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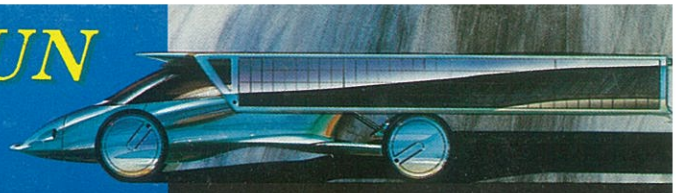

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DARWIN to ADELAIDE
1 NOVEMBER, 1987

Official Solar Magazine


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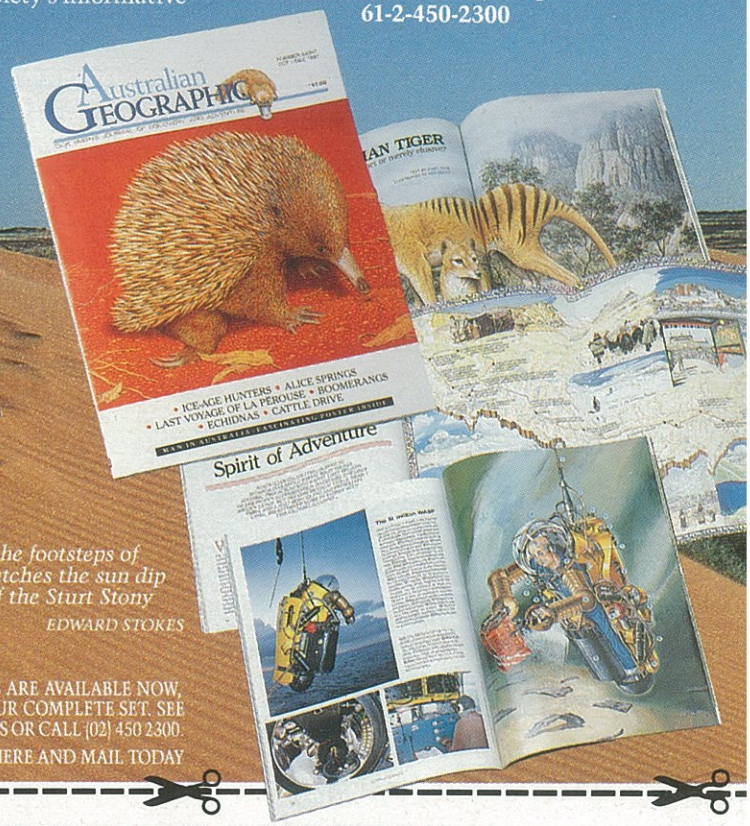

Edward Stokes, retracing the footsteps of explorer Charles Sturt, watches the sun dip below the grim expanse of the Sturt Stony Desert.
EDWARD STOKES

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B6

THE COMPETITORS AND

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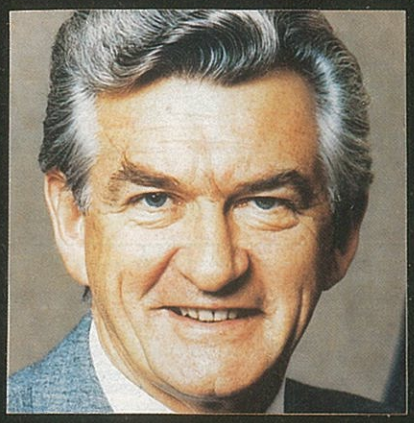


OFFICE OF THE PRIME MINISTER
CANBERRA

Australia is one of the most sun-drenched countries on earth.

As Australians then, we particularly look forward to exciting advancements in the use of the sun as energy.

With the World Solar Challenge, we welcome people from around the world to Darwin, and the start of a journey that will take them 3000 kilometres south to Adelaide.

It is remarkable to think that today's technology could allow some of these cars running on sunshine alone, to cover the vast distance in less than 80 hours of driving.

I wish all competitors the best of luck down the track towards a less polluted, everlasting energy source.

Bob Hawke

"Solar power will pour down on us long after we have run out of fossil fuel." **(Charles Fritts)**

A Message from THE ORGANISERS ...

IT TAKES about eight minutes to travel the ninety-three million miles from the sun to earth, if you are a little photon going to Darwin to power a solar car.

The World Solar Challenge will start in Darwin at 9am, on Sunday, 1st November, 1987. Earth time will be eight minutes after sun time, when the solar energy left the sun to power all the competing vehicles.

Due to the rising cost of other fuels, both financially and to our environment, it has become necessary to investigate other sources of energy.

Solar power is nothing new. It was not, as many believe, developed solely by the space program. In fact, back in 1839, Charles Fritts and Edmond Becquerel discovered we could convert the sun's rays into energy.

However, it was the space program that gave solar electricity a big boost, both in developing and economically manufacturing it.

Solar electricity is what the Darwin-to-Adelaide drive is all about. Solar power is what has developed the earth and will continue to make earth habitable for millions of years to come.

A statement was made over 100 years ago by Charles Fritts, who invented the first selenium solar panel. He said, "The supply of solar energy is both without limit and without cost; solar energy will pour down on us long after we have run out of fossil fuel."

It is a shame that Charles Fritts is not alive to see that solar energy cars will travel faster and further than anything powered by fossil fuel in his time.

To most of us, solar energy is a miracle; but then, so are pictures coming through the air to your TV screen, and this no longer

impresses anybody living outside the most remote jungle.

Yet solar electricity is far more simple. Perhaps after a few solar challenges, people will accept solar energy just as they do the TV, whether they understand it or not.

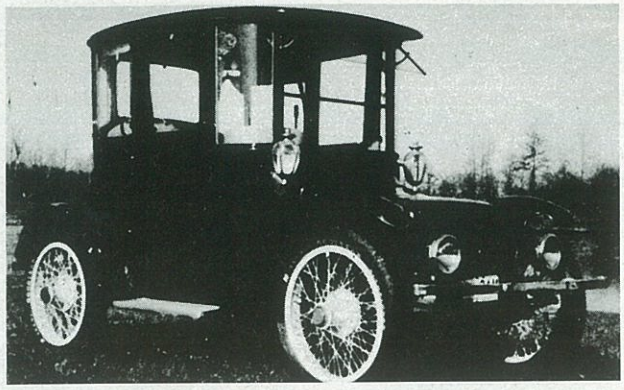
Furthermore, they will demand that solar cars make the journey from Darwin to Adelaide in two to four days, rather than the seven to seventeen days it took their predecessors to make that trip in 1987.

We at Energy Promotions will be excited, impressed and thrilled if the fastest car just breaks the average speed barrier of 50km/h, which we did not think possible three years ago when this event was born.

We wish to thank people from around the world, corporations, small and large companies and multinationals, for their unlimited supply of enthusiasm. They show that true companies can, in pooling their knowledge, financial capabilities and vision for the future, pass on the benefit to everyone, giving hope to all of us for a future full of energy. Our special thanks to Pentax, our sponsor.

Hans Tholstrup
ENERGY PROMOTIONS

Why a Solar Race? The scientists and competitors will tell you – we're …



The 1915 Detroit Electric had a top speed of 40km/h.

The successful 1983 BP Solar Trek spawned the Solar Challenge.

CONFRONTING

Variety of vehicles in the Tour de Sol crowd the ferry.

Like a giant flying ant, Denmark's "Chariot of The Sun".

THE FUTURE

Story by CAROLINE BRIGGS *(Published courtesy of "Racing Car News" magazine)*

THE Pentax World Solar Challenge is a memorable event - the first international solar vehicle race conducted across a continent. Starting in Darwin on November 1, the Challenge will end at Seppeltsfield in the Barossa Valley, north of Adelaide, some six to eight days and 3200km later. Competitors have come from the USA, Japan, Denmark, Germany, Switzerland, Pakistan and the UK, who will join entrants from five Australian States to make a field of 25.

The event is being organised by Hans Tholstrup, the man who pioneered the concept of a solar-powered vehicle, and proved what it could do when he and top touring car driver, Larry Perkins, completed the epic Solar Trek from Perth to Sydney in 1982-83. They covered an amazing distance of just over 4000 kilometres.

Now, in 1987, with new developments in design and more sophisticated technology and expertise, solar-powered vehicles are capable of higher speeds and improved road holding.

This will be one of the world's unique motoring events, and the race promises to be a major showcase of the latest in space-age design and technology. It's also an important opportunity for different countries to get together to compare their ideas and prove their worth.

Just ask Tholstrup: "A new era is beginning. Man's future on earth is limited to the future of the sun. While the sun lasts, so does solar power – the pure energy that's going to be the only power allowed for the race."

Great advances in our ability to harness the sun's energy using solar cells have occurred since the advent of the space age, with the development of new, more efficient and light-weight materials made originally to power satellites.

How Does It Work?

Basically, solar cells made from pure silicon directly convert light

energy from the sun into electricity to drive an electric motor or motors.

There is a battery in a solar car, but unlike the battery-powered vehicles which have been around since the late 19th Century, its function is to store surplus power.

The sun provides the energy, so solar cars do not suffer from the speed and distance problems of battery cars – the faster they travel, the quicker the battery becomes flat. Even on cloudy days, solar cells can now collect enough power to maintain an 80-100km/h main road speed.

A solar cell produces electricity when near infra-red rays of sunlight strike its silicon centre. This causes electrons to be released which become electric current when captured by a nearby field. The output from each cell is limited, but with continuing research, more efficient and smaller cells will be possible.

When these cells are placed in an array of panels, the power generated is a function of the size of the surface area exposed to the sun – the greater the surface area the greater the power.

Just a Few Rules

For this reason, race organisers have placed restrictions on the dimensions of the solar collection area which must not exceed 2 x 4 metres (8 sq. metres of the earth's surface) and up to 2 metres in height - kind of a "magic box" which competitors are free to use in any way they like.

And, since the race will be conducted on the open road, all competitors will be required to observe the road code – including the speed limit – of the State or Territory. Hence the power restrictions.

The vehicles must also comply with Department of Motor Transport requirements concerning stop lights, turn indicators and hazard lights, as well as brakes and overall width and length.

The performance restrictions of the vehicles will be limited only by the ingenuity of the design teams. With the aim of encouraging scientific research and development, each team is allowed to choose or invent their own method of construction. So we can expect some pretty weird, futuristic-looking contraptions setting off from Darwin come race day.

The spectacular solar vehicle race will be conducted from 8am to 5pm (while the sun lasts) each day. It will be monitored from start to finish by independent observers, each entry being appointed an observer to accompany the vehicle and ensure that no auxiliary power is used.

"Weight and aerodynamics will be a critical part of winning," says Tholstrup. "Each vehicle's driver will be ballasted to exactly 85kg, so those drivers weighing more than that will have to diet or carry a weight penalty."

In any event, the race promises to be spectacular as it makes its way from the lush tropics of the Northern Territory's "Top End", through Katherine with its majestic gorges, the harsh and barren Tablelands with its rich mining town of Tennant Creek, "The Red Centre" – the continent's heart and its town of Alice Springs – then on to South Australia and the opal fields of Coober Pedy, the gulf town of port Augusta, passing through the cultural city of Adelaide – already humming with anticipation of its third Australian Formula One Grand Prix – to finish in the lush grounds of Seppeltsfield, home of one of our principal wine-makers, in the Barossa Valley.

> "The John Paul Mitchell Systems Solar Racing Team (like the World Solar Challenge) was organised in response to the urgent problems facing the world today in the field of transportation.
>
> With nations on the brink of armed conflict over distribution of fossil fuels, and with pollution of the atmosphere reaching dangerous proportions, clearly the need for viable alternatives is imperative.
>
> The JMPS Team believes that these alternatives exist today, and that the World Solar Challenge provides both an opportunity to combine new state-of-the-art solar technologies into a transportation format, as well as an excellent way to present this format to the world.
>
> And, since "racing improves the breed", *MANA LA* Team hopes and believes that vehicles powered by the sun will be a reality for consumers around the world in the foreseeable future."

HOW THE RACE IS RUN

ASSEMBLY

Competing cars will be on display at the Casuarina Shopping Square, Darwin, for several days before the November 1 start. On October 30, all vehicles will be requires to pass a "Stability Test" - demonstrating that they can be passed by a Northern Territory "road train" doing 80km/h without becoming unstable. The result of this test will determine both starting eligibility and "grid" position.

THE START

At precisely 9am on Sunday, November 1, the Australian National Flag will drop, signalling the start of this unique event, some 25 equally unique solar-powered vehicles, representing eight countries and the scientific and engineering ingenuity of hundreds, even thousands, of outstanding people, will glide quietly out onto the Stuart Highway - their destination, Adelaide, 3200km to the south.

With the race vehicles showing the way, a convoy of other vehicles will then set out; a fleet of cars carrying service personnel, friends and relatives, catering trucks, caravans, spare parts vans, tourist coaches, even a truck carrying washing machines for the daily laundry.

Most important will be the fleet of Mitsubishi Magna Wagons - one for each competing vehicle - carrying an official observer, whose job it is to ensure the smooth, safe and legal running of his allocated competitor.

EN ROUTE

At precisely 5pm each day, observers will signal their respective competitors to stop. Their position will be marked on the road with a small stripe of Dulux paint, the vehicle will move off the road and the crew will make camp for the night - right where they are. There is no community camp-site, no motel, just a good, old-fashioned Aussie bush camp.

Next morning each crew is permitted to "topup" their vehicles batteries with power from their vehicle's solar cell. Then the observer checks the day's driver, noting the special tag he wears to signify how much ballast must be added or subtracted from his vehicle to make the official weight.

The cars are lined up on their mark on the road, and at precisely 8am each observer signals his car to start. This procedure is repeated each day.

THE FINISH

While all vehicles in the field will be required to pass through Adelaide - where a special welcome will be extended to the vehicles -the official finish and final assembly is at Seppeltsfield vineyard in the Barossa Valley to the north. Remember, unlike a normal race, which finishes when the winner crosses the line, the World Solar Challenge isn't over untill all vehicles have reached Seppeltsfield and cracked their bottle of Great Western champagne!

A combination of motor sport and science ...

THE DRIVING TEAM ...

JOHN STOREY
Mission Director, Senior Lecturer in Physics at University of New South Wales. 1987 awarded Pawsey Medal by Australia Academy of Sciences for outstanding research experimental physics. Motor sport experience includes club racing in Honda S-800.

GRAHAM ALLEN
Team Manager, Technical Officer at the CSIRO Division of Applied Physics. Has been successful rally navigator, competed in circuit racing in a Sunbeam Alpine, also built, and flown, his own ultralight aircraft.

JASON ALLEN
Driver. Technical Assistant with R & D department of Telectronics. Responsible for all chrome-alloy welding on the car, also a qualified mechanic. Competed successfully in rally Datsun 1600 he prepared.

IAN McCURLEY
Driver. Technical Officer with Austra- lian Department of Defence. Competed in motocross and endurance motor cycle races.

SIMON GIBBONS
Driver. Technical Officer with Australian Department of Defence. Motor racing experience at wheel of Morris Cooper S.

DICK SMITH
Driver, adventurer, aviator, publisher of Australian Geographic, 1987 Australian of the Year.

SUPPORT CREW ...

ROY ALLEN
Mechanical Support. Senior Lecturer in Physics at University of Sydney. Dubious distinction of being either father or father-in-law to five other team members!

GEORGINA ALLEN
Camp Boss, in charge of camp logistics during the race. Works at IBM Australia as Systems Engineer, has considerable rallying experience.

MICHELLE STOREY
Spokesperson (ie she spokes the wheels), a Research Fellow at CSIRO Division of Radiophysics. Small mass and low frontal area have made her much sought after driver in Shell Mileage Marathon.

HORRIE KINNERSLEY
Electronics Support, recently retired from a technical position at CSIRO Division of Applied Physics.

MARIE KINNERSLEY Cook, considerable experience with caravan and camping expeditions.

ANTONY SCHINCKEL
Mechanical Support, currently at Max Planck Institute for Radio astronomy in Bonn, West Germany. Keeps team informed of developments at European solar events. Motor sport experience includes rallying in club racing in supercharged, road-registered Clubman.

LIKE other vehicles competing in this event, the Australian Geographic Team Marsupial vehicle is designed to be as light and as aerodynamically "clean" as possible, and uses the most efficient solar panels, motors, electronics and trans- mission components that could be obtained.

A welded spaceframe of chrome-molybdenum steel is used, with careful design to ensure an immensely strong and safe structure. Such a spaceframe has the advantage over all other structures of being quickly repairable in the outback in the event of a failure. This spaceframe, which weighs a mere 15kg, carries tabs onto which the suspension, body and wing are mounted.

Use of Kevlar-foam-fibreglass sandwich for the body shell results in a strong and very light structure. Extra thickness of material is provided around the driver's "pod", to give added protection to the driver in the event of a crash.

Since the driver's backside is only 12cm off the road, the Kevlar seat is also designed to act as an abrasion shield should a wheel come off!

The blow-moulded canopy is from a "Stratos" ultralight aircraft. This remarkable high-performance plane is the brainchild of Melbourne-based Charles Ligeti, and uses a similar fuselage shape to that of the Australian Geographic Team Marsupial car.

A sophisticated suspension system ensures the vehicle's stability, while cushioning the rest of the car from road shocks.

At the front, a double wishbone uses pullrods to operate the inboard springs and coaxial adjustable dampers. The rear suspension uses trailing arms, which again operate coaxial spring-damper units.

Provision for fitting anti-roll bars front and rear is available, although it has been found they are not needed.

The brakes are hydraulically-operated discs at the front, with mechanically-operated caliper brakes at the rear. The use of independent systems is a further safety feature.

To maximise the flexibility in the choice of tyres, wheels have been made up with both 26 inch mountain bicycle rims and 700mm racing bicycle rims.

A wide variety of tyres has been tested by NSWIT student, Alex Hood, on a specially-built rolling resistance jig, over a range of inflation pressures from 420 to 1,000kPa. In addition, several thousand kilometres of tyre endurance testing has been carried out by towing a fully loaded wheel behind a car.

A lot of effort has gone into constructing a solar panel "wing" with the lowest possible drag. With a total surface area of over 16 square metres, the wing would otherwise totally dominate the drag performance. The airfoil section used is a NACA 66-006, which offers extremely low drag.

To achieve good performance from such a profile, however, requires exacting constructional techniques and an almost perfect surface finish.

The main structure of the wing consists of 1.5mm birch plywood ribs (which are lighter than any of the advanced composite materials in this application), held between Kevlar/foam tipribs by thin-walled aluminium tube spars.

The Australian Geographic Team Marsupial vehicle is one of the few cars using Australian-made solar cells. Fabricated at BP Solar Australia's Brookvale plant, these high-technology cells are being made in a special production run.

The cells are cut square (for maximum surface coverage) by a high-powered laser, and then laminated onto chemically-toughened 1.3mm thick glass. This type of construction, ideal for vehicle use, is being pioneered by BP Solar Australia.

While silver-zinc batteries will be used during the race, this type of battery has limited life and it is too costly to be used during vehicle development. Pacific Dunlop have kindly supplied us with their high-tech "Pulsar" batteries for the testing phase. These lightweight lead-acid batteries are another area in which Australia leads the world.

AUSTRALIA # 1

Two Industrial Drives permanent-magnet motors are used, one on each rear wheel. These motors feature rare-earth magnets, and achieve over 90% efficiency. M.B. and K.J. Davidson of Melbourne have given us valuable help in obtaining these motors.

The power electronics is supplied by Australian Energy Research Laboratories of Brisbane. Based on the innovative "Maximizer" unit made by this company, the six separate dc/dc converters in the car use highly efficient mosfet switches.

The instrumentation and monitoring circuitry (as well as the brake lights and turn signals) are powered from the 100 volt battery system by ultra-lightweight dc/dc converters, kindly supplied by Statronics Power Supplies of Hornsby.

Final drive is by standard bicycle chain. Regenerative braking is not justified on such a flat course, so a freewheel is used to minimise friction losses when coasting.

The driver sits in a contoured seat, and is faced with a conventional steering wheel, accelerator pedal, foot brake and hand brake. A digital speedometer (to 99 km/h) and a digital odometer are positioned directly in front of the driver, while toggle switches for the turn signals are conveniently located a finger tip's distance from the wheel.

However, there the similarity to a normal car ends. On the dashboard a 200 amp digital ammeter is flanked on either side by the 30 amp motor current meters. A circuit breaker on each side of the seat controls the motors, while a battery circuit breaker (70 amp) sits above the driver's right shoulder.

In the wing, above the driver's head, a further three circuit breakers control current from the solar array. Nine l.e.d. bar-graph displays continual monitor the performance of the different parts of the array.

Race Preparation

The Australian Geographic Team Marsupial car has been tested twice at Amaroo Park, and once at Oran Park motor racing circuit. With a temporary permit from the NSW Department of Motor Transport, the car can also be tested on public roads.

During the race, the support crew will travel in a group of Holden cars, kindly supplied by Holden's Motor Company. A 7-tonne turbo-charged Isuzu truck, also supplied by Holden, is being fitted out as a workshop and will carry the extensive range of spare parts needed. The car itself will be transported to Darwin in a covered trailer, specially built to the exact dimensions by Boeing Trailers, Sydney.

For the six days the race is expected to last, the crew will live out of an 18-foot caravan, supplied by Viscount Caravans.

TEAM MARSUPIAL SPECIFICATION SUMMARY

DIMENSIONS	2.0m wide x 1.1m high x 5.5m long
WEIGHT	220kg (plus driver)
CONSTRUCTION	Chrome-molybdenum steel space-frame, kevlar/foam sandwich body, birch plywood solar-panel wing.
WHEELS	700mm bicycle wheels and tyres
No OF WHEELS	Four
SUSPENSION	Front - double wishbones with pull-rods, inboard springs and dampers Rear - trailing links with coil springs and dampers
BRAKES	Front - hydraulically operates disc brakes, two independent circuits Rear - mechanically operated calipers
STEERING	Rack and pinion, 1.5 turns lock-to-lock
SOLAR PANELS	BP Solar Australia, advanced technology cells laminated with 1.3mm thick chemically-toughened glass
MOTORS	Two of Industrial Drives, rare-earth magnet, 1.5kW
ELECTRONICS	Mosfet switching converters, Australian Energy Research Laboratories
BATTERIES	Development: Dunlop Pulsar Race: Silver-zinc
SYSTEM VOLTAGE	100 volts (nominal)

THE ELECTRIC VEHICLE AGE

Experimental battery car, designed in 1979 for Briggs & Stratton to demonstrate a new system by which a tiny (694cc) motor drives a generator which charges a battery pack in the car. The duel wheels are necessary to carry the 12 batteries. B&S claimed 88km/h cruising speed and 42mpg.

Story by *PETER BREWER*
Photos *by PEDR DAVIS*

... is it still coming?

THE harnessing of electrical energy is one of mankind's greatest achievements, bringing warmth, knowledge, communication and transportation. Such is electricity's influence on our daily lives that it would be difficult to imagine Western civilisation without it - bereft of power for our factories, heat for our homes and batteries for our torches.

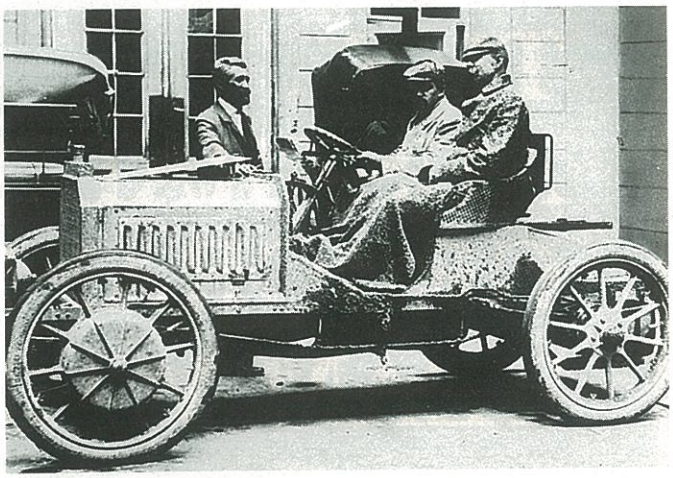
But there was such a time - before Hans Christian Oersted's discovery that when a compass is placed over a wire carrying electric current the compass needle is deflected.

It was this 19th Century revelation which set civilisation on the path to making machines perform the task of men - the harnessing of electrical energy through an electric motor to create mechanical energy or work.

English chemist John F. Daniell was credited with developing the first "primary" cell, even though his work was a continuation of electro-chemical research carried out in the late 1700s by Italian scientist, Alessandro Volta.

Volta's battery (or galvanic cell), called the "Voltaic Pile", consisted of silver and zinc discs separated with cardboard and soaked in salt water.

Built by Dr Ferdinand Porsche in 1901, this Lohner-Porsche has its electric motors built into the front hubs, drawing power from a generator driven by a Daimler petrol engine. It sold well for several years.



Daniell's primary cell was more efficient, but French physicist Gaston Plante took this discovery one step further in 1859 with the invention of the lead-acid storage battery. The modern "dry cell" battery was developed just a few years later by another Frenchman, Georges Leclanche.

From this point on, the shackles which had bound the uses of electric motors to fixed or semi-stationary positions were freed.

All over the world , scientists, engineers and chemists set about testing the parameters of this new discovery, particularly in the field of transportation.

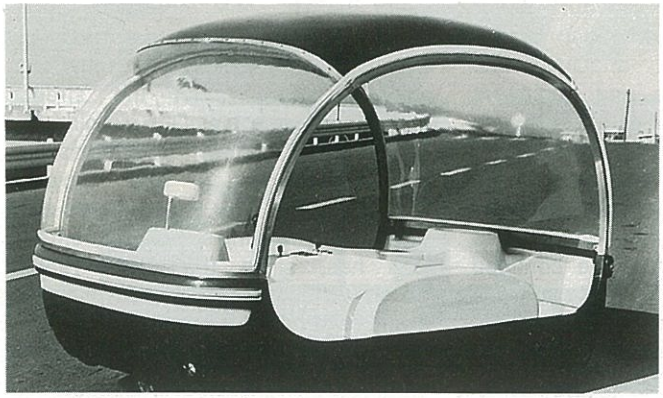
While electric-powered cars were not a new development (American Thomas Davenport used electricity to power his small carriage along a fixed track in 1834), until the storage battery arrived these machines were little more than curiosities.

Electric-powered trolleys and railways were a different proposition, and these were not dependent on the storage battery. During the 1880s these reliable, pollution-free units lured people off that other great form of transportation - the safety bicycle - and sparked a wave of inter-city commuter freedom which continues today.

But the travelling public - those who could afford it, of course - embraced the arrival of the first rechargeable electric cars with equal fervour.

Market Leader

Indeed, at the turn of the century electricity was a more popular form of motive power for "personal carriages" than the combustion engine. Familiarity with the electric trolly and tram no doubt helped weigh public opinion in favour of a power source



In 1970 Mazda built this experimental prototype city car with battery power. Some hybrid models had a rotary engine to keep batteries charged.

Ford of England built this Comuta in 1967 to explore the future of small battery-powered cars. It could be parked end-on to the gutter, but performance was sluggish.

people knew and trusted, unlike the then "dirty" and unreliable combustion engine.

By 1900, 38 per cent of pleasure cars sold in the USA were electrically powered, 22 per cent petrol-driven and 40 per cent steam-driven. But steam had had its day, and the wealthy elite showed an overwhelming admiration for the quietness and simplicity of electric cars.

The French BGS Electric Car held the world's distance record on a single charge - 290km - in 1900, while human ingenuity was already showing its hand in other areas. The Krieger Company of Paris, France, was awarded a prize at the 1897 Paris Motor Cab Trials for its front wheel drive electric carriage.

The first serious Australian attempt was made at Flinders University in SA in the early 70's. Called the "Investigator", it used 12 car batteries, two 5kW printed circuit electric motors and variable hydrostatic transmission.

The Krieger was astonishingly advanced for its day, using power steering and four wheel brakes, and boasting a top speed of 24km/h over a range of 80km.

Electric-powered taxis plied the streets of New York. The city streets were congested, so the relatively low speed of these and personal electric cars was perfectly acceptable. And, unlike the combustion engine, there was no back-breaking starting procedure - one simply positioned oneself behind the steering tiller, threw a switch and set the car in motion.

But country trips were a constant problem. While many cities were transformed by Thomas Edison's electrification, power lines stopped at the city boundaries until well into the 1930s.

With no power source at their country estates to recharge the batteries of their carriages, the wealthy found electric transport had its limitations.

There were attempts to circumvent this problem, including gasoline-electric hybrid cars. But by this time, the manufacturers of combustion-engine cars had slowly but surely eroded the slim advantages held by their rivals building electric cars.

The development of the automobile starter motor by Charles F. Kettering in 1911 ended 25 years of hand-cranking, one of the major sources of frustration for motor manufacturers and its customers.

It seems ironic that a small electric motor, overloaded to several times its capacity for just a few seconds, was one of the major factors contributing to the decline of a multi-million dollar industry and the rise of its petrol-powered adversary!

Advanced Features

The year 1912 was the high point for electric vehicles in the US, with almost 34,000 cars, trucks and buses registered for road use. Bakers, milkmen - ever breweries - kept fleets of electric trucks and trolley cars for city deliveries, rolling on solid rubber tyres.

There were some clever examples built, some with four wheel drive, four wheel steering and Couple-Gear "power steering". To turn corners, power was applied to either front wheel through a sophisticated geared motor built into the front hubs.

But the motive power which in 1899 had so dominated Europe and America that the world's fastest cars were

More than 60 Enfield electric city cars were built in 1969, with eight 12V batteries powering a 48V 8hp motor. It had a top speed of 64km/h with a range of 64km.

ELECTRIC CARS *cont.*

electrically powered fell quickly into decline when Henry Ford introduced the Model T.

This was affordable transport for the masses. In 1925, 260 US dollars bought automotive freedom for a public which could never afford electric cars. By carrying extra fuel, petrol car owners could drive as far as their desire took them.

The "superbattery" which electric car manufacturers hoped would turn the tide of public favour never eventuated and, slowly but surely, their cars became anachronisms. Their best designers and engineers left for greener pastures at Ford and Cadillac, Peugeot and Daimler-Benz.

Special Uses

Nevertheless, specialist areas of commerce and industry continue to use electric transport. The confined spaces inside warehouses are more suitable to electric forklifts because they do not produce exhaust fumes.

In the UK, milk, eggs and other perishables are often delivered by electric milk-floats which quietly and efficiently purr about the streets during the early hours of the morning.

Increased public awareness of environment issues and growing scientific alarm over the ill-effects of a combustion engine's noxious emissions has, since the early 1960s, forced scientists to re-evaluate the electric alternative.

Thousands of prototype demonstration vehicles have been built over the last two decades, some using conventional battery packs to power AC induction motors, others using more sophisticated hardware.

The 1967 General Motors Electrovan was one of the more famous examples of the fuel cell electric vehicle. Using NASA space program technology, GM engineers had developed a means of using a non-liquid membrane and costly platinum electrodes, which acted as a catalyst in the presence of hydrogen and oxygen.

It was effective but costly, heavy and fraught with safety problems. Simple solutions - lightweight bodied cars with rechargeable battery packs and efficient induction motors - were deemed more efficient and cost-effective, and both Ford, Chrysler and American Motors produced prototypes following this principle during the late 1960s.

Electric cars even made it to the moon with the Apollo 15, 16 and 17 missions. These four wheel steered Lunar Roving Vehicles, powered by two non-rechargeable 36-volt silver-zinc batteries, performed faultlessly on the dusty surface of the Moon, in temperatures ranging from minus 93 to 104 degrees Centigrade.

Despite the successes, scientists are still attempting to eliminate the fundamental problems which have continually restricted the use of electric vehicles, namely cost, range, weight and recharging time.

One of the more workable solutions in recent years has been to tap an inexhaustable energy source - the sun - to supplement or provide complete motive power for an electric vehicle.

While the increasing efficiency of solar panel technology may yet prove to be the answer, scientists the world over are convinced there is an era of personal, pollution-free, efficient electric transport almost within their grasp.

KEEP UP WITH THE PACE, TRAVELLING IN STYLE & COMFORT ABOARD

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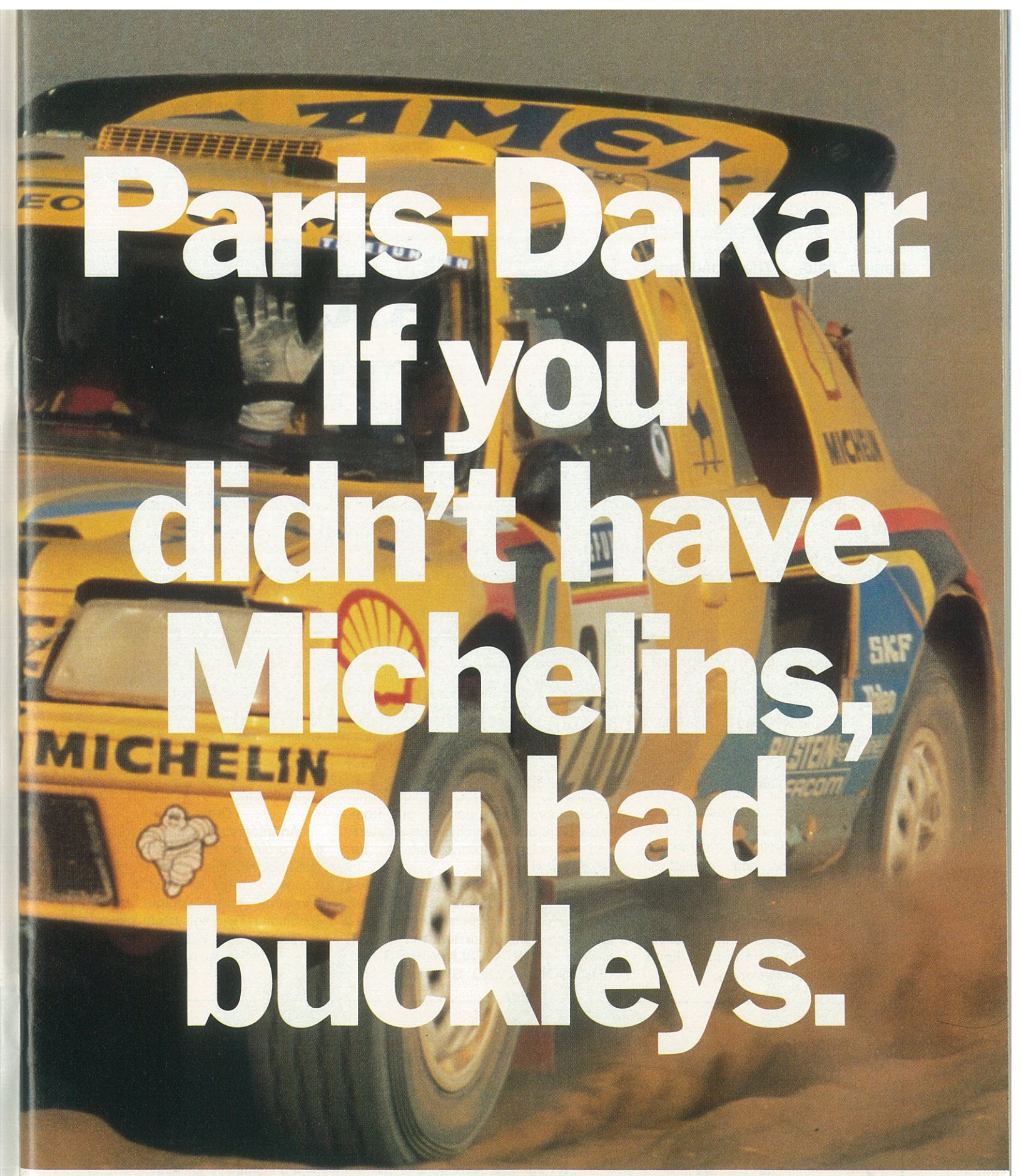
- TAA Laneway North Terrace



Paris-Dakar. If you didn't have Michelins, you had buckleys.

The first two cars across the line in this year's gruelling Paris-Dakar Rally used Michelin tyres exclusively. As did the first nine motorbikes and the first truck. What further proof do you need of Michelin's reliability under the toughest driving conditions? Demand the best.

MICHELIN

MN&C/DDB MCH 5745

SONDERBORG TEKNIK

... from solid

"CHARIOT OF THE SUN"

DENMARK'S solar vehicle is named after the real Chariot of The Sun, found some 50 years ago in a Danish field. The solid gold cart is drawn by two horses and is emblazoned with a spectacular sun.

The project was begun by engineer Neils Dryer, who passed it on to the highly regarded Danish engineering and technical school, Sonderborg Teknikum. The result, considering the absence of an automobile industry in Denmark, is quite remarkable.

The vehicle is three-wheeled, which in combination with careful material selection, ensures a very low weight and excellent aerodynamic properties.

Solar Panels

The solar panels cover an area of 8m^2. Donated by SIEMENS DANMARK, they are of the newest type on the market, achieving high efficiency in converting solar energy to electrical energy.

The effective area of the solar panels is 6.48 m^2. With sunshine and clear skies, the vehicle has more than 850W (1.14hp) at its disposal.

Electronic adjustment between the solar panels and load maximises efficiency under all conditions. The power tracker is a complicated piece of electronic equipment. It was completed by electrical engineering students as their final project in spring. an overalll efficiency of 95% is expected.

Batteries

Donated by VARTA, the batteries may be loaded each day for 4 hours while the vehicle is stationary.

"CHARIOT OF THE SUN" SPECIFICATION SUMMARY

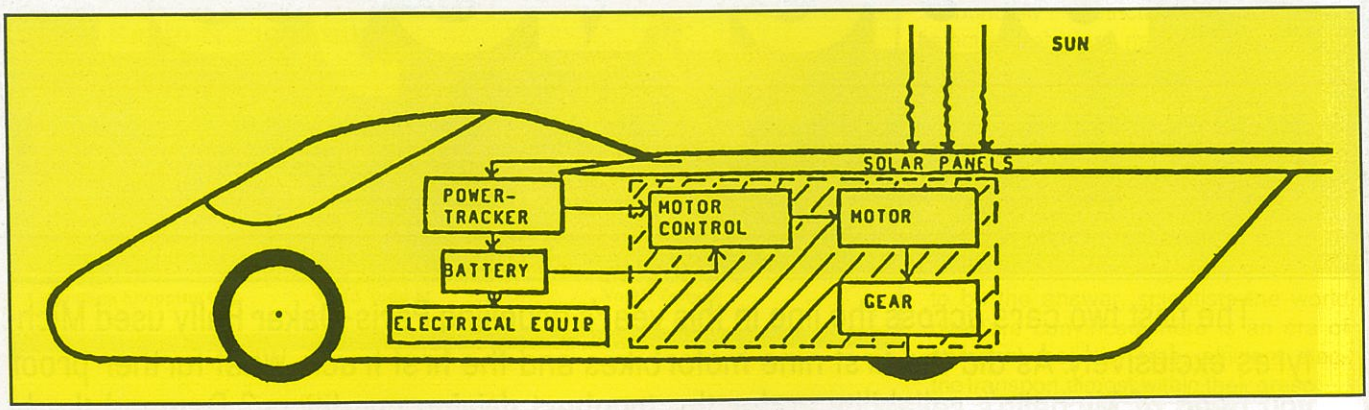
DRIVE:	Chaindrive with aluminium sprockets, delivered by SJØHOLM MOTORCYKLER free of charge.
WHEELS:	An exceptionally light magnesium alloy is used delivered by HYDRO ALUMINIUM.
TYRES:	Tyres from road racing motorbikes of the type SLICK. This tyre/type has an extremely low weight and rolling friction. Delivered by DUNLOP free of charge.
SUSPENSION:	Front: double triangle aluminium, rubber spring dampers. Rear: cantilever aluminium, 2 steel springs with dampers.
BRAKES:	Double loop system consisting of disc brakes from motorcross bikes, combined with magnesium calipers from road racing motorbikes.
STEERING:	Direct steering without damping.
BODY/FRAME:	Frame consists of a very light, strong aluminium alloy delivered by HYDRO ALUMINIUM free of charge. Chassis and cockpit made of fibreglass. Cockpit design has very good aerodynamic properties, with $C_D = 0.15$. Solar panel base made of balsawood.

The battery specifications must adhere to the precise calculations which have been carried out from knowledge of other vehicle parameters and the physical constraints to be encountered en route.

Other electrical equipment includes dashboard instruments, lights and communications. Part of this has already been donated or lent out free of charge by A/S A. FALKENBERG and ERIKSSON, RADIO SYSTEMS A/S. The vehicle must comply with safety requirements.

Drive Train

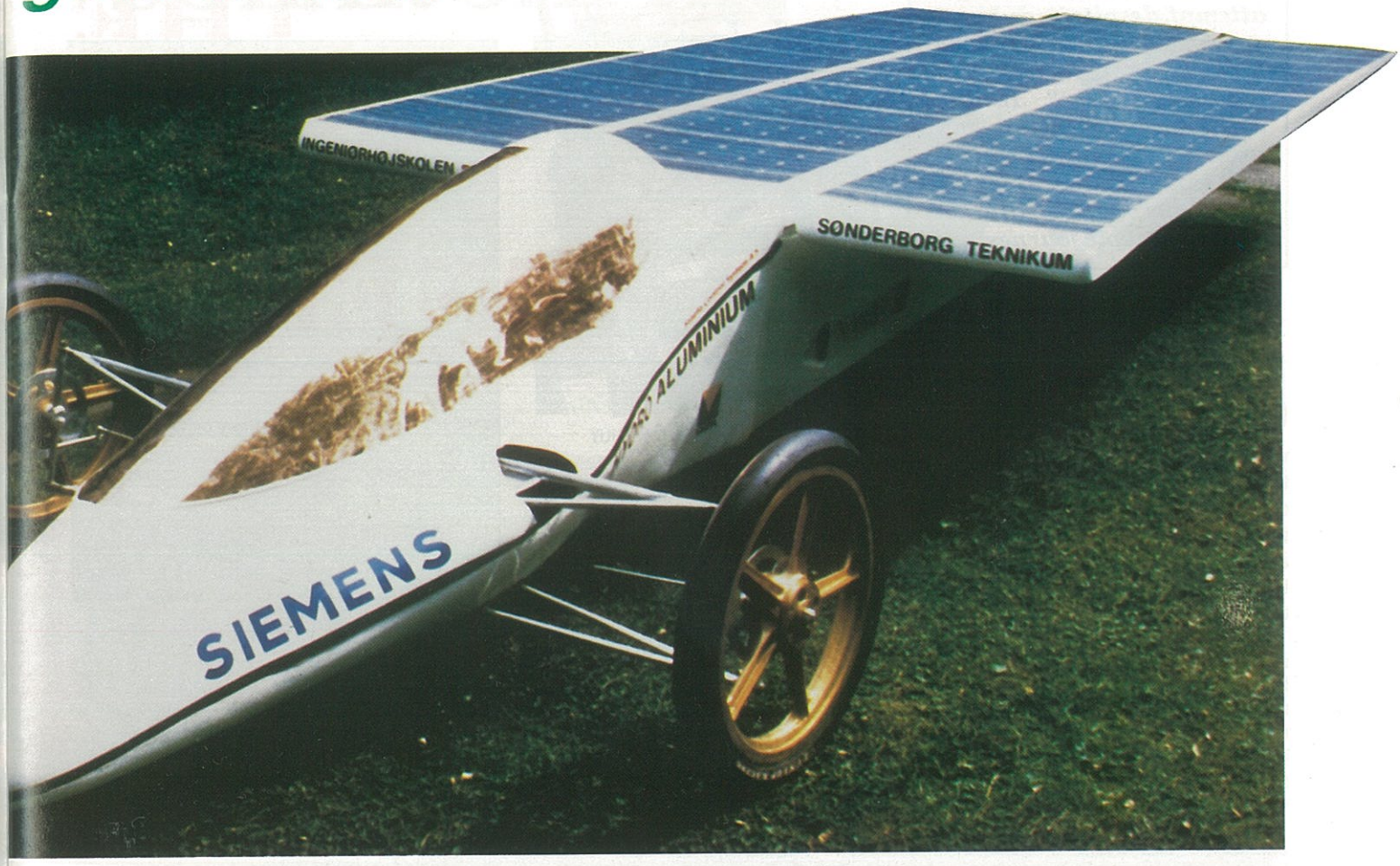
An integrated unit is used to solve the problem of gearing, with an automatic, infinite step regulation of the gear train to give a constant maximum torque output under all conditions. The solsystem will be able to deliver 680 Watts to the driving wheel under favourable road conditions.



KUM

DENMARK # 3

gold to solar



MEET THE DRIVERS...

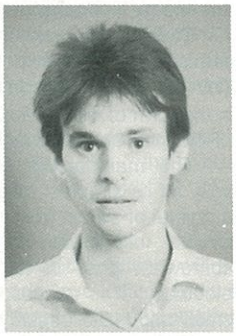
PETER NORREGORD RASMUSSEN, 28, an Electronics Engineer.

LARS JAKOB NEILSEN, 27, an Electronics Engineer.

LARS ARNDRUP POULSEN, 24, a student in Mechanics at Technical College.

MIKKEL STEEN PEDERSEN, 21, a student in Mechanics at Technical College.

TEAM MANAGER



JOHN W. TULLOCH 25, is a Mechanical Engineer in the aircraft industry.

THE CO-ORDINATOR

SVEND ERIK KNUDSEN, 52, a Civil Engineer.

What's inside those batteries that are ...

STORING THE SUN'S ENERGY

DAEDALUS may have come unstuck when he flew too close to the sun during his epic escape from the Labyrinth. However, some of the principles he applied in his successful escape attempt, despite its dubious outcome, will be put to the test once again in the World Solar Challenge". In this event, our modern adventurers will use the energy of the sun to allow them to 'glide' across Australia on an equally epic journey.

Chemical storage of Solar Energy in Lead-Acid batteries.

Story by W.F. GILLIAN

OF ALL the important technologies that have converged in the production of these 20th Century 'Sun Chariots', the two which are of most imporance will be photo-voltaics-energy generation and the lead-acid battery energy storage system.

Photovoltaic cells are constructed of semiconductor materials which can absorb light and convert it to electricity. The term itself is derived from the Greek 'photo', meaning light, and 'voltaic', from Alessandro Volta, whose discovery of the galvanic cell in 1800 has led to the development of today's storage battery.

Hindsight suggests it was indeed appropriate that these two words were linked in such a way, for the ability to store the energy generated by the semi conductor/light reaction has become the vital link in the large scale development of this energy technology.

Today the most commonly used semiconductor for this application is silicon. This is also very convenient, for silicon, in the form of silicon dioxide - SAND - is one of the most abundant materials on earth.

The manufacture of an active silicon cell, at its simplest level, involves growing a crystal of silicon from reservoirs of molten silicon. As silicon in its pure form is somewhat poor in its ability to conduct electricity, it is necessary to 'dope' it with small amounts of impurity.

The type of impurity used in this doping operation is dependent on whether we want the semiconductor to conduct positive or negative charges.

As a rule, phosphorous will be added to produce a silicon that will conduct negative charge (electrons) and is referred to as an n-type silicon. The addition of Boron to the silicon will produce the opposite effect, conducting positive charges (holes), and is referred to as p-type silicon.

Once these two types of silicon have been produced and are layered into a single cell, a junction is formed, called the p-n junction. It is at this junction that a voltage potential is developed, similar to that at the terminal of a storage battery.

When sunlight strikes the cell in the vicinity of this p-n junction, each photon (small packet of light energy) generates an electron and a "hole".

The electron and "hole" move apart; this movement of charge constitutes an electric current which can be made to do some external work, eg. drive an electric motor.

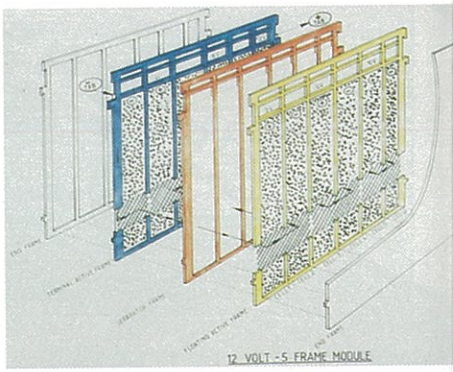
Typically, the potential difference that developes in a silicon solar cell is of the order of 0.5 volts, while the current produced is dependent on a number of factors, such as the amount of sunlight, area of the cell, etc.

By connecting several cells, in series or parallel, the voltage or current output of the array can be increased as required.

However, simply generating the electricity is not the end of the story. There needs to be a method of storing this energy and, thanks to our Mr Alessandro Volta and his galvanic cell, we now have a most efficient means of chemical storage in the form of the rechargable lead-acid battery.

Today's batteries are environmentally acceptable and offer a degree of flexibility in construction and service that is unattainable in other systems, not to mention their low life-cycle cost.

Although there are many ways of rating batteries, in this area of photovoltaics, ampere-hour (AH) capacity at the 5, 10 or 20 hr rate have been common measures. For example, if a battery is rated at 60AH at the 20 hr rate, it means that the battery can



Exploded view of Dunlop "Power Pack" battery.

be discharged at 3 amps for 20 hours without the voltage falling below 1.75V per cell, or 10.5V in the case of a 12 volt battery.

Further, as the environments in which these systems are required to operate tend to be somewhat harsh (for example, the vehicles in the Solar Challenge will be experiencing +40° C temp), the flexibility of the lead-acid system to meet these extraordinary environmental demands of remote area, where temperatures can vary from -20° up to 50°C, is a major plus.

In fact, today's lead-acid batteries are so versatile, cost-efficient and reliable that they are particularly suited to such applications.

And current research and development projects, both within the battery industry and on its perimeter, ensure that this mode of energy storage continues to improve and adapt (for example, the Pulsar power pack by Dunlop) in such a manner as to guarantee the photovoltaic industry a very bright future.

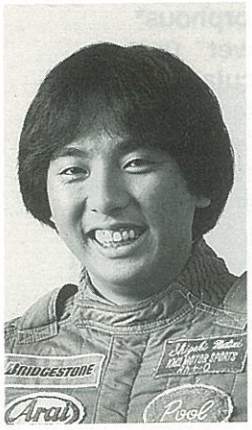
Nippon TV Leyton "SOLAR JAPAN"

JAPAN #4

TEAM SOLAR JAPAN SPECIFICATION SUMMARY

FRAME	Full monocoque body type (Carbon fibre monocoque)
SUSPENSION	(F) Double wishbone type, rocking arm (R) Delta axle push rod
STEERING	Rack and pinion type
BRAKE	Carbon disc (4-wheels)
WHEELS	Titanium disc + thin aluminium
TYRES	(F) 250/18 (R) 250/18
TRANSMISSION	(F) 4 speeds, titanium gear (R) Opposite rotation (motor), magnesium gearbox
PROTECTIVE AREA (FRONT VIEW)	1.2m^2
CD	0.24
SPEED (MAX)	85km/h
DIMENSIONS	5790mm long x 2000mm wide x 1035mm high Wheel Base: 2400mm Track: (F) 1400mm (R) 1400mm
WEIGHT	250kg

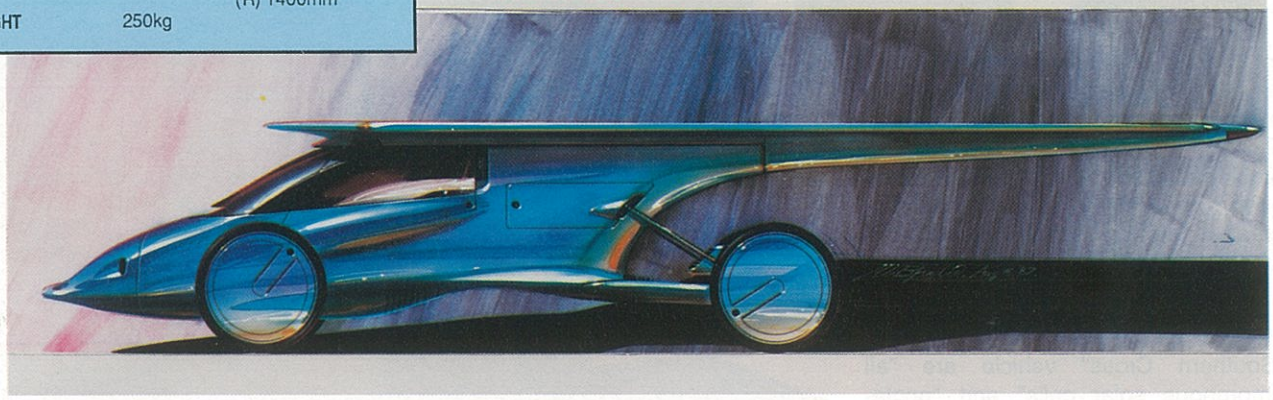
YUUJI YAMAMOTO



SHIGEKI MATSUI

YUUSUKE NATSUKI

...with a film star at the wheel



POPULAR Japanese film star, Yuusuke Natsuki, is one of the team of four men who will drive the Nippon TV Leyton solar car.

Though it appears unusual, Natsuki is very familiar with Central Australia, having driven there in 1986 in the rugged 4WD rally, the Wynn's Safari, with the leading Australian driver, Barry Ferguson. In the World Solar Challenge, he will join well-known Japanese race drivers, Yuuji Yamamoto and Shigeki Matsui, and Australian rally driver, Barry Lloyd.

The Solar Japan vehicle is made of titanium, Kevlar and carbon-fibre, high technology materials that are light in weight, yet incredibly strong and resistant to all weathers. The full monocoque body has an aerodynamic shape, and the driver is well protected from the powerful sunlight.

Suspension is similar to Formula One racing specifications - double wishbone, rocking arm damper type - while the disc brakes fitted to all four wheels have their basis in the units built for jet fighter planes, made of special carbon.

The disc wheels are made of titanium and light guage aluminium, and are fastened to the hubs with special titanium bolts.

Specially made tyres have been tested to ensure durability through the 3200km distance of the race, and their ability to absorb the vibration expected on the Stuart Highway.

Adjustable Panel

A unique arrangement of two kinds of solar cells has been adopted in the Solar Japan vehicle's solar panels. One is a silicon monocrystalline cell that gives better response to direct sunlight, while the other is an amorphous cell that gives better response to diffused light.

During the day with the direct sun, and in the morning or evening with diffused light, the driver will be able to change the angle of the solar panel's base frame, so as to comply with the angle of irradiation (light from the sun) during running.

In addition, the wings are designed to turn through a maximum 180°, thus following exactly the sun's position during the day.

In this way, the Solar Japan vehicle makes optimum use of the best characteristics of the two kinds of solar cells.

To cope with the anticipated extreme conditions inside the vehicle, drivers will be wearing specially made "cool suits", and will have the benefit of "through-flow" ventilation into the cockpit without jeopardising air resistance.

Team Solar Japan has entered this event because it believes that the knowledge gained during the production of the vehicle will prove valuable in producing such future solar-powered machines for places that lack normal energy resources. In any case, it is likely that solar-powered cars must be developed for use in all areas in the not-too-distant future.

SEL "SOUTHERN

... "we are Amorphous!"

WE ARE very happy to have the chance to test the ability of "amorphous* power cells" for power use (although not in calculators). We have been researching and developing these cells for many years and have achieved the best efficiency in all the world.

Almost all teams will use single crystal silicon solar cells or polycrystal silicon solar cells, with very high efficiency and reliability. What we will use as a power source, however, despite the weakness of the material, are amorphous solar cells.

Though we will have little chance of defeating those teams using single crystal or polycrystal, we are ready with our amorphous solar cells to offer a strong challenge.

Because we believe amorphous solar cells to be superior to single crystal and polycrystal solar cells as regards economy and productivity - although there is still a mountain of problems to solve - our solar car has been produced to demonstrate the great potential that exists for amorphous solar cells.

Unique Features

The special features of the SEL "Southern Cross" vehicle are "all amorphous solar cells" and "angle-controlled solar cells panel".

The panel is motor driven from -60° to +60°, taking the axis of rotation parallel to the direction of travel. As we run north to south, and the sun crosses over the car each day, we can "catch" the sun all day.

The material of the panel is like that of an airplane - aluminium honeycomb. The axis joining the front chassis with the rear chassis is FRP (Fibre reinforced plastic) type, while the "dachshund" style of the body offers little resistance to side winds.

For transportation our vehicle may be taken apart into four sections - front body, rear body, panels and frame.

The vehicle has two DC motors of 500 watts output, one for high speed use, the other for high torque use. Thus, while we do not expect to exceed 100 km/h, we calculate the output sufficient to run us to our goal, without hurry.

And we do not have concern about grades, for our vehicle has 12-speed transmission.

The SEL Southern Cross was designed in partnership by Mr Kazuaki Baba and Mr Shinji Imato. Mr Baba, 28, is a motor sport enthusiast and computer programmer. Mt Imato works with SEL (Semiconductor Energy Laboratory Co), is also a motor sport enthusiast, and worked with Mr Baba as a computer supervisor on the Shell Mileage Marathon in Japan.

KAZUAKI BABA, 28, computer programmer, co-ordinator with Mr Imato. Enthusiastic motor sport supporter, computer executive during Shell Mileage Marathon.

* Amorphous – a material that is not crystalline, ie. of irregular construction, such as glass.

CROSS"

JAPAN # 5

SEL 'Southern Cross' Specification Summary

DIMENSIONS	Running weight	300kg (inc. driver 85kg)
	Wheelbase	4650mm
	Track	1800mm
	Length	5900mm
	Width	1980mm
	Height	1300mm
SOLAR GENERATOR	Single Junction Amorphous Silicon Solar Cells	
	Area	7.9 sq.m (384 (modules)
	Output	600 watts at 1000 watt irradiation / sq.m
	Frame	Aluminium Honeycomb Panel
	Angle Control –60° to +60°	
ELECTRONIC ENERGY CONTROL SYSTEM	Power MOSFET DC-DC Converter	
ENGINE	DC-motor x 2 (two motors are switched. Motor 1 for high speed, Motor 2 for high torque) Power output 500w (0.68ps) / 2500rpm	
DRIVETRAIN	Transmission 6 x 2 speed manual. Ratios 62:1 - 4:1	
SUSPENSION	Independent F/R. Double wishbones and coil-springs / damper struts	
CHASSIS & BODY	Tubular Space Frames jointed by FRP pipe. FRP body	
	Brakes	Disc Brake F/R
	Tyres	20in
	Steering	Rack & pinion
INSTRUMENTS	Speedometer - Voltage & Current meter - Motor Temperature guage - Solar Cell Temperature guage - Solar Power guage - Driver Cooling Fan - Two-Way radio	

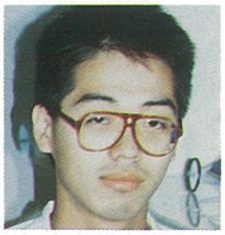
THE TEAM DRIVERS...

MASAHIRO KOJIMA 25, salesman of SEL's special semiconductor research equipment. Principal driver of the "Southern Cross"

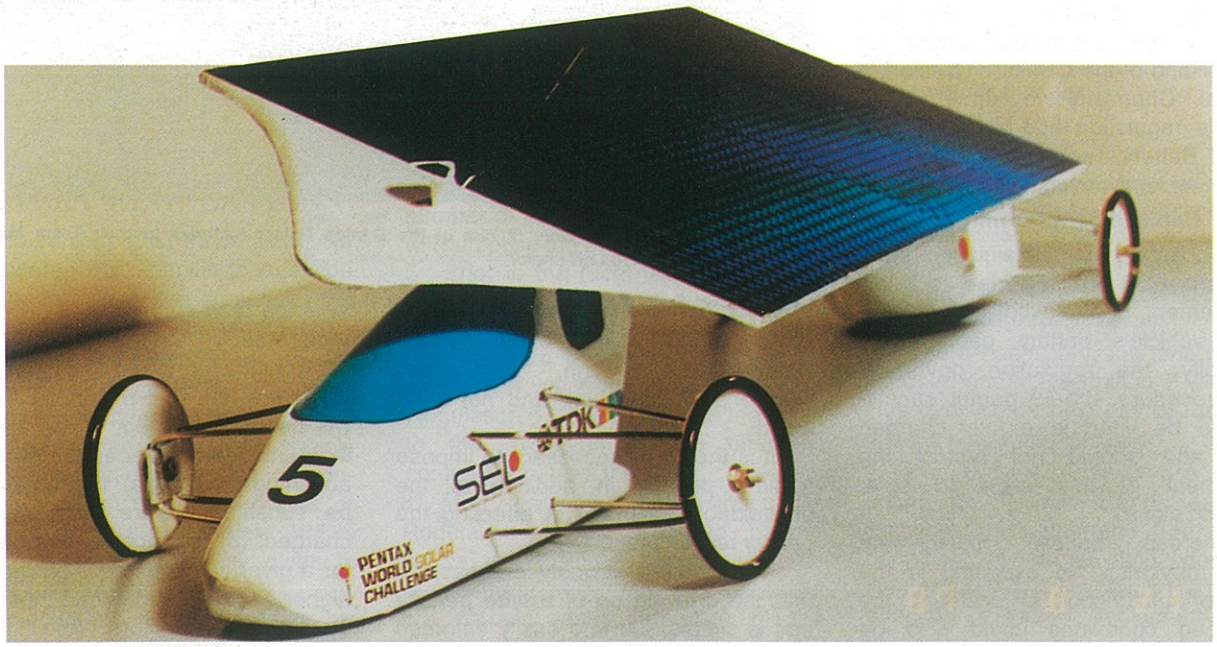
SHINJI IMATO, 28, manager of the SEL team and co-designer of the vehicle. Dreams of building a solar power plant in the desert.

HISATO SHINOHARA, 28, excellent electronics engineer and solar cell researcher who made up the vehicle's solar power and electronic control systems.

KAZUO NISHI, 22, a researcher on solar cells, has manufactured solar cells for Southern Cross. At university he captained an American football team.



OSAMU AOYAGI, 20, the youngest team member, very keen on cars and motorcycles. In charge of electrical measurements and gathering solar cell data.



POWERED BY THE SUN!

... with batteries kept under control

VEHICLES in the Pentax World Solar Challenge will be powered only through the use of solar panels, of maximum dimensions 4 x 2 x 2m. The electricity derived from this energy scource may be stored in batteries.

A battery charging period (solar only) is permitted for up to two hours before the start (6am to 8am) and at the end (5pm to 7pm) of each day's racing.

Considerable debate took place on the formulation of an effective and universal battery regulation, particularly in relation to devising a penalty for the replacement of the vehicle pack (either in whole or in part) following malfunction or accident.

Challenge organisers asked Dr David Rand of the CSIRO's Division of Mineral Chemistry to draw up a suitable regulation and to act as the official Battery Technical Adviser and Scrutineer for the event.

Replacement Permitted

In order to maintain keen competition, it was decided to allow replacement of the whole or part of each vehicle's battery pack. For simplicity, the regulation governing this procedure should permit substitutes to be fitted in a fully charged state and should not restrict the attainment of this state to solar charging alone.

Whereas battery replacement would obviously be essential in the case of malfunction or accident, the proposed conditions could also be used to strategic advantage with healthy batteries. For example, battery exchange during overcast skies or during the latter stages of a day's racing would boost vehicle performance through, in effect, injections of fossil-fuel, and not solar energy.

It is therefore necessary to impose a time penalty in addition to the unavoidable time lost in effecting the battery replacement.

It should be strongly emphasised that the drawing up of a time penalty that is simple, fair and easily enforced and policed is no easy matter, particularly given the fact that no restraints have been placed upon the type or size of batteries that may be used and there is an urgent need to reach a speedy decision.

A rigorous time penalty for battery replacement would take into account the following factors:

- the state-of-charge of the cells, or modules, to be replaced;
- the relative energy densities and size of the batteries used by the different teams;
- the insolation level and wind conditions at the time of replacement;
- the road conditions at the time of replacement.

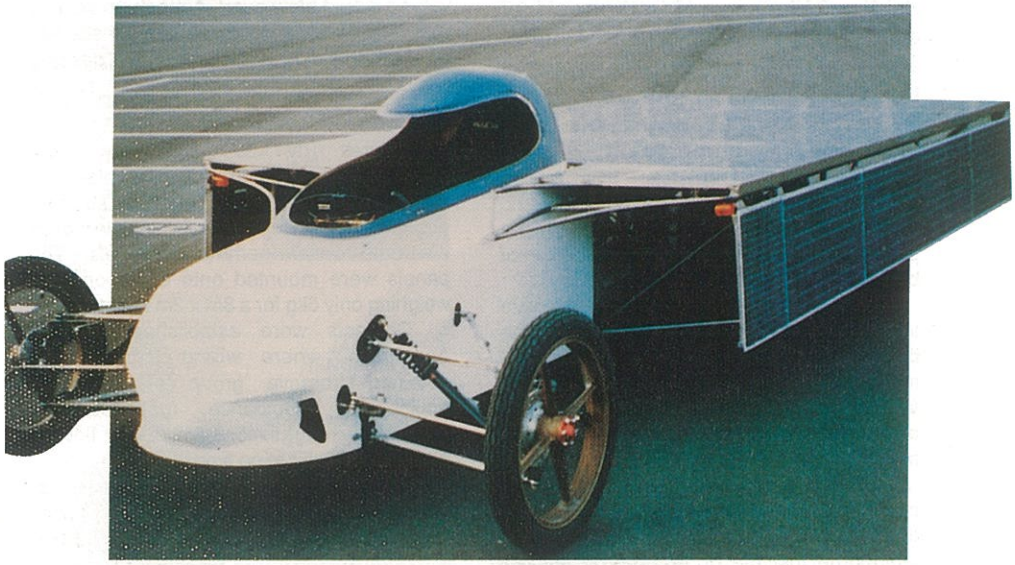
Considering these four points, and given the fact that the fresh batteries will be fully charged, it can be seen that unbidden replacement would be advantageous if: (a) the batteries to be substituted were less than fully charged, (b) the replacement batteries for a given vehicle had a considerably higher energy density than those used by other competitors, (c) inclement weather conditions were prevailing, and (d) uphill travel was to be negotiated.

Dick Smith and John Storey fit one of the Dunlop Pulsar batteries to their Team Marsupial vehicle. (JASON ALLEN Photo)

JAPAN # 6

TEAM PHOEBUS

... backed by the world's biggest



HOXAN Corporation, the world's largest manufacturer of photovoltaics, is behind this highly organised project.

Several specialists in the design and manufacture of photovoltaic cells and modules, and in the design and construction of racing cars, are included in the team.

Such high technology has produced the ultimate in photovoltaic cells, together with a reliable speed controller and high density battery, all housed in a superb lightweight body that enjoys carefully designed aerodynamics and high module efficiency.

The development of a universal battery-replacement regulation that would take into account all of the above factors was a monumental task. The regulation devised by Dr. Rand is considered to be the best solution in the circumstances, in that it will neutralise most of the perceived opportunities for gamesmanship so that the organisers objective of running the World Solar Challenge as a solar race, and not as a battery race, is achieved.

BATTERY REGULATIONS

1. Each vehicle must travel along the entire course from Darwin to Adelaide with a battery pack that comprises the same number of cells (or modules) as were fitted to the vehicle at the commencement of the race.

2. Cells (or modules) cannot be added to, or subtracted from, the vehicle pack. However, progressive one-on-one replacement of cells, modules or the entire pack is permissible, but is subject to the time penalty given in Regulation 7 below.

3. Replacement cells, modules or packs must be of the same size, type and brand as those initially installed in the vehicle.

4. Each competitor must have supplied the following to Dr. D.A.J. Rand by 1 September

(a) a specimen cell (or module) of the size, type and brand to be used in the vehicle, along with charging instructions and a statement of the total number of such cells (or modules) that will comprise the vehicle pack; or

(b) certified manufacturers' data on the voltage, capacity (C/20 rate) and weight of the fully charged cells (or modules) to be used in the vehicle, together with a statement of the total number of such cells (or modules) that will comprise the vehicle pack.

5. Prior to the race, the installed and replacement cells (or modules) of each vehicle will be inspected to confirm that they are of the same size, type and brand as those submitted under Regulation 4. Any variations may lead to the exclusion of the offending competitor(s) from the event.

6. After passing inspection under Regulation 5, the installed battery pack will be sealed and the replacement cells, modules or packs will be placed in the care of the observer appointed to each team. No seal may be broken without the observer being present.

7. Decisions to exchange cells, modules or packs should be communicated formally to the observer, who will release the required replacements and will impose the following time penalty once the exchange has been completed and the vehicle is ready to recommence its journey:

Time penalty (minutes) =

$$240 \times (1.225)^{m-1} \times \left(\frac{n}{N}\right) \times \left(\frac{ED}{40}\right)$$

where:

m = number of battery replacement pack

n = number of replacement cells (or modules)

N = total number of cells (or modules) in vehicle pack

ED = energy density (Wh/kg, C/20 rate) of replacement cell (or module)

8. Where necessary, the time penalty imposed under Regulation 7 will continue over to the next day of racing so that the full penalty is applied.

9. The Battery Adviser and Scrutineer, Dr. D.A.J. Rand, has the authority to recommend further time penalties to those laid down in Regulation 7 if, in his opinion, a team in effecting a battery replacement has gained an unfair advantage over other entrants or has otherwise departed from the spirit of the competition.

FORD AUSTRALIA SOLAR TEAM

SINCE 1980, a group of engineers in Ford Australia's Product Engineering Office, have competed in the Shell Mileage Marathon fuel economy vehicle competition and have three times captured the world record for economy. When the group heard of Hans Tholstrup's competition, they knew it was for them!

A proposal was put to the company and funding was enthusiastically provided, the project being in line with Ford's policy of being at the front of transport technology.

The team set about designing a vehicle to optimise its performance within the budget provided. Using a mathematical model of the sun's energy (insolation) and vehicle characteristics, a wide range of alternative configurations were evaluated, from the bizarre to the conventional.

Scale models of the favoured configurations were evaluated in the wind tunnel, generously provided by the Royal Melbourne Institute of Technology (RMIT). The team then chose the vehicle style which it is running in the Solar Challenge.

The choice was based on a low frontal area, low wetted surface body. To minimise the project cost a single panel of solar cells was selected and its input was optimised by tilting it to track the sun.

Much study went into vehicle stability, for calculations suggested that cross-winds and truck bow-waves would present a problem; some even suggested that the vehicle would blow over! A mock-up vehicle was built in 1986, to prove vehicle stability by conducting high speed passing manouvers using large semi-trailers.

Resources

Solarex Pty Ltd of Sydney, were approached for help in providing solar cells and were very positive in their support, providing arrays of specially selected cells built onto Kevlar/Foam/Kevlar panels. The panels were mounted onto a carbon fibre weighing only 6kg for a 8m x 2m structure.

Contacts were established at Ford Aerospace, where willing support was obtained from a group of interested engineers. Guidance, materials and invaluable suggestions started flowing across the Pacific in no time!

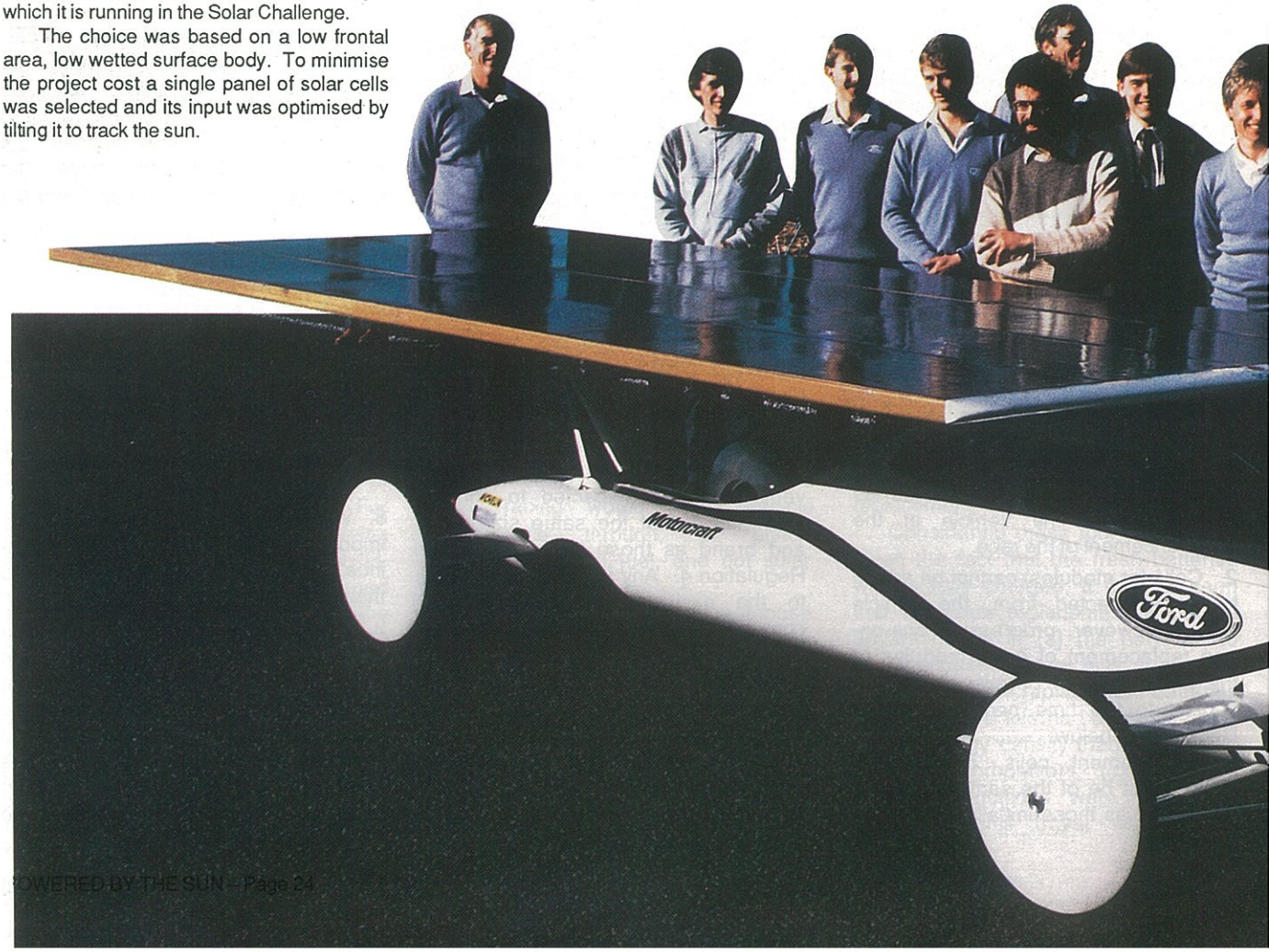
The body of the vehicle was based on a laminar flow aerofoil section, and Kevlar/Foam/Kevlar with carbon fibre reinforcement was selected as the means of construction. Suspensions were made from chrome molybdenum steel and mounted on subframes, the concept being to have all running gear mounted on removable modules. Suspension geometry was designed to minimise track change and, hence, side scrubbing of the tyres.

Silver zinc batteries from Yardney were selected, while Dunlop Pulsar light weight lead acid batteries were used in development. An Industrial Drives rear-earth motor was selected for its size and efficiency.

Computer

To monitor all control functions a Ford Electrical and Electronics Division EECIV microprocessor was designed and built to drive the display to the driver from which he will make his decisions. A number of alternative motor control and power point tracking controllers are being evaluated at the time of writing.

In minimising rolling resistance, the aid of Michelin was sought. Michelin



AUSTRALIA # 7

... the car they called the Model "S"!

constructed a mould and provided low rolling resistance tyres based on their technology in producing fuel efficient tyres.

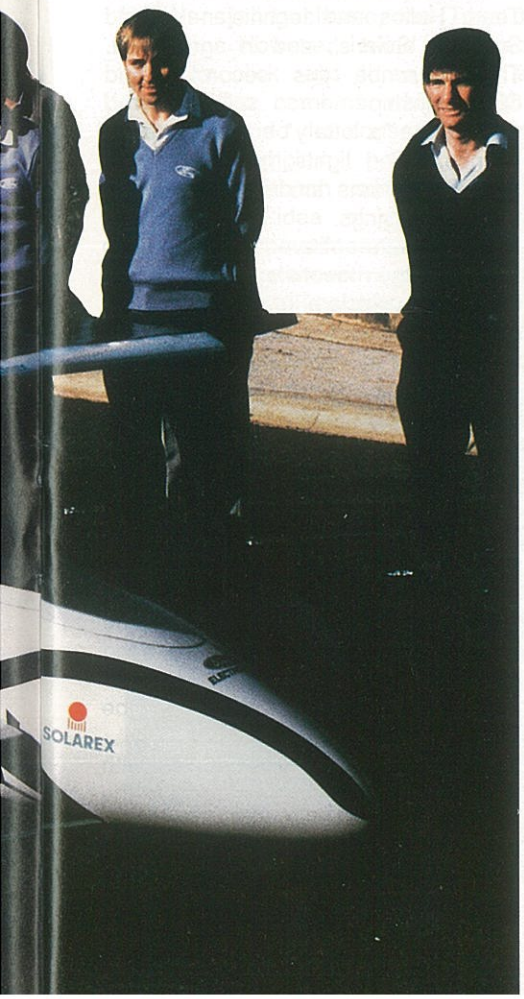
To select the best drivers the RAAF Institute of Aviation Medicine was contracted by the Company doctor. Candidates were "cooked" in an environmental room and the best drivers in terms of body core temperatures, anthropomorphic fit and concentration selected.

The team was fortunate in finding Dib Simonsen, a dietician who has weaned the members away from junk food towards a more suitable diet for long periods in a hot cramped environment.

Strategy

Cloud cover prediction is obviously a major factor in a solar vehicle race. Help was obtained from AWA in providing equipment to obtain satellite weather information.

The running of the vehicle in the race is controlled by the strategist who, using a lap top computer, will direct the driver by radio from a support vehicle.

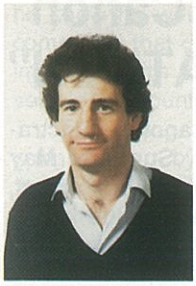


DRIVERS OF THE FORD MODEL 'S'

IAN COLE
At 31, a vehicle development engineer working on engine calibration for Falcon vehicles; qualified in Mechanical Engineering at Melbourne Uni. Responsible for front suspension design and fabrication. as test driver, has established ultimate life of electrical motor when run at 300 watts - with several motor controller burn-outs to his credit!

CHARLES LAKEY
Charles, 30, holds a degree in Mechanical Engineering from RMIT. Works in Engine Laboratory at Ford's Product Engineering Office, responsible for for future model engin program. Involved in build of most vehicle systems and lately assumed great interest in aerodynamic fairings.

JAMES HENDERSON
James, 27, has a degree in Mechanical Engineering; is design engineer in the Body Structures Dept. Helped in producing body plug, moulds and aerodynamic aids and gave CAD and stress analysis support.



LINDSAY MOLE
Lindsay, 33, development engineer with degree in mechanical engineering from Caufield Institute of Technology. Provided garage in which work was conducted then manufactured many of the systems in the vehicle. Also built a range of servicing equipment.

THE CONSTRUCTION TEAM

JON RETFORD
Team Leader. Jon is 25, with degree in Electrical and Computer Systems Engineering.

PHIL PILGRIM
At 44, Manager of Chassis and Driveline Engineering, with degree in Mechanical Engineering.

VIV BADDELEY
29 year old mechanical engineer with special expertise in noise and vibration control and dynamic.

DAVID MITCHELL
Degree in Mechanical Engineering, Melbourne Uni, now in Ford's vehicle development section.

JEREMY MOORE
26 year old Jeremy qualified as an engineer in the UK, reached Australia February, 1987.

DAVID FRENCH
David, 25, is a Ford test engineer, concentrating on servo-hydraulic testing.

STAN DOLOT
Stan, 31, is Liaison Program Manager in Ford Electrical and Electronics Division.

MICK SARGOOD
27 year old Project Engineer in Ford Design Office.

BARRY NOWELL
At 24, is currently Electronic Technician in Ford Electrical and Electronic Division.

JOHN MOLE
Manager of Advanced and Preprogram Engineering at Ford Research Centre.

CLIVE HUMPHRIS
38 year old mechanical engineer. Since 1980 associated with series of world record breaking Ford Engineers Mileage Marathon cars.

LAURIE PELECH
38 year old Laurie works as durability engineer at Ford Proving Ground.

PETER BARANOWSKI
Peter is 32, with degree in Mechanical Engineering. With Ford since 1978.

FORD MODEL "S" SPECIFICATION SUMMARY

DIMENSIONS:	2.0m wide x 1.1m high x 5.5m long
WEIGHT:	250kg
CONSTRUCTION:	Kevlar foam sandwich monocoque body with carbon fibre reinforcements. Chrome molybdenum subframes for front and rear suspensions
WHEELS:	Four 500mm diameter x 45mm section
SUSPENSION:	Independent front suspension with pull rods and inboard springs and dampers. Live rear axle with inboard springs and dampers
BRAKES:	Front - 2 x 150mm diameter disc brakes Rear - 1 x 120mm diameter disc brake
STEERING:	Rack and pinion, two turns lock to lock
BATTERIES:	Yardney Silver Zinc
SOLAR CELLS:	Solarex semi-crystaline
MOTOR:	1400w 115v DC
ELECTRONIC CONTROLLERS:	Pulse with modulated motor controller. DC to DC converter for solar cell interface. Ford EEC IV drive strategy computer
TRANSMISSION:	5-speed chain drive
ESTIMATED SPEED:	60km/h (cruise) 100km/h (max)

In Switzerland, an annual Solar vehicle fun race is now

SOLAR TOUR: THE TRAFFIC TEST

John Hill's "Dart", winner of the Electrokhana, has a small Solarex panel (0.675m^2) on a body that was once a kayak.

THE '87 "Canon ELECTRATHON"

THE 1987 "Canon Electrathon", run on Sunday, May 3, was won by Anthony Mott, whose two-wheeler (plus outriggers) vehicle Omega, achieved 140 laps of the 0.6km course set up in the carpark of VFL Park, Melbourne.

Organised by the Australian Electric Vehicle Association, the annual Electrathon and its sister event, the Electrokhana, are a test of durability and reliability of electric- powered vehicles.

The objective in both events is to drive the vehicles, each with limited electrical energy storage, as far as possible in a set time - two hours and half an hour, respectively.

Mott's achievement in covering 84km after leading almost all the way equalled the record set last year by a vehicle from the Royal Melbourne Institute of Technology (RMIT).

The Omega, a delightfully streamlined epoxy/glass body on a tubular steel frame, is just 104" long by 21" wide (264 x 53cm), with a wheelbase of 66" (168cm) and track of 1.25" (3cm). It is powered by a home-built 800w 36v BoschHillMottor, with primary gear and chain drive. It carries three 8pr Dunlop Pulsar batteries.

Development

Overall, the Electrathon is designed to promote the development of existing techniques and new technology appropriate for future electric vehicles.

The AEVA encourages the concept of efficiency as applied to road transport, and provides a forum where the skill and ingenuity of enthusiasts and professionals alike may be displayed, compared and tested.

THE World Solar Champion of Solar racing is Axel Krause, a 27-year-old physicist from Switzerland. He won his title in the Tour de Sol '87, run over a distance of some 600km on an open road course that took in at least seven major towns in Switzerland and Austria in June. Part of the new Champion's reward for his victory was transportation for himself and his vehicle to compete in the Pentax World Solar Challenge in Australia. Rather than take his own home-built vehicle, however, Krause elected to donate his prize to the "Spirit of Biel" programme. In turn, the Biel University has added Krause to its team to visit Australia.

URS MUNTWYLER, director of the Tour de Sol, shouts through a loudspeaker at race control cars: "Get out of the way, you lame ducks with petrol motors. The solar cars - cars of the future - are overtaking you."

The "Solaris" is fastest of the solar-powered vehicles and is driven by Stefan Brägger, 24-year-old motor cycle racer. Event organiser Jürg Schwarzenbach, drives like crazy, squealing the tyres of his Audi Quattro through the narrow bends of the Chur-Arosa Pass. Yet the Solaris is catching him. The top machines handle the corners easily at 70km/h.

"The cars just keep getting faster. Where's it all going to end?" asks a desperate Schwarzenbach.

There's a class for solar-powered racing cars this year and the fastest machine is cleverly named "Sun Formula One." It is hampered by lack of opportunity to overtake and speed limits which must be observed, otherwise there's an event penalty of 10 minutes.

The leading drivers complete the whole of the Tour de Sol together, virtually nose to tail. Panasonic Team Manager, Willi Stöckli, has spent a lot of money designing the aerodynamic vehicle. "It's not a race anymore."

Driver, Erwin Hungerbühler from Team Helios and technician Wilfried Schweri, 'Solaris', nod in agreement. They describe this second World Championship for solar-powered vehicles as "a lottery" and a matter of chance. Red lights, border controls and wrong turns are what determine the class placings.

Organisers have decided to shorten the sections next year. However, vehicles in the racing car class will be able to demonstrate their full capacity by completing laps of the racing circuit, Zürich-Oerlikon. The shorter sections will suit the series production cars in classes 3 and 5. They had trouble keeping up this year.

The Moor-Mobile, a mixture of Fiat 500 and Citroen AX, with solar cells, was actually pushed by driver, Nico Karrer, while co-driver Raffael Gerster tried to fix the electrics. Most of the vehicles in this category were issued with a black dot, signalling "out of the event," because they had to be recharged along the way.

Nevertheless, the future lies with this series. The vehicles look like the racy city thoroughbreds of the European and Japanese car manufacturers. Most seat two people

Tour de Sol

Condensed from a report in "Schweizer Illustrierte"

and the surface area of the sun cells on the roof is growing smaller.

Drivers find time to wave to the masses of cheering onlookers who line the roadside. Between Biel and Arosa, the crowd is almost as big as for the famous cycling classic, the Tour de Suisse. However, twice as many cameras click and three times as many video cameras whirr for this event. Nor do the conservationalists (Greenies) complain.

Schwarzenbach admits that the fundamental idea of solar-powered vehicles is sometimes overshadowed by the fascination with top speed, but the whole event is a means to an end. The public can see what has already been achieved.

The route this year was more difficult than before, yet about 60 solar-powered vehicles crossed the finishing line.

Difficulties

The Tour de Sol '87 proved that solar-powered vehicles are catching up to and overtaking petrol-driven cars. In this second World Championship, the vehicles and drivers had to contend with traffic jams and traffic lights, steep mountain climbs and long flat stretches, sauna-like temperatures in the cockpit, torrential rain and mud, and organisers keen to hand out time penalties if speed limits were not observed.

Racing driver, Marc Surer, competing in only his second event after a big rally accident, was looking forward to the long downhill run between Zürich and St Gallen, but was baulked by a truck travelling right on the speed limit.

He had been looking forward to using some driver 'know-how', but could not afford to overtake because he knew he would be penalised. He comments that driving skills are not so important - it's the performance of the vehicle that counts:

"Two things about this vehicle, sponsored by the Schweizer Illustrierten, remind me of Formula One machines - the chassis is built from the same carbon fibre and the driver sits in the middle. Everything else is different. The skill of the driver is much less important - the performance of the machine is what counts. Maybe on the mountain stretch I'll use my driver know-how.

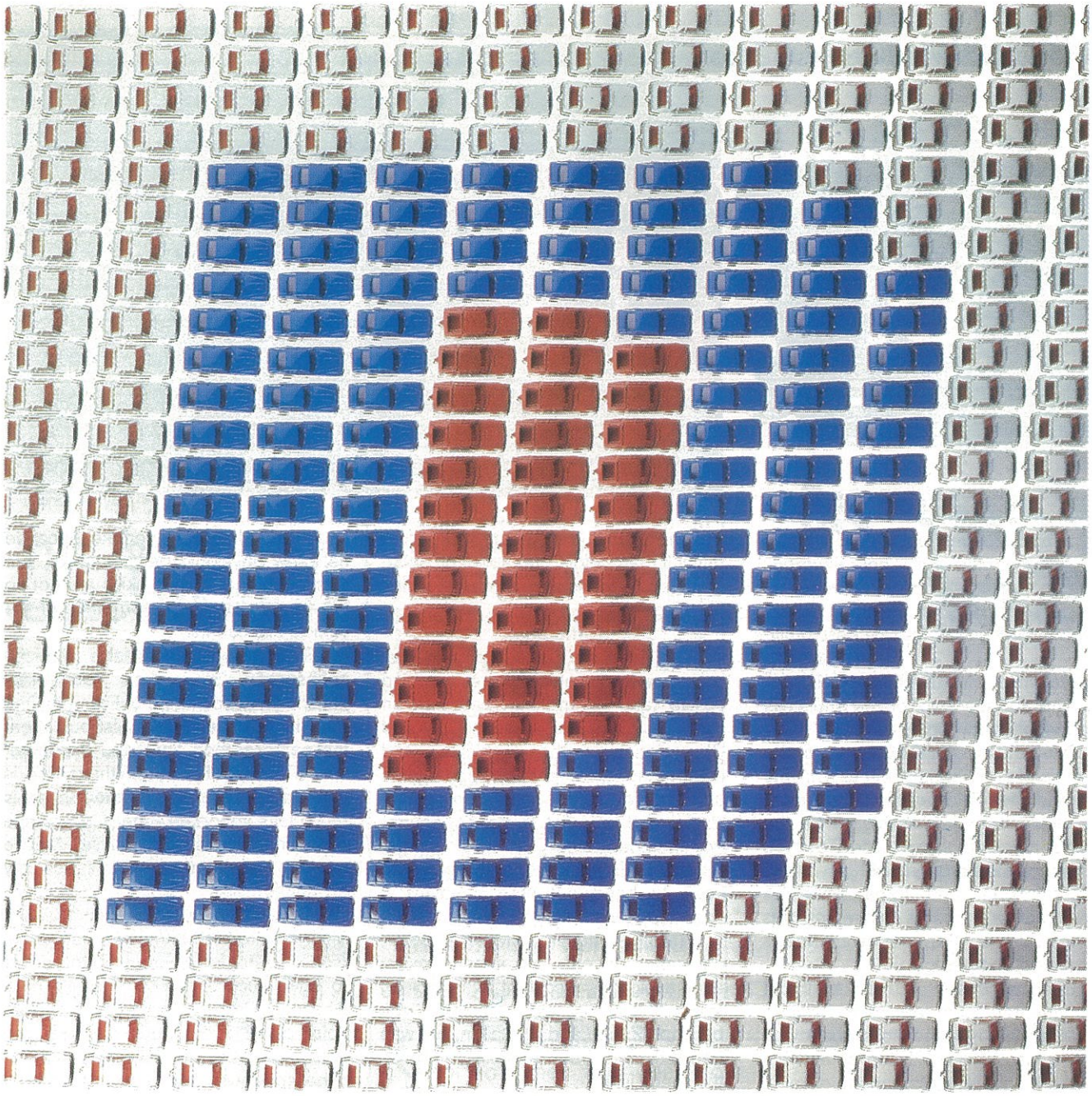
"Whenever I get to a control, I'm always asked the same two questions: Isn't it boring for a Formula One driver to drive such a box?" "No. it's not." Secondly, "Why doesn't your car have solar cells?" "Because the cells are mounted on the car at home in Möhlin." (The energy source is from batteries, which are solar-powered.)

Winner of this year's event, Axel Krause, is a 27-year-old physicist. He built the machine he drove with only one-third the budget of his competitors. By looking at his vehicle, you can tell he has a limited budget - adhesive tape holds panels together, whereas everything is perfect for driver and vehicle from the top Biel Engineering School or Panasonic teams.

He works on the vehicle in his spare time and develops the electronics in his small flat. He won't celebrate his victory, but will return to work on Monday and put in some overtime so that he can further develop the vehicle that climbs mountains at 80km/h.

ABOVE:
Racing driver Marc Surer drives along the crowd lined streets. He said traffic was a big problem - too slow!

LEFT:
... and when all else fails, one can always fall back on good old reliable human power!



MOST NEW CARS WEAR A DULUX COAT.

A Dulux coat of quality, protects and colours seven out of ten new cars made in Australia. But the facts don't finish there. Most cars are repaired and repainted with Dulux too.

When it comes to a first class finish, the great majority of Australian cars start and stay with Dulux.

AUSTRALIAN MADE

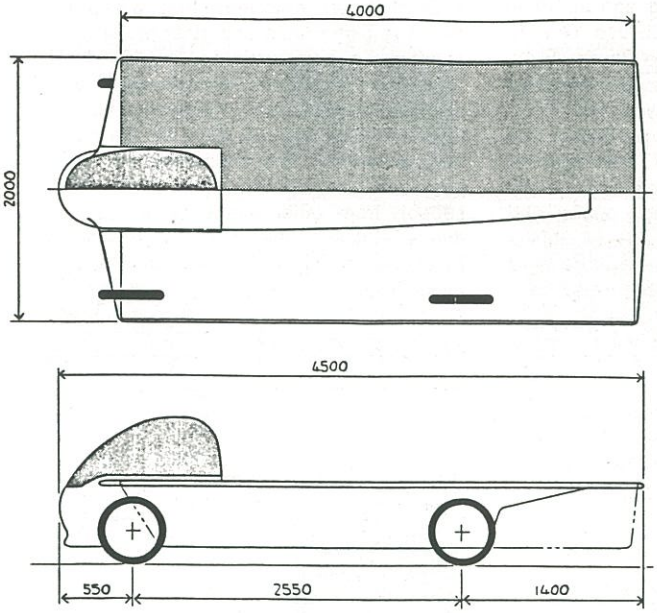
Dulux

REG'D

DUL 4606

JAPAN # 8

TEAM HAMA-ZERO



No further details supplied

SHEPPARTON PROMOTES SUPPORT PROGRAMME

A PROMOTIONAL Tour extending over 23 days and 9500 kilometres preceded a major support activity in the Solar Challenge by the City of Shepparton.

Publicised as the "Solar City" in Australia's only Solar Region", the progressive Victorian city is supplying back-up and service vehicles for two of the three Victorian vehicles in the race.

Executive Officer of the Greater Shepparton Development Committee, Don Budge, left on the tour in October to visit TV and radio stations and newspaper offices in dozens of towns and cities in NSW, Queensland, the Northern Territory and South Auatralia.

Contributing to the publicity tour were local companies SPC, Ardmona, Rosella, Bonlac and Shepparton Distilleries - and special packs of their products were presented to each media contact.

"It was probably the most ambitious promotion we've ever done, " Mr Budge said, "and it really publicised our industrial and tourist attractions."

THE SOLAR ENERGY SOCIETY

THE World Solar Challenge is being launched at an important time in Australia's history, when there are major Australian energy breakthroughs at hand. The Australian & New Zealand Solar Energy Society (ANZSES) is proud to be involved with this venture.

Recent Australian developments in the field of photovoltaics, battery storage and high efficiency electric motors at both the University of NSW and the University of Sydney will pave the way for new industries in electric vehicles, with solar being a significant energy source.

The Australian and New Zealand Solar Energy Society (ANZSES) is an affiliate of the International Solar Energy Society with branches in all States and Territories and New Zealand.

Its aims and objectives are to promote community development within Australia and New Zealand through the utilisation of solar energy.

ANZSES provides a venue for those interested in the development and promotion of renewable energy systems and membership is open to any person or group interested in solar energy and the aims of the Society.

The Society's journal, "Solar Progress", is published four times a year, providing the membership with a range of informative articles on solar energy oriented activities and research developments in both Australasia and overseas.

John A. Ballinger,
Chairman,
Australian and New Zealand Solar Energy Society.

THE PHOTON

THE Photon Flyer has been the focus of studies at the Morphett Vale High School in 1987. This school, in the southern suburbs of Adelaide, where the World Solar Challenge will finish, has enthusiastically supported the teachers who proposed the project and the 31 students who make up the team.

The project was first proposed in August, 1985, when project co-ordinator and motorsport identity, David Milne, read one of the first media reports. Returning at the time from a school ski trip he became absorbed in conversation about the potential of such a project with Hamish Robson, fellow skier and school physics teacher.

Their return to school and discussion with the school Principal confirmed their ideas that a project such as this would unite the school and combine the resources of most faculties within the school.

During 1986 the "Flyer", despite being named, was in limbo for some time while funds were sought from commercial sponsors and government grants. Economic restraints meant that the school could not underwrite a project worth over $60,000 and, whilst various organisations offered support and materials, the desision to proceed was not finally made until the end of that year.

A final team of 31 students were chosen in June, 1987, undoubtedly with adults one of the biggest in the race. Eight drivers (5 female and 3 male), six media, eight back-up, eight mechanics and one team leader will be split into two groups, changing in Alice Springs. They will be accompanied by four teachers and a number of other adults.

The 16 year old driving age in South Australia made it possible to use Year 12 and 11 students to drive the Photon Flyer, and early testing indicates that they will handle this situation admirably.

A challenge such as this provides a real meaning to education in the age of technology. The aspects of public relations, marketing, testing, public and media appearances, etc. are all things outside the normal curriculum, but are skills that have been embraced by this project.

Above all, the Morphett Vale High School Photon Flyer team looks forward to meeting the other teams and in seeing the state-of-the-art machines that will make this race bigger than any other motor sport event ever seen in Australia.

Behind the scenes, Miss Wendy House, one of the school's Home Economics teachers, prepared her team for the major task of feeding and supporting up to 24 people on the road at any time. With support from other members of staff, all things relating to the project were handled by classes and groups of students keen to make the team.

THE PHOTON FLYER TEAM

PROJECT CO-ORDINATOR

DAVID MILNE, age 41 years. Technical Studies Teacher. Has been teaching since 1966, eight years at Morphett Vale High School. Interests in Motor Sports, mainly rallying. Twice South Australian Champion Navigator. Course Director for 1986 State Bank Discovery Trial.

BACK UP CO-ORDINATOR

WENDY HOUSE. Home Economics Teacher. St Johns Ambulance Area Supervisor. Outdoor Education Specialist. Hasbeen teaching since 1981, 2 years at Morphett Vale High School.

OTHER TEACHERS AND ADULTS

KATH MILNE
JACKIE MOHR
GREG LOMAX
COLIN FLAHERTY
LYLE HARPER

PROJECT ENGINEER

HAMISH ROBSON (38). Physics Teacher Engineering Graduate. Has been teaching since 1975, five years at Morphett Vale High School. Wide background - keen musician and car restorer.

PHOTON FLYER SPECIFICATION SUMMARY

DIMENSIONS:	1.97m wide x 1.15m high x 5.5m long
WEIGHT:	220kg plus driver
CONSTRUCTION:	Aluminium tube frame with thin aluminium skin and moulded glass fibre nose. Light acrylic wind shield.
WHEELS:	700mm modified cycle wheels
BRAKES:	Hydraulically operated disc brakes on front wheels
SUSPENSION:	Front - double wishbones with coils over dumpers. Rear - trailing springs with sway bars and transverse tie rod
STEERING:	Rack and pinion, 1:3 turns lock to lock
ESTIMATED SPEED:	80km/h maximum, 60km/h cruise
MOTORS:	2 x 375 watt permanent magnet 240 volt motors driving the same shaft

FLYER

AUSTRALIA # 9

... the project that put a thrill into the Three R's!

DRIVERS ...

JULIE-ANN COPLEY (17) Year 12 student. Wants to be a teacher. Enjoys water sports, snow skiing, judo. Raced motor bikes when younger.

TANIA SAMBELL (16). Year 11 student. Wantsto be an accountant. Representative netball player.

ANN GABEL (16). Year 12 student. Wants to be a police woman. State representative Hockey player. Enjoys music and all sports.

GREG TREMBATH (17). Year 12 student. Wants to be a carpenter / cabinet maker. Enjoys horse riding, ten pin bowling and water sports.

TERESA COX (17). Year 12 student. Wants to be a swimming instructor. Champion surfer, qualified lifesaver. Enjoys netball and outdoor activities.

DARREN UNWIN (17). Year 12 student. Wants to be a systems analyst. Enjoys wind surfing and motor sport.

ROXANNE ARTHUR (16). Year 12 student. Wants to work with animals. Enjoys camping, outdoor activities and softball.

WAYNE KASTELYN (17). Year 12 student. Wants to be a sound technician. Enjoys motor cycle racing and soccer.

OTHER TEAM MEMBERS

MEDIA –
MANDY KEULEN
VIRGINIA UINGS
SIMON JONES
MICHAEL HOWARD
PAUL MANNS
MANDY SCOTT

MECHANICS –
DANIEL BENNETT
DANIEL HARDING
PAUL THORPE
RICCI CHESO
PAUL DOUGLAS
KYM MARTIN
NIGEL HART
BILL HAYES
GARY SIMPSON

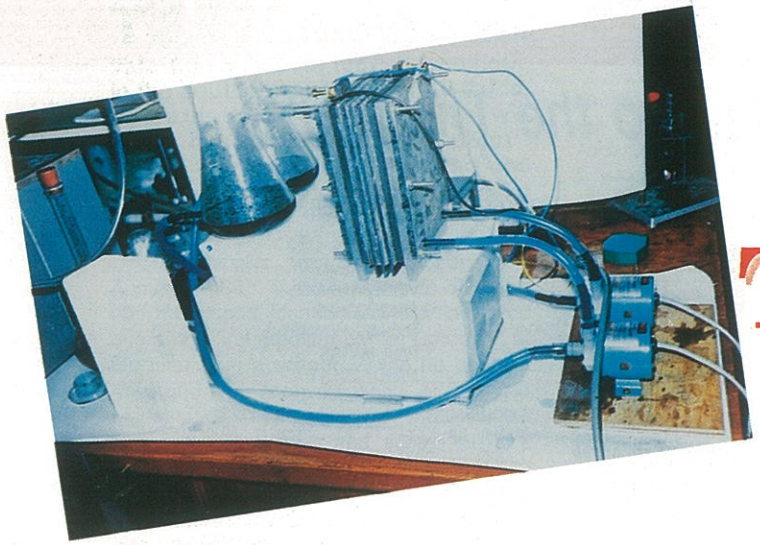
BACK-UP –
BRETT LAWSON
SIMON KERTON-JOHNSON
SAMANTHA WRIGHT
SHARON LANCASTER
TRISHA MARTIN
CLAIRE BATTERSBY
RACHAEL BENNETT
ALLISON WILLS

SPONSORS AND SUPPORTERS

Brian Phillis Auto Centre (major sponsor) - Bridgestone Tyres, Reynella - Hooker Land Development - City of Noarlunga - Philips Industries - Shell and Shell Card - Telecom - Noarlunga East Rotary Club - Budget Rent-a-Car - Comalco - Northern Territory Freight Services - Myer - Channel 9 "Come On Kids" - Ansett - Kingcraft - Lincolne Scott Australia - Anitech - Paul Barron's Cycles - Action Printing Services - Pedders Suspension - Girlock Ltd - MWA South Australia - Dairy Vale - Lazer Video - Australian Geographic - Hon Ian Gilfillan, MLC - South Coast Angling Club - Sanitarium Health Foods - Hollick Auto Repairs - Metro Meat - Woodroofes Drinks - Petroleum Refineries - Mr and Mrs L J Bennett - Electric Power Tool Services - Sola Optical - Anchor Foods - Noarlunga Lions Club -Cheap Auto Parts - Repco Australia - Stanvac Wreckers - Yazaki Australia - Slick 50 - Eveready - Honda Australia - Southern Districts Car Club - Mulford Plastics - APD Parcel Delivery.

In Australia, scientists achieve a brilliant ...

BATTERY BREAK THROUGH!



Experimental Vanadium Flow Battery connected to solution storage vessels (6-volt, 4-cell battery).

Recharge a battery in seconds!

Report by PETER BREWER

AN Australian scientist has made a breakthrough in battery technology which could herald the arrival of the instantly rechargable electronic vehicle.

Using a method known as the NASA redox flow cell, a US-developed process in which electrically-charged fliud takes the place of charged plates, Dr Maria Skyllas-Kazacos has found a means of obtaining continual power without the usual problem of contamination.

According to calculations, 70 litres of battery fluid will run an average vehicle for more than 150 kilometres before recharging is required.

And the recharging would be almost as easy as filling your conventional car with petrol, except that two pumps would be required - one to scavenge the battery tank of the charge-depleted fluid and another to fill it again.

The fluid can be re-used indefinitely, and can be recharged like a normal battery!

Dr Skyllas-Kazacos and her research group have been working on this project for three and a half years and their experiments in the School of Chemical Engineering and Industrial Chemistry (faculty of Applied Science) at the University of NSW have yielded startling results which have eluded teams working on the same concept in Japan and USA.

The basis of the Australian discovery rests with the type of chemical used in the fluid battery. It is a compound of vanadium - a metal used rarely these days except in the manufacture of stainless steel.

The vanadium compound is dissolved in an acid solution. One solution is positively charged and the other negatively, then both are pumped through different cells in the fluid battery. The exchange of electrons between the cells creates the electric charge.

Problems with the fluid becoming contaminated or losing its effeciveness over a constant period of use and re-use have not surfaced yet, according to Dr Skyllas-Kazacos.

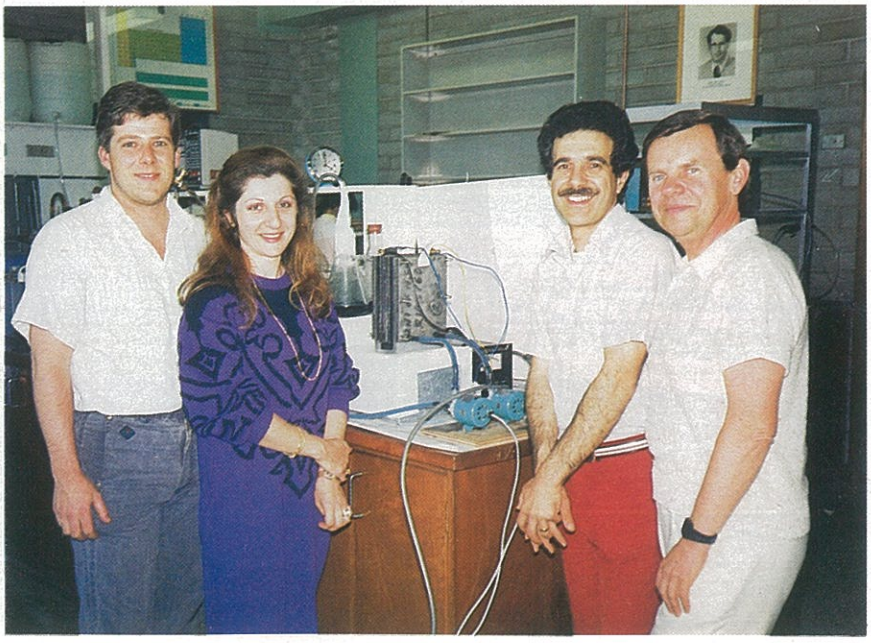
"We think this is the breakthrough we have been looking for - a battery that can be fully run down without any harm to its effectiveness whatsoever," he said.

One of the more immediate uses for the battery will be in remote areas of outback Australia, where wind generators and solar cells can be used to recharge the battery fluid, while a continuous flow of electricity was still being provided by the batteries.

It is also seen as a means of reducing reliance on back-up diesel generators for pumps.

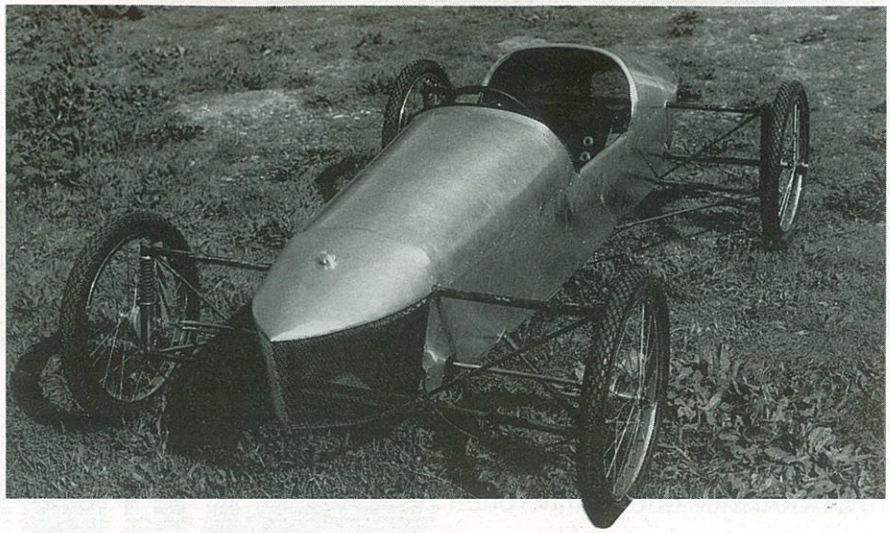
The world licence for commercialisation of the battery has been purchased by a West Australian-based company, Agnew Clough, which mines and refines vanadium.

Dr Maria Skyllas-Kazacos and her research team, (l-r): Franz Grossmith, Michael Kazacos and Miron Rychcik.



CLISBY SOLAR STEAM TEAM

AUSTRALIA # 10



"VAPOR 1"

...another creation from "the genius"

TYPICAL of the attitude that has marked his more than half a century of engineering wizardry is the creation of Harold Clisby's "Vapor 1" - something of a steam-powered David pitted against a field of sophisticated solar electric-powered Goliaths.

Clisby, 75, built his first car when he was 17. "Vapor 1" is his ninth or tenth, but more importantly, it's the world's first solar-steam car.

"We've approached this challenge from a totally different angle," the innovative genius said. "It's actually based on mechanism comparable to a solar hot water system.

"It's totally experimental, of course. We could eclipse all records, or be the slowest thing in the race."

Made from stainless steel and aluminium, Vapor 1 weighs less than 100 kilograms, complete with three-cylinder engine, six-speed gearbox and a small battery to run the car's lights.

The car was actually designed back in 1978, when it was suggested that a solar car race would be held in 1980, running from Adelaide to Darwin. The engine was built at that time, but not the car and, with the change in direction, required a slight change in design.

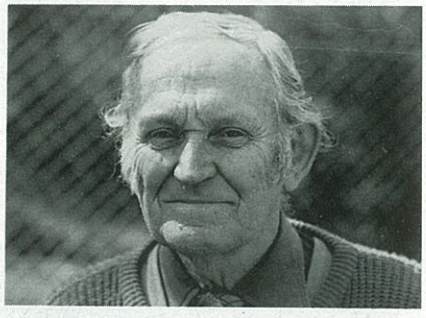
Clisby is well aware of the advantages and disadvantages of his design. "It's ultra light, because it doesn't have any great batteries to carry, so it will run easily on the road.

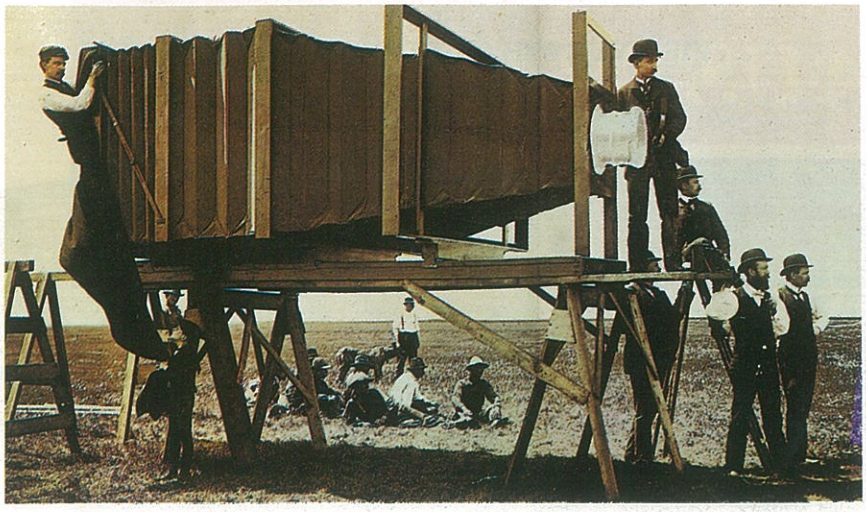
"But the disadvantage is that, while the electric cars are charging their batteries during the two hours before and after the day's running, our car gains nothing."

Another of the outstanding features of "Vapor 1" is its low cost. Built in just two months, the car cost a total of $2,500! In fact, the support vehicle for the Clisby Steam Team cost more - and is just as unique. It's a 1952 double-decker London bus. It spent much of its life in the Moomba gasfields, but has been carefully revamped and decorated especially for the Darwin-Adelaide adventure.

The Clisby Team is very much a family affair, too. Joining Harold Clisby in regular stints at the wheel will be son Orville, 17, daughter Loressa and three friends who helped build the car.

With his creation already dubbed "choo-choo car", Harold has told organiser Hans Tholstrup that he'll fit a whistle - just for the start!





For 150 years been pointing

When you look at the evolution of cameras throughout history, you will notice certain plain trends.

Obviously, cameras have been getting smaller. Lately they have become exceptionally easy to operate.

And as technology has advanced, add-on accessories have been integrated within the camera design itself.

Take a flash for example.

Once it was a pile of magnesium held aloft on a stick. Then it was a flash bulb. Then came electronic flash.

Now, for the first time in an auto-focus SLR camera, the flash is a part of the camera body.

The superb new Pentax SFX features a powerful built-in flash that pops up automatically – like the headlights on a sports car. The world's first T.T.L. flash built into an autofocus 35mm SLR.

However, the fact that such an innovation appears first on a Pentax should come as no surprise to students of camera history.

Pentax are the great pioneers in SLR cameras.

The first camera with an instant return mirror was a Pentax. So was the first SLR with fully automatic exposure. And the first one with autofocus.

Now, Pentax has taken the auto-focus concept to its logical conclusion. An autofocus system that offers the best response and accuracy available today. Pentax Super Focus.

Incredible as it may seem, it will focus from infinity to less than a metre in 0.3 of a second. There are even two autofocus modes.

You can lock a subject in perfect focus before releasing the shutter.

Or you can keep a fast-moving subject in continuous focus and release the shutter whenever you like. Pentax Super Focus even operates in total darkness.

Cameras have progressed a long way in the past few years, let alone the past 150 years.

Remember the first motor drives? They were bulky boxes that had to be bolted on to the camera body. Today, on the Pentax SFX, you wouldn't know the motor drive was there.

It is now part of the camera body and handles all aspects of film loading and winding simply and automatically.

But all of that is only part of the Pentax Super Focus story.

The long, bulky zoom lens is now a relic of the past.

The Pentax SFX comes complete with a compact 35mm to 70mm zoom.

As well as a brilliant new range of nine outstanding new SMC Pentax F lenses.

The SFX is designed to be fully compatible with current Pentax lenses and accessories.

Many existing lenses can be converted into autofocus lenses with the SMC Pentax AF Adapter 1.7X and still more can be used in the

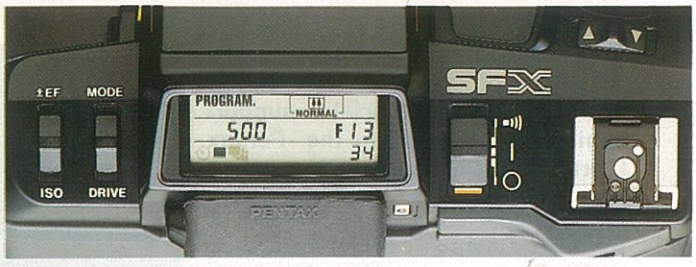
Focus Indication Mode that offers visual aids to help in manual focusing.

The SFX's versatility applies to exposure mode selection as well.

There are eight different modes – Program Wide, Program Standard and Program Tele which are automatically selected according to the lens used.

Two other programmed modes for special applications, Program Action and Program Depth, are provided as well as Aperture Priority AE, Shutter Priority AE and Metered Manual modes for maximum creativity in image reproduction.

And when you want to experiment with the creative use of flash, you can add an accessory flash to the hot-shoe.

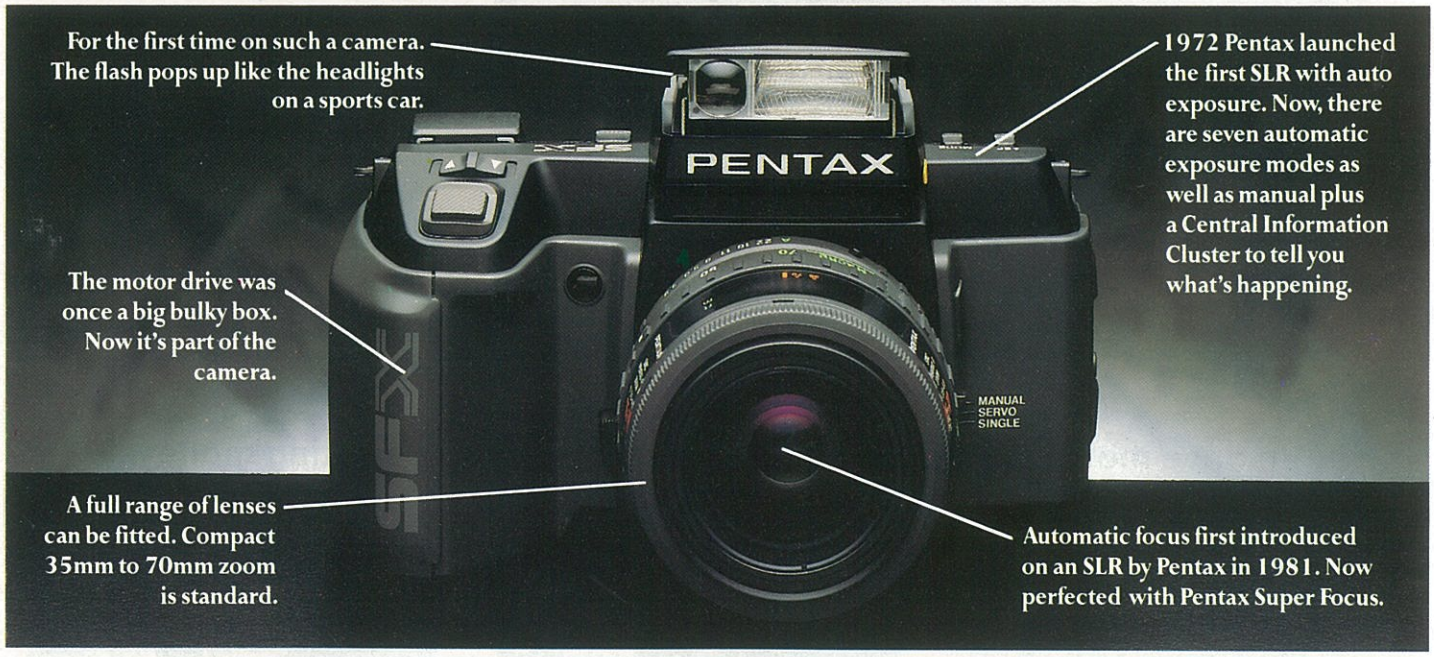


This makes even sophisticated multi-flash setups easy because the guide numbers of both the inbuilt flash and the auxiliary flash are set automatically. Even complicated daylight flash synchronisation can be achieved without any calculations or adjustments. All of this in a camera that is as simple to operate as a compact.

For photographers who recognise that certain cameras are milestones in photographic history, we have good news.

Your camera has arrived.

, cameras have in one direction.



For more information on the amazing Pentax SFX, write to: Department S, C. R. Kennedy & Co. Pty. Ltd., 7 Union Street, Brunswick, Victoria, 3056.

Name _____

Address _____

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The new Pentax SFX. Make no mistake.

CHANDLER HAMBLETON MIER CRP 0046

MAGNA WAGON TAKES ON THE CHALLENGE UNDER THE SUN

MITSUBISHI'S space and fuel efficient Magna wagon will be the official support vehicle for teams in the Pentax World Solar Challenge.

Twenty Magna GLX wagons will follow the solar powered prototypes as back-up vehicles and to ensure their safe passage.

Challenge organiser, Mr Hans Tholstrup said: "When we were setting up this event, it was vital to have very reliable conventional vehicles in a support role.

"However, it also was important for these vehicles to sit within the context of the event - energy efficiency and a testbed for design and innovation.

"We saw the Magna wagon as having a better fuel consumption to cargo volume ratio than its competitor vehicles.

"It uses less fuel than the sixes while providing about the same cargo volume, and offers far more cargo space than other four cylinder vehicles at the price of an insignificant increase in fuel consumption.

"I make no secret of the fact that I am a wagon freak. I'd prefer to sleep in a wagon and save motel bills anytime I am travelling over vast areas.

"And, according to the Australian motoring writers, you will not get a quieter and more comfortable wagon than the Magna.

"It has the best size packaging and also a massive 74-litre fuel tank for an exceptional fuel range.

"And its stablemate, the Magna sedan, was a finalist in the 1986 National Energy Management Award," Mr Tholstrup said.

Mitsubishi Motors Australia Limited also will be lending three Magna GLX sedans and two Starwagons to an international press contingent covering the event.

Solar cars . . .

. . . what a gauss!

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SOLAR RESOURCE SYNDICATE

AUSTRALIA # 11

... private but professional, with high potential

AN article in the magazine, Engineering Australia, in 1985 spawned Ian Landon-Smith's interest in the Solar Challange.

At that time Ian was operating his own civil engineering construction business and he quickly produced a design for a vehicle, leaning heavily towards an ideal aerodynamic shape.

Several changes were made following Ian's visit to Switzerland to see the 1986 Tour de Sol, but essentially the original concept has been retained and developed.

Literally a backyard project, the car has been constructed in three home garages around Sydney, finally being assembled at Ian's home in Wahroonga, a northern suburb.

In addition, the project is entirely privately funded, with no sponsorship of any kind being canvassed.

And an interest in cars in Ian's early youth is the only connection the team has had with cars.

Nevertheless, Ian has assembled a team that has planned and constructed a vehicle of very high standard in all departments.

SOLAR RESOURCE SPECIFICATION SUMMARY

DIMENSIONS	Length 6.0m Width 2.0m Height 1.05m
WEIGHT	Without driver - 132kg
CONSTRUCTION	Cr Mo and steel space frame sandwich foam, fibreglass & Kevlar body
ELECTRICAL	36V system. 1300W permanent magnet DC motor
SOLAR ARRAY	760 monocrystalline cells in plastic encapsulation
TRANSMISSION	Infinitely variable, with chain single reduction final drive
SUSPENSION	Rear - beam axle and panhand rod with air bag suspension Front - duoble swing axle with spring plate and hydraulic dampers
STEERING	Bevel gear reduction
BRAKES	Disc, dual circuit hydraulic

The Team

IAN LANDON-SMITH: Mechanical Engineer (BE Uni NSW, M.Sc. Uni of Melbourne). Designer of car, team leader and financier of project. Ran own civil engineering construction business until 1985. Now involved in solar research. Has worked in Antarctica (ANARE 1962), various parts of Australia including N.T., and Borneo. Interests include cycling, canoeing and cross country skiing.

ALEX HROMAS: Electrical Engineer (BE, University of Sydney). Designer and analyst of electrical systems for project. Presently employed as Senior Electrical Engineer, Norman Disney and Young, specialising in power engineering. Has previously worked in Switzerland and Australia for Boveri on high voltage switching. He is a keen skier and an ameteur builder.

BRUCE CRUNDWELL: Fitter and Turner, and Draftsman. The car was constructed at Bruce's private workshop and he was responsible for all welding, machining and fitting for the project. Presently employed as Technical Officer, Department of Mechanical Engineering, at Sydney University, Bruce has worked on mechanical systems for submarines and a number of high tech engineering development projects. Bruce is a keen cyclist, sailor and cross country skier. He is also an alternative energy enthusiast.

GEOFF BARKER: Canoe designer, craftsman and jack-of-all-trades. Designed and manufactured all body panels for car. Geoff has run his own canoe design business for 25 years and his designs and hand crafted paddles have been used by the winners of many Australian titles. One of his canoes was placed 4th in a recent World Cup event. Geoff is a keen canoeist and cross country skier. He is an alternative energy enthusiast and has not bought a single unit of electricity in 10 years.

HUGH WALKER: Marine Engineer. Responsible for some of car's electrical circuitry and instrumentation. Hugh is the proprietor of Electromation Pty Ltd, a nationwide electronics company. He has extensive experience with DC circuitry both in the merchant navy and whilst employed as a station chief on the "Dew Line" in Northern Canada. Hugh has driven from UK to Australia and is widely travelled in Europe, Central America, Asia and Australia.

CHISHOLM INSTITUTE OF TECHNOLOGY

"DESERT CAT"

THE only entrant from Melbourne, Chisholm Institute of Technology has combined the talents of staff and engineering students to design and build a radically different vehicle.

More than fifty Mechanical, Electrical and Industrial Engineering students have been involved in this project over the last two years. In addition, a number of other departments at the Institute have contributed; including Graphic Design, Chemistry and Psychology.

The Institute is no stranger to working on innovative vehicles. Chisholm has been the best college or university entrant up to this year in Shell Mileage Marathon, having been second outright behind Ford in four of the eight years of competition, with a best result of 2,854 miles per gallon.

In 1985, students from the Electrical and Mechanical Engineering Departments designed and built an electric vehicle which achieved the fastest lap time and the prize for innovative design in the Electrathon - a competition requiring battery power only to be used.

Chisholm's World Solar Challenge entry has been compared to a catamaran without the sails and has thus been dubbed the "DESERT CAT". The catamaran design was developed as a result of a concern to build a vehicle with both low aerodynamic drag and good aerodynamic stability.

It was felt that the winds generated by passing vehicles would give a significant lift component and could easily lift the solar panel and cause the vehicle to overturn. To decrease this risk, an asymmetric body design with the body placed on the extreme right hand edge of the panel was adopted.

A flat side panel may give rise to some lateral movement, but would prevent significant lift forces occurring. The fullscale catamaran design was then developed, using wind tunnel modelling in our own and R.M.I.T's tunnels. This proved that such a design would have both low drag and high stability.

The optimum design required the body under the solar panel to have straight, vertical sides, which was perfect for the body material selected, CIBA GEIGY'S "Aerolam" F-board, a fibreglass faced aluminium honey-comb cored sandwich panel. This provided excellent strength and stiffness while maintaining light weight.

The catamaran design offered us a second major advantage - the possibility of covering not only the top panel but also the sides of the vehicle with cells.

HOXAN, manufacturer of one of the world's most efficient photovoltaic cells (16.5%) provided thirty-five 9 cell x 4 cell modules, to give a maximum available power of 1300 watt. This will ensure a comparatively even power input over the day with the side cells providing a high percentage of the total power early morning and late afternoon.

J.E.D. Microprocessors donated a micro computer to control the onboard electronics and instrumentation. This works in conjunction with a high speed PC in the support vehicle, one of two donated by Earth Computer System. This computer accepts data from the on-board J.E.D. and uses it for strategy planning.

Five power conditioners ensure that each array delivers maximum power for any given solar input to 8 Pulsar batteries and / or 2 motors. The Pulsar batteries are 8 pair and the battery pack maintains a nominal voltage of 96 volts. The batteries store energy collected during stationary periods of the race and so ensure a more constant energy distribution during the racing period.

Two motor speed controllers govern the speed and torque of the two motors depending on race conditions. The motors are 750W and a 550W respectively, driving each rear wheel. The motors have different power ratings due to the asymmetrical design of the vehicle.

The JED micro monitors and controls power input of each solar array, battery energy input and output, vehicle speed and communications with the support vehicle. Additionally, the JED informs the driver and support vehicle of vehicle speed, power flows and alarm conditions.

On board the support vehicle the EARTH computer system simulates the race, allowing climatic and road variations and info from the JED micro, and then communicates to the JED micro the optimum wheel speed.

In addition to the contribution of components and products mentioned above the financial assistance of the Victorian Solar Energy Commission and Greater Shepparton Development Council have made the whole project possible.

Chisholm's entry is very unique. The project has presented a challenge to produce an unusual and efficient vehicle and at the same time expose students to real world engineering exercises.

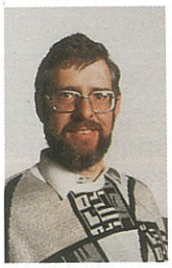
Mechanical and Electrical students have been mainly involved in research and development, design to criteria of performance, reliability, safety and aesthetics and constructed a vehicle that will compete with the best in the world. The Industrial Engineering students have contributed to project organisation, crew and driver training, publicity and sponsorship.

The unique and strong team spirit built up between staff and students during the past two years of working on the project will help the team to work together effectively, resulting in a successful result for Chisholm Institute of Technology.

THE 'DESERT CAT' SPECIFICATION SUMMARY

DIMENSIONS	5.95m long x 1.95m wide x 1.1m high.
WEIGHT	270kg
BODY CONSTRUCTION	Fibreglass faced, aluminium honey-comb sandwich panel, CIBA GEIGY Aerolam F-board
PHOTOVOLTAIC CELLS	HOXAN, 100mm square 16.5% efficient cells in 9 x 4 cell modules
WHEELS	Four 20-inch diameter BMX wheels
SUSPENSION	Front - sliding bush and coil springs Rear - swinging arms in rubber suspension bushes
BRAKES	4-wheel drums with mechanical hydraulic linkage
STEERING	10:1 worm / wheel steering box
MOTORS	1 HP and 3/4 HP 90-volt motors
ON BOARD MICROPROCESSOR	JED microprocessor system design jointly by Chisholm and JED
BATTERIES	Eight pair Dunlop Pulsars
CONTROL VEHICLE COMPUTER	Earth High Speed 20 meg PC

Project Leader ...



PAUL WELLINGTON, lecturer in Materials in Mechanical and Industrial Engineering at CIT. Initiated Chisholm's involvement in Mileage Marathon competition in 1979 and involved in management, body design and development ever since.

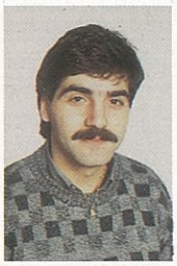
MELISSA McCULLOCH, thrid year Ind Eng, enjoys sporting activities, responsible for Cat publicity and sponsorship.

... a catamaran without the sails

AUSTRALIA # 12

THE DRIVERS ...

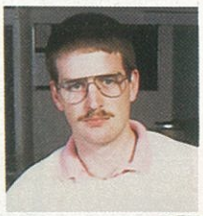
LISA ARRONS, after studying Mech Eng at CIT in late '70s, Lisa joined Traffic Operations Group at Road Traffic Authority; deals with traffic flow through Melbourne CBD. Since 1980, diminutive Lisa has been number one driver of Chisholm's Mileage Marathon cars.



JOHN PELITIDIS, third year Mech Eng student at CIT. Born in Melbourne 1962, became interested in mechanical gadgets. In 1982, enrolled at Chisholm, hopes to be designer and inventor of new projects. Has ambition to compete in Formula One. Designed steering mechanism for the "Desert Cat".

ELLIE CAMERON, decided against tertiary study to enjoy very colourful career including training polo ponies in northern NSW and driving trams in Melbourne. Now studying part-time in performing arts. Interest in solar energy and loves adventurous life.

TANIA ROSTAN, at 21 is completing final year of Industrial Engineering at CIT. Final year involves project planning, scheduling and co-ordinating. Enjoys activities, keeping fit and adventures.



SHANE RICHARDSON, fourth year Mech Eng at CIT, has designed and tested aerodynamics of the "Desert Cat'. Holds current pilots licence and is active member of Army Reserve.

SUPPORTED BY ...

STEPHEN ALLISON, 3rd year Mech Eng, designed rear suspension of the Cat.

STEPHEN BURNETT, former graduate CIT, now works in Mech/Ind Eng. Early member of project in design and computer simulation.

IAN DENT, long time technician in Mech Eng. Manager CIT Mileage Marathon project since '81. Built Cat's steering, front suspension and wheels.

KEN DEUTSCHER, course leader CIT Mech Eng. Dept.; force behind CIT Mileage Marathon entry. Designed Cat's steering, front end.

MICHAEL WILES, third year Ind Eng, has selected and trained Cat drivers.

DAIVD JONES, former student (App Sc) and tech officer in photovoltaics, now completing Elect Eng. Has built road-going electric vehicle, tends microprocessor controller of Cat.

IVOR LITTLE, lab manager Mech and Ind Eng, long involved with Mileage M'thon car, helped design and build the Cat.

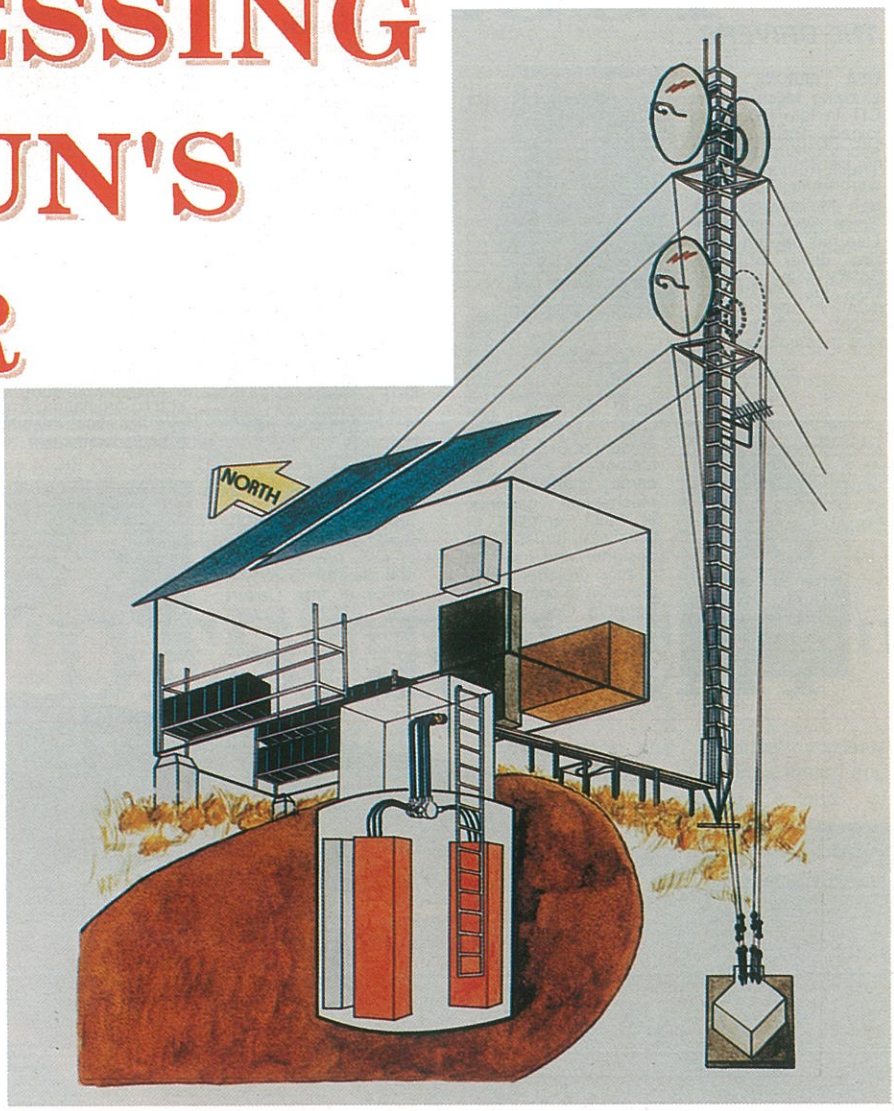
ANDREW PEELER, former CIT grad, now tutor in elec Eng. Is building solar mud brick house. Supervises elec eng of Cat.

ADRIAN SIETSMA, computer consultant, avid motor sportsman and technician at CIT.

EDWARD WITTE, fourth year Elec Eng, has developed motor controllers and solar array power conditioners of Cat.

Telecom shows the way ...

HARNESSING THE SUN'S POWER



TELECOM Australia is recognised as one of the world leaders in the development of solar technology. Its achievements in harnessing the sun's power have helped it cope with the communications of one of the earth's most widely spread populations.

And, as solar energy has revolutionised potential power sources, some of Telecom Australia's new concepts in this field are themselves revolutionary.

Until now, the utilisation of solar energy has proved to be somewhat difficult. Experiments have shown that this energy can be concentrated to heat and cool the air, and to generate power and electricity.

In many artificial earth satellites, for instance, solar cells are used as the primary source of power and electricity.

In recent years there has been growing interest in the possibility of making direct use of the sun's energy. This aspect has never been more evident than in the science of controlling the sun's energies to power telecommunications equipment and provide ways to handle Australia's harsher climatic conditions.

In countries like India, where such standard fuels as coal and oil are limited or lacking, deriving power from the sun or some other new source of energy is seen as an immediate necessity.

Even in Australia, where standard fuels are still plentiful, an increasing population and the growing demands of technology make it imperative to develop and utilise a new form of energy.

Over the years, Telecom has used many types of power sources, but none has had greater impact than solar cells. During the past 15 years, solar systems have been developed by Telecom to become a preferred remote area power source for loads up to 300 watts.

What started out as an engineering dream is now a reality. Telecom has built, in Western Australia, the longest solar-powered broadband telecommunications link in the world.

The Kimberley Microwave System, consisting of more than 40 microwave repeater stations spanning a distance of 1,595km in the north of Western Australia, is a solar-powered, technological monument to the range of applications for this versatile energy source.

The Kimberley Microwave System provides 2,500 telephone customers living in one of Australia's most remote areas with up-to-date high quality telecommunications facilities. Similar systems, many of them using solar power exclusively, have since been installed in all of the larger, sparsely populated States.

But how does one cut costs with solar energy? In the remote areas of Australia live some 44,000 people who have relied for years on an infrequent mail service or the Royal Flying Doctor Service for their communication needs.

Few people understand the magnitude of Telecom's declared target to provide all Australians with an exclusively automatic telephone service within the next few years.

Consider what is depicted by the word "outback" - vast areas of Australia comprising about half the continent. So far as is practicable and reasonable, Telecom has a responsibility to meet the social, industrial and commercial needs of the Australian people for telecommunication services.

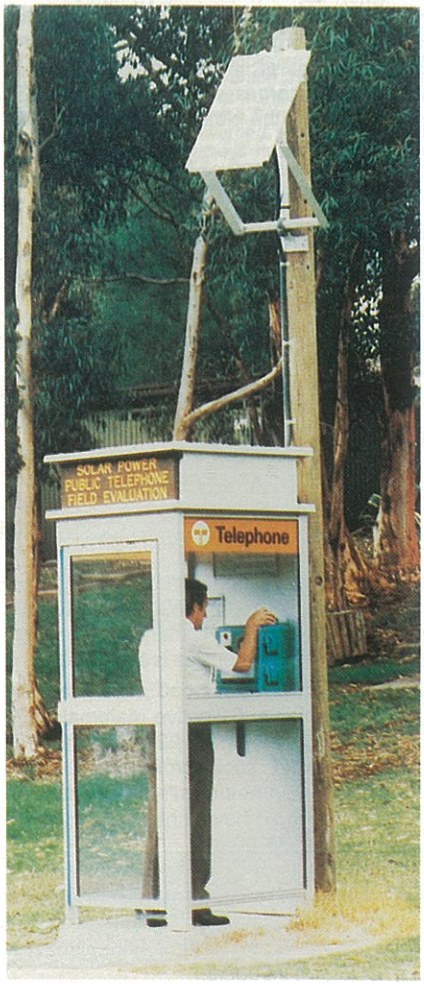
But the use of solar energy has lessened Telecom's reliance on fossil fuels, substantially reducing costs and bringing the economic viability of providing remote services to within arm's reach.

Nevertheless solar power does not come cheaply ... a photovoltaic system designed to support a 200 watt average load will cost about $52,000, including shelters. This load is only equivalent to about 5 incandescent globes or a fan, but is hardly enough to boil a kettle of water.

Sensitive telecommunications equipment must be able to withstand the rugged climatic conditions in which it will operate. Telecom's efforts in this area have made it a world leader in parallel technology of "passive cooling".

In the past, the need for equipment to be adequately cooled has necessitated air conditioning. Solar power simply cannot match such power consumption.

"Passive cooling" shelters have been developed by Telecom to match the latest telecommunications systems which bring many new services to remote areas - notably, Digital Radio Concentrator System (DRCS), the Australian brainchild designed for the specific purpose of bringing telecommunication services to distant rural areas of this vast continent.



Even the most outback areas aren't devoid of communication, with public telephones powered by a small but constantly efficient solar panel.

Multi-source or hybrid power systems are also gaining in appeal. Hybrid power systems use natural energy in the form of solar power. A diesel generator is kept as a standby source of energy. In smaller installations the diesel-generator can be operated in conjunction with either solar-array or a wind-turbine on its own.

The feasibility of hybrid power has increased dramatically in recent times due to the continuing drop in the cost of solar panels through advances in cell technology, and improvements in efficiency and outputs of components.

Another factor is the latest generation of wind-turbines, which can produce electrical energy more efficiently than their predecessors by using improved materials and construction.

Today, Telecom's expertise in this special field is second-to-none, although the technology of taking power from the sun remains in its infancy.

DISCOVER AUSTRALIA'S NORTHERN TERRITORY

AUSTRALIA'S vast inland remained a mystery long after Britain's colonies were firmly established on the coastal fringe.

As successive explorers returned with more knowledge of their new land, the theory that there was a great inland sea surrounded by tracts of rich, arable land gathered momentum.

Captain Charles Sturt held this view passionately, setting out from Adelaide in 1844 so confident of success that his equipment included a boat.

His party struggled northward, almost reaching the Tropic of Capricorn before being forced to retreat because of sickness and shortage of drinking water.

It wasn't until 1862, when Sturt's former draughtsman, John McDouall Stuart, successfully traversed the continent from south to north that interest was shown in the Northern Territory.

The South Australian Parliament acted quickly on receiving Stuart's report and applied for annexation of what is now the Northern Territory from New South Wales. This was granted by the British Government in 1863.

The development and history of the Northern Territory has been arduous and contains many heroic deeds that have become part of Australian folklore - the epic cattle drives, the Reverend John Flynn (Flynn of the Inland) who founded the Royal Flying Doctor Service and Harold Lasseter, whose tragic end, perishing in the desert, meant that his legendary reef of solid gold has never been rediscovered.

Aboriginal tribes attached themselves to cattle stations, where they were employed as stockmen and housemaids while others drifted to the Territory's fledgling towns.

Social systems and values began to break down; however, with the benefit of hindsight and government policies such as Land Rights for "traditional owners" the aboriginal people of the Northern Territory are much more able to meet the challenge of today on their own terms.

Probably the most publicised example of Aboriginal Land Rights was when on 26 October 1985, Australia's Governor General, Sir Ninian Stephen handed over the Uluru (Ayers Rock/Olgas) National Park title to the Mutitjulu community.

Uluru was immediately leased back to Australian National Parks and Wildlife Service, but with an Aboriginal majority on the Board of Management and employment of Aboriginal rangers, the whole community has been enriched - as has tourism.

Visitors are captivated not only by a stunning Ayers Rock sunset and the exhilaration of climbing the world's greatest monolith, but also by insight into the lives of a remarkable people.

The Yulara Tourist Resort, which opened officially in 1985, just outside the Uluru boundaries offers accommodation from the international standard Sheraton Hotel to campgrounds and is a model for future developments in ecologically sensitive areas.

A land of startling contrasts, from the sub-tropics of the Top End to the semi-arid Red Centre, it is the natural, unspoilt beauty that draws Australians and international visitors alike to the 'Outback'.

Alice Springs (population 26,000), in almost the geographic heart of the Australian continent, is surrounded by spectacular scenery.

Overlooking the town, the majestic McDonald Ranges dominate the view.

In 1872 the explorer, Ernest Giles, was astounded when he came across a 'tropical-like presence' - hundreds of swaying relict cabbage palms or Livingston mariea. His 'Glen of Palms', now known as Palm Valley, 130 kilmoetres west of Alice Springs, is a beautiful surprise.

The desert begins to give way to the tropics in the region known as the Never Never surrounding the town of Katherine (population 6,000), 1200 kilometres north of Alice Springs.

The Never Never's scenic highlight, Katherine Gorge, 30 kilometres north-east of the town, is in fact a series of 13 spectacular gorges whose walls tower 60 metres above the clear, blue waters of the Katherine River.

A further 300 kilometres north of Katherine lies the Northern Territory's capital city, Darwin.

A city with a colourful history dating back to 1869, Darwin was bombed during World War II and literally blown away by Cyclone Tracy on Christmas Eve, 1974.

Today, as Asia's gateway to Australia, Darwin is a cosmopolitan city that enjoys a relaxing sub-tropical climate reflected by a laid-back lifestyle.

Paul Hogan did indeed create "Crocodile Dundee" and his success has focused world-wide attention on one of the world's great wilderness areas, Kakadu National Park, 200 kilometres east of Darwin.

During the monsoonal months from December through March waterfalls cascade, flooding the wetlands to the west. Within this environment life is abundant.

Surveys have recorded more than 960 species of plants, 51 native mammals, 273 bird, 75 reptile and 22 different frog species, all in such profusion to make Kakadu a naturalist's wonderland. Aboriginal people have inhabited the region for at least 40,000 years.

Danger lurks in Kakadu's waterways, and visitors must always be aware that this is the natural habitat of the saltwater crocodile - a ferocious territorial animal that will not forgive intruders.

TEAM

"THAT sounds like one hell of a thing to do. Why don't we have a shot at it? ... and Alarus was conceived. For a fleeting moment it was to be JUST an entry, but Frank and Dimitri are achievers and it was impossible for them not to produce the best they could - limited only by financial resources, for Alarus is a private Sydney entry.

Starting with only a basic knowledge of solar energy, one of the first things they did was to buy a solar cell to learn about its energy output.

They dug out their old uni textbooks and for months researched areas of design and construction. Each design decision was computer tested to determine the best interaction of variables.

They knew that once they started building there would be no time left to play around with the design, so it had to be right first time. Particular attention was paid throughout to optimise the aerodynamic qualities of the vehicle.

ALARUS SPECIFICATION SUMMARY

DIMENSIONS:	2.0m wide x 1.5m high x 4.5m long
WEIGHT:	220kg (plus driver)
CONSTRUCTION:	Monocoque body and solar-cell panel, Kevlar/Foam sandwich composite. Solar-cell panel supported by struts from the body
WHEELS:	620mm glass-filled nylon. Three wheels (two front, one rear)
SUSPENSION:	All wheels with trailing links with inboard springs and dampers
BRAKES:	Hydraulically actuated disc brakes
STEERING:	Rack and pinion
EST. SPEED:	80km/h (cruising)

Frank Castino and Dimitri Lajovic have full-time employment as professional engineers, so all work has had to be done at weekends or into the late hours of the night - a definite test of perserverance and dedication when carried on for months on end.

With plans in hand, they were lucky enough to find Ray Tolhurst, ultra-light aircraft designer and builder

ALARUS

AUSTRALIA # 14

... the product of elevated thinking!

extraordinaire, who in turn became excited by the prospect of being part of such an innovative venture.

Full scale section drawings have been generated on the computer and Ray used these to produce the "plug" for the body. Fibreglass moulds were made using this "plug", then the Kevlar/Foam composite body was laid up in the moulds and the body was completed.

The mechanical components were machined in a factory workshop, then delivered to the garage where Alarus began to take shape.

Friends and family rallied to help in other areas, such as seeking sponsorship and publicity for our entry. Harald Tiefel created our logo and did the artwork, and Megan Gayler helped out by becoming an instant marketing person in her spare time.

Seeking potential sponsors is an unenviable task, but the Team was spurred on once Thomas Cook Aust. signed on the bottom line as the first sponsor. Impact International followed once they had seen our vehicle.

MEET THE ALARUS TEAM ...

DIMITRI LAJOVIC, 36, is a Mechanical Design Engineer with a gift for vertical as well as lateral thinking. He has always been intrerested in unconventional flight and has a particular delight in Zeppelins, gliders and scuba diving. He joined his father in business and is currently Chief Engineer as well as a director of the company. He specialises in machine design and the production of the latest plastics packaging materials. As the solar car took shape in his garage, Dimitri's only regret was having to abandon his initial plans to make it amphibious and air-worthy - the wings were too big for the garage.

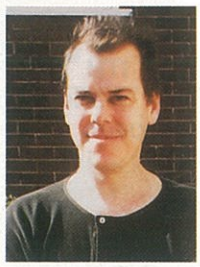
DIMITRI LADOVIC

BILL LLOYD

BILL LLOYD, 36, is a Patent Attorney and no stranger to inventive technology. In fact, he first met Dimitri when he wanted help in patenting some of his pre-solar inventions. Bill has a degree in Mechanical Engineering from the University of New South Wales, awarded with the University Medal in 1973. He enjoys music and occasional outings in his Stanley steam car with any inattached female persons willing to risk it.

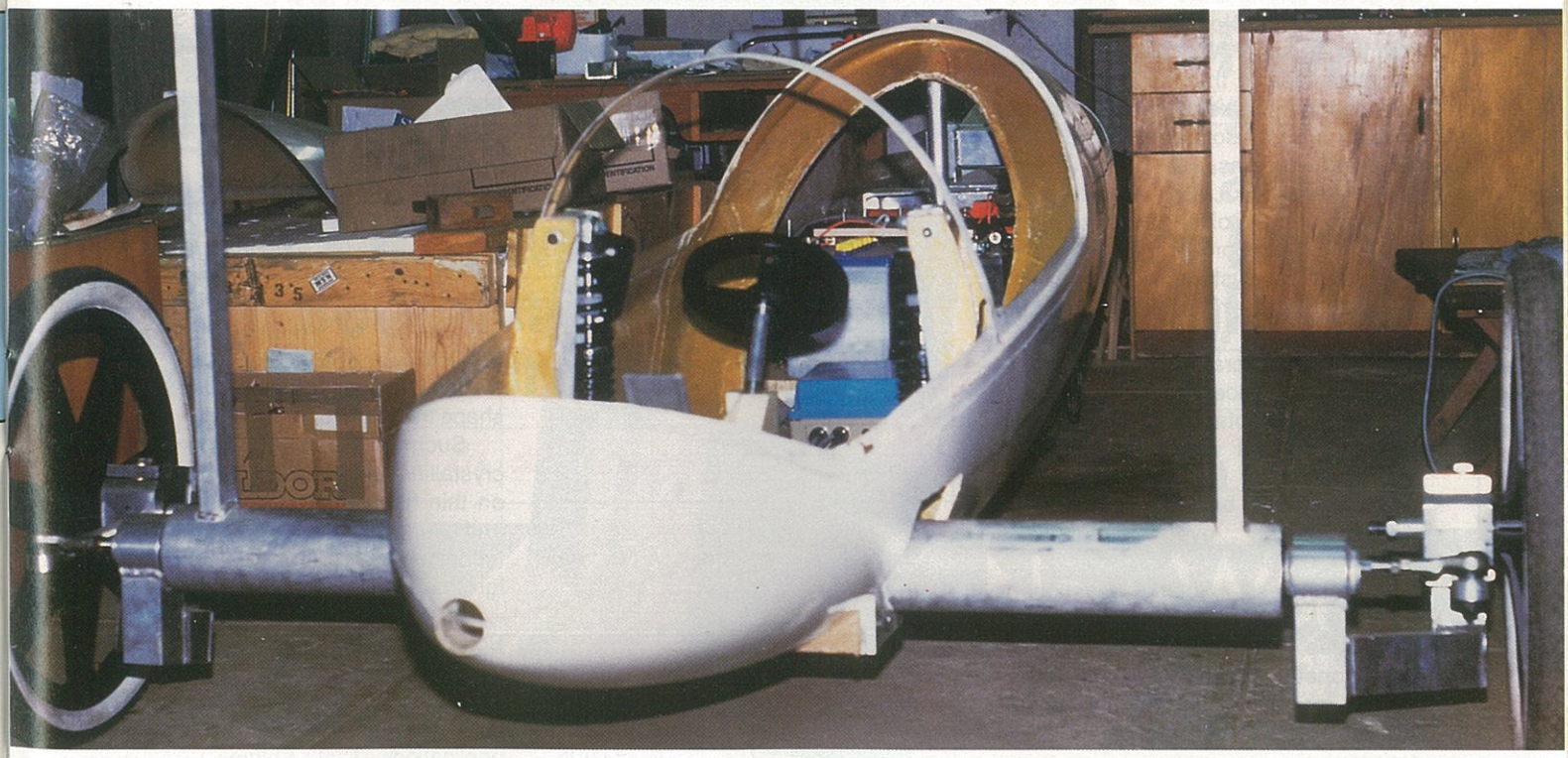
FRANK CASTINO, 35, met his team mate Dimitri when they were both studying for their Mechanical Engineering degrees at Sydney University. His Masters thesis investigated the properties of kevlar and epoxy resins, used to good effect in the solar car. Frank is a consulting engineer, but has an artistic streak and concieved the idea of entering the solar car race when painting his house. In fact, he was up a ladder when he first heard of the event on the radio. This is popularly thought to be his best example of elevated thinking.

FRANK CASTINO



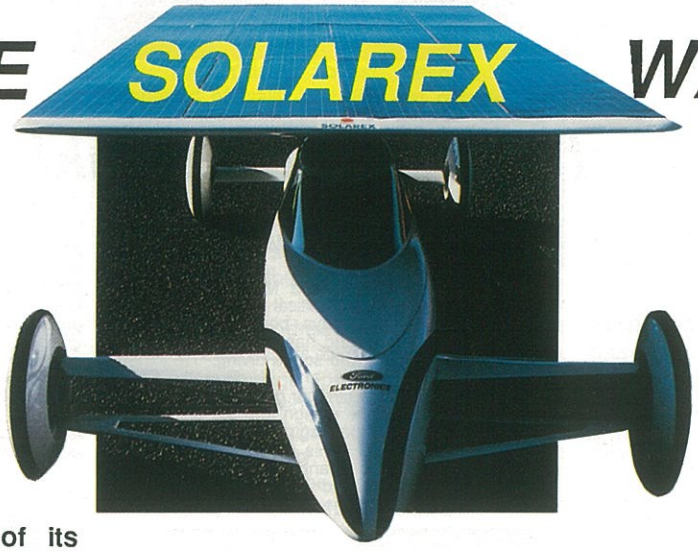
JIM COCKINGTON

JAMES COCKINGTON, 34, is a Sydney journalist who became interested in the Pentax Solar Challenge while researching a story on the event. Eventually he was asked to become the fourth driver in Team Alarus. He is particularly excited by the prospect of crossing the centre of Australia in a high-tech vehicle powered solely by the sun. He has previously raced in Formula Vee and karts and is hoping that the solar car will go faster than some of the vehicles he has previously raced. James is pleased that the race finishes in Adelaide, a city already distinguished as his birthplace.



Get aboard a Ford and follow the sun ...

THE SOLAREX WAY!



WITH the resources of its world-wide empire at its disposal, the Ford Australia Team in the World Solar Challenge has chosen an Australian company to provide the all important solar cells for its vehicle. Solarex Pty Limited, located at Villawood, west of Sydney, is Australia's oldest and biggest designer/manufacturer of solar (photo-voltaic) cells, modules and associated products.

Solarex solar power systems may be found from the rice fields of Thailand to the Nepalese Himalayas, from the desert of Abu Dhabi to remote mountain tops in the Philippines, and from channel marker buoys in Sydney Harbour to isolated microwave repeater stations in the great Australian outback.

Much of the Solarex success story lies in its development of lightweight photovoltaic systems - initially directed towards reducing the weight of satellite PV systems, later with solar-powered aircraft.

But, until recently, little interest was shown by potential users of these apparently novel experiments. The industry seemed to think they would never proceed beyond the novelty stage, unlikely ever to provide economic benefit.

Nevertheless, Solarex continued its work, the main goals being techniques and technology, rather than monetary gain. Along the way, several somewhat unorthodox users invited Solarex participation in their projects:

MICROWAVE RELAY

COASTAL NAVIGATION

• University of Queensland in the development of a solar-powered bicycle;

• Warragul Technical College in its experiments with solar-powered vehicles - one was driven from the Gulf of Carpentaria to Melbourne in 1985;

• The Natural Energy Centre in the design and development of the "Spirit of Adelaide", a Solarex powered auto that completed the Darwin-Adelaide trek in November, 1986.

With this list of successes on its record books, it wasn't long before Solarex was approached by Ford Australia - the mission: the World Solar Challenge and the Ford Model S.

Thanks to those earlier Solarex activities, the Ford vehicle's Solarex photovoltaics will be the most thoroughly tested units in the Challenge.

Founded in 1973, Solarex Corporation has become a world leader in the design, manufacture and installation of PV (photovoltaic) systems. With its world-wide association of member companies, Solarex is committed to further technical breakthroughs that will shape the future of PV.

Such developments as the semi-crystalline solar cell, continuing work on thin film (amorphous) technologies and improved manufacturing techniques will keep Solarex to the forefront in the PV industry.

Meanwhile, if it runs on electricity, Solarex can provide the power. Like Telecom's microwave relay links, air and sea navigational aids, even power for a wide range of domestic applications. That's Solarex.

New World Supermarkets...

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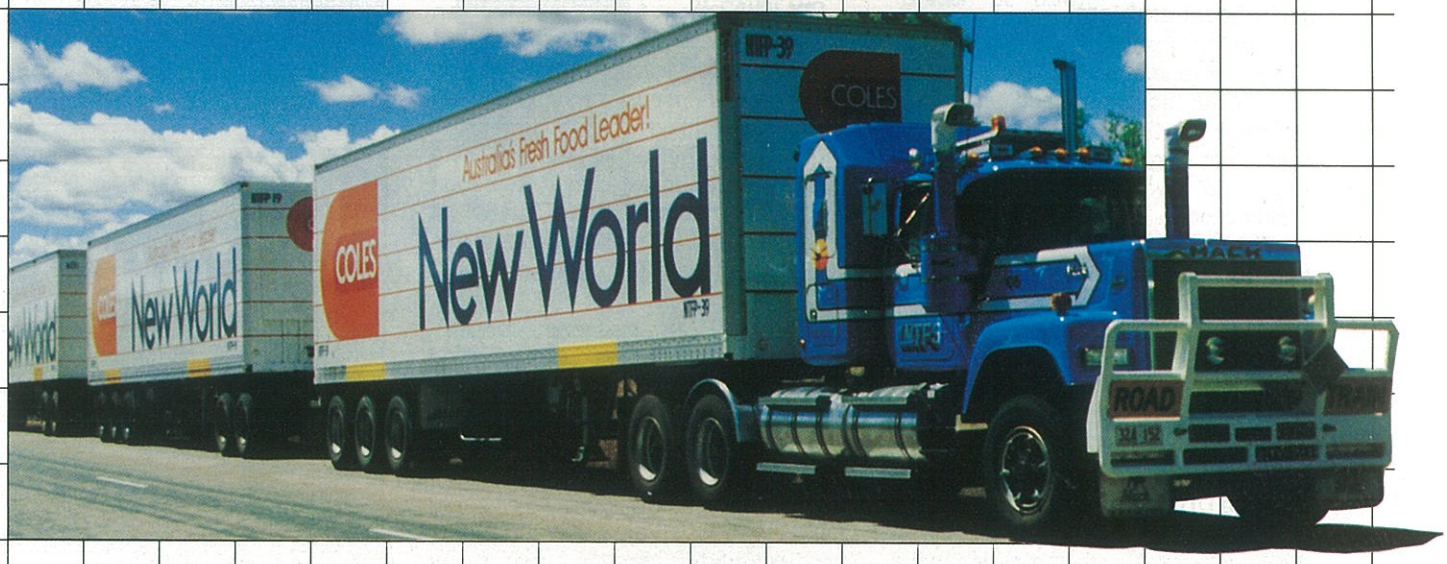
PENTAX
WORLD SOLAR CHALLENGE



As solar powered competitors strive for excellence so does COLES NEW WORLD, day in, day out, for their customers.

The roadtrains as illustrated travel the Stuart Highway 7 days a week, 24 hours a day, servicing the needs of the people of the Northern Territory.

Best wishes to all competitors from...

COLES

New World

Australia's favourite Supermarket

High Standards ...Low Prices

DARWIN INSTITUTE OF TECHNOLOGY
THE DESERT ROSE

THE Darwin Institute of Technology's solar car, "The Desert Rose", is the only Northern Territory entry in the Pentax World Solar Challenge. The vehicle is named after Sturt's Desert Rose, the Northern Territory's floral emblem.

Darwin Institute of Technology (DIT) staff and students, with support from RAAF engineers and interested members of the Darwin community, have met regularly since February, 1986, to work on design and construction.

The Desert Rose has attracted considerable local interest and support. Finance has been provided by the Northern Territory Government, the Northern Territory Tourist Commission, the Darwin Institute of Technology and Darwin and Alice Springs building contractors, Sitzler Bros Pty Ltd. In comparison to corporate entries, however, the DIT budget is quite modest.

The enthusiasm and dedication of the people involved in the project have overcome the small budget by supporting with their time and expertise.

The team leader is Dr Dean Patterson, Head of Electrical and Electronic Engineering at DIT. The crew is made up of DIT staff, students, including the Director of DIT, Mr Kevin Davis, RAAF personnel, and several supporters.

Computer Design

The DIT entry is a tri-cycle configuration with a chrome-molybdenum space frame clad in an aerodynamic shell of Kevlar.

The space frame has been designed with extensive use of computer-aided finite element analysis to achieve optimum strength with minimum weight.

The body shell and solar panel wing shape have been extensively tested in the RMIT Industrial Wind Tunnel at speeds in excess of 120km/h and a Coefficient of Drag in the region of C_D 0.2 has been achieved.

The vehicle's electronic components are a mixture of modified commercially available units and in-house constructed circuits that have yielded high efficiency and reliability.

The car is chain driven by a modified swimming pool filter pump motor that, suprisingly, has proven to be extremely efficient and highly reliable under the most adverse conditions.

Extensive testing of the initial prototype chassis and electronics under the harsh Northern Territory conditions have yielded top speeds that meet, or exceed, the claims of other competitors.

"DESERT ROSE" SPECIFICATION SUMMARY

DIMENSIONS	Car body - 1.4m high x 4m long x 700mm diameter Solar panel - 4m long x 2m wide
AERODYNAMICS	Body: NACA 111(Modified) Panel: NACA 63-006 EST C_D = 0.23 for the completed vehicle
WEIGHT	260kg (plus driver)
CONSTRUCTION	Kevlar body skin, metal hydraulic tubing in a space frame construction. The wing will be kevlar skinned with internal aluminium ribbing.
PANEL	Gas/hydraulic tilting mechanism. 42 degrees port/starboard tilt available. 4 degrees down angle of attack available.
WHEELS	Yamaha commuter bike wheels with drum brakes.
ELECTRICAL SYSTEM	Panel voltage 150V Maximum Power Point Tracker down converting to battery bus at 60V, 95% efficiency up converter producing 700V DC. Variable frequency 3 phase inverter feeding higher efficiency 460V 1.1W induction motor.
No. OF WHEELS	Three.
SUSPENSION	Front - double wishbone Rear - swing arm.
BRAKES	Front wheel drum brakes mechanically operated.
STEERING	Rack and pinion, 0.5 turns lock to lock.
ESTIMATED SPEED	Estimated 60km/h cruise speed

ALEX MONAGHAN
Lead driver. Head of DIT Automotive Engineering Div., was co-driver with Hans Tholstrup in Wynn's oilless engine world record. Many years involvement in motor sport, including mechanic during annual leave on Lotus and Brabham cars in NZ Tasman races.

DR DEAN PATTERSON
Career spans music and Electrical Engineering. Spent 8 years as a Research Scientist for the Australian Defence Department and has been professional singer and conductor. Now heads DIT's Division of Electrical and Electronic Engineering.

... symbol of the Northern Territory

AUSTRALIA # 15

CRAIG BUTLER
RAAF Engineering Officer, graduated from the University of NSW 1985 with Honours degree in Aeronautical Engineering. Worked on aerodynamic design of DIT entry, and will be one of the drivers.

PETER HARDY
Teacher at DIT past three and a half years, lecturer in Sheetmetal trade. Specialises in welding of light gauge metals and has built frame for Institute entry. Will also be one of the drivers.

BRAD DUNSTAN
RAAF Armament Engineer, worked extensively with vehicle aerodynamics at RMIT. In 1983 co-designed aerodynamic aids for Peter Brock's Group 'C' Car. Assisted with aerodynamic tests of Solar Car model in RMIT Wind Tunnel.

WARREN JESSUP
Head of DIT Mechanical Engineering Div. Originally NSW Railways apprentice, later graduated from NSW-IT with Honours degree in Mechanical Engineering, followed by nine years with NSW TAFE. Production Manager for Solar Car project.

DAVID McCAUSLAND
Industrial Designer, graduated from RMIT Melbourne, in 1980. Contracted by the DIT to produce scale model for wind tunnel testing, then to assist with making Kevlar/Foam sandwich body shell and solar panel.

JOHN SWENSON
Senior Mechanical Engineer for the Dept of Transport and Works. Has worked in aviation and automotive areas. Interest is in low powered vehicles, worked on design of DIT entry.

STEPHEN MARC ABELL
Station Manager of Radio 8TOP-FM at DIT. Interest in solar energy began with self-built solar electric home. As Secretary of Solar Car Committee, will send out reports en route.

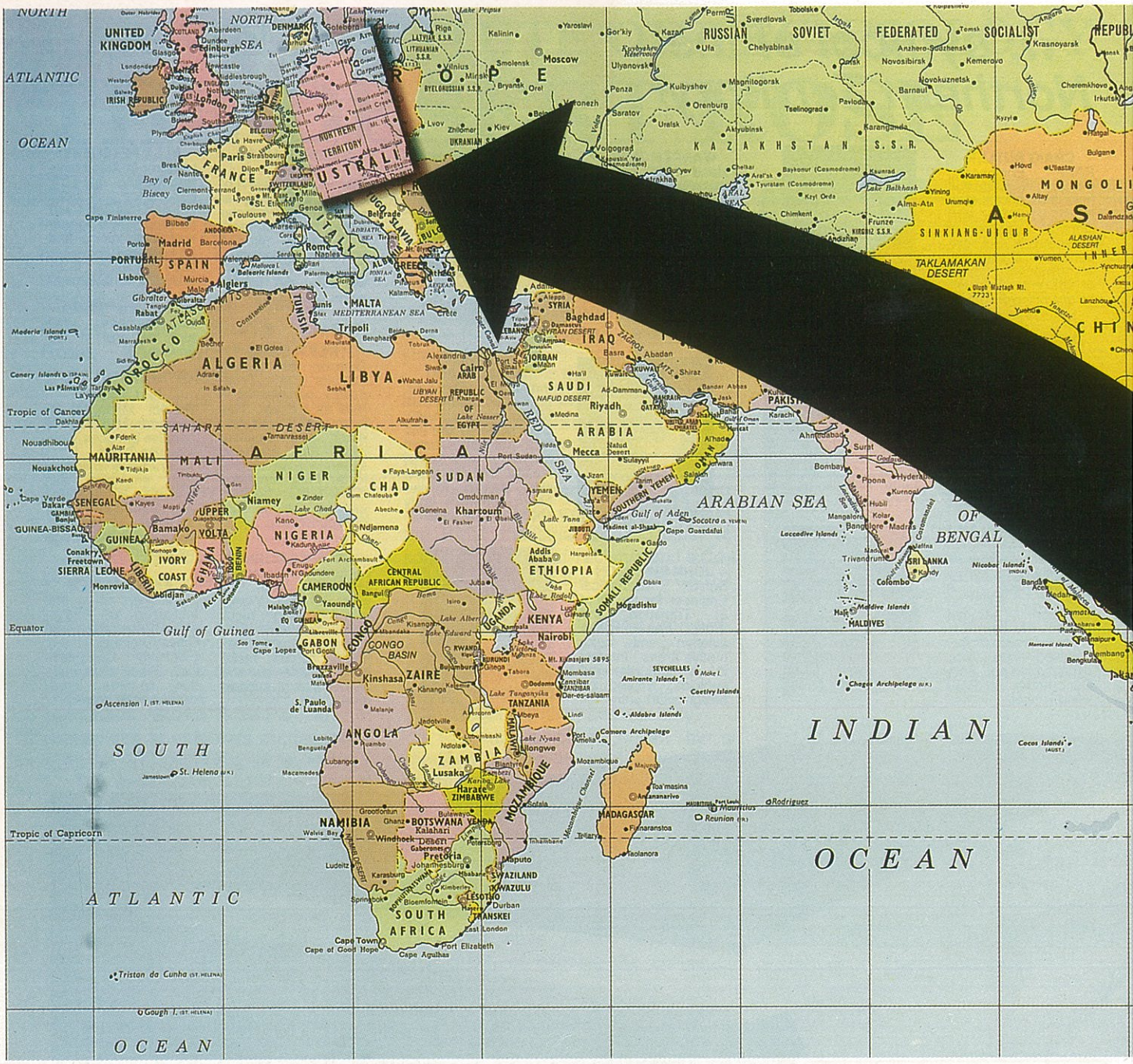
KEVIN DAVIS
Director of Darwin Institute of Technology, participating in race as a driver. Has encouraged staff research and development and endorsed several innovative projects. Fully supported "Desert Rose" project and has helped secure sponsorship.

DICK KILBURN
Lecturer in Automotive Mechanics with 10 years at DIT. Works with light weight high-tech materials, designs and builds sail boats, helped make body for solar car and will be part of support crew.

ALEX PETSHENY
Lecturer in Automotive Engineering at DIT. Experience includes chassis design and construction in speedway, drag racing and go-kart, and fibreglass body moulding. Currently Darwin Examiner for Institute of Automotive and Mechanical Engineers. Will also be one of the drivers.

BILL PARRY
Project Manager for Department of Administrative Services, Construction Group.
A graduate mechanical engineer with interest in Rodding and "individually" constructed vehicles. Assisted in the design of "Desert Rose".

JOHN SAWYER
Member of the Institution of Engineers, Australia, ex Chief Engineer of the Electricity Commission. Since retirement has become interested in solar power.



IF THE TERRITORY W
GO OUT OF YOUR W

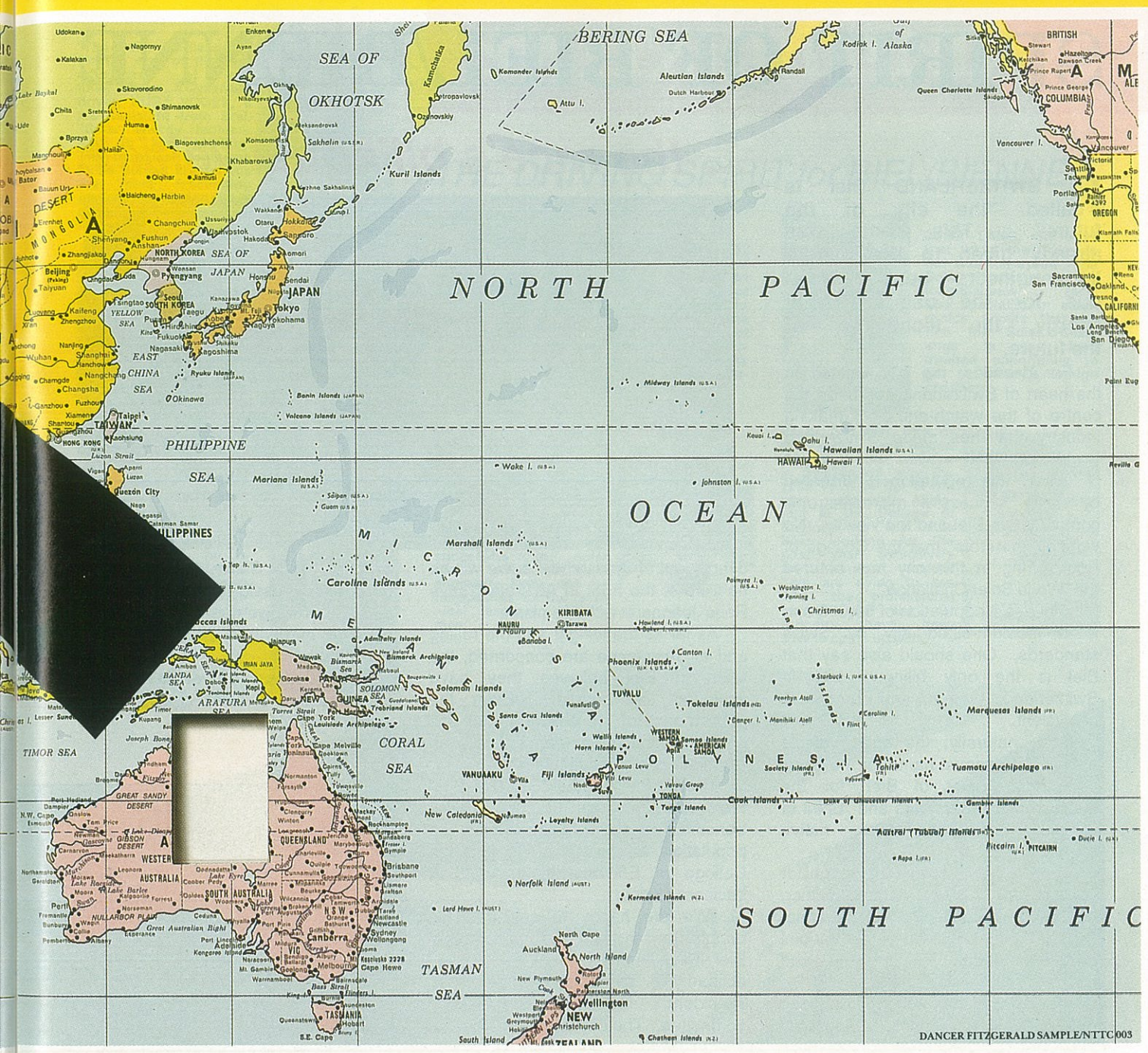
There is nowhere in the world like Australia's Northern Territory.

Yet many of us go overseas before we enjoy a unique travel experience that's right on our doorstep.

Because the Territory is equal to any of the world's outstanding travel destinations. To be enjoyed with the same awe as the jungles of Africa, the Grand Canyon of America, and the history of Europe.

But there's so much more to our Territory than just Ayers Rock.

From the vast southern deserts to the lush tropical north, with stations that are bigger



DANCER FITZGERALD SAMPLE/NTTC 003

AS OVERSEAS YOU'D AY TO GET THERE.

than some countries.

From the oldest civilisation in the world to the most modern standard of international hotels, such as the superb Yulara Resort at Ayers Rock and the casinos and new hotels in Darwin and Alice Springs.

There is nowhere in the world that comes anywhere near it, but you don't have to go overseas to find it.

See your travel agent or the Northern Territory Government Tourist Bureau to find out more.

There is nowhere in the world like your own territory.

SPIRIT OF BIEL/BIENNE

... the race's bilingual vehicle

IN SWITZERLAND Biel is called "the city of the future". This name was already given to Biel before its engineers became famous for the use of solar energy, the technology of the future.

For decades, the city located in the heart of Switzerland has been the centre of the watch-and-clock-making industry that has made Switzerland world famous.

Today this reputation is furthered by many successful microelectronic companies in Biel and the vicinity. No wonder, therefore, that the College of Engineering in this city has entered the "World Solar Challenge".

Biel has a population of 50,000 and is a medium-sized city by Swiss standards. One should also say that Biel is the only bilingual city in Switzerland. German and French are equivalent.

And, naturally, the solar vehicle also has a bilingual name for the Solar Challenge: "Spirit of Biel" for the German native speakers and "Spirit of Bienne" for the French native speakers.

"The project is a big challenge for our college," says Fredy Sidler, director of the College of Engineering, "we have to prove that the various departments can work together and cooperate." This college is one of the largest in Switzerland and the only one to have its own automobile department.

The Tour de Sol, the Swiss solar race, took place for the first time in 1985. In this race, the solar vehicles and their drivers travel across the country. Sometimes they even have to cross alpine passes.

The solar experts in Biel have entered all the Tour de Sol races, and in 1986 they took first place in the race category.

The driving force behind these solar vehicles is Rene Jeanneret, Professor of Electronics at the College of Engineering and world famous specialist in power electronics for electrically propelled vehicles. "If our opponents do not come up with revolutionary solar cells which come directly out of research labs, we will be right up at the front in Australia," says Rene Jeanneret with optimism.

As far as the weight and the rolling and air resistance are concerned, the team in Biel believes they have achieved the utmost. Even the performance of the electric motor has been optimised, thanks to an ingenious computer simulation.

The budget for the "Spirit of Biel" team amounts to 300,000 Swiss francs. The sum was raised by the population, and former students of the College of Engineering as well as business circles.

"We are happy to say that the people from the city and the region of Biel have shown us an incredible solidarity," says Martin Laminet, President of the fund-raising committee. The city council of Biel, for example, has sponsored the Solar Challenge venture by spending a symbolic franc per person living in Biel.

"Everything will be different in Australia," explains driver number one, Paul Balmer, thinking about his experience in European solar races. "The heat is one of our major worries. It will make greater demands than ever on the material, and drivers will find it difficult to concentrate when the temperature reaches 104° F in the cockpit."

There is also a new kind of competition. For the first time, the College of Engineering will be meeting professional teams from the car industry. "We have to be realistic," explains Fredy Sidler, "if we compare our limited possibilities with those of GM and Ford, we ought to be happy if we even manage to stay up front with the leaders."

Nevertheless, it wouldn't be the first time that a David could scare a more powerful Goliath.

SPIRIT OF BIEL SPECIFICATION SUMMARY

BODYWORK	self-carrying synthetic product, Kevlar and carbon fibre
CHASSIS	one wheel suspension of carbon fibre and glass fibre springs in the front
DIMENSIONS	height 1.35m, width 2.0m, length 4.3m, trace width 1.65m
WEIGHT	without pilot 165kg, with pilot 250kg
STEERING GEAR MOTOR	pinion gear direct current permanent magnet motor, weight 12kg continuous output 1.2kW, max motor voltage 150, efficiency (87-90%)
GEAR BOX	chain gear, transmission ratio free of choice between 5-3.5
BRAKES	hydraulic disc wheels in front, driving wheel behind, diameter 0.65 or 0.52, tyre with tube
STEERING WHEEL	diameter 200mm, special ultra light
SOLAR PANEL	703 cells or more, eficiency panel 11.5%
POWER TRACKER	power 220W, efficiency 97%, weight 0.6kg
BATTERY	nominal voltage (120-150)V capacity C1=20Ah, weight 33kg approx.
ELECTRONIC	step-down converter, efficiency 98.5%, voltage (0-150)V, max. power 5kW, weight 2.4kg approx.
INSTRUMENTS	tachometer, amp meter for battery, indication of km, power of solar panel, power of electronic
SPEED	max. speed depends on the transmission (62.7-95km/h)
LIGHTING	brake light, lamp-signaller, danger light

SWITZERLAND # 17

THE DRIVING SPIRIT for BIEL/BIENNE

"The Solar Challenge is for me one of the last adventures of our time," says 41-year-old driver, KURT VOGEL, a lab assistant from Biel. "Solar energy technology is just starting. The technical problems to be solved are for me the most fascinating part of the Solar Challenge."

ERNST FUHRER, 55, the oldest driver in the team, is an assistant in the automobile engineering department of the College of Engineering. After many runs in the Tour de Sol has acquired much solar experience. Also supervises error-free construction of the vehicle, and concerned for the heat of the Australian summer.

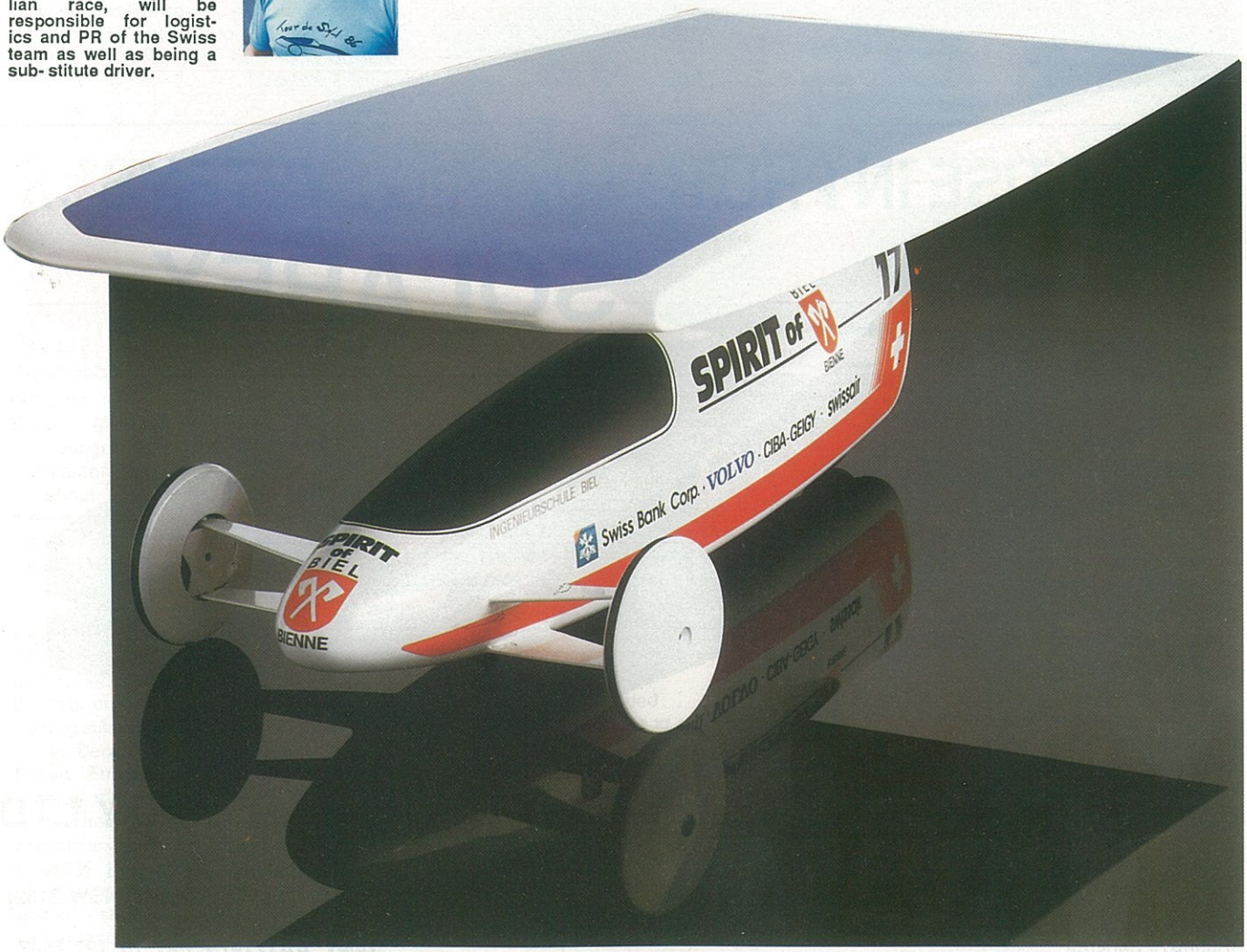
MARTIN LAMINET, 50, managing director of a trading company in Biel. As an engineer and economist, he is thrilled by the potential of solar cells for new energy-saving applications. He presided the fund raising committee during the Australian race, will be responsible for logistics and PR of the Swiss team as well as being a sub- stitute driver.

FREDY SIDLER, 42 runs the College of Engineering in Biel as well as the "Spirit of Biel" team. An economist fascinated by the technical challenge of the race, he looks forward to testing the new technology under extreme conditions.

RENE JEANNERET, 56, the "spiritual father" of solar vehicles in Biel. Thanks to him and his electronics department and the College of Engineering, Biel and its team have been very successful in solar races. As the chief engineer, Rene will be responsible for the technical aspects of the race.

JURG LANG, 37, says that while the Tour de Sol was the sprint - the Solar Challenge is the long-distance race. The specialist in electronics admits that for him the Solar Challenge is the long awaited opportunity to get to know a foreign continent.

PAUL BALMER, one of the most experienced drivers of solar vehicles in Switzerland, won the 1986 Tour de Sol in the race category. Assistant at the College of Engineering, he has been working for the past year exclusively on the solar vehicle. "We are dying to see what the professional teams from the car industry have been able to come up with."

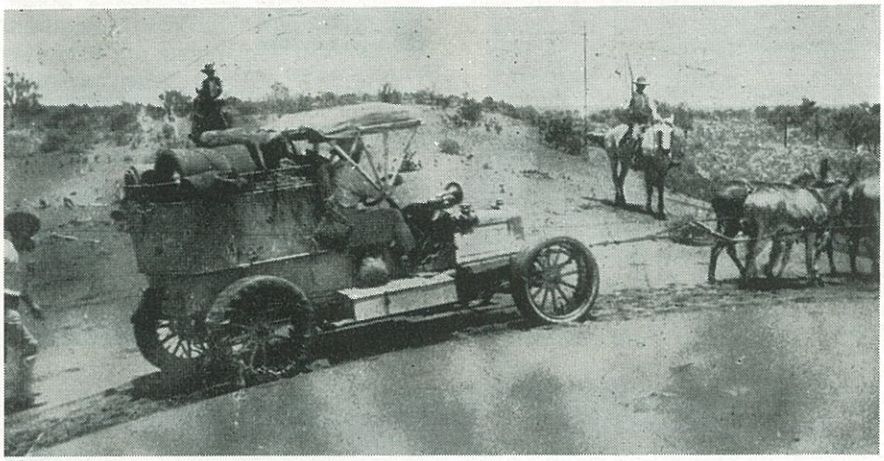


EPIC AUSTRALIAN JOURNEYS - WITH MICHELIN

IN 1907, Harry Dutton and Murray Aunger set out to be the first to drive a car from Adelaide to Darwin. While that attempt failed, in 1908 they succeeded, with a more powerful Talbot. In both cases, however, Michelin tyres were used.

In 1983 the BP-sponsored vehicle, The Quiet Achiever, made the first West-East crossing by solar power. Again, Michelin tyres were chosen by the drivers, Hans Tholstrup and Larry Perkins.

Murray Aunger walks behind as Harry Dutton steers their Talbot, being dragged over a sandhill in the Northern Territory in 1907.



Now, 80 years after Dutton and Aunger, the "Pentax World Solar Challenge" will depart from Darwin and set out for Adelaide. A downhill run, as it were, and on tarmac roads, rather than bush trails and camel tracks.

One common thread runs throughout - Michelin tyres are again involved.

Ford of Australia, who have produced one of the most technologically advanced vehicles on the Challenge, naturally chose Michelin tyres. Those tyres, developed by Michelin, are specially designed to minimise rolling resistance through the use of the most sophisticated rubber compounds.

This project is part of Michelin's commitment to excellence in tyre design. There are very few "breakthroughs" in automobile history that have not benefitted from Michelin.

One particularly relevant car was the torpedo-shaped electric car, "Le Jamais Content", which achieved the World Land Speed Record at 105km/h in 1899.

The Ford "Sun Chaser" will be able to do the same sort of speed, powered by electricity derived from the sun's rays. Such is progress!

EXPERTISE IN PHOTOVOLTAIC SYSTEMS ...

SOLAREX

"Spirit of Adelaide", the Goodwood High School's entry in the World Solar Challenge, is just one example.

More common uses include lighting systems, telecommunication installations, navigational aids and remote power supply systems for isolated properties and communities.

If you have a requirement for an alternative source of power, call Solarex for advice or an obligation-free quote. We will do our best to satisfy any requirement, whether it's routine or unusual.

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Write or call ...

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AUSTRALIA # 18

GOODWOOD HIGH SCHOOL

... taking up the challenge

"JUST MAGIC" SPECIFICATION SUMMARY	
DIMENSIONS	5.2m long X 2.0m wide X 0.93m high
ORIGINAL DESIGN and CONSTRUCTION	PECAN ENGINEERING PTY LTD, 72 Hanker St, Brompton. SA. 5007
SOLAR PANEL	Manufactured by SOLAREX
OUTPUT	920 Watts
MOTOR	ELECTRIC PRINTED CIRCUIT 3HP.
WEIGHT	275kg approx (plus driver)
CHASSIS	Tubular Space Frame
BODY	Fibreglass and Kevlar
SPEED	60km/h (est.)

"JUST MAGIC"

A GROUP of Year 12 students from the core of the Goodwood High School team, headed by Physics/Computing Master, Mr Tom van Ruth.

Younger students, aided by teachers and parents, form the support crew and, in all, about 18 Students, Staff and Parents are expected to take part in the actual race. Many other students at the school are involved in the preparation process.

Unlike the exercise undertaken by our fellow SA competitors from Morphett Vale High School to build a solar car from scratch (on which we heartily congratulate them), Goodwood High School has set itself the task of re-designing and re-building an existing solar car to compete in the race.

In December, 1986, this car, built by Pecan Engineering P/L of SA took a leisurely six weeks to travel the 3200km course from Darwin to Adelaide and is the only solar vehicle, so far, to have made this journey.

The challenge for the Goodwood High School students is to improve the performance of the car, and in this process they will use many of the hand skills and theory work taught in the school's Intensive Trade Courses. The students consider the prospect of repeating the trip at speed 'JUST MAGIC', which is the name choosen for the car for this race, and hope to complete the race in under 10 days.

The re-building program was quite extensive and concentrated on reducing the weight of the car and improving its solar collection area.

Specifically it included ...

- Changing the shape to carry more solar panels,
- Rewiring the car,
- Replacing the axles,
- Fitting a lighter motor,
- Repositioning the driver,
- Fitting new gearing,
- New instrumentation,
- ... and many more small changes.

Many areas of the school's curriculum have contributed to the logistics of the venture as the following list shows:-

ART ... Logo Design and Advertising,
ELECTRICAL TRADES ... Wiring, Instrumentation,
ENGLISH ... Communication, Media,
MATHEMATICS ... Budgeting, Gearing and optimisation,
METAL MACHINING ... Axles, Refitting bearings and trailer,
MOTOR MECHANICS ... Steering, Brakes and trailer,
SCIENCE ... Panel testing and controls,
SOCIAL ED ... Camping, planning and Logistics,
WOODWORK ... Wind-tunnel models.

A great deal of support and advice has been received from outside the school and the students and staff and indebted to the people and businesses are helping the school achieve its goals.

With this help and the many changes, our car will have a new look, a vastly improved performance and a new name which, like Solar Energy, is 'JUST MAGIC'.

MIT-SOLECTRIA IV-B

IN JUNE, 1986, James Worden, a Freshman at MIT (Massachusetts Institute of Technology), entered a solar-powered racing car in the "Tour de Sol", a five-day race across Switzerland between solar cars.

It was the first American entry in the three year history of the race and proved American technology and spirit with its successful completion of the 400km tour.

Deeply interested since his early years in mechanics, electronics and solar energy, Worden in high school began working on many robotic projects. Later, his love of the automobile combined with an awareness for the environment to produce an ambition to develop a solar commuter car.

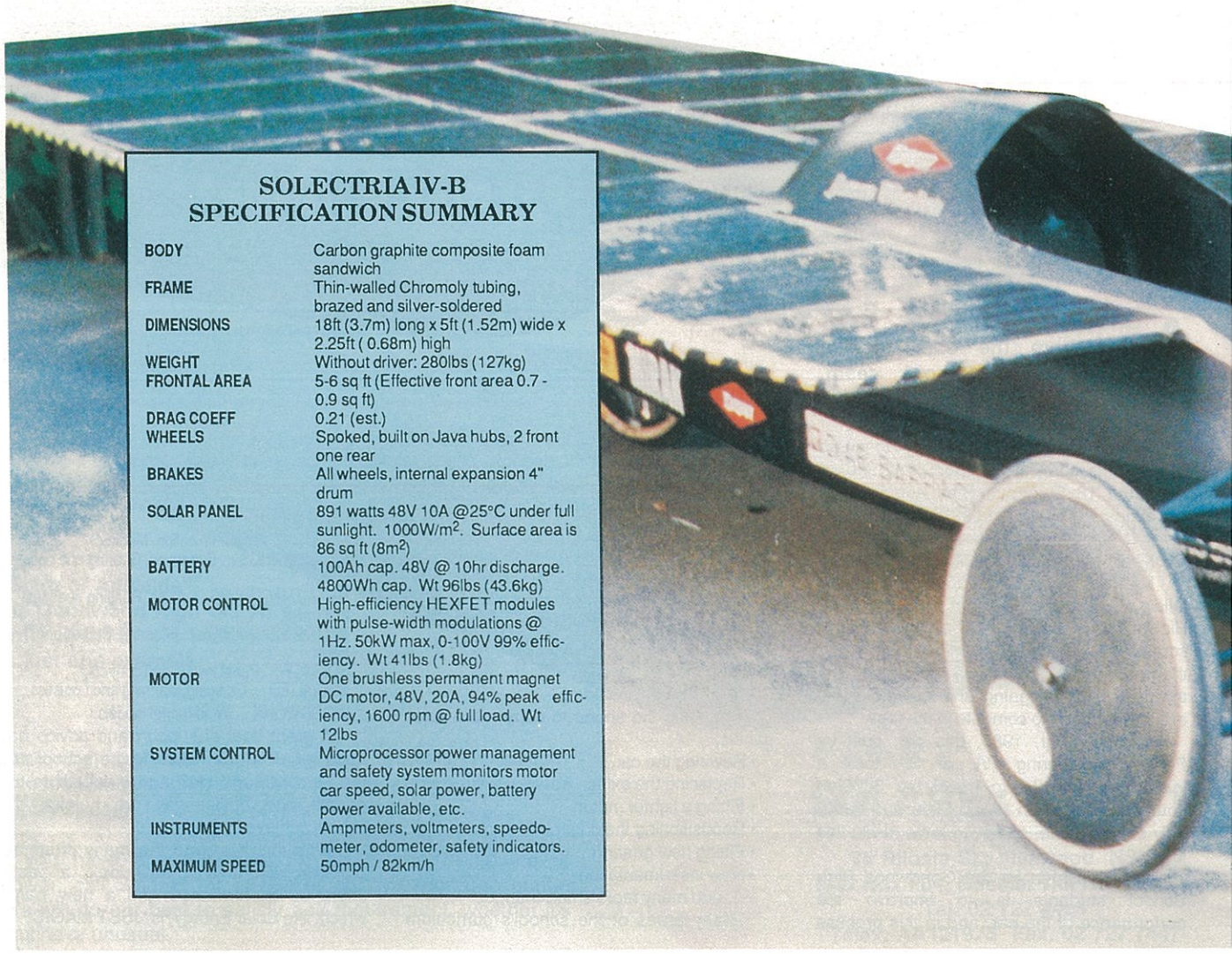
Starting in 1982, the first of Worden's Solectria car series was designed. Sparked by the 1983 solar car crossing of the Australian continent, he completed the car and won the Mass State Science Fair. Following years saw the development and continuous use of Solaectria II, a roadworthy, two-person prototype that has been registered and road-tested in traffic for over 5000km.

His achievement in building Solectria III in just four weeks prior to its successful competition in the 1986 Tour de Sol earned him great respect, along with ready support for the Solectria IV World Solar Challenge project.

Backed by support from Dow and Arco Solar, Worden last spring assembled a group of interested MIT students, who built a far more sophisticated car (SolectonIV), which Worden drove in the '87 Tour de Sol. Its outstanding performance in that event, particularly over the final stage, where the cars climbed over 3700 feet in 18km, convinced the group they were on the right formula for the Solar Challenge vehicle, Solectria IV-B.

Input for the project has come from a highly skilled group. Erik Vaaler, presently working on a Doctorate of Science in Mechanical Engineering (research in robotic assembly), has constructed the chassis and built and painted the body.

Second year Mechanical Engin-



SOLECTRIA IV-B SPECIFICATION SUMMARY

BODY	Carbon graphite composite foam sandwich
FRAME	Thin-walled Chromoly tubing, brazed and silver-soldered
DIMENSIONS	18ft (3.7m) long x 5ft (1.52m) wide x 2.25ft (0.68m) high
WEIGHT	Without driver: 280lbs (127kg)
FRONTAL AREA	5-6 sq ft (Effective front area 0.7 - 0.9 sq ft)
DRAG COEFF	0.21 (est.)
WHEELS	Spoked, built on Java hubs, 2 front one rear
BRAKES	All wheels, internal expansion 4" drum
SOLAR PANEL	891 watts 48V 10A @25°C under full sunlight. 1000W/m^2. Surface area is 86 sq ft (8m^2)
BATTERY	100Ah cap. 48V @ 10hr discharge. 4800Wh cap. Wt 96lbs (43.6kg)
MOTOR CONTROL	High-efficiency HEXFET modules with pulse-width modulations @ 1Hz. 50kW max, 0-100V 99% efficiency. Wt 41lbs (1.8kg)
MOTOR	One brushless permanent magnet DC motor, 48V, 20A, 94% peak efficiency, 1600 rpm @ full load. Wt 12lbs
SYSTEM CONTROL	Microprocessor power management and safety system monitors motor car speed, solar power, battery power available, etc.
INSTRUMENTS	Ampmeters, voltmeters, speedometer, odometer, safety indicators.
MAXIMUM SPEED	50mph / 82km/h

... inspired by the Tour de Sol

USA # 19

eering student, Catherine Anderson, from New Zealand, has already worked with Worden on two of his cars. She specialises in bicycle-related design projects for which she has already won awards for excellence in engineering and design.

Design and construction of Solecria's motor control and energy insturment circuits have come from Gill Pratt, a graduate student of MIT's Electrical Engineering Dept. He is a dedicated enthusiast of hybrid car design, in which a tuned prime mover is coupled to a generator, storage batteries and 4-wheel electric drive to create a very responsive, highly efficient automobile.

THE "SOLECTRIA IV-B" TEAM...

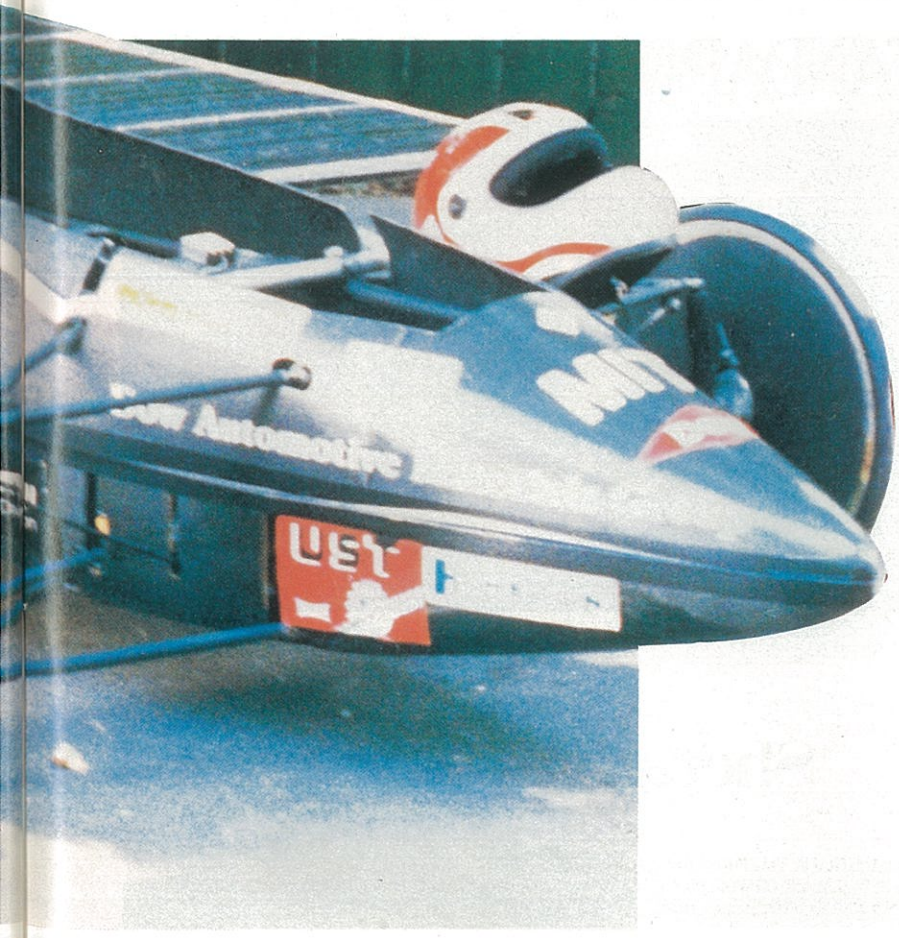
CATHERINE ANDERSON from NZ, is a leading student in second year Mechanical Engineering, doing joint Bachelors / Masters degree in Mechanical and Biomechanical Engineering.

GILL PRATT, 26, teaches computer design and researches neural networks - but his past contains the skillful restoration of powerful Chrysler autos from the 60s.

ERIK G. VAALER, former machinist, mechanic, welder, panelbeater, antique auto restorer and basketball player (West Torrens Eagles, SA.). Now 34, he's contributed to almost every aspect of the car.

ROBERT J. WEBSTER, an Electrical Engineerng grad student, doing a thesis on inter-active visual exhibition driven by Analog VSLI chips that model the retina.

JAMES D. WORDEN, only 20, but already a third year undergrad in Mechanical Engineering. This is his fifth solar car and he has a dream for a solar commuter car.



MEGAN J. SMITH, 22, from Buffalo, NY, extensive award winner in Alternative Energy Design, now doing Masters degree in Mechanical Engineering.

...with Support from:

Christie Alvord, Dave Brancazir, Sherman Huang, Tanya Jergeris, Mike Westphal, Peter Worden, Clive Bolton.

... and Advice from:

Professors Ernesto Blanco, Woodie C. Flowers, Harry West, David G. Wilson, David Wormley and Eric Johnson (Asst Dean of Engineering for Resource Development).

...and Supporting Sponsors:

MIT - DOW Chemical - ARCO Solar - Yardney Battery, ... and Solectron, Micro Switch, Mirak Chevrolet, Arlington Centre Auto Parts, International Rectifier, Arlington Motor Sports, Avocet Corp., Bicycle Corner, UST/Tsubaki Moto, Mienike, Diab-Baracuda, Alpha Auto Part, Hacon/Sturdy Group.

REPORTING ALL THE FAX

A TOSHIBA facsimile from Mitsui Computer Limited will be a vital part of the 'media truck' covering the World Solar Challenge.

Connected into the Aussat transmitter, the Toshiba facsimile will be used to transmit data to race organisers back in Sydney and media outlets in major capital cities while the solar challengers make their way to Adelaide.

The facsimile is set to become one of the major communication machines of the future, while they have already become a vital component in the fully automated office of today.

The wide variety of communication needs are increasingly being met by the facsimile, which offers an immediate, simple and low cost means of communicating text and graphics.

It dosen't matter if the race organisers and the associated media reporting on this futuristic Solar Challenge are in Darwin or Adelaide, or somewhere between Tennant Creek and Coober Pedy; via the Aussat link and Toshiba facsimile they can be in contact with any place in the world. It is as simple as dialling a phone and pushing a button.

The Toshiba facsimile gives crisp and clear reproduction of documents, graphics and photographs with sixteen shades of half tone grey and a unique manual contrast control.

When sending media reports world-wide, maps showing the race positions of all challengers, photographs, race organisational reports and general information concerning the organisation and running of the World Solar Challenge, clarity, quality and speed of transmission are all important.

The Toshiba range of facsimile is recognised as one of the finest facsimiles in the world, regardless of the condition of the transission line. The full range also has the capability to automatically slow transmission speed when a line suffers interference, to ensure the clarity and accuracy of the transmission is maintained.

An added bonus with Toshiba is that all their machines take a 100 metre paper roll, which makes paper use more economical. This feature is just as important in the office when crucial faxes arrive overnight, as it is when the facsimile becomes a vital communications link in remote areas of central Australia.

Toshiba's world-wide reputation for the highest quality advanced technology business machines and Mitsui Computers' years of experience with facsimile, and their technical support and back-up, are just some of the reasons why Mitsui Computer offers the best faxes under the sun.

Energy Promotions, organisers of the World Solar Challenge, rely on Toshiba to maintain vital communication links because they understand the need for clear and accurate transmissions. They know they can trust quality products backed by Mitsui Computer.

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In the centre of Darwin City the Sheraton Darwin Hotel. A new Hotel where you will find international standards of style and comfort. For the travelling executive the perfect location with facilities for exclusive business meetings or larger conferences in our ballroom.
At the day's end the Hotel will let you wind down, maybe a workout in the gym, a swim. Followed by a cool drink in our Lobby Bar before you select which of our two restaurants appeal.
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Campbell

PAKISTAN # 21

SYED ATTIQUE SHAFAAT

... a step into solar technology

WITH its entry into the World Solar Challenge, Pakistan has taken the first step into the solar age, according to the Vice Chanc-ellor of the N.E.D. University in Karachi.

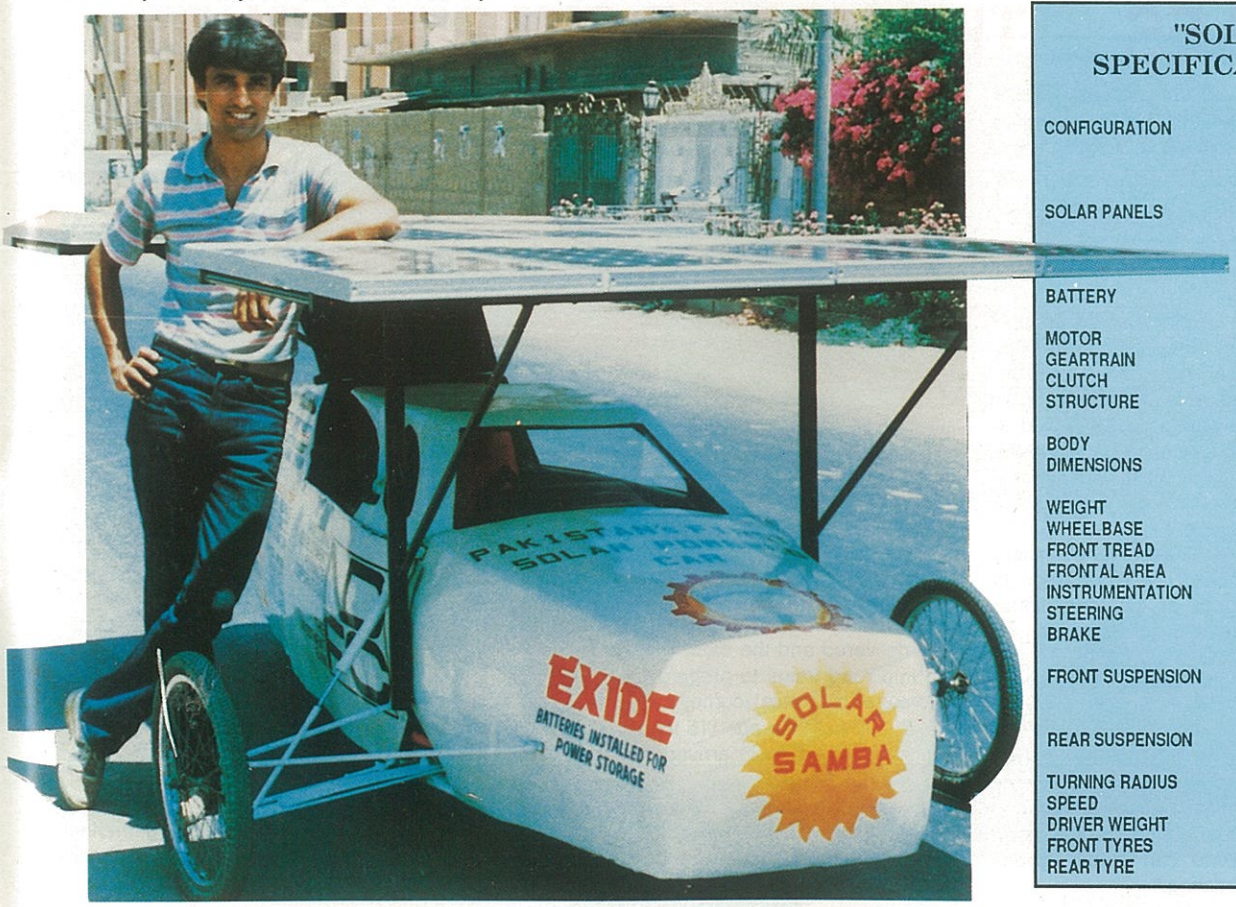
Dr Jamell Ahmad Khan, who as Head of the Mechanical Department guided the project, said he was proud that his country was sixteenth in the world to introduce a solar car. He praised the University's students, saying that they had shown the way towards the great uses to which solar energy could be put.

The students' group is headed by Syed Attique Shafaat, the entrant, supported by Syed Moham-med Baqir and Syed Sirajul Matin, assisted by Irfan Saied, Abdul Munaf and Khurshid Saeed.

The students built the vehicle entirely in the University as their final year project. First conceived in 1982, the project had been in the doldrums until these students revived it and took up "the challenge".

The solar car cost 70,000 rupees ($5600), but refinements over the next five years could reduce it to one-tenth that amount, Dr Khan said.

Mechanically the car is perfect, he said, trouble-free and with a top speed of 36km/h. India has yet to produce a solar car, he added.



"SOLAR SAMBA" SPECIFICATION SUMMARY

CONFIGURATION	Mid powerplant, rear wheel drive, single seater, three wheeled experimental prototype
SOLAR PANELS	Model - GL 3641/12 (BP 1238) Quantity - 10 units Peak output - 360 watts Surface area - 4.0986 m^2
BATTERY	Lead-acid, 12 volts, 97 amp-hr, 2 units
MOTOR	One DC motor, 24 volts, 1hp
GEARTRAIN	3-speed gearbox
CLUTCH	Multi-disc, manually operated
STRUCTURE	Tubular space frame made of thin mild steel pipe
BODY	Fibreglass
DIMENSIONS	130 in. long x 75 in. wide x 52 in. high
WEIGHT	250kg
WHEELBASE	76 in.
FRONT TREAD	70 in.
FRONTAL AREA	9.078 sq. ft.
INSTRUMENTATION	Analogue
STEERING	Sprocket-n-sprocket
BRAKE	Internal expanding drum, location - aft, type - mechanical
FRONT SUSPENSION	Independent, upper wishbones lower transverse leaf spring, tubular dampers
REAR SUSPENSION	Trailing fork, two coil-over-shock units
TURNING RADIUS	20 ft.
SPEED	36km/h (max)
DRIVER WEIGHT	135 lbs. (61.7kg)
FRONT TYRES	Two bicycle
REAR TYRE	One motorcycle

GERMANY # 22

TEAM TRYKOWSKI

...success at the Tour de Sol

SOFA III '87 SPECIFICATION SUMMARY

DIMENSIONS	4.7m long x 1.95m wide x 0.85m high.
WEIGHT	120kg without batteries
BATTERIES	Weight 96kg, capacity 4.5kWh
BODY	Kevlar/Nomex sandwich
CHASSIS	Lattice construction with Mannesmann chrome-moly tubes
MOTOR POWER	Average 2 x 1.4kW, max 2 x 2.0kW. 80-90% efficiency
SPEED	120km/h max.

THIS team comprises an enthusiastic group of young engineers - professionals in electronics, mechanics, aerodynamics and design - and a lot of volunteers.

Together we achieved success with our vehicle in the '86 Tour de Sol - 5th place - followed by victory in the Solar Grand Prix at Nurburgring.

We have received much support from German industry - for example, special tyres from Continental, batteries from Varta, shock absorbers from BASF, and specially designed solar cells from Siemens Munich (our thanks to Messers Aulich and Cammerer).

Finally, Lufthansa has supported us with transport and tickets. Thank you to everyone.

COLES ... THE MOBILE SUPERMARKET

WHAT IS 50 metres (168 feet) long, has 68 wheels, carries 2000 litres (450 gallons) of fuel and travels 250,000 kilometres (155,000 miles) per year?

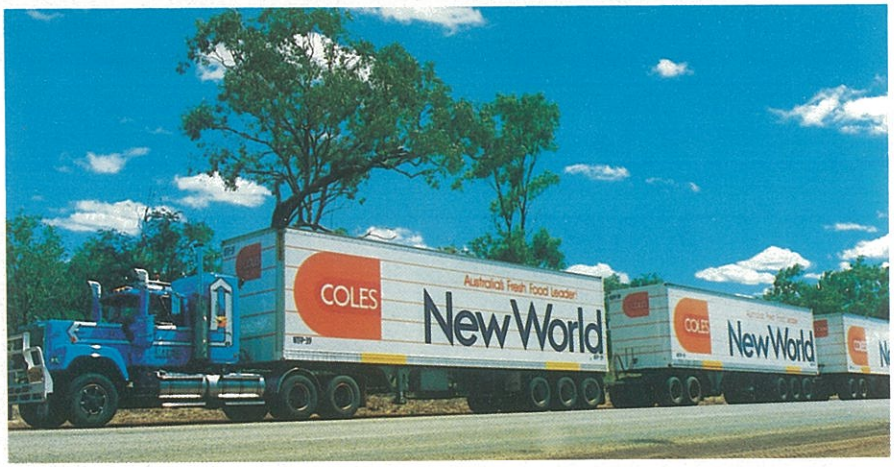
It is a supermarket on wheels ... a Coles New World road train.

Each day the familiar red, white and blue colours of Coles New World are waved along the Stuart Highway, the route of the unique Pentax World Solar Challenge.

New World road trains are coupled in Alice Springs for their travel to Darwin in the Northern Territory, but their story really begins in Australia's south at Adelaide, the capital of South Australia.

It is here, some 3200km (2000 miles) from Darwin, that Coles New World loads its pentechnicons with all of the food, liquor and apparel commodities required by Territorians.

Coles New World Managing Director, South Australia & Northern Territory, Mr Andrew Tregaskis, said, "The procedure is a complicated one to the uninitiated, but with modern technology and the efficiency of the company's staff in Alice Springs and in Darwin and the Distribution centre in Adelaide, New World can supply goods within two days of ordering."



Upon arrival in Alice Springs, the pantechs containing stock for local stores are delivered and the other units are made up into road trains to prepare for the 1600 kilometre (1000 mile) journey to Darwin.

In this exercise our 115 tonne (125 ton) road train would have arrived in Darwin by six the following Monday morning, given that there were no hazards, the least of which are the ever-present water buffalo.

Coles New World SA & NT Transport Manager, Mr Don McLaren, said that the checking and changing of tyres may prove an inconvenience, but there is nothing to match a water buffalo ripping its horns through a radiator.

Coles New World road trains are Northern Territory's camel of the desert, even to Solar Challenge organiser, Hans Tholstrup.

"Coles New World at Alice Springs and I have been buddies for many years," said Hans. "It has been my oasis for gathering supplies during many of my outback adventures."

JOHN PAUL MITCHELL 'MANA LA'

HAWAII, USA # 32

... with the "snail shell" wing

THE John Paul Mitchell Systems Solar Racing Team has captured international attention with the entry of the *MANA LA* into the World Solar Challenge.

The *MANA LA* utilises a unique arching wing which serves a two-fold purpose. First, as a mounting assembly for the 125 sq. ft. photovoltaic array, it mirrors, on the car, the arch decribed by the sun as it daily moves across the sky. This provides an optimum constant energy transfer through at least a portion of the array surface at all times throughout the day.

The *MANA LA's* unusual arched shape is based on a patented design concept of one of America's foremost aeronautical engineers, James Amick of Ann Arbor, Michigan. Jim and his equally talented son, Doug, were vital members of the *MANA LA* team from its inception.

Jim assisted with the design of the car's shape and with wind-tunnel testing, performed at the University of Michigan, as well as with the statistical analysis of the design data, while Doug designed and built the special carbon fibre swing arm suspension assemblies and steering assembly.

MANA LA'S lightweight body is a foam and carbon fibre composite construction. All parts bonding in the frame and subassemblies was accomplished with various blends of cyanoacrylates glues formulated by Pacer Technology & Resources of Campbell, California.

"MANA LA" SPECIFICATION SUMMARY

DIMENSIONS	19 ft long x 6'6" wide x 6'6" high (580 x 198 x 198). Weight - 550lb (250kg) approx.
SOLAR ARRAY	125 sq. ft. (3.5m^2) high efficiency photovoltaic cells
BATTERY	64 silver-zinc cells, 96 volt configuration
PROPULSION	Two 2hp samerian cobalt motors
BRAKES	Hydraulic disc and elrctric regenerative
WHEELS	Custom built, true tracking motorcycle racing
BODY	Carbon fibre/sandwich
ADDITIONAL	On board computers to monitor speed, side forces, current, voltage, temperature, etc.

The MANA LA Solar Racing Team ...

PAUL MITCHELL
Sponsor and driver, an internationally known artist in the field of hair design whose line of hair care products has taken the world by storm. Paul has displayed his innovative nature as well as his concern for the ecological future of the planet by establishing the *MANA LA* Solar Racing Team.

JONATHAN TENNYSON
Project Chairman, designer and driver, the motivating energy of the *MANA LA* project. Has designed and built solar and agricultural research centre on the island of Hawaii, he applies agricultural expertise to methods of growing fruits and vegetables without pesticides or chemical fertilizers. 15 yrs of experience in designing and building solar energy devices.

JOHN WORCESTER
Team Manager and the project's organiser; connecting craftsmen, artists, suppliers, materials, sponsors, etc. Responsible for much of *MANA LA's* electrical installations and component designs, as well as handling most of the press and public relations work that brought *MANA LA* to the public's attention. Born and raised in Ohio, John has made his home in Hawaii for the past seven years.

JOHN PAUL JONES DE JORIA
Sponsor and driver, a man at home anywhere and with anyone. Chief Executive Officer taking his company to the top sales position for hair care products in America. Makes his home in Beverly Hills.

GM SUNRAYCER

DESIGNED by a team of engineers from Aero-Vironment, Inc., and General Motors, the aerodynamics of the GM Sunraycer give it a teardrop shape. The goal was to achieve extemely low aerodynamic drag, with low side forces during crosswinds, while still providing a suitable surface for the solar cells and adequate space for the driver.

The shape was refined by the use of an advanced computer program called VSAERO, developed by the National Aeronautics and Space Administration (NASA). The final configuration minimises overall up or down aerodynamic forces on the GM Sunraycer at high speeds.

Tests of a one-quarter model at the 3 metre GALCIT wind tunnel at California Institute of Technology (Caltech) exhibited the lowest drag coefficient ever measured at Caltech for a road vehicle.

Results of the wind tunnel tests on the GM Sunraycer helped the team to fine tune the aerodynamics with the addition of a small vertical fin, called a strake. Mounted on top of the vehicle just above the driver's head, the strake helps keep the car on the road by reducing upward lift in a crosswind.

Six ventral fins located under the rear edge of the vehicle also reduce the effect of crosswinds on vehicle stability and control.

Light-Weight Materials

The chassis of the GM Sunraycer is welded aluminium tube spaceframe - built like a cage and inherently lightweight. This frame weighs just 7kg, yet it supports a vehicle weighing 248kg, including a driver (ballasted to 85kg), electric motor, solar panel, batteries and electronic components.

The body is made like a sandwich of Kevlar (trademark DuPont) / Nomex (DuPont) / Kevlar. The centre portion of the sandwich, made of Nomex, looks like a slice of honeycomb, giving the body great strength and rigidity with very low weight (3 ounces per square foot - 7.9g / m^2).

With temperatures reaching 48 degrees celsius, the gold plated canopy plays a vital role in protecting the driver from the intense radiation of the Australian sun. The gold plating reflects 90 percent of visible light and 98 percent of the infrared radiation.

Since the car is only driven during the day, the 10 percent of visible light available to the driver is sufficient. By blocking the infrared rays, the canopy helps to keep the driver relatively cool and, therefore, allows him or her to remain in the car longer, requiring fewer stops.

Even the seat is designed to keep the driver cool. Made like a sling or hammock, the nylon mesh will allow air to circulate around the driver, helping to remove excess heat from his / her body.

For safety the driver is held securely in place with a lap belt as well as shoulder and leg harnesses that are attached to the frame of the car.

POWER

Solar Array

The scource of power for all the Solar Challenge racers is, of course, the sun. The GM Sunraycer uses 7,200 of the K7 solar cells built by Hughes Aircraft Company's Spectrolab subsidiary - the same type of cells used on Hughes-built communications satellites, such as the AUSSAT satellite for Australia.

Batteries

An indirect scource of power is the batteries. The GM Sunraycer uses 68 rechargeable silver zinc cells, each providing 1.5 volts and 25 ampere-hours, producing a total of 120 volts.

The silver zinc cells can operate at high temperatures and at high rates of charging, with an energy recovery efficiency of 75 percent. Battery power is used early and late in the day to supplement the reduced solar power available at these times.

The batteries are recharged by the solar panel during the two-hour periods just after sunrise and before sunset. The batteries can also be used to provide additional short-term power for acceleration and for hill climbing.

Wheels, Suspension, Steering

To minimise rolling resistance, the GM Sunraycer's wheels use bicycle tyre technology. Custom-built wheel hubs were designed by Dr. Chester Kyle, who developed much of the bicycle technology for the United States bicycle team in the

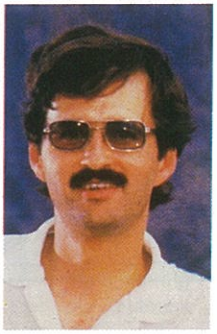
THE DRIVERS ...

TERRY SATCHEL: Engineer with Chevrolet, in advanced product development, specialising in suspension design. Active competitor in Club level motor sport.

Dr ALEC BROOKS: Project Manager, from Aerovironment, responsible for design and development of Sunraycer. Designed and built recent world record breaking human-powered water vehicle.

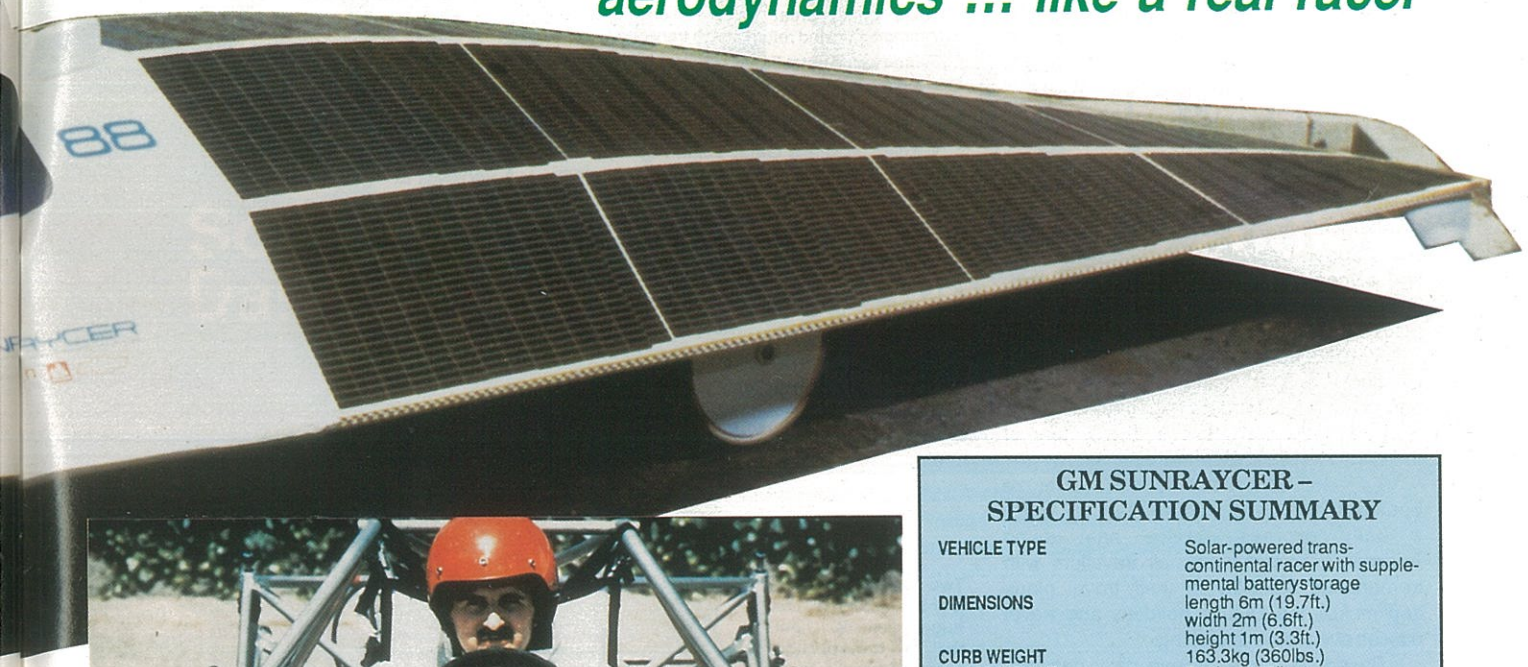
JOHN HARVEY: Many times champion of various racing categories, this top Australian is representing Holden's in an international line-up.

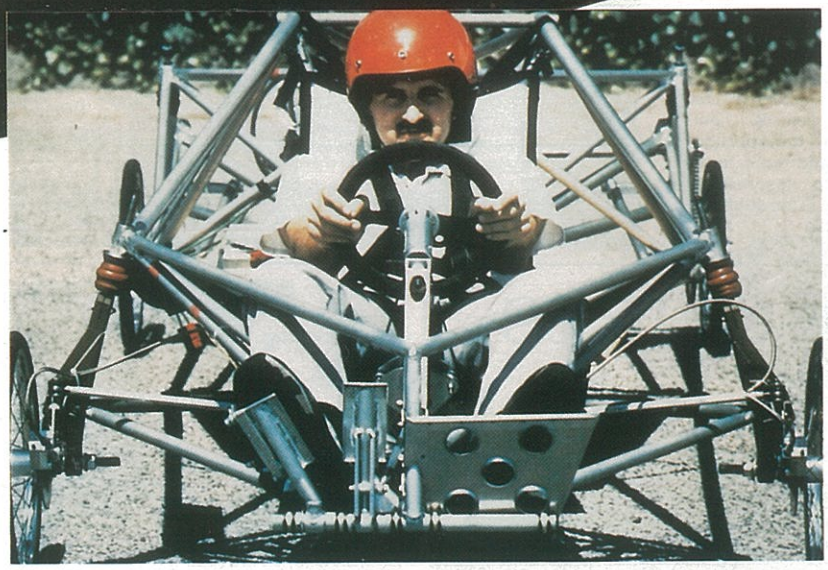
MOLLY BRENNAN: Young engineer at Chevrolet, working on future model program. Rhodes scholar and accomplished athlete.



USA # 88

Kevlar, space frame and aerodynamics ... like a real racer





GM SUNRAYCER – SPECIFICATION SUMMARY

VEHICLE TYPE	Solar-powered trans-continental racer with supplemental batterystorage
DIMENSIONS	length 6m (19.7ft.) width 2m (6.6ft.) height 1m (3.3ft.)
CURB WEIGHT	163.3kg (360lbs.)
GROSS WEIGHT	248kg (547lbs.)
MOTOR	1.5kW (2hp) Magnequench brushless DC
SOLAR ARRAY	2.55m^2 (90 sq.ft.) 150 volts, 1kW peak power
BATTERIES	silver-zinc, 68 cells with 25 amp hrs each, 102V (27.2kg)
CHASSIS & SUSPENSION	Aluminium tube frame with MacPherson struts in front and trailing arms in the rear
BRAKES	primary: regenerative secondary: hydraulic disc brakes on front wheels emergency: mechanical disc on right rear wheel
TYRES	17-in. by 1-in. Moulton cycle tyres, 90 psi
PERFORMANCE	0 to 40mph (64km/h) 20 secs Max speed - pure solar 45+ mph (72km/h). Max speed - solar + battery 60+ mph (97km/h)

1984 Olympics.

The 17 - inch spoked wheels have aluminium rims and quick-mount hubs for fast wheel changes. The spokes are covered with discs to reduce aerodynamic drag. Dr. Kyle is conducting a test program to investigate the rolling resistance of a wide range of candidate tyres.

Kevlar (trademark of DuPont) ply tyres with a slick tread are among the most promising options. The tyres are custom manufactured for the GM Sunraycer by the Wolber Tyre Company in association with Alex Moulton Limited, England.

The four wheel independent suspension, designed by Terry Satchell of the Chevrolet-Pontiac-Canada Advanced Vehicle Engineering Staff, uses MacPherson struts in the front and independent trailing arms in the rear, with adjustable roll steer. The suspension uses steel springs with conventional gas charged shock absorbers.

Magnequench Motor

A new motor, designed by General Motors Research Laboratories (GMRL), will power the GM Sunraycer. Using recently - developed super-strength, rare earth, iron-based permanent magnets, called Magnequench III, the motor will have an efficiency rate of 92 percent, compared to similarly sized standard electric motors, which have 75 to 85 percent efficiency.

Magnequench is a trade name for a patented process developed by GMRL and GM's Delco Remy Division. The motor weighs 3.7kg and produces two horsepower continuously at 4,000rpm, which is about 30 to 40 percent more than comparable sizes commercially available motors.

Magnequench Process

Named after the processing technology which instantly cools (quenches) a stream of molten metal contacting a spinning wheel in an oxygen-free environment, MAGNEQUENCH combines Neodymium, Iron and Boron.

Quenched at the rate of one million degrees centigrade per second, the rapid solidification process creates magnetic metallic ribbon-flakes in step one of a patented process as unique as the product itself.

Personal Plate: GM SUN 88

The GM Sunraycer will carry a California licence plate labeled: GM SUN 88. It will be fitted inside a clear plastic aerodynamic fin located on the underside of the trailing edge of the solar powered racer.

The number was chosen because:

- 1988 is Australia's bi-centennial year
- 1988 is GM's 80th anniversary
- 1988 is Holden's Motor Company's 40th anniversary as a car manufacturer in Australia. Holden's is a GM subsidiary.

DELUXE COACHLINES

BLUE RIBBON SERVICE AROUND AUSTRALIA

DELUXE COACHLINES began operations just over eight years ago with one Express service between Sydney and Perth. The Company has since grown to become one of Australia's most progressive national express coach and tour operators.

Deluxe is presently operating a fleet of 110 luxury coaches, including 15 revolutionary new double-deck German-built "Super Deckers". With the average age of coaches being just 23 months old, Deluxe justly claim to have one of the most modern fleets in Australia.

In 1986, 43 new vehicles were added to the fleet - a $14.5 million investment, and one of the largest orders ever placed by one express coach company in the history of the industry in Australia.

As of 16 March, 1987, **Deluxe became the first company to offer a daily express service** right round Australia. This provides all travellers with tremendous flexibility in their travel plans and makes the Deluxe holidays and travel passes even more appealing.

Based on this extensive daily network, Deluxe has developed a wide variety of Great Value Holiday programmes and travel passes which include:

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The Company employes in excess of 600 people throughout Australia, with offices in every capital city as well as Canberra, Alice Springs, Townsville and Surfers Paradise. Deluxe are also represented in the United Kingdom, the United States of America, New Zealand, Singapore and Japan.

When travelling with Deluxe Coachlines, you will quickly realise that passanger enjoyment and comfort has been given the highest priority - along with price.

Two friendly, informative coach captains are on board Deluxe Coachlines' vehicles at most times and they are backed by years of experience throughout Australia.

Deluxe coaches are luxuriously appointed with comfortable aircraft-type reclining seats, and all are rest-room and toilet equipped, making the trip more pleasant. All the while, passangers travel in fully air-conditioned comfort with individual reading lights and air vents.

Two of the magnificent coaches in the huge Deluxe fleet that is transporting more and more tourists to fascinating places throughout Australia.

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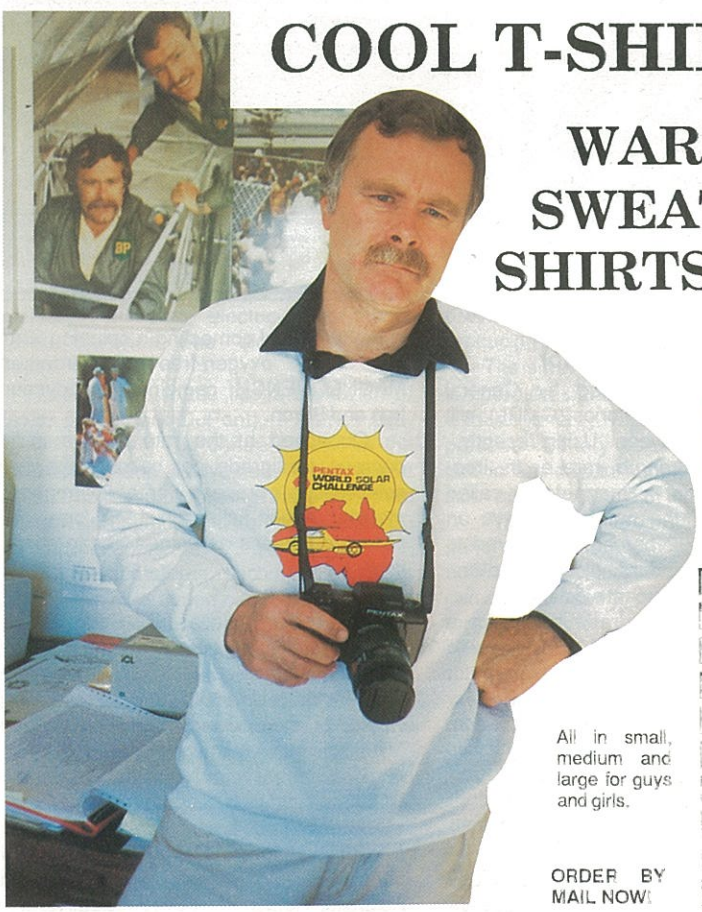

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WORLD SOLAR CHALLENGE

Solar-powered cars race over 3,200km!
Darwin to Adelaide, November 1-6, 1987

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AUSTRALIA'S DRIVING FUTURE HOLDEN

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Crowder College *STAR* Team

... it's the Solar Trans

CROWDER College provides one of three entries from the United States, Crowder being a small, public community college of 1300 students located in the midwestern part of the United States in Neosho, Missouri.

One thing that distinguishes the Crowder entry is that this is the second solar car project for the College.

In 1984 a group of adventurers associated with the College designed and built the first solar car to successfully cross the United States. This first vehicle was built for less than $5,000, and the project was largely financed by the crew members themselves.

While the first car was rather crude by the standards of today's solar cars in the Australian race, the Crowder vehicle completed the historic 3,900 kilometre crossing from the Pacific to the Atlantic Ocean in 45 days.

As with the first solar car, the ***STAR*** project at the Crowder College is being financed without College funds. This time, however, the Crowder team effort is receiving support from a wide variety of sources, primarily the local community. Individual gifts of money are making possible the construction of a very competitive vehicle for the Australian World Solar Challenge race.

The use of composite materials, aircraft frame tubing and custom solar array has reduced the total weight of the new ***STAR*** vehicle to less than half that of the original Crowder solar car. Advanced aerodynamics and drivetrain components make possible speeds three to four times greater than the original car.

The Crowder team, which consists of students, College employees and community volunteers, is confident that their experiences from the first continental crossing of the United States will give them a competitive edge in the Australian World Solar Challenge.

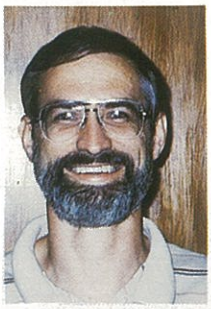
Much of the fabrication work on the STAR was done by Dwyer Enterprises. Here, fabricator **TED SCHAFER** works on the rear axle and drive train.

CHRIS KALMACH
...35, married, two year old son. Hobbies include motorcycles and ultra-light aircraft. A 1972 Crowder College graduate, currently Vice President of Operations at Datametre, a manufacturer of electronic instruments and controls. Co-captain and originator of first Crowder solar car project. Responsible for design work and logistics.

USA # 99

STAR Team Drivers

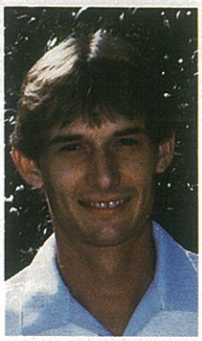
ART BOYT
...36, married with two children. A 1971 graduate of Crowder College, he teaches alternative energy and computer classes in the Science and Technology Division of the College. A co-captain on the original Crowder solar car team. Interests include bicycling, motorcycles and ultra-light aircraft. Supervised construction of the ***STAR***.



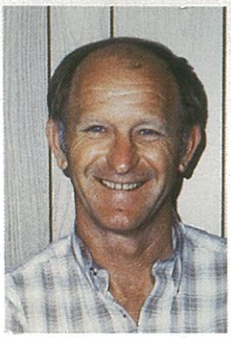
KENT FARNSWORTH
...42, President of Crowder College, sponsor of the ***STAR*** team. A former US Air Force pilot, long-time strong advocate of alternative energy development. Responsible for design and fabrication of aerodynamic components (wheel fairings and driver's pod).

Australia Racer

STEVE TIPTON
...24, unmarried. Graduated in 1985 from Crowder College, where he was active in the Alternative Energy Program. A driver on Crowder solar team in 1984, since formed own business in electronics field. Other activities include flying, jogging, and motocross. Has overseen soldering of the 17,000+ connections in the solar cells of ***STAR***.



JIM WHITE
...48, married with 3 sons and 8 grandchildren. A former stock car driver, hobbies include fishing, motorcycling, gardening and flying. Professional truck driver for 17 years, currently coordinates the truck driver training program at Crowder College. Responsible for construction of driver's pod and trailer for ***STAR***.



STAR Team Sponsors

ARCO Solar: maker of high-efficiency solar cells used in a wide variety of applications...donating the solar cells to the project.

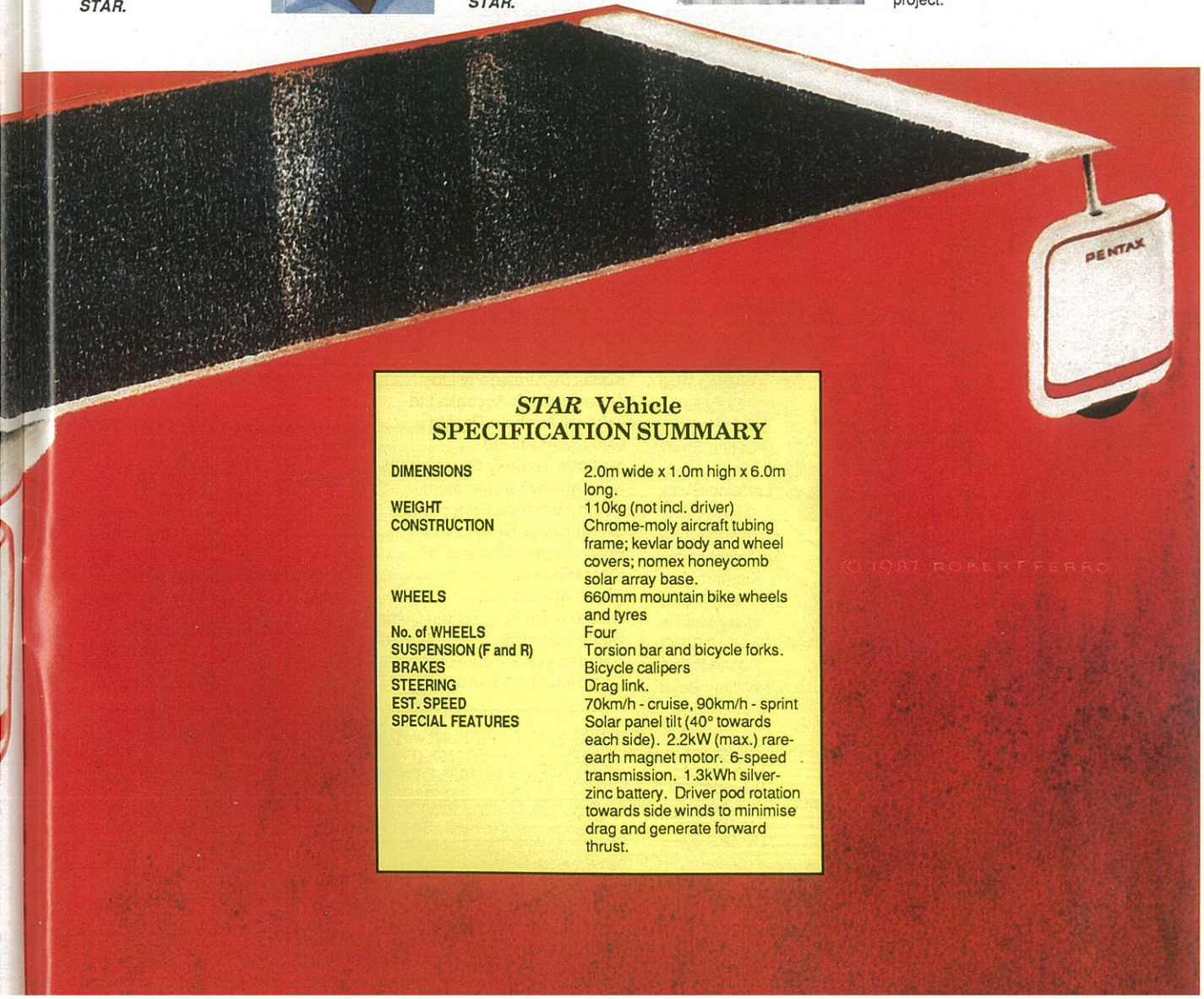
Crowder College: providing facilities and volunteers. The College is the site for project planning, vehicle assembly and testing.

Dupont Corporation: providing Kevlar® and Teflon® materials and design expertise in light-weight composites.

Dwyer Enterprises: this Neosho company does a wide variety of high-tech fabrication and manufacturing in metals and plastics. Dwyer is donating materials, engineering expertise, and some 400+ man-hours to the project. Ted Shafer, chief STAR vehicle fabricator, has over 30 years experience in the aerospace field. Dwyer Enterprises also fabricated the first solar car to cross the United States, the *Pheonix*.

Eagle Picher: the Joplin division of Eagle Picher is providing light weight, high efficiency batteries to the STAR project. These silver-zinc batteries are similar to those manufactured by Eagle Pitcher for NASA's Lunar Rover. Eagle Picher also donated batteries to the *Pheonix* project.

Other Contributors: more than 20 volunteers, from high school students to engineers, mostly from the Neosho area, have provided expertise and energy. Other contributors include the many local individuals and businesses who have donated some $7,000 in cash and materials to the project.



STAR Vehicle SPECIFICATION SUMMARY

DIMENSIONS	2.0m wide x 1.0m high x 6.0m long.
WEIGHT	110kg (not incl. driver)
CONSTRUCTION	Chrome-moly aircraft tubing frame; kevlar body and wheel covers; nomex honeycomb solar array base.
WHEELS	660mm mountain bike wheels and tyres
No. of WHEELS	Four
SUSPENSION (F and R)	Torsion bar and bicycle forks.
BRAKES	Bicycle calipers
STEERING	Drag link.
EST. SPEED	70km/h - cruise, 90km/h - sprint
SPECIAL FEATURES	Solar panel tilt (40° towards each side). 2.2kW (max.) rare-earth magnet motor. 6-speed transmission. 1.3kWh silver-zinc battery. Driver pod rotation towards side winds to minimise drag and generate forward thrust.

PENTAX WORLD SOLAR CHALLENGE

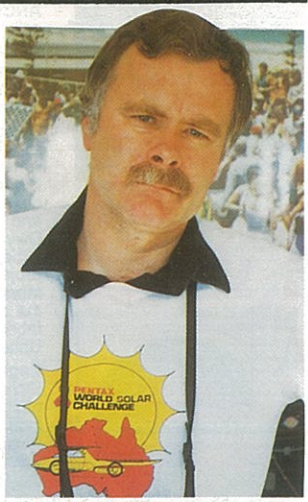
Organised by ...

ENERGY PROMOTIONS is an Australian firm that has alrady been associated with and responsible for some of Australia's most outstanding epic adventures, from a bicycle race in the Simpson Desert to the first crossing of the Australian continent by a solar-powered vehicle.

Heading the organisation is adventurer Hans Tholstrup, well known for several dramatic solo achievements, including a flight round the world in the smallest aircraft, round Australia in an open boat and a drive from Lapland to South Africa in a small car - and, of course, the crossing of Australia with Larry Perkins in the solar car, BP Achiever.

TOKYO EIZOSHA CO. LTD is a Japanese film production company that was established in 1971 by a group of leading outdoor cameramen. Central figure is Masaru Otaki, winner of an Oscar for Best Documentary for his film "The Man Who Skied Down Everest".

Eizosha is renowned for its professional imagery and production, some of their previous achievements being "Men and Nature", a film of a round-the world journey by the yacht "Synara", over the ancient spice routes, and the coverage of Yiuchiro Miura's incredible performance in skiing down from the peaks of mountains in all seven continents. Eizosha also filmed the renowned "Paris Dakar Rally" in the Sahara Desert, and will be covering the Solar Challenge.



ASAHI OPTICAL CO. LTD, the sponsor of the event through its principal brand, PENTAX, is a pioneer in the field of single lens reflex cameras with an impressive store of advanced in-house technology and expertise. Recent developments and releases includude the Pentax SFX, the first camera in the world with an internal retractable TTL strobe, and the ZOOM 70, the world's first compact camera equipped with a power zoom.

Today, Pentax is pressing forward into new fields of technology, such as CAD/CAM, medical electronics, video equipment and ceramics, successfully diversifying its field of professional expertise.

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Director	Hans Tholstrup
Co-ordinator	Rona Wall
Secretary	Sully Brien
Assistant Secretary	Ann Heaney
Technical Officer	Laurie Shaw
Technical Officer	Dave Ellem
Timekeeping	Lorraine Shaw
Chief Operations Officer in Darwin	Jack Mullins
Observers' Manager	Tony Maguire
Food Truck (Supermarket)	Jim Swinbourne
Sponsors' Liaison Officer	Kitahara San
Meteorological Services Officer	Jim Arthur
Licence and Weigh-In Officer	Mary Mullins
Battery Technical Officer	Dr David Rand - CSIRO
Support Vehicle Controller	John Byrne
Medical Officer	Dr William Boyd

OBSERVERS

John Buchan	Rog Collins	Brian Scholz	Tom Hayller
Richard Dollman	H.F. Tollenaar	Ian Hese	Frank Knight
Geoff Wachtel	Mark Kramer	Ken Toseland	Robert Murphy
Peter McLaren	Nigel Wood	Terrence Tierney	Keith Neville
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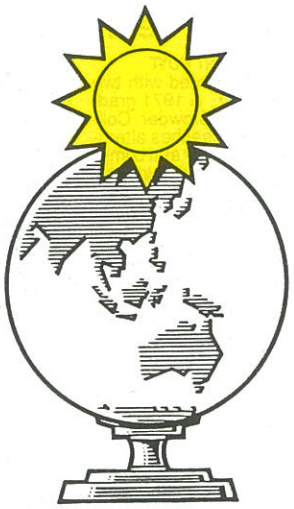
William Ions	Sandy Pulsford	Margaret Wallace	Donald Snaith
John Rasmussen	Mark Jansen	Tim Hunt	

The perpetual trophy for the World Solar Challenge

The Solar Cup

This handsome trophy, provided by The Broken Hill Associated Smelters Pty Ltd at a cost of $20,000, will be presented to the winner of the Pentax World Solar Challenge. Made of Australian metals, the sun is made of gold, the earth sphere of silver, all mounted on polished rosewood base.



SUPPORTERS and SUPPLIERS

The Broken Hill Associated Smelters Pty Ltd	$20,000 Trophy
BP Australia Ltd	Official fuel suppliers to the event
Citizen Watches	$20,000 and watches
Mercedes Benz Australia Pty Ltd	Media truck and three cars
Mitsubishi Motors Australia Ltd	15 support cars
Casuarina Shopping Square	Venue for strart and scrutineering
Sheraton Darwin Hotel	Twenty rooms
B, Seppelt & Sons Ltd	Venue for finish & presentation, & champagne
Deluxe Coachlines Pty Ltd	Free coach seats and event freight
ICL Australia Pty Ltd	Office computer
G.J. Coles Ltd	Refrigerated catering truck
Hatadi Electronics Corp Pty Ltd	25 CB radios
Fairey A'Asia Pty Ltd	Radar
New Energy Development Corporation	$5,000
Mita Copiers Australia Pty Ltd	Photocopier and copy cost
South Australian Brewery Pty Ltd	Pallet of beer
CSIRO Inst of Energy and Earth Resources	Battery srcutineering
Coca Cola Australia	100 cartons of Coke
BHP Colorbond	Scoreboard
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Rola Roof Racks	Support car racks
Panalpina World Transport Pty Ltd	Custom clearing for competitors
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Kodak (Australia) Pty Ltd	Film and photo of cup (prizes)
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NT Highways Department	Road profile
South Australian Government	Assistance
SA Highways Department	Road profile
Police Depts of SA and NT	Assistance
City of Darwin	Hospitality and start ceremony
City of Adelaide	Hospitality
Northern Territory Tourist Commission	Assistance
South Australian Tourist Commission	Finishing Certificates
Barossa Valley Tourist Commission	Hospitality
Department of Resources and Energy	Trophy for Best Australian Car

"POWERED BY THE SUN" was produced by Max Stahl (Barmera Pty Ltd) of 17 Edgecliff Rd., Umina 2257 (Phone and Fax 043-43-1164) for the Organisers, Energy Promotions, 1697 Pittwater Rd., Mona Vale 2103 (Phone 02-997-8011, Fax 02-997-3294). Typesetting by Central Coast Promotions Pty Ltd, 27 Morrison St., Saratoga 2250 (Phone 043-69-2760), printed by Offset Alpine Pty Ltd, Derby & Wetherill Sts., Silverwater 2141(Phone 02-647-1000), print management by Print Concepts Pty Ltd, 11 Ross St., Forest Lodge 2037 (Phone 02-660-4755).

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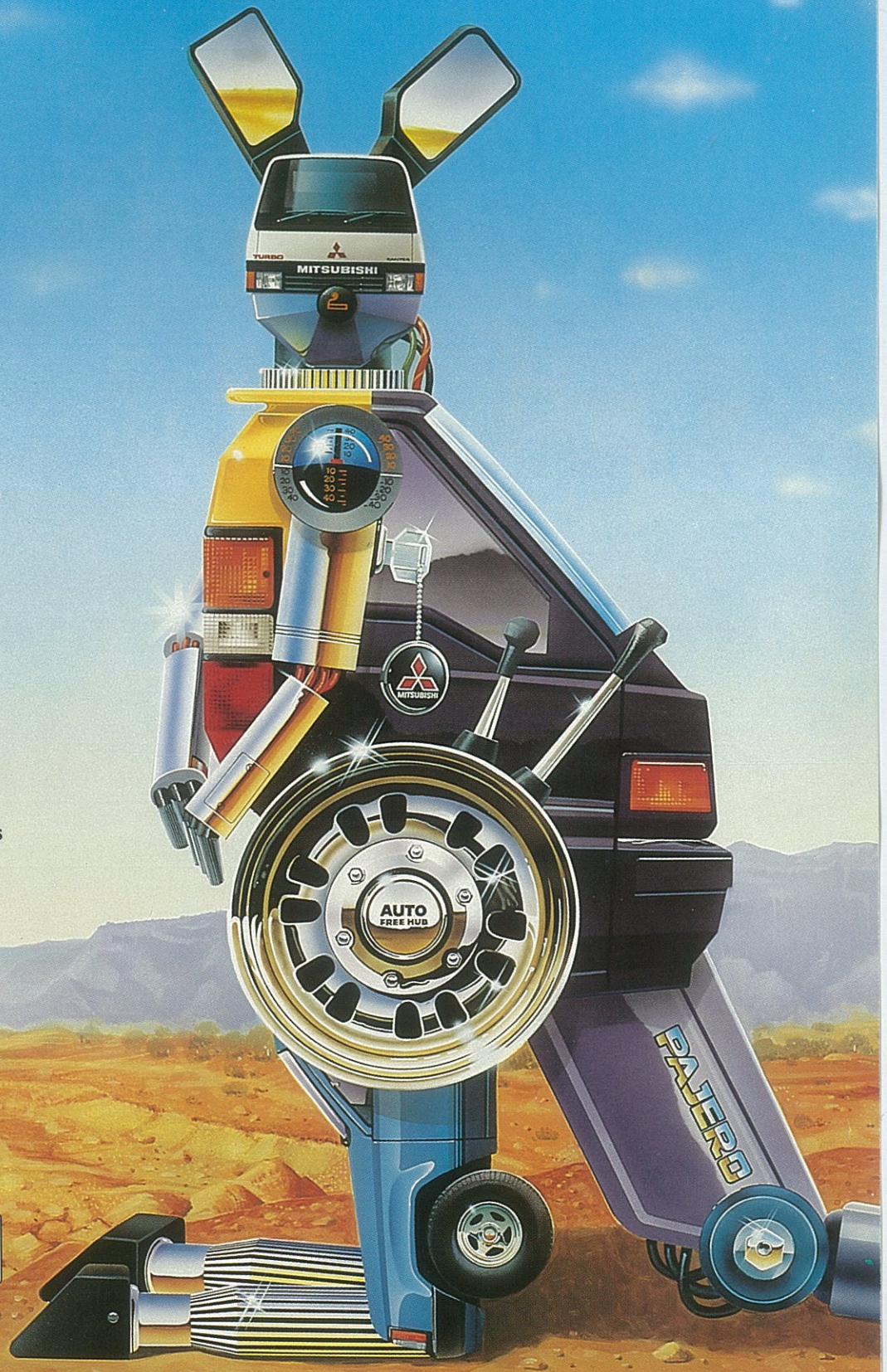

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Scanner's notes

October 31, 2017

This magazine was published for the inagural World Solar Challenge in 1987. While there's no publication date, it was likely between June and November of that year since there's a reference on page 26 to Tour De Sol 1987 as already happened in June, and the lack of any coverage of the 1987 WSC itself.

This copy was given away by Hans Tholstrup at the end of the 2017 World Solar Challenge, to commemorate the 30th anniversary of the race. I scanned it so at least one solar car hardcore fan out there can read it.

Readers interested in the 1987 World Solar Challenge should check out either of these two books. The first book is Sunraycer's Solar Saga, by Bill Tuckey (published 1987). This book covers the day-to-day happenings of the race, with a focus on the Sunraycer itself (since it's the one all media cars are following - a lot of things never change, even after 30 years). The follow-up book, titled "Sunraycer", also by Bill Tuckey is published in 1989. This one has extra content on the development and aftermath of the race for the sunraycer team in addition to the race coverage, which seems nearly identical to the previous book.

I wonder if the T-shirt order coupons are still valid...

Anyway, see you next race!