SUFFOLK MILLS GROUP

Newsletter Number 16

JULY / AUGUST 1980

SECRETARY: Peter Dolman,
95, Bixley Road,
Ipswich

EDITOR: Mark Barnard,
41, Melbourne Road,
Ipswich

As I write the fortnight's 'work-in' at Thelnetham mill is drawing to a close, and has been a great success thanks to the involvement of quite a large number of Suffolk Mills Group Members as well as several other friends. There will be a fully illustrated report of the work in the next Newsletter, but I would like to take this early opportunity to thank all those who came along to help.

In the past couple of years we have undertaken a certain amount of urgent weather-proofing work to the smock mill at Drinkstone, mainly towards the end of the summer and into the autumn. This year we hope to carry out similar work to Syleham post mill, which we believe is now the most serious case of neglect in the county. Details of this work appear inside under 'Events'.

Since S.M.G. was formed in 1977 we have held visits to most of the best mills in the county and we now seem to be running a bit short of ideas for new mills to see or other events to organise which would be popular with Members. If anyone has any novel ideas in this direction I would be pleased to hear from them.

Mark Barnard

MODERN WINDMILL DESIGN

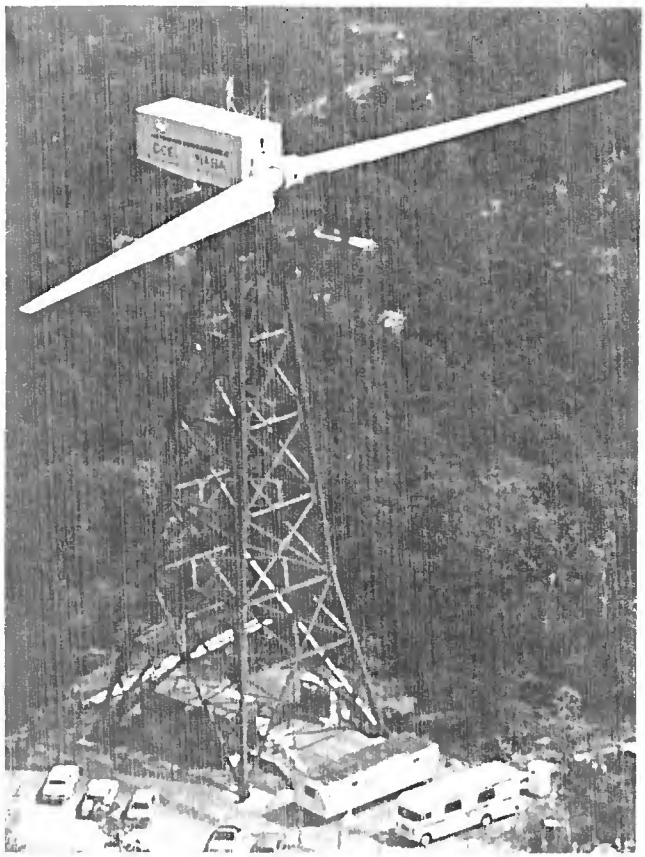
C.B. LOVETT and D.L. PEARCE

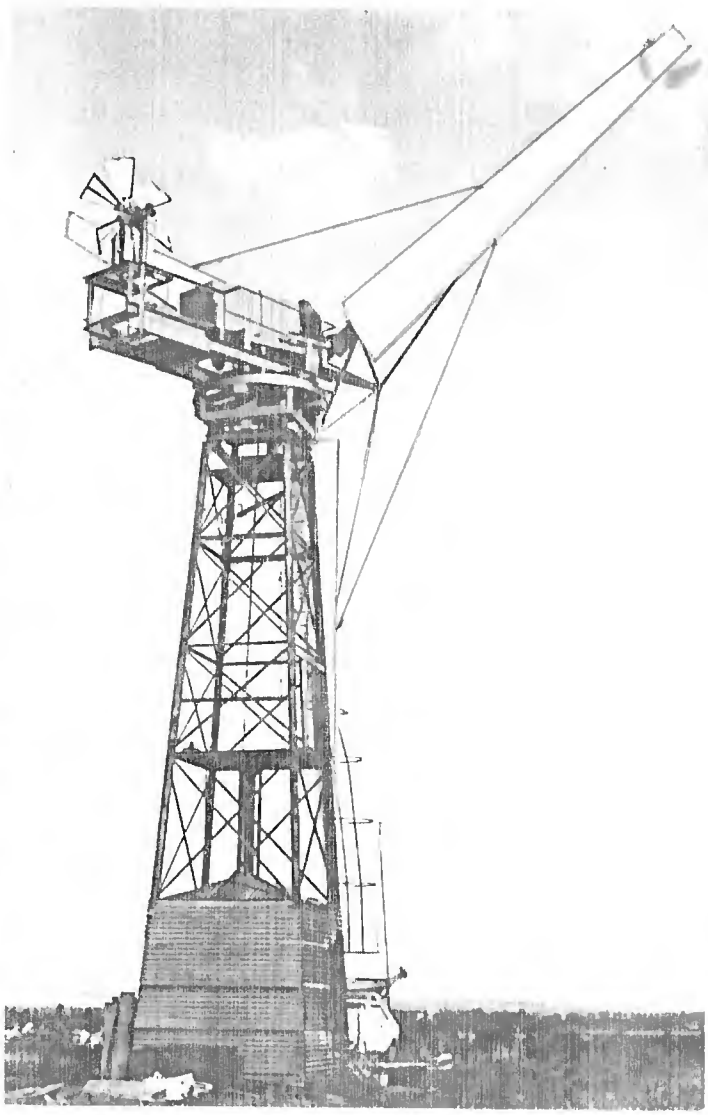
Introduction

Considerable efforts are being made in many parts of the world to harness windpower to provide basic energy requirements, particularly in the form of electricity. It is realised that fossil fuel reserves are gradually being exhausted and rapidly becoming expensive; there is a growing belief that the 'renewable' energy sources can be tapped effectively.

A great deal of research has been done on windmill design in the last ten years, and a number of large machines have been built. Currently the world's largest is that at Boone, North Carolina, U.S.A. (Fig.1). This machine has a 61 metre (200 ft.) diameter 2-bladed rotor and its rated power is 2 megawatts (a little over 2500 horse power); the rotor will be turning at 35 revolutions per minute. It has been undergoing commissioning trials since July 1979. Britain is not yet in this league, for up to now the future of large scale electricity supply has been seen to be mainly in coal and nuclear plant. However, significant machines have been built: the largest is that near Boroughbridge, Yorkshire, built by the engineering firm Sir Henry Lawson-Tancred and Sons (Fig.2). This interesting machine is similar in size to a traditional mill, with a three-bladed rotor 17 metres (56 ft.) in diameter, rated at 100 kilowatts (about 135 horse power). It is undergoing tests at present.

A novel vertical shaft turbine with troposkien-shaped aerofoils (Fig.3) was patented





Above Fig.1 Mod-1 wind turbine at Boone, North Carolina, U.S.A.

Right Fig.2 Wind turbine at Aldborough, Boroughbridge (Sir Henry Lawson-Tancred & Sons)

by the French aerodynamicist Georges Darrieus in 1927. (A troposkien curve describes, for example, the shape of a spinning skipping rope. Its use can reduce undesirable bending forces in the blade.) This idea remained undeveloped for 40 years until two National Research Council of Canada engineers, Raj Ranji and Peter Smith, independently developed the same idea. About 1975 Dr. Peter Musgrove of Reading University patented a variable geometry straight bladed version (Fig.3). Variations of this machine are currently being manufactured under licence by P.I. Specialist Engineers Ltd. at Alresford, Hampshire. There is still controversy amongst aerodynamicists as to the performance and reliability of the Darrieus rotor in comparison to the more traditional horizontal shaft rotors.

In addition to these large 'industrial' mills there is a growing interest in small machines for the individual enthusiast. Wind engineering is a rapidly developing area; these articles are intended to demonstrate, in as non-technical way as possible, the principles on which the basic types of modern mill are designed. We hope the advantages and disadvantages of the various types will become clearer, and that we will be able to answer questions of the sort:

- 'Why did traditional mills usually have four sails but modern mills generally have two or three?'
- 'How efficient are windmills?'

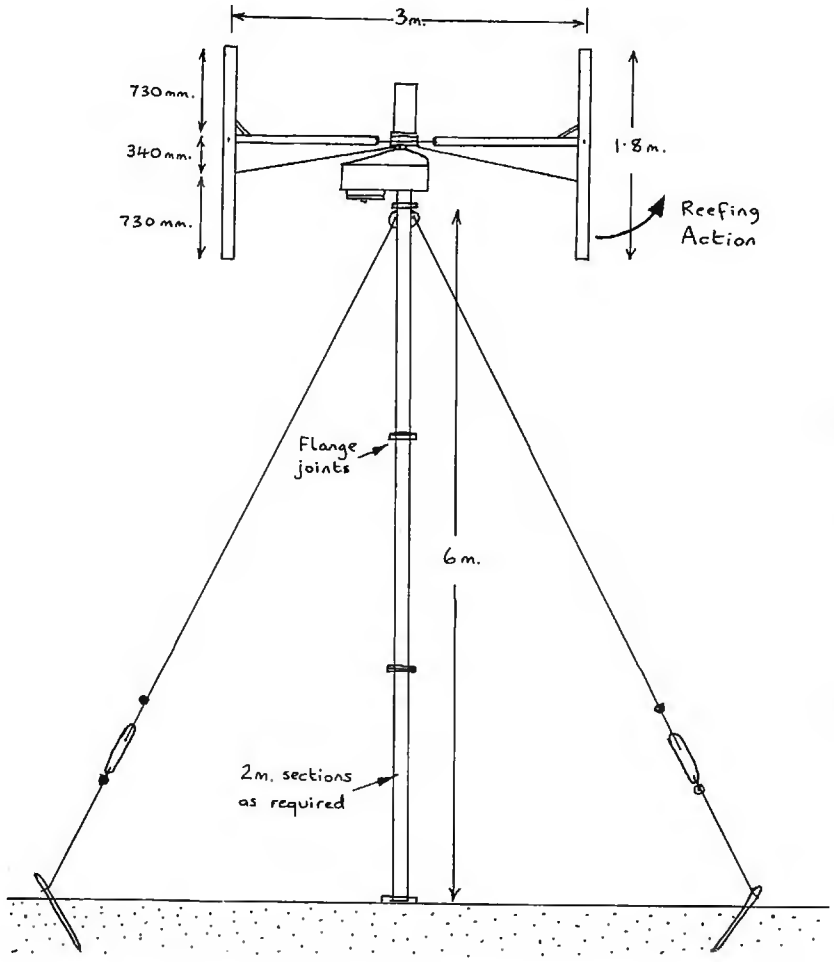
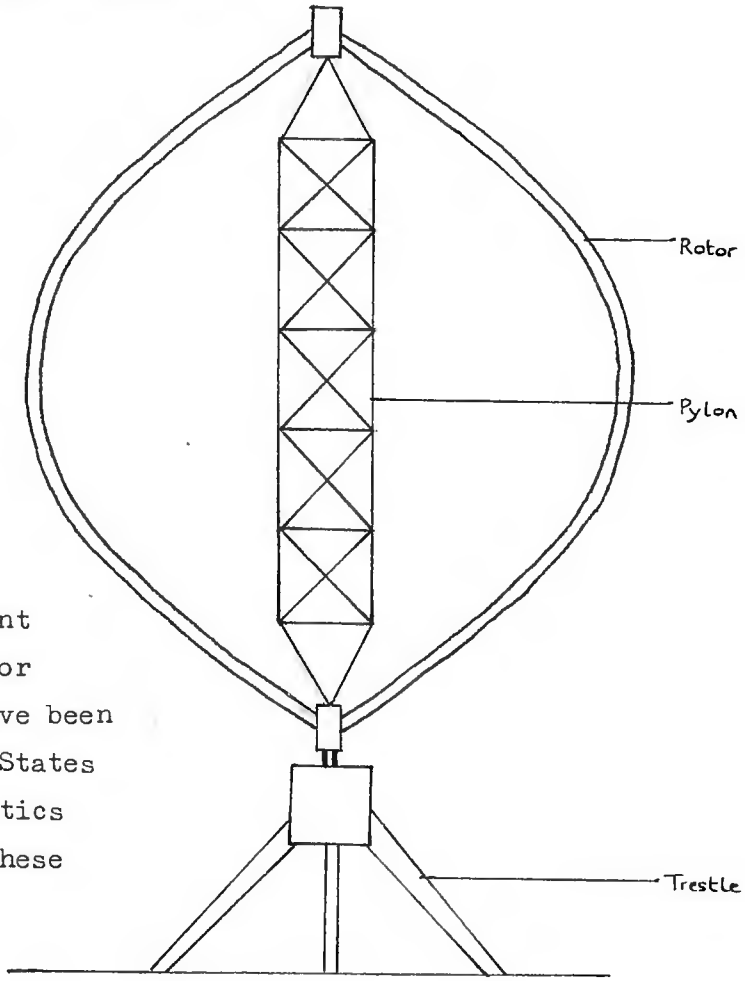


Fig.3 The Darrieus Vertical Shaft Turbine

Left: Elevation of proposed straight bladed variable geometry turbine
3 metre diameter rotor
2 x 1.8 m. long blades
Blade section as Fig.4

Below: Typical turbine with troposkien shaped blades.
Section as Fig.4

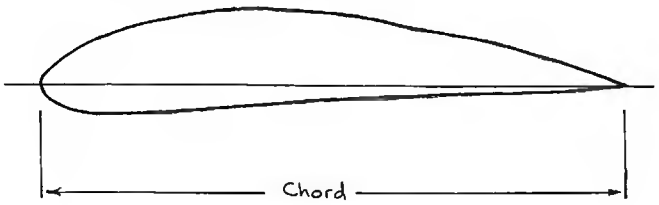
- 'How on earth do Darrieus turbines work?'
- 'Can vertical shaft rotors approach the efficiency of horizontal shaft ones?'



The Aerofoil Blade

The single most important advance in windmill design brought about by modern aeronautical engineering is the introduction of the aerofoil blade (Fig.4). The traditional sail or sweep, which was in essence a flat board, is replaced by a smoothly curved surface, with rounded nose and gently tapering tail. This allows the air to flow much more smoothly and effectively over the sail. Many different aerofoil sections have been developed for aeroplane wings and their properties have been published by bodies such as the United States National Advisory Committee for Aeronautics (NACA); it is equally possible to use these sections in windmill design.

Fig.5 shows the air flow over a



NACA 4418 Cambered, suitable for horizontal shaft machines

NACA 0015 Symmetrical, suitable for Darrieus machines

Fig.4 Typical Aerofoil Blades

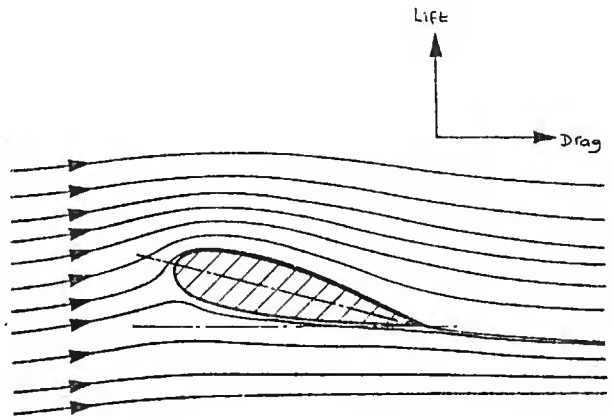


Fig.5 Aerofoil lift

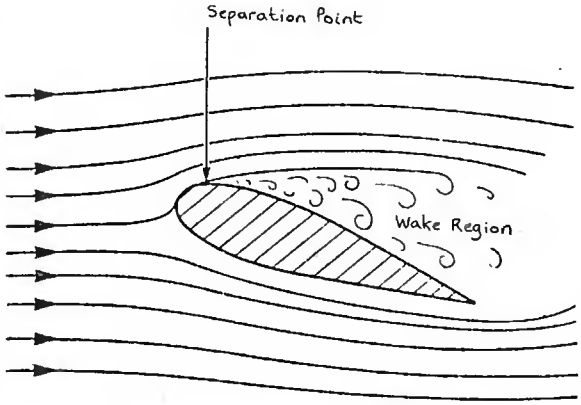


Fig.6 Aerofoil stalled

stationary aerofoil section. The flow lines are what engineers know as streamlines; in a flow over a suitably streamlined body the air runs steadily over the body without separating from it. Since the aerofoil is inclined to the wind the air flow is not symmetrical around it. The streamlines are compressed closer together over the upper surface of the blade; the air flows more quickly here. Similarly, the streamlines move apart on the underside of the blade, and the air flows relatively slowly. As a 'rule of thumb' in fluid flows, if there is an increase in speed along a streamline there is a decrease in pressure, and vice versa. Therefore the pressure on the upper surface of the blade is relatively low, and that on the lower surface is relatively high. There is a resulting upward force on the blade, known as the lift force. At the same time there is a force, due to friction, acting in the same direction as the free wind; this is known as the drag force. A well-designed aerofoil blade can produce lift up to about 50 times the drag force.

If the aerofoil is inclined too steeply to the wind, the streamlines separate from the upper surface (Fig.6). There is a very disturbed region above the blade. The blade is stalled. The suction effect over the top of the blade more or less disappears, leading to a severe reduction in lift; at the same time the drag forces increase substantially.

Aerofoiled windmill blades are generally several times more efficient than traditional sails; for practical purposes traditional mills did not utilise the suction effect on the back of the blade. Notable attempts, such as Dekkerisation in the Netherlands, have been made to improve the performance of traditional mills

by making the sails approximate to aerofoils.

Different types of modern windmill designs

This article will restrict itself to brief descriptions of some of the different windmill types that have been tried this century. The two aerofoil-based machines will be considered in detail in a following article; they are most suited to high power applications.

(i) Horizontal shaft, aerofoil type (Fig.1)

This is the successor to the traditional mill. It derives its power from the lift forces described earlier, and can be very efficient; up to about 35 per cent of the available mechanical energy in the wind is converted to shaft work in the best machines. (The absolute maximum theoretical efficiency of a windmill is 59 per cent.)

Viewing a blade from above, when it is vertical, the forces in it are as shown below (Fig.7). An important feature of windmill design is suggested here. The apparent wind seen by the moving blade is different to that seen by a stationary observer - it is the relative motion of the wind and the blade that count in driving the mill. At the top the blade speed is often several times the true wind speed (commonly about six times in modern machines). The apparent wind approaches the blade at a shallow angle, 8 degrees say. A lift force is generated at right angles to the apparent wind; this is generally much greater than the drag force, resulting in a nett leverage which turns the sails.

(ii) Vertical shaft mill, aerofoil (Darrieus) type (Fig.8)

The Darrieus turbine is structurally simple, but is a little difficult to understand. It will be explained in more detail in the following article. However, careful consideration of the relative motion of the blades and the wind shows that if the blade speed is high enough then the leverage generated by lift forces will turn the shaft in the same direction wherever the blades may be. (N.B. When the blades are

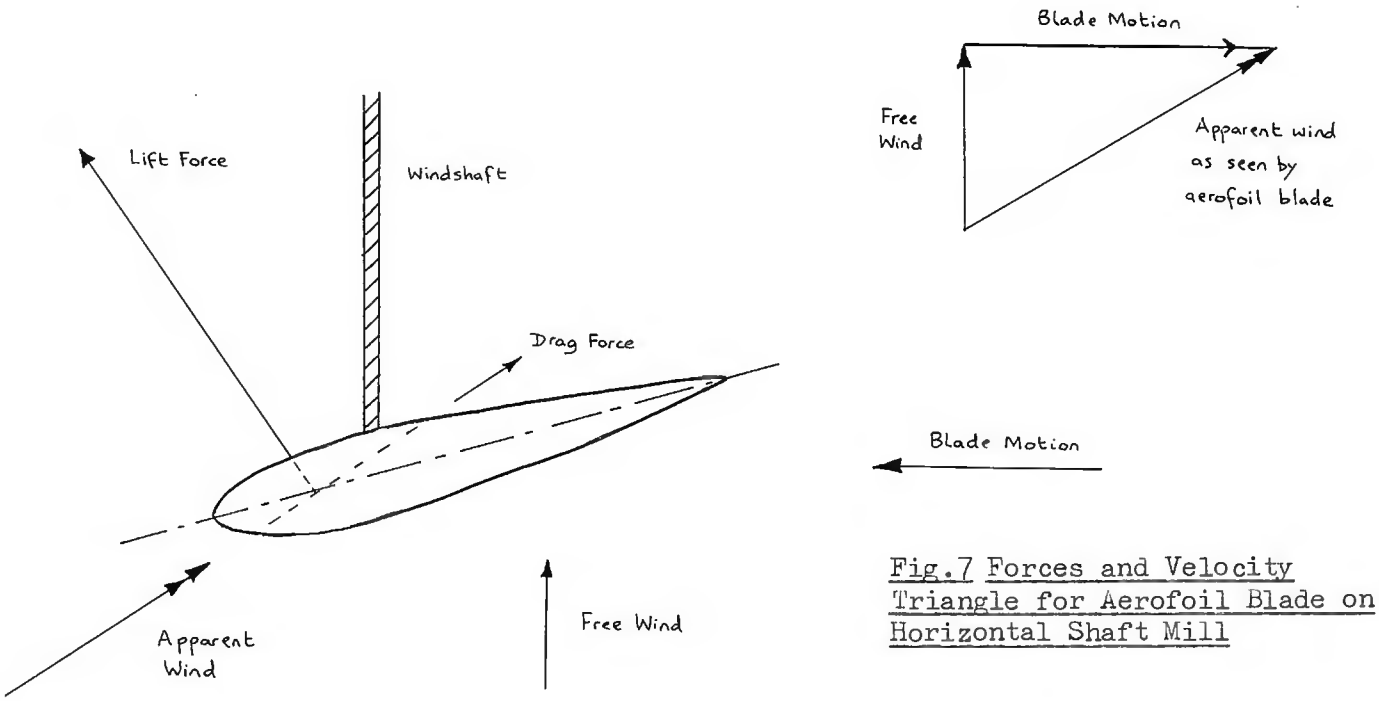


Fig.7 Forces and Velocity Triangle for Aerofoil Blade on Horizontal Shaft Mill

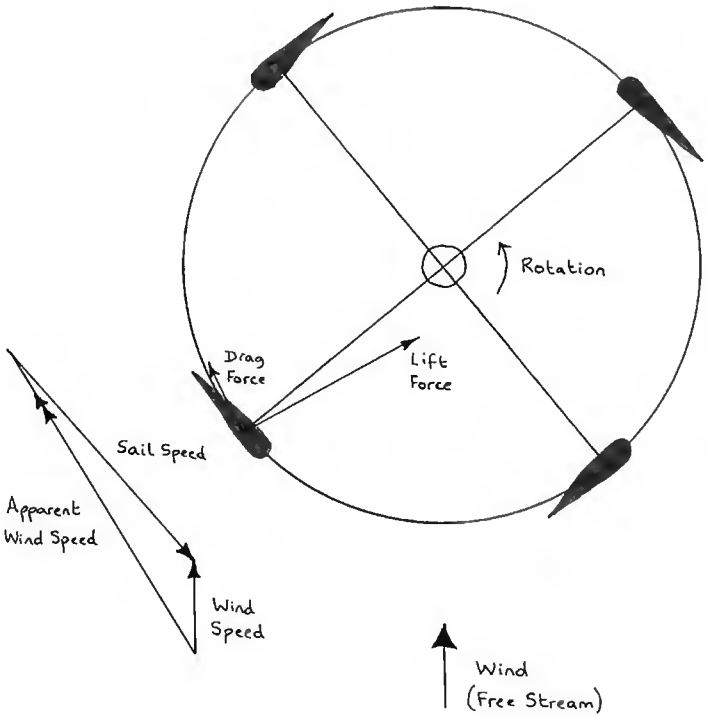


Fig.8 Plan view of 4-bladed Darrieus turbine

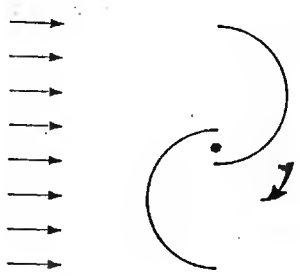


Fig.9 The Savonius wing-rotor

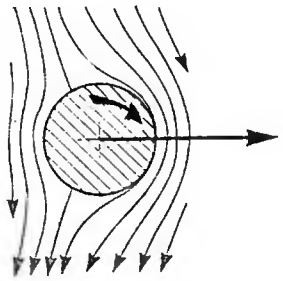


Fig.10 The Magnus effect

leading or trailing edge-on to the wind there is no lift force on them.) The rotor has the advantage that, once spinning rapidly, it will generate power whatever the wind direction. However, in common with other designs of modern windmill, the Darrieus rotor is often not self-starting.

(iii) Vertical shaft mill, drag type (Fig.9)

The Savonius Rotor relies on the drag force on a convex surface being less than on a concave one. It again has the advantage that it will work no matter what the wind direction. However, unlike the Darrieus turbine, the blade coming into the wind opposes the mill's rotation, so overall efficiency is relatively low. Therefore the Savonius Rotor is not suited to applications where maximum power is required, but is useful for tasks such as wind speed measurement, where the time taken by a horizontal shaft rotor to face the wind would be an embarrassment.

(iv) Flettner's rotor mill

This type is included as a curiosity, and is closely related to the well-known rotor ships built (or converted) for Herr Flettner in the 1920's. The operating principle is the Magnus Effect, demonstrated in the diagram (Fig.10). A spinning cylinder in a cross-wind experiences a lift force at right angles to the wind direction, because the rotation of the cylinder augments the wind speed on one side of the cylinder and reduces it on the other. This results in a pressure difference as described in the section on aerofoils, and hence a side thrust on the cylinder. The Magnus Effect also explains, for example, how a spinning golf ball veers off course. A number of test windmills were built in the 1920's, culminating in one of 60 ft. diameter, equipped with $11\frac{1}{2}$ ft. long spinning cylinders, which were spun by motor. We do not know the overall efficiency of the machine; there was one clear advantage

though. The mill could be stopped in a storm without a mechanical brake; cutting the power to the rotating cylinders would bring the mill rapidly to a halt.

Acknowledgment

Figs. 5,6,9,10 are copied from 'Windpower Principles' by N.G. Calvert (Charles Griffin & Co. Ltd., London and High Wycombe). Readers wishing to gain insight into windmill design principles will find this book very helpful.

EDITOR'S NOTE The authors hope to contribute another article in the near future, giving fuller consideration to the Darrieus turbine and the horizontal shaft 'propellor' turbine.

A.G.M. REPORT

For this year's A.G.M. we decided to return to the village of Bardwell, scene of the Suffolk Mills Group 'work-in' last summer. Thanks to the kindness of Mr. and Mrs. Johnson, we were able to hold the meeting in the primary school just opposite the tower mill. The beautiful June weather no doubt played its part in attracting the thirty five Members and friends present - the largest attendance at any of our A.G.M.'s to date.

The meeting commenced at 11.20 a.m. with a welcoming speech from Chairman Chris Hullcoop. Apologies were received from John Snowdon, Mike Organ and Don Porter. The minutes of the last A.G.M. (as contained in Newsletter 10) were put forward as an accurate record: this was proposed by Mark Barnard, seconded by Brian Flint, and agreed. The treasurer, Brian Flint, then presented the accounts, which showed a turn-over for the year ending 31st. March 1980 of over £1000. Despite giving a grant of £200 to the Thelnetham mill restoration project, the balance had still increased by over £200. (Copies of the 1979/80 accounts are available on request from the Secretary.) Chris Hullcoop asked if anyone knew an accountant we could ask to audit our accounts in future years, as we had had some difficulty with this. Ian Taylor said he knew someone who might be able to help.

Mark Barnard gave a brief resumé of his work over the last year as editor, and said he hoped to maintain the standard of the Newsletters, although unfortunately it looked as if printing costs would increase considerably in the near future, perhaps forcing a reduction in size or frequency of issue.

Secretary Peter Dolman reported that membership of the Group stood at 115 and was still slowly growing. He then explained the need for a modest increase in subscriptions, especially as the basic rate had not changed since the Group was started in 1977. It was suggested that this should be increased to £3.00, and this was formally proposed by Cliff Lovett. Reg Clover pointed out that we may lose Members, as some people tended to belong to several such groups. Roger Lee asked whether a Deed of Covenant arrangement had been considered: the Chairman replied that in principle this was a good idea but with a small society such as S.M.G. the administrative difficulties would be too great. Brian Flint said he would oppose any increase, given the healthy state of the Group's finances. An increasing proportion of the Group's funds is being used to finance practical work on various mills, and Chris Hullcoop explained that,

whereas the Bardwell repairs were only meant as a holding operation, the Thelnetham project demanded permanent work of a much higher standard, which would be more expensive. Ian Taylor said he was willing to second the proposal, and would be happy with the £3 rate, provided we reminded Members that it was the first increase in three years. Mark Barnard suggested a minimum subscription of £2.50, leaving Members to pay more if they wished (which a few already did). Colin Budgie reckoned a covenanted subscription might lose the Group money, as Members would have to commit themselves for seven years to one rate. In view of the interest shown, a vote was taken on the proposal to increase subscriptions for individual membership to £3, and this was carried by about 11 votes to 2.

Election of the Committee followed: as all expressed their willingness to soldier on for another 'term', Reg Clover proposed that the existing Committee be re-elected; this was seconded by Colin Budgie and agreed.

The meeting closed with a review of S.M.G.'s work during the year since the last A.G.M., illustrated with slides. Chairman Chris Hullcoop gave a full and at times very humerous account of the public meeting and the window publicity display in Ipswich, comments on planning proposals and other advice, and of course the various visits and practical projects, including Thelnetham. He ended by drawing attention to the three authors on the Committee - Peter Dolman ('Windmills in Suffolk: a Contemporary Survey'), Brian Flint ('Suffolk Windmills') and Mark Barnard ('The Preservation of Windmills and Watermills in Suffolk' - an unpublished planning thesis) - and held up a copy of each of their works. The meeting ended at 1.10 p.m..

At lunch Mrs. Johnson and Mrs. Gould surprised us with a tasty array of sandwiches and cake as well as providing tea and coffee. Several people took the opportunity to look round the tower mill across the road, and venture up into the cap roof we built ten months earlier. Later we went on to Stanton post mill before finishing the day at Thelnetham mill.

Special thanks are due to Mr. and Mrs. Johnson (the school caretakers) and Mrs. Gould, not only for giving up their Sunday morning to open the school, but for the splendid food and generally making us 'feel at home'. Thanks also to Chris Hullcoop for organising the day, which everyone present found most enjoyable.

THE HUNT FOR HAMPSHIRE'S WINDMILLS

PETER JENNINGS

When the account of my search for Hampshire's windmills appeared in the S.M.G. Newsletter two years ago (Newsletter 6) I thought it was about to be outdated by Southampton University's publication 'Water and Wind Mills in Hampshire and the Isle of Wight' which appeared the same year. In fact, the University's Industrial Archaeology Group lists only eight Hampshire and two Isle of Wight windmills. It omits some shown in the S.P.A.B.'s Windmill Index and in a list compiled by Peter Dolman.

I have now been able to make a longer list of 12 Hampshire and four Isle of Wight windmills, helped by information from a number of mill enthusiasts, particularly members of the East Kent Mills Group.

I have not yet been able to revisit the county to re-check any of the sites and there are still doubts about some of them. Corrections and additions to the list will be very welcome.

Hampshire

BURSLEDON (T) 482108 Restored

CHALTON (T) 716162 House conversion

DENMEAD (?T) Gales or Barn Green Mill 672142 Small remains; burnt 1900; demol'd 1922

ECCHINSWELL (P) Pound Down Mill 485592 Site only

GRATELEY (T) 264413 (? or 269418) Site only, demolished 1977

HAYLING ISLAND (T) 719028 Site only, burnt 1886

HYTHE (? type) Langdown Mill 420064 Site only

LANGSTONE (T) 721051 House conversion

PORTCHESTER (T) Burrant Mill 619044 Truncated; store

PORTCHESTER (T or S) Wicor Mill ?612047 Site only, demolished c.1920

PORTSMOUTH (T) Dock Mill 650989 Site only, demolished 1925

WESTON (S) 728218 Remains

Isle of Wight

BEMBRIDGE (T) Knowle Mill 640875 Preserved

RYDE (T) 587924 Site only

RYDE (T) Addermoor Mill 582906 Site only, demolished 1916

WEST COWES (T) 495953 Site only

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NEW BOOKS

Reviewed by PETER DOLMAN

'WINDMILLS IN SUSSEX' by Arthur C. Smith. Stevenage Museum Publications; 1980. 48 pages. Price £1.65.

'WINDMILLS IN STAFFORDSHIRE' by Wilfred A. Seaby & Arthur C. Smith. Stafford County Museum Service publications; 1980. 28 pages. Price £1.20.

These are two further volumes in the 'Contemporary Survey' series, produced to the high standard which was set by Arthur Smith's earlier titles, and are recommended to Members.

The Sussex volume describes and illustrates 71 windmill sites where at least something remains. The fieldwork was carried out between 1970 and 1979, although this has been up-dated where necessary. The survey shows how many more preserved mills Sussex has compared to the total number of remains than Suffolk. Unfortunately many of the preserved mills are house conversions (like Battle or Mark Cross) or 'shell' restorations of little interest to the enthusiast. This is proving disastrous to the post mills, most of which are in need of major attention. The county also has its share of obscure remains, such as the iron windshaft with compass-arm slots cast in which is preserved at Sullington. There are also bright spots, such as Earnley (under repair by the owners), 'Jill' at Clayton (now under repair), Nutley, Polegate, Punnett's Town, Shipley, Singleton, Stone Cross and West Blatchington (all well preserved). 'Sussex' is available from Stevenage Museum, St. George's Way, Stevenage, Herts., price £1.65 plus 30p. postage.

Staffordshire is almost unknown as a windmill county, which is not surprising as there is not a single sail to be seen at any of the 24 remaining mills described by the authors. Indeed, even machinery is only to be seen in decrepid form at two mills. The most interesting mill is the sole surviving post mill remain at Essington, where part of the lower framing of the body survives, enabling the visitor to see the iron wheels which ran on a curb on top of the roundhouse wall - a feature of the Midlands type post mills. All the other remains are of course tower mills, many house-converted. The serious mill hunter will be pleased and perhaps surprised at what has survived - indeed, the total number shows Staffordshire to have been fairly populous in windmills, with types ranging from East Midlands towers to West Country 'rustic' towers. Wilfred Seaby has searched out some historical data to fill out the bones of the bare skeleton survey, and both authors are to be congratulated for this excellent introduction to the mills of a county well outside the main windmill areas. I hope they can 'do' Shropshire next (and perhaps Cheshire?), where I understand there are even more interesting survivals.

'Staffordshire' is available from the Museum of Staffordshire Life, Shugborough, Stafford ST17 0XB, price £1.20 plus 25p. postage.

CORRESPONDENCE

The following letter has been received from Don Paterson:

THOUGHTS ON THE REMOVAL OF MACHINERY FROM MILLS

The first thought that comes to mind is 'not over my dead body' - but then many mills are already dead bodies and no longer earning their keep except in the aesthetic sense as a picturesque ruin. Mills are ephemeral, especially when they are no longer used; it is therefore imperative that they should be recorded and measured for posterity and the future use of industrial archaeologists and historians. In recent years dead mills have been stripped to equip the spare part surgeries of millwrights, whether professional or amateur, but now with so few millwrights left discussion is centred on the philosophy of removal. Do you or don't you, and if you do, when? When do you consider a mill past rescue? Should rescue involve rebuilding? What is the value of a rebuilt windmill? When you restore should you put in features that were not in the original mill? Are you restoring a unique mill or a mill to show the general process of milling? If so are we going to end up with a number of hermaphrodite mills not truly representative of local milling traditions but only representing the basic mill? These and many other questions need to be asked, mulled over, and answered depending on the aims of restoration, and the circumstances of threatened or imminent danger of destruction or conversion. One thing is clear, the only way to make certain of the continued existence of mills and the milling tradition is to record by photographs or measured drawings all machinery *in situ* before it is removed. Once removed without this precaution, a jumble of cogs, gearwheels and shafts in the grass can never be re-assembled even by the expert because the layout problems in each mill were unique to that mill and solved accordingly.

NEWS

MORE MILLS FOR SALE

Yet more Suffolk mills have been on the market recently. The best is probably Ufford watermill, which although partially house converted, retains some of its machinery and character. With a new wheel, stone nuts and millstones this mill could work again as the water supply is excellent. Together with the mill house and over three acres of land with a long frontage onto the River Deben, Ufford mill was sold for £95,000 at a recent auction. Another watermill available is Coddenham Road Mill, Needham Market, or 'Bosmere Mill' as it is sometimes (incorrectly) called. This has long been gutted apart from the large iron waterwheel, and was renovated and converted into flats in the late 1960's. Last year planning permission was given for alterations and extensions to turn the ground floor of the mill into a restaurant, but this has yet to be implemented. The asking price is £70,000, including the house adjacent. The agents are Oxborrows, 3, Princes Street, Ipswich.

Also for sale is the small tower mill beside the A144 at Ilketshall St. Lawrence, which has been a shell for many years. This was to be sold by auction, together with the mill cottage.

SEARCH FOR A WATERMILL

S.M.G. has recently been contacted by a Hertfordshire-based firm of bakers who are interested in aquiring a watermill to work commercially, producing stone-ground flour by water power. As Members will appreciate, while this could provide an ideal opportunity to bring a Suffolk mill back into production, the number of mills available for purchase at any one time is extremely limited, and those that are on the market often have serious drawbacks such as lack of water or the need for extensive refitting. While we hope that the firm in question will be able to find a suitable mill in Suffolk, if any Member knows of a reasonably complete mill with a good water supply for sale in the general area north of London, up to about 50 miles out, please contact the Secretary.

EVENTS

VISIT TO PAKENHAM WINDMILL: BANK HOLIDAY MONDAY AUGUST 25th. 1980, from 2 p.m.

By kind permission of Mike Bryant we will be making our annual pilgrimage to Pakenham windmill on Bank Holiday Monday afternoon. This will be a public open day and we will be keen to attract as many visitors as possible with the aim of raising funds for the replacement of the pair of sails which has been missing since last summer. Together with a new steel stock, this work will cost over £5,000. Let's hope for a good wind to set the remaining two sails turning!

FIRST AID REPAIRS TO SYLEHAM POST MILL

In the last Newsletter we listed several jobs which we were planning to tackle this year at Drinkstone post mill. We now feel however that these can wait until next year and the remaining months of good weather will be better spent on work to Syleham post mill. Of the eight post mills in the county, this is the most neglected and although

it was at work by wind well into the 1950's, and restoration was talked of in the 1970's, it now presents a sorry sight (see photographs above, taken last summer). Several boards are missing from the buck roof, which is deteriorating fast, allowing water to penetrate to the machinery immediately below. The porch and fan have gone, and the plaster is flaking off the walls of the roundhouse, exposing the soft clay lump which once without its protection is very vulnerable.

We are planning some basic weatherproofing repairs to halt the rapid decay of the mill and ensure that it remains standing for several more years so that its long term future can be decided. We are hoping for a small grant from Mid Suffolk District Council to help towards the cost of materials for the work, which will mainly consist of making the buck roof weathertight by strengthening the roof ribs and replacing the missing weatherboards.

The work will probably take place over a couple of week-ends in September or October. If you would like to lend a hand to help save the last surviving small East Suffolk post mill, please contact Chris Hullcoop, 42, High Road West, Felixstowe (Ipswich 76911 during working hours).

A WORKING WATERMILL SOON!

Thanks to the endeavours of John Popham and the Suffolk Preservation Society the repairs to the mill building and the engine shed at Pakenham watermill are now complete. However, repairs to the machinery have yet to be started and with a loan of some £20,000 to be repaid, S.P.S. need all the help they can get.

The machinery can be compared to a veteran car which is used summer week-ends only. With care it will last for ever, but give it to a 'rep' and ask him to

travel 40,000 miles a year in it and it will soon be worn out. The same applies to the machinery at Pakenham. Fortunately the wheel, wheel shaft, pit wheel and wallower were all replaced in the late nineteenth century and with care this iron machinery should last indefinitely. However the wooden upright shaft, spur wheel and crown wheel are all about 100 years older and showing signs of wear and in their present condition not capable of hard use. With a little reinforcement and alignment and some careful simple repairs there is no reason why this machinery should not last for a very long time. Such repairs, often called 'bodges' by millwrights, can be seen in almost every mill and kept the mill going when to call in a millwright might well have ruined the business.

S.M.G. will do what it can in the way of these small repairs to help S.P.S. turn the stones again at Pakenham, albeit a little shakily. We hope to start this work in the autumn; for further details please contact Chris Hullcoop (address on p.12).

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NEW S.M.G. MEMBERS SINCE NEWSLETTER 13

ANDREWS, Norman (F)
20, Marlowe Square, Mitcham, Surrey CR4 1DT
Tel. 01-640-0486

BICKNELL, J.P. (F)
13, Turner Close, Cowley, Oxford OX4 2UA
Tel. Oxford 778743 (Home); Oxford 49567 (work)

BURROUGHES, E.E. (F)
Southgate Farm, Rickinghall, Diss, Norfolk

DUNSDON, R. (F)
Willow Cottage, Low Street, Bardwell, Bury St. Edmunds, Suffolk
Tel. Honington 251 (Home); Bury St. Edmunds 66155 (work)

FRANCE, J.B. (F)
27, Compton Road, Kensal Rise, London NW10 5RP

HOLDWAY, John M. (F)
Mill Farm House, Lavenham Road, Cockfield, Bury St. Edmunds
Tel. Cockfield Green 828597

HOLMES, F.A. (F)
1, Kimberley Cottages, The Heath, Hadleigh, Ipswich

JONES, T. (F)
8, Cannonfields, Bury St. Edmunds, Suffolk IP33 1JX
Tel. Bury St. Edmunds 62430

LANGMAN, Bridget (Miss) (Jun.)
24, Leigh Close, Addlestone, Surrey KT15 1EL
Tel. Weybridge 47101

MARTIN, Melvin (F)
Springvale, Hadleigh Road, Sproughton, Ipswich

NEWTON, Michael (F)
Stow Mill, Paston, Mundesley, Norfolk

PARGETER, Vincent (F)
46, Heybridge Road, Ingatestone, Essex CM4 9AQ

POOL, P.M. (Mrs.) (Grp.)
134 Grand Chemin D'Oppem, 1970 Wezembeek-Oppem, Belgium

PROSSER, Ian (F)
22, Beehive Green, Welwyn Garden City, Hertfordshire AL7 4BG

SMITH, Richard W. (F) (Hon.)
131, Dover Road, Ipswich
Tel. Ipswich 73824

STOYEL, Alan (F)
Venn Mill, Garford, Abingdon, Oxford OX13 5PA
Tel. 023-587-264

WHITE, D.C. (F)
26, Rowan Green, Elmswell, Bury St. Edmunds, Suffolk

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