CONSERVATION

Taming Ol' Man Ribber

Scientists Lay Plans to Keep Water, Most Valuable Of Our Mineral Resources, as Servant, Not Enemy

By DR. FRANK THONE

GOLD is not the most precious of America's mineral resources. Oil is not. Neither is copper, or coal, or iron.

The most valuable mineral we have is water.

Common water, the stuff we drink, and wash ourselves and our clothes in, that we use to irrigate our fields, float our boats, put out our houses when they catch fire. Water, which we long for as a lost friend in drought, and dread as a destructive demon in time of flood. Water, which we waste lavishly, pollute shamelessly with factory wastes and city filth. Water, the fluid of life, the fluid of death.

"Free as water" has been for ages and still is a proverb-phrase taken for granted by everybody. It is to be had for the taking, without even the formality of asking. Only in the world's most arid and forbidden places can it be sold as a commodity. Elsewhere, to ask men to balance it against silver or gold is looked upon—and resented—as effrontery. So fixed is this idea in our psychology that there is a widespread practice on the part of city water works to charge their patrons for services rendered in delivering the water, but to insist that the water itself is not an object of sale. The water is free.

But as we approach maturity as a nation, it begins to be borne in upon our sobering minds that while water is free to use, it cannot safely be left free to abuse. If we waste it in the spring, we may have the distress of seeing our town well run dry in a droughty summer. If a town or factory pollutes a stream, communities farther down, that must drink from the same stream, will have a sympathetic audience if they curse us out as reprobates, and maybe have the law on us. If we over-cut our forests and overplow our fields, we are ruined by erosion, and folks downstream are equally ruined by the floods we loose, with their aftermath of drifted sand and silt. For this sort of thing, water is not free.

In this day, when the irresponsible adolescence of our nation is ending, and reflective men among us are giving thought to what we, as a people in the earlier stages of social maturity, should be doing with ourselves and the land of our inheritance, water has come in for its full share of discussion and planning. Our lakes and rivers, even our brooks and springs, our swamps and seepage-places, are beginning to be seen as diversified parts of an organic unity, even as a people we are diversified and yet one.

There have been thoughtful examinations of water problems even of old time. Indeed, the world's earliest civilizations were in a sense the product of water problems, for canals, flood control, irrigation, city water supply, were what first brought the little city-states of ancient Egypt and Chaldea into being, and then operated to knit them together into kingdoms and empires.

Even in our own land, in the days of its earliest and loosest freedom, there had to be community action to obtain clean water, to dispose of wastes, to regulate port and river traffic. And as we have grown, there have been extensions of this "city-state" stage, where each municipality was a law unto itself, into wider regional "kingdoms," where several adjacent cities or states have found it mutually advantageous to ally themselves, as New York and the cities of the New Jersey shore in the Port of New York Authority, or the Ohio valley states in their cooperative attack on the flood problem.

It has not been easy for us to do things of this kind, for as a people we are extreme individualists, and as communities we are exceedingly parochial, each town keenly jealous of its own rights and advantages, and prone to eye the claims of the next town with hostile suspicion.

But it may be that we are developing a wider, a more national outlook, a greater willingness to let the other fellow have a fair share and not try to grab everything in sight for ourselves. And even if we have not evolved far along this pathway to a larger civic morality, at least a somewhat more far-sighted self-interest may move us to yield a little now in order to obtain greater advantages (or escape greater ills) somewhat later on.

Out in front of the rest of us, there are pioneers of larger cooperation, who by putting a dozen good heads together have evolved the beginnings of a full-sized national scheme for making the most of our national resources in water, and for mitigating the evils which this two-sided silvery servant of ours can inflict on us when we are not watching.

A notable accomplishment among the many hopeful plans that have been put forth lately for national betterment is the

A SERVANT NO LONGER DOCILE

We have stripped forests, plowed grasslands, that once controlled the flow of rivers. Is it any wonder that they have lost their old friendliness, and sometimes run amuck?

report of the Mississippi Valley Committee of the the Public Works Administration. It has operated under the chairmanship of Morris L. Cooke, an experienced engineer who can "dream dreams and see visions"—and then proceed to make them real. With him have been associated a number of other leaders in the field of engineering and economics—men in private practice, University men, Army men.

For a "sample river" to use in drawing up their first model plan they chose boldly—no less than the Mississippi system itself, probably the most important river drainage basin in the whole civilized world today. Though bold, their choice was wise; for in the vast stretch between the dry, thinly populated Great Plains that rise to the Rockies on the west, to the humid, rich, closely farmed lands of the inner East, encroached on by the jammed industrialism of the Pittsburgh region, there are all imaginable varieties and difficulties of water-use problems.

They have taken a wide view of their mandate: "Planning for the use and control of water is planning for most of the basic functions of the life of the Nation. We cannot plan for water unless we also consider the relevant problems of the land. We cannot plan for water and land unless we plan for the whole people. It is of little use to control rivers unless we also master the conditions which make for the security and freedom of human life . . . Under the proven system of democracy no plan can be imposed upon the people. Government may inform, educate, and guide. It may mobilize resources for the common task. It cannot dictate . . . We are but tenants and transients upon the earth. Let us hand down our heritage not only unimpaired but enriched to those who come after us."

Principles laid down by the committee shine with common sense: Improvements should be supported as nearly as can be determined in relation to their benefits; Federal participation should be freely entered into when national benefits are anticipated or national ills are to be averted; for the rest, render unto the state the things that are the state's, unto the town what is the town's. Encourage first such projects as are most likely to pay their own way in the long run: deepen the river if there is going to be enough traffic to justify it, otherwise go slow about spending the money. The same for irrigation projects. The same, within somewhat wider limits, for power projects; for it is recognized that though modern steam plants can often underbid water power in cost per installed kilowatt, nevertheless coal and oil are exhaustible, while rivers go on forever.

DIVIDE AND RULE

Little dams like this, added together in thousands, work wonders in controlling erosion and also accomplish something toward slowing the runoff waters that become floods when they reach the rivers.

The terrible evil of water erosion, which scourges East as well as West, and impoverishes in terrifyingly short time any region where it is permitted to go on unchecked, the committee sees largely as a problem of roots. To be sure, check dams and grading can do something against advanced gullying. But the most widespread damage is not so conspicuous as this; it is the insidious sheet erosion that takes away the irreplaceable topsoil, before gullying begins. Here the cure must be a living cure: reforestation, brushland that at the same time shelters game, restoration of range grass where plowland lays the soil bare to the raids of water and wind. Terracing slopes, where farming is too profitable to be abandoned, plus strips of long-lived, deep rooted crops following the contour lines and interdicting the gully-cutting downhill drainage.

Pollution, it goes without saying, is an intolerable evil. No community can be allowed to assume the privilege of befouling its downstream neighbor's drinking water with sewage, or poisoning it with factory wastes. Disposal plants are practicable for most of these sources of pollution, and for the still unconquered types of factory waste means of treatment may be found by more intensive research.

Recreation is recognized by the committee as a public interest of increasing importance, which can often be promoted as a co-project with such things as power or water-supply storage dams, navigation improvement, and game refuges in reforested lands on slopes salvaged from erosion and the breeding of floods. Recreation again is promoted by the re-flooding of lake and swamp lands, unwisely taken away from the ducks and fish during our national madness in land speculation of a generation or two ago.

Flood control comes sharply to the fore, especially now that the Great Drought of the early thirties has broken in spectacularly destructive deluges of rain in what had begun to be called the "dust bowl." Floods are recognized as problems practically throughout the entire great central basin, but the problems are particularly acute in the Ohio system, where northward-draining rivers from the Tennessee valley bring heavy freshets in late winter and early spring, and in the "delta country" ot the Lower Mississippi, from Memphis to the Gulf, which is the bottleneck through which all the drainage of the great inland empire must flow.

Most of us commonly think of flood protection in terms of levees, high earthworks that resist the frontal attack of the river with a stubborn frontal defense. Levees have their very important uses, but a dependence on them altogether is apt to be a snare and a betrayal, for if the flood becomes mighty enough to top them, the last state of that land becomes even worse than the first. (*Turn to Page* 126)

flow through like sand in an hourglass." Yet the egg assumes a normal egg-shape after it is laid, none the worse for its experience. Laboratory experiments, pulling and squeezing these tiny eggs, showed a remarkable degree of toughness and resiliency.

The adult female of this species also feeds on the grain moth larvae herself, though she never sees them. She does this by puncturing a larva with her ovipositor. While the tip is still imbedded in the stung larva, the ovipositor exudes a viscous fluid which hardens on the outside, forming a tube.

The insect then withdraws her ovipositor, leaving the tube intact. Through this the insect drinks the blood of the larva "as daintily as a college girl sipping soda water through a straw."

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ENTOMOLOGY

Did Spiders Teach Man The Weaving of Nets?

See Front Cover

GREEK legend has it that Arachne, the first mortal spinster, learned so perfectly Athene's art of weaving that she became presumptuous enough to compete against the goddess, and as a punishment was transformed into a spider.

Whatever may be the justification for the old story, it would seem at least as likely that men learned from spiders the weaving of nets to trap birds and other small quarry, more directly than women did the art of weaving cloth. While nobody knows when or how nets were actually invented, it is easy to speculate that some Neolithic hunter, idling among the riverside reeds on a day when birds were shy, may have watched a spider spread her net for her own winged prey, and so received the inspiration to try something of the same kind to catch his food with more certainty and less labor.

Arachne may have taught men the use of birdlime, too, for the cross threads in her web are sticky with a glue of her own making, which is the ultimate prey-catching device that makes the whole mechanism effective.

So fine are the treads, even thus coated, that under ordinary circumstances they are quite invisible. But after a cool night they may be so beaded with tiny dewdrops that they can be photographed. It was in this state that Cornelia Clarke caught the web shown on the cover of this number of the SCIENCE NEWS LETTER.

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ECOLOGY

Prairie's Own Soil Management Superior to That of Man

MAN, the land-hungry, the land-exploiting, ultimately the land-ruining, can learn much from the prairie grasses and herbs that formed the original sod in the Corn Belt states, some fragments of which still remain unplowed, especially in Nebraska and the Dakotas. Studies reported by Drs. J. E. Weaver and Evan L. Flory of the University of Nebraska indicate that the soil management practised by the prairie sod excels that carried on by man in practically every important respect.

Man's soil management is a business of extremes. His tillage, for field crops such as corn and cotton, keeps the soil stirred and loose all the time, a ready prey for erosion by wind and water. Prairie sod thrives without this constant disturbance—earthworms are plows enough. Man strives to give a field to a single plant species as a monopoly, and to kill all other growths as weeds. Prairie sod turns the acres into a mixed community of many species; there is competition in it, to be sure, but there is a sort of tolerance even in the competition. Man's crops cover the soil only during a part of the growing season; before planting and after harvest the soil is naked to the attack of the elements. Prairie sod is a constant protecting mantle; the seeds of its various constituent plants ripen at different times the whole summer through.

Cooler Air Over Sod

Quantitative measurements of climatic and other factors bring out dramatically the superiority of sod-economy over plow-economy. On a given summer day, the air in a cornfield at four feet above the ground was hotter by four degrees than air at the same level over the prairie. At four inches the difference was 11 degrees, at the soil surface itself the cornland was 21 degrees hotter than the prairie sod, and just below the soil surface the cornland was 38 degrees hotter.

This difference is reflected not only in the greater strain put on the endurance of the plants themselves, but in the conditions which the important nitrogen-fixing microorganisms of the soil have to face. The cornland was too hot for them to live, while the temperature of the prairie sod soil was still within survival limits.

The evaporating power of the air showed like differences. At the height of the plants, it was 27 per cent. greater over the cornfield; at half the height, 106 per cent. greater, and near the soil surface the difference was 68 per cent. to the disadvantage of the corn. These heightened evaporation rates are of critical significance in time of drought, when soil water conservation is of supreme importance.

Drs. Weaver and Flory do not contend that all the West should be returned to grass. There must obviously be corn and wheat, alfalfa and soybeans. Nevertheless, they contend, "we may profitably consider the natural environment. Not until the native environment in its relations to water, humidity, temperature fluctuations and other critical factors of both air and soil have been compared with that of overgrazed and cropped areas will it be known how widely we are departing from Nature's plan of a stable environment."

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So supplementary means must be devised. Important are flood-water reservoirs, which will hold back part of the water until the rest has been drained off, and then release their impoundings as rapidly as possible. There have been proposals to build such flood checks right in the Ohio itself, as well as in some of the other larger tributaries of the Mississippi from the west. These the committee doubts, but it gives its approval to a considerable number of flood-water dams on other tributaries, and even suggests that these may be the key to flood defense.

But in spite of all this, floods will still develop. Here a third strategy comes into play. If you cannot hold your adversary back, yield and let him rush through a path of your own choosing. This is the principle of the so-called floodways of the lower Mississippi. These are auxiliary flowage paths for the river, with guide levees along their sides. In normal years they remain empty, and may even be farmed. But when a Great Flood comes, once in a generation or oftener, the weaker "fuse plug" levees that close their upper ends are permitted to give way, and the surplus waters pour through on their way to the sea.

The committee also recommends a unification of the entire levee system of the lower river, with established standards of construction and height, and a better coordinated system of administration. In the past, each community has tended to regard its own flood protection as its private problem; so much so, that we have frequently had to witness the scandalous spectacle of American citizens dynamiting the levees that protected the property of other American citizens, to relieve the river's pressure on their own front.

Such a too-rugged individualism, more suggestive of the doings of Ur and Kish and Lagash on the Tigris and Euphrates thousands of years ago than of what we would like to believe of our America of today, will become forgotten legend if the persuasions of the Mississippi Valley Committee are listened to:

"Life in the Mississippi Valley of the future need not be poverty-stricken or precarious. The forces making for health and well-being, once they are controlled, are greater than those which make for disaster. The quality of life in the Valley can be enormously improved. It need not go the way of the valley of the Nile, the valleys of the Tigris and Euphrates, where sands have drifted into old irrigation ditches and the sites of opulent gardens, or the stripped valleys of China. We have knowledge that the older civilizations lacked. If we synthesize that knowledge to make our plans, if we put a common purpose above local jealousies and conflicts of interest, the future is in our own hands."

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BOTANY

Cannas, Flowers in U. S., Starch Source in Hawaii

CANNAS may be just flowers in the continental United States, but in Hawaii they are a possible source of commercial starch, according to President David Livingston Crawford of the University of Hawaii.

Their thick, tuberous roots, rich in starch, grow abundantly and to extraordinary size in average sugarcane land. Sugar mill machinery needs to be modified but little to extract their starch. Canna starch has been found advantageous for use in putting a smooth finish on paper.

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The earlier a cross-eyed child receives glasses, surgical treatment, or eye-training, under competent medical guidance, the greater the hope of correcting the defect.

CHEMISTRY

NATURE RAMBLINGS
by Frank Thone

Lignin

WHAT is one man's meat may, under another guise, be the same man's poison.

Chemistry, and the great family of industries it has mothered, are notoriously indebted to coal: dyes, perfumes, solvents, explosives, a whole worldful of things come from coal.

Coal exists because woody plants, millions of years ago, contained the same stuff that makes their remote descendants woody today: lignin. Lignin, a chemical second cousin to starch and cellulose, is a hard, tough, refractory stuff, exceedingly difficult to digest; even bacteria, molds and other organisms of decay cannot do much with it, and leave the lignin remains of a log in the soil long after they have used up the softer cellulose. That is why the remains of Coal-Age plants persisted long enough to become buried in their own accumulated masses, and eventually to turn into coal.

But that same refractory indigestibility of lignin is the despair of the chemist today. It forces wood-using chemical factories to throw away just half of every stick they grind up for cellulose, and it produces a bulky, troublesome waste that is in everybody's way.

At the meeting of the American Chemical Society in San Francisco, Prof. Walter M. Fuchs of the New Jersey Agricultural Experiment Station told what chemistry can do with lignin today—which isn't much—and how soon the science runs into a blank wall—which is very soon indeed.

"For each ton of cellulose produced, one ton of solid waste substances is obtained, and hundreds of thousands of tons of this material are available each year," he said. "The discharge of these liquors in the rivers endangers the fish and does not contribute to the beauty and amenity of the country.

"Inventors have tried to produce adhesive, tanning and plastic materials starting with these waste liquors. Lignin may also be utilized in the repair and construction of roads; but in general, utilization of lignin and lignin-containing waste liquors is still an open problem.

If anything in the chemical world cries aloud for liberally supported research and lots of it, that thing is lignin.

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CHEMISTRY

Pigment Differences Make Paints Incompatible

HIDDEN conflicts between "antagonistic" paints cause the failure of many exterior paint jobs through premature cracking, scaling, and peeling.

In fact, many paints, like people, are mutually incompatible and have an antipathy to each other, chemists of the Department of Agriculture's Forest Products Laboratory discovered recently. This is due mostly to differences of the pigments.

When a house or building exposed to the weather is coated with a paint with an antipathy to the previous paint job, there is likely to be early trouble. For example, if a formerly brown or green building is painted white without removing the old paint, peeling will be the probable result.

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