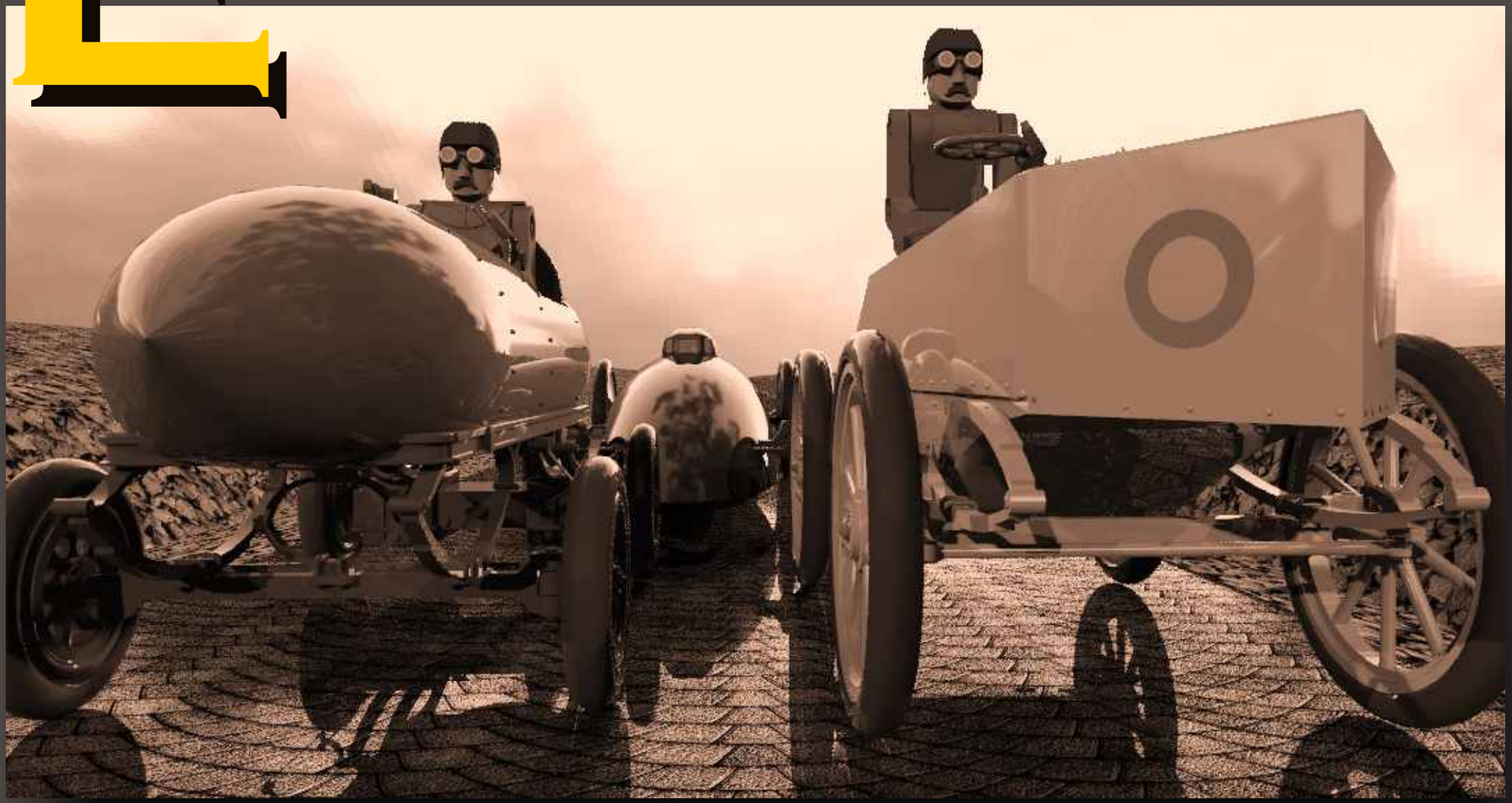
ERACERS



A HISTORY OF ELECTRIC RACE CARS

C. Michael Lewis

600BC

Electron

1600AD

Electricity

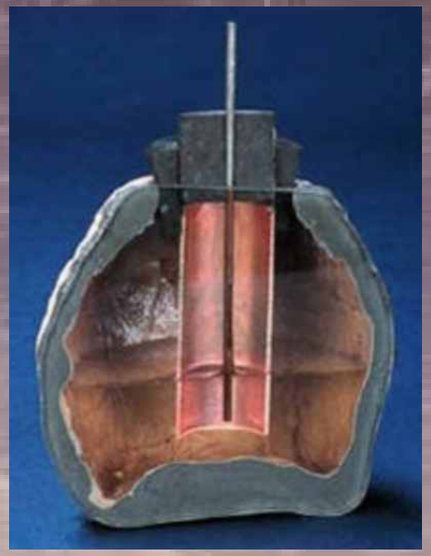
Thales of Miletus

William Gilbert

250

Baghdad Battery

copper/iron



1746

Leyden Jar

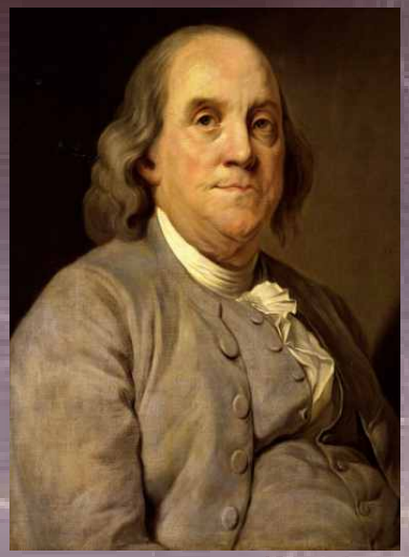
Glass/iron

Pieter van Musschenbroek

1760

'Battery' of Leyden Jars

Glass/iron



Benjamin Franklin

1799

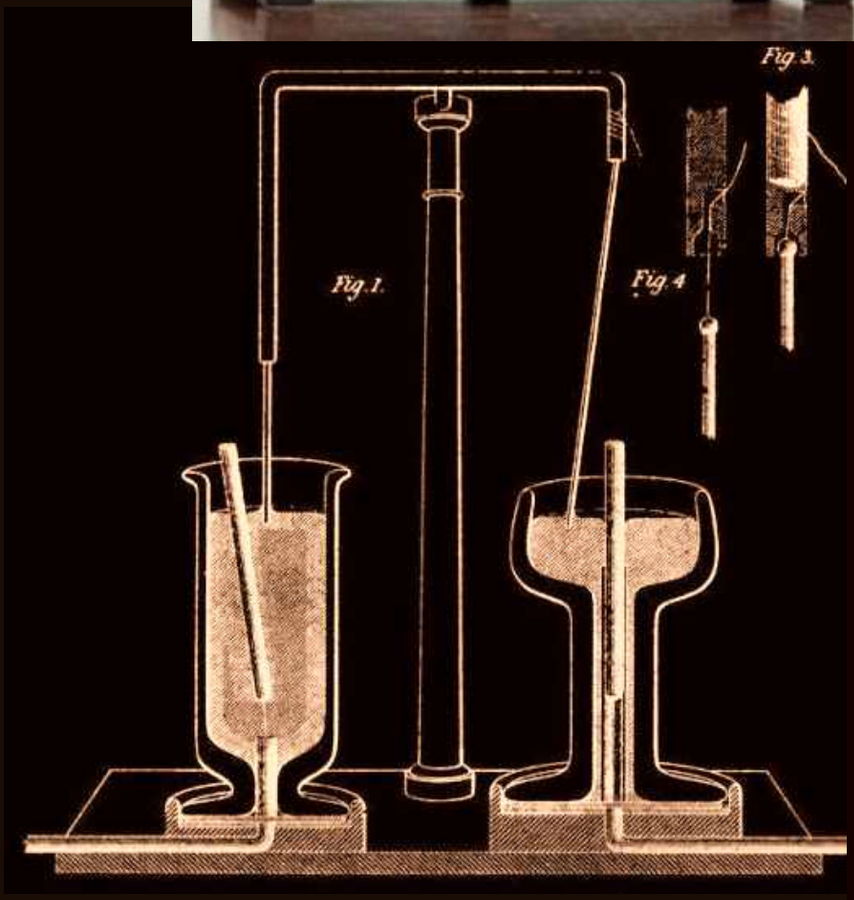
Voltaic pile

copper /zinc

Allesandro Volta

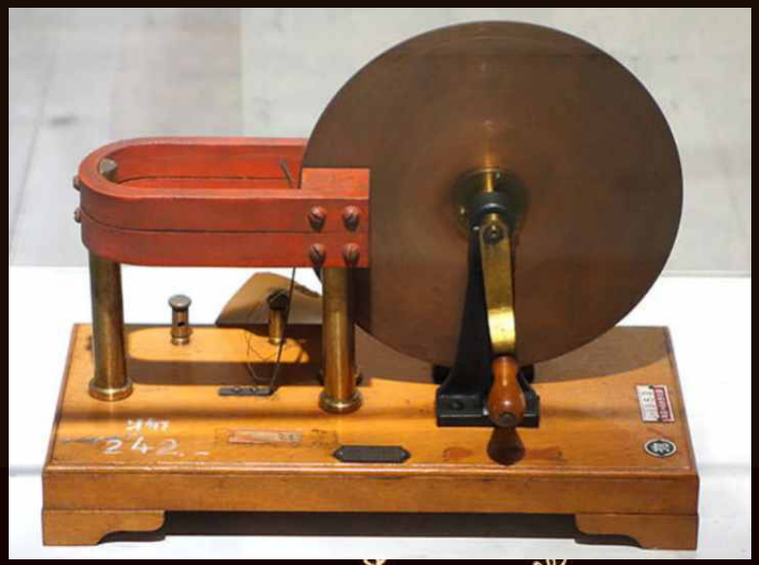
1821

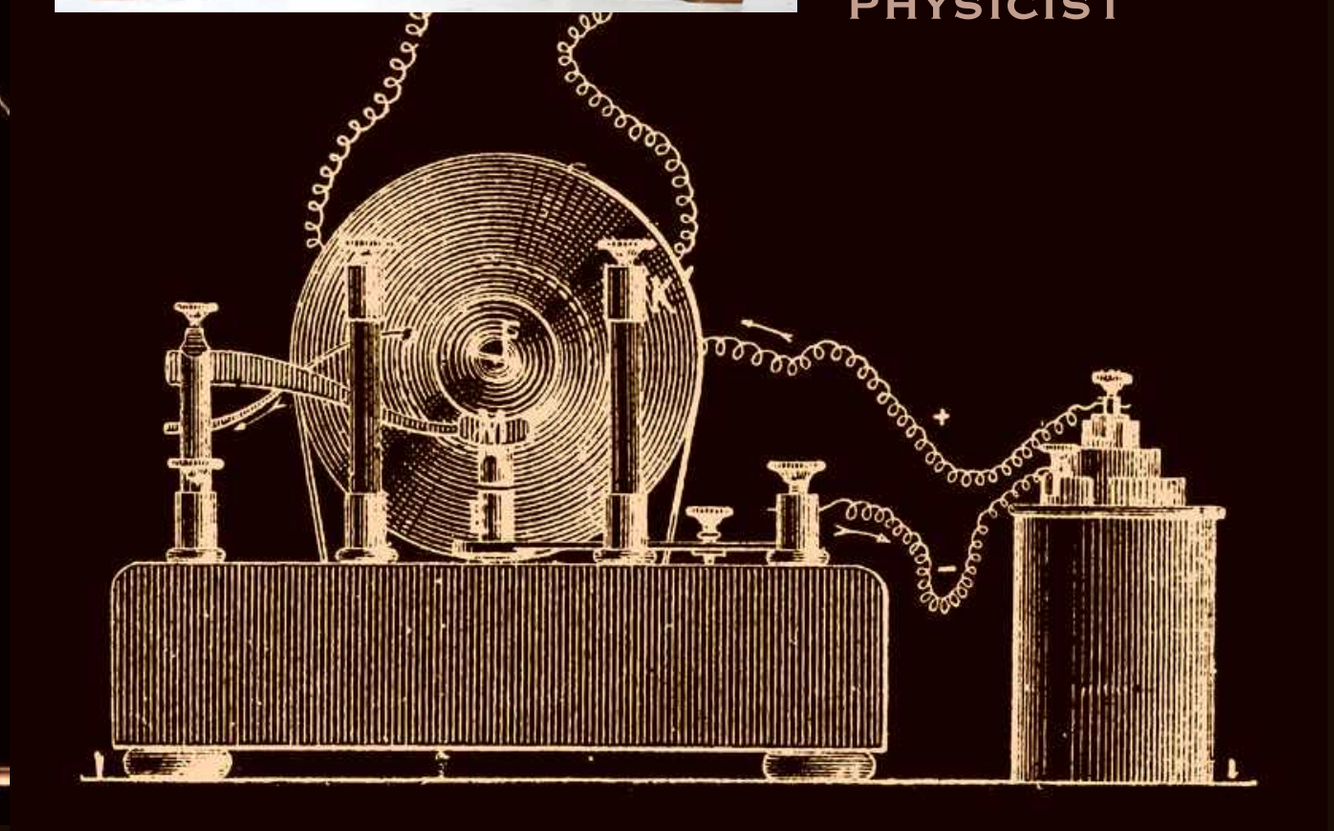
MAGNETIC ROTATION



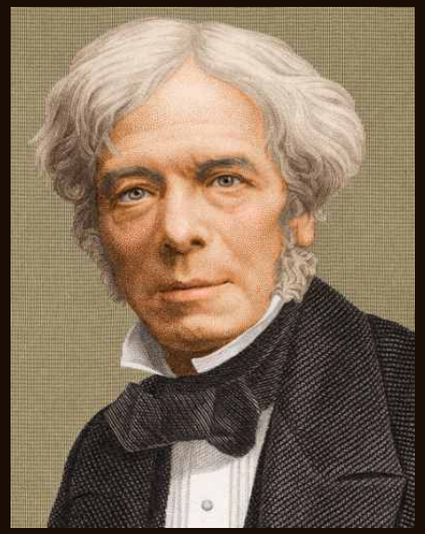
1831

DISC GENERATOR





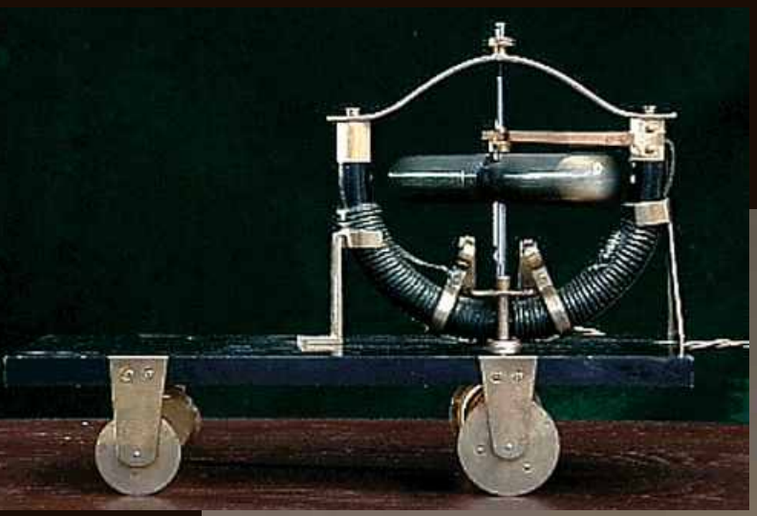
MICHAEL FARADAY

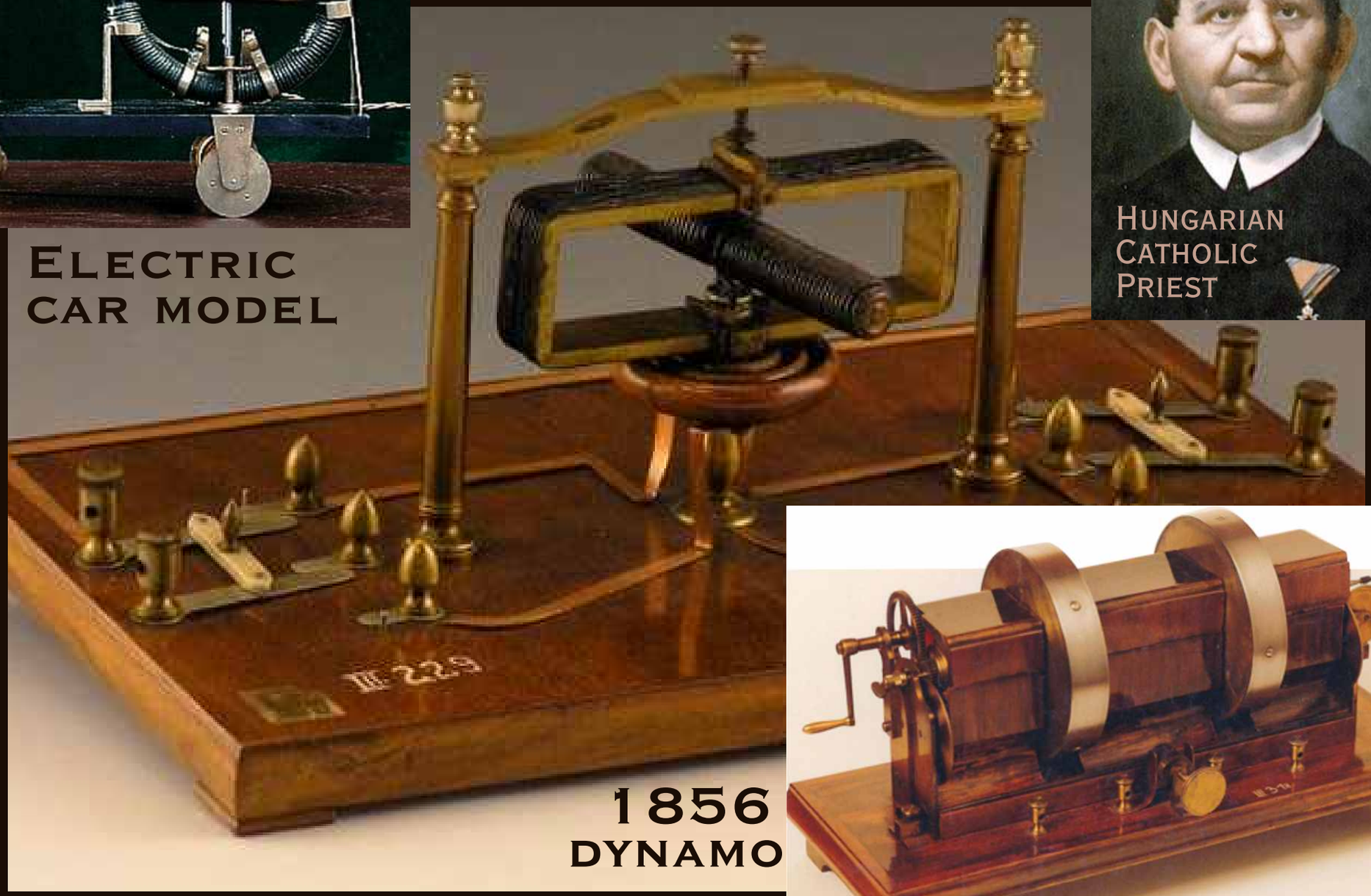


BRITISH PHYSICIST

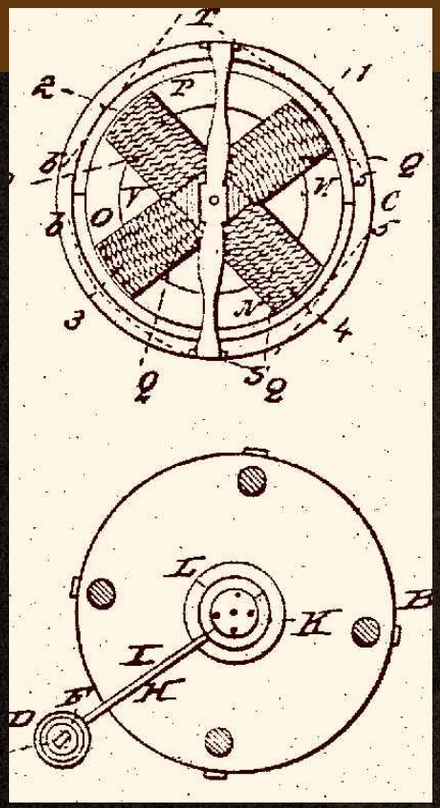
1828
DC motor

Anyos Jedlik





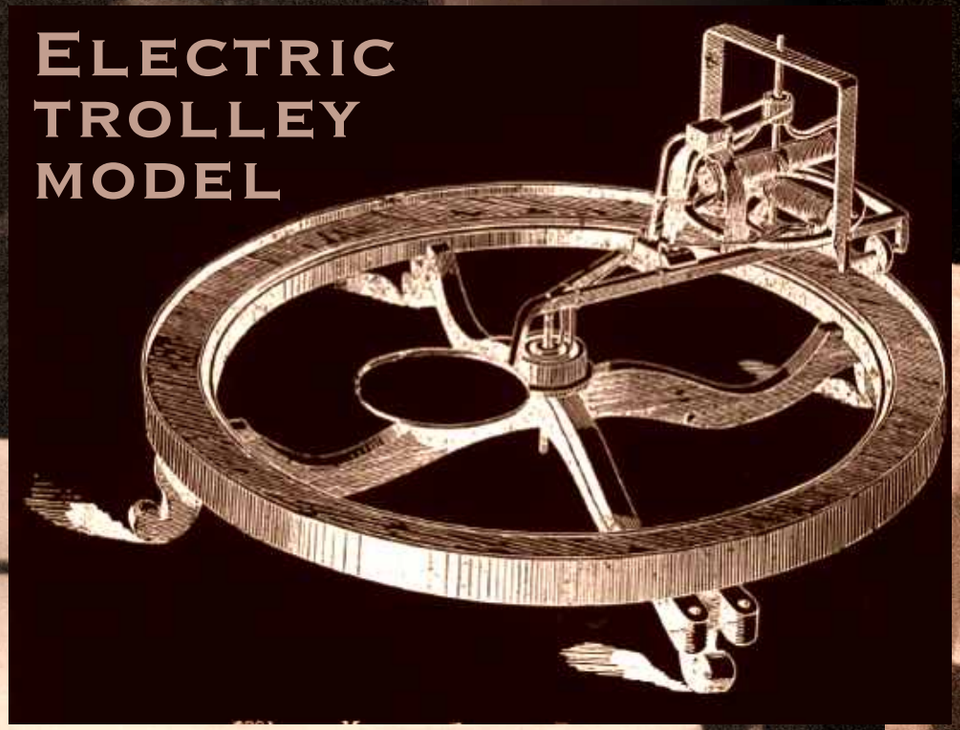
1833
DC Motor



Thomas Davenport

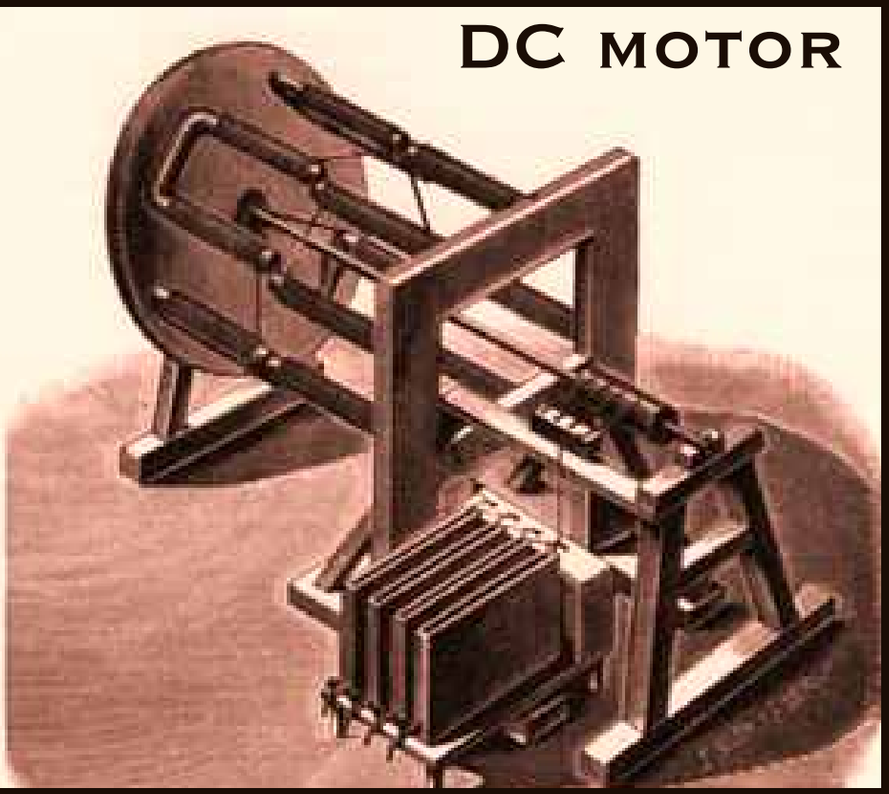
Vermont blacksmith

1835
Electric trolley model



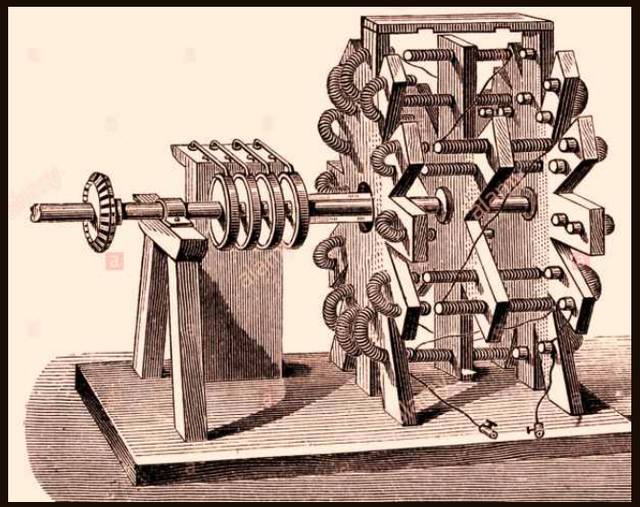
1837
First US Electrical patent
US 132

1834

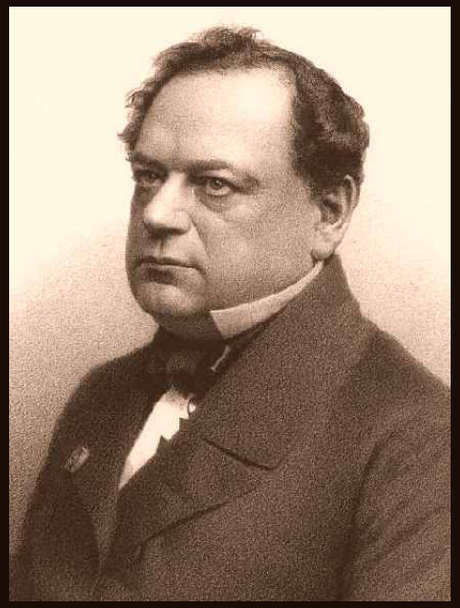


1838

Electric paddlewheel boat for Czar Nicholas



Moritz von Jacobi



Prussian engineer working in Russia

1834

Sibrandus Stratingh

1835

Dutch professor

with assistant Christopher Becker

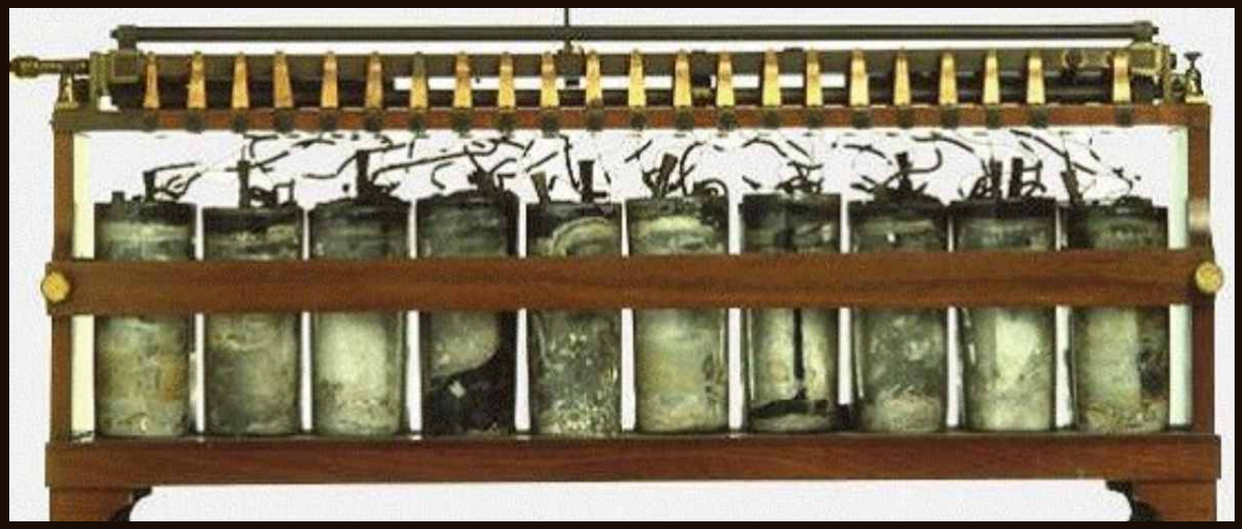
Gaston Plante 1859

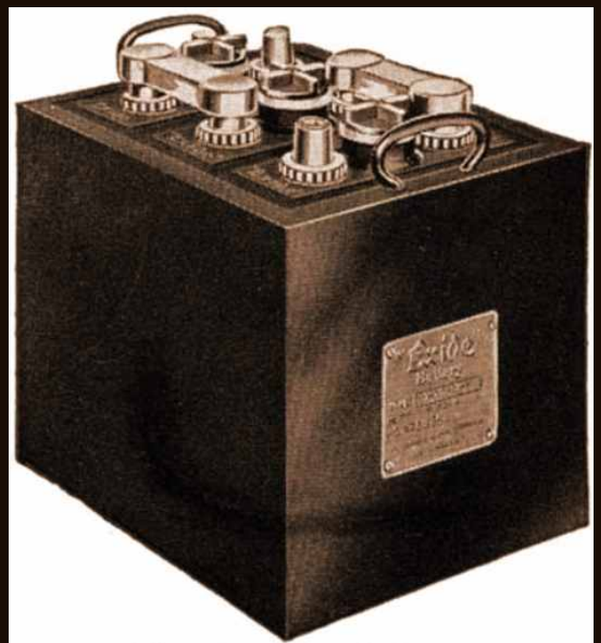
1886 Henri Tudor

Rechargeable Lead Acid Battery

French Physicist

Luxembourg Chemist



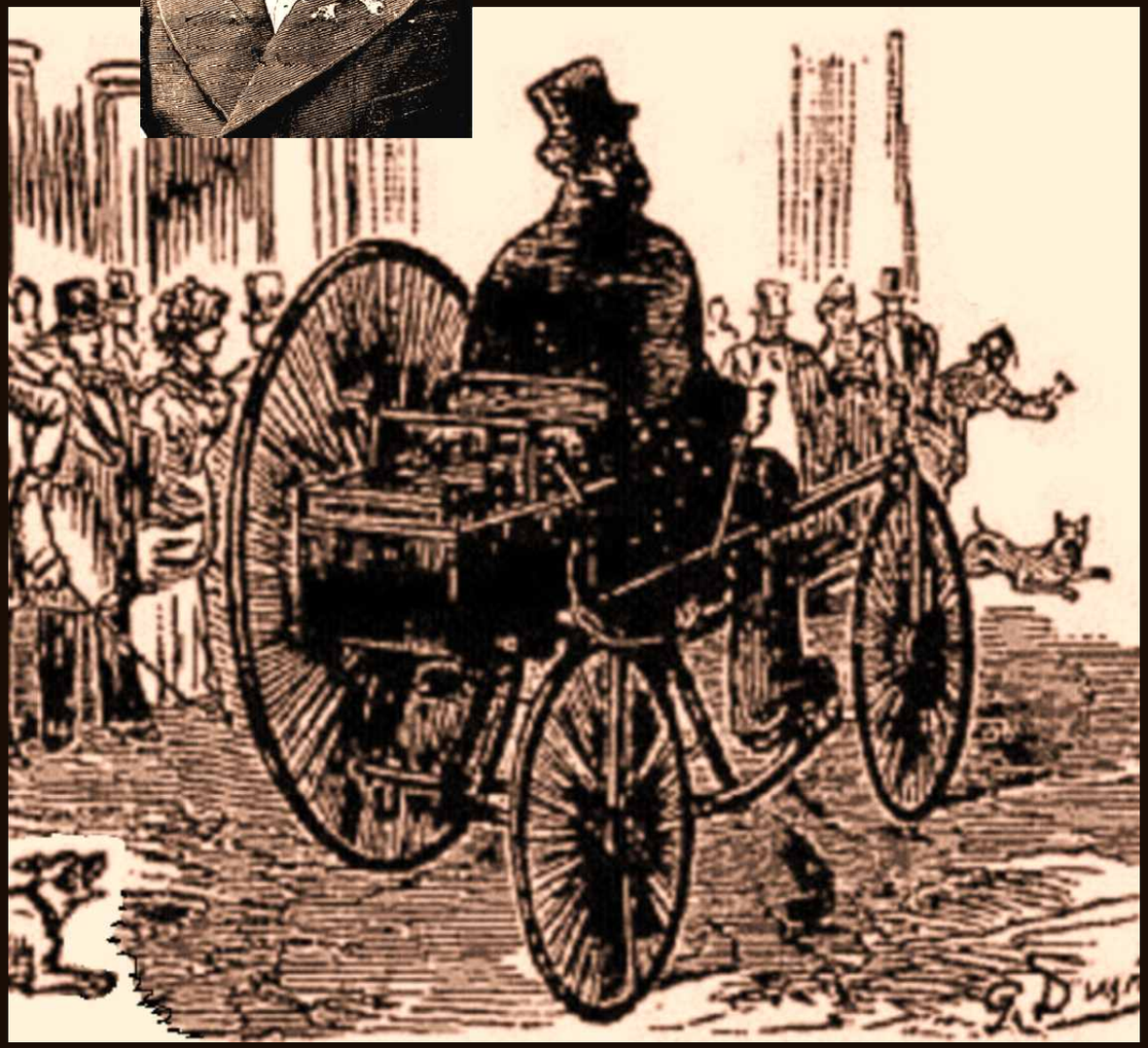


1881

First Electric Vehicles

Gustav Trouve

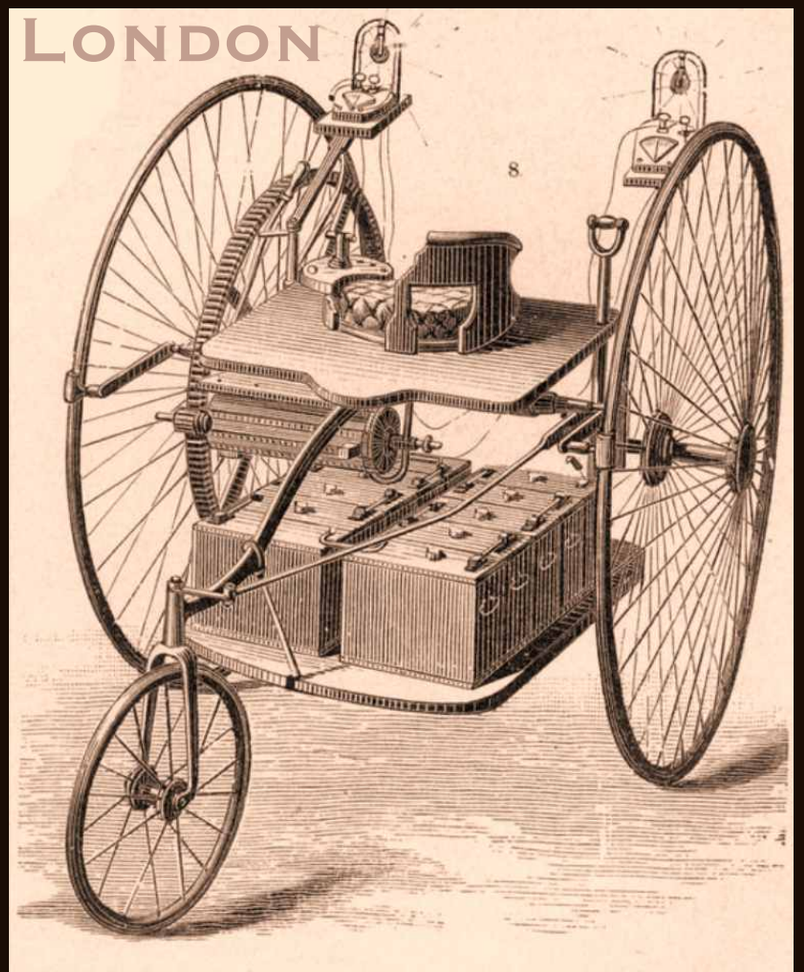
Paris



John Perry

William Ayrton

London

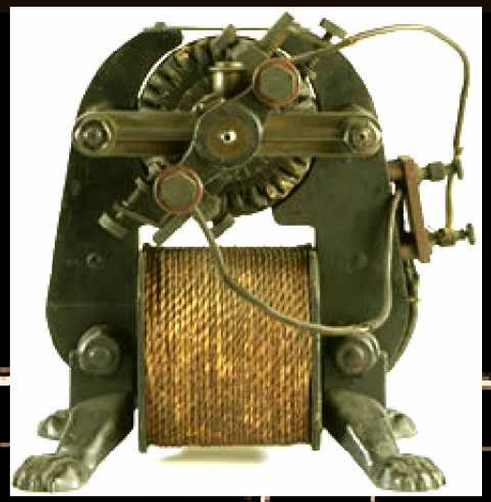


1884

First prototype

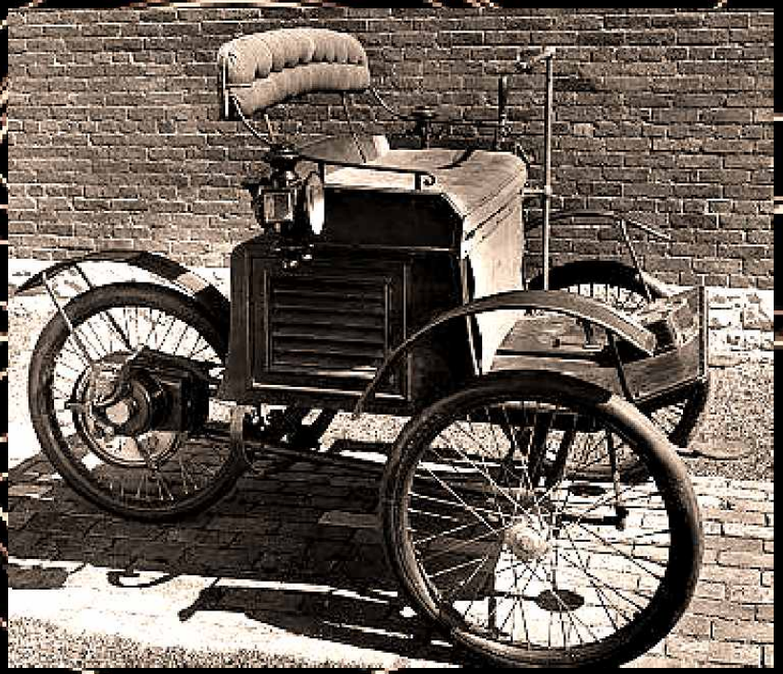
1888

Riker Electric Motor



Andrew Riker

NYC
AUTOMOBILE
DESIGNER
1st PRESIDENT SAE



1890 1891 electric carriage

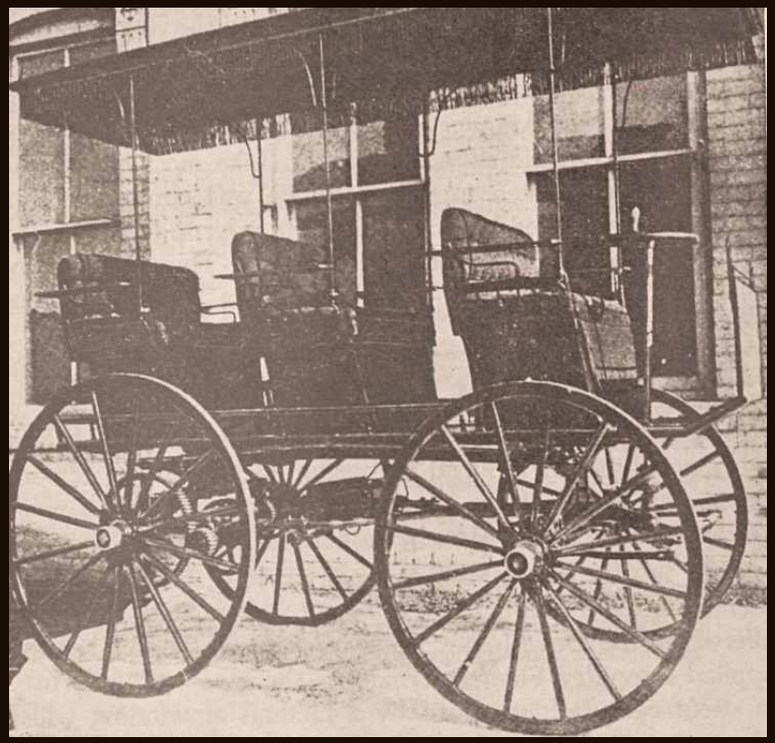
First prototype

Built by to order by Shaver Carriage Co.

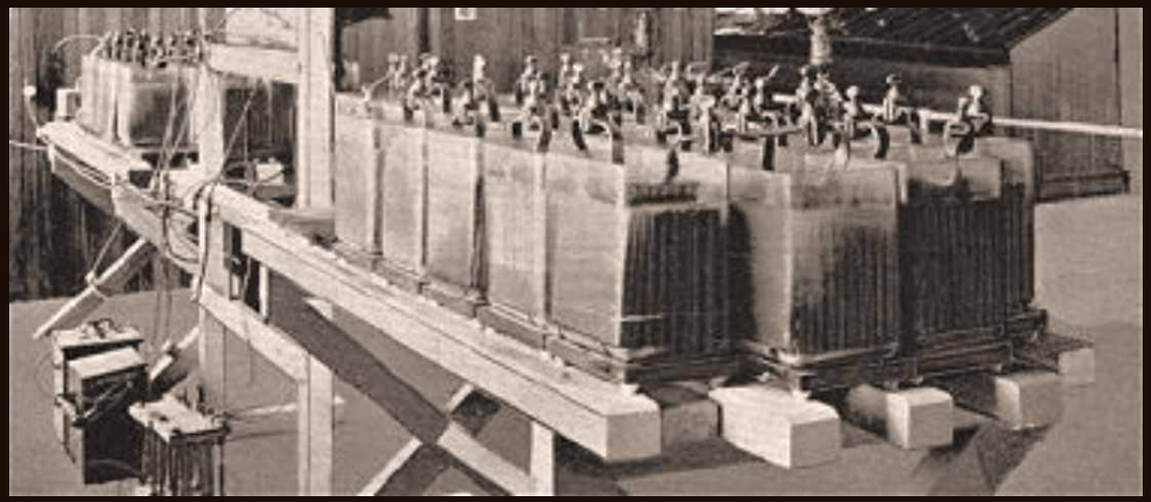
Second prototype

Exhibited at 1893 Chicago World's Fair

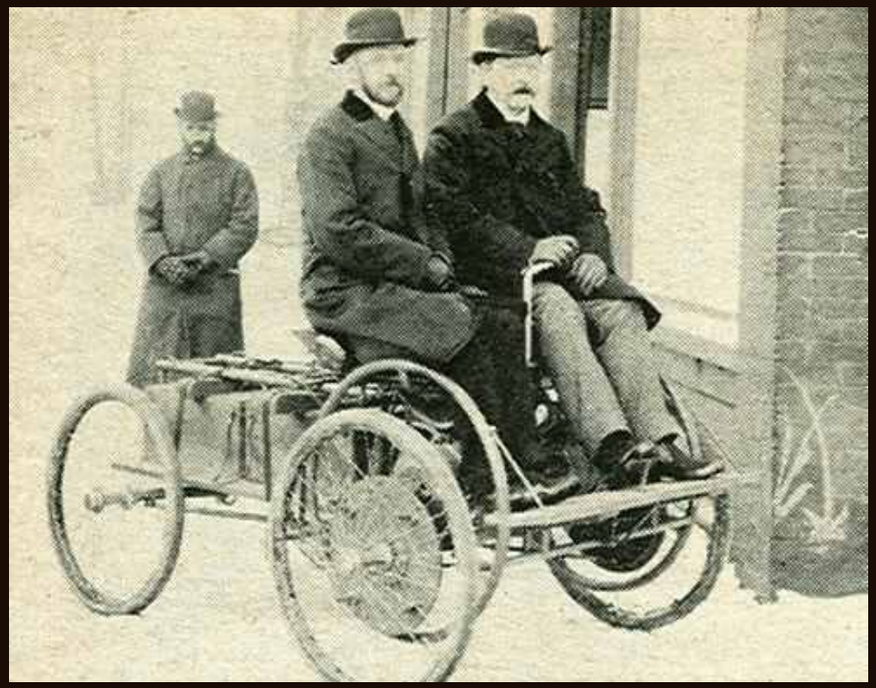
William Morrison
Des Moines, IA
chemist



24 Lead Acid ABC batteries 112 amp @ 48v 13hrs@15mph

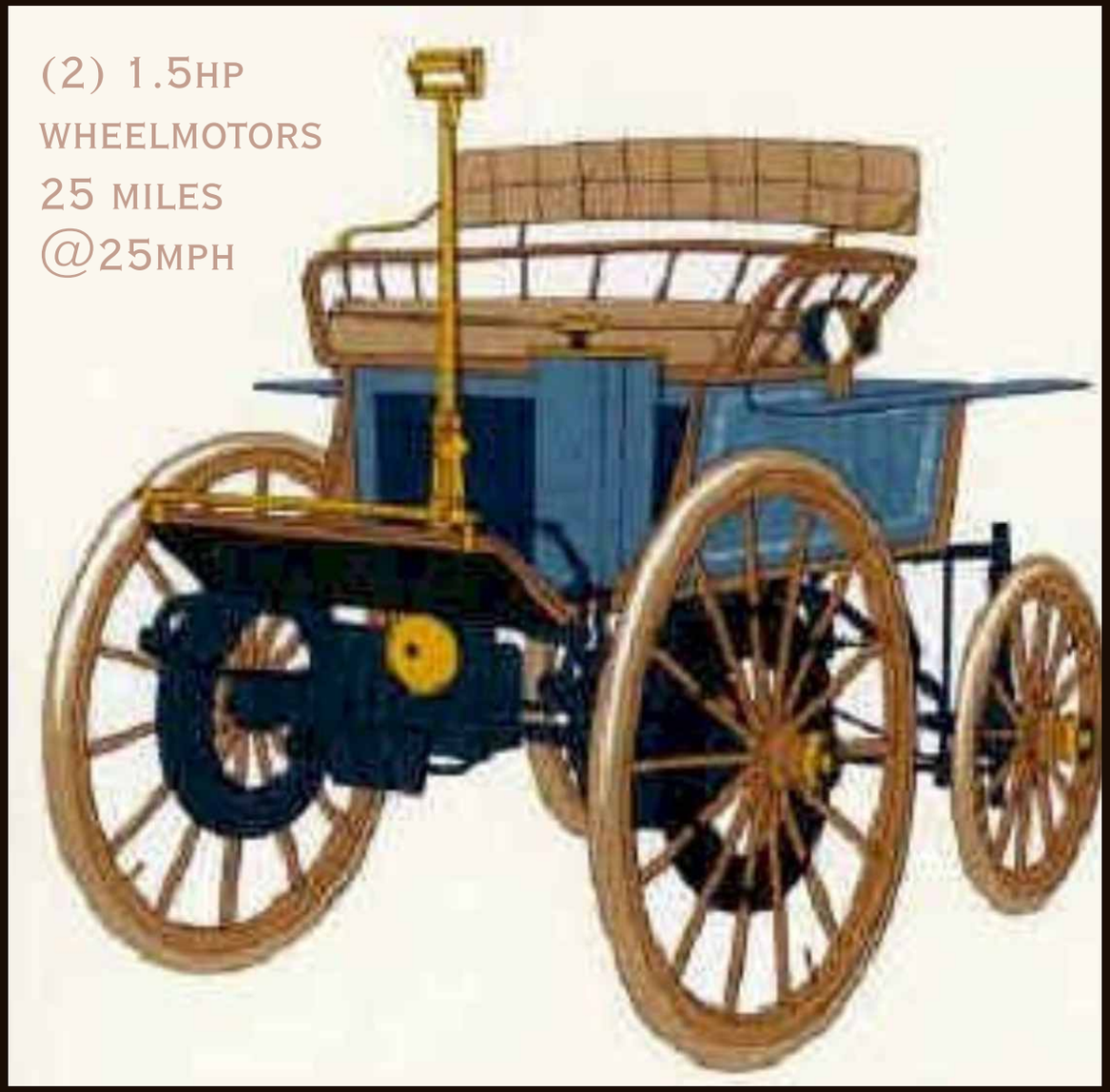


Electrobat 1894



Henry G. Morris - Philadelphia engineer
Pedro G. Salom - Philadelphia chemist

first successful electric automobile



Chicago Times Herald Race 28 November 1895

First Automobile Race
54 Miles $5000. Prizes

6 Starters, 2 Finished
First: Frank Duryea
Motor Wagon
$2000.
10hr:23m

Harold Sturges
Morrison/ABC
Electric Carriage
$500. 13miles

Morris & Salon
Electrobat
gold medal for
best showing in
official tests

Narragansett Park, Cranston, RI 1896

5-9 SEPTEMBER

first closed course auto race in the USA,
50,000 spectators 7 competitors

$900. Won by The Riker Electric Vehicle Company.

1 mile course (3) 5 lap heats

1-Anthony L. Riker
2-Henry B. Morris
3-J. Frank Duryea

1-Anthony L. Riker
2-J. Frank Duryea
3-Henry B. Morris

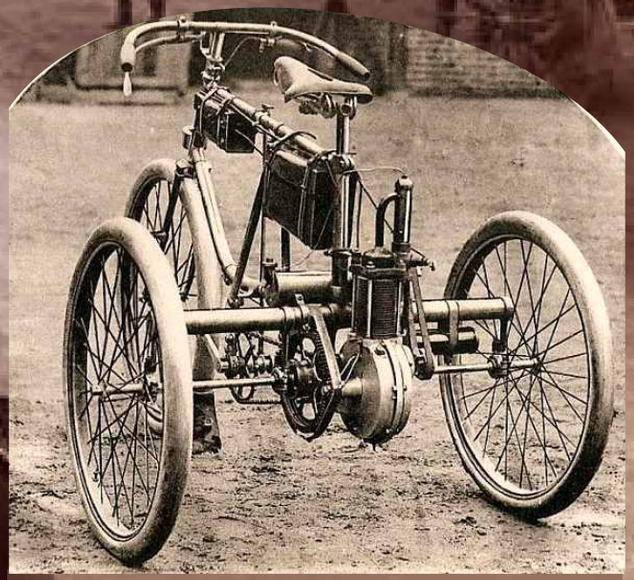
1-Henry B. Morris
2-Anthony L. Riker
3-J. Frank Duryea

Springfield-Babylon, Long Island, NY 1896

50 Mile road race

14 April

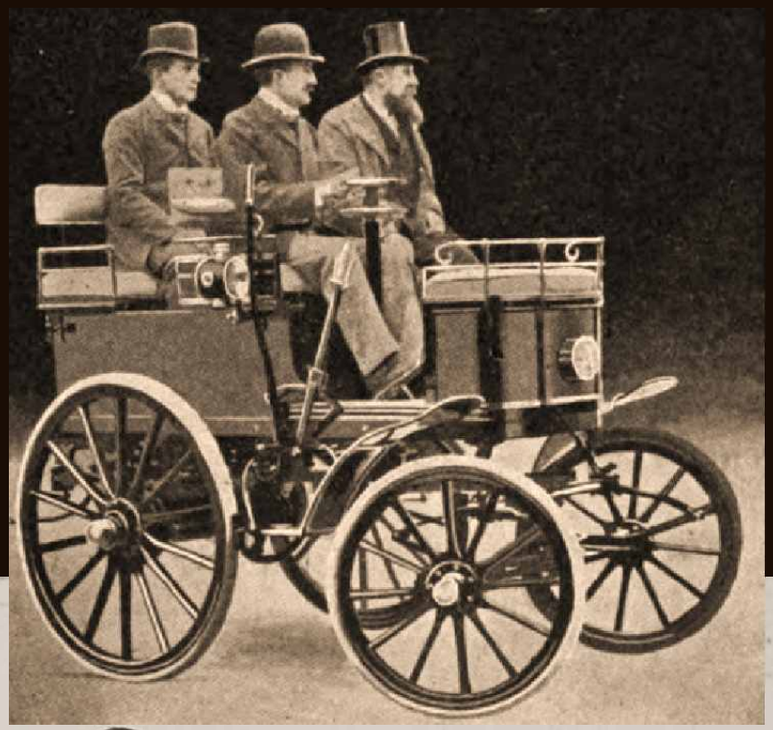
A. L. Riker
2:03:30
25 mph

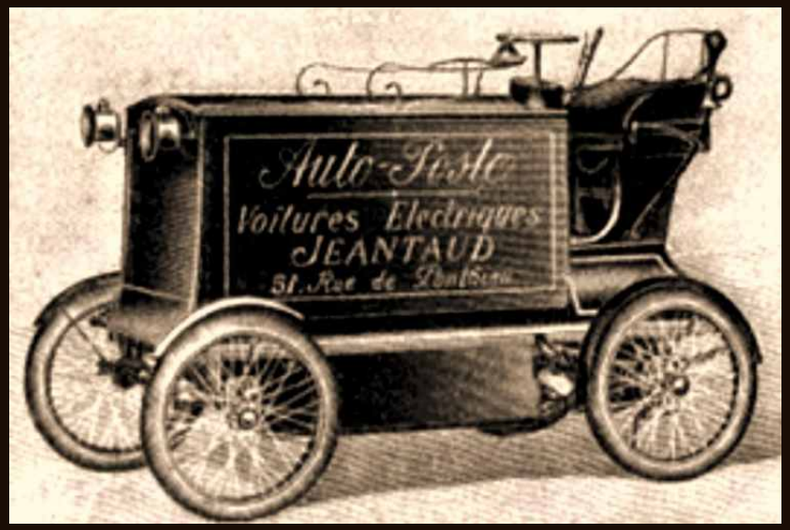


C. H. Tangeman
2.25 hp De Dion-Bouton
1:58:00

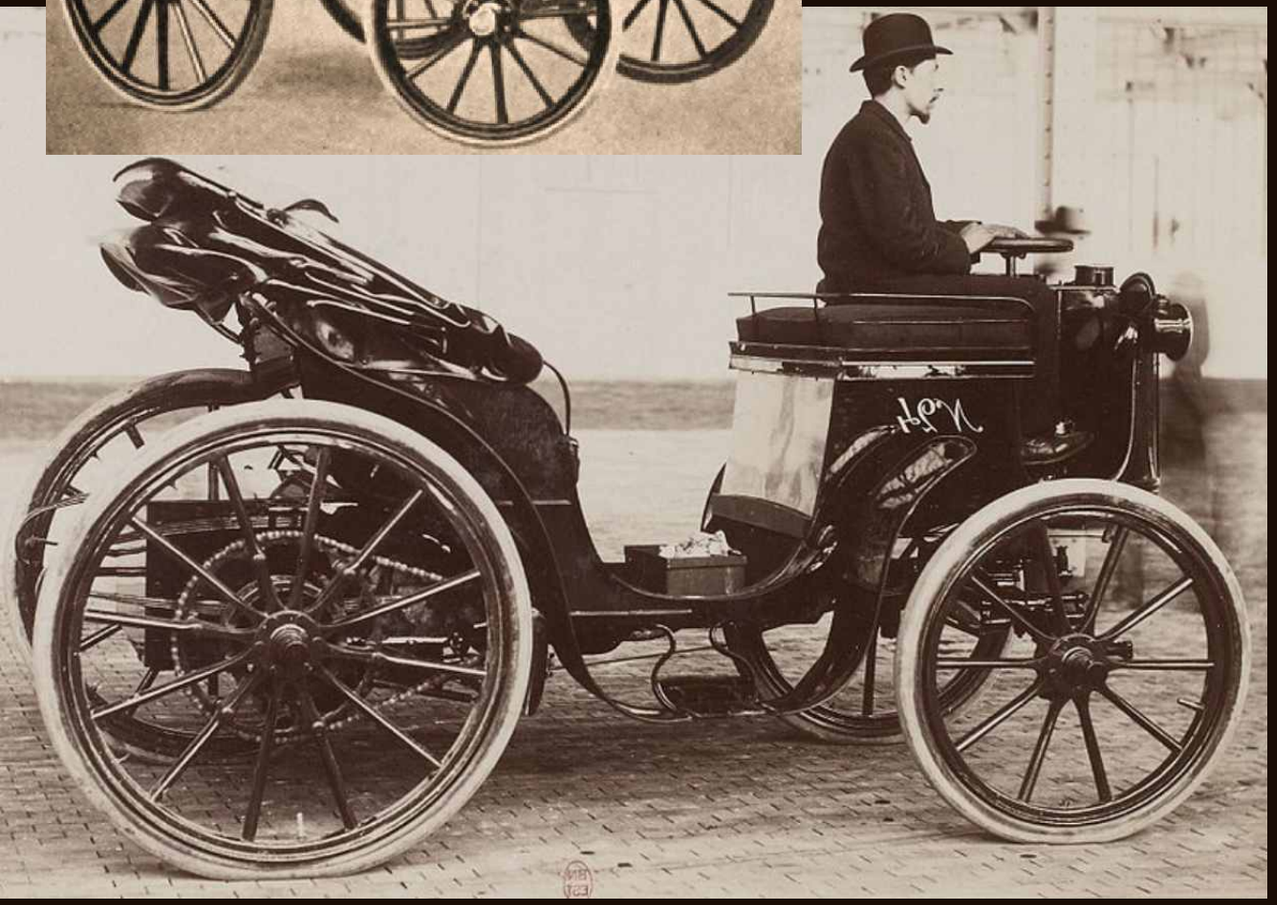
1881

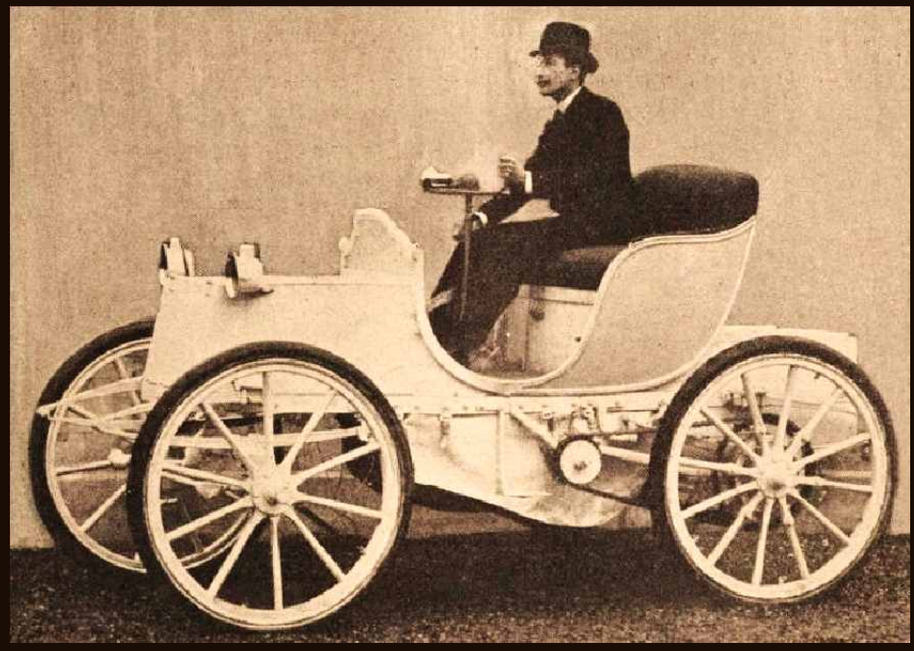
Charles Jeantaud





French automobile engineer



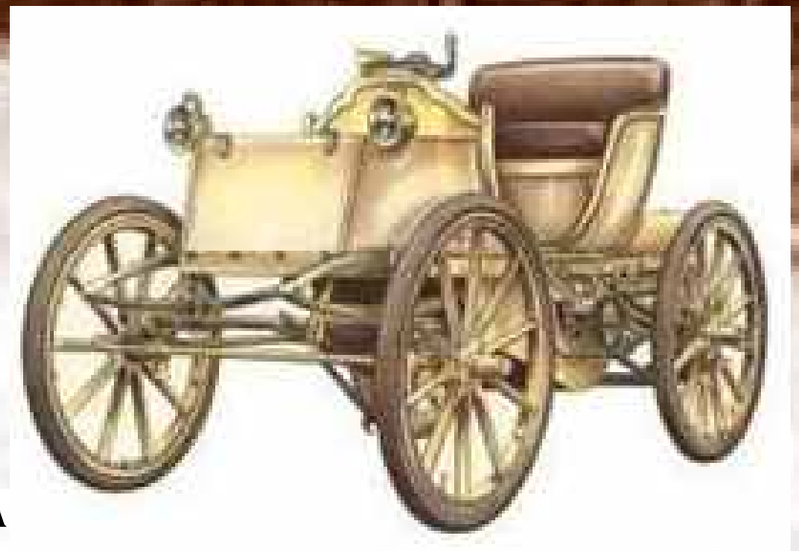


La France Automobile Magazine Trials 18 December 1898

Acheres (near Paris) France
First LSR 39.25 mph

Le compte Gaston de Chasseloup -Laubat

The Electric Count



36 hp Jenta
Fulman alkaline batteries

17 January
second LSR 41.42 mph

CGA Electric Dog Cart

one 80 cell Fulmen lead acid battery

Camille Jenatzy

Belgian race car driver

17 January
third LSR 43.6 mph

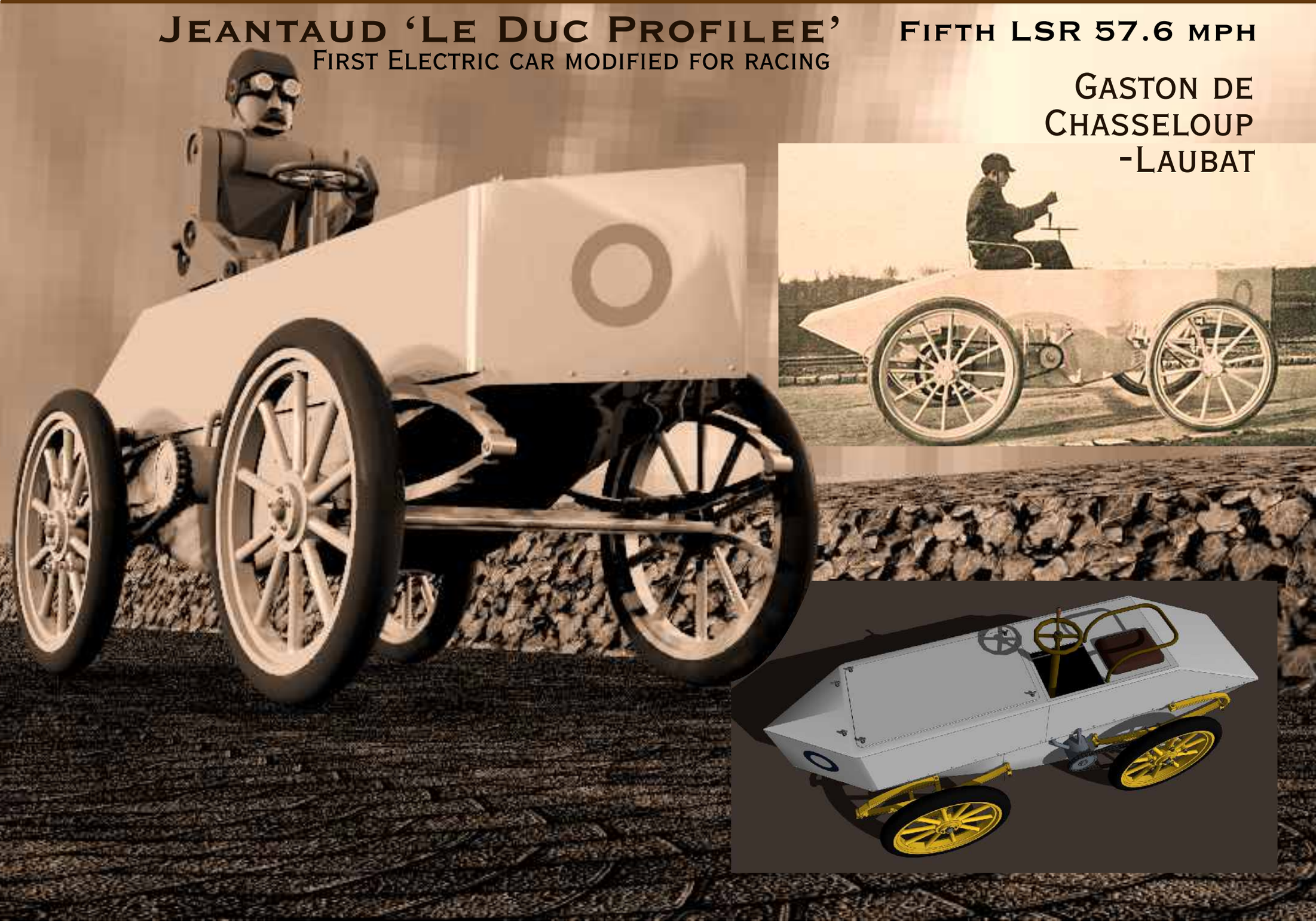
27 January
fourth LSR 49.93 mph

Jeantaud 'Le Duc Profilee'

First Electric car modified for racing

Fifth LSR 57.6 mph

Gaston de Chasseloup -Laubat



La Jamais Contente

sixth LSR 65.79 mph

First electric car built for racing

CITA No. 25
Compagnie Internationale des transports automobiles électriques

Camille Jenatzy

(2) 80 cell Fulmen lead acid battery
(2) direct drive Postel-Vinay 25 kW motors, 124 amps at 200 V
68 horsepower.

partinium bodywork

1899

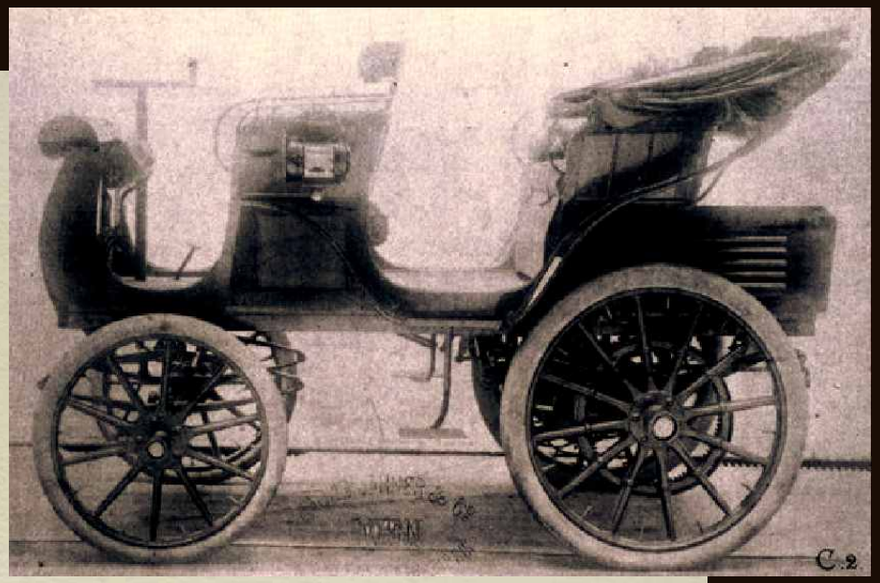
Camille Jenatzy 'the red devil'

Egger-Lohner electric vehicle, C.2 Phaeton model (P1) 1898

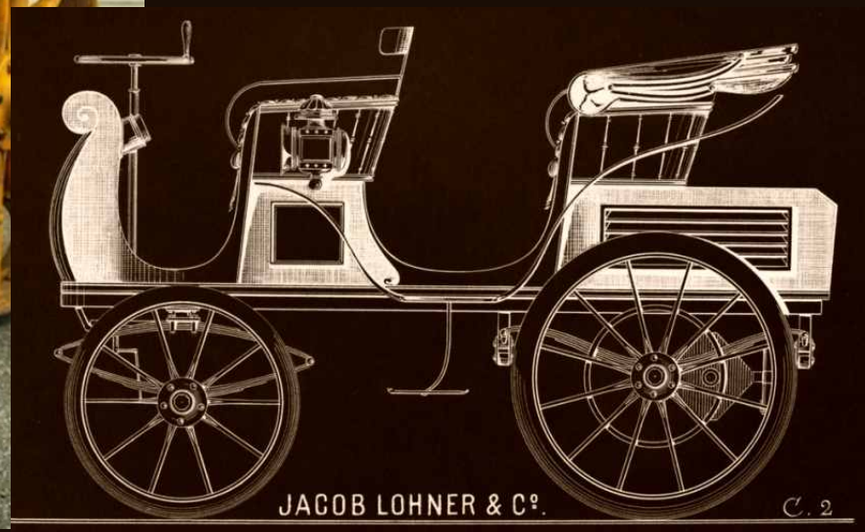
5 hp 22mph 80amp 110v
49 mile range
3000 lb (1000lb batteries)

1899 Won Berlin 40km
Electric road race by 18 min.
over 28 entries and
won energy efficiency prize

Dr. Ferdinand Porsche



Austrian automobile designer age 22



Lohner-Porsche- La Toujour Contente 1900

Grand Prize 1900 Paris World Trade Expo
series hybrid 8000 lb total

Lohner-Porsche- Semper vivus 1900

2,640 pounds

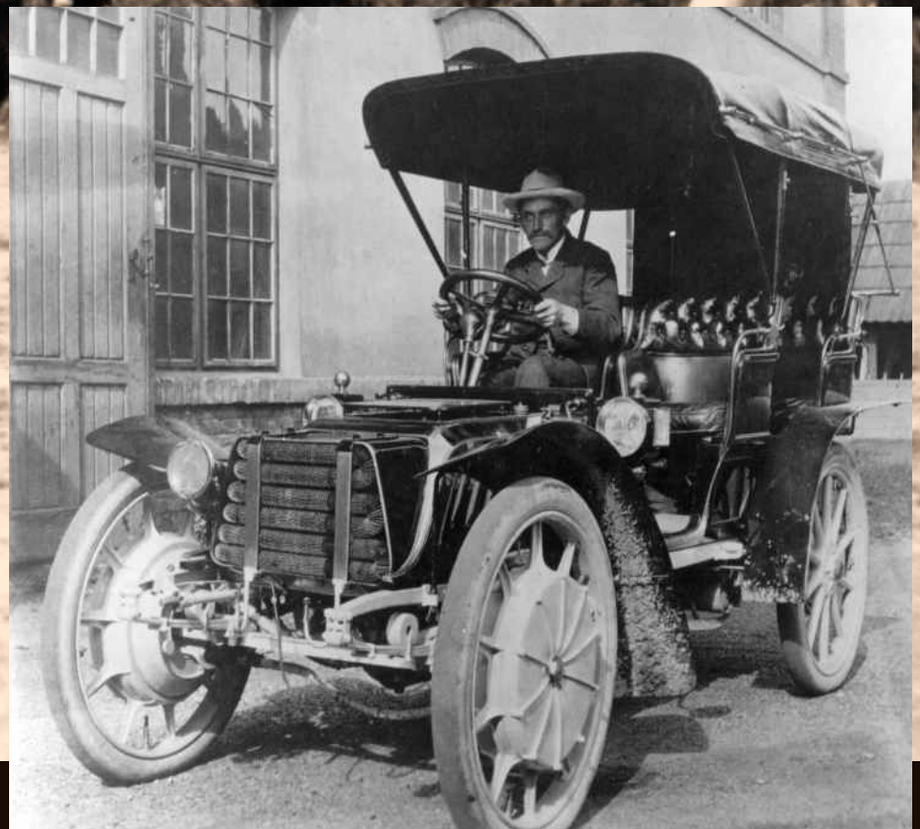
(2) one-cylinder
De Dion-Bouton
engines 2.5 hp ea

(2) generators
20 amps @ 90 volts ea

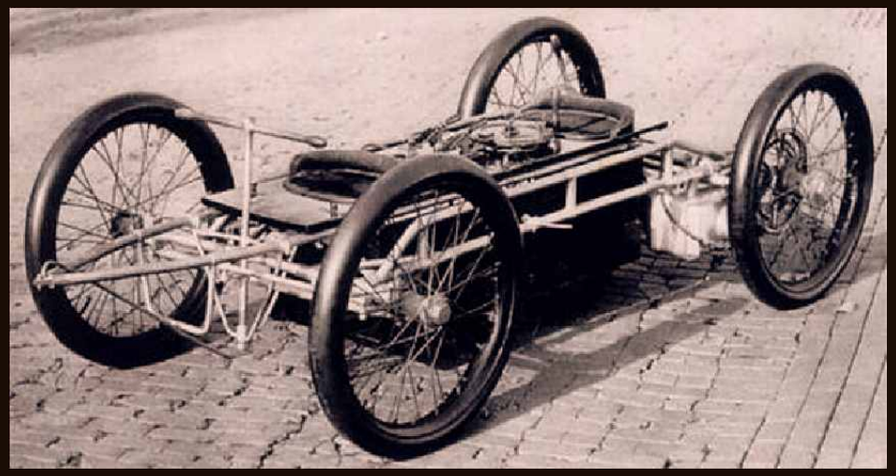
(2) wheel motors 5 hp ea

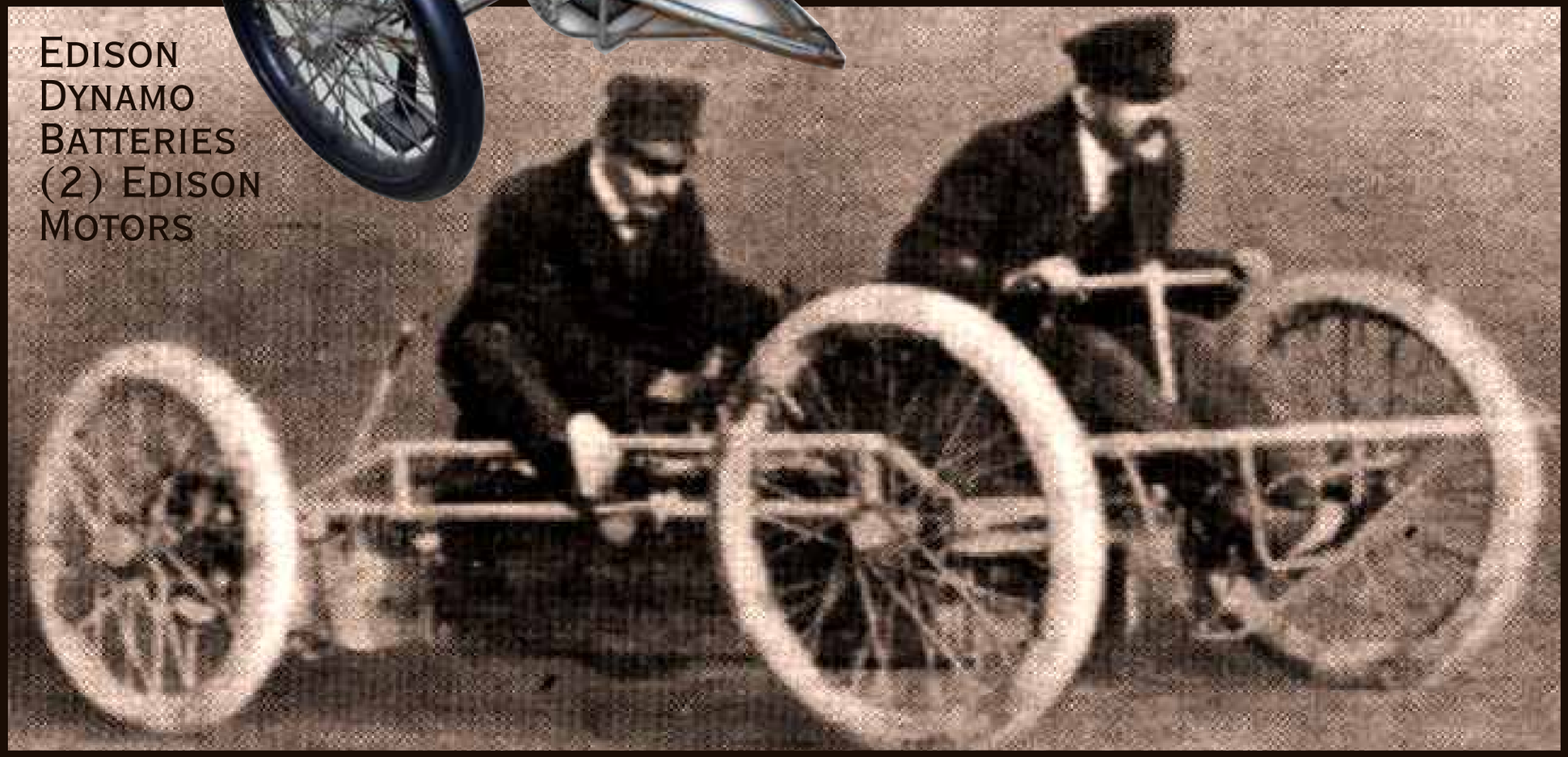
Lohner-Porsche- Mixtewagen Hybrid 1901

5.5-liter Austrian Daimler
25 hp engine
powering
generator



Riker Torpedo 1901



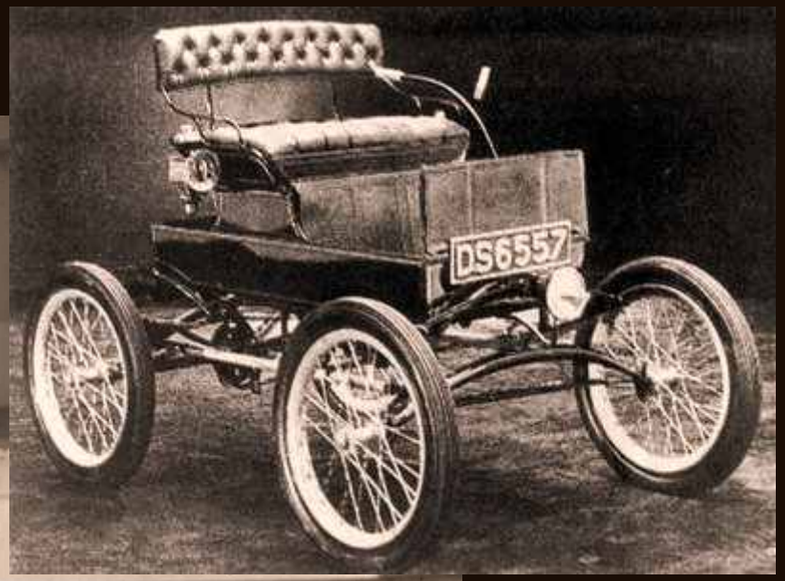


U.S. Electric LSR 57.1 mph Coney Island, NY

1898

Walter Baker

Thomas Edison's first car

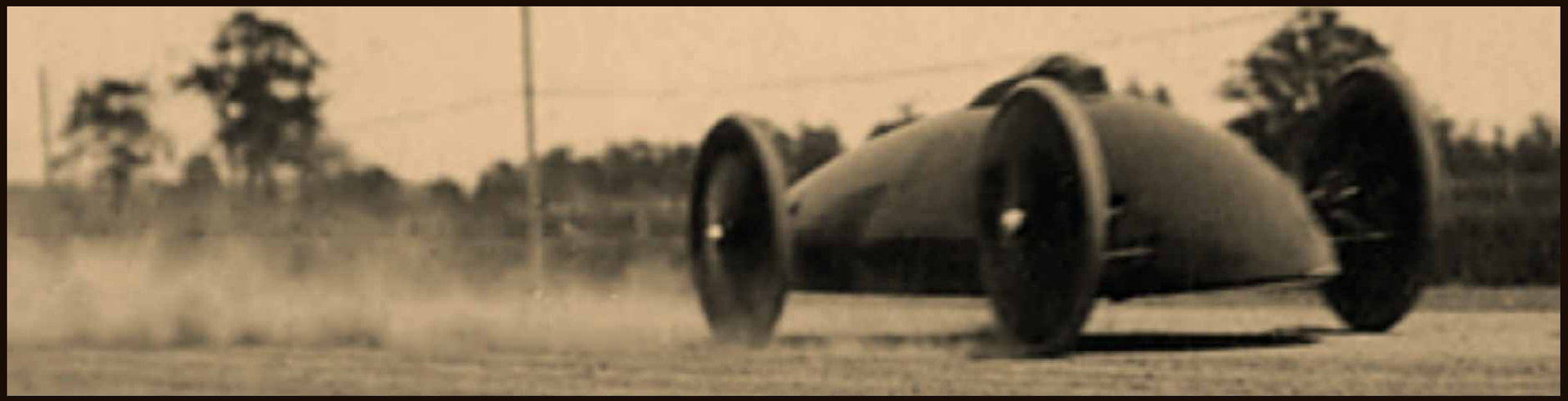


Cleveland Industrialist

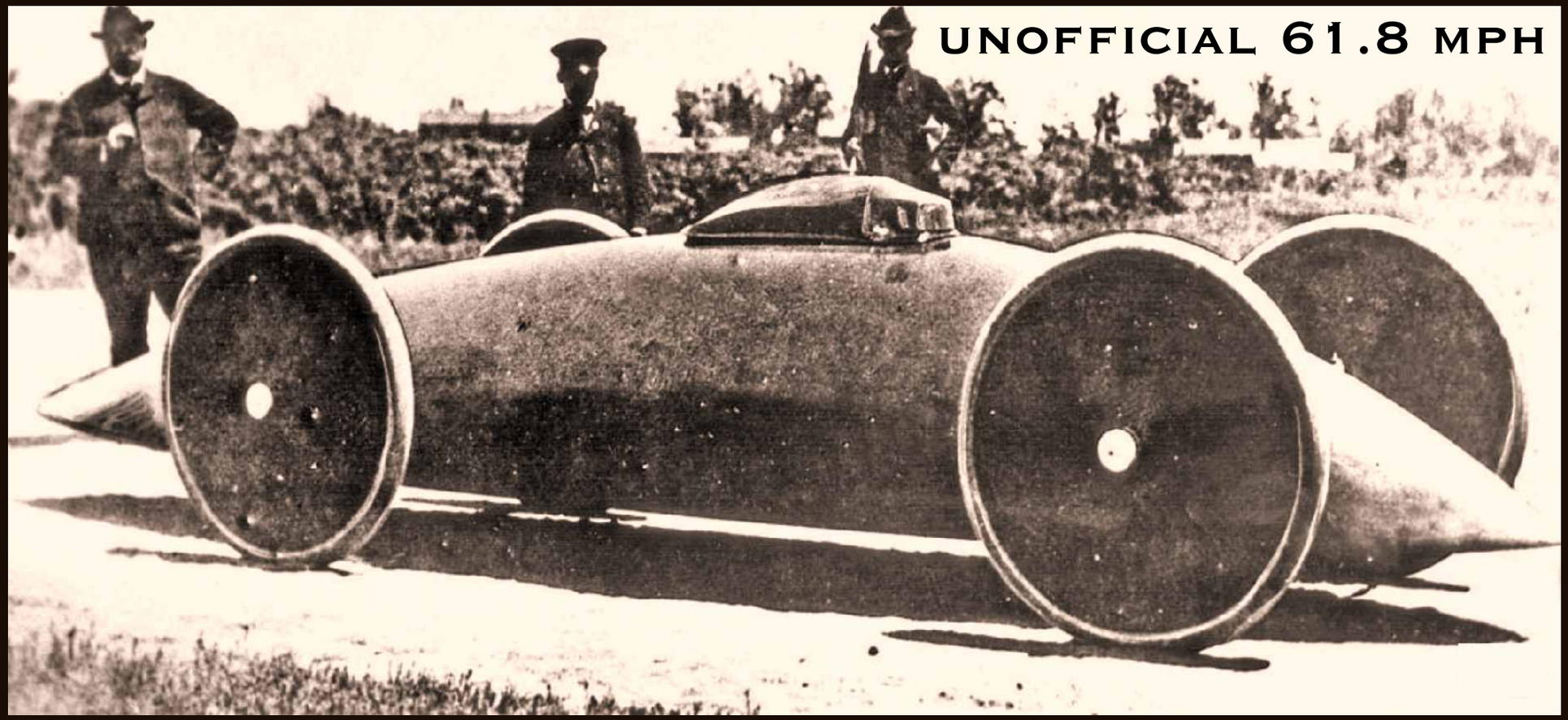
Baker Torpedo 1902

Baker Torpedo 1902

31 May

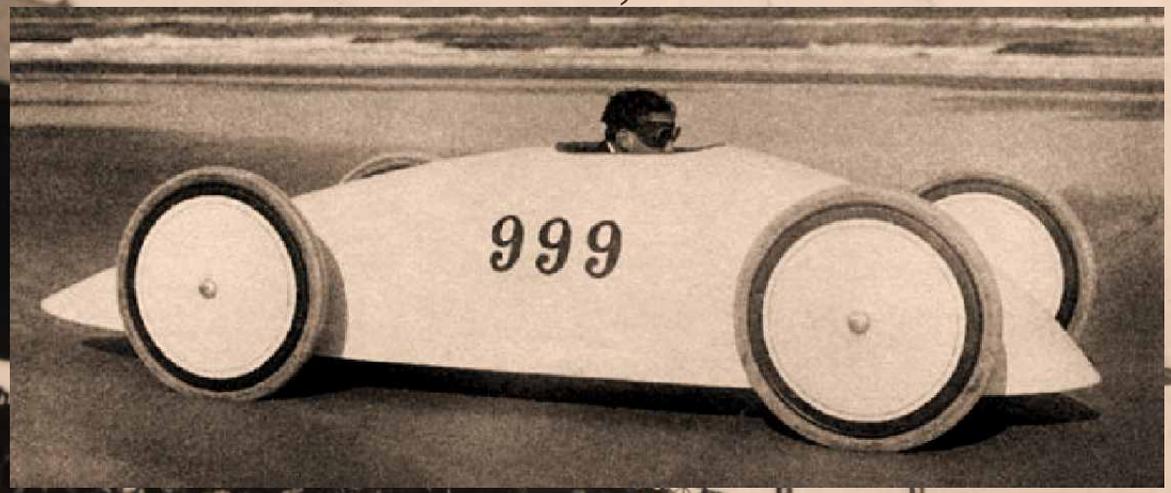


Automobile Club of America Speed Trial-Staten Island, NY

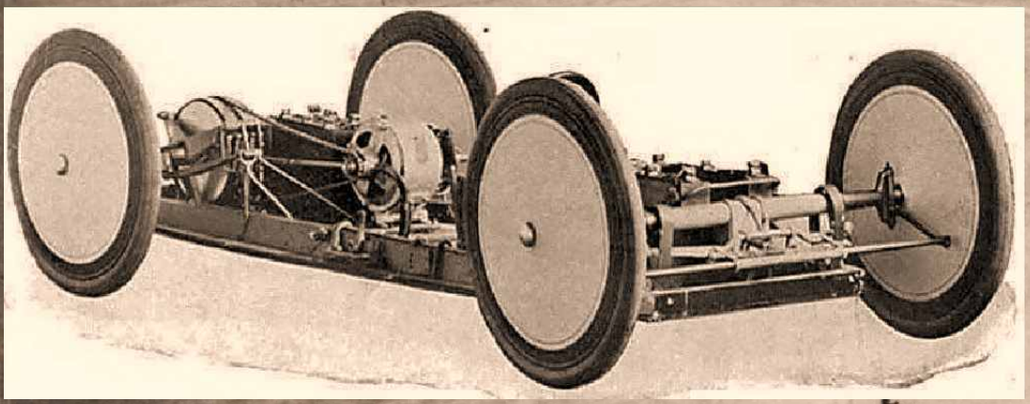


Baker Torpedo Kid 1903/04

1904 Ormond Beach, FL unofficial 62 mph



Glenville Park, Cleveland, OH

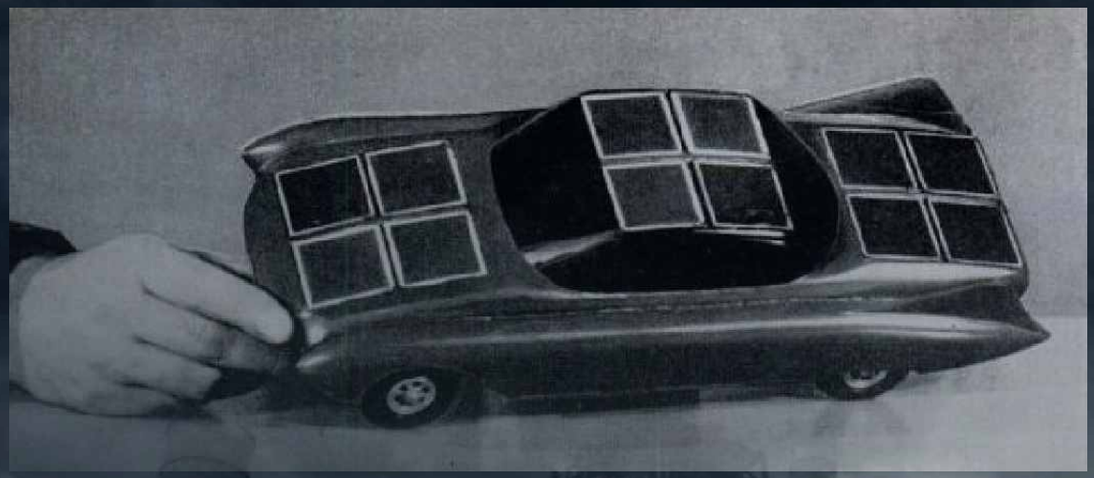


1.5 HP motor from production car

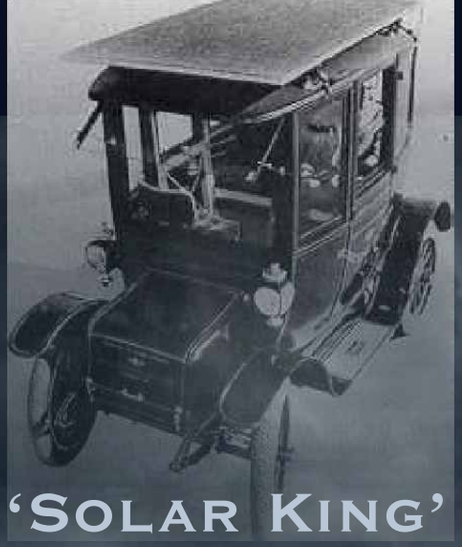
THE DARK AGES

1954 1955 1959

First photo-voltaic cell Bell Labs



GM Sunmobile working models

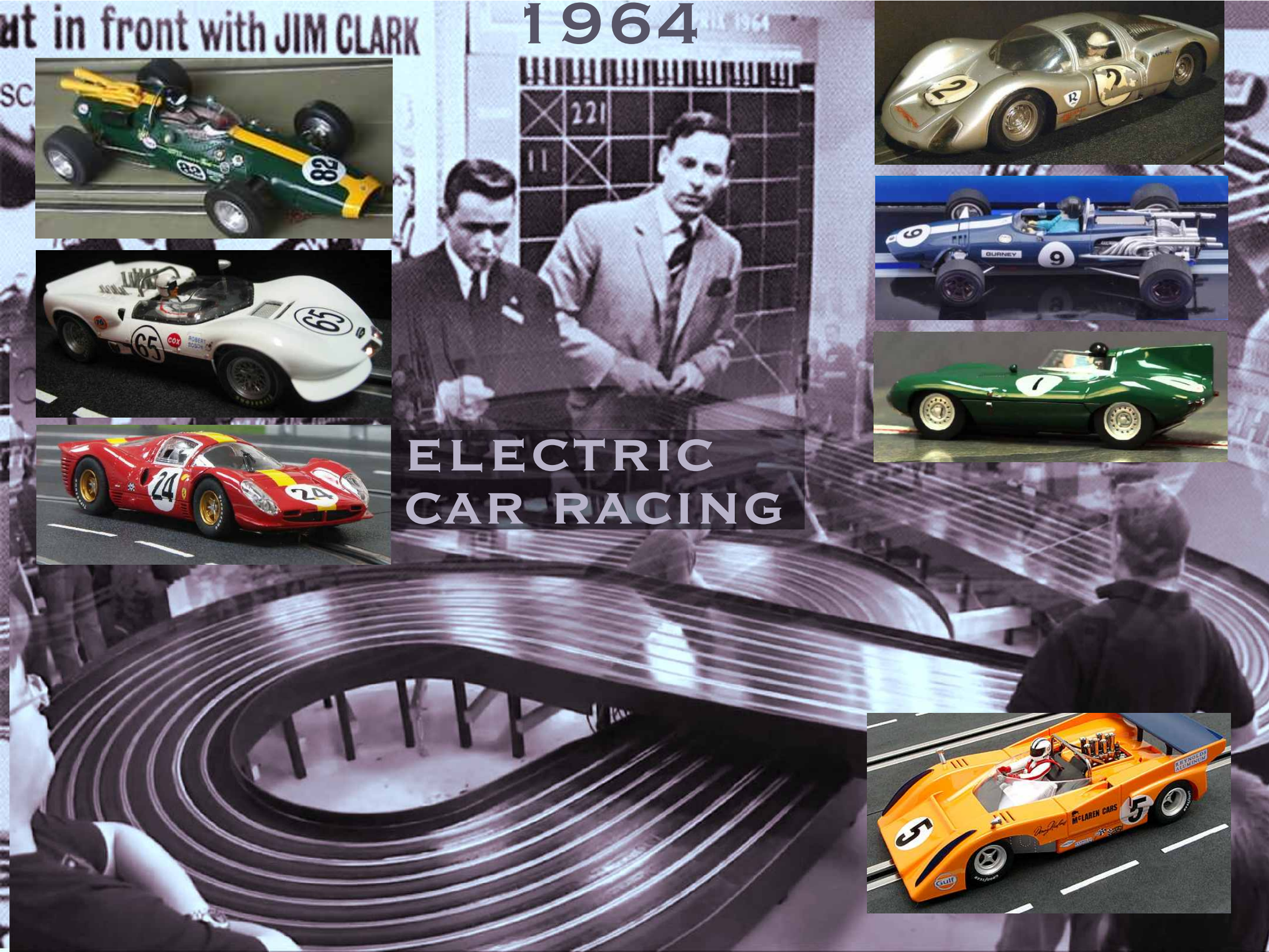


'Solar King'

International Rectifier Co. 200w PV on 1912 Baker

1964

ELECTRIC CAR RACING

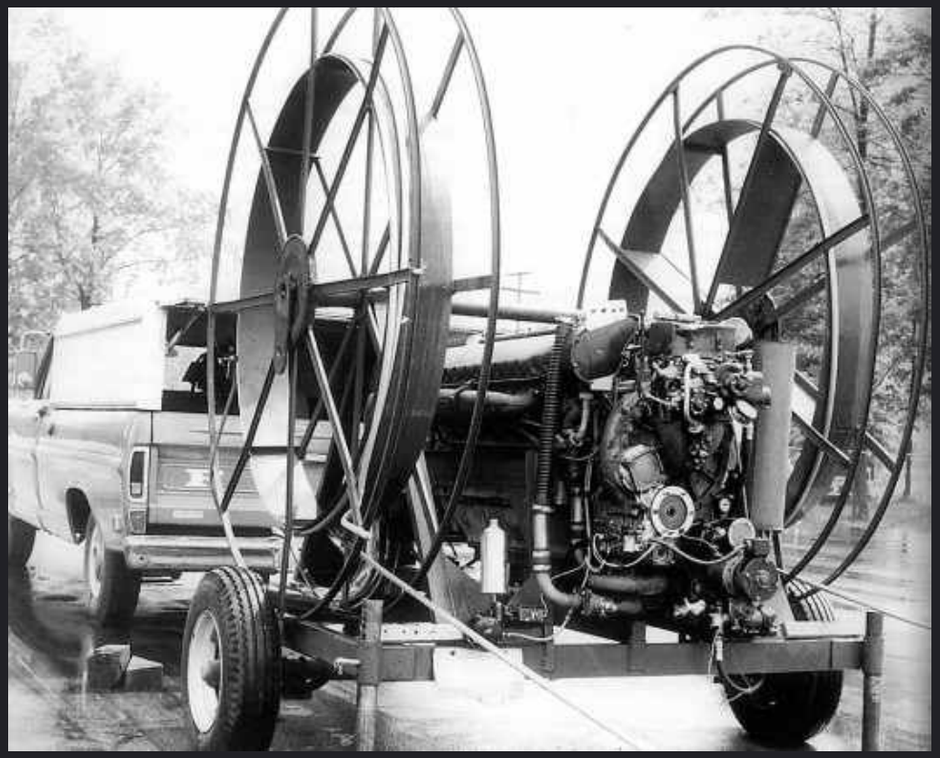


E. J. Potter 'the Michigan Madman' 1968

MG 1100
(4) 200 hp
aircraft
starter
motors

1/4Mile@120mph

v12 Allison
Aircraft engine,
Generator and
1320' extension cord

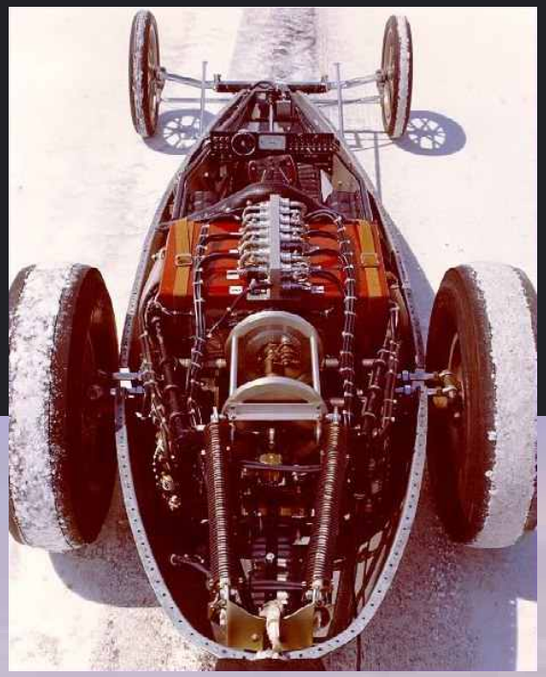


Great Transcontinental Electric Car Race

September
1968
campus
to campus
210 hrs

1970 Clean Air Race

Silver Eagle 1971



Max: 152.6 MPH

180 rechargeable silver-zinc cells
40 Amp hrs @ 216 v
102 hp GE series wound DC motor

1,070 lbs Class 1 <1,102 lbs)
1,160 lbs Class 2 >1,102 lbs)

Lightning Rod 1997

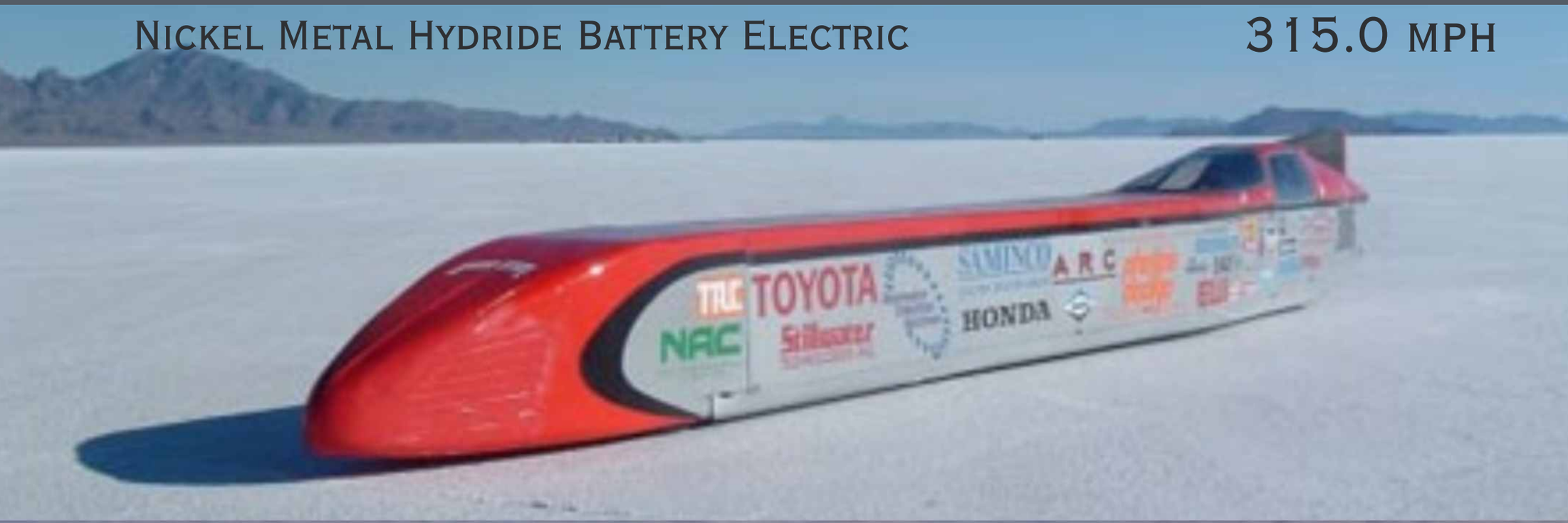
215.3 mph

245.5 mph

White Lightning 1999

Ohio State University Buckeye Bullet 1997

Nickel Metal Hydride Battery Electric 315.0 mph



Hydrogen Fuel Cell Electric 303.0 mph

Ohio State University Buckeye Bullet 2 2009

Ohio State University Buckeye Bullet 2.5 — 2010

Lithium-ion Battery Electric

307.7 mph

Lithium-ion Battery Electric 3000 hp

341.4 mph

Ohio State University Buckeye Bullet 3 — 2016

Brigham Young University Electric Blue 2014

204.9 mph
FIA Class 1
Electric

400 amp
A123 lithium-ion
cells.

1994
GM Impact (Ev1)
183 mph

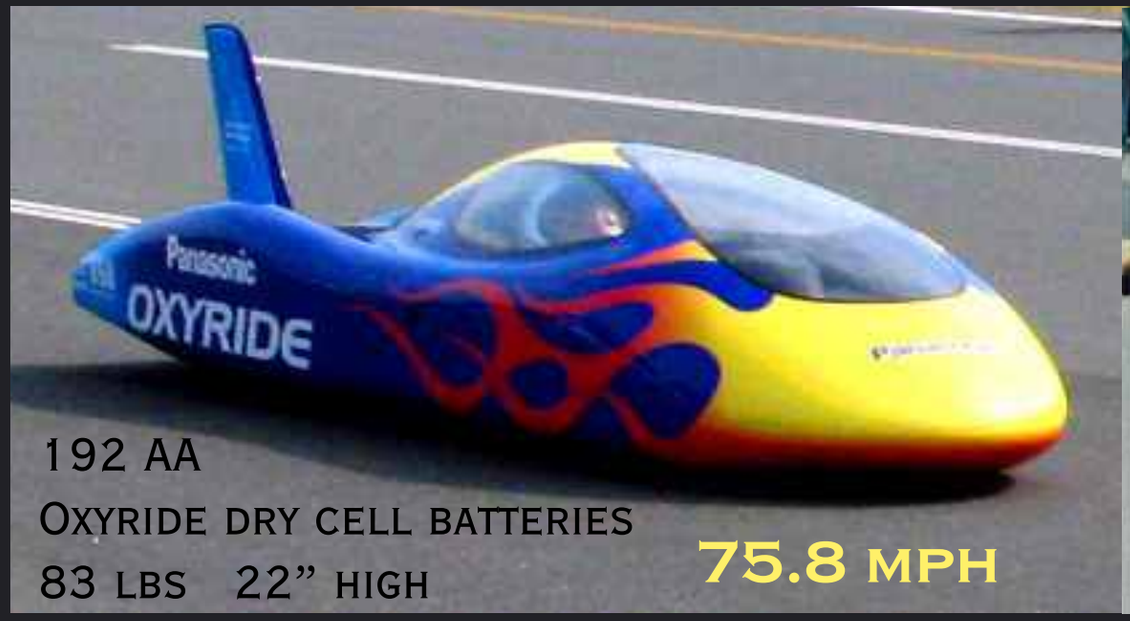
2004
Toyota Prius
131 mph

2007
hydrogen fuel cell Ford Fusion
206mph

2016
Hyundai Ioniq Hybrid
158 mph

Bertone ZER 1994

124 miles in one hour 188 mph max



192 AA
Oxyride dry cell batteries
83 lbs 22" high

75.8 mph

Panasonic OxyRide 2007

World's Most Efficient Vehicle PAC car II 2005

Swiss Federal Institute of Technology, Zurich

12,665 MPG(E) Shell EcoMarathon Clermont-Ferrand

Hydrogen Fuel Cell Electric

Tour de Sol 1985-1993

Tour de Sol 1990

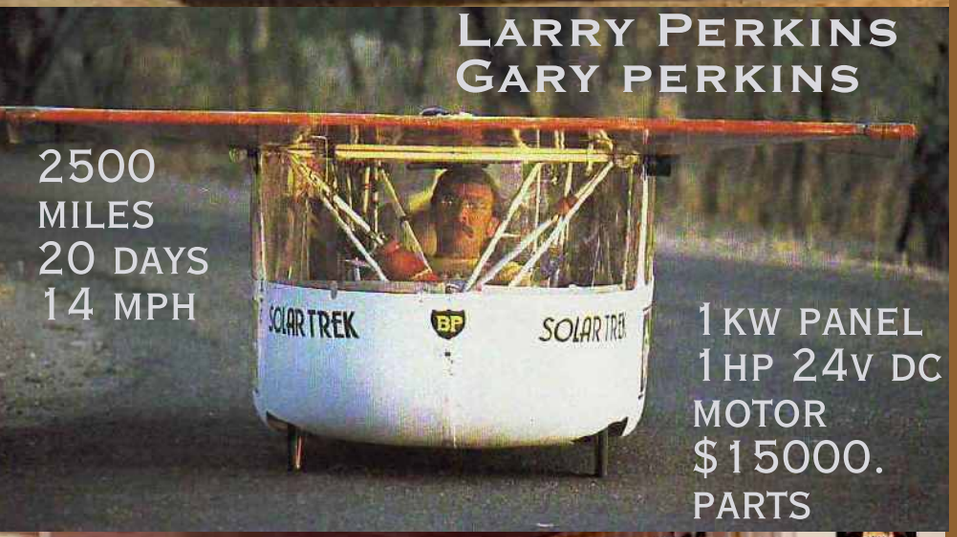
Tour de Sol 1990

1982/83

The Quiet Acheiver

Hans Tholstrup

Larry Perkins
Gary perkins



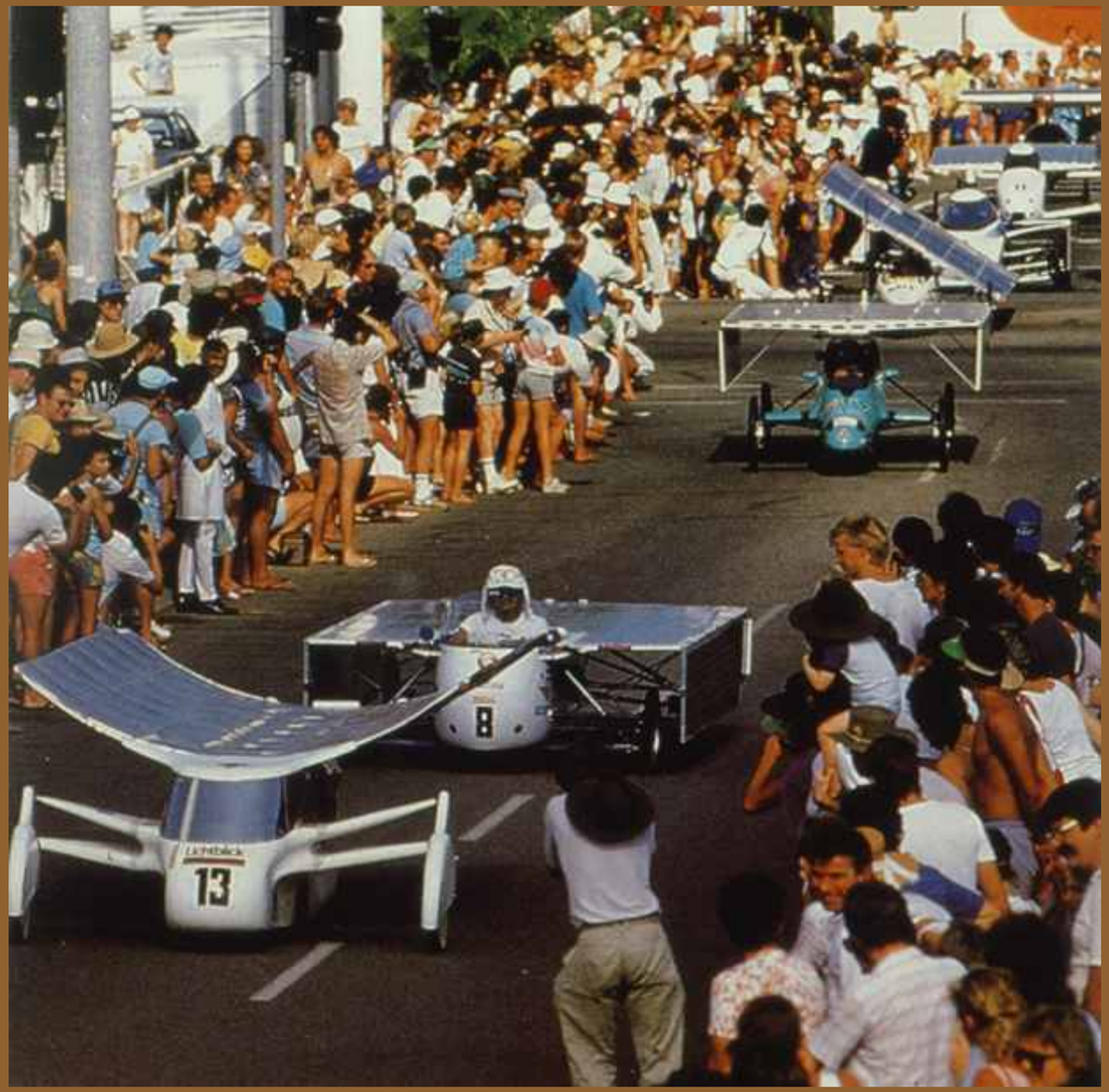
2500
miles
20 days
14 mph

1kw panel
1hp 24v dc
motor
$15000.
parts

1987-

World Solar Challenge

Darwin - Adelaide
2000 miles
13 finishers



World Solar Challenge

1987
GM Sunraycer
GM, Hughs Aircraft,
Aerovironment
42 mph
1400 watt PV
3kw/hr silver zinc
2 hp dc brushless
385 lb curb wt

1990
Spirit of Biel
Biel School of
Engineering and
Architecture
46 mph

1993
Honda Dream
Honda R & D
53 mph

TEAM NUON Delft University of Technology (ND)

64 mph avg @ 1900 miles

91 mph max

VEHICLE:

Weight: 440 lb

Length: 16.5'

Width: 5.9'

Height: 2.6'

POWER:

Lithium/Ion Batteries-

66 lbs

5000 watt/hrs

Solar Panels-

9 sq. meters

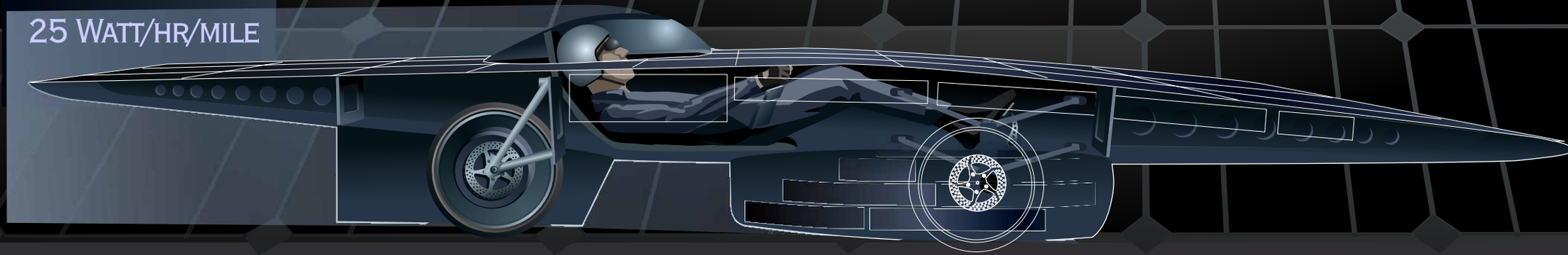
Galium Arsenide

26%efficient

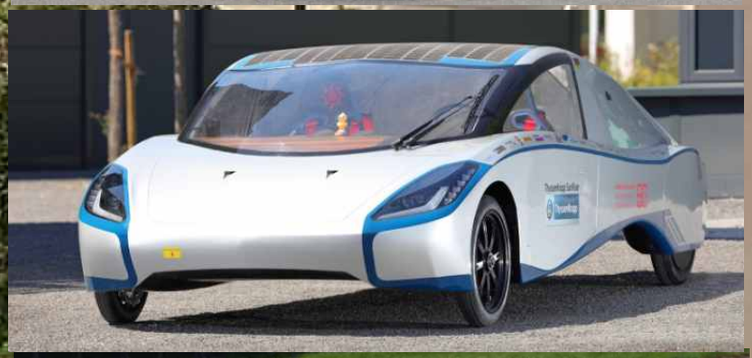
1500watts

EFFICIENCY

25 Watt/hr/mile



World Solar Challenge 2015



2011 PURE SOLAR WORLD RECORD 2014

Sunswift Ivy

University of New South Wales, Sydney, Australia

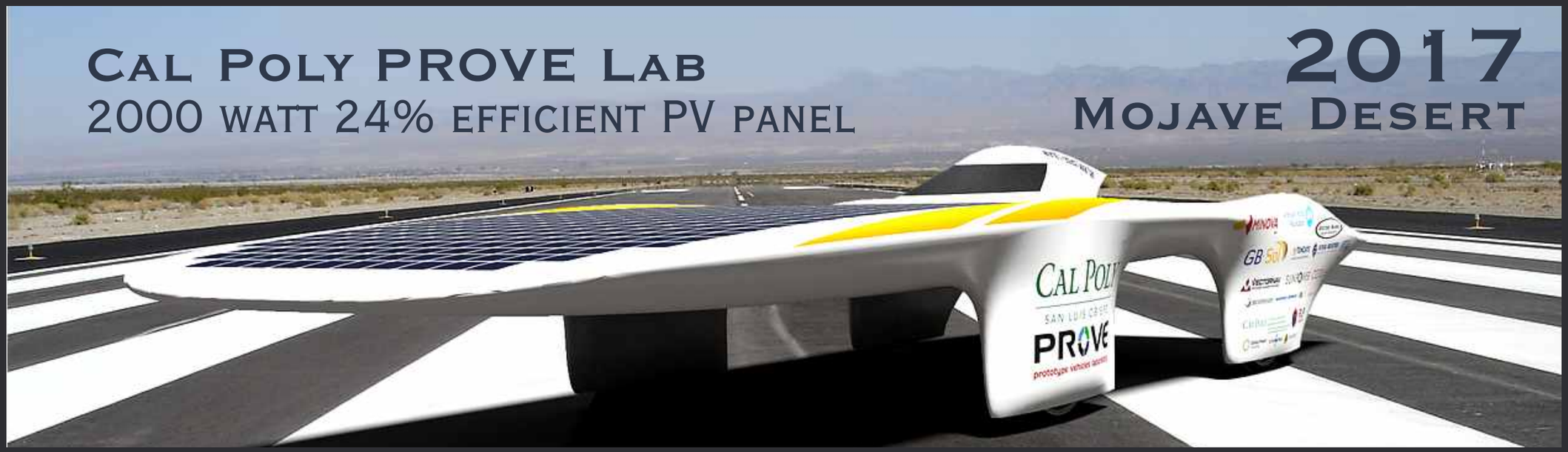
Sky Ace Tiga

Ashiya University, Ashiya, Japan

Cal Poly PROVE Lab

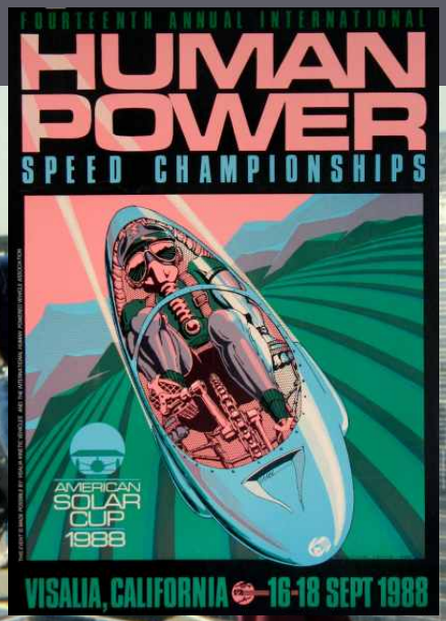
2000 watt 24% efficient PV panel

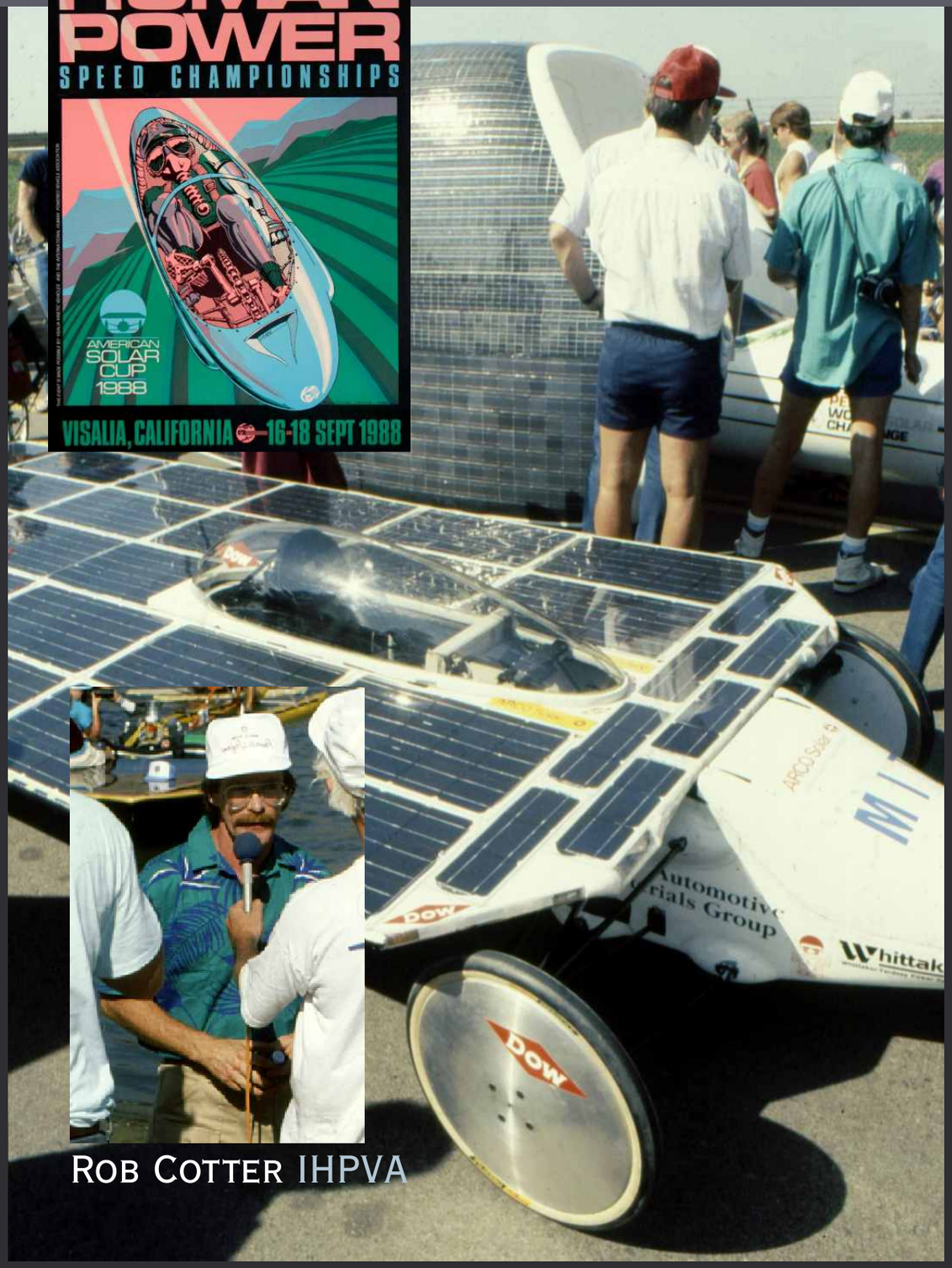
2017 Mojave Desert



In 1984, Greg Johanson and Joel Davidson : Sunrunner solar race car Guinness world record in Bellflower, California of 24.7 mph.
In the Mojave Desert of California and final top speed of 41 mph was officially recorded for a "Solely Solar Powered Vehicle"

American Solar Cup 1988





Rob Cotter IHPVA

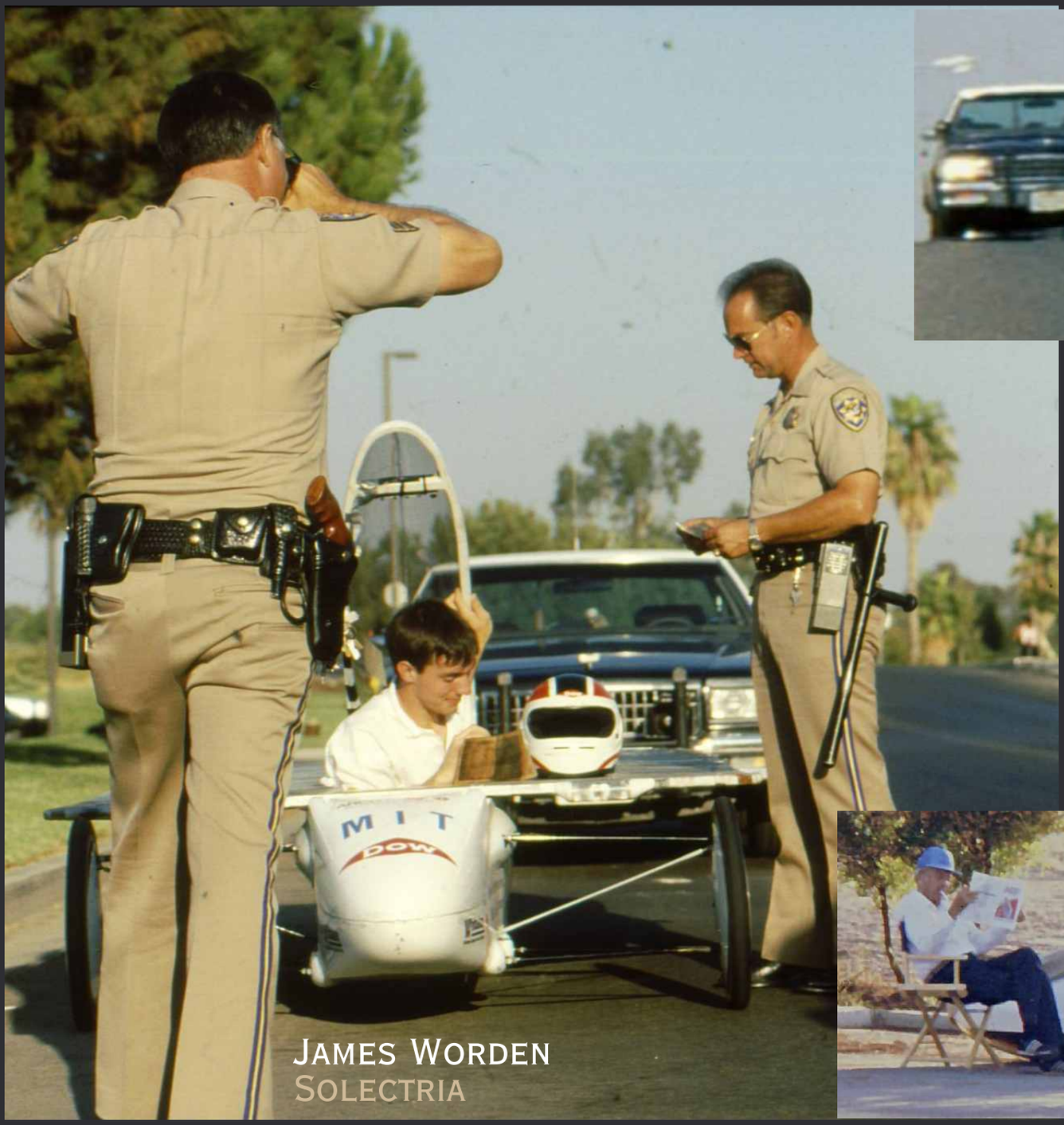
First U.S. Solar Car Race Visalia, CA

Mana La- John Paul Mitchell

Dr. Paul MacCready
Aerovironment

American Solar cup 1988

80 mile road race



James Worden
Solectria

GM Sunrayce USA

University of Michigan Sunrunner

Florida-Michigan 32 teams

University of Michigan Maize & Blue

Texas to Minnesota 34 teams

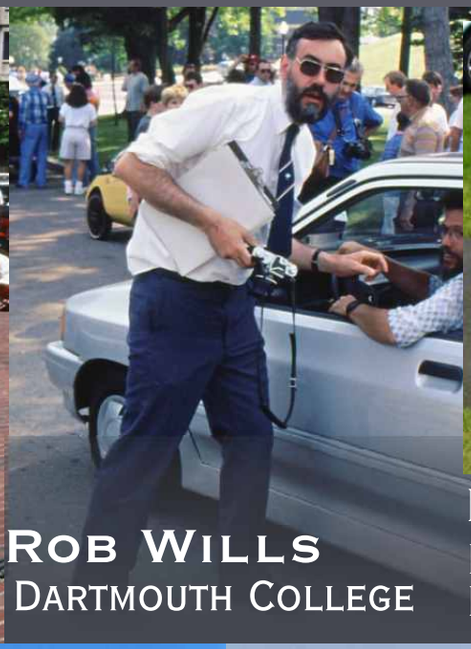
MIT Manta

Indiana to Colorado 38 teams

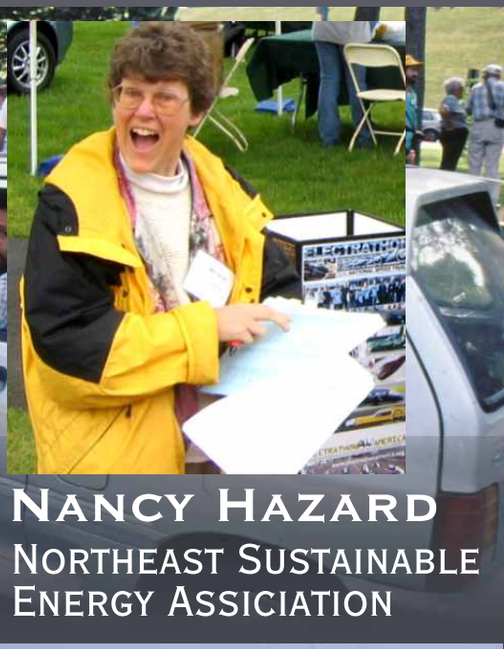
American Solar Car Challenge 2001-

American Tour de Sol 1989-2006

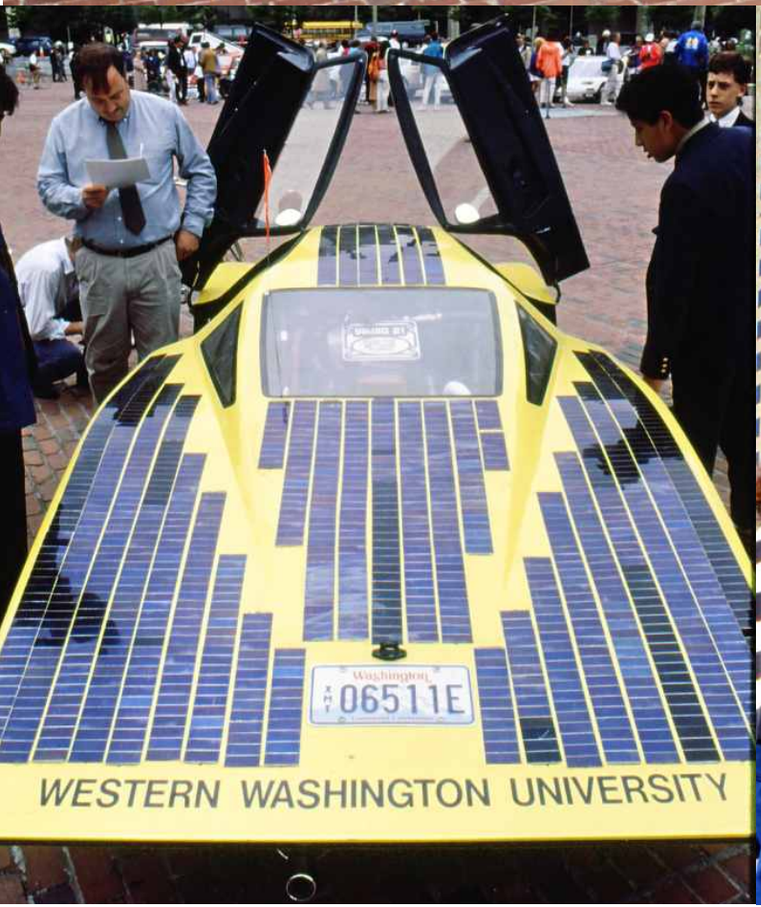
American Tour de Sol 1989-2006

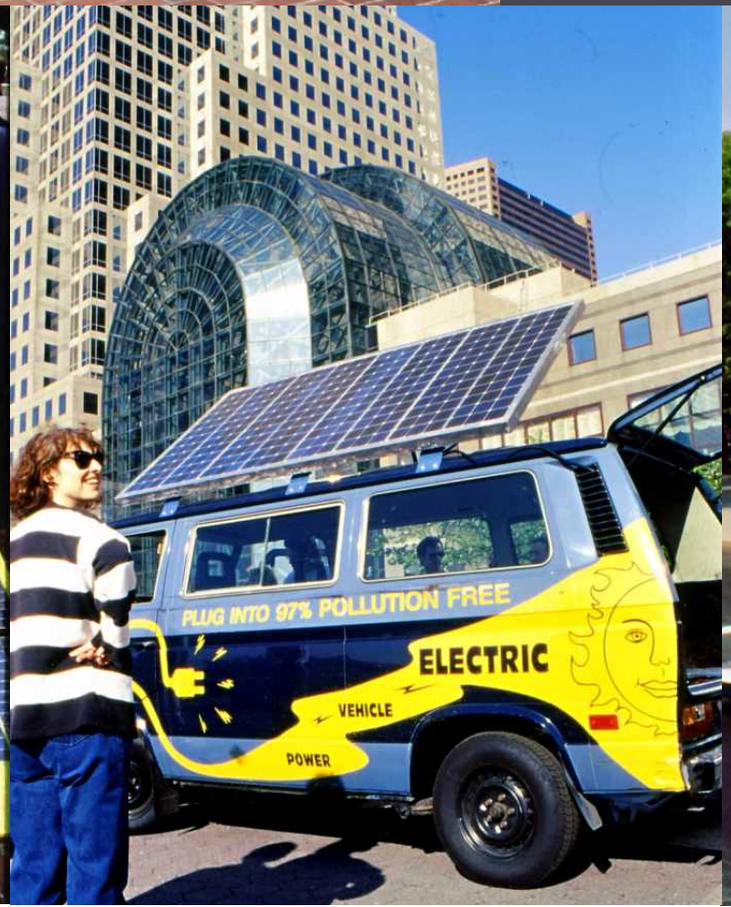


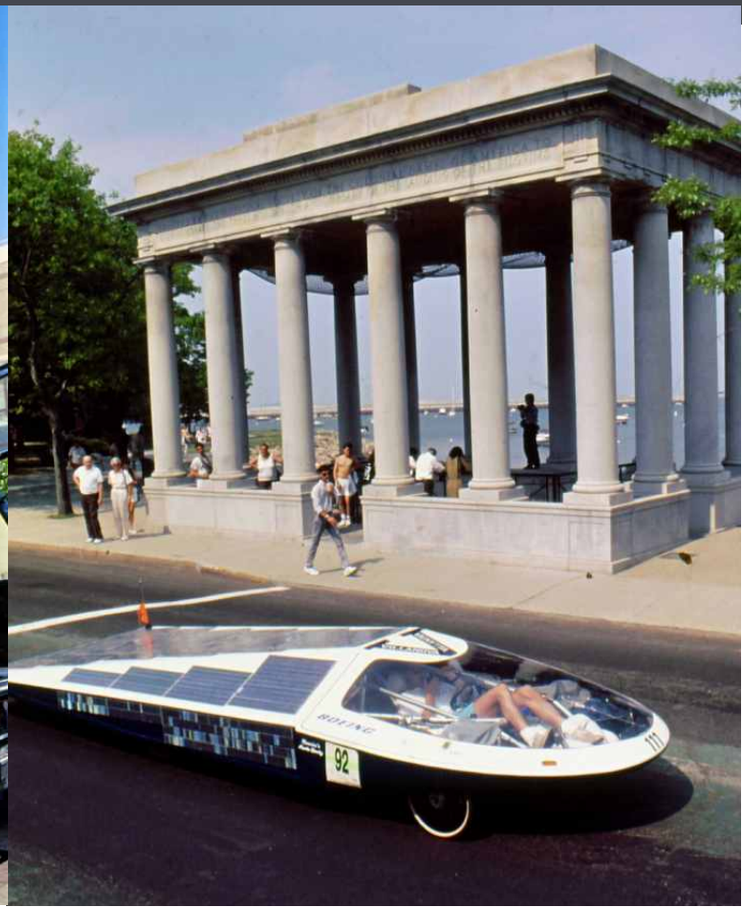
Rob Wills
Dartmouth College



Nancy Hazard
Northeast Sustainable Energy Assiciation







American Tour de Sol 1995/1997

Solar Blast
Portland, Maine

Solectria Sunrise
215 mile charge

Electrathon

Autocross

American Tour de Sol 2005-2006

Saratoga Springs, NY

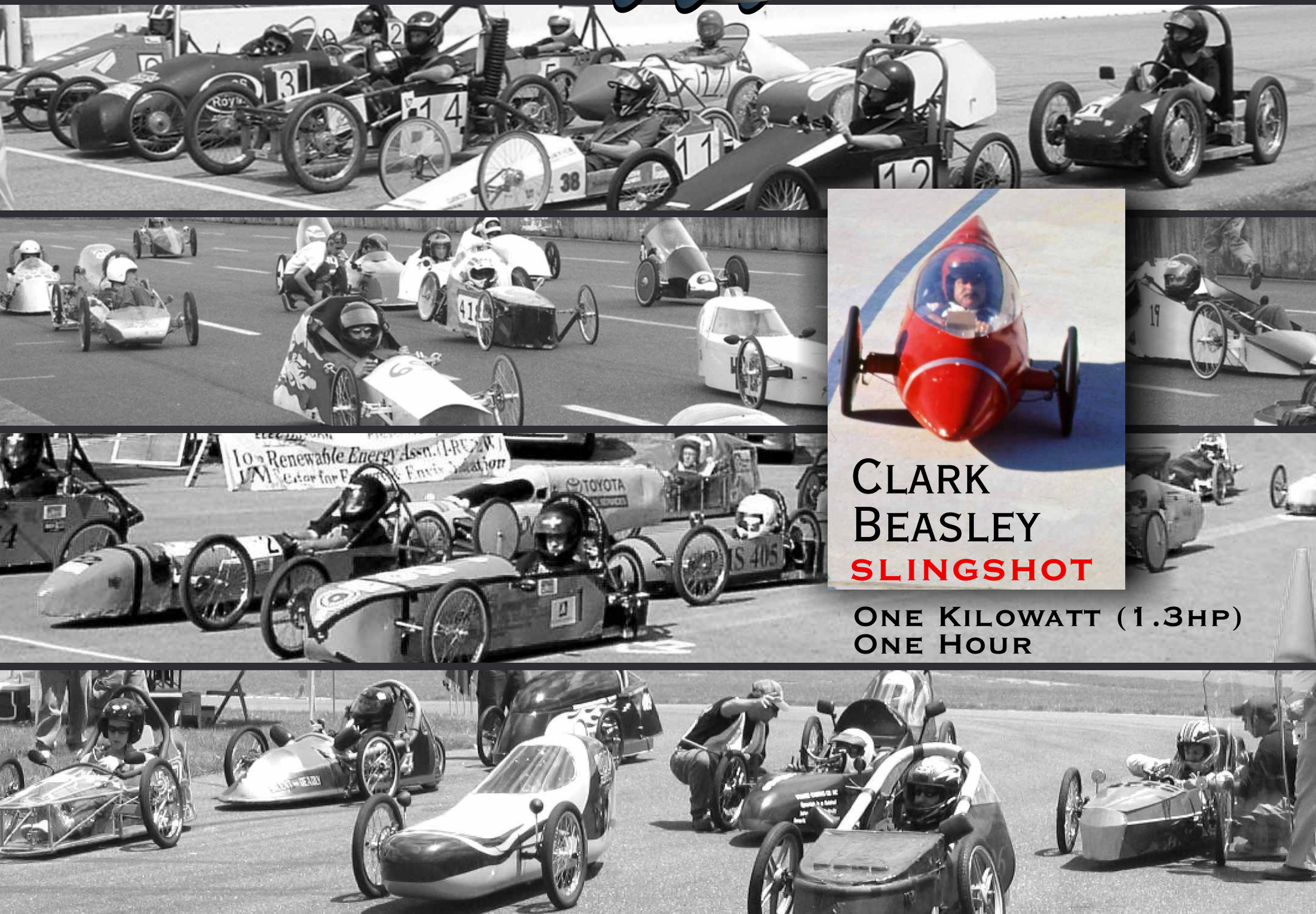
Nancy Hazard / Jim Dunn

Green Grand Prix 2005-

Watkins Glen, NY

Bob Gillespie

Electrathon America 1990-



Electrathon National Championships

1997

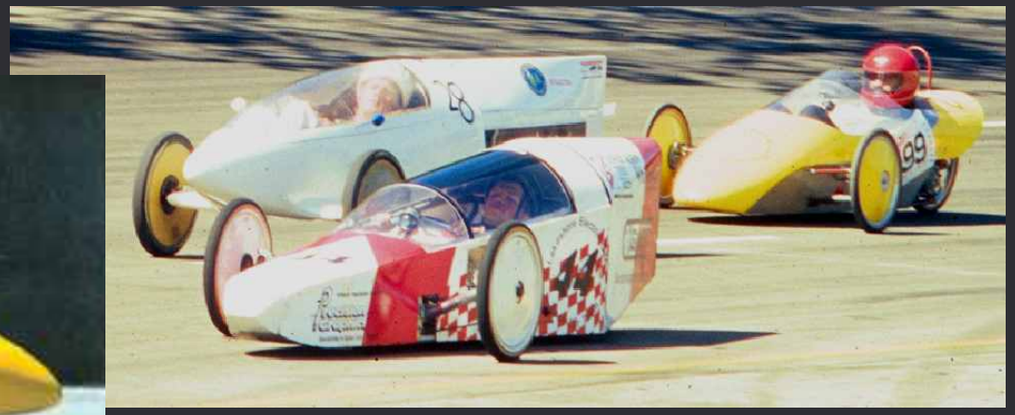
Berlin Speedway - Marne, MI - .5 mile oval

38.39

miles in one hour

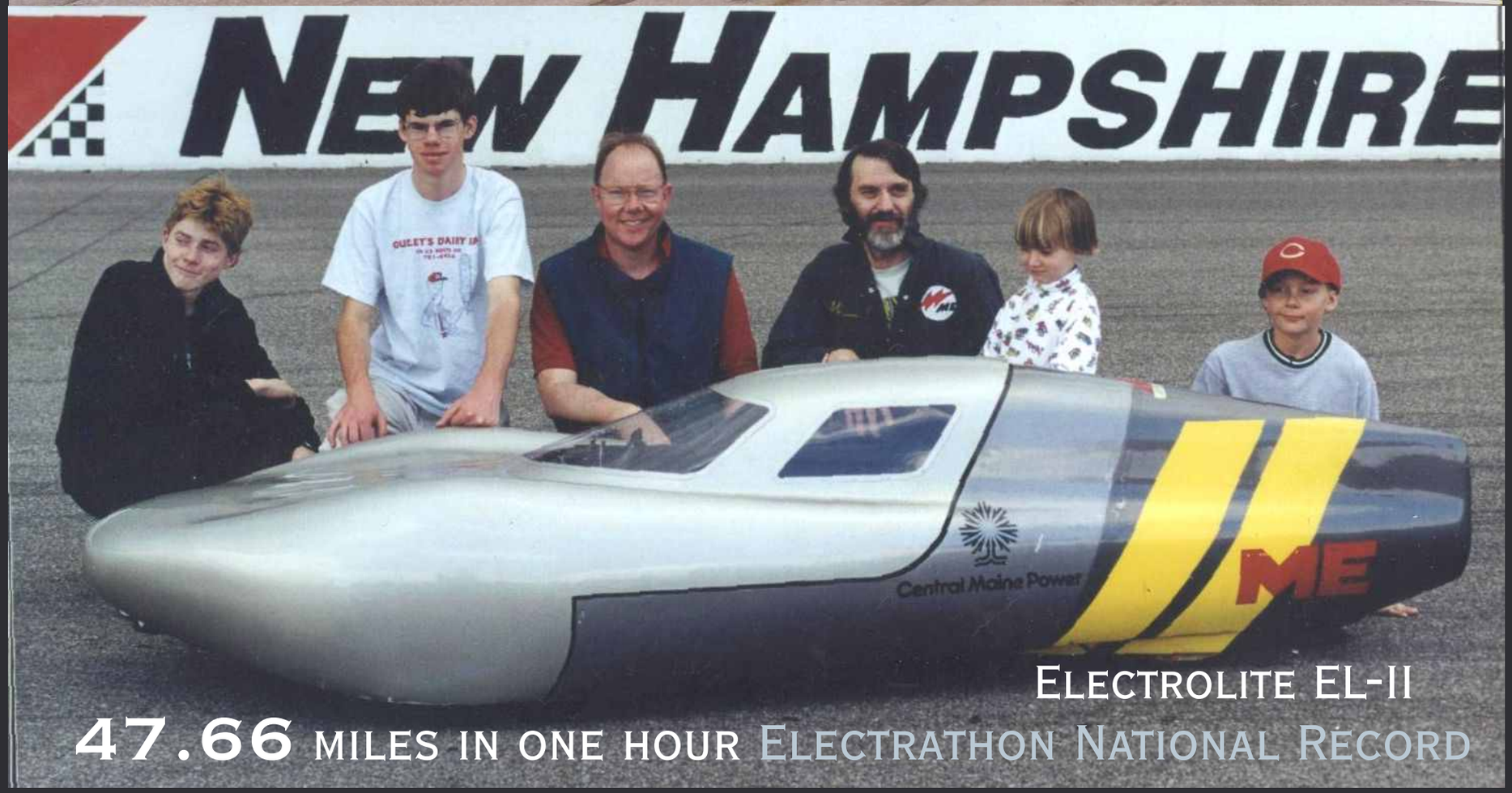
National Electrathon record

Holt (MI) High School



Electrathon National Speed Trials 1999

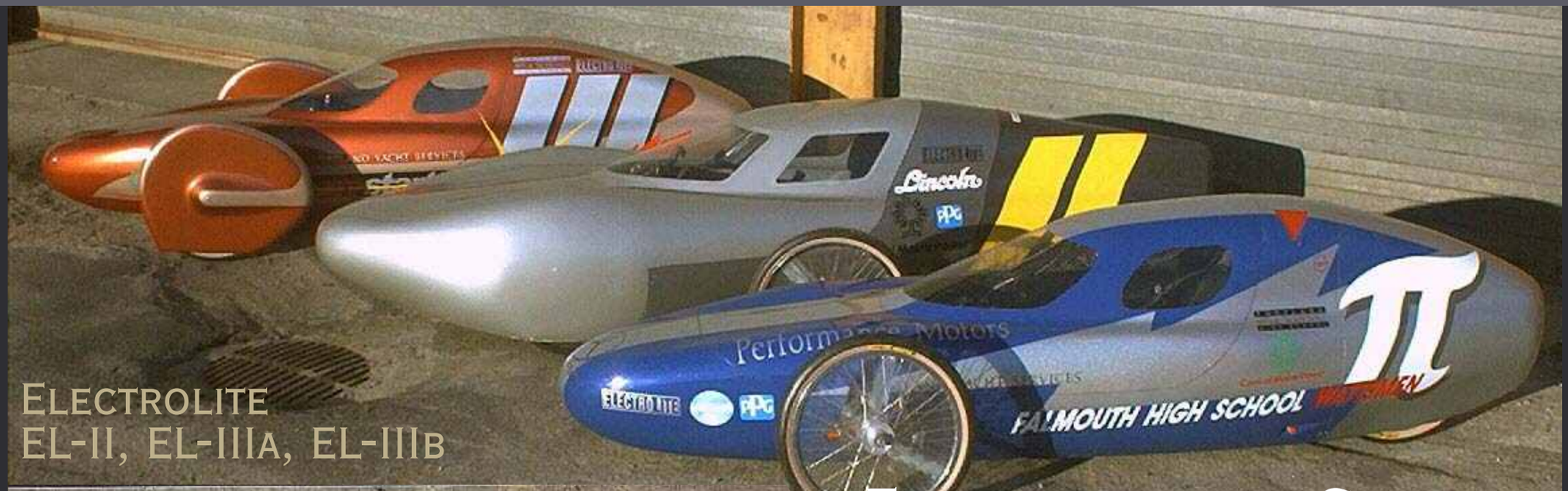
New Hampshire International Speedway. Loudon, NH - 1 mile oval



Electrolite EL-II

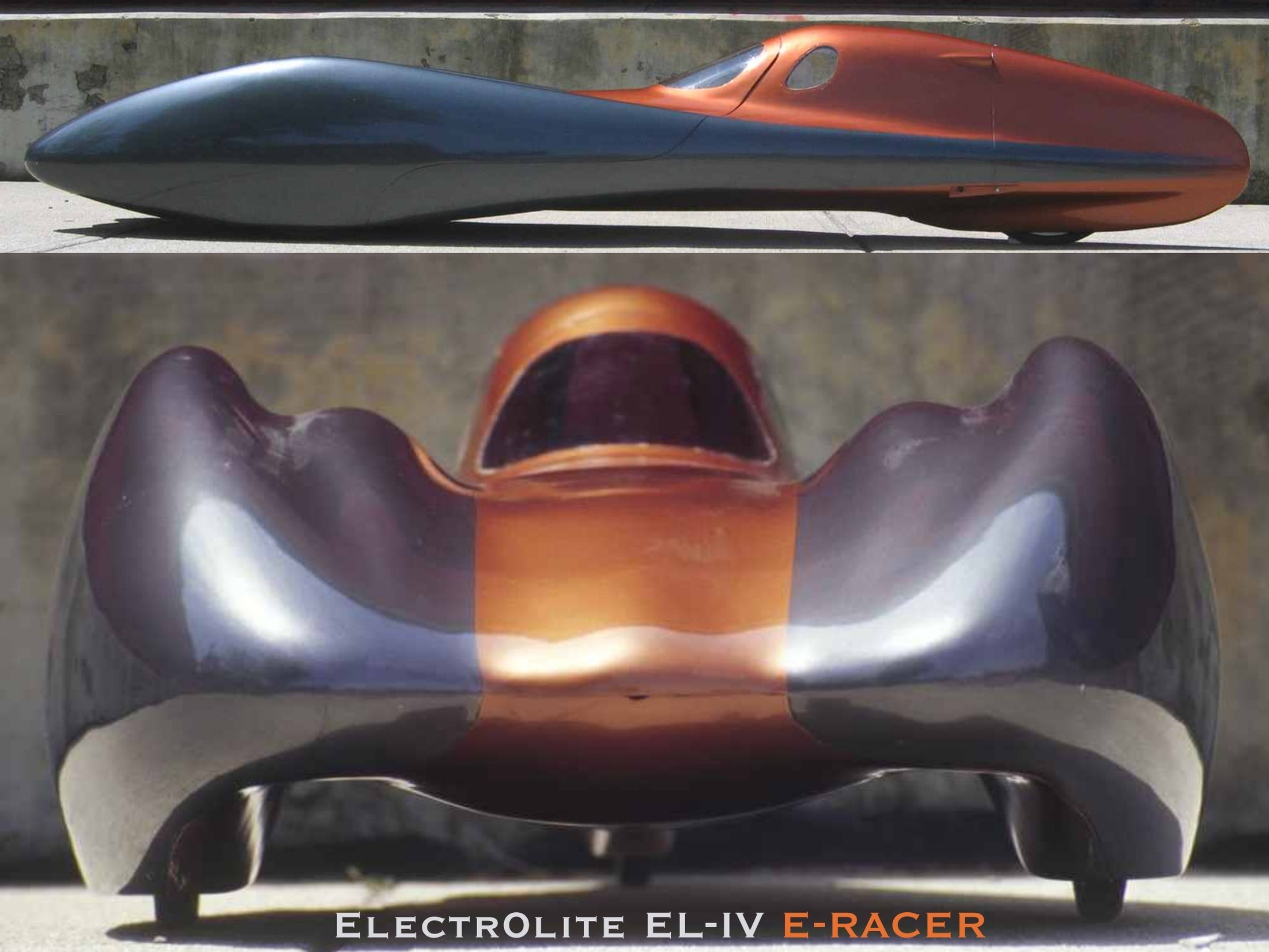
47.66 miles in one hour Electrathon National Record

Electrathon Maine 1999



Electrolite
EL-II, EL-IIIA, EL-IIIB

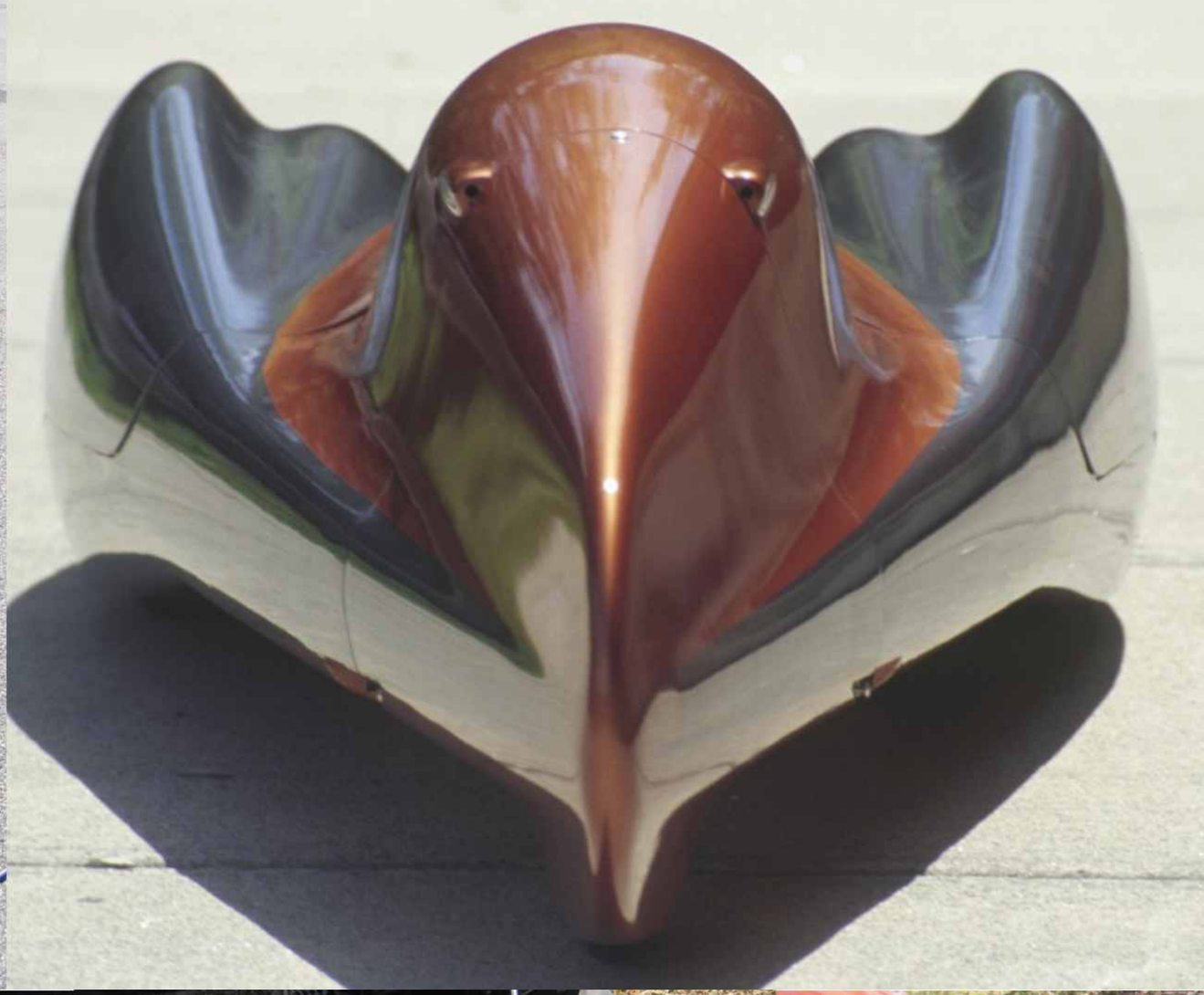
Falmouth high School
Maine State Champions



ElectrOLite EL-IV E-RACER

Vehicle:
carbon/kevlar, 3/8" balsa core
120"h x 32"w x 19"h, 105 lb
Cd: 0.133, frontal area 3.108sq.ft
Tires:
(3) 17" x 1", 120psi
motor:
Lynch LEM200
@ 1500rpm
85%efficient
batteries:
(2) 12v Optima AGM
45Amp/hr @ 24v
(1.08 Kw/hr)
1.45hp, 73lbs.

ELECTROLITE



Electrathon National Speed Trials 2006

New Hampshire International Speedway. Loudon, NH - 1 mile oval

53.16 miles in one hour National Electrathon Record

USFRA World of Speed

2007

Bonneville Salt Flats

Kirk Swaney
Destiny
Vehicles
89.4 mph
Standing mile

UTAH SALT FLATS RACING ASSOCIATION

BONNEVILLE

17-20 SEPTEMBER 2008

INTERNATIONAL ALTERNATIVE FUEL RACING ASSOCIATION

WWW.ALTSALT.COM

ALTSALT

ALTERNATE ENERGY LAND SPEED RECORDS

USFRA World of Speed 2008

Bonneville Salt Flats - Wendover, UT

Honda Insight

97.39 mph

Standing mile

Electrolite EL-IV

100.39 mph

Standing mile

USFRA World of Speed 2008

Bonneville Salt Flats - Wendover, UT

Shannon Cloud

Cloud Electric Vehicles

110 mph Standing mile

Kan-Am Electric Challenge 2008

Kansas Speedway, Kansas City, KS - 1.5 mile oval

Electrolite EL-IV

58.2 miles in one hour National Electrathon Record

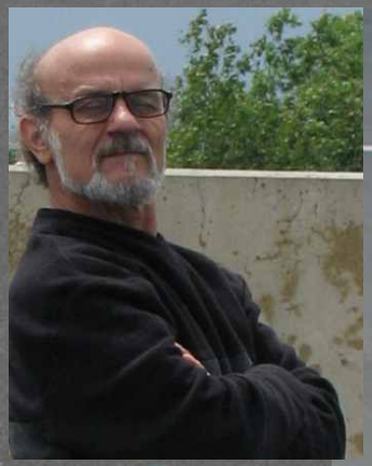
Electrathon Extreme Efficiency Trials 2008

Ford Michigan Proving Grounds. Romeo, MI - 5 mile oval

Electrolite EL-IV

62.05 miles in one hour 2370 mpg equivalent

National Electrathon Record



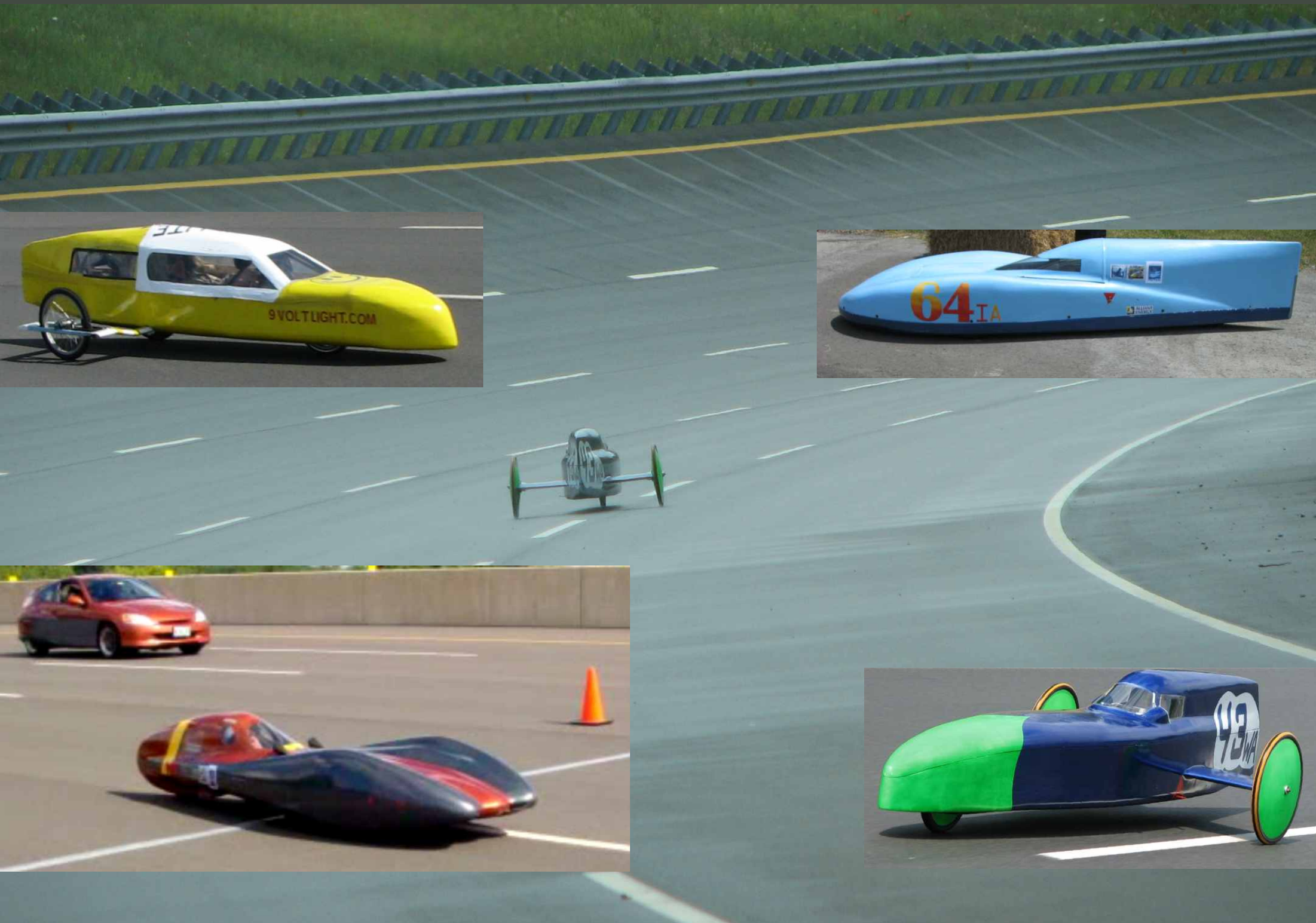
Georgi Georgiev's Varna

Sam Wittingham 56 miles in one hour

Barbara Batouis 52 miles in one hour

Worlds Fastest Humans

Electrathon Extreme Efficiency Trials 2008



Arizona Public Service Electric 500 1990-95

Firebird Raceway,- Tempe, AZ

Electric Drag and Road Races,
Electrathon and Formula Lightning

Formula Lightning 1994-2004

26-32 12-volt lead acid batteries
1200 lbs in 30 second pitstops

8kwh 300Amp @ 350 volts
60 Kw AC motor

2013-

Formula SAE Electric

2006-

Formula SAE Hybrid

2008-(UK)

Formula Student Electric

Institution of Mechanical Engineers

2016 Grimsel

0-60mph

1.513seconds

Academic Motorsports Club Zurich (AMZ)

390lb 200hp

4 wheel motors

Pikes Peak International Hillclimb

1912-

156 turns in 12.4 miles 4,720 feet of elevation

6 motors
50kWh
Li-ion
1595hp
1858ft/lb

Built in Latvia

2013
current record:
Sebastian Loeb
8:13.88

2015
9:07.02

2016
8:57.12

Rhys Millen Drive eO PP100

1500hp

Built in Croatia

2015
09:32:40

Nobuhiro "Monster" Tajima Rimac E-Runner Concept One

Rally Dakar 5000 miles

2012

Drive eO (Latvia)

OSCar eO

Series Hybrid
435hp Electric
with 78hp range
extender
52 kWh Li-ion
battery

Electric Rallycross

2018
E/Racing
550 hp for
15 minutes

2017
El Acciona
(Spain)

340 hp electric
Lithium-ion

Electric GT (EGT) Championship 2018

EGT Tesla V2.0 based on the P100DL

778 HP
1290 lb ft torque.

0-62mph: 2.1 seconds

100 kWh Li-ion battery

56 miles at racing speed

Le Mans 24hr 1993

Chrysler Patriot

Gas turbine / electric

1998

Panoz Q9

V8 / battery electric

2012

First hybrid victory

Audi R18 e-tron quattro

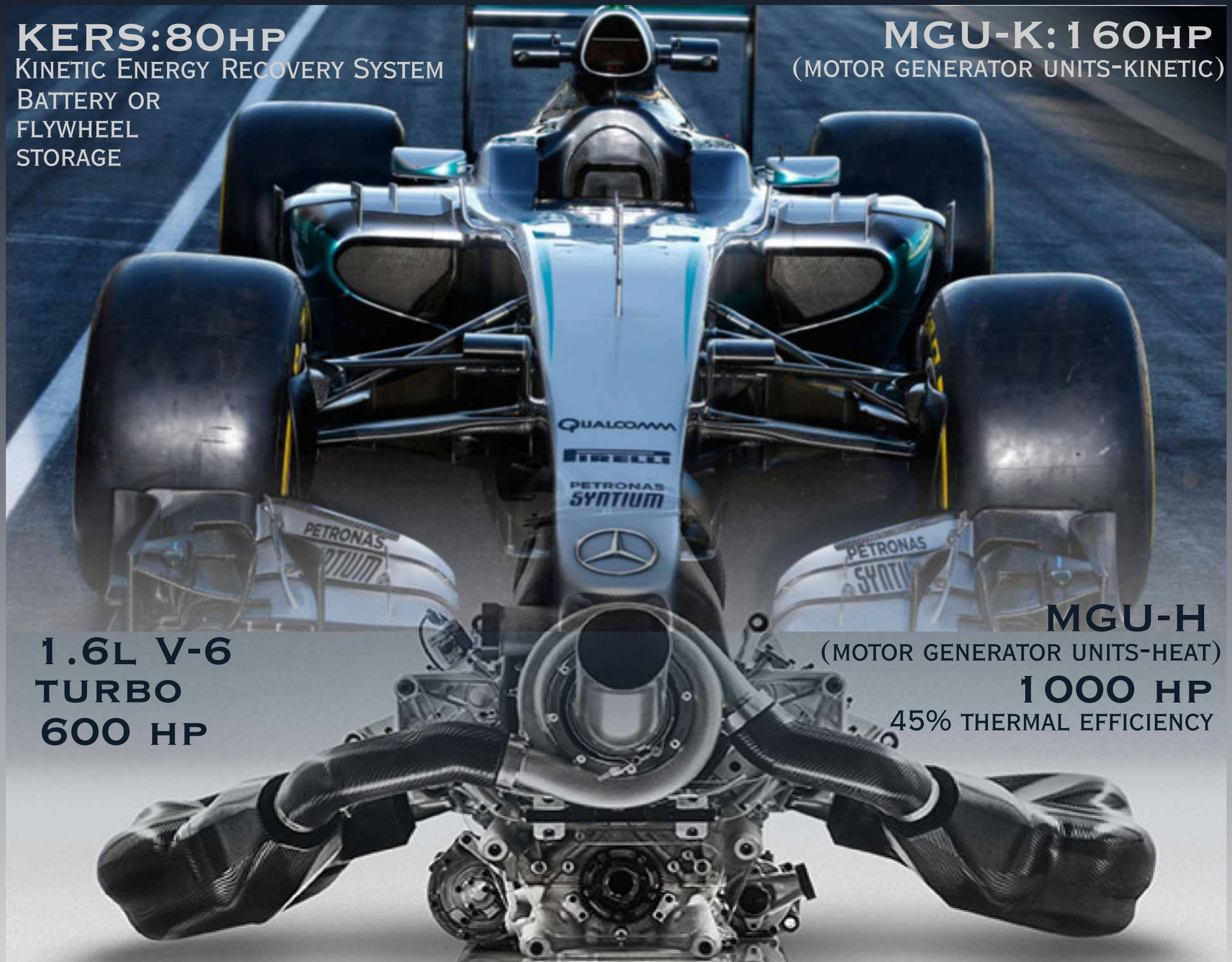
510 hp 3.7L diesel V-6
(2) 100 hp
front axle
electric motors
flywheel accumulator

500hp 2L turbo V4
exhaust recovery
400 hp
front axle
electric motor
Li-ion batteries

2018

Porsche 918 hybrid

2009 Formula One 2017



Formula E 2014-

Max power: 270hp
Race mode: 203hp
Fanboost: up to 234hp

0–62 mph: 3 seconds
Max Speed: 140 mph

Tires:
fr: 260mm x 18
rr: 305mm x 18

Overall weight:
(inc driver):
1954 lb min
Batteries alone:
704 lb max

battery packs: 28kWh

Rechargeable Energy
Storage System (RESS)
440lb max

FIA Formula E 2016/17

APX ONE HOUR RACES WITH ONE CHANGE OF CAR

Hong Kong, HK
Marrakesh, MA
Beunos Aires, AR
Mexico City, MX
Monaco, MC
Paris, FR
Berlin, DH
NYC, U.S.
Montreal, CA

previously:
Beijing
London
Long Beach
Miami
Moscow
Punta del Este
Putrajaya

Formula E 2016/17

Current Teams:

DS Virgin Racing
Next EV NIO
Venturi FE Team
Faraday Future Dragon Racing
Renault e Dams
Abt Schaeffler Audi Sport
Mahindra Racing FE Team
Panasonic Jaguar Racing
Tacheeta
MS Amlin Andretti

Corporate Involvement:

Michelin
Dallara
DHL
BMW
Williams
McLaren
Mercedes

and possibly:

Ferrari

Formula E Long Beach, CA April 2015

FIRST U.S. RACE

Formula E Long Beach, CA April 2015

Formula E Long Beach, CA April 2015

Practice sounds:

GRINDING
carbon brake discs

HOWLING
18" treaded tires

CLICKING
5 speed sequential gearbox

WOOSHING
carbon wings and diffusers

SCREAMING
17,500 rpm motor

Race day sound:
Rock and Roll music

Formula E -- ROBORACE

2017?

ROBOCAR

WORLD'S FIRST AUTONOMOUS RACE CAR

Design by
Daniel Simon

Kinetik
Nvidia

ROBORACE / DANIEL SIMON ©

DEVBOTS in Buenos Aires