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HUMAN POWER

Official Publication of the INTERNATIONAL HUMAN POWERED VEHICLE ASSOCIATION, INC.

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Yiorgos Naoum photo

The IHPVA's 8th Speed Championships were a media hit.

THE EIGHTH IHPSC

By Chuck Champlin

Despite a few birthing pains, the 8th International Human Powered Speed Championships finally did come to life on the beautiful, sunburnt weekend of Oct. 2 and 3 in Southern California.

Competitors seemed to agree that this time the race was one of the best organized and most enjoyable in the history of the IHPVA. And there was even some real drama for the crowds as a peppy, last-minute entry from England – Bluebell, ridden by Tim Gartside of the Nosey Ferret Racing Team – set a new world record for a bicycle of 51.919 mph. That beat the former record of 50.84 set by Fred Markham on an Easy Racer back in 1979 at Ontario Motor Speedway in California.

Gartside also did what was starting to seem impossible. He beat the single Vector ridden by David Ware, who went 51.84 mph in the 200 meter sprint, unlimited run-up.

The highest speed of the weekend was set by the Tandem Vector at 57.90 mph. Riders were Fred Markham and Nelson Vails.

Saturday's events were held at Orange County International Raceway in Irvine, an hour south of downtown Los Angeles. The 3/4-mile-long strip is normally host to noisy drag races, but on IHPVA day it saw a new HPV event, the 200 meter sprint with a 600 meter run-up.

The course clearly showed the advantages of a long run-up for acceleration. The best time of the event was by White Lightning at 50.58 mph, more than 10 mph off its best. Still, that's the record now for multiple vehicles in the new 200/600 meter event. The single vehicle record was set by the White Vector which went 48.84 mph.

In the afternoon at OCIR, two road races were scheduled: a 20 kilometer Le Mans-style start, and a 50 kilometer paced start. The first race was disallowed, however, because of a dispute over lap counting.

In deference to exhausted riders, the second race was shortened to 25 laps around the 0.8-mile course, becoming a 20-mile event. It was one of the dramatic highlights of the weekend as the White Vector, the Easy Racer and Phoenix all battled for the lead. Final placement: first, Greg Miller in the Easy Racer; second, David Ware in the Vector and third, Thurlow Rogers in the Phoenix. It was a close finish.

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UPDATE ON THE OLYMPIC BICYCLE PROJECT

By Chester R. Kyle, Ph.D.
Professor of Mechanical Engineering

The attempt to improve the U.S. Olympic cycling teams performance by using the science of biomechanics and mechanics is proceeding. Led by Dr. Ed Barke, Technical Director of the USCF, the team of 10 scientists and engineers is attempting to revise cycling technique, training methods and equipment in order to make the U.S. Cycling Team more competitive.

The program is a part of the Elite Athlete Project of the USOC which covers Volleyball, Fencing, Weight Lifting, Track & Field and Cycling. They have funded specific research and equipment development in each field. In Cycling the Biomechanics Group has filmed the 1982 World Championships and is analyzing the high speed motion pictures to study winning techniques. They are also involved in an extensive ergometer study of pedaling technique to improve efficiency. The study has used champion U.S. cyclists as subjects. Dr. Peter Cavanaugh of Iowa State University, Dr. Peter Francis of San Diego State University, and Dr. Robert Gregory of UCLA are coordinating the Biomechanics work.

On the equipment improvement project, IHPVA members Chester Kyle, Paul Van Valkenburgh, Paul MacCready, Allan Abbott, and Jack Lambie have met several times to discuss possible legal cycle design changes. So far wheels, helmets, and bicycle clothing have been tested in the CSULB and UC Irvine wind tunnels, and engineering prototypes of helmets, wheels, components and bicycle frames have been built and are being tested. In theory the new system should be faster, but it remains for comparative time trials and competition testing to prove this. Hopefully the bicycle and associated equipment items will pass the test of legality since many are radical departures from conventional racing equipment.

Companies such as Bell, Shimano, Campagnolo, and the Southland Corp have donated funds to support the cycling project which will continue until the Los Angeles Olympics in 1984.

How to Decrease the Aerodynamic Drag of Racing Bicycles

Since over 80% of the friction force against a bicycle in level motion is caused by air drag,

Please turn to Page 10

COMPETITION NEWS

COME TO THE 9th IHPSC AT INDY

When Ontario Motor Speedway closed in 1981, it became obvious that the IHPVA's annual Speed Championships would eventually have to leave Southern California to find a suitable home. It looks like 1983 is the year of transition.

Opening festivities for this year's event begin September 29 in Indianapolis, Indiana, hosted by the Indiana Chapter of the IHPVA. The main competition days are Friday, Sept. 30 and Saturday Oct. 1. Speed runs will take place early Saturday morning at Indianapolis Motor Speedway, the granddaddy of U.S. racetracks.

A search for a sponsor or sponsors continues. If anyone has contact with major corporations or ad agencies and could offer help, please contact Bill Bailey in Indianapolis (address below).

The IHPVA would like to thank member Dan Metz for his help in getting us into Indy. Metz was the advisor to HPV Team Phoenix at Cal Poly San Luis Obispo some years ago and is now on the rules committee at Indy.

Excitement in the Indy area is mounting steadily and the volunteer support in the Indiana Chapter is very impressive. With the Indy 500 over at the end of May, finalizing of arrangements of the 9th IHPSC will go into high gear.

Entry forms will be included in the August HPV News.

Any questions about the Championships, or offers of help, may be directed to Rob Cotter, VP-Land, 215 Knox St., Costa Mesa CA 92627; or, Bill Bailey, 340 Ripple Road, Indianapolis, Indiana, 46208.

HYDRO CHALLENGE, SEPTEMBER 4

In the spirit of the Gossamer Condor's figure-eight flight that won the first Kremer Prize, the Gossamer Albatross' English Channel crossing, the tandem Vector's 63 mph and the numerous HPVs to exceed 55 mph, the IHPVA's Water Division is pleased to announce the First Annual Hydro Challenge.

The purpose of the Challenge is to see if creative and unrestricted engineering can result in an HPV that is faster than the world-record-holding, eight-man shell that went 13.46 mph over 2000 meters, and/or more maneuverable than a white water kayak.

Tentative events include:

- 2000 meter long course
- 200 meter sprint
- 50 meter figure-eight race

The Craft: Any solely human-powered watercraft.

Date and Place: September 4, 1983, at Long Beach Marine Stadium, Long Beach, California. (A possibility exists of a simultaneous event in Schenectady, New York.)

Entry Fee: $25 per vehicle.

Rules: The watercraft must be powered by human muscle only. There is no limit to the number of crew members or method or propulsion. Oar-powered racing shells, pedal-powered craft, canoes, water walkers, kayaks and paddle wheelers are all welcome.

Classes are yet to be defined. The winners of each event will be determined purely on elapsed time with no consideration for type of vehicle or design.

In keeping with the spirit of IHPVA, there will be no stored energy allowed (the energy content of the craft at the start and finish lines must be equivalent), no wind aiding, no lighter-than-air gas, no fluids or other substances released by the craft to reduce drag.

For safety, each craft must have enough floatation (foam or sealed air bags) so that when fully swamped it will have positive 25 lbs buoyance. There must be on board a Coast Guard approved personal floatation device for each crew member. Additionally, all crew members must have the ability to exit the craft rapidly and safely, regardless of the craft's orientation in the water.

On issues of safety and compliance with the human-powered intent of the rules, the judgement of the IHPVA Hydro Challenge Race Committee will be final.

Events:

2000 meter long course: This event will be a timed race over a 2000 meter course, standing start.

200 meter sprint: This event will be a flying-start sprint through a 200 meter course to determine highest absolute velocity. To minimize effects of wind and current, two runs in opposite directions will be made within 20 minutes of each other and the times averaged.

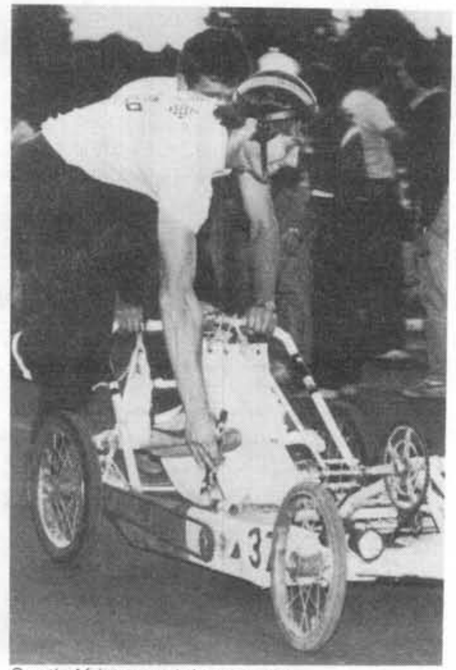
Slalom Course (tentative): This event will test maneuverability. It will be three laps around the figure-eight course.

More details and entry forms will be forthcoming. Volunteers anxious to assist in any areas in running the First Annual IHPVA Hydro Challenge write to

IHPVA Hydro Challenge,
1203 Yale Ave.,
Claremont, CA 91711

or call 714-987-8003.

Peter Boor
Vice President, Water
(With special thanks to David Ullman)



South African pedal car racers change riders six times per race.

SOUTH AFRICA HPV RACING

It was with great interest that my colleagues and I, read about the IHPVA in *Bicycling Magazine* and the *Readers Digest.*

Our University was one of the founder members of the *South African University Students Pedal Car Championships* which is a very similar organization to yours, the difference being that our races are a Grand Prix type race around fairly tight circuits as opposed to a sprint event on a straight track.

Our series is based on six hour endurance races around circuits that vary in length from 1,5 km (0,94 miles) to 2 km (1,25 miles) having steep uphills and downhills with bends of up to 360°. Each team has six drivers per car with a driver change after each completed circuit.

The restrictions on the shape or size of the car are as follows:

1. Height of seat above the ground = 650 mm maximum (25.6")
2. Track width of wheels = 1000 mm maximum (39.4")
3. Total width of car = 1150 mm maximum (45.3")
4. Wheel size = 650 mm maximum (26", to be practical)
5. Naturally no mechanical power units.

These cars have to be fairly robust as driver changes are none too gentle and hairpin bends taken at speed stress the frameworks to the limits. As a result of the interest shown by the students and the competitiveness of these races, the analysis of the frames has become more and more sophisticated with the result that the materials used in the construction of the frames have also become more exotic (i.e., Chromaloy, Titanium).

Mr. W.M.G. Burdzik
Dept. of Civil Engineering
University of Pretoria
PRETORIA 0002
South Africa

HUMAN POWER

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Richard L. Hargrave, *Editor and Art Director*
Chuck Champlin, *Managing Editor*
Yiorgos Naoum, *Photographer*
Tom Milkie, *Technical Editor*

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Until further notice, please address all correspondence relating to this publication c/o Chuck Champlin, 2614 Halm Ave., Los Angeles, CA 90034 USA. Communications to specific staff or officers will be forwarded.

IHPVA NEWS

A WORD FROM THE PRESIDENT

It is with great pride (and relief) that we present another edition of Human Power magazine. We hope you enjoy it.

The momentum of the IHPVA has never been greater than it is now, and I'm truly proud and excited to be part of the HPV revolution.

This year is packed with important events. Already we've held a race in Carson, California: the Carson Human Powered Speed Challenge (article on Page 9) where the Easy Racer missed breaking the 4000 meter individual pursuit record set by the Vector last October by barely a tenth of a second.

The American Society of Mechanical Engineers (ASME) entered the HPV world in a big way with a race held May 21 and 22 in Davis California. The June HPV News will contain a full report.

Our Hydro Challenge is finally going to happen this year. Allan Abbott is organizing the second HPV Scientific Symposium for October 22 in Long Beach. And, the Speed Championships are moving to Indianapolis this year, finding a good home at last with enthusiastic and highly qualified organizers.

Here at IHPVA headquarters, the officers and I have been working in close cooperation on a four-part campaign to strengthen and expand the association.

1. *Increasing awareness about the organization, and increasing membership.*

There is an ever growing interest in the HPV movement and opportunities for expansion of the IHPVA are fantastic. Tell your friends about us. If you are interviewed on TV or in the press, try to mention our name and the city: Los Angeles or Seal Beach. We finally have a number in the phone book. It's 213-204-2424.

Increasing membership is the best way for us to offer races and other activities for members. Any way you can spread the word will be appreciated.

2. *Holding more races and other events.*

The reason we exist, after all, is to allow vehicle builders to show and race their creations in a controlled setting with timing and safety assistance.

3. *Moving boldly into water-vehicle championships.*

Vice President for water, Peter Boor, is organizing the first Hydro Championships, to be held at Marine Stadium in Long Beach, California Sept. 4. We feel this is a major step for the IHPVA, to broaden its appeal. So get to work on those vehicles (and see Peter Boor's message about the race in this issue).

4. *Firming up production of IHPVA publications.*

We have committed to sending you an HPV News or Human Power every month, to keep you up on events and design ideas. Of course we welcome any and all information and articles.

Finally, I'd like to second the thoughts expressed by Lynn Tobias last spring. The IHPVA is truly a human-powered organization, with annual energy expenditures running into the thousands of Humes. (A hume is the energy spent on a volunteer basis by one person in one hour.)

The volunteers at headquarters love their work with the association, but it often cuts into their real work time and time with their families, sparking problems in both areas.

May I urge you to make the headaches worth it. Stay in touch with letters or calls. Let us know what you would like to see happening and where the association should go. But most of all, think of ways you might help.

Anything you do will be greatly appreciated.

Personally, I would like to hear from anyone who has a thought, a gripe or a due bill (just kidding on that one). Feel free to write me at 2614 Halm Ave., Los Angeles CA 90034. I'd like to help make your organization more of what you had in mind.

Chuck Champlin
President, IHPVA

GOODBYE, MR. PRES., HELLO, VP-AIR

The past year has seen the beginnings of many new areas of growth for the IHPVA. Not only has the membership doubled (about 975 members now), but the number of members who are actively participating in the functions of the Association has increased dramatically. This includes members forming local chapters in their areas, working to develop new race locations such as Indianapolis, and those in Southern California who are involved in the administration and publications of the IHPVA. With this help we can provide more and better competitions and keep you better informed with more frequent issues of 'HUMAN POWER' and more up to date through the 'IHPVA NEWSLETTER'. But there are some other 'mores' that the IHPVA needs; they are more input, more feedback and more involvement from YOU, the members who ARE the IHPVA. Without the efforts of a great many of its members, a volunteer organization such as ours will never reach its full potential.

Here are some areas that need the most help: more local chapters; more races and the establishment of better sites for record attempts; more articles of all sorts for publication in 'HUMAN POWER', especially technical articles on design and construction of vehicles; seeking and acquiring financial support and sponsors for the IHPVA and for races; and the development of better member services such as sources of information or materials, donation or discounts on components, or finding out who in your area is doing what.

AND NOW A WORD FROM THE NEW V.P. – AIR

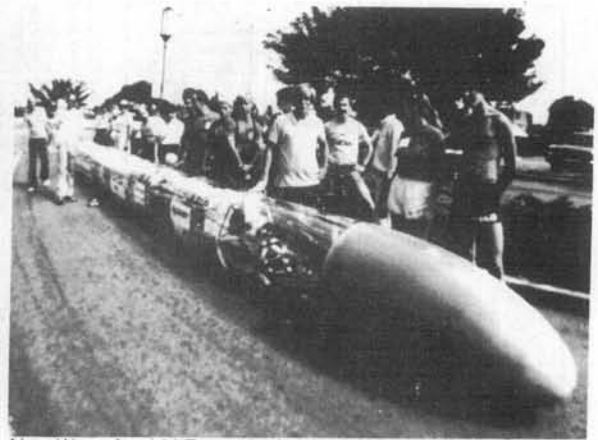
You haven't seen much about human powered air vehicle activities in the past and I can't guarantee that this situation will be radically altered. Nevertheless, I would like to hear from anyone and everyone who knows of any human powered air vehicle activities anywhere!! I know Paul MacCready has spoken of a competition for aircraft powered by animals (other than humanoids) in which flying animals would be restricted from employing their normal mode of flight. There are also awards offered for human powered flight in England and for helicopter flight. If you know of others or have details on these competitions, drop me a line.

I would like to see more activity stimulated by the IHPVA. Some practical possibilities include; a design competition (on paper which would hopefully lead to construction); scale-model competition; human propelled lighter-than-air vehicle competition; or perhaps a ground-effects competition. Again, if you have any comments, please write.

Lynn John Tobias,
6372 Alexandria Dr.,
Huntington Beach, CA
92647

Yiorgos Naoum photos

Bluebell and the Vector dominated the races.

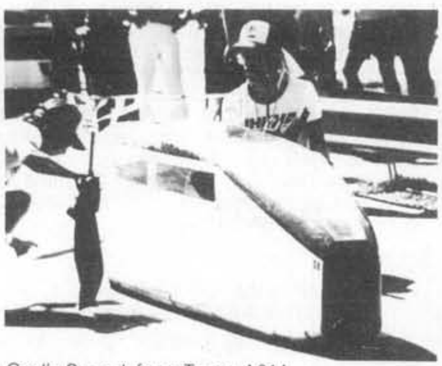


New Wave from MIT was the largest vehicle yet.

Easy Bus, from Danny Pavish.

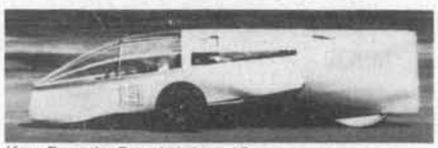
Tensor from Northeastern was plagued by difficulties.

White Lightning, No. 8.

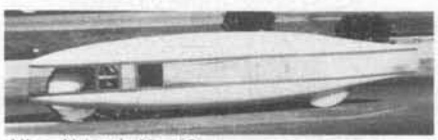


God's Speed, from Texas A&M.

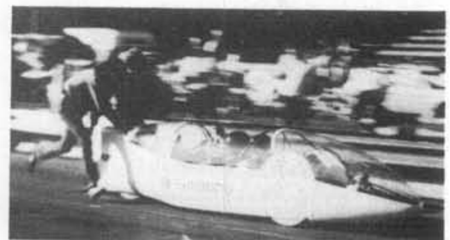
Steve Blair's Phoenix, No. 42.



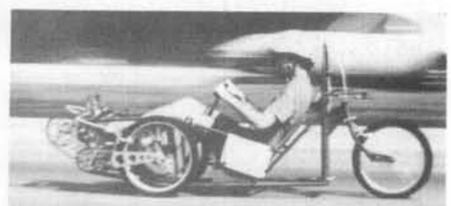
Ken Brant's Gemini, No. 19.



Allan Abbott's No. 10.



Vector Tandem, off to a good start.



No. 37 from Karl Payne.

CHAMPIONSHIPS

From Page 1

Also held on the Saturday were the First Annual Human Powered Quarter Mile Drag Races, organized by Doug Malewicki, using the OCIR Christmas Tree starting lights and the drag strip. The event was quite popular with the crowd, which was invited to participate. First place went to White Lightning which reached 43.60 after the quarter-mile acceleration.

Probably the most important event of the Saturday was the Practical Vehicle Competition, designed by Allan Abbott to promote more street-usable vehicles, since the speed sprints were being dominated by super streamliners that can barely deviate from a straight line. Abbott describes the results in this issue of Human Power.

Sunday, the crowds and competitors moved 25 miles up the San Diego freeway to Carson, California, where a 1.8-mile stretch of Del Amo Blvd. was closed from 4:30 to 11:00 a.m. The event was a 200 meter sprint with unlimited run-up (actually about one mile).

The IHPVA had never gone to city streets for a long run up event before, and this one presented some problems that later planners will have to solve. The main one was getting vehicles to the starting line on trucks, of which there were not enough.

But generally, the entrants seemed to like the course. The teams with large multiple vehicles wished it were longer, while some of the single-vehicle riders got tired before they reached the traps.

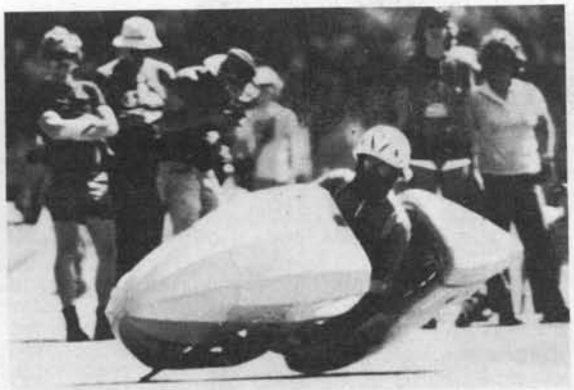
The only disappointment was that no one approached the land speed record of 62.92 mph set by the Vector Tandem at Ontario Motor Speedway in 1980. Some attributed this to the slight curve that the vehicles had to negotiate just after the traps, which might have created a psychological barrier. Others pointed out that the slight downhill slope didn't begin to equal the one at Ontario, though both courses were within the 2/3rds of one percent grade required by the IHPVA rules.

If the 8th Speed Championships showed one thing, it's that there is still lots of life and surprise left in HPV design and competition. Just when it looked like the bicycle was dead and the three-wheelers were taking over for good, along came Bluebell, a production Avatar 2000 recumbent with full fairing, to win the top speed for singles. And there was the production-model Easy Racer with (full) fairing winning the road race.

And this was the year of the behemoths. From MIT came New Wave, a five-man, 40-foot rocket, complete with yellow/red nosecone, that its designer, Bruno Mombrinie thought would go 70 mph. Chains slipped off the gear clusters, however, which limited it to 43 mph on Del Amo. The four-rider Tensor from Northeastern University, which looked like a big red cigar on stilt wheels, had *real* drive train and steering problems. It never got going at all at OCIR and only ran once on Del Amo Blvd – 11.11 mph.

Both Mombrinie and the Northeastern

The Land Scull, No. 7.



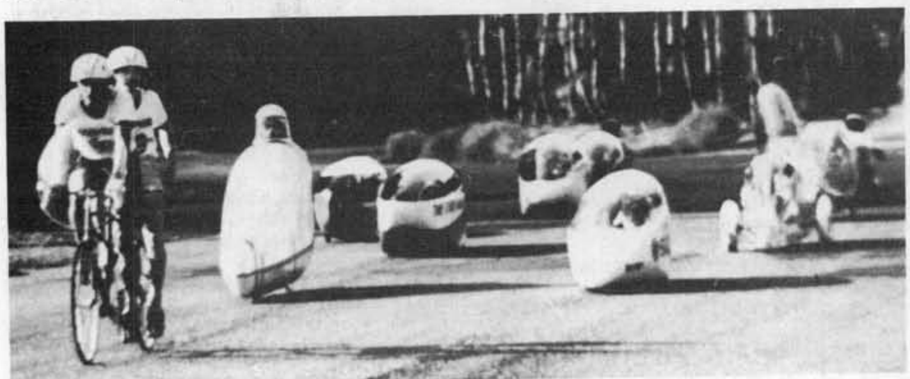
Tim Brummer's No. 49, down in a turn.

Scalar from UC Davis, No. 44.

Ready. Set . . .

Fred Tatch's ManUped tandem.

Tom Rightmyer's No. 21.



Easy Racer took first place in the paced-start road race.

team insist they have only begun to fight, and plan to run again. Human Power will feature profiles of these two teams and their vehicles in its next issue.

Propulsion innovation also continued unchecked. From Ross Designs came the Land Scull, a nicely finished hand-and-foot-powered vehicle that used a rowing type motion. Steering was by a twist of the wrist. And Fred Tatch's Manuped was back as a tandem with a lever-drive rear end. Aerodynamically, Bluebell showed that possibilities with fairings beyond low-slung bullets are far from exhausted.

Interest in building better vehicles and better machinery to go in them continues unabated. It seems there will never be a shortage of new invention and new entries for the Championships.

But every year there is the hope that the Championships will draw huge throngs to gasp at the technical marvels. Again this year, that didn't happen. There was the usual polite gathering of the curious.

Clues that there is drama lying dormant in HPV racing could be heard at the weekend's closing events at the Cal State Dominguez Hills Velodrome. There the onlookers cheered as they also cheered the Saturday road races at OCIR. They were still contests of machines, but the crowd was picking favorites, because the human element was important, too.

The Sunday afternoon event was 4000 meter pursuit races. Bluebell, ridden by Tim Gartside, placed fourth at 4 minutes, 38.41 seconds. Third came Mark Whitehead in the Red Vector at 4 minutes, 13.77 seconds. Second, the Easy Racer with Greg Miller riding at 4 minutes, 5.76 seconds. And first was Kevin Lutz in the White Vector, 4 minutes, 5.14 seconds, barely half a second ahead of the Easy Racer.

That close finish itself was dramatic. And the times themselves were amazing. Lutz beat the best pursuit team time by 12 seconds and the best single track rider time by 50 seconds.

The IHPVA exists primarily because of the engineering challenge in designing more efficient vehicles. But the crowds seem to like events that bring out the "H" in HPV.

RESULTS

OCIR 200/600 Meter Sprint
October 2, 1982
Single Rider Vehicles

No	Vehicle, Team	Speed (MPH)
24	VECTOR WH SHIMANO, Versatron	48.84
84	BLUEBELL, Nosey Ferret	47.95
28	VECTOR RED HUFFY, Versatron	47.72
31	EASY RACER, Gardner Martin	44.80
74	DRAGONFLY II, Steve Ball	44.60
23	THE OTHER WOMAN, Kirk Newell	42.94
42	PHOENIX SINGLE, Steven Blair	42.01
34	GOD'S SPEED,Texas A & M	41.95
85	NUMBER 85, Dan Egger	41.73
10	THE ABBOTT, Alan Abbot	40.67
27	ROC'S ROCK-IT, Roc Fleishman	39.90
3	RED SHIFT II, Tom Milkie	38.09
49	Tim Brummer	36.54
21	Tom Rightmyer	34.28
19	GEMINI, Ken Brant	34.27
32	AEROCOUPE, Mark Murphy	33.73
60	AEROCOUPE, Jeff Wills	32.84
1	Chester Kyle	31.32
43	SL PLATING SPECIAL,Mike Spangler	30.68
7	LAND SCULL, Ross Bicycles	30.22
38	NYAB, Carson Noel	22.31

Multiple Rider Vehicles

No	Vehicle, Team	Speed (MPH)
8	WHITE LIGHTNING, Chris Dreike	50.58
29	VECTOR TANDEM, Versatron	50.55
44	SCALAR, UC Davis	42.45
25	NEW WAVE (MIT), Bruno Mombrinie	42.28
68	MANUPED TRAVELER, Fred Tatch	34.85
50	TENSOR, Northeastern University	32.93
88	EASY BUS, Dan Pavish	31.83
91	EARTH ANGEL, Mickey Marlar	28.47

CARSON Speed Trials
October 3, 1982
Single Rider Vehicles

No	Vehicle, Team	Speed (MPH)
84	BLUEBELL, Nosey Ferret	51.92
24	VECTOR WH SHIMANO, Versatron	51.84
28	VECTOR RED HUFFY, Versatron	50.89
10	THE ABBOTT, Allan Abbot	50.44
31	EASY RACER, Gardner Martin	49.52
74	DRAGONFLY II, Steve Ball	48.77
34	GOD'S SPEED,Texas A & M	46.35
23	THE OTHER WOMAN, Kirk Newell	46.35
42	PHOENIX SINGLE, Steven Blair	45.75
36	BLACKBURN, Jim Gentes	44.34
27	ROC'S ROCK-IT, Roc Fleishman	39.25
21	Tom Rightmyer	38.69
3	RED SHIFT II, Tom Milkie	34.87
7	LAND SCULL, Ross Bicycles	33.95
60	AEROCOUPE, Jeff Wills	33.49
43	SL PLATING SPECIAL,Mike Spangler	33.06
19	GEMINI, Ken Brant	30.70
32	AEROCOUPE, Mark Murphy	26.82
37	Karl Payne	21.71

Multiple Rider Vehicles

No	Vehicle, Team	Speed (MPH)
29	VECTOR TANDEM, Versatron	57.90
8	WHITE LIGHTNING, Chris Dreike	52.08
25	NEW WAVE (MIT), Bruno Mombrinie	48.93
44	SCALAR, UC Davis	44.60
50	TENSOR, Northeastern University	11.11

TO BLUEBELL GO THE SPOILS THIS TIME

A playful "Get Vector" sentiment has been growing in strength over the past few years as the Versatron vehicles have won one event after another, so it's no wonder that the scrappy team behind Bluebell so tickled the crowds at OCIR and Carson. They got Vector, beating it 51.919 mph to 51.84 on the Carson course.

Rider Tim Gartside wrote the following article for the International Cycling Guide just after his return to England last October. The Guide has graciously permitted us to reprint the article, which nicely shows where some good-natured determination can get you. Gartside, an Australian lawyer, ran a pedal-powered rickshaw service around London with his friend, teacher Melanie Ward, before being swept into HPVs.

Del Amo Boulevard, Carson, California, 8a.m., Sunday, 3rd October, '82. "Rider ready?" A few deep breaths and then an affirmative grunt. "It's all yours. Take it away!. . ." Hermetically sealed and pushing hard in a lowest gear of 108 inches I take off in the Nosey Ferret Racing Team entry, Bluebell, down the long, flat boulevard.

Only three months earlier, in late June, I had been sitting comfortably, an absolute HPV virgin, in Richard Ballantine's office discussing a project for his magazine, Bicycle. There was a lull in the conversation. Richard rolled his not inconsiderable weight back into the chair, flexed his bushy eyebrows in my general direction and said "Melanie's probably a pretty strong rider, isn't she?" And indeed, Mel, my partner in the Rickshaw Roadshow is a very strong rider.

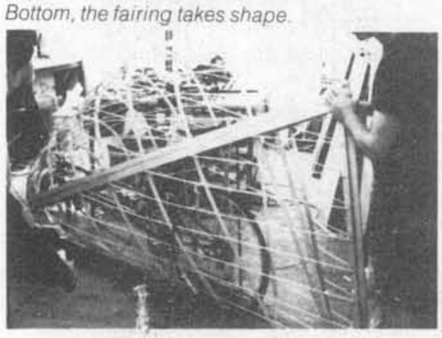
The story began to unfold. Richard had a semi-recumbent bike, an Avatar 2000. Derek Henden, Bike-Hod person and cycling fetishist, was prepared to build an aerodynamic fairing for the Avatar. The deal was Derek would build the fairing if Richard would find a rider for the HPV championships in late August at Brighton and Brands Hatch. Richard thought Mel, at 126 lbs, would have a very good power-to-weight ratio for tackling the steep climbs on the Brands Hatch circuit.

A couple of days later Mel and I were down at Regent's Part with Richard, learning to ride the Avatar. We mastered it in reasonable time and took our new toy home to North London. Our idea was that we would start training at the Eastway Cycle Circuit. I contacted Les Jordan, manager of the circuit and a respected BCF Coaching Scheme coach. Les suggested a program of interval and circuit weight training.

We were fully equipped to begin training: The "Bluebell" test combined with our vast racing experience (Mel had never ridden a cycle race in her life and I had ridden in two time trials in the Middle East on the way out to India in the winter of '81/'82). What was supposedly a casual interest had begun. It was to be an extraordinary three months.

The first fairing was an absolute work of art, beautifully constructed by Derek and his assistant, Matt. I was the first to test it out at Eastway. When the lid was put on I suffered an intense bout of fairing phobia. The world certainly took on a different perspective inside there. Visibility was through a narrow section of opaque film, slightly better than looking through a clogged tea strainer. It didn't help much because peripheral vision is quite critical in balancing a two-wheeled vehicle and keeping it upright.

The fairing was slightly too wide at the bows and touched going hard around one of the corners at Eastway. The front wheel lifted instantly and the whole kit and caboodle slid along the track at 35 m.p.h.-plus, which would have been reasonably dandy in a fiberglass fairing similar to the Vector's. Our's was a fragile plywood and ramin construction covered in Solar Film (you wouldn't be sprinting to leap into it if a nuclear blast were imminent). Anyway, I came out of it reasonably unscathed frothing about what a marvelous line I'd taken through the corner and yes, it was quite tight, but if the fairing hadn't grounded . . .



Top, Tim Gartside and Bluebell.
Bottom, the fairing takes shape.

Before the crash I did enough riding to get the taste of it. It was exciting. There was a startling difference between riding the bike without and then with the fairing. With the fairing it was no problem to idle along at 20 m.p.h. It was as though a whole barrier had been removed as indeed it had. The vehicle really slid easily through the air.

It was back to the drawing board for Derek and Matt. The second fairing was to be narrower at the front and have more vision. In conjunction with the building of the fairing we were trying to sort out things on the machine itself like tires and gearing. After a series of developments with gearing we ended up with a 12 gear cross-over drive configuration. The final drive is a conventional 52-42 with the freewheel ratios depending on the type of event. The primary drive is a 60-tooth ring back to a 30 TA ring from a tandem cross-over drive. This yields a top gear in the vicinity of 216 inches!

The second fairing was ready only a few days before the British championships. Fortunately it survived unscathed another trial at Eastway. We headed down to Brighton with really no idea of how we would go. We hadn't had the opportunity to trial the vehicle on a straight section of road, so the sprint at Brighton was an unknown quantity. Also we didn't have any idea of how we would go in the road race at Brands Hatch on the Sunday.

At Brighton, it was decided I would ride the vehicle, which had been christened 'Bluebell', as I had demonstrated an ability to go quite fast along the short straight at Eastway. My best speed for the day was 46.05 m.p.h. which put us third behind the Vector at 48.01 and Poppy Flyer, 47.31 m.p.h. A very pleasing result which had us looking forward to Brands Hatch the following day.

Brands Hatch is easily summed up: frighteningly close. I passed the Vector on the sixth lap after being well behind at the Le Mans start, only to have one of the rear cantilever brake blocks twist and cause the rear tire to blow out.

That could have been the end of the Ferrets. It had been a grand weekend but really there was nothing definite on the horizon. Despite that, Richard, Derek and I all went away thinking the team had something very special to offer and that we ought to continue. Where? There was talk of an event in California in early October, barely six weeks away; It did seem farcical to suggest competing in the American event. Nevertheless we developed a contingency plan. We would make an attempt to break 50 m.p.h. which would be a British record. And then seek sponsorship to compete in Los Angeles.

With the cooperation of Peter Selby, the organizer of the British Championships, we arranged to go out to Greenham Common Air Base, on a Saturday in the middle of September. We would make the attempts on the main runway. Unfortunately, after we arrived at the base, it took me some time to settle down into the mental equilibrium required, by which time the breeze had sprung up well beyond the 6 k.p.h. restriction for an official record. The wind didn't settle down for the rest of the day. The weather forecast was worse for the Sunday. Best recorded speed was 47.3 m.p.h. We went back to London disappointed, but much the wiser.

Despite the Greenham Common result we launched a last minute desperate drive to go to California. We couldn't get anyone to rise to the bait. On the Wednesday morning, a bare two days before the competition was due to begin, we realized we'd done our absolute best and that we'd just have to resign ourselves to the fact that we weren't going. But as the day drew on it just didn't seem an acceptable decision. I got together with Richard in the afternoon and said, "F- - - - it! Let's buy a ticket on overdraft," so that's what we did.

We fronted to the airport on Thursday morning, went to cargo where they told us the bike and spare fairing would cost "thousands." After some reasonably swift talking, the cargo people became infused with enthusiasm and decided it would be a good idea if the team from Britain could get to the States. We were two hours past deadline but they got our stuff on as accompanied baggage.

Derek and another member of the team, Linda Allman, had used their savings to fly out to visit a few friends, have a holiday and see the event anyway. So we had a skeleton team of three. They worked till 4 on Saturday morning making final preparations to the equipment.

There were four events over the weekend. A short run up 600/200 meter sprint (similar to the sprint at Brighton) on the Saturday morning and a road race in the afternoon. A long run up 2,000/200 meter sprint on Sunday morning and pursuit racing on the Olympic track in the afternoon.

We placed second to the white Vector on Saturday morning with 47.96 to 48.8. People began to notice the outrageously underprepared

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THE HISTORY OF AN HPV: EASY RACER

Gardner Martin has done by far the best at combining a race-winning vehicle with a sellable one. This year's HPSC entry, the Easy Racer, was one of his stock recumbent bicycles with a full fairing on it. The vehicle not only won the road race just ahead of the Vector and not only went 49.52 on Del Amo Boulevard, but, sans fairing, won the Practical Vehicle Competition as well. No wonder he's been able to sell hundreds from his headquarters in Watsonville, California.

He claims to not be a writer, but we had no trouble with his history of the Easy Racer.

Easy Racer sprang from a modified tandem bike.

In 1975, I entered a prone recumbent in the first HPV speed meet at Irwindale Raceway. Although prone recumbents showed potential for speed, we saw that the laid back, supine recumbents had possibilities for street use, with a comfortable riding position.

My wife, Sandra Sims Martin, wanted me to build her a practical recumbent for street use. With my experience building race cars and motorcycles and my abilities as an artist, I thought I should be able to design it on paper. However, months went by with no suitable results, until one day in the fall of 1975. I was on an old tandem bicycle when inspiration hit me.

Since the tandem bike had a lady's-style frame in the rear, I figured I could sit down on the frame tubing, stretch my feet forward and pedal on the front set of pedals. I told my buddy to lift his feet up and without stopping I got off the regular seat, sat on the frame and then moved my feet to his pedals. It worked.

So we hurried home, hacksawed off the front rider's seatpost, installed a laid-back Stingray handlebar so the rear-seated rider could steer. We then wrapped the seat area on the frame with partially inflated innertubes. Voila! Instant recumbent. We had a workable machine after less than an hour, and that may be a record for building time.

In early 1976, we met Nathan Dean, an avid bicyclist who volunteered to ride our new Easy Racer in the upcoming Speed Championships. We didn't have time to build any streamlining and were not competing with the fully streamlined bikes. However, we did have by far the most comfortable and practical vehicle at the event.

Over the next two years, we built six more Easy Racer supine recumbents, changing and improving each one as we went. We put thousands of miles on them and proved to ourselves that we had a better bicycle. We knew we would never go back to the old style.

In 1978, we got two top bicycle racers from Northern California to ride our streamliners in the Speed Championships at Ontario. Kurt Miller won the first IHPVA road race on a streamlined Easy Racer. Kurt also did well in the other events, placing 2nd in the hour and 4th in the speed sprints at 45 mph. Our streamlining was rough with lots of night-before cardboard fixits.

Our best effort went to streamlining the prone recumbent which Fred Markham rode to second place in the speed attempts, 46.75 mph. With some refinements to the streamlining on the prone bike for the next year's race, Fred won the speed event and was the first single human to break 50 mph. He pushed it to 50.84 mph, which was the record for a bicycle until this year and Bluebell.

Meanwhile, the supine Easy Racer, now affectionately called Orca because of its black and white killer whale body, had to sit out the speed runs because we couldn't get a rider lined up.

But there was another Easy Racer entered in the 1979 speed events. The previous year, Danny Pavish, an aerodynamics engineer at McDonnell-Douglas became our first customer when he bought a bike for touring. But the racing bug soon bit and with help from his friends and co-workers Lynn Tobias and Stu Huston, he designed a new, high-tech fairing for the Easy Racer. Many changes and improvements were made to the body, now called the Land Shark, but they added a lot of weight. Danny planned to make molds to cut the weight down from

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BLUEBELL

From Page 6

British team. They were going fast. They were worth following.

The road race brought another crash, while in second place behind Team Phoenix. We still had a lot to learn about the handling limits of our machine. Nevertheless we went to bed on Saturday night very pleased with ourselves.

On Saturday morning we arrived at Del Amo Boulevard early. I rode quitely up and down the mile long course on my bike, as Derek prepared Bluebell. Eventually the officials and the timers were ready and the runs began. After the experience at Greenham Common I had a reasonably clear idea of how I would approach the event.

In my first run I had built a good speed base by the half mile mark. I went hard from 400 meters, panicked that I might not be able to sustain it, eased and went again from 250 meters . . . 49.6 m.p.h. A pretty useful start.

We went straight back to the top of the course to get in the queue for another run. There was quite a delay as 20 or so competitors were trying to squeeze in as many runs as possible before the road re-opened at midday. Chester Kyle, the founder of the IHPVA, wandered up to me in the staging area, congratulated me on the first run and with a twinkle in his eye, mentioned that the fastest speed for a two-wheeled vehicle was 50.84 m.p.h. I was acutely aware of that barrier. One of the team fantasies was that we would topple the record speed.

I was nervous. I had dearly wanted to break the 50 m.p.h. in the first run. It was the barrier that had baulked us so badly at Greenham Common.

My second run was coming up. I began the ritual. A nervous wizz across the road, return to the vehicle now only two or three back from the start line, Skid Lid on, then the elbow pads, mitts and finally the racing shoes. I am not used to racing shoes and find the pair I have a bit uncomfortable; so they were the last thing to go on. Laced up tight so as not to sacrifice any power.

Into the machine, cleats in the pedals, toe straps up tight, into the shoulder harness and then the top of the fairing is closed over you and you are into your own space. The vehicle is wheeled up to the starting position.

"Rider ready?" I bark "No!" I want a few seconds to take four or five deep breaths. Then I indiate that I am ready. As ready as I'll ever be. Derek steadies me as I take off; not always a straightforward operation in a gear of 108". I get underway easily, trying for a smooth power input, working hard aerobically without prejudicing the final anaerobic burst.

Shift down through three gears on the freewheel, off the starting sprocket of 28 to 19, 17, 15, onto the big ring, the half mile sign is in view. Two gears left. Important to be settled into the top gear and steady before the half-mile sign – Snick into 14 and then into the final 13 sprocket. Start building up before the sign indicating 400 meters to the beginning of the traps – Absolute effort from 350 meters – 300 meters. Negotiate the slight bend in the road. 200 meters. The traps clearly in view. 100 meters – Still trying to accelerate, lungs beginning to scream, only four or five seconds and then into the critical, timed 200 meters. Aim to peak about 500 meters through and just hang on – The road is thick either side with people cheering madly. They really do just seem a blur. The finish banner. The run is over. It's a good one, certainly faster than the first.

I make a conscious effort to brake before the netting which is strung across the boulevard to prevent vehicles careering into an open intersection a bit further down the road. Earlier in the morning, Allan Abbott had

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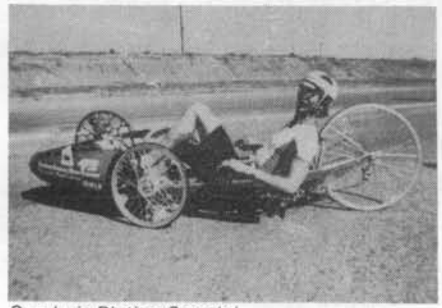
Yiorgos Naoum photos

Tour Easy recumbent.

PRACTICAL VEHICLES AT LAST!

By Allan Abbott



San Luis Plating Special.

Aerocoupe Cyclecar.

After seven years of Human Powered Vehicle races there were increasing concerns that the race-winning vehicles continued to be quite impractical. At the 8th IHPVA Speed Championships, Allan Abbott organized a new competitive event which was not a race; it was a judging of the most practical human powered vehicles. The rules were purposely kept simple and the judges were selected to represent an informed marketplace. They included a mechanical engineer (IHPVA founder Chet Kyle), a seasoned bicycle racer (Ron Skarin), and an experienced bicycle-riding grandmother (Mrs. Jean Boor).

The judges each rode the vehicles on a winding parking lot course and on a straight speed course. They completed scoring sheets on each entry and scored the following categories: comfort, safety and stability, speed, ease of entry and exit, ventilation and weather protection, and utility and ability to carry light cargo. In each category the judges were instructed to select a number from 1 to 10, with 5 being consistent with a conventional bicycle. Finally, the scores in all categories were added together for each vehicle and the highest overall score was the winner.

Under these rules, five vehicles were judged superior to a conventional bicycle for practical everyday use. These five are listed below according to their relative scores, and it should be noted that the scores were extremely close. There were 15 entries which included supine recumbent bicycles, supine recumbent tricycles and one modified standard bicycle. Several of the recumbent bicycles suffered from stability problems, and although there were no crashes, the judges had a few scares and scored them poorly. In each case the owner was well practiced and could ride the bike well, but the judges said "if it feels that unstable, no one is going to buy it".

First Place:

The "Tour-Easy" is a supine recumbent bicycle designed and built by Gardner & Sandra Martin, 2891 Freedom Blvd., Watsonville, CA 95076. Gardner has developed and refined this design over several years and now offers it for sale at $795. It is hand-built of 4130 Chromoly tubing and weighs 27 pounds. It comes fitted with a Zzipper fairing. The judges gave it particularly high marks on speed, appearance, safety and stability. It was rated better than a conventional bicycle in all categories except in ventilation and weather protection, and in that category it was given marks equal to a standard bicycle.

Second Place:

A new production prototype tricycle was entered by Aerocoupe Cyclecars, 537 S. Raymond St., Pasadena, CA 91106. Aerocoupe is now offering the vehicle for sale for $750 in kit form. Our grandmother judge rated this entry highest. It has two steering wheels forward and the single driving wheel behind the rider. This configuration is much like the Vector except that the front wheels are placed much wider apart, thus giving it stability to please a grandmother. The judges liked its parking brakes and gave it top marks for ease of entry and exit and stability – they seemed to love high-speed "drifting" through corners. Despite its extremely low profile and its width which would seem to make this tricycle relatively unsafe in automobile traffic, our judges scored the Aerocoupe second.

Third Place:

A sophisticated new tricycle with a configuration like the Aerocoupe was ranked a close third. This immaculate front and rear steering trike was entered by San Luis Plating, 111 Higuera, San Luis Obispo, CA. In machine work alone, it looked to be well worth its estimated $2500 value. It received good marks in appearance and stability. It was not fully set up for street use and lacked some maneuverability, but the concept showed promise.

Fourth Place:

Another recumbent bicycle, "Infinity," was ranked fourth. This bicycle utilizes cable steering linkages with handlebars beneath the seat. The judges agreed on its comfort and good appearance, but they disagreed on its stability. The judges were unfamiliar with all of these machines and the Infinity apparently takes more getting used to than the Tour-Easy. This square-tube bicycle is similar in design to the Avatar. The Avatar was unfortunately not entered in this judging, but equipped with a full fairing set a new record in the top speed event. The Infinity is made by Ace Tool and Engineering Co., 292 W. Harrison St., Mooresville, IN. 46158. Its price is between $700 and $1000.

Fifth Place:

Next came a modified conventional racing bicycle from Zzip Designs, Glen Brown, 458 Thayer Road, Santa Cruz, CA 95060. It is equipped with a Zzipper fairing to which is attached a cloth "girdle" which fits around the rider's hips to reduce wind drag between the fairing and the rider. The bike has already proven itself for long-distance speed having been ridden down the California coast in record time. It rated especially well in speed and was criticized only on ease of entry and exit.

Hopefully next year the judges will get a chance at more new designs and designs already proven. The competition rules will remain essentially unchanged except that two additional judged categories will be considered; safety in traffic and cost. Some of the entries might have rated better with partial fairings and with better provisions for carrying light cargo.

One of the original goals of the IHPVA was to encourage the development of a practical, improved alternative to the conventional bicycle. It seems that giant steps have already been taken in this direction and that interest in these designs is mounting. The practical vehicle judging is here to stay and will be a part of every IHPVA Championship event in the future.

EASY RACER

From Page 7

75 pounds, but before he did, the bike crashed into a curb during a race, badly damaging the bondo-and-fiberglass shell.

For the 1982 Championships at OCIR and Carson, a new streamlined body based on the old Land Shark was built. Nathan, Alan and I ressurected the damaged Land Shark fairing and spent several hundred hours and a dozen gallons of Bondo body filler repairing, smoothing and refinishing it.

We decided to change the body design so that the rider's head stuck out the top, covered by a separate streamlined headpiece. We also changed the open, flat bottom to a closed rounded one, which allowed the bike to lean into corners without scraping and kept the airstream flowing smoothly underneath.

We used a production model Tour Easy inside, the only modifications being higher gears (68-12) and narrower handlebars. We were more interested in road racing than top speed.

With Greg Miller's riding skill we got a win in the road race, and placed sixth in the sprints at 49.52 mph, 2 mph off the winning speed for single vehicles.

Another good event for us in 1982 was the 4000 meter pursuit races on the banked Velodrome at Cal State Dominguez Hills, which we almost won. We were beat by the White Vector on the last lap by 6/10ths of a second.

Allan Abbott's Practical Vehicle Competition was important to us and to win with our standard Tour Easy was particularly gratifying since we feel this part of human-powered vehicle development is probably more important than the speeds achieved with super streamlining.

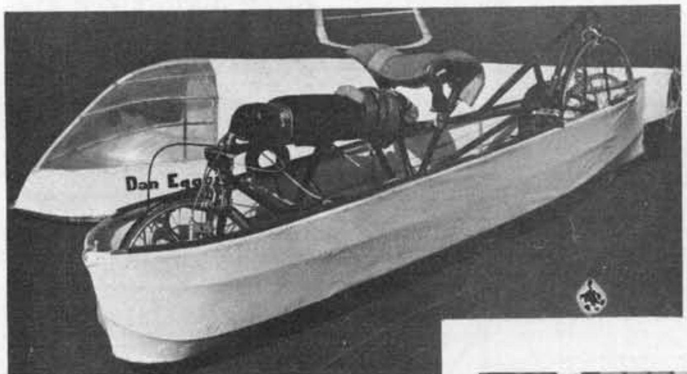
In the past three years we have seen steadily increasing sales and we think the bicycle market will slowly switch to recumbents. In order to help IHPVA members get into recumbent riding, we will offer a discount of $5 off on plans – regularly $25 – and 5% off on complete bikes and parts.

Future Easy Racers? We are currently testing two versions of a tandem recumbent bicycle and plan to offer tandems for sale soon. We are also working up a design for a lightweight, streamlined body and tour pack to fit our standard Tour Easy and homebuilt Easy Racers, to use on the street. This should increase efficiency and weather protection. And, we're testing ultra-light aluminum frames.

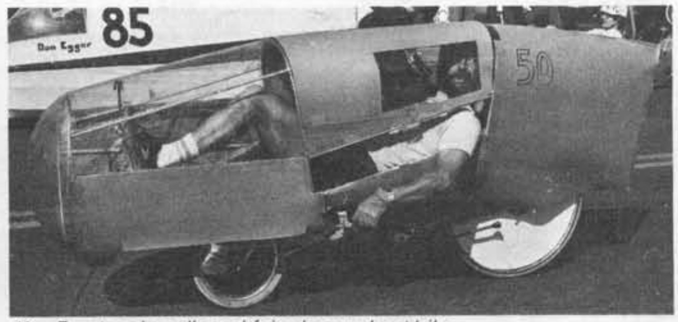
Chuck Champlin photos

Greg Johnson took first easily on Quantum Cruiser in Carson.

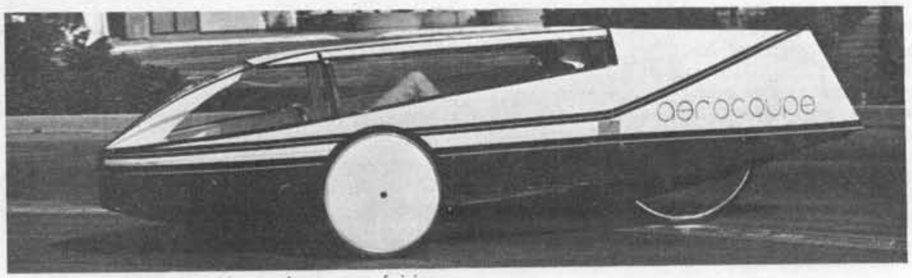
Alan Osterbauer, 3rd on Easy Racer.



Dan Egger's prone bike, No. 85.



Ken Brant and cardboard-faired recumbent bike.



Aerocoupe Cyclecar with new foam-core fairing.

CARSON SPEED CHALLENGE

By Chuck Champlin

The speed runs went so well in Carson last fall that we decided to hold some races there April 30, especially since Cal State Dominquez Hills invited us to race in the nearby Velodrome that day as part of the college's open house.

Opening the day's events was a 15-mile road race, 30 laps on a half-mile course at the Carson Mall parking lot, laid out with traffic cones and flags. McDonald's co-sponsored the event (hamburger powered vehicles?) with prizes donated by the Broadway ($100 gift certificate) and J.C. Penney ($35 and $65).

It rained all week before the event, which kep a lot of spectators home, but it cleared at the last minute; planners and entrants breathed a sigh of relief.

Tom Rightmyer brought his aluminum monocoque tricycle, ridden by Tom Kessler. Mark Murphy and Jeff Wills of Pasadena brought two Aerocoupe Cyclecars (one with a new complete fairing). Gardner Martin entered his faired Easy Racer, but decided not to run in the road race because rider Fred Markham had not ridden the machine before that morning.

San Diego was well represented by Greg Johnson (Quantum Cruiser) and Dan Egger's Number 85, both prone bicycles. Kirk Newell brought The Other Woman, a Vector-like tricycle that uses a sailplane canopy for its windshield. Tom Milkie rode the original Red Shift tricycle, without a fairing. Carsten Idland rode Roc Fleishman's Rock-It, and Ken Brant brought two of his vehicles, a recumbent bicycle with cardboard fairing, and an unfaired tricycle.

Ken Brant easily won a five-lap practice race, but it was Greg Johnson in the Quantum Cruiser who quickly took the lead in the main event. Brant followed 6 to 8 seconds behind all the way in his faired bicycle, finishing second, about 15 seconds ahead of Alan Osterbauer who rode an Easy Racer with Zzipper fairing. Fourth was Dave Egger in brother Dan's prone bicycle.

Tom Kessler in Rightmyer's vehicle was forced to drop out in the 19th lap when the left wheel fairing broke loose and jammed the wheel. He had been in the middle of the field.

In the afternoon, events moved up to Cal State Dominquez Hills where Mark Murphy and Jeff Wills set up a new IHPVA event, a tight course around traffic cones that was designed to test maneuverability and was expected to show the superior handling qualities of recumbent bicycles. Surprisingly, a Schwinn BMX ridden by Aaron Martin ran the twisting 100-yard course in 25.85 seconds, far ahead of the best recumbent tricycle time of 29.3 seconds set by Fred Washburn. Even a Rans recumbent bicycle, ridden by Marshall Chee, took only 28.19 seconds. There's a lesson in those figures.

The 4,000 meter HPV pursuit races in the 7-Eleven Olympic Velodrome saw only eight racers enter, but one of them was Fred Markham in Gardner Martin's Easy Racer which in its first run went the four kilometers in 4 minutes, 5.30 seconds. That was barely one tenth of a second behind the Vector's world record of 4:05.14 set last October in the Velodrome.

(There is a good chance that the Vector and the Easy Racer will face off July 9th as part of the International Invitational pre-Olympics event to be held at the Velodrome. It would be an IHPVA exhibition match seen on ABC TV's "Wide World of Sports" later in the fall.)

Second in the pursuits was Greg Johnson in Quantum Cruiser at 4:25.34; third, Dave Egger at 4:39.14. Through a local sponsor the Unversity awarded prizes of $150, $100 and $50. Kirk Newell's Other Woman placed fourth at 4:43.98.

Speed runs had been planned for Sunday May 1, on a new course suggested several years ago by IHPVA co-founder Chet Kyle: the San Gabriel Flood Control Channel near Seal Beach. It's a long, flat (less than a tenth of a percent grade) cement surface that several riders and builders feel will make an excellent site. However, the recent rain had dumped too much water into the channel for it to be usable that day. Those high speed-runs have been moved back to August 6th, a tune-up for the 9th Speed Championships set for Indianapolis Motor Speedway September 29 – October 2.

Figure 1. Human Powered Vehicle Speed Records

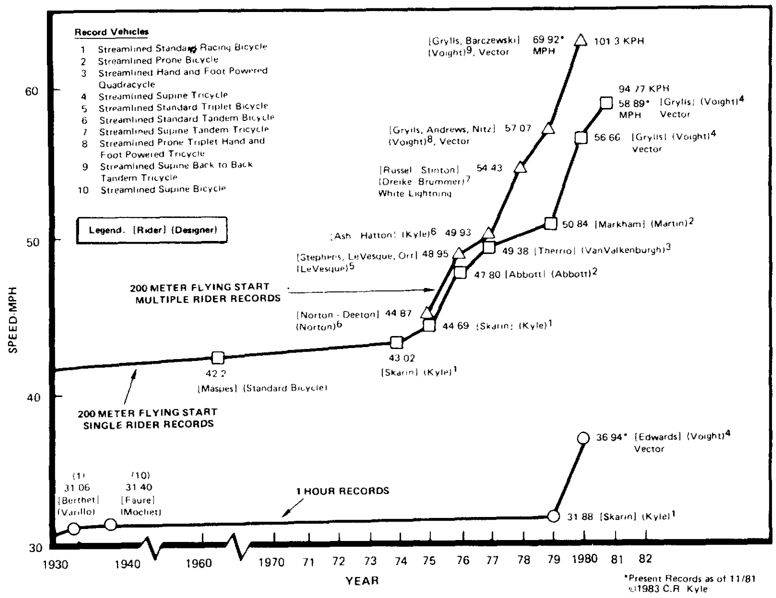


Figure 2. Aero Drag of Bicycle Wheels

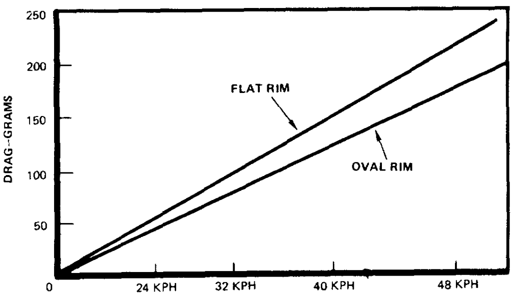


Figure 3. Effect of Winds[5]

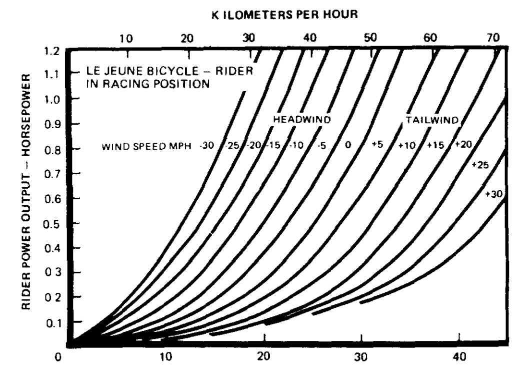


Figure 4. Estimated Effect of Passing Traffic[6]

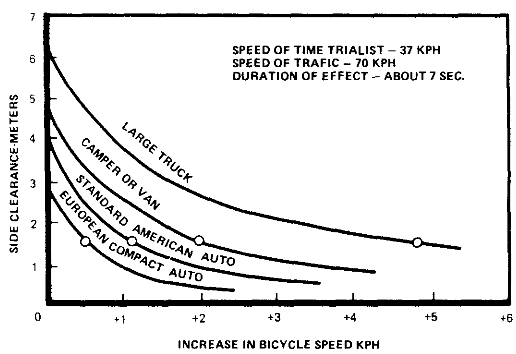
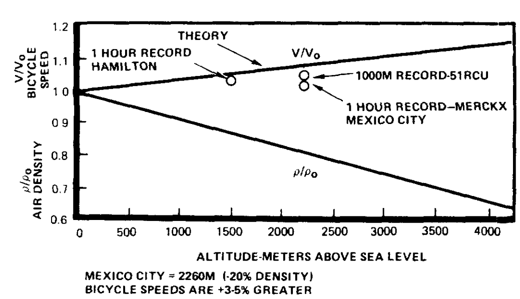


Figure 5. The Effect of Altitude Upon Air Density and Bicycle Speed[6]



OLYMPIC BIKES

From Page 1

bicycle racing speeds can be dramatically improved by lowering the wind resistance of a racing bicycle, and the rider. About 2/3 of the air resistance is due to the rider and 1/3 due to the bicycle.[1] The aerodynamics of the rider can be improved by design of helmet, clothing, and shoes and by choice of rider position. Some of the common ways of improving the aerodynamics of the bicycle itself are by streamlining, smoothing components, decreasing surface roughness, lowering frontal area, and by proper location of the components. Wind resistance against the cyclist may also be lowered by external factors such as tail winds, cross winds, drafting, auto traffic or even by holding races at higher altitudes. A brief discussion of each of the above factors follows.

Equipment Modification

1. Streamlining

Figure 1 shows that the world human powered vehicle speed records increased rapidly when completely streamlined pedal cycles began to be used for record attempts. Streamlined vehicles are much faster than standard bicycles. The present 200 meter flying start record for a standard bicycle is 68.05 KPH (10.58 sec), and was set by Gordon Singleton of Canada in 1980. The record for a streamlined vehicle is over 25 KPH faster; 94.77 KPH (7.597 sec), set by Dave Grylls of the USA using a streamlined supine tricycle. The movement toward completely streamlined human powered vehicles accelerated rapidly after 1975 when the International Human Powered Vehicle Association was organized. Table I shows the comparative power required by some of the human powered vehicles that have been developed since 1975. At 32 KPH, the newer machines require less than 30% of the power used by a standard bicycle at the same speed. Obviously from the above, streamlining can dramatically improve both the speed and the efficiency of a bicycle.

However, such exotic streamlining is illegal in standard bicycle racing, although some streamlined components and frames have been permitted. Since the elaborate streamlining used by the vehicles in the International Human Powered Speed Championships cannot be discussed in standard cycle racing, it will not be discussed further. Only modifications that are legal within the Union Cycliste Internationale rules will be covered.

Table 2 – Improvement in Bicycle Speed by Aerodynamic Drag Reduction. 400 Meter Pursuit, 50 KPH

Drag Decrease Grams	Time Decrease Seconds
0	- 0.0
10	- 0.2
30	- 0.8
50	- 1.5
100	- 2.7
200	- 5.5
300	- 8.5

D = 3.11 + 0.176 V^2, where V = m/s and D = newtons

Table 3 – Aerodynamic Drag of Bicycle Equipment

Bicycle Components – Speed 32 KPH[4,5]	Drag Increase Grams
Bicycle Bare	0
Bicycle plus Water Bottle	+40
Bicycle plus Fenders	+130
Bicycle plus Paniers and Pack	+270
Bicycle with covered Fr	
Bicycle with covered Frame and Wheels	-90
Aero Drag of Helmets at 48 KPH	
Bare Manikin with wig (hair)	0
Manikin plus Cinelli Strap Helmet	-60
Manikin plus Brancale Hemlet	-120
Best Czech Aero Helmet	
Worst - Head with Hair	

Table 4 – The Effect upon Acceleration Time of Adding Mass to a Bicycle. 4000 Meter Pursuit, 50 KPH.

Added Mass Grams	Added Time Seconds
0	0.0
50	+ 0.01
100	+0.02
200	+0.04
400	+0.08
600	+0.11
800	+0.15

Assume 15 seconds to accelerate to 50 KPH

$t_2 = t_1 \frac{m_2}{m_1}$, m_1 = 80 Kg (the mass of cycle plus rider), t_1 = 15 seconds

If the aerodynamics of the bicycle and rider are to be improved as much as possible, then each equipment item should have an efficient geometric form such as the typical wing shaped oval. As it is, even on the best racing bicycles have components that could be improved greatly. The question is whether such equipment is important in racing? Table 2 shows how much the times would improve in the 4000 meter pursuit race with aero drag reductions of from 10 to 300 grams. Even 10 grams less drag would give a 0.2 second advantage; so obviously aerodynamic equipment would be useful if significant drag reductions could be achieved and if the equipment could be made to function properly. Table 3 and Figure 2 show the aero drag of typical items of bicycle equipment such as wheels and helmets. The measurements were made in a wind tunnel or by coast down tests. As can be seen, rather large aero drag decreases are quite easy to achieve.

However, sometimes aero components weigh slightly more than standard. Another question is whether the added weight might cancel any advantages? Table 4 shows the effect of adding mass to a bicycle in the 4000 meter pursuit race. As much as 800 grams may be added if as little as a 10 gram reduction in aero drag can be achieved. At least in this comparison, the positive benefits of aerodynamics far outweigh the negative effects of adding mass.

There has been some speculation that aero equipment would be worse in cross winds because of higher drag and instability. This would depend upon the wind velocity and direction and the equipment. Aero tubing for example can actually have a lower drag in a cross wind because of aerodynamic lift (it acts like a sail). Of course stability, component stiffness and other factors must also be considered before using aero equipment in a particular race. Road races and sprints are obviously quite different than time trials, and therefore quite different equipment should evolve for each.

2. Smoothing of Components, Decreasing Surface Roughness

Poor aerodynamic shapes such as bolts, clamps, levers, cables, posts, etc. can all be improved or eliminated by proper bicycle design. The object of smoothing components is to avoid sharp edges, corners, rapid changes in contour, or other shapes that might cause turbulence or unnecessary air resistance. Rough surfaces can also cause excess air friction.

One interesting factor to consider in smoothing components is the speed that the bicycle will travel. All types of bluff or streamlined shapes such as wings, cylinders, ovals, cubes or spheres go through an aerodynamic transition when the wake changes from laminar to turbulent flow and the drag forces decrease. Streamlined shapes go through a gradual transition but objects such as cylinders abruptly change as the critical speed is exceeded. This transition was noted frequently during wind tunnel tests of both helmets and bicycle wheels. At racing speeds, bicycles have many components that operate around the critical transition point. In this case it may be more advantageous to have rough surfaces than smooth (like the dimples on a golf ball), in order to prematurely trip the flow and cause turbulence in the wake. Careful wind tunnel work is required to identify those components that can be improved by utilizing supercritical flow.

3. Proper Location of Components.

Given a choice, aerodynamically poor components should be located in the wind shadow or wake of other equipment so that the combined drag will be less. For minimum drag it is more important to have a clean streamlined front face than to improve the rear profile. Items such as brakes, cables, rods, etc. should be either hidden in the frame or placed behind other more efficient shapes. A streamlined water bottle cage can be designed for example that presents a smooth profile to the wind when combined with the bottle.

4. Decreasing Frontal Area

Since pressure drag normally predominates over friction drag for bicycle components, minimum frontal area is important. Components that can be redesigned or oriented differently to give less frontal area will have a lower air drag. A good example is the bicycle rider using the uncomfortable egg shaped body position. This posture minimizes frontal area and also is more streamlined, giving much less resistance than a more upright position. When riders are in crouched racing position, with elbows bent and hands on the lower handle bars, they have at least 20% less wind resistance than when in touring position with hands on the upper bars and elbows straight.

Other Methods of Decreasing Wind Resistance

1. Drafting

In a pace line, closely drafting riders are in an artificial tail wind that decreases the air drag of those in the rear by over 40%. Power required is about 30% less for all except the leader who uses about the same amount of energy as a solo rider at the same speed. Table 5 shows the decrease in wind resistance with the wheel spacing between bicycles. Naturally the closer they draft, the greater the benefit.

Drag and Speed Characteristics of Streamlined Human Powered Vehicles

	Machine	Frontal Area m^2 (Area in^2)	Drag Coefficient C_d	Percent Drag Reduction at 32 KPH	Required Power at 32 KPH-Watts	Speed With No Power Increase-KPH (Increase-MPH)	Maximum Competition Speed-KPH* (Speed-MPH*)
	Bare Bicycle	.50 (19.6)	.78	0	203	32 (19.8)	----
	Bicycle + Front Fairing I	.50 (19.6)	.60	13%	177	33.5 (20.8)	54.72 (33.9)
	Bicycle + Front Fairing II	.55 (21.6)	.52	22%	159	34.7 (21.5)	
	Palombo Supine Tricycle Bare	.35 (13.7)	.77	26%	151	34.5 (21.4)	58.21 (36.1)
	Van Valkenburgh Aeroshell (Covers Upper Body)	.65 (25.5)	.32	34%	125	36.8 (22.8)	54.22 (33.6)
	Aeroshell + Bottom Skirt	.68 (26.7)	.21	48%	97	39.8 (24.7)	74.85 46.4)
	Palombo Tricycle with Fairing	.46 (18.1)	.28	55%	92	40.9 (25.3)	71.42 (44.3)
	Kyle Full Fairing	.71 (27.9)	.10	67%	68	46 (28.5)	74.77 (46.4)
	Van Valkenburgh Prone Quadracycle with Fairing	.46 (18.1)	.14	68%	64	46.9 (29.1)	79.47 (49.3)

*Measured at the International Human Powered Speed Championships

From: "Predicting Human Powered Vehicle Performance Using Ergometry and Aerodynamic Drag Measurements" Proceedings, International Conference on Human Powered Transportation, San Diego, 1979. Chester R. Kyle.

Table 5 – The Effect of Drafting[3]

Wheel Gap Meters	Decrease in Wind Drag
0.2	-44%
0.4	-42%
0.6	-38%
1.0	-34%
1.5	-30%
2.0	-27%

2. Tail Winds and Head Winds

Figure 3 shows the effect of tail winds and head winds upon bicycle speed. If it is assumed that a rider can produce the same steady state power no matter what the wind speed, then the curve may be used to predict bicycle speed with either leading or following winds. As a rule, a bicycle is affected about half the wind speed. That is, a 10 KPH head wind will slow the bicycle about 5 KPH while a 10 KPH tail wind will speed the bicycle up about 5 KPH. Cross winds can either increase or decrease speed depending upon the design of the bicycle components. Large front fairings have been tested in a wind tunnel and at yaw angles up to about 20° their drag was actually lower, showing that they extracted energy from the wind much like a sail.

3. Passing Automotive Traffic

Time trial speeds are often influenced by passing automotive traffic in open courses. Figure 4 shows the approximate effect of passing traffic upon time trial speed with vehicles from small autos to large trucks. The curve was made by observing a very consistent time trialist on a level public highway, and by using a very accurate speedometer. Speed increases from 1-5 KPH were measured when vehicles passed with about 1.5 meters side clearance. If strong cross winds existed, then almost no effect was measured. When passing traffic slowed, approaching the speed of the cyclist, then the duration of the effect increased until sometimes it became permanent (the cyclist was drafting at the side of the motor vehicle). Naturally when motor vehicle traffic was heavy then the speed increase was greater. If a steady stream of traffic was going by then the speed increased as much as 5 to 10 KPH continuously.

4. The Effect of Altitude upon Bicycle Speed

As elevation increases, air density decreases, as does the wind resistance. If bicycle speed depended only upon air resistance then velocities would be much greater at higher elevations. However, less oxygen is available and thus aerobic endurance is less, so the effect is lower than might be predicted by theory. Figure 5 shows the variation of air density with altitude and the theoretical increase in bicycle speed with altitude. Some actual race results are plotted, these are less than theory in all cases. The world 1000 meter record, and hour record were set in Mexico City, elevation 2260 meters, where the air density is 20% lower than at sea level. Surprisingly however, the records for the 200 meter sprint and for the 4000 meter individual and team pursuit were set at near sea level. In general bicycle speeds at Mexico seem to be from 3 to 5% greater than at sea level. It would be interesting to hold a world track championship at La Paz Bolivia, elevation 3960 meters, where air density is 33% lower than at sea level. If Top athletes were present, world records would surely be inevitable.

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FREE-BLOWN CANOPIES FOR HPV'S

By Tom Milkie

While many builders of human-powered vehicles can come up with methods for building an aerodynamic body, they are stymied when it comes to making a transparent canopy. One method of making a good transparent canopy is by the process of free-blowing. In free-blowing the canopy is formed by mounting a heated sheet of plastic to a form and blowing air under the plastic, until the desired canopy height is achieved. This technique was used by the Schwinn Red Shift team of Tom Milkie, Gary Hoisington, Steve Fujikawa, and Scott Rowe, to make the vehicle front canopy.

This method has the advantage that no tedious construction of a mold or plug is required. The only tooling required is a template, which can be made in an hour. The finished canopy can take on a smooth, contoured shape, even a shape with a large amount of compound curvature. (Compound curves are those that bend in 2 directions, like the surface of a sphere.) The optical quality of free-blown canopies can be excellent. This is especially important since most human-powered vehicle designs have the rider sitting very low, looking through the canopy at a low angle to the surface of the canopy. This situation causes the slightest optical flaws in the canopy to greatly distort the rider's vision. Flaws which are not noticeable when looking at the vehicle from the outside can still have quite a significant effect on the rider's vision.

Of course, free blown construction has its problems. The most serious problem is the lack of close tolerance control over the shape and size of the canopy. Only smooth-contour shapes which can be cut from a free "balloon" shape can be made by this method. The exact size and slope of the canopy surface at the edge of the canopy can only be estimated. The free-blown method also puts limitations on the type of materials and minimum thickness of the material which can be used.

A free-blown canopy can be made from acrylic plastic sheet. Acrylic is best known by the Dupont brand name, Plexiglas Clear high-impact styrene has similar properties. These materials are quite clear, but will scratch, and will shatter upon impact. They are available in sheets up to 4 ft by 8 ft and are sold at plastic supply stores and in some hardware stores, mostly as window replacement material. These plastics are also sold in a variety of tinted shades. Lexan is the GE brand name for a polycarbonate plastic which is tougher and stronger than acrylic. It is also twice as expensive as acrylic. However, it has a more delicate formable temperature range, and requires more pressure to stretch it. Therefore, Lexan probably can not be used for free-blown canopies. The acrylic should be 1/8 to 1/4 inch thick. When the plastic is stretched by the blowing process, the thickness will decrease. Thinner plastics will develop blister bubbles when the canopy is formed, due to local stretching.

A canopy is blown by mounting the heated sheet of plastic in a form, as shown in figure 1. Air is then blown under the plastic to form a bubble. The template form must be built quite strong to resist the large forces on it. 3/4 inch to 1 inch plywood is recommended, with 2 x 4 reinforcing glued and screwed to the underside of the base. Felt is glued to the base of the form to act as an air seal, as shown. The edges of the felt are sealed by filling with silicon sealer compound. The air hose is firmly mounted to the plywood, and should be covered with a heat-resistant, strong material such as rubber, leather, or canvas, to prevent the air flow from impinging directly on the sheet plastic. The plastic is sandwiched between the base and the template and held in place with C-clamps.

The template shape determines the eventual shape of the finished canopy. The cutout shape can be drawn from the vehicle body shape. However, the bubble will be rounded on all sides, so the template shape must be rounded on all sides, even if one end of the canopy will be cut off straight (see figures 2 and 3). If the size permits, it is possible to form a good shape for a cutoff canopy by drawing the template such that two canopies are formed, back to back, as shown in figure 3. The height to which the canopy can be blown is practically limited to the width of the canopy. Also, the slope of the edge of the canopy is determined by the blowing process. True vertical edges are difficult to attain, and shapes containing more than a semi-circular cross section, as shown in figure 4, are not possible. Some creative cutting of the finished canopy will be required to fit it to the vehicle body. It might be a good idea to make the canopy before the vehicle body. Then the body shape can be modified slightly to accommodate the shape of the canopy.

The canopy is formed by heating the acrylic to about 300 degrees (F) for an hour or more. This should be done by hanging it in an oven. Other methods, such as heating the plastic with portable heaters, have shown limited success, due to the necessity of uniform heating. The exact temperature of the plastic is not critical, but the plastic should take on the limpness of a slice of cheese when heated.

The plastic should be rapidly removed from the oven and firmly clamped between the template and base with 20 or more clamps. The plastic will stay flexible for a minute or so after removal from the oven. However, it would help to retain heat by preheating the template and base before use. The air supply used should be able to provide 100 psi of dry air. Moisture in the air can cause condensation on the plastic and form spots. The air pressure must be maintained until the plastic cools. After forming, the acrylic is marked and cut with a hacksaw blade or other fine-toothed saw. Masking tape acts as a good saw guide and protects the edge of the cut from scratches. However, the adhesive in masking tape can attack the acrylic if the tape is left on for a long period of time. Power tools are not recommended as the vibration can cause cracking of the acrylic.

There are some limitations to the free-blowing method of producing a canopy. However, the ingenuity of the designer can result in a perfect canopy, fit for any human-powered vehicle.

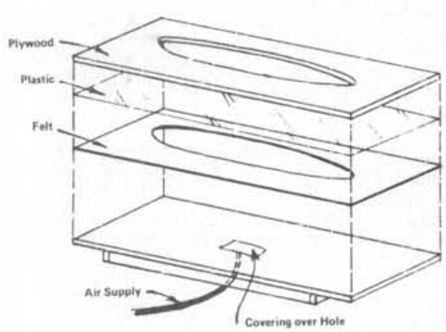
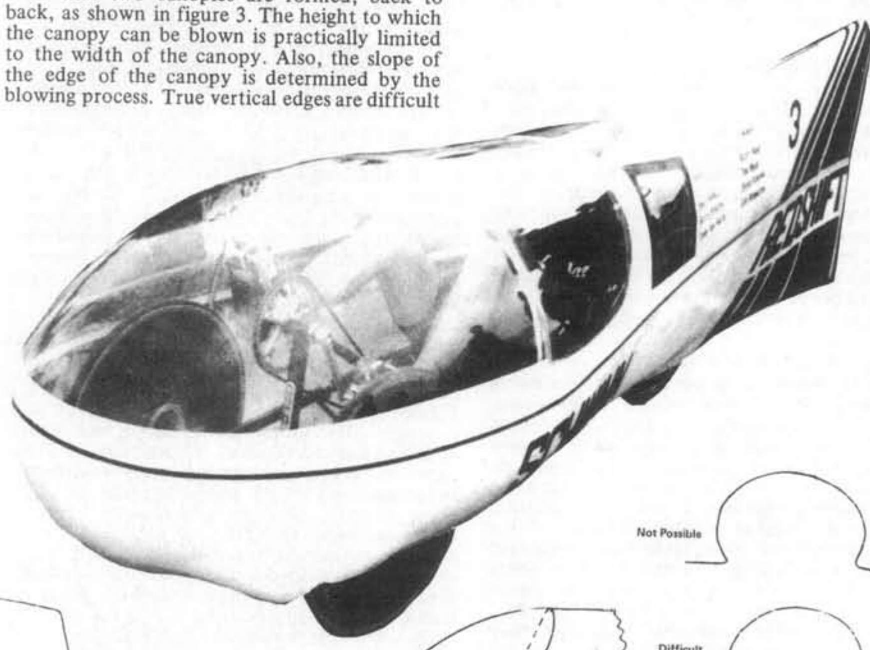
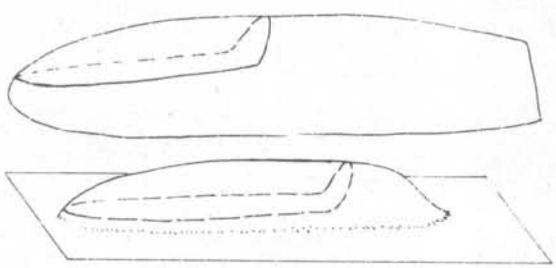


Figure 1

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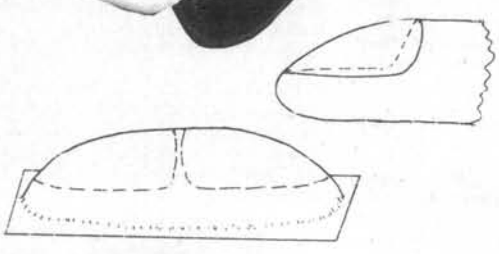


Figure 3

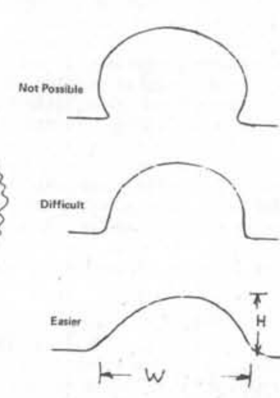
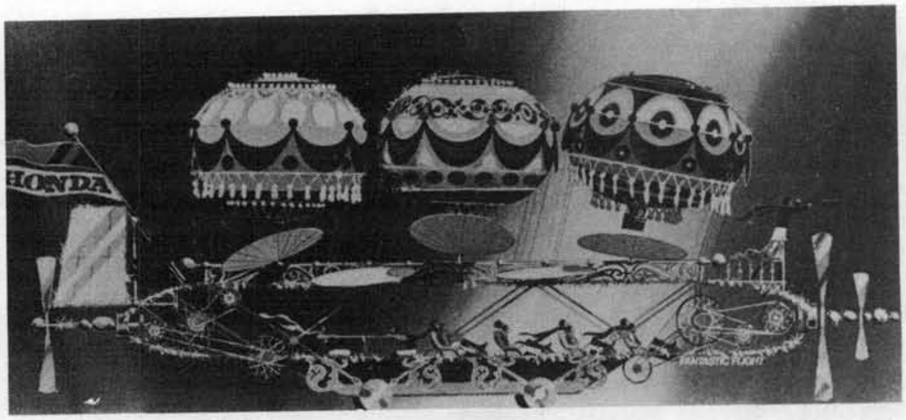
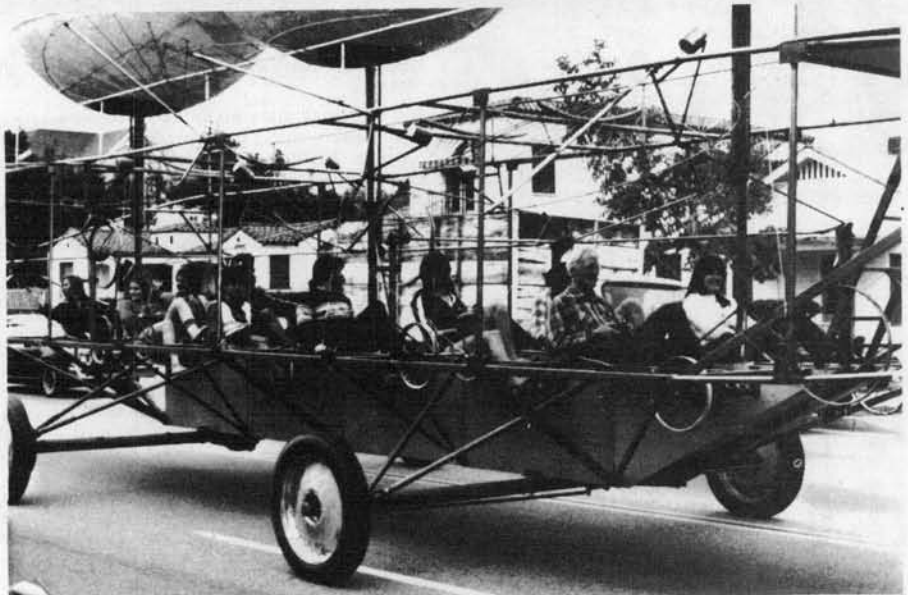


Figure 4





IHPVA members pedaled human powered float in the Rose Parade, Jan. 1.

HUMAN POWERED FLOAT NOTES

By Alec Brooks

How did thirteen members of the IHPVA end up pedaling a three and a half ton float down Colorado Blvd. on New Year's Day?

It all started last year at about this time. The 1982 Honda Rose Parade float, a miniature roller coaster complete with a loop, had been a resounding success, despite some problems with flowers and glue setting onto the coaster tracks, and two flat wheels (not tires!) during the parade. The float builder, Steve Serrurier of Serrurier and Associates in Pasadena, began thinking of concepts for a float for 1983 that might top the coaster. He had long thought that a human-powered float would be a new twist, but wasn't sure it was possible. Serrurier was familiar with the IHPVA, so he sought advice from both Paul MacCready and Chester Kyle. They advised him that the human-powered float would be no problem at all as long as the weight was reasonable.

Floats are by nature not lightweight, as evidenced by the roller coaster's 15+ ton weight. Obviously, a human powered float would have to be lighter than the average float, but how much lighter? At this point, I entered the picture, doing some more detailed analysis for Serrurier. The major things considered when determining the allowable weight were the slopes along the parade route, the number of riders and their physical condition, the rolling resistance of the type of tires to be used, and wind resistance. At parade speed of 3 m.p.h. the wind resistance would be negligible, but headwinds might cause a very large amount of drag. A study of topographic maps revealed that a large part of the route was very slightly downhill, with only a few short uphill grades. One of the hills was quite steep at 4% grade, but was only a block long. The other hills were longer, but not as steep, at about 1.5% grade. It would be acceptable to go up the short, steep hill slowly in a very low gear, but it would be necessary to go up the longer hills at parade speed to avoid holding things up. This then became the worst-case power output condition.

Assuming that the riders would be reasonably good cyclists, and that the tires would be at least as good as car tires for rolling friction, it was determined that the float could reasonably weigh as much as 1000 lbs. per rider. For example, if there were 10 riders, the weight could be as much as 10,000 lbs. This is lighter than the average float, but certainly possible using even the welded steel construction favored by float builders. At this point the matter was dropped until late September, just before the '82 IHPSC, when Steve Serrurier called to tell me that Honda had approved a human powered float design, and wanted the IHPVA to provide the powerplants for the float. He also asked me to help with the drive system design and structural engineering.

The selected design was a large fanciful airship depicting man's early attempts to fly, entitled "Fantastic Flight". The design wasn't really a design at all, but rather an artists conception. Our job was to design and build something that looked something like the artists conception in only two months.

Most of the design was accomplished in only one afternoon. I sat down with Ralph Hudson, who was responsible for seeing to it that the float actually got built, and we just went through the whole structure, estimating the sizes and weights for all of the main structural members. Very simple structural calculations were done at the same time to determine load carrying capacities. We decided to use square tubing, rather than round, for most of the main structure, to avoid the time-consuming job of "fish-mouthing" all of the tube ends. The result of this session was a list of most of the steel tubing required and a component-by-component weight breakdown. The good news was that the weight estimate was only 5500 lbs, ready to roll, minus riders. This would be no problem at all for the planned twelve riders.

As construction rapidly progressed, three major problems remained. The original design called for the three large balloons to be actual helium balloons, to help support the weight and thus reduce rolling friction. It was decided, however, that the balloons would not have enough lift to support even themselves after being covered with flowers, not to mention the difficulties of putting flowers on an inflated balloon, and the danger of a balloon springing a leak during the parade and draping itself all over the float. The solution was to build the balloons up with steel rods, covered with chicken wire and urethane foam. Instead of helping to lift the float, these "balloons" would push down with a weight of nearly 600 lb. each.

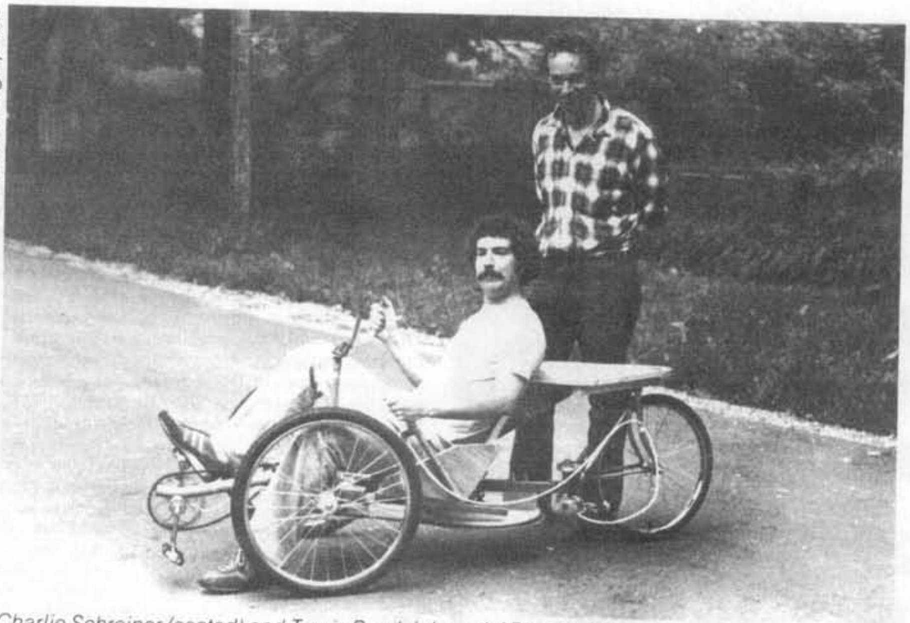
The second problem was the drive train mechanism. We wanted to have a clutch in the final drive in order to be able to keep the animated fans and propellers moving during the frequent stops during the parade. But we couldn't decide on whether to have variable gearing, such as bicycle deraileurs for each rider, or go with a simple, but extremely reliable single-speed chain drive. The single speed would be a bit of a problem on the hills, but the weight estimate indicated that the hills could just be climbed at the normal parade speed. Another problem was that the rear axle, which simply connected the two wheels together without any differential, would experience critically large torsional stresses as the float turned sharp corners. All of the drive problems were solved elegantly in a single stroke, with the idea of one of the float fabricators. His idea was to use a Honda transaxle, which combined a five-speed transmission, clutch, and differential, all in a small, lightweight package.

The final problem was the wheels and tires. For low rolling friction, we wanted high-pressure tires, and the wheels were out in the open, so they had to look good. The optimum tires would be high-pressure, large diameter and quite narrow. After much searching, Ralph finally found a set of 37-in diameter antique fire truck tires, but no wheels. Drawing on the experience of several of the float fabricators in off-road racing, the wheels were custom-made by bolting together two spun aluminum disks. The completed wheels were beautiful, and very lightweight. Unfortunately, no one knew quite what either their load or pressure ratings were.

The construction went quite fast, but the first test drive didn't take place until early December. The big tires seemed to have exceptionally low rolling resistance, and one person could easily pedal around in low gear. The only problem was that four strong people could slip the clutch if the brakes were held on. (People can put out only a small amount of power, but can produce huge amounts of torque!) The clutch was removed and sent to a clutch shop to be beefed up. When it came back, it was only marginally better, with five people able to slip it. It went back to the clutch shop again, this time to get a double diaphragm spring installed. With over 1200 lbs of preload on the clutch disk, twelve people now could just barely slip it.

Please turn to Page 15

Debra Wierenga photo



Charlie Schreiner (seated) and Travis Randolph model Prototype I.

LIFE WITH AN HPV BUILDER

By Debra Wierenga

It's not as though I didn't know what I was getting into. The first time I came to the house of the man I am now married to, I saw the odd assemblage of wheels, sprockets, and chains out in the garage, noted that the back yard resembled a graveyard for old bikes, thumbed the dusty stacks of bicycling magazines and technological journals stacked on his coffee table.

We hadn't been seeing each other a month when I could recite by heart the Inherent Design Flaws of the Conventional Ten-Speed. It wasn't long before I could be heard using words like "recumbent" and "HPV" as though they had always been essential components of my vocabulary. Jogging in the morning, I paced myself to a little chant called "Three Wheels Good: Two Wheels Bad." No, I could foresee basically how it was going to be: I just didn't know how much it was going to be.

As the legend has it, this all started on a bleak February night three years ago when my husband and his friend, Travis, were drinking Jack Daniels and lamenting the lack of imagination displayed by American manufacturers today. Someone's glance fell upon Charlie's 10-speed Fuji, which was wintering in the front hallway. Now there was a product that hadn't been really rethought in years. Uncomfortable, fairly dangerous, requiring a degree of balance and dexterity that limited its use to certain age groups and body types: it was a wonder the things found a market at all! And those big tricycles, of course, only gave older people a false sense of security; they were prone to tipping while taking corners. . .

By the end of that fateful evening, a vision had been born of a stable, comfortable, three-wheeled, rear-steering, recumbent vehicle that young and old, tall and short, healthy and paunchy would love at first pedal. The two friends agreed to be partners and to purchase a welder and one of those inherently unstable adult tricycles.

The latter purchase was ruthlessly cut apart and welded back together again, with the addition of a plywood seat and a Rube Goldbergesque mechanism that used more chain than a fleet of Schwinns. This is the slightly vehicular-looking thing you see pictured here, known historically as The First Prototype and around the neighborhood as The Gossamer Armadillo.

There have been several prototypes since. A patent has been applied for. Charlie and Travis learned about and joined the IHPVA and I felt vaguely comforted at the thought of other spouses around the world whose garages were no longer their own and who wrote large checks for COD packages containing mysterious parts.

Everybody loves an inventor – my relatives and friends, every kid in Saugatuck between the ages of 9 and 96. Nobody thinks much about the inventor's marital partner who might prefer dinner and theater in Chicago to the SAE Convention in Detroit. Whose family album consists mainly of photos of prototypes I-V. Whose legs are too short to get the full ergonomic effect of that funny-looking thing anyway.

I have been patient. I have made sacrifices. I once sat through an entire half hour of an awful TV program called "Chips" in order to witness a thirty-second segment showing odd little pedal vehicles scuttling through a park. Recently I went so far as to run up and down the street, pushing Charlie in Prototype-Something-or-Other so he could test the steering:

"Do you think Mrs. Edison had to put up with this sort of thing?" I asked, grateful for the moment that my feminist friends live in other states.

"Thomas Edison never took baths."

"What?"

"He never took baths. He believed that body oils were condusive to creativity."

I didn't say any more, but was relieved to hear the familiar sound of the shower that evening.

Not that there haven't been compensations. How else would I have met Ruben who rides an Avatar 2000 and writes bicycling articles for the Ann Arbor paper? Or George the traveling bicycle and tennis racket repair man who owns a Stratus? These are not the type of people one is likely to run into while taking in dinner and a ballet in Chicago.

And then, as I said, everyone loves an inventor. I am no exception. Who can resist the eternal optimism, the sheer joie de vivre of a man who still believes in the unlikely?

From my desk in my at-home office I hear a large, happy sound that can only be approximated in writing by something like "TEE-HEE". Out in the garage, Charlie is pushing the steering wheel of Prototype N down into the steering column and pulling it back out to where it makes a satisfying little click. "Look at this," he says. In, out, click. In, out, click. "A collapsible steering wheel," he says, still chuckling gleefully. "Do you believe that?"

I'm beginning to.

TRAVELING WITH THE VECTOR

By Eric Edwards

I've just returned from a trip to Melbourne Australia, where I exhibited one of the Vectors in an energy conservation exposition. The trip was sponsored by their natural gas company, the Gas and Fuel Corp. of Victoria. Gas and Fuel has taken quite an interest in HPVs and is helping to set up a local chapter of the IHPVA in Australia. Due to the high costs of such a trip the arrangements were very uncertain at first. I made one of the Vectors collapsible with slip-joint fittings so that it could be packed in a crate half the regular size (which cut the air freight costs in half). Gas and Fuel also secured some co-sponsorship for the event.

On the weekend, the Vector was displayed at the Gas and Fuel's energy conservation exhibition called "The Energy Zone." I found the Australians very energy conscious, and very much interested in HPVs. Next to my display was the world record holder vehicle for high gasoline mileage. It was like a competitive HPV with a fairing like the Aeroshell and a rider/wheel configuration of a Vector. It was powered by a four-stroke 6.4 cc (cubic inches) model airplane engine and got over 2700 miles per gallon! One of the designers, Lachlan Thompson, expressed great interest in HPVs and is planning to build one if a race is organized there. After the exhibition I gave a talk on HPVs to a crowd of over a hundred. There, a committee was formed to start a local chapter of the IHPVA. They are hoping to organize a race to be held in about one year. During my stay, the Gas and Fuel Corp. did an excellent job of arranging these events, and is planning to help the HPV movement get started in Australia.

I'd like to share some thoughts on international travel. If you don't have a passport and you think there is a chance of traveling, be an optimist, and apply for your passport and visa right away. The more time you allow, the easier it is. If your plans are at the last minute, you can usually go into a major city and get them in a few days but it is a *lot* of trouble (be sure to call ahead to find out all the requirements). Since most passports are good for *five years*, I would suggest that you apply for one now and avoid the hassle when you are busy arranging the trip. Customs is one of the biggest problems confronting a traveler with cargo. It takes at least one or two days for a crate to clear customs, and I plan on three days to be safe. A customs broker can be very helpful. Most of all, be pleasant with customs, passport, and visa agents and ask them to help you with your problems. If you are not pleasant you will have a lot of problems. If you take foreign made goods or a custom built (guess what.-rlh) item, you should show it to our own customs people **before leaving**, so that you will not be charged duty when you return. It is a good idea to mark the country of origin on your vehicle. Air freight is very expensive; a Vector in a crate would cost over $3,000 round trip from Los Angeles to Melbourne. Since HPVs are so light, they are charged by volume and not by weight. It definitely pays off to design your vehicle to breakdown into a smaller container if that won't interfere with it's competitiveness. Different rates apply to different size ranges; so check with the airline of your choice to figure out how cost effective the volume reduction is.

FLOAT

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We weighed the float two weeks before the parade, and found to our dissapointment that the weight was already 5000 lbs. There was still another 800 lbs of wood and steel to add, as well as at least 1200 lbs. of flowers, glue, paint, etc. There was nothing that could be done about it at this point, so we just hoped there wouldn't be a headwind down Colorado Blvd. on New Year's day.

New Year's eve was spent inching through the streets of Pasadena in a convoy of over twenty floats to the parade staging area on Orange Grove Blvd. The float felt more sluggish than it had during tiral runs, and the flowers and glue were causing minor problems with the mechanisms that actuated the five fans on each side. Paul MacCready was driving, practicing the steering and braking he would be doing during the parade, and I was practicing my job of operating the clutch and gearshift levers. The steering position was on a platform ten feet off the ground at the front of the float, and the gearshift was in the fifth row seat. To communicate, Paul and I had two-way voice actuated headset radios, which seemed to work very well.

The other float pedalers for the parade were Chester and Joyce Kyle, Bryan Allen, Joan Lind (an olympic silver medalist rower), Ron and Sue Skarin, Allan and Colony Abbott, Izzy Lewis, and Jack and Karen Lambie. Everyone arrived at Steve Serrurier's house at 5:30 a.m. on new year's day for breakfast and to try to fit into the shorts and t-shirt outfits provided for us. After packing the float's trunk (yes, it even had a trunk!) with everyone's clothes, camera bags, sleeping bags, wheel chocks, etc., we were ready to go. As soon as the parade started, I realized that the two-way radio was going to be almost useless – the noise from the marching band behind us and the crowds beside us was deafening! I couldn't hear anything over the radio. I could see Paul waving to the riders to speed up as the gap between us and the band in front widened. Yelling as loud as I could, I got the attention of Allen Abbott sitting in front of me. I told him to go to 100 percent power and to pass it on. We finally caught up as we neared the main reviewing stands and television cameras.

Everything went smoothly for the next mile until we got to the short steep hill. The plan was to go up at about 2 m.p.h. in second gear. As we started up, it immediately became apparent that we weren't going to make it in second, so we stopped and shifted into first, and got underway again at less than 1 m.p.h. The crowd really loved the challenge, and cheered us on. After cresting the hill, I shifted through the gears, going up to fourth, and we all took it easy coasting down the 3 mile down grade ahead of us.

The easy going didn't last long. While inching along slowly waiting for a delay in the parade, the left rear tire suddenly exploded violently, sending up a shower of dried yellow flower petals. We stopped dead in our tracks, and parade officials ran over to inspect the damage. They found that the wheel rim had broken, and they immediately called for a tow truck to pull us off the parade route. Luckily the tow bar that we were carrying was stuck inside the central frame, so we were spared the embarrassment of being towed. Instead we started up again under human power, rolling on what was left of the rim and tire. The ride was extremely rough, and the balloons were wobbling precariously over our head. After three blocks, we were able to turn left onto a side street.

Minutes later Steve Serrurier and Ralph Hudson arrived with tools and a spare wheel. In another ten minutes, the new wheel was mounted, and we backed down the side street back onto Colorado Blvd., and took off again in the parade.

Things went well enough until we started up the final hill near the end of the parade. Even with all of us putting out maximum power, we steadily fell behind the float in front of us. Then it happened. The left front tire exploded, just as before. This time we knew what to do – we just kept on pedaling and again turned off on a side street. We were close to the end of the route, and there wasn't much time for another wheel change, so we just walked the rest of the way.

I haven't determined yet why the wheels failed, but I later found out that the tire pressure had been increased from 40 psi to 60 psi the day before. Maybe this increase, along with heating from the sun, pushed the pressure above what the wheels could safely handle.

Finally, it is interesting to compare the Honda float to the Arco hand-carried float. The Arco float weighed 1200 lbs. and was carried by 40 people, so each person was in effect propelling 30 lbs. of float. The Honda float weighed about 7000 lbs. and was propelled by only 12 people, or each person was propelling almost 600 lbs of float – 20 times more than Arco!

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BLUEBELL

From Page 7

misjudged his run, not seen the end of the traps, kept powering on, saw the net when it was far too late and hurtled into it at 35 m.p.h., stopping very quickly and without injury or damage. But I manage to stop safely.

The speed is announced. 50.88 m.p.h. A world record. Fantastic! The fastest bicycle in the world. A feeling of sheer elation, but much more powerfully a sense of relief. A strikingly clear thought that the whole gut-busting effort to get to California and compete was well worth it.

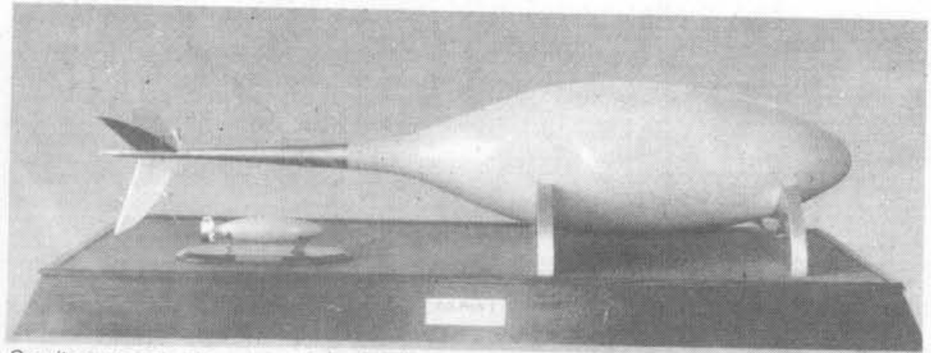
After calming down, we headed off, Bluebell in the back of our hired van, for a third and final run. The atmosphere was developing. The two other competitive bicycle teams run by Gardiner Martin and Allan Abbott were absolutely determined to beat my speed. To have beaten the record and then have it eclipsed within half an hour was a simply appalling thought. Apparently the Vectors, three-wheeled and thus not a threat to the record, had had their last run and packed up confident of winning overall with a speed of 51.8 m.p.h.

I had decided to modify my strategy and made my burst from slightly before the 400 meter mark with the hope of being able to claw the timed 200 meters. Everything went well? it was a very smooth run. The speed 51.919 m.p.h. – not only comfortably secured the two-wheeled record but beat the Vectors on the day.

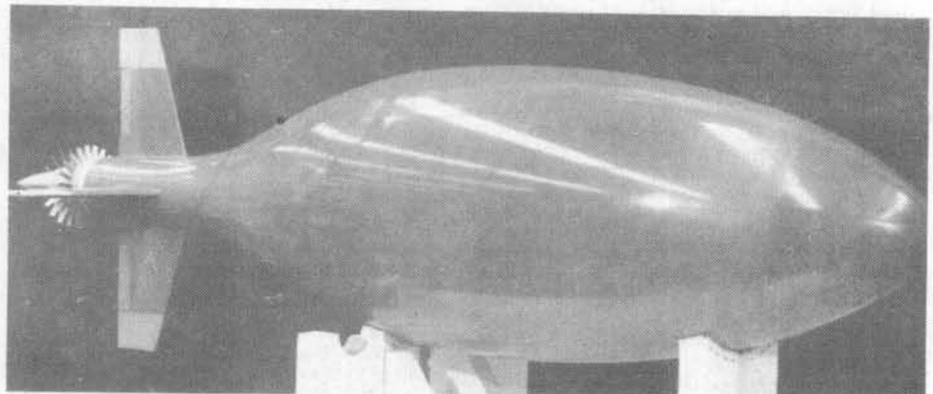
After taking fourth place in the pursuit in the afternoon we retired from the melee, exhausted, but thrilled with our performance.

Now, back in London, as the rain pisses down outside, it doesn't seem of any great consequence to be the fastest pedaler on two wheels in the world. The Nosey Ferret Racing Team project swallowed up vast amounts of time, precious financial reserves and yielded not one brass razoo. You can be sure the absolutely fabulous contributor's rates paid by the International Cycling Guide won't have dramatic effect on that position. Nevertheless I still have a powerful enough mental imprint of a little cell with intercom, dictaphone and telephone, to make me sober up and realize the lot of an impoverished HPV addict isn't an unhappy one.

It *was* an achievement to be part of a team that in the space of three and a bit months went from nothing to a victory against a vehicle that has been highly developed over several years with considerable financial support, and in so doing, eclipse the previous fastest world time for a two wheeled vehicle. We can go faster!



Gravity powered underwater vehicle, Dolphin I.



Electric Powered underwater research vehicle.

LAMINAR FLOW UNDERWATER VEHICLES

By Bruce Carmichael

The gravity powered vehicle was designed by Dr. Max Kramer, IHPVA member Bruce Carmichael, and Bill Knoll in 1961. The shape was obtained by rotating an NACA 66030 form. Flow acceleration and therefore laminar flow possibility existed to 60% of basic hull length. It was stabilized for vertical ocean descent by the boom and 3 fins. The nose cap and internal ballast was released at 800 feet for buoyant return to the surface with recorded speed, depth and time history: world's first demonstration of extensive laminar flow on *underwater* vehicle. Drag was only 40% the drag of conventional underwater bodies of equal volume. Transition length Reynolds Number 18 million. Small vehicle is NASA 67020 body of rotation with shroud ring stabilization. Three inch diameter compared to 19 inch on large body. Laminar to 70% of hull length.

P.U.R.V. IV
(Powered Underwater Research Vehicle)

The powered vehicle had identical hull to the gravity powered version and had an active control system. Counter rotating multi bladed propellers were immersed in the boundary layer. Acceleration of the fluid slowed down by friction with the hull skin results in increased propulsive efficiency over a propeller in the free stream. This vehicle achieved a speed with 30 horsepower which would have required 80 horsepower using standard propulsion techniques still in use today.

HUMAN POWER

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