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"The River of the Mother of God" by . Aldo Leopold

Engineering and Conservation [1938]

The text of a lecture that Leopold delivered to the University of Wisconsin College of Engineering is printed here from a revised typescript, dated April 11, 1938, edited in Leopold's hand. It wryly points out the untoward ecological consequences of civil engineering, treating engineering not only as a profession with goals that often overlap and conflict with those of conservation but also as an emblem of the public state of mind and the dominant idea of the industrial age. Withal, Leopold achieves a remarkably diplomatic, positive tone.

The public mind is a mirror into which every vocation reflects its image. That image may flatter its subject, or the contrary, depending upon accumulated public impressions of the group and how its members live, think, and work.

A decade ago the public image of labor was a rather pleasing one. Since the advent of CIO it has become much harder to look at.

In the writings of Alexander Hamilton and Thomas Jefferson we find the word "industrialist" used as a term of high honor. Today one uses the term guardedly.

The banker's picture has of late suffered an unflattering distortion, culminating in the newspaper epithet "bankster" in the early 1930s.

Not long ago the railroads had cloven hooves; now what with rate reductions, streamliners, and 35-cent dinners they have acquired merit and may soon sprout wings.

It is clear that, in general, the underdog tends to be uppermost in public favor. Conversely, when a profession becomes important or powerful, it has need to look to its laurels.

The engineer, from Kitchener to Herbert Hoover, enjoyed a public image of ever-increasing comeliness. The reasons are too well known to need comment. At the present moment, however, the word "engineer" in the minds of some conservationists is associated with an attitude toward natural resources which they dislike. It evokes in them a mental image of marshes

needlessly drained, of rivers expensively channelized to revive an expiring navigation, of floods aggravated by stream straightening and by constricting levees, of irrigation reservoirs silted before the maturity of their bonds, and of a veritable mycelium of roads at least a part of which are built regardless of cost or need.

This tendency to challenge the engineer is admittedly confined to that small group preoccupied with the biological aspects of public policy. As a member of this group I here attempt to shed some light on their reactions. That these reactions are just and fair I cannot certify, but the avowal that they exist may be a useful first step toward clearing the issue.

We may perhaps strike at the root of the matter by this generalization: the engineer believes, and has taught the public to believe, that a constructed mechanism is inherently preferable to a natural one. The conservationist believes the contrary.

All generalizations are inaccurate, including this one. A few cases may help clarify the intended meaning.

Consider the Columbia River dams. As between abundant power and abundant salmon, priority automatically went to power. The dams were started before the probable destruction of the salmon resource was seriously debated. It made no difference that the need for power was questionable, the fate of the salmon was nearly certain. By an axiom long in the making, the man-made resource must be superior to the natural one. I do not know whether the engineers built the axiom or the axiom built the engineers. The result is the same.

The Mississippi dams involve a more subtle issue. That the great river is sick all will agree. Treatment can be applied either to the channel where the symptoms are most conspicuous, or to the deranged watershed which gives rise to the symptoms. The engineers started to bandage the channel with steel and concrete before giving ear to the question of what ails the organism as a whole. The case of course involves many other issues which I do not here discuss. I point out merely the seeming assumption that skillful structures can solve our water problems, and (by implication) exempt us from the penalties of bungling land use.

The history of irrigation reservoirs in the West presents a similar question. In many instances the silting life of a storage basin was assumed during the promotion stage to be perpetual. During the construction stage it would be scaled down to a century, and during the pay-up stage it would finally appear as a generation. Isolated errors in predicting the life of reservoirs would be natural enough, but their repetition through forty years of experience forces the observer to conclude that the profession as a whole is not yet conscious of that organic disintegration which has afflicted nearly all semi-arid watersheds since their occupation by livestock. (There are brilliant

individual exceptions to this rule. Olmstead's report on the Gila River is one such.)

When some inventor comes out with a new alloy the engineers lose no time making a path to his door. But discoveries outside the engineering field may have an equal bearing on the responsibilities of the engineering profession. Take, for example, Lowdermilk's formulation, in terms of physical chemistry, of the basic mechanism by which plants influence runoff. This reorients the old controversy about the influence of forests and presents a challenging opportunity for joint research by soil chemists, engineers, and botanists. But who is doing such research? I here criticize all three parties for inaction.

Again, take Weaver's discovery that the composition of the plant community determines the ability of soils to retain their granulation, and hence their stability. If finally verified, this new principle may necessitate the revision of our entire system of thought on flood control and erosion control. I do not hear it discussed among engineers (nor, for that matter, among economists, business men, or statesmen).

The cases I have cited all involve big and complex issues of national importance. Consider now, for contrast, a small and local one. In the sand counties of central Wisconsin are many defunct drainage districts. In 1933 the government began to buy out the surviving farmers and convert the area into a wildlife reservation. Travel in the area had always followed "sand-tracks." There were hundreds of miles of these tracks; unimproved but passable routes winding picturesquely through the jack pines and scrub oaks.

I believe it is an engineering fact that in sand a semi-sodded track is the best possible road short of a surfaced turnpike. But the engineers could not resist the temptation of soft yardage, abundant CCCs, and government gas. Today the area is geometrically gridironed with graded sandpiles, expensively inferior to the old tracks. It looks as if some new glacier had acquired the knack of laying down eskers with a transit. The drainage of this region was, by hindsight, a mistake, but now in our effort to give it back to the birds, we must give it one last mutilating gouge with power tools.

This same propensity for carving soft landscapes perhaps accounts for the recent drainage of nearly the whole Atlantic tidal marsh from Maine to Alabama. This was done with relief labor, in the name of mosquito control, over the protests of wildlife interests. These marshes are the wintering ground of many species of migratory waterfowl and the breeding ground of others. The effectiveness of such drainage as a mosquito control measure is at least debatable. Biological methods of mosquito control are known but were not tried. The project was not led by engineers and is chargeable to engineering only in the sense that it shows what the mechanical idea of landscaping can do when combined with too much haste, too much govern-

ment money, a resort-owner's chamber of commerce, and the prevalent unconsciousness of biological equilibria. I suspect that the real impulse behind the whole venture is the local realtor's solicitude for silk stockings on his beaches.

I mention last what to me seems the least discussed but most regrettable instance of short-sighted engineering—the wholesale straightening of small rivers and creeks. This is done to hasten the runoff of local flood waters, and of course aggravates the piling up of flood peaks in major streams. It is, on its face, a process of pushing trouble downstream, of seeking benefit for the locality at the expense of the community. In justice the stream-straightener should indemnify the public for damage; in practice I fear the public may at times subsidize him with relief labor.

I know of at least one engineering group which has foresworn stream-straightening—the Soil Conservation Service. I salute them.

The interplay of engineering and ecological evils is an insidious thing. I know a locality in western Dane County where erosion is gradually destroying the upland cornfields. The farmers must have corn; their only recourse is the marshy creek bottoms. These, however, are subject to flashy floods. To raise corn on the bottoms the floods will have to be prodded downstream by straightening, which in turn will aggravate the flashy runoff and augment erosion. Thus the cycle of misuse.

Incidentally these marshy bottoms contain the only wildlife cover and are now good pasture. The cover will disappear with straightening, and the pasture will have to move back to the eroded uplands.

These cases collectively imply, but I will now specifically admit, certain qualifications which, in justice, I must attach to my criticism of the engineer.

First of all, let me admit that in some cases the biological professions seem just as remiss as the engineering group.

Secondly, let me admit that the engineer is to me a symbol for a state of the public mind, as well as a professional man who has made mistakes. The cited instances of error are chargeable to voters and politicians as well as engineers. The Columbia dams, the Mississippi dams, the irrigation reservoirs, the needless roads and the mosquito drainage were backed by strong local booster and even pork-barrel interests. Every professional man must, within limits, execute the jobs people are willing to pay for. But every profession in the long run writes its own ticket. It does so through the emergence of leaders who can afford to be skeptical out loud and in public—professors, for example. What I here decry is not so much the prevalence of public error in the use of engineering tools as the scarcity of engineering criticism of such misuse. Perhaps that criticism exists *in camera*, but it does not reach the interested layman.

I admit, too, that the engineer is not the only focus for biological

discontent. The chemist scattering new comforts with one hand and new pollutions with the other, evokes in us the same disquiet. Both professions exemplify priority for the synthetic over the natural, a certain atrophy of esthetic discrimination, a yearning for prosperity and comfort at any cost. I do not claim that we, the disaffected, disdain the prosperity and the comforts. Our only contribution is the idea that the cost is large, unnecessarily large.

With these qualifying admissions I now summarize my criticism: The engineer has respect for mechanical wisdom because he created it. He has disrespect for ecological wisdom, not because he is contemptuous of it, but because he is unaware of it. We have, in short, two professions whose responsibilities for land use overlap much, but whose respective zones of awareness overlap only a little. What can we say about their future relationship? About the direction of possible adjustments?

All history shows this: that civilization is not the progressive elaboration of a single idea, but the successive dominance of a series of ideas. Greece, Rome, the Renaissance, the industrial age, each had a new and largely distinct zone of awareness. The people of each lived not in a better, nor a worse, but in a new and different intellectual field. Progress, if there be any, is the slender hoard of fragments retained from the whole intellectual succession.

Engineering is clearly the dominant idea of the industrial age. What I have here called ecology is perhaps one of the contenders for a new order. In any case our problem boils down to increasing the overlap of awareness between the two.

This may prove less difficult than appears on the surface, for the ecologist is in many ways an engineer. The biotic mechanism is too complex to enable him to predict its reactions; therefore he advocates what an engineer would in like case: go slow, cut and try.

He feels an engineer's admiration for this complexity which defies science, and an engineer's aversion for discarding any of its parts. The real difference lies in the ecologist's conviction that to govern the animate world it must be led rather than coerced. To me this is engineering wisdom; the reason the engineer does not display it is unawareness of the animate world.

The tools which the engineer has given the public are so crude and powerful that they invite coercive use. It is not likely that the public will lay them down. The only alternative is the pooling of engineering and ecological skills for wiser use of those tools. Is this pooling under way? Perhaps. We now see engineers and ecologists jointly attacking the soil erosion problem, but only after the resource reached an advanced stage of deterioration. Need we always await the willy-nilly pressure of wrecked resources before professional cooperation begins?

We end, I think, at what might be called the standard paradox of the twentieth century: our tools are better than we are, and grow better faster than we do. They suffice to crack the atom, to command the tides. But they do not suffice for the oldest task in human history: to live on a piece of land without spoiling it.