia, grow only where there is water; the sea is the home of fish and of other food used by men; steam power and electricity depend on water; mechanical and chemical processes in industry need water; from earliest times, water has provided men with a means of transportation; water dictates the location of cities and farms; in the form of ice, water is used universally for cooling and preserving; water is the great determinant of political boundaries.

With so many demands upon it, there naturally is competition between one use and another. Sometimes municipal or provincial or federal governments must step in and establish priorities. They may prohibit street washing, or reduce withdrawal for electric power generating, or ration the supply to industries.

Our disregard of the importance of rainfall and water supply has become a dangerous influence in our civilization. It leads to faulty economic ideas, confuses our thinking about colonization and immigration, blinds us to the consequences of building bigger and bigger cities, and leads us into wrong judgments about the location and prospects of factories.

Water is benevolent, when properly managed. It can be productive and will support prosperous communities if its flow is wisely used. Our water problems are the outcome of our efforts to adapt our physical environment to our economic and social needs, without reckoning sufficiently on nature's unchanging ways.

By drying up marshes and lakes we have destroyed the homes and breeding grounds of useful water-fowl and fur-bearers. By clearing lake and stream banks of bushes we have exposed the water to sunshine, warming it so that it is spoiled for the best fish life. By denuding hillsides of trees we have increased water wastage and lowered the water level in great areas, making it impossible for the roots of food plants to find moisture. By inadequate management, we run short of water flow for production of electricity, as in Ontario last year, and of water depth for navigation, as in the Lachine Canal last year.

There's Beauty in Water

We should not become so wrapped up in the utilitarian use of water that we forget its contribution to the beauty of our surroundings. Imagine the barrenness of a world without water!

Water is the source of all the changefulness we see in clouds, and the reflector of wonderful shades of light and shadow. Water modelled our earth's surface, chiselled our Canadian mountain crags into grace, and at the appropriate season throws a mantle of white around them. Every river that flows has something worthy to be loved, from the inch-deep streamlet beside a British Columbia mountain road to the massy and silent march of the St. Lawrence as it sweeps around Anticosti Island.

Poets, philosophers and movie makers alike have chosen the banks of rivers on which to sing of love, to escape from everyday things into meditation about their high desires, and to stage drama amid beautiful settings. Everyone knows how much more pleasant a

railway journey becomes when the train follows the course of a river. We have all seen how idlers in a town choose a bridge for their passing of time, or sit on the edge of a dock with their feet hanging over the water.

Charles Darwin, the great naturalist who gave his life to such studies as *The Origin of Species,* once wrote to his wife about falling asleep beside a brook. "I awoke with a chorus of birds singing around me, and squirrels running up the tree, and some woodpeckers laughing; and it was as pleasant and rural a scene as ever I saw; and I did not care one penny how any of the birds or beasts had been formed."

That is what brooks do to the observant person. They whisper an old tale, or give birth to a new one; they play a soft obbligato to a bird's song, or they chatter boisterously about things only they know.

But we, happy as we should be to linger, must occupy ourselves with aspects of water more serious and work-a-day.

In the Beginning

All the water available to man is derived from the condensed vapour of the atmosphere. An important step forward in the science of hydrology (which is concerned with the properties and distribution of water) was taken in recent years. It was recognition of the fact that the distribution and transport of water obey a fundamental law of equilibrium. This relationship is called the hydrologic cycle. It represents the balance of water that exists between (1) oceans, lakes, streams and underground waters, (2) the solid part of the earth, and (3) the atmosphere.

Water is ceaselessly circulating from the earth to the atmosphere and back to the earth again. Evaporating from ponds, streams, lakes, rivers and oceans, it forms water vapour in the air; this condenses to form clouds, and later falls back to the earth as rain.

Rain which falls on the land is disposed of in some or all of four ways: some evaporates directly, some is held in the surface soil and subsequently evaporated by plants, some filters through the top layers and passes to the rocky strata beneath, and some runs off into rivers and streams. The amount of rainfall available for the good of humanity is determined by the temperature, the nature of the land surface, vegetation, and other geographical features.

That part of the rainfall that is absorbed by the ground is of very great importance. It sinks down until it joins the vast underground reservoir of water that exists under practically all of the earth's surface. It is this groundwater, as it is called, that feeds springs and wells and rivers. It furnishes water to plants by capillary action. It dissolves mineral matter out of the soil, thus supplying food to the plants.

The only way to get more water for our use is to intercept it in the run-off, and this is the prime feature of conservation.

It is obvious that there is little use in crying for rain if we then allow it to wash across our fields and make its quickest way to the sea along some river bed. Man's limited comprehension has wasted millions of acres of land, caused sharp drops in crop yields, starved cattle, spread deserts over the face of the earth, and devastated industrial areas.

Canada's Water Supply

Some persons have expressed the belief that our water supply is decreasing. Their opinion is based upon such facts as were revealed in Ontario surveys a few years ago. Within the last one hundred years between 80 and 85 per cent of once permanently flowing streams have become temporary, drying up for at least part of a normal summer.

But our earth's water resource is permanent and indestructible; it is the amount available at a place or at a time that is changing. Demand is rising in response to population growth, industrial progress, and rising standard of living. Such developments as air conditioning and the spread of rural electrification create great new needs for water.

These are legitimate changes. E. Newton-White expresses the opinion in his text-book *Canadian Restoration* that they could have been effected without damage or loss, if made wisely and carefully. But by removing natural barriers we have speeded the water movement so that it does not reach the ground water reservoir. Water runs so fast across our land that it picks up soil and carries it away out of economic reach.

So, in spite of the fact that Canada is richly endowed with water resources, we have no room for complacency. We have 228,307 square miles of fresh water within our boundaries. Lake Superior, forming part of our southern border, is the largest body of fresh water in the world. We have great rivers. The Mackenzie, our longest, reaches 2,514 miles from Great Slave Lake to the Arctic Ocean; the St. Lawrence and the Great Lakes provide a shipping waterway 2,338 miles long from the Strait of Belle Isle to the head of Lake Superior, the heart of the continent. Our seacoast is one of the longest of any country in the world, with 14,820 miles of mainland sea frontage and 34,650 miles of island frontage.

Enough, one might think, to minister to all human needs. Enough to give us the moisture that dissolves the oxygen we breathe, to liquefy the food we eat so that it can be digested, enough to supply our health and industrial needs.

But look at the demands made upon it. Three hundred tons of rainfall properly used are required to grow one ton of corn, and it requires 700 gallons a day to supply the demands of every person for food and the other necessities and amenities.

To bring all the needed water to cities is a tremendous undertaking. Ancient Rome had eleven aqueducts bringing a daily supply of 40 million gallons to its one million people. That was the same average per day as in Montreal in 1869, but today's water supply for

Montreal averages 120 gallons per person per day, just about the same as Toronto's. New York needs 1.2 billion gallons a day.

When Water Runs Short

There is, without doubt, a serious situation in regard to water in many parts of the world. Scarcity of drinkable or otherwise usable water is fast becoming the limiting factor in the expansion of agriculture and industry and the growth of communities. Many a city and town that only a few years ago had adequate reservoir capacity is finding that an unexpected increase in population taxes its water supply. The farmer finds that he must dig deeper wells. In some places, where water is drawn from artificial reservoirs, silt is being carried from eroded watersheds to fill up the storage capacity.

But we are very trustful. It is difficult to awaken interest in water conservation. We are, on the whole, much like the mouse in Gustav Eckstein's popular book *Everyday Miracle.* This mouse would lean out under a water tap that was shut off, and return again and again, confident that sooner or later someone would turn on the tap and let a drop fall. Dr. Eckstein doesn't say it was the same mouse, but one mouse did come finally to drinking ink.

New York's plight of recent months is noteworthy only because it is on such a large scale. Many other cities suffer in a degree only less because of their relative size.

Around Baltimore the underground water level has fallen so low that a well must be drilled 146 feet deeper than in 1916. William Vogt, of *Road to Survival* fame, says "one of the most asinine wastes in history was in California's Santa Clara Valley." Artesian resources were tapped for irrigation, nothing was done to preserve the source of the water, and after about thirty years the water gave out. The last artesian well ceased flowing in 1930. With the supporting water gone, the valley floor itself sank five feet in twenty years, doing millions of dollars worth of damage. But nothing was done to help. In 1922 they voted down a $4 million conservation plan, and in the twenty succeeding years they spent $16 million for new wells and equipment. Not until salt water from San Francisco Bay started seeping into their pumps did they do something about getting rain water back into the ground.

Instead of working from rock-bottom up, and from the mountain-top down, to build a sure supply of water, there are some who propose fantastic expedients. There's lots of water in the ocean, say some, so why not distil it? The answer is, in part, contained in a paper presented to the United Nations Economic and Social Council last August: cost. Estimates vary from 25 cents to $1.25 per 1,000 gallons. Take the modest estimate half way between these figures, and New York's cost would be about $350 million a year.

Others suggest the feasibility of collecting dew. That was a system used in ancient Britain, and dew ponds are still to be seen on the chalk hills. The suggestion was brought seriously before the United Nations Economic and Social Council last year, and the United States representative was forced to admit that dew was not recognized as a source of water supply even in the western arid regions.

The Other Extreme

An excess of water can be almost as bad as a shortage. Tropical rain forests and swamp land are unfit for permanent settlement. Even passing floods make life miserable for many cities and farm districts.

In recent floods, such as those in 1936 and 1937 at Port Hope, in 1937 at London, the 1946 overflow of the South Sydenham and other streams, and especially the 1947 floods in southwestern Ontario, there was considerable damage, besides hardship and interruption of communication.

In parts of the United States, nature's balance has been upset all the way from mountain top to valley floor, and the loss through flood and sedimentation averages $300 million a year. Soil-depleting farm practices, the irresponsible cutting of trees, and general laxity in preventing erosion have contributed to flooding.

Even where there is abundant water, and not too much, men seem to be perversely determined to ruin it. They saturate it with millions of tons of filthy waste. Our coasts and our rivers are dotted with the rotting bath houses and bathing enclosures of once-beautiful beaches, where the signs read: "No swimming. Polluted water."

Safe water "in the raw" is available on a relatively small portion of our 3,690,000 square miles, mostly in the high plateaus and mountain ranges beyond the reach of settlement. Only there, where the water has been filtered in its passage through layers of virgin soil, or washed down from a melting snowbank or glacier, can a person feel quite safe in drinking from a spring, pool, lake or stream.

The harmful effects of polluted water fall into three broad categories: dangers to human health, direct economic losses, and damage to recreational resources. The most important impurity, of course, is the presence of bacteria.

This is a national problem, varying in importance by river basins and by localities. In some drainage basins, municipal sewage contributes most to the impurity of the water, while elsewhere the damage is done by mining and industrial operations.

Obviously, it will not do to stand idly by while mountains of germ-ridden garbage are dumped into our waterways. Not only we, but game and fish suffer. Even irrigation water drawn from polluted streams may carry lethal germs to vegetable products and spread disease.

Our Obligations

It must be obvious by this time that natural laws impose limitations and obligations upon us. Whether

it is convenient or not, whether it is politically expedient or not, water is going to run downhill and its destructive force is going to increase with the rate of runoff; water is going to become impure if we pour impurities into it; water tables are going to sink if we pump water out of them and turn aside the replenishment that is their due.

Even if nature were benevolent instead of rigidly and logically impartial, she could not restore the lost soil short of that infinitely slow process by which soil was formed in the first place from the foundation rocks of the world, nor can she overcome by her mild processes the rabid poisoning carried on so ruthlessly by human beings.

The classic examples of civilizations wiped out by their misuse of water and soil are the once mighty, now buried, civilizations of Babylonia and Assyria, and the colossal destruction wrought in the once rich soils of the vast regions of northwest China. Erosion destroyed or sapped all the Mediterranean civilizations, past and present, from Athens and Rome to Italy and Spain, to say nothing of the formerly fertile plains of North Africa where once flourished great Carthage.

We, in this day, are living in an age when world agriculture is not able to meet the nutritional needs of a rapidly growing world population. Much depends upon our capacity to cope with problems of deficient or excessive water supply.

Nature's Way

A detailed study of irrigation must await another month. It is a matter of great significance in the Canadian west. Prodigies are being performed there, not only in great schemes affecting thousands of acres but in the building of little individual farm dams and dugouts. A whole new life is opening up for western plains farmers, a development which will take our whole 3,500 word-space to summarize in a future article.

It is necessary, however, to draw from this present survey of the importance of water in our lives, some lesson and perhaps hint at a plan for water conservation. The plan we have in mind is nature's way.

The most damaging impact of civilized man on his environment is the shattering of the water cycle. In the wilderness of Canada, before the coming of the white man, there was built up a mutual society of balance among the waters, soils, grasses, forests and all animal life.

How it operated is well told in *Canadian Restoration* by Mr. Newton-White: To this society each member contributed its powers of control and protection, and was in turn itself controlled and protected. In result the streams and rivers ran clear, cold and constant, and carried away, with little disturbance, the surplus water left after all the demands of the natural reservoirs and animal and vegetable life had been satisfied.

But we have broken off our contact with nature, hiding behind our mechanistic contraptions with a sense of security that is false. We harvest grain, grind flour and bake bread by machinery and electric power, but forget that the materials of a pound loaf have used up almost two tons of water. We use square miles of corn either to eat on the cob or to feed our livestock, without remembering that an acre of corn in its growing season transpires 3,000 tons of water, equal to about 15 inches of rainfall.

In thinking about food, let us start with the one essential ingredient: water. In thinking about soil conservation, let us start with the element which is the greatest friend or most ruthless foe of soil formation: water. And in thinking about water, let us start, not at the tap or at the river-mouth, but away back where the flow begins, on the mountain tops and the hillsides.

No Mean Objective

Control and conservation of the water resources of our western plains — the breadbasket of the world, as we are fond of calling them — begins on the slopes of the Rockies. Serious depletion of forests there increases the rate of spring flooding and sends cascading down rivers the water that should seep into the ground to maintain our underground reservoirs.

There's no use in spending huge sums on river control and valley development unless it is accompanied by a thoroughly effective attack on the needless evil of forest devastation. Well-managed forests are the best of all soil and water holders. A record was kept of more than 100 storms in a period of two years on the Appalachian watersheds. It showed that the flow of water from deforested areas during floods ranged from ten to twenty times greater than that from forested areas. Small streams from forested land are usually continuous, but streams often dry up between rains on unforested land.

Forests act as balance wheels. In the dry seasons the water stored in the soil dribbles out in springs and streams, and the water table is kept up in adjacent lands. Forests may not increase the total rainfall, but certainly they help to dispose of it more fruitfully than does land without forests.

This is not to say that we need go to the extreme of taking land out of agricultural use to be reforested, though some of this may be needed. A wise use of land is to be aimed at, in accord with its natural aptitude.

Huge dams and reservoirs are glamorous things. These monumental masses of concrete, as A. H. Carhart calls them in his article in *The Atlantic* of February, are expected to serve irrigation, control floods, and produce power — all good objectives. But with sick watersheds above, the days of such dams are numbered.

Conserving water nature's way is no mean objective. To unriddle the subtle aspects of the soil-water-plant-animal complex offers the natural sciences an exciting co-operative adventure. To persuade men of the wisdom of co-operation and forward-looking, slighting their immediate gain for the good of all, is an objective worthy of the best in the social sciences. To deal wisely with the varying needs of agriculture and industry in the present and for the future: that is a challenge to governments worthy of the best that is in them.

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