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Volume 17 Number 3 Autumn 2004

# Electric Boat **NEWS**

The Journal of the Electric Boat Association



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## Information sheets from the Electric Boat Association

1. **PRODUCT GUIDE & EBA TRADE MEMBERS**  
(free upon request)
2. **SOLAR PHOTOVOLTAICS** by Paul Lynn
3. **ELECTRIFYING YOUR BOAT** by Hawthorne & Wagstaffe
4. **HULL DESIGN FOR ELECTRIC BOATS**  
by Andrew N Wolstenholme
5. **LEAD ACID BATTERIES - OPERATION & MAINTENANCE**  
by CMP Batteries
6. **HIGH SPEED ELECTRIC BOATS** by Lorne Campbell
7. **HYBRID POWER** by John Hustwick
8. **TRAILERS AND TRAILING** by Paul Lynn
9. **FITTING OUT AND LAYING UP YOUR BOAT** by John Hustwick and Ian Rutter

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# EBA CALENDAR

## October

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**18th**      **EBA Event**      Laying Up Supper  
Maidenhead Rowing Club

## January

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**6th - 16th**      **EBA Interest**      London International Boat Show  
at ExCel

## April

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**tba**      **EBA Event**      Launch Supper

**For further details of the above, or notice of other events,  
please contact the Secretary**

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**Cover Picture: Electric Dragon Boat on Kunming Lake  
Photo: Ian Rutter**

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Although not as exciting as last year, when the EBA 21st Anniversary and the wonderful weather combined to make the 2003 season particularly memorable, this has been a good summer for electric boating with shows and events on the rivers Great Ouse, Thames and Stour attracting a lot of participants and interest from the public. The recent Norfolk Cruising Weekend, incorporating the new Broads Electric Boat Show, has been a great success and a full report will appear in the January edition of Electric Boat News.

Looking forward to 2005, the season begins with the London International Boat Show, including the Inland Waterways attraction which was such a success last year. The show will also see the announcement of the winner of the Concept Boat Competition, this time aimed specifically at environmentally friendly designs, and the launch of a new trophy for boats with a hybrid propulsion system which must be primarily electric.

And if you need advice on looking after an electric boat over the winter, the EBA has a new information sheet on laying up and fitting out your boat, which should ensure that you are well prepared for all the boating activities in store next year.

*Sylvia Rutter*

### Editor

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### Copy Deadlines:

Material to be considered for inclusion in the next edition of Electric Boat News should be sent to the Editor (preferably by email) by the following date:

Winter 1st December



Electrics at Sea Page 10



Showing the Flag Page 13



Wind in the Reeds Page 16

# SLOW BOAT TO CHINA

**The lake at the Imperial Summer Palace near Beijing is a very popular tourist attraction, especially in the heat of summer when the cooling breezes on the water are particularly welcome. And the best way to see the lake and the surrounding gardens is from an electric boat. Report by Sylvia Rutter, photographs by Ian Rutter.**



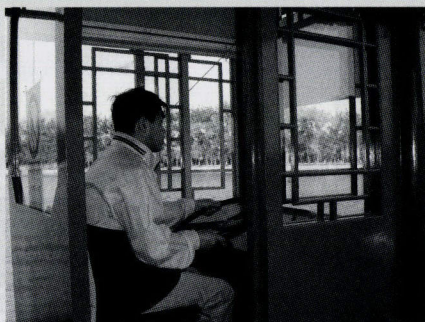
*Electric Dragon Boat*

Ten colourfully painted dragon boats, decorated in traditional style and packed with passengers, ply Kunming hu (Vast Bright Lake) at the New Summer Palace about twelve miles northwest of Beijing. Around 80% of tourists in China are Chinese, exploring their own country, and they seem to appreciate the boats as much as the foreign visitors do. A trip from one side of the lake to the other costs 8 yuan – about 50p.

Five of the dragon boats have diesel engines and five run on electric power – the perfect combination of the traditional and the modern. Each electric dragon boat has two DC motors rated at 17.6 kW each. These are controlled by individual switches which give three forward and three reverse speeds, very useful when manoeuvring a large heavy boat at the jetties where passengers embark and disembark. The lake is very shallow (in winter it freezes over and is a popular spot for skating) so the boats are flat-

bottomed. The operating voltage is 220 V and the maximum current is 80 amps.

The gardens of the Imperial Summer Palace have existed for over 800 years but they were extensively re-modelled by the Dowager Empress Cixi (memorably portrayed by Flora Robson in the film '55 Days at Peking') who ruled China from 1861 until her death in 1908.



*The driver*



*The controls*



Cixi joined the Emperor's household as a humble concubine but after giving birth to the Emperor's only son, and supposedly disposing of a number of rivals, she became the most powerful lady in China.

The Dowager Empress began work on the gardens in 1886 and had them rebuilt again in 1902 after they had been destroyed by foreign troops. She took a great personal interest in the restoration, demanding regular progress reports and making frequent visits to check on the work. The landscaping and rebuilding swallowed up enormous sums of money apparently destined for (and much needed by) the Imperial Navy.

The Empress liked to spend her summers at the New Summer Palace, 'from the flowering of the magnolias to the withering of the chrysanthemums'. The wardrobe she kept there (contained in 3000 chests) held robes reflecting the change of seasons, embroidered with wisteria and peonies for spring, lotus blossoms for summer and chrysanthemums for autumn, with every accessory embroidered to match. A hundred separate dishes were served at the two main meals of the day, with at least twenty more for light refreshment in between.

One of Cixi's more extravagant follies was rebuilding the 'marble boat' on the lake shore in a style combining the traditional Chinese with a Mississippi paddle steamer, complete with stained glass windows. The interior of the 'boat' (an extremely solid structure and not suitable for conversion to electric power) has Minton floor tiles and mirrors to reflect scenes of the lake. The Empress and her retinue used to take tea there.



*Interior of the Dragon Boat*

The five big dragon boats are not the only electric boats on Kunming. For those who prefer to explore the lake independently there is a fleet of 150 small electric firebrenglass dayboats which are available for individual hire by the hour. The price for one hour is about £3 and they are very popular, particularly with younger visitors.

When the Qing dynasty in China was overthrown in 1911 the gardens of the Imperial Summer Palace remained the property of the last emperor, Pu Yi, but the grounds were opened to the public for a small fee. In 1924 they became a public park but in subsequent years grew dilapidated until their restoration after 1949. Now the gardens, lake and palace buildings are a UNESCO World Heritage Site and well worth a visit.



*The marble boat*

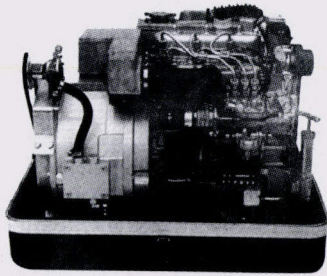


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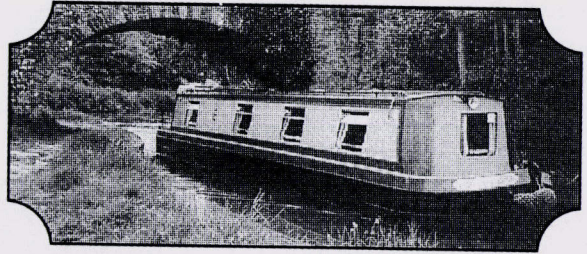
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# FIREBIRD'S BIRTHDAY

**A very special party was held at Great Cornard on the River Stour in Suffolk to celebrate the hundredth birthday of the steam launch *Firebird*. As well as steamboats of all shapes and sizes the guests included the 'Electric Lot'. John Hustwick explains.**



VANESSA WORRALL

Veronica Worrall

*Party at the boathouse*

The 'Electric Lot' (which was how the steamboaters referred to us) consisted of three Frolic electric launches: *Georgie* owned by the Watersons, *The Lady Susan* owned by new EBA members Stephen and Veronica Worrall and yours truly in *Rhapsody*. Also included was EBA business member Colin Henwood with his wife Lucie. Colin was responsible for the recent restoration of *Firebird* and what a credit it was to him.

Robert and Tina Baker, the owners of *Firebird*, had invited a number of friends to the celebratory weekend at their home beside the River Stour and as well as *Firebird* and the three Frolics there were Colin Henwood's skiff, a variety of steam launches, a full size traction engine and steam wagon, two large scale model traction engines, three 7 1/4" gauge steam locomotives on the garden railway, a radio controlled model steam driven tug and several vintage cars.

After the Saturday afternoon tea and cutting of the birthday cake and a period of chatting and relaxing, an excellent barbeque followed in the early evening with more convivial chatter. Then when it was completely dark and after what I believe was a 125 round firework display – well a 100 round salute plus some extra for luck, a number of boats, including the three electric launches, cruised from Great Cornard to Henny, a distance of about a mile. Unfortunately the Swan pub at Henny was being refurbished so we couldn't partake of refreshments there but the trip was very enjoyable, with the river so tranquil and interesting at night.

Next morning after a bacon and egg breakfast cooked by Tina on

the barbeque, there was more steaming and cruising on the river up to Henny. Then after a picnic lunch on the river front it was off through the lock at Cornard and up to Sudbury for afternoon tea at the Granary. The cut outside the Granary was filled with boats, which confused some members of the public who thought they might be able to have boat trips. After a relaxing cup of tea and more chatting, it was back through the lock to the Bakers' slipway ready for hauling out.

As you will have seen in previous issues of Electric Boat News, the EBA have provided comments and suggestions for a feasibility study on the opening up of navigation and have also been involved with other activities to promote electric boating on the River Stour. Based on a number of comments made by members of the public, including a few canoeists, the idea of electric boats on the river seems to be a good one.

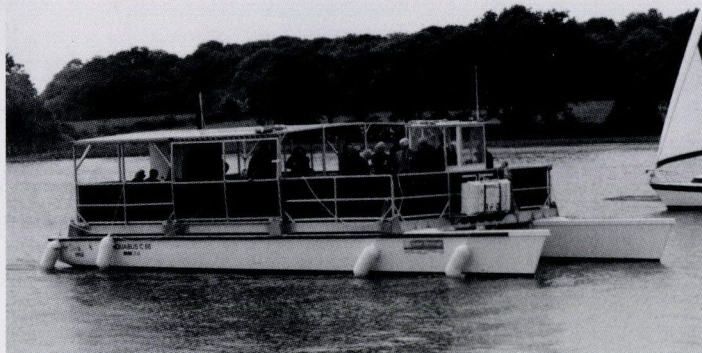
Finally, on behalf of the 'Electric Lot', I would like to thank Robert and Tina Baker for their wonderful hospitality and to say we hope to see them in an electric boat before too long, something Robert is seriously thinking about.



HUGH MOTHERSOLE

*Boats at the Granary*

## NEW SOLAR BOAT AT CHICHESTER



*Solar Heritage*

Britain's largest solar-powered launch has been running almost daily educational cruises around Chichester Harbour over the summer. *Solar Heritage* was launched at a special ceremony at the end of May by Lady Pippa Blake, the widow of Peter Blake, the famous round the world yachtsman. EBA representatives John Hustwick and Steven Schrier, who is a Chichester Harbour Conservancy committee member, were on board the 54 seater launch for its maiden voyage.

*Solar Heritage* was bought with part of a Heritage Lottery Fund grant towards the educational facilities run by the Chichester Harbour Conservancy. Steven Schrier says that the Conservancy is a very 'green' organisation and an electric boat seemed right for the job. As well as being 'eco friendly', the ability to cruise quietly up to the wild fowl which inhabit much of the harbour is a big advantage.

The boat weighs 16 tons and is 14 metres long by 6.6 metres wide. Half the full length canopy is covered in solar cells generating 2 kW in full sun, which is enough to drive the boat at 6 kph. The solar cells charge two battery banks of 540 ampere hours each at 48 volts and these raise the speed to 10kph via the two 8kW electric motors. She was built in Switzerland by MW Line and Trace Engineering supplied much of the electronics. By the end of the first year of operation *Solar Heritage* will have completed about a hundred trips, forty more than planned.

**Cruises run from Dell Quay, Itchenor and Emsworth.**

**For details contact the harbour office on 01243 512301.**

## SOS – SAVE OUR SLIPWAYS

The Thames Traditional Boat Society has launched a campaign to save public slipways and other access points on Britain's rivers and canals. TTBS Captain Robin Ford said their concern was that more and more slipways and access points were being lost in new developments, blocked by local authorities overreacting to health and safety concerns, or sometimes restricted by adjacent inns and pubs.

The TTBS is devoted to the preservation, maintenance and use of traditional unpowered boats. Its members come from all over the country and use a variety of waterways in addition to the Thames.

They are campaigning not just for their own members but for all boaters who enjoy Britain's waterways in a trailable or car top boat.

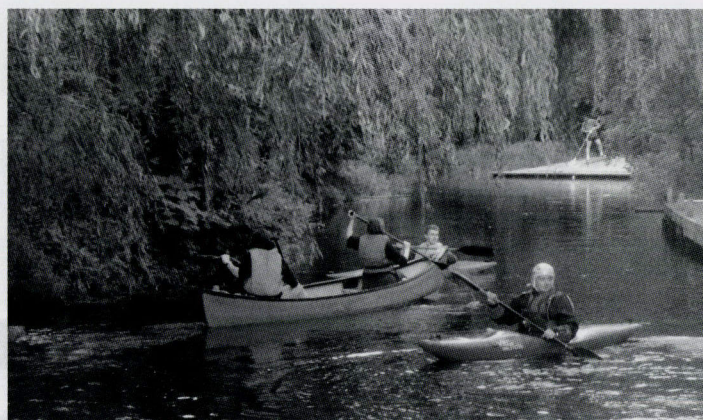
**Society committee member Keith Odle is collating information on access points and slipways in danger of disappearing. For more information, or to pass on information e-mail [sos@ttbs.org](mailto:sos@ttbs.org).**

## S2C – SUDBURY TO THE SEA

Sudbury to the Sea is an annual event organised by the River Stour Trust who invite owners of small boats to take a two-day journey along the River Stour to Brantham and, if they wish, to go over the rollers and into the tidal estuary.

Normally only manually propelled craft are permitted to travel the whole length of the river but this year's event, held on 18th and 19th September, allowed participants to add an electric outboard as part of the Environment Agency's trial of electric propulsion on the Stour. Of the 55 boats taking part, 2 dinghies and a Canadian canoe carried batteries and electric outboards supplied by the Thames Electric Launch Company. Unfortunately the boats struggled to get round numerous obstructions on the river and the dinghies were unable to complete the course, although they got as far as Wissington, but the Canadian canoe made it all the way.

The crews will be reporting back to the Environment Agency on the obstacles they encountered and the difficulties involved in carrying boats made heavier by motors and batteries.



*Electric powered Canadian canoe with paddle powered kayaks*

## SHOW IN MONACO

The 21st Worldwide Battery, Hybrid and Fuel Cell Electric Vehicle Symposium and Exhibition will be held in Monaco from 2nd to 6th April 2005. The show is organised in conjunction with the World Electric Vehicle Association and the theme for this year is encouraging the industry to 'Act Now for Sustainable Mobility'. There will be an opportunity to test drive vehicles on the Monaco Formula One circuit.

**For more information contact Laure Hatchuel-Becker, Marketing and Sales Director, MITI, 13 Bd Princess Charlotte, 98000 MONACO Tel. +377 93 50 13 44 or e-mail [lhb@miti.mc](mailto:lhb@miti.mc)**



## CRUISE ON THE OUSE

New EBA member Chris Morgan has been granted a licence by the Environment Agency to run trips on the River Great Ouse at weekends and bank holidays. His 21 ft electric boat *Whisper*, built by Phoenix of Potter Heigham and sold recently through the EBA



*Whisper*

website, takes passengers from St Ives to Hemingford Lock and the one hour round trip costs £3-50 for adults and £1-50 for children. The St Ives Riverboat Company has only been operating for a few months but the service has proved very popular and will continue through the winter unless river levels are too high. The company is also happy to quote for private hire for birthday parties and special celebrations and for weddings at churches alongside the river.

**Telephone 07906 257308 for bookings or more information.**

## SUSTAINABLE DEVELOPMENT FUND

The new £65,000 custom-built electric motor cruiser *White Admiral* has joined the fleet at the Nancy Oldfield Trust, the water activity centre for disabled and disadvantaged people. The Broads Authority gave £20,000 from its Sustainable Development Fund towards the cost of the boat which was designed by Andrew Wolstenholme and



*White Admiral*

built by Haines Marine of Catfield. The 28 ft cruiser, which can carry up to 12 passengers, has stern and side access for wheelchairs, a hydraulic wheelchair lift and accessible toilet and galley facilities.



*Jackie*

A grant from the Sustainable Development Fund also went towards the cost of a 20 ft picnic boat from Martham Boat

Building. The Jaunty 20 is based on a day hire boat which has been in service on the Norfolk Broads since the late 1940s. Originally made from wood, the boats now have modern GRP hulls with an electric power unit. The first boat, *Jackie*, was at the Broads Electric Boat Show, along with *White Admiral*.

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## GO ELECTRIC

Tony Fogarty reports that Go Electric chose ten boats - five cruisers of 24 to 34 ft, 2 small cruisers of 21 ft and one dayboat - for possible conversion to electric power with the help of Sustainable Development Fund grants. Two of the large cruisers have dropped out and work has started on the 34 ft traditional wooden Broads cruiser *Dawn Star*. Most of the drag tests have been done. Two of the boats are undergoing renovation and a number are awaiting inspection by the Broads Authority before work can begin. The scheme continues to attract a steady number of enquiries.

## NEW MOTOR FOR THE WAGONA PRINCESS



*The Wagona Princess*

The Australian Electric Boat Company have supplied a new Lynch motor for the old 'cream boat' the *Wagona Princess*. Built around 1905, the boat has been operating along the coast of New South Wales for the past ten years as a 36 passenger tour ferry. The old motor has been replaced but has been repaired as a spare.

'Cream boats' were once common on the estuaries of Australia's eastern coast. They normally had a counter stern which allowed them to reverse up to the bank at a dairy farm where the cream churns would be rolled straight on to the deck without the need for a wharf or jetty. As well as servicing the farms and butter factories they often provided the only practical transport for people, mail and supplies.

# BACK TO BISHAM

**Last year's 21st Anniversary celebrations at Bisham Abbey near Marlow were such a success that the EBA was delighted to be offered a return visit. This summer's event, held on 11th July, was rather lower key but still a most enjoyable day. Words by Sylvia Rutter, pictures by Ian Rutter.**

With plenty of mooring space provided by the Bisham Abbey Sailing School, nine electric boats assembled along with EBA members from the Thames area and further afield, including Hans and Betty



*Raffle winner Ulrike Lynn*

Asyee from Holland. Boats travelling upstream to Bisham had been caught in a bit of a traffic jam at Marlow Lock and boats travelling downstream, after the Henley Festival, experienced even longer delays but fortunately nobody missed lunch. The weather in the morning was distinctly chilly so, unlike last year, people were pleased to retreat into the



*Competition winner Hilary Fletcher*

warmth of the Abbey, where those who had come by boat were able to shed several layers of warm clothing.

The excellent buffet lunch was accompanied by lots of lively conversation among EBA members old and new. Hilary

Fletcher, the winner of the Thames Quiz in EB News, was presented with her prize of a voucher for goods from the EBA shop by Chairman John Hustwick. The raffle for a bottle of champagne was won by Rike Lynn (and apparently came in very useful later in the summer to celebrate the arrival of a granddaughter.)

Fortunately by the afternoon the weather had brightened up, so nearly everyone returned to the boats for a cruise downstream to the Cookham reach of the Thames. Marlow Lock is a popular spot on Sunday afternoons for people to sit and watch the boats, but the arrival of a totally silent fleet filling the lock caused some surprise – and even more surprise when it departed just as silently. Even for the crews it was a slightly surreal experience (although a very pleasant one) not to have the usual noise of revving engines and clouds of blue smoke as the lock gates opened.

After a most enjoyable cruise around the two islands below

the lock, and having transferred passengers from boats which had to carry on downstream, the fleet returned to Bisham for tea and farewells. Our thanks go especially to Roy and Janet May of the Bisham Abbey Sailing School for providing help and mooring facilities and to the staff at the Abbey who looked after us so well.



*The silent fleet enters Marlow Lock*

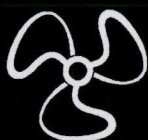


*...and prepares to depart just as silently*



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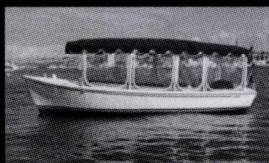
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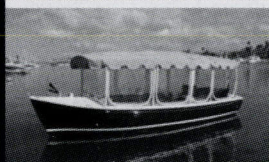
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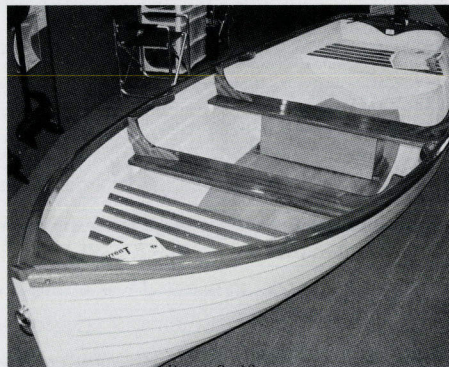
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# ELECTRIC PROPULSION AT SEA

## New EBA business member, Graeme Hawksley, explains how he's turning a hobby into a business project.

At the age of 33 I gave up my job in a hi-tech silicon chip company to sail the world. I sold everything (house, possessions and career) that would not fit into my leaky old wooden sailing boat and turned right out of Portsmouth Harbour. Four and a half years later I found myself in New Zealand, married and with a baby on the way. As three into a 26 ft (now even leakier) wooden boat did not go, we sold up and came back to the Isle of Wight to roost.



Sister ship Wylo 2

It was not long before we started building our next boat, a 32 ft steel gaff-rigged cutter called *Maud*, a 'Wylo', designed by an Englishman for home build. This would be big enough for four (second baby on the way by this time) to venture across the seas again. During the initial build of the hull the designer suggested using an electric engine and gave me a few articles on cruising boats with electric drive. This is where my interest in electric boating first started.

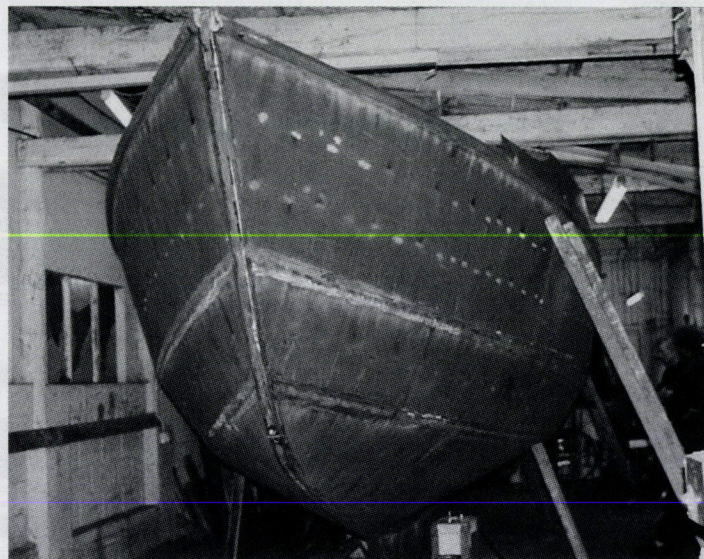
I took a look at electric boats in use and was interested to see the main uptake was at both ends of the boating spectrum. Vessels would either be small river craft using drive systems up to a few kilowatts or very large passenger and cargo ships with megawatts of power. Apart from a few one-off craft there did not appear to be many small sea going vessels with electric drive.

A 30 ft (waterline length) river craft may have a 2-4 kW motor. A similar size of sea-going auxiliary sailing vessel may have a 15-40 kW

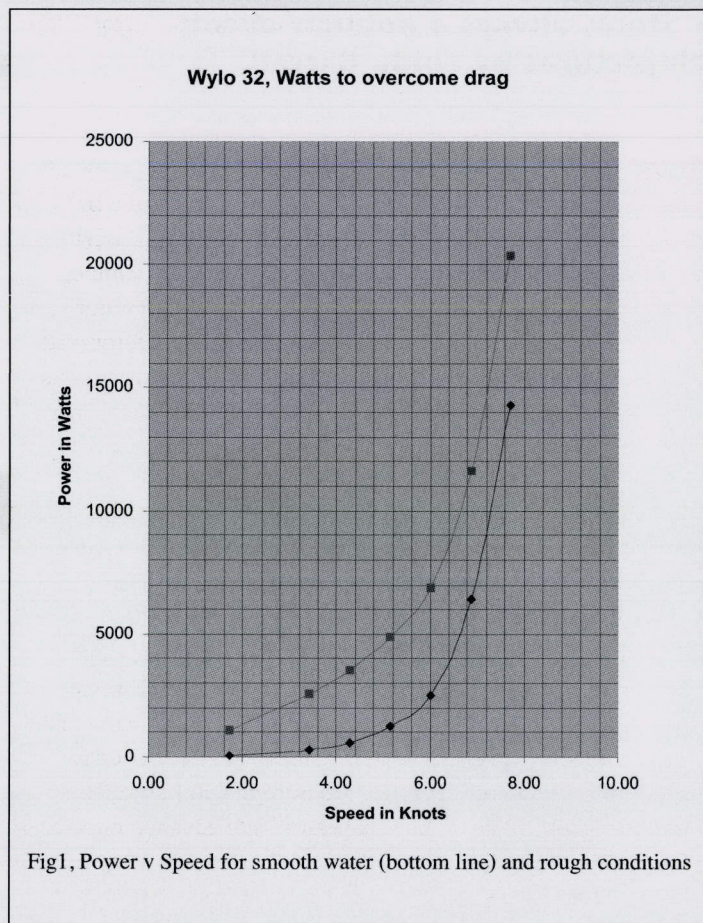
diesel engine. A sea-going motor launch may easily have a 100 kW engine. In order to understand this wide variation I started by developing a drag curve for *Maud*. Using standard yacht design resources and with the help of a yacht designer friend of mine, we came up with Fig 1. The bottom curve is for smooth water conditions and is close to figures I have seen for river motor craft of similar length. The top curve is for rough conditions and starts to illustrate how the requirements for sea going craft deviate from river craft. It is developed from the Gerritsma model whose parameters are as follows: North Sea open water, wind force 7 (near gale), heading at 45° to wind and waves. It can be seen clearly that when conditions get tough a great deal more power is required to move the vessel.

Here are a few reasons I came up with to help explain the differences in power requirements between river and sea craft:

- Hull speed can be thought of as the maximum realistic vessel speed. Beyond this point most of the energy is going into making waves and trying to climb up hill against them. Hull speed is related to the square root of the waterline length but varies a great deal depending on hull shape. A simple equation often used for medium-body displacement craft is speed in knots equals  $1.4 \times \sqrt{l}$  (square root of waterline length in feet). For our 30 ft craft this gives an approximate hull speed of 7.7 knots. The speed of river craft is limited by regulation to 4-5 knots. This is a long way below hull speed and very little energy is required in smooth water to achieve it. Sea-going craft are not so constrained by regulations and manufacturers will often size their engines to obtain close to or above (for planing craft) hull speed.



Bare hull of Maud



- Sailors are very sensitive about drag while sailing and will size propellers to reduce this to a minimum. This often results in selection of small diameter, two bladed propellers and a consequential loss of efficiency when under power. To compensate, larger engines are often fitted.
- Electric boaters have adapted to the requirements of lower powered systems and derive pleasure from low impact quiet boating. However, big, powerful, noisy, fuel guzzling boats sell and the only place to use these is at sea. Perhaps there is some element of natural selection here?
- Sea-going boats have to deal with far more severe conditions than river craft. A large safety factor is required. Being caught out on a lea shore in a rising gale is not the place to be with only a 4 kW motor.

Next I set to and specified my ideal requirements for an electric drive system:

- Long range and self-sufficiency. I could not rely on mains charging and the vessel would need to travel long distances in remote areas. It is hard to beat the energy density (and availability) of diesel fuel so a diesel generator would be required.
- A full range of charging characteristics would be required from bulk charging to equalisation to charging while driving the vessel.
- When in smooth water and calm conditions, I wanted the ability

to travel for most of the time only on battery power, with short intermittent use of the generator.

- Enough battery storage capacity to travel 6-8 hours on a charge allowing 'charge point hopping' on rivers and canals.
- The ability to accumulate large amounts of energy (over time) from environmentally friendly resources such as solar panels and wind generators.
- Since the system would be fitted to a sailing vessel, the ability to charge regeneratively (when sailing, the propeller drives the motor and puts current back into the battery).
- A reasonable safety factor. The system would need to be powerful enough to deal with adverse conditions.
- When the generator was required this would be run in a highly efficient manner keeping fuel use and emissions to a minimum.
- The ability to use the accumulated energy for more than driving the vessel. With the use of inverters and DC-DC converters the ship's DC and AC power could be supplied from the battery bank.
- A sophisticated control system that managed all the resources and was simple to operate.

Pure electric boating is difficult to achieve for seagoing vessels but a hybrid system offers a practical migration path to move from total reliance on fossil fuels towards clean, green and quiet boating. Maximum use can be made of environmentally friendly resources, thus reducing fossil fuel consumption.

Looking around at available motors, batteries and generators it appeared that components were available to fulfil my requirements. What was lacking was an integrated control system that tied them all together. It seemed that if I could develop such a system there might be significant commercial applications.

At this stage I drew up a detailed technical and commercial specification and approached the D.T.I. for funding. After an extended application process I managed to receive support under the 'SMART award scheme' to run a feasibility study. So I have managed to turn my interest into my job and possibly into a future business outlet.

I am now six months into the 18-month project. In a later issue of EB News I will provide more technical information on the system and describe the progress achieved so far. In the meantime I am happy to answer any questions by email at [graeme@hawkss.com](mailto:graeme@hawkss.com)



Daughter Alice checking the depth of the battery compartment!

# STEAM AND ELECTRIC ON THE STOUR

**The Steam and Electric Boat Day on the River Stour, always a popular event, took place in July. Emrhys Barrell reports, with pictures by Linda Barrell.**

The 10th Sudbury Steam and Electric Rally was another great success.

Organised by the River Stour Trust, and sponsored by the Environment Agency, the event took place over the weekend of the 10th -11th July at the Granary, Sudbury, Suffolk.

Ten electric boats attended this year, ranging from canoes to launches and cruisers, and including the Trust's own trip boat. On the Saturday evening they formed an illuminated procession, while on Sunday they took out several hundred visitors for trips on the river, raising over £350 for the Trust funds, and introducing local people to the river, most of whom had never boated on it before.

Several EBA members brought their boats to the event from around the country, to add to those normally based on the Stour, and launched at the excellent slipway alongside The Granary.

This year the event formed part of the joint campaign between the Trust and the Environment Agency to widen awareness of electric boating on this historic waterway, and possibly to increase the use of lightweight electric boats on the navigable sections. Next year's event has already been scheduled, and as usual will take place on the same weekend in July, the main event being on Sunday 10th July 2005.



*Mike Finch, Secretary of the River Stour Trust, in his boat Mersig*



*Emrhys Barrell in Electron*



*River Stour trip boat Rosette*

# SHOWING THE FLAG AT THE THAMES TRAD

**The Thames Traditional Boat Rally at Henley on Thames, which is open to boats built of traditional materials or in traditional style, was held this year over the weekend of 17th to 18th July. Report by Sylvia Rutter, photographs by Ian Rutter.**



*Terence Casey shows the flag*

helpers ready to answer questions from the public; this time our 'Go Electric' sign was at the other end of the site alongside Terence and Ann Casey's *Shiel Water*, dressed overall and looking very elegant.

Another picture of elegance on the water was the Victorian launch *Pike* with EBA member Jack Henley at the helm. In August 2001 *Pike* made a journey of 137 miles in 30 hours and entered the record books for the longest non-stop boat journey under electric power on a single charge of the batteries.

EBA business members exhibiting at the show were Peter Freebody & Co, Hambleden Sales & Charter and Henwood & Dean, with their by now familiar tent in the form of a Mongolian yurt. While Lucie Henwood was kept busy with visitors, Colin Henwood was occupied in judging for the Simonds Trophy, open to electrically powered boats and awarded for smooth running and overall appearance.

Commenting that it was a very difficult job – "it always is" – especially in deciding between the first two boats, Colin made the award to *Viola*, owned by Victoria Fash, with *Lisbeth*, the restored 1953 saloon launch belonging to EBA member Bryn Evans, the runner up.

The EBA certainly showed the flag at Henley this year. Not only was the EBA stand in a prominent position, with pictures and information on display and John Hustwick and

*Viola* was built by Taylor Bates around 1898 of mahogany on oak with teak and oak decks and is powered by a Taylor Coventry Simplex 4-cylinder motor. The curved hull design, which keeps the bow low in the water to minimise wash, received a patent from the King in 1905. EBA business member Rupert Latham saved *Viola* from being scrapped and undertook a complete restoration, replacing timbers in the hull, renewing all fixtures and fittings including the canopy, and applying seven coats of varnish.

Very little is known about *Viola's* past, apart from the fact that she was originally code-named 'Clevedon', and her present owner would love to know whether anyone has details of the boat's history over the last hundred years.

**If you have any information about *Viola*, please send it to the Editor at the address in the front of the magazine and I will pass it on.**



*Viola*

# NOTICEBOARD



## WELCOME TO NEW MEMBERS

Private Members	Location	Boat where notified
Jamie Page	Devizes, Wilts	
Glyn Trollope	Berkhamstead, Herts	The Cambrian
Paul Morton	Norwich, Norfolk	skiff
Don Wright	Altrincham, Cheshire	
Alice Cullen	Sheffield	Cowslip and Firefly
Chris Morgan	St. Ives	Whisper
R Grant	Bisham	Electra
Peter Kimber	Huntingdon	Ruby
Mr. D.E. Gray	Rye	Faith

## Business Members

Chesterfield Canal Boat Co Lincoln

Aesir Power Ltd Great Chesterford, Essex

Kingline Cruisers Horning, Norfolk



## NEW E-MAIL ADDRESSES

The e-mail addresses for Ian and Sylvia Rutter have been changed. The addresses are now: [ian\\_rutter@onetel.com](mailto:ian_rutter@onetel.com) and [sylvia\\_rutter@onetel.com](mailto:sylvia_rutter@onetel.com).



## EXPLORER TROPHY

It's time to send for your entry forms for the 2004 TELCO Explorer Trophy. The EBA's latest trophy, presented by the Thames Electric Launch Company, will be awarded to the boaters who have visited the most waterways in the 2004 season, but there will be runner-up prizes for special efforts and every entry will receive a certificate.

Each river, canal and lake will count separately, even if they are connected, and you can also include hiring boats on distant or foreign waters. Send an SAE for the forms and rules to: The Thames Electric Launch Company, PO Box 3, Goring, Reading, RG8 0HQ or e-mail: [thameselectric@goring.co.uk](mailto:thameselectric@goring.co.uk)



## FREE ADVERTISEMENTS

An endorsement for the free advertising space on the back page of the magazine and the EBA website has come from the former owner of *Whisper*. As soon as the ad appeared, he said, he was overwhelmed with enquiries and could have sold the boat several times over. All private ads from EBA members for boats or chandlery items should be sent to [eboat@mail.com](mailto:eboat@mail.com). On the website your ad can include a j-peg picture.



## NEW INFORMATION SHEET

A new Information Sheet on Fitting Out and Laying Up your Boat is now available. If you would like a copy please contact EBA Secretary, Barbara Penniall. Information sheets (see advertisement on the back cover) are free to members and cost £1.50 each for non-members.

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# LETTERS

*From John Murch, Bournemouth*

*Dear Sylvia,*

*Thank you for the summer issue of E.B. News, enjoyed as always.*

*I was surprised by the tone of Roger Richardson's letter regarding the article about Carolann.*

*The technical detail required by Roger is of interest to me, but by no means essential and in the case of Carolann almost irrelevant, given the clearly expressed reasons for the conversion.*

*I believe that articles like that of David Graham are essential, as they show that electric installations are suitable and practical for a wide range of 'mainstream' craft, not just for specialised launches on inland water. If every article were full of technical detail, it would be very dull. Like David Graham, my boat is used on the sea and has a sail, although I am probably 60% power 40% sail. It is a source of wonder to me that I am the only electric installation (to my knowledge) in Poole Harbour. Articles like David's may influence a few more people to convert without feeling that you need to be a technical whiz kid.*

*I have been insuring my boat through Navigators & General (the EBA scheme) for the last few years. The premium has been increasing substantially each year. Other members may have had the same experience!*

*I have now insured through Cheers Insurance Brokers [www.cheersinsurance.com](http://www.cheersinsurance.com) at a very much lower premium. Hope that this may be of some value.*

*Regards*

**John A Murch**

# TECHNICAL REPORT

## ELECTRIC POINTS: 'POWER, THRUST, AND SPEED'

**In the fourth of a series of short articles on technical aspects of electric boating, EBA Technical Officer Paul Lynn discusses some basic aspects of boat performance.**

In the Spring 2003 issue of EB News (volume 16, number 1) I reviewed some basic units of electricity and discussed the relationship between volts, amps, watts and horsepower. This time I should like to consider how the electrical power delivered by batteries to a propulsion motor is actually used to drive a boat through the water. After all, this is what the whole business is about!

You may object that electric boaters should not be concerned with 'power, thrust and speed'. We are not trying to compete with internal combustion engines; we don't want to fix a 50 HP engine to a small boat and destroy both the peace and the river bank. Well, that is certainly true. But in electric boating, most of us *are* concerned to use relatively small amounts of power as *efficiently* as possible. If we waste it, we end up with poor performance or empty batteries, or both. So what exactly are the issues affecting the efficient use of relatively small amounts of power?

When we flick the 'start' switch, power is transferred from the batteries to an electric motor which turns the propeller (perhaps via gearing or a toothed belt). The propeller's job is to convert rotational power into useful thrust to drive the boat forward. But there are substantial power losses:

- The motor gets warm (we hope not hot!). Such heat always denotes power wasted. Motor efficiencies range from about 90% for a Lynch motor down to only about 50% for a small electric outboard. We might use 70% as a typical figure.
- A propeller wastes power by churning and rotating water, rather than propelling it backwards to produce thrust. Propeller efficiencies vary widely, and depend on many factors, but again we might use 70% for illustration.

Now if your electric boat gets 70% (0.7) efficiency from the motor and 70% (0.7) from the propeller, you end up with 49% efficiency overall ( $0.7 \times 0.7 = 0.49$ ). So only about half of your battery power is actually being converted into forward motion. This may all seem a bit gloomy, but there is little you can do about it except specify as efficient a motor/propeller combination as possible.

How does all this translate into the actual battery power required to drive electric boats through the water at reasonable speed?

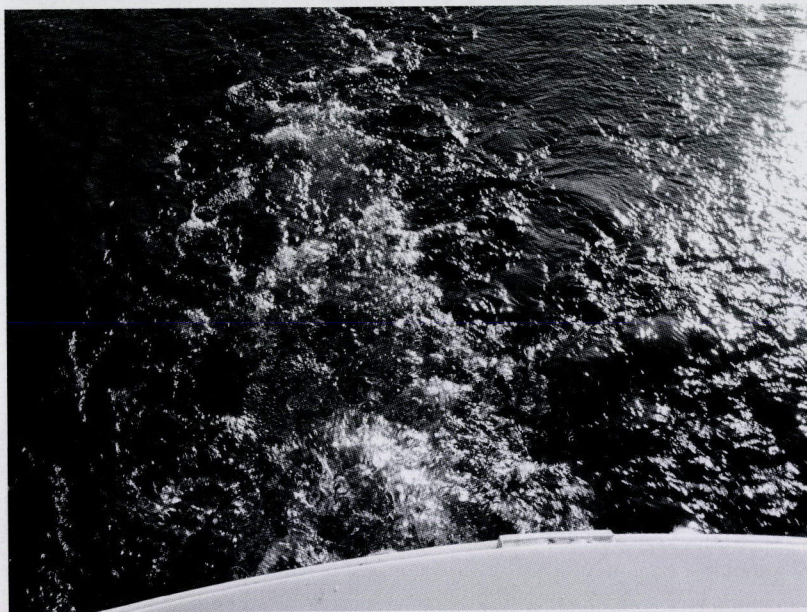
Recent articles in EB News give some interesting examples. At one end of the power scale, Tony and Gill Sauer's 62 ft narrowboat *Switched Off* takes about 3 kW from the batteries to move at 4 mph; Tony Fogarty's Broads cruiser *Moonglow* needs about 1.1 kW to move at the same speed (assuming 50% overall efficiency); whereas towards the lighter end of the scale, my own solar catamaran *Solar Flair* needs around 350W. Finally, John Poland has underlined the amazingly low power requirements of a modern racing single scull - just a few tens of watts at 4 mph or 3.5 knots.

Such figures probably cover the whole range of EBA members'

boats. I should add straight away that they would all increase disproportionately with speed. For many boats, raising speed from 4 to 5 mph (a 25% increase) would require an increase in battery power of more like 70%. Speedy is certainly greedy! Another important point is that power depends not only on a boat's size (or displacement), but also crucially on hull shape. A well-designed sleek hull is worth its weight in gold. I hope to return to these points in a later article.

For the moment let's take 1 kW as a typical battery power for driving a medium-

size electric boat at a reasonable speed. It is interesting to note what this means in terms of horsepower. As I pointed out in my Spring 2003 article, one horsepower (1 HP) is precisely equivalent to 746W. So 1 kW equals  $1000/746 = 1.34$  HP. What, then, are all those petrol and diesel-driven boats doing with their multi-horsepower engines? Even a very small petrol outboard may have '4 HP' stamped on its outer cover. But note that just because this (or any other figure) appears in big bold letters on an engine casing does not mean that it actually delivers this much power to the propeller, or that the propeller can convert it into useful thrust. For example if we were to fit a tiny toy propeller, the engine certainly wouldn't develop 4 HP no matter how fast we ran it. Fitting a larger propeller might produce a lot more power - but we still don't know how much of it would be converted into forward thrust. So the overall message is that the rating of an engine doesn't tell us much about the *useful* power it delivers. We may certainly be sceptical about the power ratings advertised by the manufacturers of internal combustion engines - and proud of the relatively small amounts of power actually required by well-designed electric boats.



# BIRDS, BATS AND BATTERIES

**Boat trips through a nature reserve are a great idea – but not if the noise of the engine frightens all the wildlife away! The solution at Wicken Fen was to convert the boat to electric power. Sylvia and Ian Rutter explain.**



*Electric boat at Wicken Fen*

Wicken Fen in Cambridgeshire is the National Trust's oldest nature reserve. Covering an area of over 538 hectares, it is the most important surviving area of the Great Fen of East Anglia.

For many years a traditional clinker-built reed cutters' lighter had been used for winter maintenance work along the lodes. Originally punted through the water, it was fitted with a petrol outboard for passenger trips around the site. But the noise of the engine not only frightened off the wildlife but made it difficult for the guides to talk to the passengers.

The Thames Electric Launch Company was therefore asked to replace the petrol outboard with an electric one. The unit chosen was the Combi 2000, installed with a 48 volt bank of individual 2 volt gel batteries for minimum maintenance. For simplicity and robustness the speed of the Combi is controlled by a lever-operated switch, giving two forward and two reverse speeds.

Initially the waterways were badly weeded up, causing navigation problems, but National Trust volunteers cleared the weed, which had the unusual side effect of making the boat go too fast, even on the slow speed setting. Thames Electric were called back to install an additional switch to enable the battery bank to be arranged as either a 48 volt or 24 volt supply. This now gives a total of four forward and four reverse speeds.

The boat lives in a pretty thatched boathouse with the charger installed inside. Charging is fully automatic, with the boat plugged in at the end of a trip. An added bonus is that there is no need to top up the batteries with water.

Over the summer the electric boat has done around 25 trips, taking up to twelve passengers at a time for day or evening excursions. Evening journeys can include a meal at a restaurant at the end of the lode.

Kevin James, Deputy Head Warden of Wicken Fen, says that the advantage of electric power is not just getting much closer to the wildlife but feeling a sense of the wilderness, hearing the bird song and the wind in the reeds. Bitterns are now over-wintering at Wicken and their booming call has been heard for the first time in forty years. At night the lode is lined with glow worms, giving the impression of being on an aircraft coming in to land. Long-eared and Daubenton bats follow the boat as darkness falls: they hunt over water and the boat stirs up the insects for them.

During the winter the Trust staff will be using the boat to get around the site with their maintenance equipment, saving the soft muddy banks from damage by off-road vehicles. Boat trips for visitors will start again in the spring.

**For information on the boat trips and other events at Wicken Fen, telephone 01353 720274, e-mail [wickenfen@nationaltrust.org.uk](mailto:wickenfen@nationaltrust.org.uk) or look at the website [www.wicken.org.uk](http://www.wicken.org.uk)**



*Kevin James and Ralph Sergeant in the electric boat*

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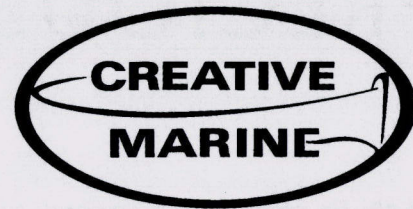
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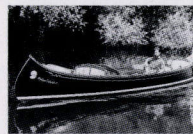
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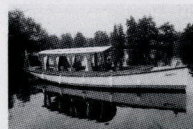
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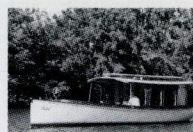
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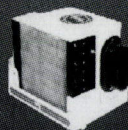
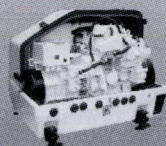
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# PRECIOUS METALS

**With increasing concern about the security of oil supplies throughout the world, it is timely to look at the strategic situation for battery and magnetic materials. Frank Wykes, MA (Metallurgy), a member of the Battery Vehicle Society, discusses what goes into a battery – and where it comes from.**

The metals lead and iron are the most commonly used materials in batteries and magnets respectively. They are also the most recycled materials in terms of tonnage, and whilst lead is only the 33rd most abundant element in the earth's crust, it occurs in Zambia, Australia and America in enough concentrated locations to be mined economically for some years to come. Iron, the fourth most abundant element in the earth's crust, is so widely distributed as to be of little or no strategic importance in terms of long-term availability.

It is when we come to nickel, cadmium, lithium, cobalt, neodymium and chromium that strategic locations of economically mineable ores of these metals become significant for the future.

Nickel ores are found only in a few places that are economic to mine, although at 21st in the league table of abundance it is seven times more common than lead. Nickel is extracted in Sudbury in Canada, Australia, South Africa, Zimbabwe, New Caledonia in the Pacific, and in north-west Russia at Petsamo in what was formerly Finland. In World War II the Petsamo nickel mines were fought over, firstly between Finland and Russia and secondly between Russia and Germany, such was its importance for making armour-plated steel, as well as nickel-based batteries. The price of nickel has fluctuated wildly over the years, particularly when the Canadian nickel miners went on strike. However, with the ending of the Cold War, the military demand for nickel dropped, and since then there has been evidence of strategic stock piling of nickel, particularly in Canada, to try to keep the price up. New Caledonian nickel is under French control, although there is a potentially unstable colonial situation developing there. However, New Caledonian nickel only represents about 5% of the world's output. It is a matter of political judgement as to how stable the supply of nickel coming from Zimbabwe and South Africa will prove to be in the future.

**Cadmium** is a metal that is both toxic and rare - almost as rare as silver - and is obtained as a by-product of zinc smelting (there is still plenty of zinc in various geographic regions). So, although the

French have a plant at La Rochelle for recycling both nickel and cadmium from scrap Nicad batteries, these batteries are gradually being phased out in favour of the more environmentally friendly nickel-metal-hydride cells.

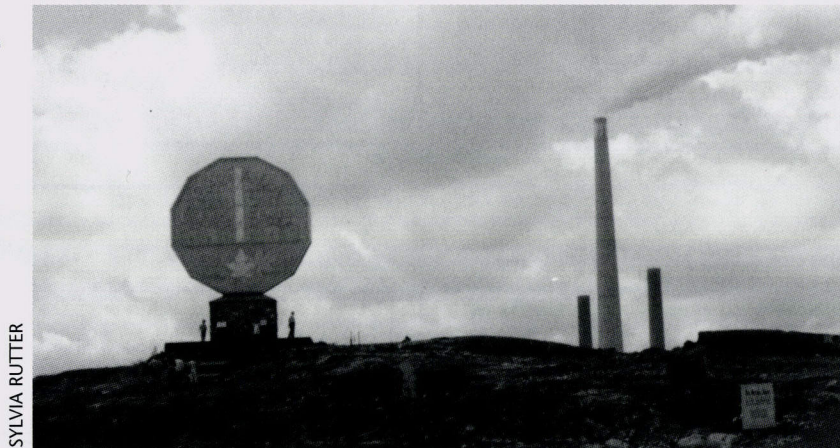
**Lithium** is more abundant than lead - and only slightly less so than nickel. However, although lithium is widely distributed in small quantities, it is only mined economically in a very few places. China is sitting on two-thirds of the world's lithium, with America having significant quantities from Lithia Park in the State of Oregon, certainly enough to build its H-bomb arsenal over the years.

Small amounts of lithium also come from Italy and New Zealand. Russia has some too, as it does of most metals. The Chinese version of the lithium-ion battery uses the lithium/fluorine/chromium system as its basis, though other possibilities exist.

Most of the metal ores that occur in Russia are also present in South Africa by an accident of geology. In particular 90% of the world's **platinum** comes

from the Rustenberg mines in South Africa, whilst almost all the rest comes from Russia. Small amounts of this precious metal have also been extracted as a by-product of nickel. This is significant because platinum is used for auto-exhaust catalysts and for platinum-cobalt high-power magnets for hearing aids and for military requirements. Platinum-cobalt magnets outperform neodymium-boron-iron magnets in all respects except in price, which makes platinum-cobalt prohibitively expensive for electric motors, unless they are micro-miniature in size. I did some of the original development of this material as a young metallurgy graduate at Johnson & Matthey in the early 1960s. About ten years ago Japan tried to buy up most of the world's platinum, saying that Japanese women preferred platinum-based jewellery, whereas in fact they needed it for catalysts in Japanese cars.

China has significant quantities of chromite, the ore of **chromium**. Outside China, South Africa is the main producer of chromium, and it was this fact that reduced our ability to apply sanctions effectively to the apartheid government there in the early



Nickel mine at Sudbury, Canada



1980s, as they threatened to cut off the chrome in response. Had they done this, we would have had to rely on Argentina for alternative supplies, just at the time that we were having a little argument with them over the Falklands! The main use of chromium is for making stainless steel, and it was Sweden which developed this material more cheaply than other European countries, relying on its own supplies, but these are nearly exhausted now.

**Manganese** is another metal that is widely available; indeed it occurs in almost pure nodules on many ocean floors just waiting to be mined when it is economic to do so. It is more familiar in its oxidised form of manganese dioxide in the long running zinc-carbon dry cells, where it surrounds the carbon anode, acting as an oxidising agent to slow down polarisation. More recently it has been used to make the lithium/manganese dioxide rechargeable battery. It can also act as a cathode in metallic form in both primary and secondary (rechargeable) alkaline batteries. Manganese is more electro-positive than chromium, nickel or iron, though less so than aluminium and magnesium. It is on a par with zinc in its chemical activity and low cost.

Future availability of some of the metals mentioned above also needs to be considered. **Neodymium** is another metal with which China is disproportionately endowed; certainly it can make it cheaper than anyone else, although India may become an increasing source of this metal in the future. **Cobalt** is less abundant than neodymium, and is usually extracted as a by-product to copper in Zambia, the Republic of the Congo, Chile and the State of Utah in America. Like nickel, it is ferro-magnetic as a pure metal but is always alloyed with other metals, principally iron, for making permanent magnets. In recent years, samarium-cobalt magnets have been developed as a cheaper alternative to platinum-cobalt, and have been tried out successfully in fractional horsepower motors. However, it is more expensive than neodymium-boron-iron. **Samarium**, a rare earth metal like neodymium, mainly comes from India. **Boron** is fairly widely distributed in small quantities as the familiar salt borax, which again is mined in the state of Utah, USA.

Finally, what about the materials that actually conduct electricity efficiently? The best metal is **silver**, but it is too expensive and too heavy for use in electric vehicles. **Copper** is still the best material in terms of conductivity for the minimum volume of space occupied. However, pure **aluminium** is an alternative where weight reduction is at a premium. But it is bulkier and suffers from fatigue in bending and more difficult joints. However, copper is very price-sensitive, and if the price goes above a certain level it becomes self-defeating as industries which use copper in a big way turn towards the alternative of aluminium, although this may still have to be copper plated to facilitate ease of joining by soldering etc. I had personal experience of this nearly 40 years ago when I was in Zambia for a year, learning about the extraction and separation of copper and cobalt and their electrolytic refinement. The price of copper used to go up and down like a yo-yo, depending on whether the Chilean copper miners were on strike or not, although ironically our

monthly bonuses were directly tied to the price of copper at any one time! In recent years the price of copper has stabilised at a level significantly lower than the price above which buyers turn to the aluminium alternative.

What are the lessons we should learn from all this? In the long term, batteries should be developed which rely on strategically neutral materials, that is materials which are widely available throughout the world, and whose price is reasonably stable over time. In this respect it was a pity that the sodium-sulphur hot battery had to be discarded on safety grounds a few years ago. Both sodium and sulphur are widely available from common salt and from volcanic regions respectively. In terms of abundance in the earth's crust, sodium is 7th, and sulphur is 15th. The beta alumina solid electrolyte was derived from the third most abundant element, aluminium. Alternatives are magnesium-based batteries, which operate at ambient temperatures and look promising. Magnesium has been used for a long time in primary cells, often in association with silver and seawater for short-term powering of torpedoes, and for various marine safety devices including emergency lighting and radio signals. Magnesium has a higher electro-potential than aluminium and requires less energy to make (volume and weight). It is even more abundant than sodium, though heavier, but only two-thirds the density of aluminium. Whereas 20 years ago the price of magnesium was about twice the price of aluminium, mainly due to the much smaller tonnages being produced, in recent years it has been brought down to the same level as that for aluminium on an equal-weight basis, due to the increased use of magnesium in the aerospace and motor industries. The difficulty up to now has been to make a viable secondary or re-chargeable cell based on magnesium. However, the October 2003 issue of *Batteries International* reports that work on a rechargeable battery involving magnesium is well advanced in Israel. It is thought that it is a magnesium-air based system - the analogue of the zinc-air battery also being developed in Israel. Certainly, from the Israeli point of view, magnesium makes better sense than zinc which has to be imported, since there are ample deposits of magnesium chloride around the Dead Sea and the Sea of Galilee. From the British perspective, we have a choice of magnesium chloride from the Cheshire salt deposits or from dolomite, that is magnesium limestone carbonate, in Yorkshire and elsewhere in the UK. By contrast, bauxite - the ore for making aluminium - has to be imported from Australia and Jamaica, although some comes from Ireland and is processed in Scotland and on Anglesey.

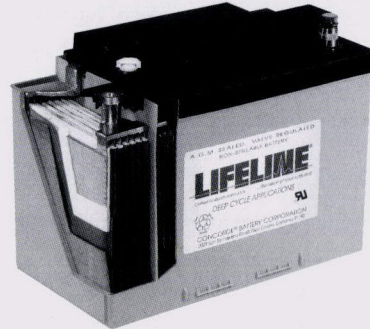
In conclusion, it is worth pointing out that the low-cost lead-acid battery industry is highly dependent on the recyclability of lead. Since without it there would not be enough to go round and the price would have to rise sharply.

**This article first appeared in Battery Vehicle Review. All references to abundance of elements are from Kaye & Laby, 16th Edition 1995, pages 216 - 8.**

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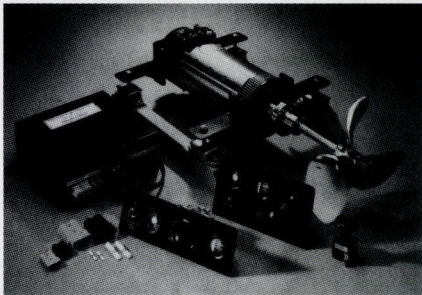


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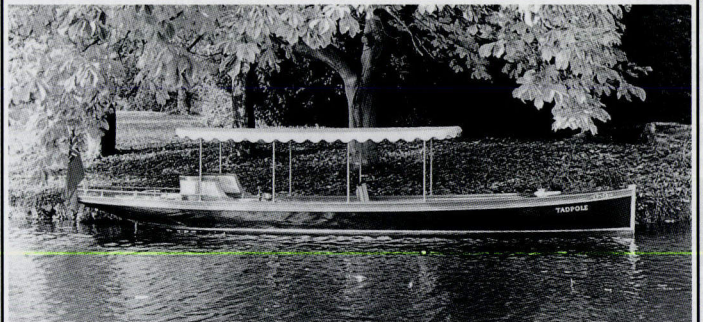
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