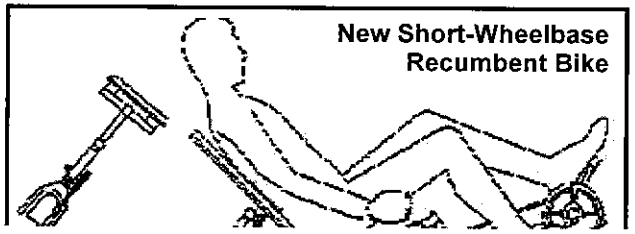
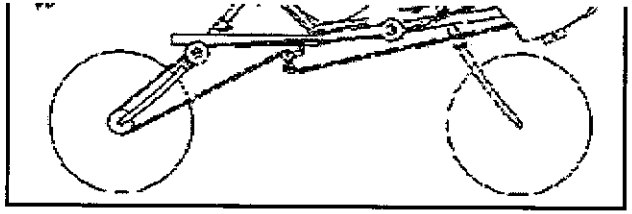
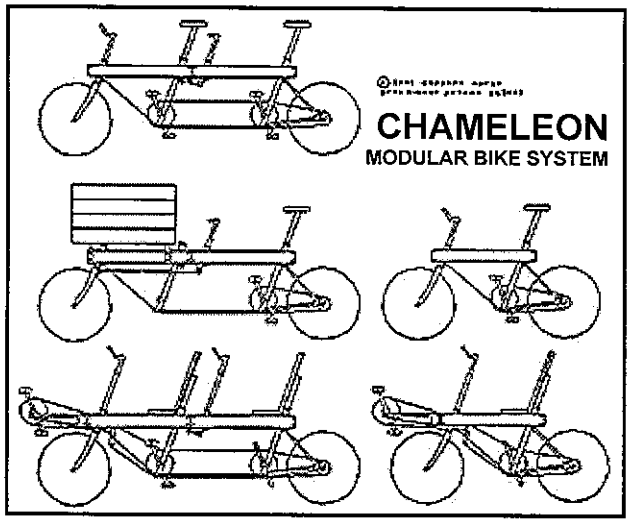
Q: Stephen, checking back, I see that you made your first appearance in BR&K in 2001, with your design for a short-wheelbase recumbent bike, with a post-script regarding your Bike Chameleon modular bike concept. It was great to see that you've continued the process of developing the Chameleon system, with resulting photos on your website. How long have you been working on that concept, presuming it wasn't 2001?



A: It's a bit hard to put a date on it as I don't keep a detailed diary. There's an article on a type of modular bike in a **"Bike Culture Quarterly"** from July 1999, and not long after that I would have built my own version of that bike from a couple of folding bike frames found in a rubbish collection. There's a photo of the bike I built at the top of this page- I'm riding with my son and he's 19 now, so you can see it was a while ago!



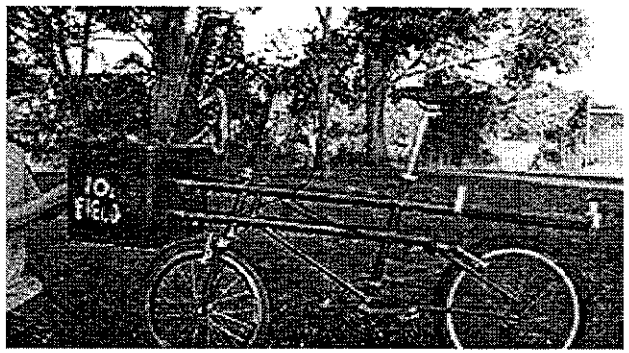


Anyway, that was really my start point, having a bike you could muck around with and change, and then thinking what if you started with a clean sheet of paper and made a bike designed to be versatile and modular. In about 2005 I stopped working on it and moved on to other bike projects. The modular bike idea works and I still have a modular tandem but I wasn't going to take it any further without some support. At one stage I sold a modular bike to a guy in Western Australia for about $600 but I'm not a spray-painter so it's really hard to get a good finish on a bike. As well, I work full time so you don't get much leisure time left when you're also building up a bike for someone else.

Q: So many projects, so little time, eh? I can certainly relate to that situation. I still find the modular concept fascinating; and could easily envision an urban rental shop based upon the concept, in which customers could put together a rental bike for various purposes, such as cargo hauling or taking a child for a cruise on a tandem.

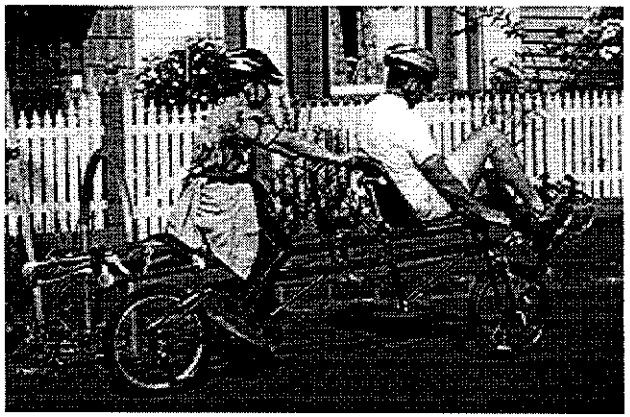
I notice that there were design changes between your earlier concept drawing and the more recent proof-of-concept photos. If you were to continue work on the project, would you make further changes to the design? I was wondering about the weights of the various modules. They look somewhat heavy, at first look. Is that so?

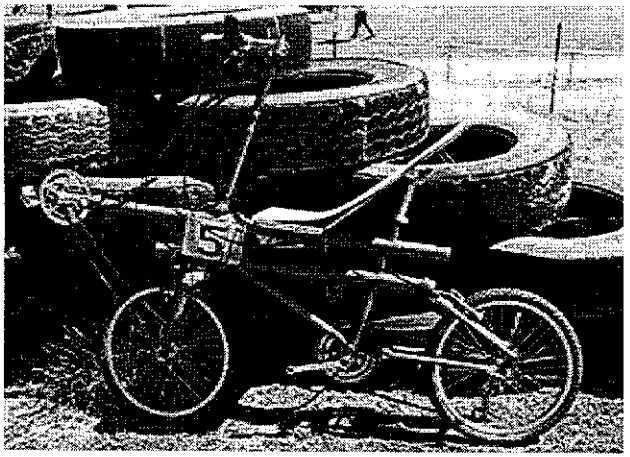
A: The bikes in the current webpage photos (http://modularbikes.com.au/modular.html) were the third or fourth version of the bike frame and the one that worked best. Yes, the bike frames are heavy. The two top tubes are built from 45mm x 1.2mm mild steel, which is pretty chunky for a bike frame. And everything had to be built to take the weight of two people. It needed to function in lots of different ways so quite a few extra bits were added on.

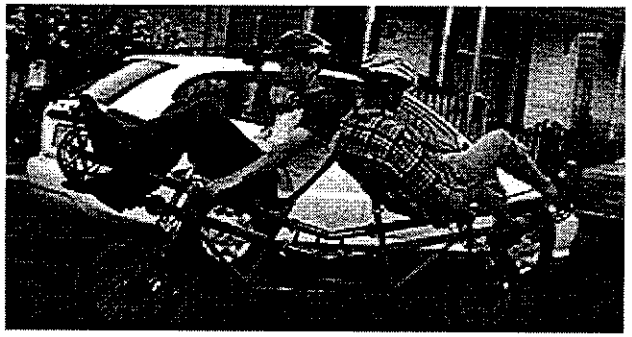


If you build a bike it's most important that it works and it's always possible to reduce weight at a later stage or in another version. Factories that make bikes have so many technologies available to them like aluminium welding and hydroforming, you just can't make bikes in your shed that are as good or as light. You just have to do your best and be proud of what you've made.

As far as the hiring of a Modular bike for all sorts of different purposes goes - well it would be nice if it happened! I've learnt not to build up huge expectations for my designs; you just have to enjoy creating and using them. If they're hugely successful that's a bit of a bonus but I'm not relying on it







Q: Regarding the weight, this is BR&K after all. We might as well have called it "Heavy Bike Quarterly". We don't much care about mass around here. It makes us fitter, dunnit?

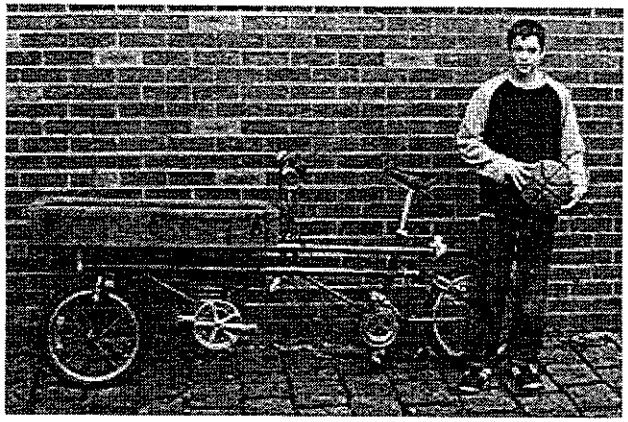
Do you have a list of other modules you've envisioned for the system?

A: Actually I haven't thought about any other modules too much. In some pictures I did I had a lighting module that clips on to the front. Maybe something like a set of rear wheels that turns the recumbent bike into a delta trike would be another idea. Really, the number of bike types you can make from 2 frames and some additional parts is confusing enough. There are 7 pictures on the website of different bike types but it's easy to add a few more to the list. Some of the ones not shown are a conventional tandem which could convert to carry a load on the back (a modern equivalent is the **Circe Tandem**, a steers-from-the-back standard upright tandem and a full front-and-rear drive recumbent tandem (like a Zox tandem). It's a hard concept to get your head around and even harder to sell. Maybe the load carrying jobs the bike can do are its strong point. And bike weight doesn't matter so much when you're carrying a truckload.

Q: I like the trike module idea, especially for hauling larger things, like refrigerators, for example. Balancing something large and heavy on two wheels would seem a tad problematical- at least to me. But I'm timid that way.

Not that it probably matters much in a freight-carrying vehicle, but I've always had the impression that the tadpole trike configuration was more stable and handled better than the delta layout. This is mostly due to my study of the pre-WW2 Morgan Trike racers, banned back then because they were faster than their 4-wheeled competition, while delta trikes are noted for being unstable during fast cornering. Of course, if you're carrying a refrigerator within the center triangle, it's unlikely that you could lift one of the wheels during cornering, anyway. But, that said, is there any reason why the delta configuration is more appropriate to your freight vehicle's function than the tadpole layout?

A: Well, it's about simplicity, really. If you added 2 wheels to the back of a front-wheel- drive recumbent bike there is not much to think about. On a front wheel drive



recumbent the back wheel doesn't steer or drive so it can be replaced by 2 un-driven wheels. You'd have to think about braking and whether you let the pair of wheels tilt.

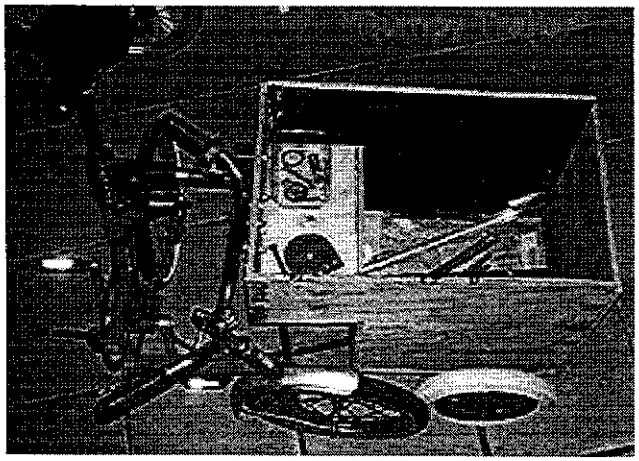
But compared to setting up steering front wheels it would be fairly easy. For the most part I have avoided building trikes because they're too complicated. Bikes are very simple by comparison, if wheels aren't aligned properly the bike just gets on with it whereas a trike starts scrubbing tyres. People riding behind me like to point out that the wheels aren't straight but I like to point out that "the bike doesn't know it's broken".

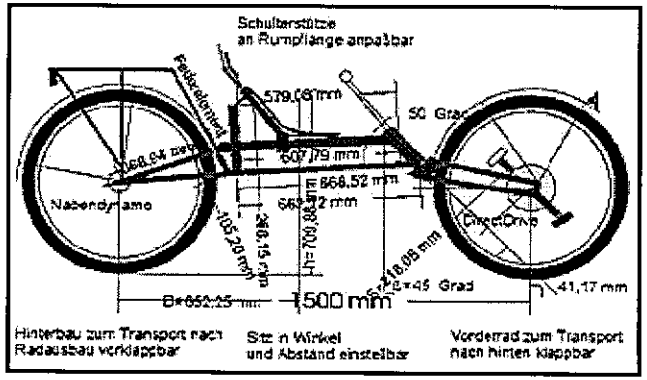
There's a few things to think about when you're laying out a load carrying cycle. It's nice being at the back with the freight at the front so you can see your luggage. If the luggage is behind you it needs to be really secure and anything like an open top trailer for shopping should have some sort of net or cover over it. Actually I don't carry much really heavy stuff on my bikes either, but I'm always using the tailbox on my recumbent to carry shopping - see attached photos. As well, I'm working on a big boxy bike trailer that you can wheel into the supermarket with you- its about 600x600x600mm or 2 foot by 2 foot by 2 foot.

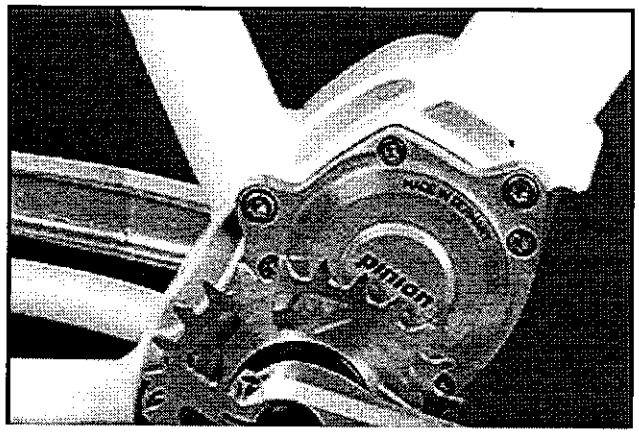
Q: Suddenly, we're at one of those cusps, which makes conducting interviews so interesting. On the one hand, I have more I'd like to inquire, regarding the trike topic, but on the other, you've introduced, with the trailer topic, something which has given me a new idea I'd like to discuss. Let's do some trailer talk, and hit the variant on the trike topic a bit later, if you please.

Your shopping trailer concept, volumetrically, pretty much describes my wife's folding shopping cart, which is roughly 450x450x800mm or 18" by 18" by 30" tall. She uses it to transport about a week's worth of groceries six (NYC) blocks from the neighborhood supermarket to our home, on the 4th floor of our building. My problem with trailers, in regard to bikes is the trailer's length added to the bike's typically-lengthy footprint. Once I started down that path, I began thinking about trucking tractor/trailer rigs; in which the tractor is much shorter (typically) than the trailer. Coincidentally, this issue's BRK Gallery shows a clever extremely-short-wheelbase bicycle. Given a smaller rear wheel, it would seem that the theoretical concept would possibly be ideal for a bike-tractor/trailer combination. What do you think?

A: Definitely a good idea







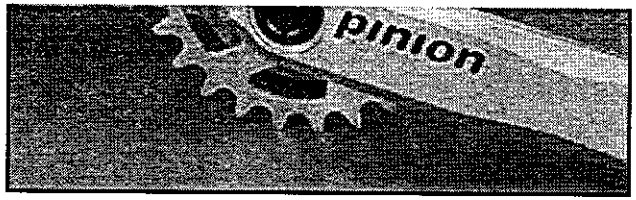
Bikes don't get used much for shopping and they probably should. Here in Melbourne lots of guys do 100k recreational / fitness rides on a Sunday morning but few of them would ever dream of doing the shopping on a bike. But you still get the exercise and with the right equipment a bike + trailer could fit in a lift and the trailer can go into the market. So the time spent for the trip could be the same as or less than the car trip without the problems of parking, transferring shopping from supermarket trolleys etc.

The short wheelbase bike Thomas has built looks awesome and I especially like the paint job. A bike that short would make a really good combination with a trailer and make it ok for taking on trains and lifts. A slightly different arrangement would be to have the pedals running right through the centre of the back axle. That would keep things a bit lower. In Human-powered-vehicle circles there's been talk about a full hub gear setup for pedals on the same axis as a wheel for ages. There's a picture of one here **http://home.arcor.de/da-ckel/ddb/ddb.html** and Left. New things are coming on the market all the time now. How about mucking around with one of these **http://www.pinion.eu/en/index.html** and Lower Left to make an in-hub gearbox!

The "dumpy trailer" I'm working on is shown in the photo that's attached. above. When you use it with a 16" wheel folding bike you can really cut down on the length of bike + trailer. In my case I am keeping the trailer volume high & the bike + trailer short by making the trailer overhang the back wheel.

Q: Those are great links! That gearbox is one of the more beautiful pieces of technology I've seen in a long time. Since there is no pricing information on the gearbox itself, as it'll only be available on complete (and presumably expensive) bike frames designed for the purpose, I doubt most of us will be getting our hands on one anytime soon. The possibilities are fascinating, though.

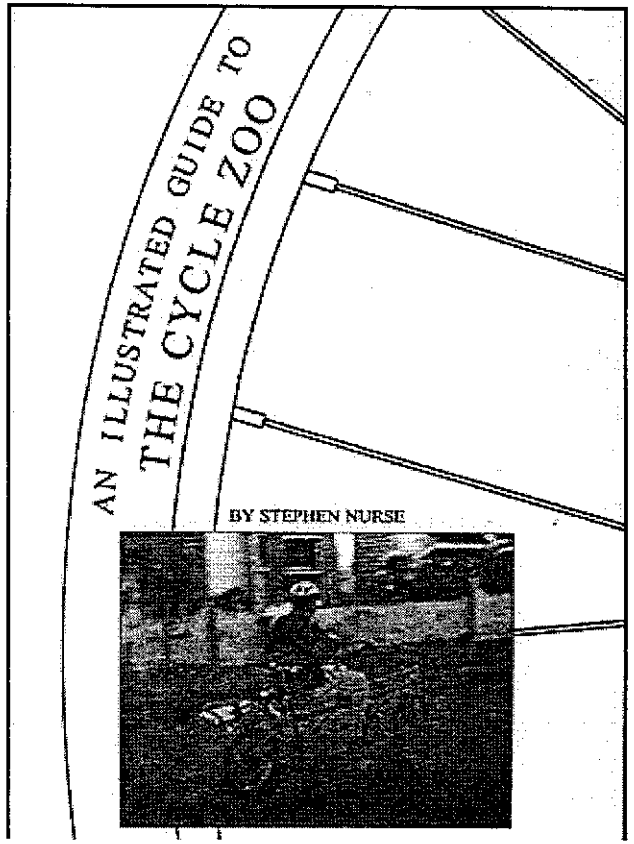
I don't suppose there's an existing stock gearbox suitable for experimentation purposes?



Your "dumpy" trailer looks like a good solution, especially combined with the small folding bike. Looks like the combo would easily be accommodated by almost any elevator.

This looks like a good time for us to discuss your recent book: "An Illustrated Guide To The Cycle Zoo". You've managed to cram a lot of information into 122 pages. Among other outlets, it's available through your website http://modularbikes.com.au/book, which also carries supplemental material related to the book's content.

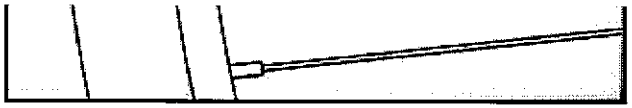
I like the book a lot, of course. Who else did you write it for, and what do you expect they will gain from it?



A: On the gearbox, the design is for a bike with a massive gear range of 634% and a gear is always engaged. The driven wheel is a sprocket. For an in-hub gear you would get away with a smaller gear range and simpler gearset, you would probably want a clutch and the driven wheel would just be a bike wheel. I guess the main thing for the in-hub gear is that a very similar layout would be possible. There is the possibility of getting a really high efficiency with no chain or belt losses. It might come one day! Not sure if anything else has the same layout.....

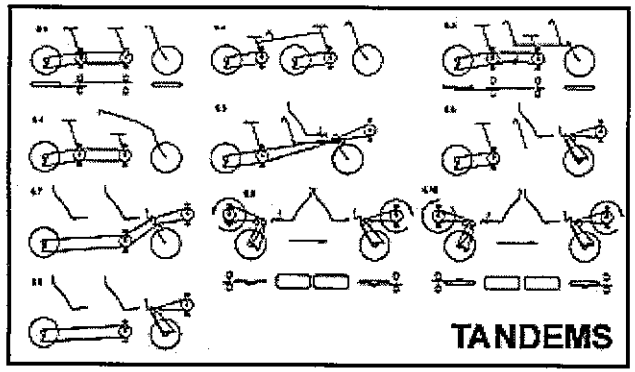
It's not very visible but in the trailer there is a wooden pole which slots into a guide at the front of the trailer and forms a stilt so the trailer is stable on its own. The idea is that the pole be raised or lowered in its guide - it could be a flagpole in the "up" position.

On the book - well I guess I wrote it for anyone curious about some of the more interesting bikes and cycles that are getting around these days and interested in having a crack at choosing, building or designing one. Recumbents and trikes and load carriers are still fairly rare and someone seeing one in isolation amidst a mass of more standard cycles would tend to wonder what's going on. There are books like the various editions of **"encycleopedia"** which show lots of different styles of cycle but they don't really relate one type of cycle type to another. I've tried to do that in the book, show a lot of human powered vehicles and how they go together to form a "map" of different cycles for different purposes. I've tried to talk about cycle physics and engineering design as well and then show how it's applied by giving examples of my own bikes. Maybe what people would get out of it is a sense of ownership and

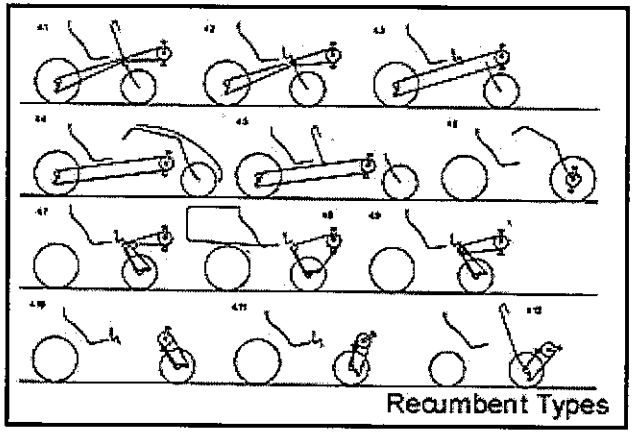


my own bikes. Maybe what people would get out of it is a sense of ownership and control and understanding of a bike - one of the few things today we can have ownership, control and understanding of. But I can't really say, everyone would take it differently.

To be honest I wrote it for myself as well. While my bike designs work and perform as well as some of the mass-produced bikes getting around, I was very far from having them widely accepted or produced or making a profit. So the book was sort of like another bike project, something I could do that would maybe turn a profit (no problem if it didn't) but be fun to do along the way. It's nice to get to the end of the year and think that you have achieved something. I can't imagine getting to the end of the year and saying "wish I'd watched more television" or that my football team winning the grand final was my year highlight.

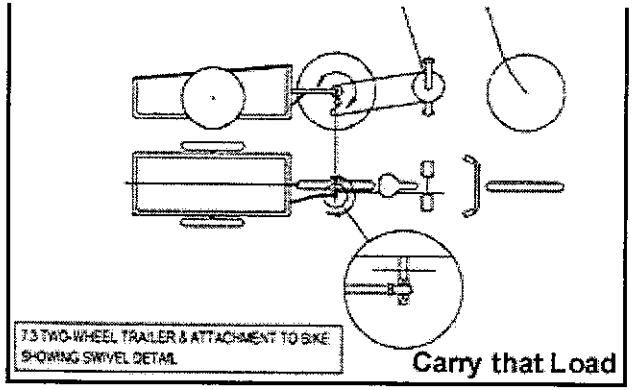


Q: As one who's always eager for an opportunity to conduct bike design and construction courses or seminars, I like your book as a good introductory textbook for the subject. I'd suggest that others who have that urge also consider it in that light.
By showing schematic diagrams of an incredible number of variations on the basic recumbent, tandem, and workbike themes, you really present the reader with a wealth of possibilities to choose from, if wanting to decide upon a project. I must admit that I'd never thought of half of those variants. And I have a feeling that would apply to most people experiencing an urge to build a human-powered vehicle, while wanting to develop the skills and craft to do so.



This seems much more constructive than merely presenting students with a giant pile of trash bikes and a sketchpad. Was that your scheme with these chapters?

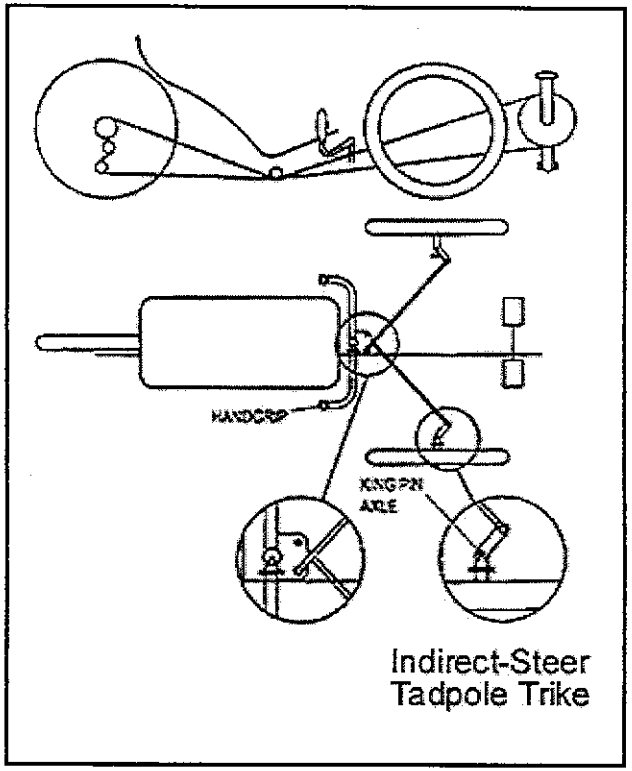
A: Well I really didn't have a scheme, it just sort of grew on me. At the start I did a translation into English of something I found on the German Human Powered vehicle site. This was a description with diagrams of all the types of recumbent bikes. When I finished translating it I started rewriting it in my own words and diagrams and it ended up as an article in the Australian Human Powered Vehicle (OzHpv) magazine "Huff".
When I did the work on the other chapters on trikes, load carrying and tandems, I just extended the concept. There was a bit of work in that, especially on the chapter on trikes. I've never built one and don't ride one regularly but have seen and tried lots of them in varous group rides. A few keen trike riders helped me out on it.
Quite pleased with the way it all turned out. A lot of keen Human Powered Vehicle

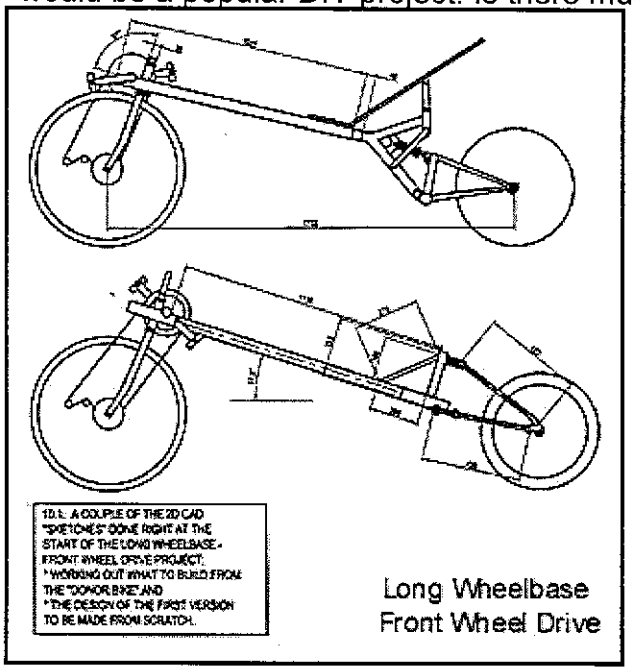


builders carry most of this knowledge in their heads but it's been good to get it down on paper so anyone can understand it.

Q: Those chapters do that very well. The chapter on recumbent trikes is quite informative also, especially considering that you've never built one yourself. But the information is out there, and your research seems to have been thorough and successful.

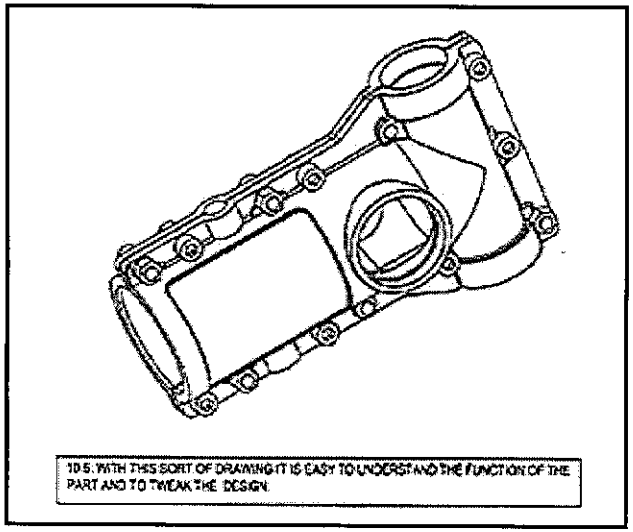
I found the chapter on your long-wheelbase front drive recumbent to be fascinating. It was a treat that you show five iterations of the same basic design, and the increasing elegance of each version. The Mark 4 is quite slick, but the preceding wooden version has a lot of appeal as well. Considering that many more people have existing woodworking skills than have metalworking skills, I would think that it would be a popular DIY project. Is there much performance difference between the



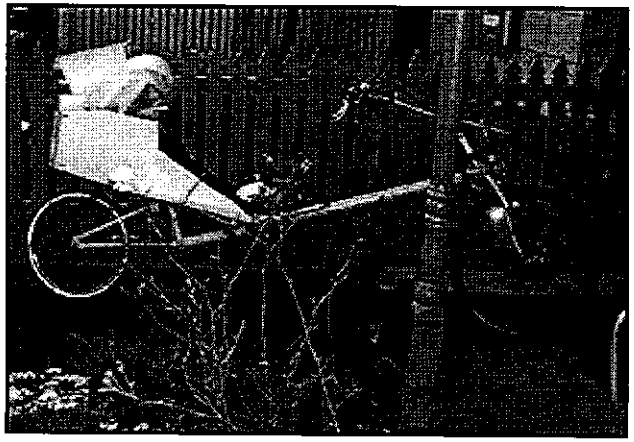


A: The only performance difference between a wooden version of the bike and a steel version is weight, and that would likely be only a kilo or two. On the flat this doesn't matter much. And if you put a set of fairings and a bodysock on either bike, it should go faster than a racing bike, on the flat and downhill at least. You've gotta love that.

Amongst the more glamorous bikes, I am showing very early hack bikes which are proof of concept. I tried to make it look fairly simple to start building a novel bike and to encourage people to build something and not worry too much about mistakes.



10 5. WITH THIS SORT OF DRAWING IT IS EASY TO UNDERSTAND THE FUNCTION OF THE PART AND TO TWEAK THE DESIGN.



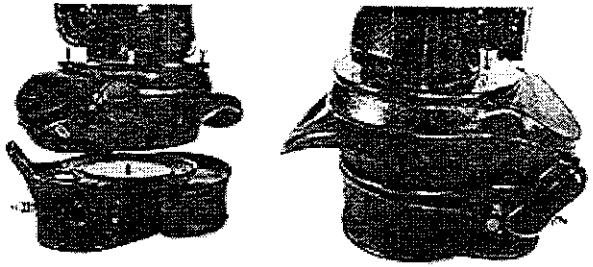
Q: I was impressed that you designed and had aluminum castings produced for the Mark 4 version. That's what I call putting money where your mouth is. And I was especially impressed that you made two identical sets of castings perform different jobs at each end of the boom. That's also what I call efficient!

Even using two sets per bike, you must have a lot of them hanging around. Do you plan to sell the units in excess to your immediate and future needs? Or are you considering kit production of the whole machine, since you already have the trickiest manufacturing aspect covered?

A: They didn't need to make a die to get those bits made so the cost wasn't that much and I only have a few of the bits hanging round the house. I work as an engineer and deal with diecastings quite often and managed to get sponsorship for some of the cost.

There are lots of methods out there for making parts without dies these days and these were made straight from a 3d computer model using 3d printing then lost wax casting. The method of making bikes with this casting hasn't continued on but it would be a nice way of making a kit bike. I'd like to see the castings done in a tough plastic. It's very hard to have all the skills necessary to see things like this through to series production: the entrepreneur and marketing bits I'm not so good at!

Q: Sorry for my confusion, I thought you'd already gone to the more expensive die-casting process, with the $10,000 tooling cost you mentioned. For the benefit of our readers, lost-wax casting is cheaper in the short run, but pricier in the long run. I presume a silicone mold was pulled from the rapid-prototype solid model. Wax replicas are cast from the silicone mold, encased in refractory material, then cast in molten metal probably using a centrifugal casting rig. The metal vaporizes the wax, leaving a metal replica inside the cavity in the refractory clay shell, which is then pulverized and removed. Voila, metal part which is produced in fairly small quantities due to higher time/labor costs as compared to die-casting which has high tooling



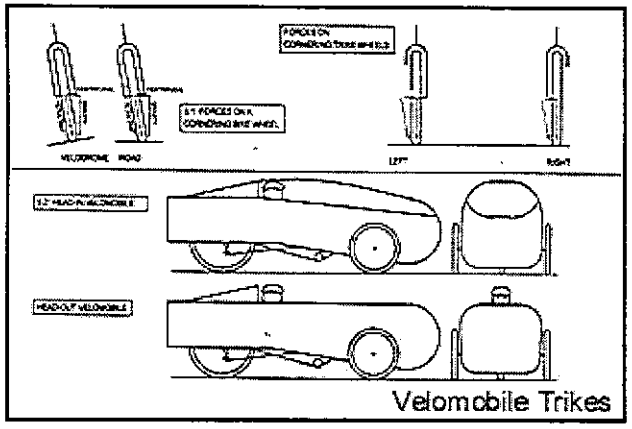
GLOBUS 360 Medium-format panoramic camera
Composite components designed by Jim Wilson

cost on the front end but much lower time/labor costs on the back end. Glad to have cleared up my confusion.

For very expensive limited production products, I've used similar silicone molds to make cast-composite parts, but the time/labor cost was probably higher than for lost-wax metal casting. But, in that instance, only a few parts were needed and chopped fiberglass/graphite/epoxy composite was the preferred material for the final parts.

Considering that you had boom-bending problems with the earlier steel frames, and presumably similar stresses would apply to the cast parts- that would probably need to be a very strong plastic to do the job- carbon nanotube composite? Dilemmas such as that are why I also avoid mass-production-based entrepreneurship. My theory is that one is either that kind of guy, or our kind of guy. Kyle Watson, whom I interviewed a while back, set out to produce his fabulous stainless-steel chopper in a limited-production run of 100. By the time he'd finished the first five, he was bored out of his skull by the thing.

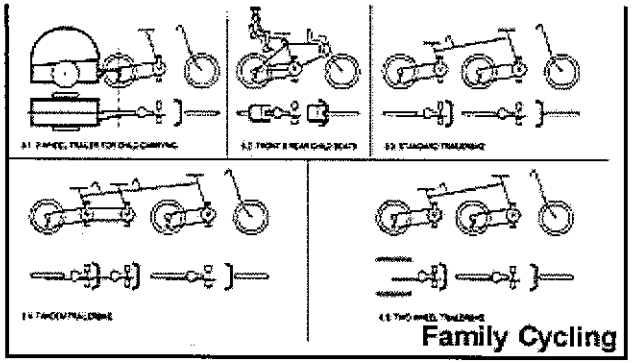
In your trike chapter, you dip into the enclosed-recumbent "velomobile" topic. I see a real market in urban areas for a sort of "velotruck" all-weather load-carrying delivery vehicle- kind of a human-powered van-shaped recumbent with electric-assist drive. That would work very well in NYC, which has a 35MPH speed limit anyway. While I could easily design such a vehicle, and build a working prototype, the thought of what would be required to put the thing into actual production and successfully market at a reasonable price seems nightmarish. Is that also your attitude?

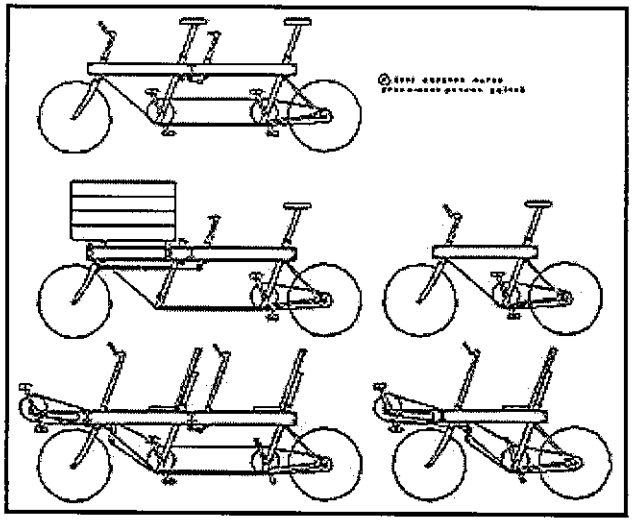


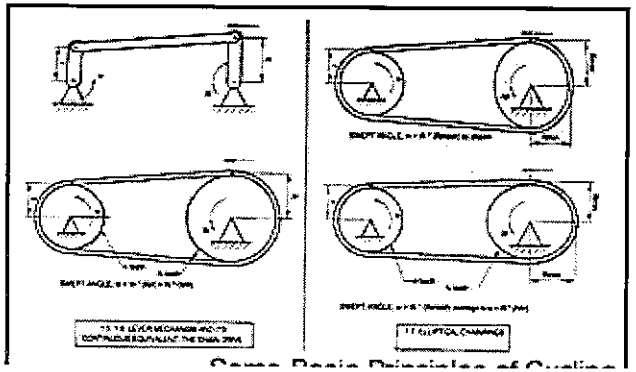
Velomobile Trikes

A: On the structural aspects of the castings, the bending of the bike frame (with under-strength for the job mild steel) happened right in the middle of the bike and not at the ends where my castings are. So possibly there wouldn't be many issues with castings made in different material. Plastics that aren't too exotic can still be very tough, strong and durable.

As far as buiding a velomobile - truck - vehicle goes, you have to realise your limitations and also what you enjoy doing. What you enjoy doing is possibly what you're best at anyway. So I like developing ideas and am not very good at commercialisation but I'm happy with that. If the commercialisation comes along, so much the better but I wouldn't do all the work of taking it to the next step. A lady who lived across the road used to ask if my bikes were prototypes, and I used to say no, these are just bikes I ride. A novel design doesn't have to be commercial and almost







all your B R & K contributors would agree.

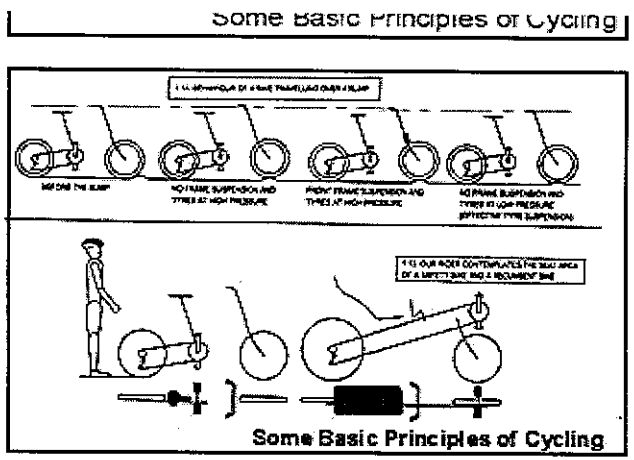
Q: And so would I. But it's always fun to fantasize using your skills to tackle a new and different sort of project- such as a human-powered truck. I've always wanted to design and build a submarine, too. But, neither are logistically possible without going into business to do so. Plus even if doing it for fun, neither of those fantasy projects would fit into my elevator, even if finished. I guess I'm stuck with the bike or kiddy auto projects I usually tackle.

Speaking of kiddies, I was quite impressed by your chapter on **Family Cycling**. I agree on getting children involved with biking as early as possible. Many parents, especially in cities, are afraid for their offspring to "face the danger of the streets". My daughter's in her mid-20s now, and has been riding since kindergarten; she has friends her age who've never been on a bike. The difference is amazing. The bike-deprived ones tend to be timid about many things, even other than bikes, whereas my daughter is bold and confident in everything she does. Sure, she's had her share of road rash, but that's merely demonstrated to her that she's tough enough to handle almost anything. Do you find this to be true for your offspring as well?

A: Most of us don't have the option or the sheer persistance of will to "starting a business to build something". I read the weekly section on cars in the newspaper and find out about big projects that way - there's lots of interesting developement in electric vehicles at the moment. Just having small projects to deal with outside of my normal work is lots of fun. When you work for a bigger company the sense of artistic control is not often there.

My son's 19 now and he's grown up with bikes and bits of bikes and tortured bikes and alternative bikes around the house the whole of his life. He rides his bike or takes public transport most places he goes and he's confident and outgoing. A lot of the kids I see at our (OzHpv) human powered vehicle meetings seem to be the same. Growing up around bikes certainly doesn't seem to do any harm but I'm not really a keen observer of kids' behaviour and wouldn't really draw any conclusions beyond that. A lot of how your kids turn out is luck and you sort of have to go with it.

Q: Maybe luck in inheriting superior DNA? ;-) I would go so far as to say that "Kid + Bike" is superior to "Kid Bike" though, if only in relation to fitness. Of course, there

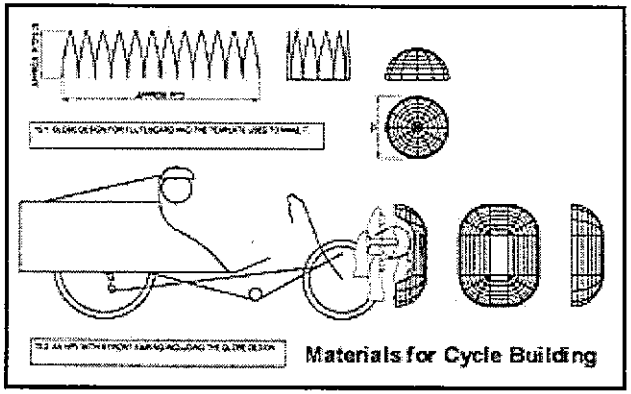


are bound to be positive consequences when a child owns and is responsible for its own real-world rolling physics lab.

Speaking of which, I found your chapter on "Some Basic Principles of Cycling" to be pretty edifying. Not that I have an extensive library of cycling books, but I do have some of the basics. Since I learned several things from your book I didn't already know from others, such as Richard Ballantine's or Brad Graham's, for example, I feel it's safe to assume that you cover cycle physics more than other writers on the subject. Is that because you're an engineer by profession?

A: When I wrote the chapter, I guess I picked what I thought was important and wrote about that. Being an engineer doesn't come into it that much. I didn't set out to be more comprehensive on cycle physics than other books but didn't want to bury stuff like why recumbent seats can be more comfortable than standard bike seats in the middle of the book.

Being an engineer helps with the writing process though. It means being able to do the drawings (in 2d CAD) so the explanations can come through and also being used to technical writing. There has to be a balance between being over-technical and over simple.



Q: I think you've struck a nice balance between the two extremes, Steve. You've managed to fit a tremendous amount of useful information into a nice little book without over-simplfying anything. It should be at the top of the must-read list for anyone even considering making their own human-power vehicle. And, as I mentioned before, it's a natural for use in bike-building classes and workshops. Thanks for sharing it with us.

A: Well thanks for the interview. We've covered a lot of territory! Keep up the good work at B R & K, Jim.

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