Goodwin Park News

Winter 2020

Club Details

The newsletter of Plymouth Miniature Steam. Published quarterly (normally March, June, September & December) and issued free to members. **Cut-off date for submissions is 24th of the preceding month (i.e. Feb, May, Aug & Nov).**

We operate a ground level track of approximately half a mile in length at our site at Pendeen Crescent, Southway, Plymouth, with facilities for 3½, 5 and 7¼ inch gauges. Public running occurs on the first and third Sundays of each month, from April until the end of October.
For further details and membership information, please contact Ian Jefferson (01752-788862) or Rob Hitchcock (01822-852479).
Current Membership Rates - Adult £25, Junior £10.
Workshop facilities available to members at 'Tor Bridge High' (was Estover Community College), Plymouth, £25 per term (10 weeks) or £3 per session.

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We also operate an email message service within the membership; if you wish to join, please contact 'the membership secretary'
Please note that contributions reflect the views of the writer and are not necessarily endorsed by the Company.
Members' advertisements for models and other related items are published free.
Non-members and Trade, by arrangement. All items for inclusion to be sent to the Editor.
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Your committee for 2020

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Nick Hill	Vice Chairman
Ursula Brown	Secretary
James Atkinson	Treasurer
Selwyn Brown	Track Marshal
Alan Smith	
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Ti Daley	
Rob Hitchcock	

Please make sure that any change of address, email or mailing preference are notified to the membership secretary promptly in order that we can keep you informed. If you do not wish to receive communication by phone or email, please ask the membership secretary to delete that information.

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Front Cover: *Building the boiler for Highlander – see page 8. (Photo: Tom Pawley)*

Editor's Ramblings:

Again, really pleased to see new contributors with very interesting articles – many thanks!

I guess the extra & varied articles are as a result of 'lockdown' arrangements? Presumably people have been both spending more time in workshop activities, plus time to produce a write-up? Whatever the reasons, please keep them coming – it will give us all something to read, especially during the cold, dark, Winter evenings ahead.

We have two new members to welcome to the club. Mark and Mackenzie Creece.
One of our apprentices, Reece Burgess, has just started an engineering apprenticeship with GWR at Laira depot. Congratulations and best wishes to him.

From the Chair

As we hurtle towards the end of the year and the news seems to bring no respite, our thoughts turn to one particular key worker; 'How is Santa going to cope this year?' How is he going to deal with the plethora of different regulations around the world? All those quarantine regulations in different countries and then the inability to enter homes unless he is in a 'support bubble', which is unlikely. There is the issue of sanitising his hands and what about the reindeer's hooves? And of course, leaving his details for 'track and trace'. But in reality, what will Christmas 2020 bring us? I can not foresee much joy in the world and I do not see the New Year bringing any rapid respite, we can but hope that 2021will at last see the beginning of an improvement in the current situation as is being promised by some recent developments.

So, as we cast an eye over 2020, we were on the brink of opening up for the public running season, when 'lockdown 1' was invoked, so everything just stopped! Well almost; with a little inventiveness we were able to complete Hernia's rebuild and continue with a little bit of grounds maintenance. But with the prospect of no income, thoughts turned to how well we could survive the year. Fortunately we received the windfall of a government grant, but the sting was that it had to be spent within the accounting year, so more thought was required and hence this has funded a big piece of work that we were dreading, as it meant that half the track would be out of commission for a prolonged period, but of course it already was! So, we managed to 'lift the bridge' and the approaches are now on the way to being re-established. As things eased through the latter part of the year, consideration was given to limited opening, but this was rapidly dismissed, so we pressed on with various little jobs including; improving the walkways towards the building, removing the hump against the north wall of the building and protecting the electricity supply cable, getting the new windows installed and of course, further locomotive and stock maintenance. Most of these jobs are still ongoing, but at least we have made progress through the year.

Improved protection for the electricity supply

Pathway at the west of the building

The new main window

Pathway at the east of the building

Stock preparation roads

Now, in November, we have 'Lockdown 2' and are once again restricted, but we are doing what we can to continue with some work, especially 'construction'. Obviously, this is going to impact us in several ways and command us to once again be inventive in how we go about things for the next few months. Inevitably there are jobs that can only be done at the site, but it is the other things for which we will have to find alternative solutions.

The first item to be addressed is that of membership renewals; as I mentioned in the last magazine, we have decided not to implement the increase that was approved at the last AGM, so this will remain at £25 for adults and £10 for juniors this time. It is planned that the renewal notices will be sent out in December, so that we can include a number of other documents. But of course, because we will not have the opportunities to meet in person, we will have to rely on the old 'snail mail' and bank transfer for most of the renewals. Normally we would get a number of renewals at our January 1st members' day, but as it is inappropriate to try to hold such an event in the current climate we will lose this opportunity, as well as the chance of a social get together. I am in the process of organising a substitute for this in the form of a 'virtual at home' on New Year's Day; an opportunity for members to get together in a virtual world and at least see and speak to one another for a few minutes; details will be sent out nearer the time. Another aspect of life that we are distinctly missing, is the ability to get together at Torbridge. With the return of the schools in September, it did look as if there would be the possibility of us getting back, but within days, the 'rule of 6' came into being and this effectively closed that opportunity as well. Now, looking at the prevailing restrictions, the prospect of getting back to school is rather slim and the near future does not hold that much hope, so it could well be that it will be several months yet before we can resume. Unfortunately it also looks as if a price rise will be forced upon us, so this will also result in our having to increase the charge, but this will be kept to a minimum and hopefully will still represent good value. There is one item that we are legally required to do within the next few months and that is to hold our AGM. We are unlikely to be able to hold this in the normal manner, so we are planning to organise facilities in order that we can hold it using one of the internet based video conference facilities that have come to prominence in recent months. All being well, the details will be sent with your renewal notice and the final connection details will be sent by email; it is acknowledged that this will exclude a handful of

members from being involved, but remember that proxies can still be appointed in the normal manner. As we look at means of communication, I am trying to tidy up the manner in which we keep you informed by email, as such you will start to see messages from a new address of pms.messenger@outlook.com . As I look to increase the usage of this, I would suggest that you make sure that this is known to your email system either by adding it to your 'white list' or setting it up as a contact to ensure that messages do not get routed to your junk mail.

So, as we press on with the annual maintenance, whilst for some items, the normal scheduled work applies, for others, different work is required because of the lack of use, this is manifesting itself most noticeably with the locomotive batteries, where their condition is deteriorating appreciably. For other items, notably the passenger set bodies, there is the opportunity to catch up on some overdue repairs, as long as we have the volunteers to do the work. Similarly we are pressing on with the work on the track maintenance and whilst we were hoping to have the concrete poured very soon, this has slipped appreciably due both to weather and the current restrictions, so we hope that when we are ready, the restrictions will have eased and we can get as many members as possible to help with the work.

Elsewhere, as you will be aware I have been pressing on with the disposal of Colin's effects. I have now reached the point where I only have a few significant items left, the remainder having been either sold or disposed of. As a last opportunity before I look to dispose of the remainder by alternative means, I am therefore offering these to any member in return for a reasonable offer; the items so remaining being the George Adams lathe, the Heilan Lassie chassis and the Myford change gears.

So as I conclude this little missive I would ask you to remember your club, renew your membership promptly and subject to the restrictions give what assistance you are able. I wish you well for the coming months and hope you stay fit.

And finally, a quote from Churchill, which I feel is very appropriate in the current climate:

Success is not final.
Failure is not fatal.
It is the courage to continue that counts.

Well, it seemed a good idea at the time!

Tom Pawley

And the time was a Saturday in September 1967, when I wandered into the Village post office to collect my copy of Model Engineer. One look at the front cover and my fate was sealed! There was a photograph of a Stanier black five at speed and the caption was; “the start of our new constructional series, a 7 ¼ gauge Back Five.

I just knew that I had to build one although the designer, Martin Evans, stated that “this is not a project for a tyro”. Well, I fitted that description, never having built anything like that before. My workshop and equipment were primitive in the extreme, an old damp stable building, a 3 ½ Britannia treadle lathe and an old shaper rescued from the scrapyard. Undaunted, a few weeks later the frame steel arrived. Two 5 foot long by 6” $^{3}/_{16}$ steel, sheared from plate, so the edges were in no way straight. A visit to the nearest glazier yielded a six foot long piece of plate glass to make a surface plate and bolting the two together, I set to with files to true up the best edge, with that done, I faced the prospect of sawing 1/4” off the other side as the plates were too wide. A pack of hacksaw blades and a permanently damaged elbow joint later, they were the finished size. Oh for Laser cutting! With all the cutouts stitch drilled, chiseled and filed to shape, the stretchers, buffer and drag beams fitted, the thing was beginning to look quite loco like. However... about this time I met my future wife and loco building came to an abrupt halt. The frames and sundry castings and bits were packed into a wood crate which followed us through assorted house moves for the next 40 years!

After returning to Cornwall following a one year sailing trip that lasted for ten, we settled into a house with workshop and some good machines, I extricated the great box and opened it. “What on earth is that” said Lesley. My explanation that it was an embryo steam locomotive brought muttered comments about “It isn't the only loco thing around here”.

That was 2011, and I have made progress since then. The machine work was most enjoyable, building the steel boiler was rather trying with all the controls and regulations, but satisfying to see it completed. It's almost possible that the engine may be near enough finished to run it next year. Would I do it again, well yes, in fact if I live long enough I may build a 7 ¼ single wheeler, but don't tell Lesley.

Renovation of Sack Trucks

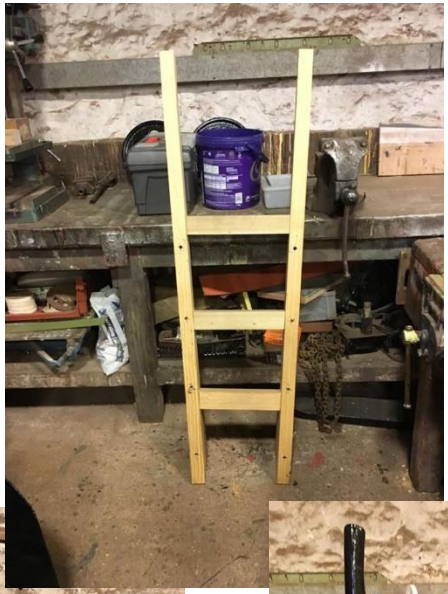
Michael Bryant

The South Devon Railway has inherited a number of antique trolleys in various conditions. Over a period of time many of these trolleys have been renovated.

A company named Slingsby made a number of these trolleys and this company has been in existence from humble beginnings in 1893 and has become a highly trusted 21st century name today. In their many years a lot has changed since they started out as a manufacturer of labour saving trucks and trolleys. They are now one of the UK's market leaders in the distance selling of industrial and commercial equipment.

Slingsby manufacture and distribute over 35,000 high quality products covering everything for the workplace; from handling and lifting and premises equipment to retail and office supplies.

Below are the results so far of the ongoing renovations to the trolleys here at SDR in the Carriage Workshop. Ensuring these useful and historic items are preserved for future generations to experience and enjoy.



End Covers on the Wren.

John Briggs

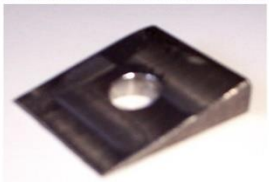
Having completed drilling the ports, I have been tackling the end covers.
The only unusual thing to report was the lack of a full set of castings as, sadly, the patterns have been lost and two of the front covers and two of the rear covers had to be machined from cast iron round bar. The front covers were completed using the lathe, however I used a combination of lathe, miller, hacksaw and file to get the rear covers out of a round bar. The photos show the main stages of production.

Restoring equipment for the Lynton & Barnstaple Railway

E.W. (Ted) Lawrence

Living six miles north of Plymouth it meant a 2 hour journey of some 80 miles to Woody Bay Station to be able to help and work on the L & B Railway, with ideally overnight accommodation to make any help worthwhile. Both I and my wife, Clare, were already helping on the sales stand at the spring and autumn Galas by staying three nights in Lynton. Martyn Budd the General Manager of the railway had quite a lot of platform equipment donated to the railway that needed major remake/restoration and was looking for help in getting it restored. The ideal situation was to transport it to my home workshop where I had all the facilities for the work needed. The first item was a porter's sack truck type of luggage barrow. This required removing all the highly corroded metal components to see what was reusable from the wooden frame, as well as many years of muck from where it had been stored prior to arriving at Woody Bay. A new side member and bottom cross rail was required and made in oak that I already had. The original handle piece was spliced into the new side member using a diagonal joint that was glued and screwed to the new side member. The stopped mortice and tenon joints were glued and screwed using Cascamite Glue and brass csk. screws, the heads being filled with Epoxy Putty. New tie bars were made from 8mm studding sheathed in aluminium tube. All of the bolts and screws had to be replaced using zinc plated nearest metric equivalent bolts and brass screws. Steel parts were derusted using a chipping hammer and powered wire brush and then given a coat of anti-corrosive solution, then red oxide, undercoat and two top coats of paint. Cast iron wheels and axle blocks were similarly treated but without the anti-corrosive treatment.


GENTLEMEN
BOOKING HALL
L&B.R.



The next item I was presented with were two very rusty SR platform seat ends and one piece of rotten wood. First the metal seat ends were given the chipping hammer and power wire brush treatment. There were two pieces of metal missing, the centre brace that is attached underneath to all of the seat slats and the diagonal V' shaped tie bar to tie the seat ends to the centre brace. Where the centre brace and tie bar are joined under the centre of the seat it results in a compound angle at the tie bar joint. It was easier to use a steel wedge to compensate for the compound angle, than try and form it in the centre of the tie bar, easily made on the milling machine. The metal parts were primed with red oxide, an undercoat and then three top coats of SR green. All new pressure treated timber was used for the seven slats and all new zinc plated bolts. The seat slats were painted with primer/undercoat and three coats of SR green. The seat now resides on platform 2 at Woody Bay Railway Station.

The next item to arrive for restoration was a Baggage Barrow that had lain derelict in the garden of the Lynton Museum. The tubular frame was so badly corroded that metal was non-existent in places. The end 9 inches of the handles were completely corroded away. The axle and bore of the wheel were badly worn and corroded. The timber boards were in a state of decay. Arc welding was obviously out of the question and my MIG welder was restoring a Barn find Austin A95 Westminster in Australia. So a bit of lateral thinking was required. For the handles I found some 24 inch lengths of steel tube on EBay that were the same bore as the outside diameter of the handles.

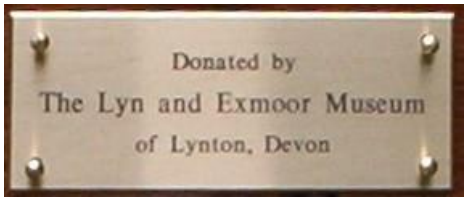
A pair of these would sheath the old handles and give the correct length for the handles.

The ‘U’ shaped part of the frame was badly corroded with metal completely missing. These areas were coated with an anticorrosion treatment. New pieces of sheet metal were formed up to cover over these areas of missing metal. Using high strength Araldite the new pieces of metal were clamped to the frame and secured with 4BA studs

and thin nuts to add strength to the joints. When fully cured after 48 hours the new metal was fared into the frame using Plastic Padding Chemical Metal. A new steel axle was made to suit the worn bore of the wheel with the wheel being

drilled and tapped both sides for ¼ BSF grease nipples. All metalwork parts were given a coat of red oxide primer, undercoat and two top coats of paint.

The rotten boards were replaced with pressure treated timber and stained light oak and then three coats of Yacht Varnish. I managed to source a pair of $1^{3}/_{8}$" bore handgrips, which took a bit of finding (6 week lead time), as they are mostly made with a 1 1/4" bore. The Lynton Museum had a brass plate made to indicate the donation of the barrow. Altogether a challenging exercise using a bit of lateral thinking and an unorthodox fabrication method. The baggage barrow is thought to have been used to transport passengers' luggage from the railway station to their hotel.



The next two items to be tackled were two porter's luggage barrows. Restoring/remaking these two helped to keep me sane during the virus lock down and restrictions. The larger one of the two needed all new woodwork as all the existing woodwork was rotten and falling apart. It was possible to use one side member as a template for the two new ones. The only reusable parts were the handle ends, which were diagonally spliced into the new side members, glued and screwed with brass screws, the heads then filled with epoxy adhesive for a smooth finish. The framework was assembled using stopped mortice and tenon joints glued (Cascamite waterproof) and screwed with brass screws. The woodwork was given a coat of primer, undercoat and two top coats of SR green. The handle grips were stained light oak and given four coats of yacht varnish.

All metalwork was thoroughly derusted and treated with an anti-corrosive solution, a coat of red oxide, then two top coats of Hammerite smooth black or SR green. The tie bars were replaced using 8mm studding sheathed in steel tube between the side members. All bolts and screws were replaced with zinc plated parts and brass screws.

For the smaller barrow the main wood framework was sound but the handle end support blocks were rotten and likewise the axle bearing support blocks. These were

remade in Oak and Mahogany using a jig saw to cut the profile of the handle end supports, finishing the profile using a spokeshave.

The metalwork was treated in the same way as the larger barrow and after cleaning and straightening the original tie bars they were found to be reusable.

The joints on the frame had dried out long ago and were loose so needed to be re-glued and secured with brass screws. With the two reusable tie bars secured in the frame, it was once again a very strong structure.

The cast iron wheels were cleaned up and derusted then drilled for ¼" BSF grease nipples followed by a coat of red oxide and then two coats of Hammerite smooth black.
The two finished barrows just require the L&B R legend to be hand painted on each side prior to delivery to Woody Bay Station

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The project for the next lockdown is a Southern Railway barrow requiring new support legs, some top boards, all the metalwork dismantled and stripped. It interestingly has the axle mounted on leaf springs.

For anybody undertaking work that requires especially long coach bolts or odd sizes of screws, particularly brass, I have found a number of sources on Ebay. Kayfast for brass screws and zinc plated coach bolts, AJ timber Supplies for very long zinc plated coach bolts, Screw City and A3 Fixings Ltd. for large split pins.

Who Were The Wright Brothers?

Rob Hitchcock

Few inventors have had the opportunity to solve and overcome one the most difficult of mankind's perceived problems, such as controlled powered flight. The Wright brothers achieved the impossible at the turn of the 19th century by demonstrating something that was regarded as just as difficult as the moon landing of 1969. At this time ballooning was popular with the wealthy but was now regarded as commonplace. The worldwide public and press was showing intense interest in powered flight and was ready for a breakthrough. There was a common belief that powered independent flight was impossible and unnecessary. Around the world a large number of experimenters were trying to fly with a variety of machines which ranged from the ridiculous to the outright dangerous, nearly all of them were gliders, they were unable to travel very far, and without any real control. Most of them needing to be launched off high places, sometimes ending in death and very often destruction of their plane. Why should this pair of brothers from mid-west Ohio be so different from the others?

The Wright family was headed by their father Milton Wright who was a bishop in a strict non-conformist church known in the mid-west as the United Bretheren. Wilbur and Orville had two elder brothers, Lorin, Reuchlin, and a sister Katharine. There were also twins that died in infancy. Their mother Susan, who had died in 1889 from Tuberculosis, was a graduate of Hartsville College, a church training school, and was a great influence on the younger Wrights. Bishop Wright was a travelling preacher and away from home much of the time. The two elder brothers had left home by 1900, Katharine was a teacher in a Dayton high school, and the family lived together at this time in a modest house in a suburb of Dayton, Ohio.

Wilbur, through an accident playing ice hockey and subsequent illness, did not go to college; although he was extremely clever and well capable of succeeding. Bishop Wright had hopes he would go to Yale. More academically gifted than the practical Orville, Wilbur stayed at home and neither of the brothers achieved a formal college education. Their characters were undoubtedly influenced by their harsh early life on mid-west farms and also their disciplinarian and righteous father who involved the family in his religious political battles. In fact Wilbur became an adept lawyer representing his father successfully on church issues on many occasions. Wilbur emerged as a very intelligent and analytical young man but without any great cause or ambition in life. The astonishing speed at which the pair decided to attempt and conquer powered flight is testament to their determination to systematically learn, identify, and apply science and mathematics to the problem. Whereas most of their contemporaries failed to understand sufficient of the aerodynamic principles required to progress their work into practical flying machines.

Orville at the later stages of high school found an interest in printing and left school before graduating, to gain employment in a printing company. Later, he and Wilbur built a simple press large enough to produce a newspaper. The press was made from scavenged

materials including the hood metalwork from a horse buggy. Both he and Wilbur became adept at setting type and printing, eventually in 1889 producing a weekly newspaper. The competition with other newspapers made this enterprise unprofitable and the brothers changed to commercial printing. This occupation satisfied their interests until one day, both brothers bought safety cycles which were a replacement for the penny farthing. Soon they were racing these machines competitively as a new chain driven cycle craze swept America.

Inevitably their enquiring minds and thirst for new stimulus led to bicycles becoming their focus of interest, as they took advantage in the nationwide boom in cycling. They were to set themselves up in a succession of cycle repair shops in Dayton, as this business started to take off and become their main source of income. Soon the brothers were manufacturing their own hand made cycles, as well as selling the more well-known mass produced ones. It is a source of wonder where and how the pair achieved the engineering and technical skills that allowed them, in just a few years into the future, to build the first flying machine. What was more astonishing was that this machines' four cylinder engine was designed by Wilbur and built by them both and Charlie Taylor in their cycle shop. It is understood that they both worked at lathes in their workshop, whether this was just in trueing and machining tubes prior to brazing , or manufacturing actual cycle components, we do not know for sure. It is likely that much of their practical skills were formed building cycles. They were quite capable of teaching themselves and acquiring skills quickly. The high school curricula of those days was based on the entry requirements of eight main colleges or universities, which considered the classics and the study of Latin and Greek to be more important than science or engineering. There was some latitude for vocational training where industrial or agricultural centres influenced the state high school system. It is possible that Wilbur and Orville benefited from some school technical education. Their technical and practical ability marked them apart from many of the gentlemen of that time who aspired to fly and generally lacked this asset. Their close relationship with few outside interests led them to become rather insular and introverted. It is known that both were shy and found socialising with the opposite sex difficult. They were however always ready to discuss and sometimes heatedly debate their views and theories between themselves, which in itself developed into a major problem solving tool. It has been observed that Wilbur, being the elder, always took the lead and it is debatable that they would have taken up flying at all if he had not started investigatory work. Later, when their work became public, they were always at pains to describe themselves as "The Brothers" or "Wilbur and Orville".

So imagine these two brothers slightly set in their ways, on the way to acquiring eccentricities due to their upbringing and exclusive way of life, both going to work at the cycle shop formally dressed in business suits and hats with celluloid collars. Their manner of speech also rather formal but very polite, but not really cut out to be high power businessmen. On weekends they would cycle out to the hills beyond Dayton and idle their time watching birds and becoming fascinated by bird's ability to fly, soar, and glide without any apparent effort. This curiosity and the realisation that Otto Lilienthal, a German aeronautic experimenter, had just crashed and died may have provided the seed of an idea that set both of them on the same quest to achieve powered flight. It was not until 1899 that the brothers decided that flight was

possible and began investigations into the current state of the science (if at that time it could be considered a science). Wilbur wrote to the Smithsonian institute in Washington DC asking for information, it being common knowledge that Samuel Langley (its director) had been given $50,000 dollars to develop a powered aeroplane for the US army. Langley having already flown model steam powered gliders, had developed a whole department within the Smithsonian institute to pursue the powered flight problem. The brothers received some reports in response and a recommendation to contact Octave Chanute, an American Civil Engineer who had collated information on many of the attempts at flight to that date. Chanute was to become a good friend of the Wright family, although he was to later quarrel with them over his release of some of their confidences and his egotistical claims that he gave the Wrights all their ideas. Chanute became an eminent personage within the aeronautical field and was a facilitator and encourager, even funding some ideas himself. Although he was quickly outclassed by the Wrights level of understanding.

Wilbur and Orville became aware that there had been several attempts at flying, some more successful than others. Lilienthal was probably the closest to achieving some control of flight using a machine that looked like a hang glider and moving his body weight around to alter the centre of gravity of the machine, allowing a degree of directional control. At this time, the understanding of the aerodynamics of wings and "lift" and the need for sufficient wind speed over the wing which are the main elements required to prevent "stalling" was not understood, and this is how Lilienthal died.

Over 100 years previously an English aristocrat named Sir George Cayley, a self-taught amateur scientist and inventor, discovered by experimentation that wind rushing over a cambered wing caused it to lift. However he did not understand why. Cayley did experiments with a whirling arm machine to identify the optimum wing shape, which was progressed to the building of a glider, piloted by his coachman, and is said to have flown across a valley for over 200yards. The terrified coachman resigned on landing, quoting what is now the well-known phrase, "Please Sir George I wish to give notice I was hired to drive not to fly!". Cayley's work puts him amongst the first flyers to scientifically study flight although his detailed records did not come to light until 1926 and not fully until 1962. This work was totally unknown to the Wrights.

In the US, there were a number of amateurs building kites and gliders achieving limited success, however the holy grail of powered flight eluded them all. These included names such as Edward Huffaker, Augustus Herring and Glenn Curtiss, who was later to overtake the Wrights in aeroplane technology and eventually to own a national aircraft manufacturing corporation. Langley's $50,000 dollar powered aircraft plunged head first into the Potomac River near Washington in 1903. Langley wrongly scaled up his model design and believed in flat wing surfaces which provided no lift. Four large wings and a massive 48hp engine did nothing to propel the craft into the air and luckily the pilot was rescued.

In Britain the Army General Staff were not interested in flight and still believed in Horses and Cavalry, despite this being only 14 years before world war one . There was a small resource dedicated to powered flight at the Army Balloon factory which later became famous as the Farnborough Aeronautical Research Establishment. The British army were determined to

build their own planes and they were eventually left behind by the US and France. Sir Hiram Maxim, the inventor of the Maxim Machine gun, had some wild ideas about how to achieve powered flight but this was never a practical proposition. This machine with 18ft steam driven propellers raised itself a few inches off the ground and then thrashed itself to pieces.

Also in England, Percy Pilcher managed to fly a hang glider like machine similar to Lilienthal's with some control. Although it was not powered this machine, called "The Bat", flew in 1895 managing up to 200 metres. Pilcher was an engineer having trained in Glasgow's shipyards. He also produced a later plane called the "Hawk", which was a forerunner of a planned powered plane with a 4hp engine. Unfortunately Pilcher also crashed and died in 1899, when his tail plane snapped at 10 metres in the air. The planned powered triplane was in advanced stages of construction when he died and Pilcher and Britain potentially could have been the winner of the race for powered flight. Unfortunately Pilcher and his work became buried in history.

Wilbur and Orville quickly realised that if they were to fly, then they would need to build up their skill and knowledge. It was then commonly assumed that flying machines needed to have intrinsic stability in their design, such that the pilot only needed to be concerned with the direction he wished to steer. The brothers having studied birds and their ability to correct their flight due to wind and other events realized this was a fallacy and established for themselves the three main control principles of "roll" "pitch" and " Yaw", which strangely enough we find today on any modern aircraft. Their approach was to experiment on a large kite first, which embodied some of these principles and, as they did not want to end up like Lilienthal, do so by remote control lines from the ground. Lilienthal controlled his direction by "warping" his wings up and down to produce roll and this was to be reproduced in the trial glider. The "angle of attack" or the angle of inclination of the wings to the wind, was a principle means of gaining "lift". This could be maintained on a hang glider type machine by moving the centre of gravity (the body) forward or back. They were aware that a cambered wing (i.e. one where the wing is curved on the top surface) would produce superior lift and that the centre of the lift force moved, depending on where the highest point of camber was and its angle of attack. Some of the information given to them from the Smithsonian Institute consisted of formulae and tables for "lift" and "drag" produced by a civil engineer named John Smeaton, who was well known 150 years previously as a windmill and lighthouse designer (Smeaton's Tower would be recognised by anyone living in the Plymouth area). They wrestled with the mathematics involved realising Lilienthal had used similar information to calculate the size of wing required to lift a certain weight and the drag produced by the structure of the kite that would need to be overcome. Initially they intended to have no directional control other than the wing warping or roll effect to change direction. So emerged their first design, a 5ft wing span bi-plane kite with a tail stabilizer which used many principles and data from previous designs. Even the wing warping banking mechanism, which was thought to be an original Wright idea, was in fact used previously by several others but not patented or continued with. It was flown sometime in 1899. One could speculate as to the Autumn as this was when most of their cycle work tailed off, leaving the winter period for cycle building prior to the spring and summer peak. This plane or

kite performed well and proved the banking system worked. It also had articulated or hinged wings which allowed the centre of Lift to be moved either forward or back, causing the plane to rise or fall. This craft more than anything, gave the brothers confidence that they could convert thought into practice but also proved the wing warping system, which became a feature of their aeroplanes and over which some fairly savage patent battles were to be fought in the future.

Late 1899 sees the brothers contemplating their next project which was a pilot controlled biplane glider. They had the outline of a design but were aware that the winds in Dayton Ohio were not sufficient to provide Lift for a plane of any size. They consulted the U. S. weather bureau, who advised the best areas to be the shores of Lake Michigan or the North Carolina outer banks. The latter was favoured as being as far from civilization as they could get, as the brothers were aware of the intense press interest in any flight attempts and wanted nothing to do with it. However the logistics problem of transporting their machine and equipment across three States via rail, road, and sea was considerable. At that time the main populated area on the "Northern Banks", so called for the continuous strip of sandbanks and dunes that paralleled the main shoreline, was Kittyhawk. At best not more than a few hundred sparsely populated people and almost no one on the sand dunes at "Kill Devil" four miles to the south where they eventually based their operations. "Kill Devil" (thought to be of Native American derivation) now boasts a population of over 6,000 and is full of holiday homes.

Not much work on the biplane glider was done until the spring of 1900. They worked through all the previous designs and made their own judgements on the sizes of wings to lift a man into the air. The brothers must have been slightly built, allowing for only 140 pounds weight and a wind speed of 15 MPH.

The brothers planned to have a forward wing which would have a mechanical means of altering its inclination to control "pitch" and this became a feature of all their machines, as they thought that this would help to prevent them crashing into the ground. Stalling was a very real fear in those days. This type of forward wing, sometimes called a "canard", can be seen in some modern jet aircraft to improve their performance. The canard featured in all their designs except probably the latest. The quantity of conflicting information regarding the design of wing was extremely large. They eventually designed a cambered wing based on Smeaton's earlier work, which was known to have been used by both Lilienthal and Pilcher. The aircraft was to have controls for roll and pitch, worked by hand and foot levers but having no tail or stabiliser relied on the roll axis effected by warping the wings for directional control. By the end of the summer of 1900, Wilbur was assembling the glider and readying for the trip to Kittyhawk. The plane was despatched incomplete, there not being sufficiently long high quality ash for the wing spars available in Dayton. Wilbur is known to have searched for the timber in Norfolk Virginia, on his journey settling for 16 ft lengths of pine rather than 18ft length of ash. The total cost of the glider was estimated as only $15 or around $300 today. Wilbur paid a boatman $3 to take him across the Channel to the banks. He later wished he had paid more and used a bigger boat after suffering violent storms and springing leaks and worse still catching bedbugs from the infested boat. Wilbur lodged with the Tate family until Orville arrived and erected an awning at the Tates' house to build the glider. Mrs Tate and her sewing machine helping to piece together

the light fabric covering. Later they moved to an 18ft tent to accommodate them and the glider. The cycle shop was left in the care of two employees. Bishop Wright had implored Wilbur to take no risks, however after two or three tests with control ropes still attached Wilbur climbed onto the pilots position. As the glider began to rise, the action of the glider initially unnerved both brothers and they continued with control ropes only, eventually trying lighter pilot weights using local boys and lighter winds. It was clear that their lift calculations were wrong as the raised angle of attack of the wings sufficient to raise machine and pilot weight made the machine unflyable in the lighter winds they had designed for. The brothers began to suspect their design assumptions.

One night in October a storm battered their tent and damaged the glider. It was quickly repaired and they moved site to "Kill Devil" where a large sandhill promised to provide the necessary lift they required, combining lower windspeed with a higher forward speed due to the hill. This proved more successful and they both managed reasonably controlled flights of about 100metres. Most of these flights were made by Wilbur. The brothers returned to Dayton on 23rd October 1900 moderately successful. Their glider now almost beyond repair, there were problems to attend to at the cycle shop and they could stay no longer. Unfortunately no photos were taken of the first glider and very few records made of events.

By May 1901 the brothers were ready to try a re-design of the first 1900 plane. This had been re-engineered to give more lift, with wings which were now 22ft by 7ft. The wing design had been changed to give more camber on the top surface and the plane now weighed 100 pounds without the pilot. This time on their return to the Kill Devil hills they decided to ship a wooden hut to house themselves and the glider. Octave Chanute and two guests also decided to invite themselves to the flying and intended to bring a cardboard glider built by Huffaker and funded by Chanute. This glider never left the ground and fell apart during a storm. The brothers took an instant dislike to Huffaker who they thought sufficiently dishonest to steal their designs. They were now becoming very aware that they had no patent protection, that what they were doing was near the cutting edge of flying and they needed to think about security. The first flights revealed an instability which Wilbur as the pilot had difficulty in controlling. It appeared to have too much lift which they attributed to the 1:12 width to thickness ratio of the wing section, which had been used by Lilienthal. They set about modifying the wings to 1:19 (the 1900 glider wings were 1:23). This appeared to solve the instability problem, only to find another when Wilbur attempted to bank the machine. The testing continued carefully until a mistaken operation of the levers by Wilbur caused a crash. This being their first, he ended up with a black eye, cut face and bruises. By now they were achieving flights up to 400ft but were no further forward in solving the instability on banking. They left the glider in the shed and dejectedly headed for home on 20th august 1901.

Later the brothers were to review the glass plate photos which had been taken of the flights and Wilbur assembled a technical report on their design and its flight performance, he forwarded it to Chanute hoping to get some help. Chanute was so impressed and astonished by their grasp of the maths and aeronautical principles involved that he asked Wilbur to present a paper on their work to the Western Society of Engineers. The result of this presentation which

was widely reported put the brothers into the fore front of aviation research. The review of their design threw up a suspicion with Wilbur that the original Smeaton work may be inaccurate, there being a relationship between velocity and lift pressure which is different for different mediums the brothers had accepted this multiplier as fact.

They decided to test the theory and built a crude test machine mounted on a bicycle handle bars. When pedalled at speed a test wing could be measured at different angles for lift, and different shapes tested for drag. The results of these early tests revealed enough discrepancy in the Smeaton figures that they decided to spend time and money on a wind tunnel. Nowhere else in America had this been done before. The wind tunnel initially was a crude machine being run from a fan on a natural gas engine connected to the cycle shops gas lighting system. One could only assume this engine was also a source of power to run their lathes. This simple wind tunnel proved conclusively that there was a need for accurate figures for lift and drag, and a larger tunnel was built being 6ft long and 16 inches square, this is tiny compared to today's standards but provided reliable results. NASA were to later test these results and remarkably find only minimal difference to their own. *(Details can be found if you google "Re-living the Wright way" so I will not burden the story with more detail).* It is recorded that Orville, who was adept at geometry and trigonometry, carried out many of the experiments over the winter of 1901 /early 1902 creating their own tables for lift and drag. The tests were wide ranging and involved hundreds of samples of wing shapes and differing resistance shapes for drag, even checking drag on different wing covering materials.

The notebooks containing these results are now the treasured possessions of the library of Congress in Washington DC.

The 1902 Glider promised to be the most aeronautically perfect aeroplane yet built however the brothers were not always able to devote time to their project, they also needed to keep their business going with the help of Charlie Taylor and also needed to support their father in some of his religious court battles. It was not until 25th August that they set off for their camp at Kill Devil. The 1902 biplane glider was a new plane of 32ft wingspan but the wings were narrower, thinner, and more aerodynamic being only 5ft across.
(*Google "aspect ratio of plane wings")* The changes made had doubled the aspect ratio to 6.4 it being uncertain whether this factor was fully understood at the time, as they were more concerned with lift and drag as separate entities. The camber on the new wings upper surface now peaked at 1/3 from the leading edge, and its thickness could be adjusted by the rigging to between 1:24 and 1:30 the latter of which proved better. The forward elevator or canard was also smaller, and for the first time twin fixed stabilizers were fitted. The brothers had concluded that the previous glider was unstable due to rotation of the plane on banking, causing it to turn in the opposite direction due to the raised wings increasing drag. The new plane weighed 115 pounds. The control system now consisted of a hip cradle, moved by the pilot's body to effect wing warping and roll movements, also a lever to move the forward elevator up or down to control pitch.

Re-establishing the camp at Kill Devil took a great deal of work and time. The weather had all but destroyed their shed with the old glider still in it and this time they extended it and

built a kitchen and living quarters. Flying resumed with the new machine tested tethered as a kite and the indications were that this plane would be exceptional. The new aerodynamic wing shape provided an increased amount of lift and stability. Again, Wilbur made the first flight soaring down the highest slope and making a number of 200ft glides, the plane controlled well and showed no signs of the previous instability on banking. They adjusted the rigging to lower the wing tips as the plane reacted to cross winds. The plane was also flown by Orville several times until he stalled the plane and crashed to the ground. Not much damage had been done and they were back flying again in three days, completing over 100 glides between them over several days. The reason for Orville's crash became clearer as they found the need to be able to correct tailslides. Orville's solution was to provide a single controllable tailplane instead of the two fixed stabilizers. The modifications were carried out on site and was linked by wire control lines to the wing warping system. The plane was now the first in history to have a three axis control system.

There were a number of visitors to the camp which concerned the brothers regarding the privacy of their ideas. Chanute brought two gliders with a pilot to test fly them on the Kill Devil hills. The pilot Augustus Herring was the builder of one of the machines, the other a triplane built by Lamson, a west coast jeweller. Neither flew any distance and the owner and pilot were humiliated when the brothers glider, recently modified started to perform fantastically well, now cured of all vices it was totally controllable and consistently flying up to 650ft, and soaring in 30 mph winds. Their flights lasting up to 26 seconds. Wilbur and Orville were breaking records, and by alternating the flying became practiced pilots making between 700 and 1000 flights, even so this only amounted to a few hours each.

"All it needs is an engine." The brothers were elated, even before they left Kill Devil in October they were planning the powered "Flyer". This time their design needed to include an engine, transmission and propellers. Exploring availability of a light four cylinder engine revealed nothing suitable, so they decided to build their own, this would be a gravity fed horizontal petrol engine of about 8hp. The aluminium crankcase was cast in a Dayton foundry and used cast iron liners, the cylinders were water cooled with a gravity header tank. The engine bearings seized up during the first test due to overheating, and a new crankcase had to be made, it is apparent that Charlie Taylor did most of the machining, even making the crankshaft in their workshop. This was a daunting project even for the most experienced and well equipped workshop. The Wright's machine shop was at best rudimentary.

They estimated that the engine developed 12 hp when working properly. The propellers were to be connected to the crankshaft by layshafts, sprockets and chains, the chains running in metal tubes. They found the propellers to be a more difficult problem than the engine as they had no basis to work on. Again they reverted to the wind tunnel to find the right profile. It was a realisation of great intellect and intuition that made them realise that an air propeller should be treated like a rotating wing on a helical course generating lift rather than like a ships propeller which wound its way through the water and was at that time not very efficient. They built a scale model to test their ideas and then built two full size propellers 8.5ft long of 3 laminations of spruce, these were carved by themselves with an axe and knives. The aeroplane

developed as a 40ft wingspan biplane similar in design to the 1902 glider and with twin rudders, and elevators. It was so big it could not be trial assembled and caused disruption in their cycle shop. The return to Kitty Hawk and kill devil did not take place until Sept 25th 1903, Storms had again moved the shed with the 1902 glider still inside, this was repaired with Dan Tates' help (Bill Tates' brother) and the two brothers put in some practice gliding while awaiting the shipped "Flyer". Their flying operations now attracted many spectators, it was common for the lifeguard station men to help out and they were welcomed. By now they had developed a flag signal system when help was required to move the planes. Now more unknown visitors came to watch their flying, particularly as they were staying aloft for a minute or more. There were many difficulties encountered before they were able to make a serious attempt. The weather was cold and stormy and the winds ranged from almost nothing to 30mph and even stronger gusts. The flyer could not use normal wheels because of the soft sand, a 60ft wooden track had been manufactured in sections with a carriage of cycle spindles to launch the plane. The flyer arrived and was assembled, the brothers proceeded to test run the engine, almost immediately the layshaft which took the drive from the engine to the propellers began to vibrate and distort due to an engine misfire, this problem was to necessitate a number of improvements supplied by Charlie Taylor in Dayton, until eventually Orville with the most recent set of shafts resolved to return to the cycle workshop and make new ones from solid bar rather than tube. Of the testing that had been done they found they had an excess of thrust of approx. 30% which should be more than adequate to get lift off. This was determined by running the engine and propellers while lifting a weight which was attached to the rear of the plane and run over a pulley on a short tower. The brothers were under some pressure to try to fly in 1903 as they were aware that Langley was set to make another attempt at flying his plane called the "great aerodrome" this attempt was also doomed to failure with the plane again crashing headfirst into the river.

By the 12th December Orville had returned to kill Devil, the new shafts had been fitted and they were ready to make a flight attempt, the flyer had to be flown down a slope on its first flight due to a lack of wind however it rose well into the air being quite sensitive to fly. It was to be after four or five further flights taking off from level ground and alternating between Wilbur and Orville when on 17th Dec 1903 (mid-day) that Wilbur lifted off in a 24mph wind and achieved a flight of 852 ft in 59 seconds, turbulence forced him to the ground or it could have been longer, they returned the flyer to outside the workshop where strong gusts of wind turned the plane over and smashed it to pieces, so ended the record breaking series of flights in 1903.

This has been just part of the Wright story, the world took some time to accept that they had actually achieved this remarkable feat, Samuel Langley must have been outraged at their success with such little outlay $1000 dollars compared to his highly publicized and expensive failure. He and others, together with the Smithsonian institute tried to deny the brothers success. The Langley plane eventually being made to fly in 1914. Was stated to be the same that flew in 1903 although there was photographic evidence that it had been heavily modified to do so. Some years later in anger, Orville offered the first flyer to the London Science museum where it remained labelled as the world's first flying machine until its return to the U.S, in 1948, it is now correctly labelled in the Smithsonian.

Wilbur and Orville embarked on improvements to the flyer and over a number of years perfected it as a practical flying machine, it was demonstrated by them in many countries but did not develop many sales this was probably down to the brothers themselves who eventually gained patents on their three axis control system, and fought everyone else who tried to use it. They were very protective of their intellectual property and Wilbur especially spent much of the future years left to him fighting court battles, he eventually died in May 1912 officially from Typhoid fever but just as likely from overwork and exhaustion. In hindsight the effort that was expended in protection of their ideas and need to maintain control was to the detriment of flight, as their designs quickly became outdated and their control system using wing warping soon replaced by Curtiss and many others as "wing ailerons" with single joystick 3 axis control. The Wright controls were not easily learned and many an owner of a Wright Flyer ended up dead. It is known that Orville on 7th October 1908 had a major crash when demonstrating a Wright machine to the U.S. military. Army Lieutenant Thomas Selfridge was killed and Orville suffered broken ribs and a broken leg, this was not caused by pilot error but by failure of a Propeller which split and cut through rigging wires causing the plane to collapse at a height of 30m. Orville was to be permanently affected after this crash and used a stick to aid walking in older age.

The brothers had formed a Wright company to exploit the patents but although they became very wealthy they were not fabulously so. The company eventually joined with Glen Curtiss and became the Curtiss Wright Co. The patent problem was ended in 1917 when the USA joined the First World War and the U.S. Department of Defence abolished the patents. Orville was not cut out to be a businessman and retired to the home that he and Wilbur had built, he died in January 1948. The pair were to become revered heroes of the United States and awarded honours by many countries.

Reference Sources & General Notes for 'Who Were The Wright Brothers?' *(pp22 – 31)*

There is a tremendous amount of research available about the Wrights which has almost become of cult status in the U.S. with differences of opinion ongoing even 120 years later. None of the above are newly discovered facts and I suggest if you want to delve deeper start with Wikipedia and or search for "Re-Living the Wright way" *(NASA – Ed)*. A search on any of the names above will reveal a wealth of information impossible to reproduce here. One of the most readable and interesting books on the Wright Brothers is "*The Wright Brothers: The Aviation Pioneers Who Changed The World*" by Ian Mackersey, 1st published in 2003 which may still be available.

Going Electric

John Briggs

I converted to an electric car in 2016 with a Nissan Leaf. The 'Leaf' was the first model to be designed and built from the ground up as an electric vehicle, rather than conversion of an existing model. The battery energy capacity is 30 KWh, the largest available at that time. Fully charged it offered a range of 126 miles, when new, falling to 108 miles now after 50, 000 miles and 4 years use. Nissan deserve credit for a well-designed faultless build from their Sunderland factory, but this article is not about the cars but the experience of using them.

The car can be recharged at home, either by using a dedicated cable on a 3-pin plug supplied with the vehicle, or by installing a 7 KW home charging unit; these do attract a grant on first installation but that still leaves an additional expense to the purchase of the car.

Careful planning is needed if you are not to run out of energy, which has been a close run thing twice, arriving at the charging point with barely 4 miles range left; this experience is known as "range anxiety". The internet and the car's navigation system can be used to plan your journey, normally I aim to reach the next charging point with a spare 20 -30 miles left in the battery thus making allowance for charging points being out of action at the first choice. My regular journey of 240 miles necessitates recharging 3 times making for a journey time of 6 hours instead of 4.5 hours using a petrol car.

The car is designed for an AC or DC input but not both. Charging points are either rapid (50 KW) or slow (7 KW). Rapid chargers all have a DC cable and an AC cable available but can only charge one vehicle at a time; the fastest charge connections are DC - known as Chademo. The DC cable supplies DC that has already been converted from AC by the charger and the charge can go directly to the battery management system, but charge from the AC cable has first to be converted in the car which is slower. There is also only one type of DC connector but two types of AC connector; I first became aware of this when using Chademo, at one of the three available chargers at Exeter, on finding a Renault Zoe driver waiting to use my charger when two other chargers were empty but had the wrong AC connection for the Zoe.

Controlling the chargers and payment for the supply is gained using an App on a smart phone, or an RFID card, all registered on an account with a credit card. Driving long distance means having more than one account available. For example, the whole of the motorway uses chargers from Ecotricity, but in Cornwall rapid chargers are mainly provided by SSE, known as Geniepoint, who also provide for the Southampton area, but Dorset uses 'Charge your Car'. Slower 7KW chargers similarly - Waitrose uses Chargemaster, Park & Rides use Pod-Point, and other shopping venues use EV Charge. I already have five accounts to cover a limited area of the country.

Four years ago most charge points on the motorway stood vacant, they are much busier today, although so far my journey has not been delayed waiting for a charger. I do not see how the system will cope in future with widespread ownership of battery electric cars that take 30 minutes to recharge. The cars are improving with batteries double the size and range of my 2016 Leaf - a 240 mile journey can be done with only one recharge necessary - which might now take 45 minutes for the larger battery.

I have been very impressed by the car and will not change back to petrol, but at a loss to understand how the charging infrastructure and design has been allowed to become so fragmented. At the start, I assumed that all electric cars had the same connector, could plug in to any charge point and payment would be simple with a credit card. The choice of chargers off the motorway appears to depend on local councils or local businesses. If there is anyone reading this who can explain why Brussels has failed to enforce a Europe wide system and what the supposed advantages might be of the system we have - do please write to this magazine to enlighten us all.