A PROPOSAL TO PUBLISH

LIGHTEN UP: SOLVING VEHICLE IMPACTS

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Every person has had at least some very practical experience of how a heavier object will do more damage than a lighter one. Yet, we live in a world where:

1) Sports-utility, pickup trucks, and vans are nearly twice as likely to be involved in an accident -- and then to cause at least twice as much damage -- as a passenger car of half their weight. But the more dangerous vehicles pay lower insurance rates.

2) Road rage is becoming endemic, following a doubling of vehicle size that reduces by more than half the potential traffic flow rates among the same number of humans.

3) Auto manufacturers claim it is consumer demand for larger vehicles that causes them to be built, although those same manufacturers spend billions of dollars selectively advertising their behemoths, always concealing their relative destructiveness, while profiting especially mightily from them.

4) Highway-generated damage remains the only place in our society where the doer of the damage's relative potency is considered in neither statistics nor law. Increased vehicle weight is a purchaser's choice, yet punishment is never meted out for the much greater resulting damage to others. Instead, "no-fault" has removed both accident cause and intensity from legal compensation. Accident reporting continues as if the victims have the only responsibility for their safety. Thus, the myth lingers that heavier cars are safer. By the same logic, there would be no legal difference between guns and knives, leaving assaults with weapons to be judged only by the relative effectiveness of armor.

5) Pollution output remains proportional to fuel burned, as long as there is equivalent control technology and other use characteristics (e.g., time and distance). So does total fuel burned to weight moved. Cutting the average on-the-road mass by 1,000 pounds (which was nearly done between 1975 and 1985, but has been more than regained in the last 10 years) would reduce U.S. emissions of greenhouse and related polluting gases, e.g., CO_2, NO_x, and CO, by more than 200 million tons. That would be notably more than 10% of the entire U.S. output of these greenhouse chemicals. Yet, vehicle weight is almost never mentioned in regard to global warming.

6) In national parks and most towns, highway infrastructure is conspicuously deteriorating. That road damage is absolutely related to the total weight passing over it. But neither park admittance nor road use fees seriously consider vehicle weight at all, or like vehicle registrations in general, administer a trivial payment difference.

7) Vehicle performance on the road is determined by the available power <u>divided</u> by weight. Air resistance comes from the coefficient of drag <u>times</u> frontal area. Yet, almost all advertisements and auto reviews mention only horsepower and drag coefficient, as if these alone count.

These are but the first of many anomalies, if it is thought that the importance of weight in trransportation is widely or deeply understood. This book combats a variety of dangerously related myths by thoroughly exposing them, and then by illuminating just how many improvements -- in so many parts of life -- could follow dealing with on-(and off)-the-road weight both more straightforwardly and creatively.

How It Does It, In Outline, With Selected Passages

Chapter 1:

Relating Vehicle Impacts 24 pages, 6 illustrations

"Data without generalization is just gossip." (Robert Pirsig, *Lila,* 1991)

Problem one: resource managers, politicians, and the general public have not had consistent tools to fairly discuss either damage or performance by vehicles, including how motorized units contrast with other road and trail users. The underlying issues have been missed through being too embroiled in detail, or by failing to look closely enough at the unifying characteristics of their effects. Simpler calculation methods that more effectively integrate overall damage are vital.

Vehicles moving off roads offer one of the most transparent ways to connect more general issues. It is less complicated to evaluate the results of passages along forest trails than on highways, since plants are more immediately sensitive than concrete or other vehicles. This chapter traces the development of an equation from which key comparisons may more equitably begin: IMPACT equals [MASS plus (POWER divided by MASS)] times (WIDTH times DISTANCE TRAVELLED). Within this readily accessible sum, the greatest emphasis falls upon dead weight, because power, width, and distance tend to vary so consistently with it.

This new, basic computing tool is anything but purely negative, however. The potential for performance rises — when measured from many levels — as the structural mass involved in transportation is thoughtfully lightened.

In order to follow the development of this initial chapter, readers do not need to be fully interested in science or its details. Its conclusions, and the reasons behind them, are approachable as easily by casual browsers as they are by those who need a more technical foundation to be convinced. The central equation illustrates how its simplified mathematics do not hide behind abbreviations, but instead use numbers clearly backed by understandable word pictures.

A sample paragraph:

Each “full-sized” four-wheel drive utility vehicle or pickup truck may have more than six times the mass of a horse and 200 times its available power — which can be much more easily sustained for longer distances and periods of time — and is capable thereby of creating the same damage to plants, soil, or road surfaces as 1,500 hikers. As vehicle weight continues to increase, typical motor homes, for example, will more than double that baseline impact. Semi-trucks take it up fifteenfold further, dwarfing all of the other motorized categories, although not as thoroughly as they crush the wholly motorless.

Chapter 2:

Broadening Appreciation of What is Affected 52 pages, 5 illustrations

“A useful test for free choice is to ask, ‘What would the world be like if everyone did as I do?’” (Terence Yorks, *Journal*, 1994)

Since the initial development focused mostly on impacts to soils and vegetation, chapter 3 expands the book’s viewpoint to consider wider-scale damage by highway traffic and even broader issues. These range outward to cover worldwide pollution, resource use, and employment. More weight in motion means deeper potholes, more fuel burned, more pervasive well drilling, more intensive accidents, more earth torn by mining, and more unrecycleable (and toxic) junk. Accomplishing the same functions with fewer materials requires more thought before, and care during, design and construction. This change can mean more people, employed in more places, doing more interesting, safer work.

This chapter also questions how far — and for how long — particular technologies can be spread. A notable example is what would happen if our present American high-mass transportation system was to be expanded, as is now being contemplated, to a billion more people in China, and to that many more polluting motorists again in other presently less-than-universal-private-vehicle countries.

Personal tales are used as well as more straightforward fact to deepen reader interest. The underlying principles themselves thereby become more deeply backed.

From the text:

A classic study was done in the 1970’s by *Road and Track* magazine, where the experimenters taped over the speedometers of a variety of vehicles and had drivers cruise highways at the speed at which they felt most comfortable. The fastest speeds turned out to be maintained by the drivers in a van, who drove more than 10 miles per

hour faster than they did in a Porsche 911. Few would argue that the ability for safety or control would be better in the van. Sitting high and with plenty of sound insulation, the driver is divorced from the world outside, losing a relative sense of motion. Without an internalized perception of speed, one tends to less effectively regulate it.

I have repeated this experiment myself, both as a driver and as an observer, and found it to be consistently true among otherwise equivalent driver groups. It is not fair to unrestrictedly compare older female drivers who choose luxury cars with younger males in more open sporty cars. But when the users are sociologically similar, they tend to go faster the higher and/or the more isolated their vehicle is (specifically, in the present context, through the sensory-dampening effects of greater mass), especially when weather conditions deteriorate. This is precisely opposite to the control potential available. Once again, the government does not compile weight-related statistics for the causers of accidents, but only for the recipients thereof, which leads to further tragic misunderstandings.

Chapter 3:

The More Bearable Being of Lightness 35 pages, 4 illustrations

"...by what we think, we create the world around us, daily new."

(Marion Zimmer Bradley, *The Mists of Avalon*, 1982)

The final chapter develops a solution set for the problems that were related earlier. Since this resolution runs counter to commonly accepted directions, additional, readily approachable scientific proofs are assembled to support it. From them, a surprisingly more satisfying lifestyle can be inferred worldwide. This is a reach of a promise, of course, but it has the component facts in place to confirm it.

At the core is the premise that when physical efficiency rises, the consequent environmental damage from the same function can fall, and in an extended way. Using less fuel to travel a given distance, for example, not only reduces overall air pollution, but also the probability for oil spills. If carelessly applied, however, the potential utility of mechanical efficiency can be complicated by a new set of associated mistakes. Microcomputers, although using far less materials and energy than their precursors, require exotic compounds that can release selectively active toxins during careless manufacturing. Fortunately, that sort of complexity is more amenable to high-employment, lower-net-damage resolutions than are high-mass approaches.

This section does not stint on the details required to create the desired effects, unlike most prescriptive documents for transportation. The best word remains *synergy*, where doing right in one area is beneficial to others. "Less is more" was one of the key related strategies for Buckminster Fuller, who had so much to do with the intellectual and practical enlightenment of many of us. But this chapter goes

beyond his compatriot E.F. Schumacher, whose generally useful “small is beautiful” brings fear to many when applied to travel. Instead, it shows that lightness does not restrict travelers to a spatial straightjacket, and emphasizes how weight reductions can proportionally increase both individual and general safety and comfort -- and even industrial administrative and worker profits.

Specifically:

A significant proportion of the extra energy required to increase speeds around corners comes with providing enough down-force to maintain traction. When the rules have allowed it for pure racing cars, traction potential has been selectively increased by an active design (such as a tuneable airfoil or suction) which is brought into play only when needed. Thereby, instead of adding weight to force the tires into contact, which applies a constant drag, overall efficiency can be raised so much that performance remains dramatically higher.

That differential becomes even greater in more difficult circumstances, such as bad weather or slippery ground. In the latter case, when weight is kept lower, one does not have to deal with the vehicle sinking in as severely, nor needing the transfer of as much energy to get moving in the right direction. This means in the first place, one is less likely to get stuck, and then if one does get mired, the vehicle will be much easier to push or pull out.

Appendix:

Supporting the Basics 28 pages, 10 illustrations

“Passion was inversely proportional to the amount of real information available.”

(Gregory Benford, *Timescape*, 1980)

This follow-up underlines for the inevitable doubters and the intellectually curious how the strikingly straightforward first chapter did not come from an excessively simplified analysis, despite the clarity of its results. Those initial conclusions ought to be obvious, but they have not been respected, either widely or deeply. The results should prompt many readers to ask why this core has not been presented before, and in this fashion.

This appendix strengthens the conclusions from the first by compiling a plausibly thorough set of particulars. These should also provide considerable data for further contemplation. The rigorous part keeps these many details successfully clear of the overwhelming jargon that commonly inhabits scientific writing, yet retains sufficient depth to furnish acceptable proof for affected professionals.

This more detailed analysis is presented without being hidden

behind complex mathematics. Nevertheless, to be fully credible to other scientists, these clearly-defined general relationships are revealed as thoroughly supported by underlying evidence, which includes some reasonably specific language. Readers who are not fully interested in this more technical development will be invited at the outset to lightly skim this second section, with the understanding that the underlying pieces are available should they desire to return and pursue them further.

For example:

A closely related factor is the additional width of the disturbance by vehicle type. This includes the physical width of the wheel/foot track(s) and the effects that reach outside that direct track: both by protruding edges above the ground and soil buckling below or adjacent to the vehicle path. A logical objection could be that body edges contact only higher-growing species. In response, these consequences tend to affect portions (e.g., woody branches) which require a much greater nutrient investment by the plant in question, and are thus more difficult to replace.

The species that are selectively affected by body edges will be those with low resilience. This magnifies, from a species balance standpoint, the impact of vehicle perimeters, and therefore overall width and height. To a tree sapling, for example, there is little difference to its probability for survival between impacts from a wheel or from a bumper or roof edge if each has the same mass and speed behind them. Wilshire *et al*. (1978), studying desert environments, have emphasized the practical importance of plant damage well outside wheel tracks, which is caused by vehicles' superstructure (Lathrop 1983).

Background

This integrative project began with a thorough evaluation of the literature on vehicle impacts on vegetation and soils, which was sponsored at Utah State University by the U.S. Army Corps of Engineers. More than 400 books and articles (from a much larger pool) passed evaluation as being useful and were distilled into a working computer database for further analysis. The initial peer-reviewed conclusions have recently been published by the international scientific journal *Environmental Management*.

That preliminary work repeatedly suggested that there were far wider relationships which could be pursued from the information collected, and that these should be of great importance to the majority of people on earth. The thrust of these early conclusions made the original patron uncomfortable (given the great investment of our current military in heavyweight equipment), at least at the incomplete level of development that a preliminary analysis could supply. Modest, but vital, follow-up funding was provided by the Utah State University Research Foundation. The author then continued without outside

support, feeling that the ideas being developed were too important to drop just because they were consuming an inordinate amount of time before their complexity could jell and become more accessible.

Forty-five formal references are cited within the present manuscript. These, along with additional leads, are described in a briefly annotated bibliography. With the information more fully supported and clarified, the Army's engineers may be among those who find the fleshed out inferences useful. Efficiency and performance remain at least as valuable to military defense as they do to the rest of our needs.

Similar Books

An intensive investigation turned up none. Engineering textbooks in vehicle design derive equations in which the vital elements are inherent, but they consistently lose track of larger relationships during their quest for accuracy in extreme detail.

Island Press offers two of the most integrative transportation planning books now available (i.e., *At Road's End* and *Future Drive*), but both neglected the scientific core of the problem. The Worldwatch Institute has published shorter papers on the subject, with summaries in their annual *State of the World*, but these are incompletely developed, and also miss the unifying premise of *Lighten Up*. This essence is apparently so obvious that it has remained peculiarly elusive, which strongly supports the need for another examination.

The general issue of transportation, of course, is featured within a great many investigative books with a creative eye turned to the future. This includes those by Bill Mollison, Paul Hawken, Amory Lovins, and Wendell Berry, which are referenced directly within *Lighten Up*. In each case, their conclusions can achieve deeper utility with a better understanding of what stands another step behind them.

Status and Adjustments for a Lay Audience

The manuscript is presently complete as outlined. With active publisher interest, it could undergo further editing to remove the vestiges of the convoluted academese that it is so difficult for an active scientist to avoid. More detailed graphics would undoubtedly be helpful, beyond striking photographs of resource damage from vehicles that are already on file. These are currently being prepared.

Associated Potentials

Several who have heard about this project have suggested that it be made into a television series, often mentioning public television and the Discovery Channel. In the meantime, the book itself has the potential to make a major impact, including being the foundation for a world-wide speaking tour, which would thereby make it self-promoting.

The Author

Beginning with chemistry and physics, Dr. Terence Yorks has been an eclectic researcher and teacher in food production, systems ecology, animal sciences, and range management at several major

universities for more than 25 years. He has constructed computer-enhanced models of land management and energy utilization for private corporations, the states of Wyoming and Colorado, and the governments of Kuwait and the United States. Yorks has evaluated large-scale chemical impacts for the Environmental Protection Agency and the National Research Council. These have been the basis for an extensive list of technical publications, with topics as diverse as food safety in international trade, wilderness ecosystem productivity, and more effective use of photography in assessing rangeland condition.

Counterpointing his scientific accomplishment, Yorks actively practices Lawrence Durrell's dictum that a sense of play makes a vital difference in the quality of both life and work. He is probably the only scientist whose Ph.D. dissertation literally begins, "Once upon a time..." Yorks continues to be a student of photography, history, philosophy, the theater, and literature, especially the work of the Tolkiens *père et fils*. He relaxes reading science fiction and history, listening intensively to a full spectrum of music (from medieval ballads to the Grateful Dead), practical carpentry, skiing, and hiking in natural areas for as much distance as time permits. These allow continually gathering the eclectic observations that grew into this book.

Central to his life is a thirty year love affair with his wife, Dr. Kathleen Capels, who has her own distinguished career spanning medieval literature and contemporary public policy administration. She continually aids his further recovery from the obscuring prose that so tends to engulf academics and bureaucrats, having known him from the time when creating poetry was a primary goal, when his pen began in uninhibited lyricism and continued in joy. Her editorial contributions are extensive in the current manuscript, and would become more so following formal publisher interest.

Recapitulation

This book is all about a simple equation, which others may label Yorks' Law of Vehicle Impact. That key statement effectively ties together the fundamental transportation operating factors: weight, power, and distance.

Its immediate purpose is to allow managers to more reasonably and equitably assess fees upon, or restrict, the various types of land users. These restraints would be based on the resource damage most likely to be done.

The rest of the book goes much further, exploring the consequences of this summary law across wider spheres of human society. It reaches across and links material resources, employment, solutions to pollution problems, and general comfort. These show that the logical outcome of the initial equation allows designing much better vehicles, in all possible senses of the word 'performance'. It also would make possible a dramatically improved transportation system that more people around the world could enjoy, for far longer. This can produce a more comfortable life for all, while strikingly lessening overall resource damage.