Leyland Torque

INCLUDING JOURNAL

THE Leyland SOCIETY

VOLUME 11 NUMBER 81 AUTUMN 2018

THE Leyland SOCIETY

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MEMBERSHIP

Subscription levels are £27 per annum, £33 for EEC members, £38 (in Sterling) for membership outside the EEC. Anyone joining after 1st April and before 31st July will have their membership carried over to the next 31st July, ie up to 16 months. This is good value for money and new members are welcomed. Application forms are available from the Membership Secretary or via the Website www.leylandsociety.co.uk

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Issue No. 81 Autumn 2018

Leyland Torque

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EDITORIAL

Welcome to the new A4-sized Leyland Torque, which now incorporates the Society Journal. This is a bumper issue as we would normally expect 40 pages – even that would be more page space than both Torque and Journal put together, but this is 48 pages and is made possible by having two major 'Journal-style' articles in this issue. We have also added a few pages in colour although that does push the cost up considerably. The new Torque now represents even more value for your subscription and we aim to produce it to the highest possible standards.

In this issue we have part two of an in-depth look at the L60 multi-fuel engine, written by a knowledgeable ex-employee of Leyland Motors, Bill Pitcher, and this is expected to go to four parts, covering a topic about which relatively little is known. John Howie writes in detail about the post WW2 Leyland double-decker body, this article completing his set of articles on Leyland's bus bodybuilding activities in the period 1945-54. We also include our regular Torque topics 'Food for Thought' (where we need some more questions and queries please) and 'Odd Bodies' which continues to have a strong following. Both of these sections ultimately lead to further research with articles on new subjects and keep up a healthy dialogue between readers and the editor. Likewise, please keep sending your letters and emails with interesting facts and finds.

It is pleasing to announce that we have several major articles ready for inclusion (or in progress) and these include the Leyland Test Centre, the introduction of the Leyland Comet, the story of the Roadrunner, Stock-Build PD2s, PD2 Gearboxes, Cancelled Export Orders, Lynx production, Todmorden (the remaining parts) and several Fire Engine articles. We're also hoping to revive Leyland Lions Part 2 which may be serialised in Torque. So, plenty of goodies in the pipeline to look forward to, but I could always do with more articles, however long or short; please keep them coming.

It is with great regret that, as we go to print, I have to inform you that our Chairman, David Berry, has passed away after a short illness.

Mike

Editor

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Leyland Torque (incorporating the Journal) is a newsletter and magazine dealing primarily with the activities of Leyland Motors Ltd and operators of their vehicles, published by The Leyland Society Ltd, which aims to promote the study and preservation of Leyland vehicles.

www.leylandsociety.co.uk

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MEMBERSHIP RENEWALS

This issue of Leyland Torque is the last magazine that you will receive if you have not renewed your membership for 2018/19. A reminder is enclosed with this issue of Torque if you hadn't already renewed by the time we prepared the distribution list so, if you have not already done so, please renew as soon as possible – Thank you. (Note that we no longer issue membership cards as they served very little purpose and cost a lot of time and money).

Please note that our membership secretary is John Ormiston and his address is on the renewal form as well as on the inside front cover of this issue.

LEYLAND SOCIETY AGM

Sunday 25th November, 2018

This year's AGM is to be held on Sunday 25th November at 1.30pm at our usual venue, the Coventry Motor Museum. Please come to the meeting, particularly if you have not been to an AGM before; they are friendly gatherings and you will be most welcome. It would be good to see some more new faces this year in addition to our regulars who appear virtually every year; we very much appreciate your support.

Light refreshments (tea/coffee/biscuits) will be provided 'on the house', there is a cafeteria. After the meeting there will be a talk by Paul Hirons. You may recall that last year, Ian Hirons gave us a splendid talk on his time at Leyland and this year his brother, Paul, will give us a talk about Stokes Hall and the graduate training scheme at Leyland. Paul was sponsored by Leyland through university and joined in 1966, leaving to work for Seddon Atkinson in 1976. His first job was in Product Planning and later in Finance.

Please come and join us for the AGM and talk; you will find it to be a very friendly and informative.

2018 LEYLAND MEMENTO BADGE

This year's Gathering memento is a little larger and more elaborate than usual, to celebrate our 20th Gathering and '20 Years of The Leyland Society'. It is based on the Leyland Royal Tiger badge of the early 1950s and which continued on the Royal Tiger Worldmasters for some time. The leaping tiger was first introduced in 1929 for the TS1, at the same time as was the roaring Lion (the latter never becoming a badge on a vehicle), and a magnificent enamelled version with the Leyland chrome-plated wings came out in 1950. This badge replicates the 1950s badge and the price, including postage and packing and the gift case, is the same as our other badges, ie. £7.00. Available at present from John Howie – address on the inside front cover of Torque, or via our website, **www.leylandsociety.co.uk**. To avoid disappointment, you should order as soon as possible.

APPEAL FOR HELP

We're looking for someone who would be prepared to volunteer to take charge of the Society stall and be able to attend 3 or 4 events annually – usually between April and October.

The stall and stock will fit into a car and ideally, you'd need to have a reasonably good knowledge of the Leyland brand – although you wouldn't be by yourself as Committee Members are often in attendance at these events and able to lend a hand. Reasonable expenses will be reimbursed. If you would like to find out more please message us or email theleylandsociety@btinternet.com

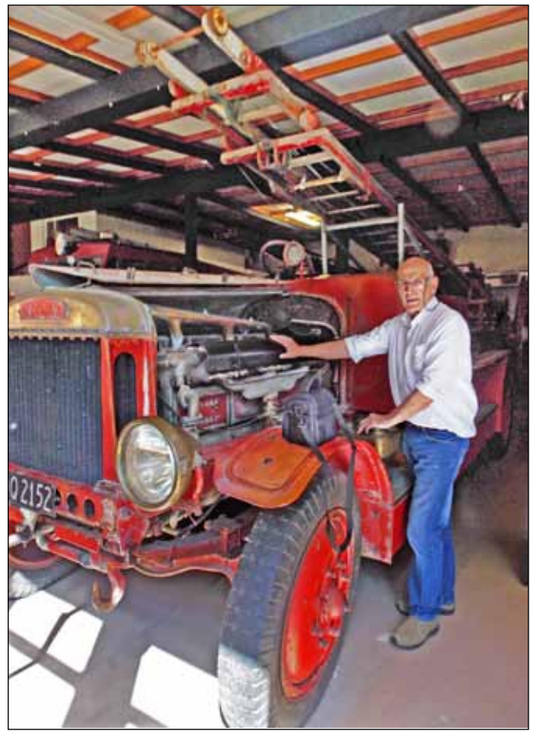
Each year we attend a number of events, including our Leyland Gathering, with our sales stall and a small stock of books, branded clothing and memorabilia. These events are an invaluable way to stay in touch and recruit new members, also to meet other owners of vehicles with a Leyland heritage.

DAVID BERRY

It is with great sadness that we have to report the death of David Berry, on 20th August at the age of 67. He had been our Society Chairman for over four years. David was taken ill just before our Gathering at Crich and wasn't able to attend the event, hence our rather makeshift Society stall at Crich.

David was one of our founder members, attending our first meeting at the British Commercial Vehicle Museum in 1998, joining the committee then as Vehicle Registrar. He took on the additional responsibility of Treasurer when Keith Watson went abroad and held those positions until late 2012. At that time he became Vice Chairman and also took over the responsibility for the Website and Society Sales, becoming Chairman following the untimely death of Neil Steele in the Spring of 2014.

David also took charge of our Society stall and attended many other rallies and events, giving our Society a professional presence at those rallies and attracting new members. At these events David was enthusiastically supported by Elizabeth; they made a very happy couple, getting married in September last year, the marriage being cruelly brought to an end within the first year.



David examines the ex-Dunedin 1924 Leyland F.E.3 (80hp) at the Yaldhurst Museum, NZ, in March 2018

The happy couple last year

David was born on 6th November 1950 and he and his first wife, Vanessa, had two girls, Miranda and then Jacqueline sixteen years later. From November 1971 he was a Retained Fireman for Wiltshire Fire Brigade at Ramsbury, later Wholetime Fireman, then Leading Fireman at Swindon. In October 1985 he moved to the position of Sub Officer for London Fire Brigade at Chiswick, later becoming Temporary Station Officer at Lambeth HQ. In 1993 he retired on medical grounds.

Whilst serving in Wiltshire he took over the running of the Brigade-owned 1950s Dennis F12 Pump Escape and kept it in pristine condition. As a result he joined the Fire Service Preservation Group in Dec 1978 and remained a member for many years. During his time in the FSPG he was Chairman and subsequently the 5th President in 1995. After moving to London he was unable to look after the Dennis so he looked for a project. He then took on the ex-Bristol Fire Brigade Leyland Lioness Six fire engine. Having joined the Leyland Society and taking on more responsibilities, he resigned from the FSPG in 2001.

David was friendly, easy-going sort of person, he had a good sense of humour and kept us all in order at our committee meetings which were casual, friendly but to the point. He will be sadly missed by us all. ***MAS – Ed.***

The splendid Leyland Lioness Six

Two of the oldest vehicles at the event parked outside the Red Lion pub, the S3.30.T with Brush body dating from 1913 and the 1946 Interim Beaver Brewery Lorry. *(Peter Quinn)*

THE 2018 LEYLAND SOCIETY GATHERING

Our 2018 Gathering was held at the Crich Tramway Museum on Sunday 8th July and unusually this year we did not need to worry about the possibility of rain, but rather the opposite as the whole of the UK was basking in a heatwave! We had a total of 29 vehicles attending on the day, split between 16 lorries and 13 buses which is probably the first time we have had more lorries than buses at the event. This year, to celebrate the formation of British Leyland and the resulting amalgamation of many British companies under one organisation, we extended the invitation to all marques within the British Leyland commercial vehicle range. It was pleasing to see some new vehicles attending and if any members would like to give us feedback on continuing this idea in future years we would be pleased to hear from you.

A wide selection of Leylands of all ages attended, many being regular attendees but also some that had not been to the event for some years, as well as some new ones. The Red Lion pub in the Tramway Village provided a period backdrop for photographs so the oldest vehicles were parked nearby, these being the Beaver TC7 of W. H. Bowker, Mike Sutcliffe's S3.30.T Barnsley & District single-decker bus and the Interim Beaver entered by Paul Wotton, which of course had to be parked outside the pub as it was a brewery lorry!

William Bowker's magnificent 1933 Beaver TC7. *(Peter Quinn)*

Gordon Brooke's Yorkshire Woollen PS1 Tiger enters the tramway through the famous Bowes Lyon Bridge. (Peter Quinn)

The long door version of the LAD cab is fitted to this Albion Clydesdale chassis with platform body and dummy load. Manufactured in 1969, it entered service with registration YWU 613G and is powered by a Leyland O.401 engine. (Gary Dwyer)

The rounded lines of the short door LAD cab fitted to the 1960 Comet show the contrast in construction technique when compared with the simpler design of the Weymann bus body of the 1961 Leopard L1, which was new to Halifax Corporation. (Gary Dwyer)

A pair of tippers contrast the simple lines of the earlier version of the C40 cab fitted to the 1985 Constructor 24.21 against the restyled grille fitted to the 45.130 produced in the Leyland DAF era, although the common parentage is clear. (Gary Dwyer)

Almost all of the different lorry cabs used by Leyland over the years were on display at the event, the Mouthorgan cabbed lorries were represented by a Comet of Brian Thomas and the Steer entered by Matthew Wright who drove all the way from Leyland! It was also good to have some LAD cabbed vehicles at the event, the short door version being seen on the Comet of John Thomas and the Albion Clydesdale of Andrew Oakey from Worcester had the longer door variant. The lighter weight Redline range built at Bathgate was represented by a relatively rare Chieftain tractor unit entered by Darren Oxley. Despite the long production duration of the Ergomatic cab, the only representative was the AEC Mercury of Trevor Diggins, although the Bison of John Bateman could technically be included in that category but it had been fitted with a modified T45 cab by the MOD, making it look a more modern vehicle. The T45 range is becoming better represented at our events now and Jeff Sproston brought along his Cruiser 16-26 with a Constructor 6 on the trailer, accompanied by their 45 Series tipper which was the newest vehicle at the event and is still used for local sand and aggregate deliveries. Neil Garlick brought along his smart Constructor 6 tipper restored to a high standard in a livery similar to that used by Tarmac.

There was an equally wide selection of buses and coaches at the event, from the early bonneted designs through to some of the last of the modern models. Apart from Mike's S3.30.T Combination Car, the other earlier single-deckers attending were limited to Terry Ellin's Duple bodied Comet ECPO/1R and Gordon Brooke's half-cab PS1 Tiger with Brush bodywork to a standard BEF design.

Unusually, there were two Burlingham bodied coaches attending, both entered by Bernard Rogers. Outwardly they looked of similar construction but one was built on a Tiger Cub chassis whilst the other was on a very rare Guy Arab underfloor chassis. The Leopard was the most popular underfloor engined single decker of the 1960s of which two were on display, the luxury of the Harrington bodied coach entered by David Prescott provided a contrast against the more utilitarian Weymann bus body example entered by Kelvin Waites. A relatively rare Leyland chassis that has survived into preservation was the MCW bodied Panther of Norman Johnstone which was very different in specification from the standardised design of the first production National 2 which travelled from Hull to the event. Double-deckers included the London Transport RTL of Graham Branch and two rear engine double-deckers were on display, a Hull Corporation Roe bodied PDR1A/1 Atlantean (recently featured in B&CP magazine) and a Northern Counties bodied Olympian of Redfern Travel which is still operated, together with several similar vehicles, on school services.

We would like to say a big "thank you" to all vehicle owners who brought their vehicles to the event in such hot conditions. We appreciate that older vehicles can be hotter and harder to drive than more modern vehicles but on the other hand, modern vehicles, with larger windows can become very hot in the summer sunshine without good air flow through the saloon. The vehicle parking was rather more restricted than our previous event at Crich, resulting in the need to use many different locations around the site, and we thank all drivers for their patience and flexibility in manoeuvring into the parking locations. However, it was a more intimate gathering with virtually all of the vehicles in and around the tramway street.

The location for next year's event has not been confirmed yet but we plan to announce the details in the next issue of Torque and we hope to see you all there. At this stage however, we're not sure that we can guarantee the same good weather as this year!

The simpler lines of the 1961 Ribble Leopard L2 with Harrington body contrast with the more ornate design of the two Burlingham Seagull bodied Tiger Cub and Arab coaches although they were only built a few years apart. (Peter Quinn)

The standardised design of the National 2 contrast with the bespoke design of the MCW body of the Preston Corporation Panther PSUR1/1. Parked nearby is a 1986 Cruiser 16-26 tractor and low loader trailer carrying a 1984 Constructor 24-21 tipper. (Gary Dwyer)

The newest vehicle at the event was the 45 Series tipper powered by a Cummins B Series engine. It was new to Swift Transport of Glasgow before being restored by Mr Sproston, who still use it as a revenue earning vehicle. (Gary Dwyer)

WHAT LEYLAND'S DOING

(The title of a weekly publicity publication once produced by Leyland Motors Ltd)

By Steve Whelan

Leyland Trucks training develops workforce for the future

- Leyland Trucks Engineering Career Pathway (ECP) scheme is now 3 years-old
- Structured workplace training to make the best of internal talent
- First alumni (students) secure new roles at the company

Leyland Trucks is reaping the benefits of a unique employee training scheme designed to harness the talents and enthusiasm of existing employees and encourage them into engineering. The Career Pathway scheme was first introduced at the company's Lancashire manufacturing facility in 2015, offering employees full-time training across a broad range of roles, to improve their skillset and widen career options. The scheme initially focussed on engineering but is now expanding to provide opportunities in other business areas.

The two-year scheme allows employees to dedicate 100% of their time to learning, leaving their current role, and embarking on structured rotations in assembly engineering, supplier quality assurance and design engineering. In addition, participants are encouraged to complete further education in engineering related courses, to expand the applied learning gained on each rotation.

Now, the first employees to complete the scheme are one year into their new roles. Josh Little (30) from Preston, started work at Leyland Trucks as an apprentice 11 years ago, and is now a Commodity Manager in purchasing. He said "My background was electrical engineering and I had worked on different production and manufacturing engineering functions. I saw the ECP route as a way to progress these skills further, but I didn't realise just how much we would learn. The scheme exposes you to departments you wouldn't usually see, for example, manufacturing wouldn't have day to day contact with the supply base, where I now work. It has certainly broadened my exposure to the wider company and without a doubt helped me progress and better achieve in my new role."

Sean Winstanley (27) from Chorley has also just completed his first year as a Design Engineer after completing the ECP, designing chassis and suspension systems. Sean started work at Leyland eight years ago as a prototype fabrication apprentice, spending four years as an apprentice and one year as full fabricator. He said "I am quite an academic person and knew that engineering was what I wanted to do. I met suppliers during my Supply Quality Assurance rotation, and gained a much deeper understanding of their processes, which helps the design process."

The ECP encourages participants to look to further education, with day release for university an option. Josh is about to start his final year of a Mechanical and Production Engineering degree at Lancaster University, and Sean is completing his final year of Mechanical Engineering at the University of Central Lancashire. Josh said, "The ECP made me re-evaluate my role and think about what I could do as my career develops. If friends and family ask me what the company is like, I always mention the ECP and the opportunities it has given me."

Leyland Trucks created the programme in 2015 to make sure that the talent fostered in its apprentice scheme was fully nurtured, and to give its locally-based workforce additional opportunities to further their professional education. Now in its fourth year, there are currently five employees on rotation in engineering, with a new Finance Career Pathway set up in 2017, on the strength of the engineering route.

HR Director, Ivan Shearer at Leyland Trucks, said "The scheme aims to build upon base knowledge and supplement with learned experience in other technical departments. It helps the business develop the skills and knowledge required for the future. Taking people out of their current roles and putting them into full-time training represents a significant investment for us, but we are fortunate to have a bank of talented and committed people employed at Leyland."

Left Sean Winstanley – Right Josh Little

FROM DAF TRUCKS LTD

By Robin Easton.

DAF partners with VDL Groep for fully electric CF truck

DAF Trucks is partnering with VDL to release a first series of CF Electric trucks into operation with leading customers in the course of this year. The vehicles feature state-of-the-art VDL E-Power Technology for zero emissions and ultra-low noise. These field test trucks will be manufactured by DAF and the full electric installation will be completed by VDL Groep, demonstrating the strong cooperation between both companies in the field of electrification of commercial vehicles. Their key features will be:

- State-of-the-art DAF CF Electric trucks, put into operation
- VDL E-Power provides for 100 km range and fast battery charging
- Zero Emissions in city distribution
- Ultra-low noise for quiet night-time deliveries

Customer First Technologies

"DAF has a strong history of developing innovative solutions to meet the evolving needs of our customers and we will continue to provide them with the full complement of appropriate technology choices to ensure their success", stated Preston Feight, DAF Trucks' president. "DAF was among the first manufacturers to introduce a hybrid electric distribution truck in Europe and has continued to develop hybrid and electric powertrains. As cities announce their intention to require zero emissions and ultra-low noise we will make sure our customers have the optimal solutions for their success."

VDL Groep: leader in commercial vehicle electrification

For the CF Electric, DAF is partnering with VDL Groep, also based in Eindhoven, The Netherlands. VDL is a technology leading company with substantial experience in commercial vehicle electrification, especially in the field of public transport buses. "VDL has proven itself as a leader in fully electric buses for public transport and has already delivered hundreds of electric buses to public transport operators throughout Europe", said Willem van der Leegte, president of VDL Groep. "Partnering with DAF on this electric truck is an exciting development and represents a tremendous opportunity for two Eindhoven based technology companies to lead the electric commercial vehicle world."

Driving zero emission in city distribution

The CF Electric is a 4x2 tractor unit developed for up to 40ton distribution applications within urban areas in which single or double axle semi-trailers are the standard. The truck is based on DAF's CF – 'International Truck of the Year 2018' – and uses VDL's advanced E-Power Technology for fully electric operation. The center of the intelligent powertrain is the 210 kW electric motor, which gets its energy from the lithium-ion battery pack with a current total capacity of 170 kWh. The CF Electric has a range of approximately 100 kilometers which is appropriate for high volume distribution applications. Quick charging of the batteries can be executed in 30 minutes or a complete full charge can be accomplished in as little as 1½ hours.

Technical Spec. Summary

Tractor weight	9,700 kg
Electric motor	210 kW
Torque	2,000 Nm
Battery pack capacity	170 kWh
Full electric vehicle range	100 km
Quick battery charge	30 minutes
Full battery charge	1½ hours

FOOD FOR THOUGHT

Compiled by John Howie
All correspondence to Mike Sutcliffe

(We are now very short of new items to include in Food for Thought so please put your thinking caps on and come up with some more problems and queries to be solved. Thank you – Ed.)

287. Hants & Dorset / Chisnell PD2s

The subjects of stock-build PD2s and PD2s with crash gearboxes have been raised several times now and have generated a lot of interest. These topics are therefore to be dealt with separately and will be the subject of articles in forthcoming issues of Leyland Torque.

The Leyland Standard 500 Gal Pump in 1919 (BCVMT L000095)

296. Leyland Fire Engine

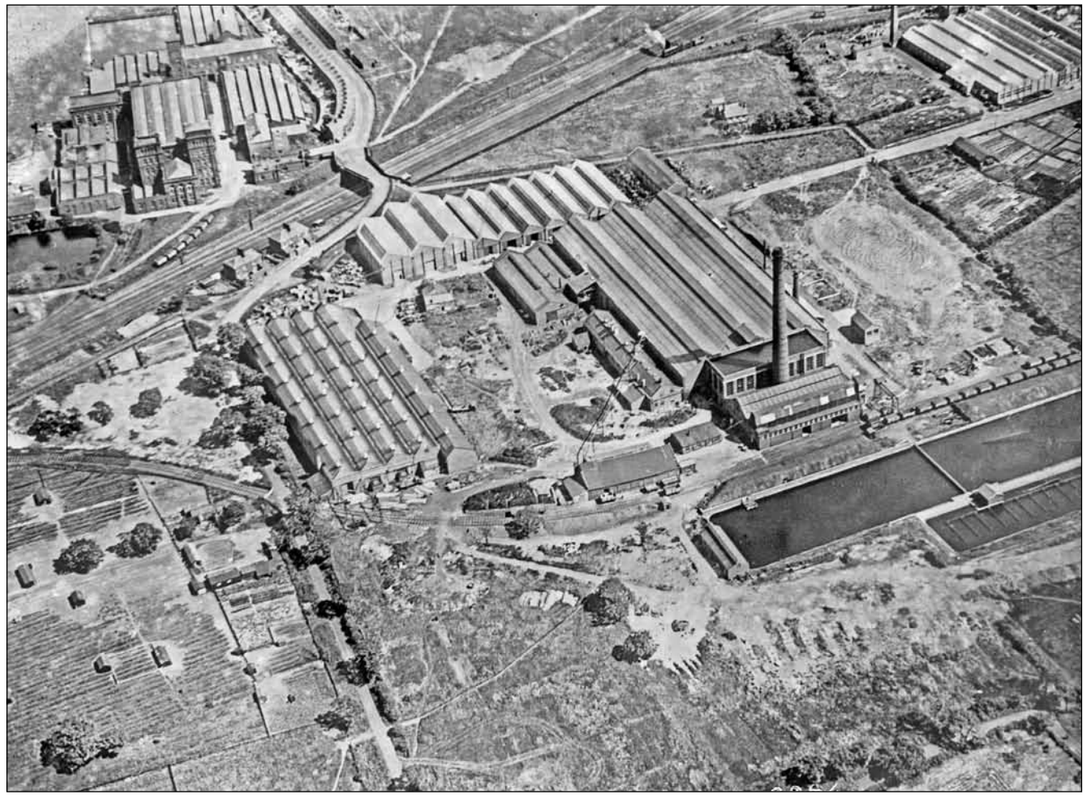
Mike Sutcliffe has the answer regarding the queried Leyland Fire Engine photo found on Facebook by **John Meakins** (see Torque No.78). It is a Leyland Standard 500 Gal. Pump, possibly used at the Farington Works around 1920 and certainly looking the worse for wear. It is pumping from a local brook to fill one of the new lodges (reservoirs) for the Farington Foundry at Leyland Motors, to supply the boilers at the back of the Foundry. More of what's going on can be seen from the rest of the photos in the sequence showing the lodge being filled and some of Leyland's apprentices then enjoying themselves. Note the changing hut, unmistakably Leyland! The aerial view opposite, taken in 1931, puts it into perspective. For those who initimately knew the site:

- The two lodges are to the right, later filled in and built upon
- Above is the Foundry (3 bays) and Power House, built before WW1
- To the right of these, land upon which BX, Comet Factory etc were built
- Factory entrance, from Northgate, by Leyland Paints (top right)
- Later a new Engine Shop was built on land up to the railway lines
- LNWR/LMS Railway line, with Dewhurst's Farington Mills (top left)
- Railway bridge leading to Carr Lane and new Running Shop (later engines)
- Machine Shops (5 bays) – middle left
- Railway Branch Line / level crossing, for coal wagons (see trucks by lodges)

Anyone wishing to discuss the development of the site, please contact Mike Sutcliffe.

One of the two new lodges, surrounded by fields (BCVMT L000094)

Leyland apprentices were brave in those days! (BCVMT L000763)



The top end of the Farington site (BCVMT L008964)

299. New Zealand car transporters.

Still no-one has yet come up with any information on these two Leopard car transporters in New Zealand. The photograph is therefore repeated here in the hope that someone will have the answer – come all you Leopard enthusiasts!

306. Leyland Cub Fire Rescue Tenders

Simon Ryan has the following query for readers – In his excellent book 'Leyland Fire Engines 1930-1942' the late Neil Steele includes details of the three custom-built tenders with bodies built by Leyland to the specifications of the individual brigades, these were as follows:

	Model	Reg No.	Chassis No.
Glasgow Fire Brigade	SFK5	**BGG 305**	13150
Liverpool Police FB	FK3	**LV 5010**	1467
Rochdale Police FB	FK3	**DK 9584**	3014

(The Liverpool machine was known locally as a 'Light and Air Van', a name it took from an earlier Dennis tender and originally the name was borne by a modified steamer which carried an air pump and a generator).

In addition to the above he has traced three more FK chassis which were used by UK Fire Brigades as Rescue Vans or Tenders. These appliances were as follows:

Kingston-upon-Hull Police	FK?	**RH 5333**	?
Nottingham Police FB	FK?	?	?
Oldham Police FB	FK?	?	?

The Hull Tender was bodied by the Kingston-upon-Hull Cart Works and was delivered in 1932, while Nottingham's may have been as late as 1940. Two seem to have used a standard commercial van body which was then fitted out internally, probably locally in some cases using firemen who were also skilled tradesmen.

He knows that the Cardiff Police Fire Brigade operated a Special Equipment Tender in the 1930s but has so far been unable to confirm a make. Other

Brigades such as London, Birmingham and Sheffield used Dennis chassis while Stoke had a Morris Commercial, and Manchester opted for a Bedford for their Rescue Tenders.

If any member has chassis numbers or indeed any further details of these three appliances, Simon would be delighted to hear from them, via Mike, to shed some light on these forgotten vehicles.

307. Leyland Bison TSG1

Mike Sutcliffe saw this Leyland Bison, **WX 8873**, a model TSG1, chassis 67767 (new to the Cleveland Oil Co in January 1932) at the Philpp sale in June 1995. It was in a sorry state but definitely restorable. Does anybody know if it still exists and if so, what state it's in?

308. Leyland Atlantean PDR1/1

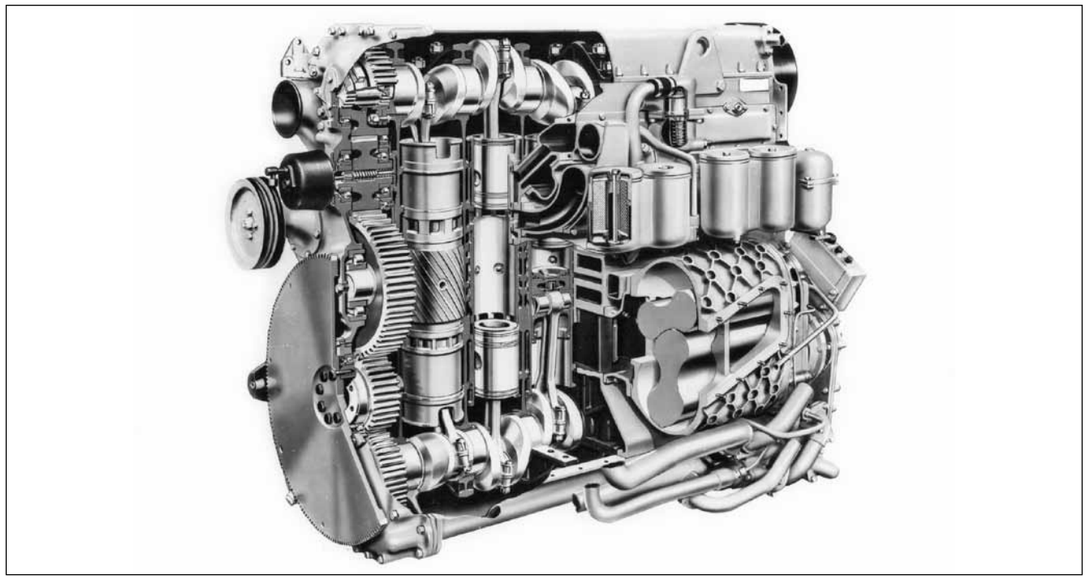
Roger Monk has sent this picture of a Mexborough & Swinton trolleybus replacement Atlantean, photographed by his father **Alfred Monk** at Victoria Coach Station on 26th July 1960, possibly on delivery from Weymann, Addlestone. Does anyone know what it was doing there accompanied by some 'officials,' possibly staff of a trade magazine (***Commercial Motor***?)

THE LEYLAND L60 - Part 2

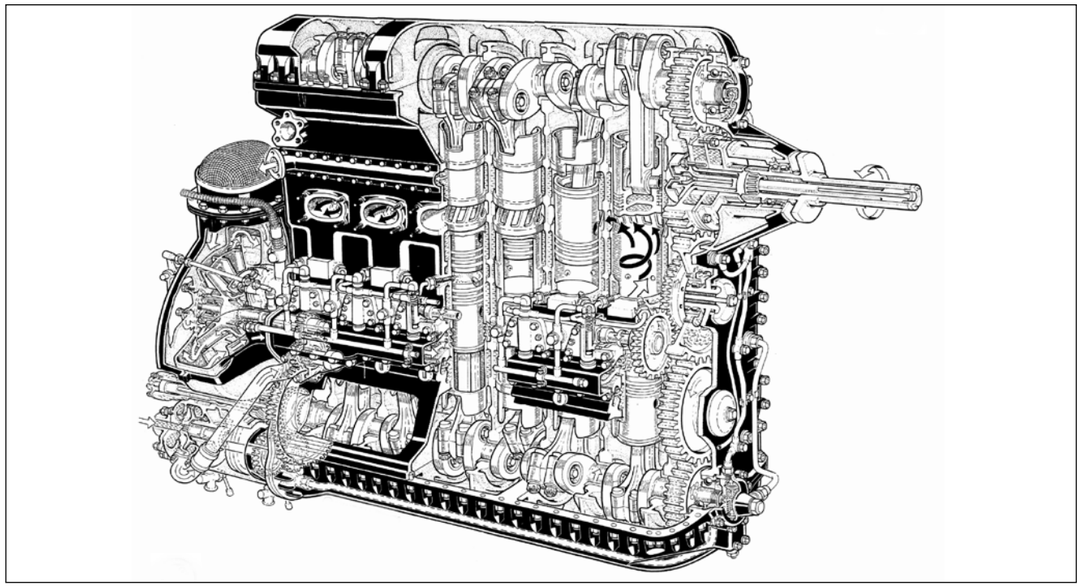
DEVELOPMENT OF THE TWO-STROKE OPPOSED-PISTON MULTI-FUEL ENGINE

By Bill Pitcher

In Part 1, Bill set the scene with the recent history of engines for British tanks prior to the L60, he also included the thinking beind the introduction of the multi-fuel L60 opposed-piston engine. On pages 11 & 12 of the last issue of the Journal the printers put in the wrong photograph on page 12 and we missed this in the proof checking, so both pictures are included below for comparison, before we proceed with Part 2.



Cross section of an L60 engine showing the opposed-piston design and two lobed Roots scavenge blower.



Cross section of a Junkers Jumo 205 diesel opposed-piston engine, included to illustrate the similarities with the L60 engine. This engine was fitted with a centrifugal scavenge blower.

DEVELOPMENT OF THE LEYLAND L60 TWO-STROKE OPPOSED-PISTON MULTI-FUEL ENGINE

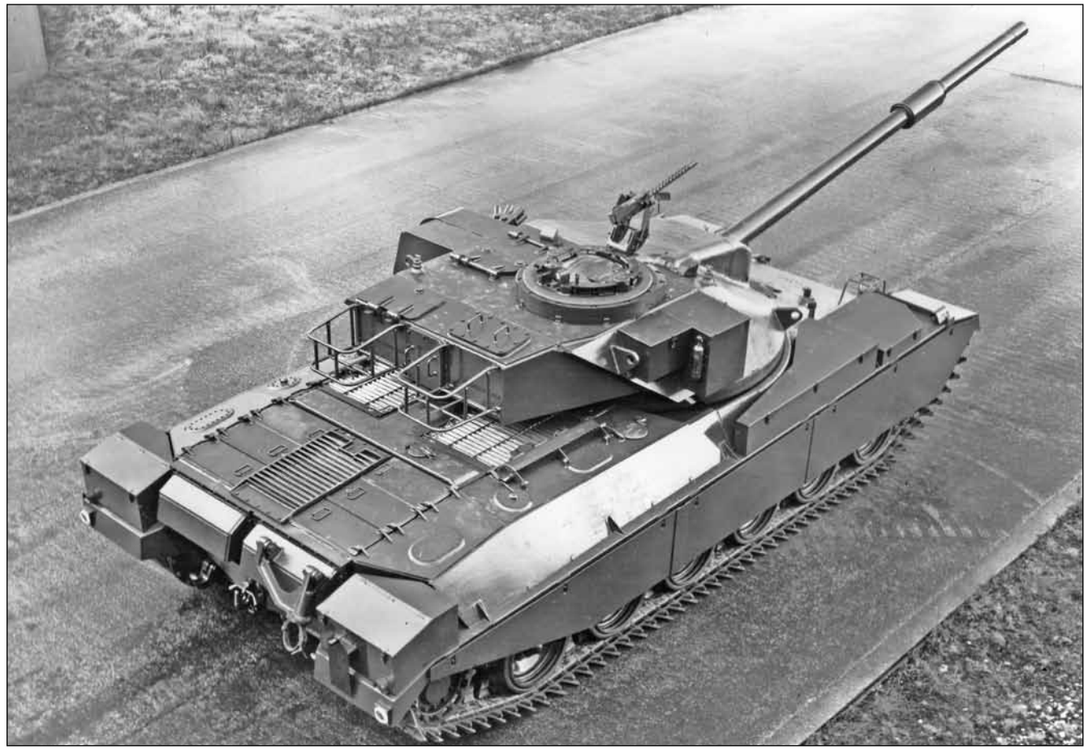
Although the story of the Chieftain tank can be traced back to the early 1950s, work on the L60 engine only began at the end of that decade. This was due to several reasons, the initial aborted attempts to use a V8 or V12 engine, the NATO directive for multi-fuel capability and the increasing weight of the tank due to design changes. Initially Leyland Motors was tasked to not only supply engines for the Chieftain but also to build prototype vehicles – they provided six prototypes between 1960 and 1962 numbered P1 to P6. Eventually however the supply of further vehicle prototypes fell to the Royal Ordnance Factory in Leeds and Vickers Armstrongs based in Elswick in the North East, leaving Leyland to concentrate on the design and development of the L60 engine.

As was the case in the early stages of development of many engines prior to the introduction of computer modelling, initial work on the Leyland L60 engine was in the form of single cylinder engine testing. This method of development has several advantages, material and component costs are reduced, component and design changes can be made relatively quickly, tighter control over test conditions can be obtained and changes to fuel injection equipment, injection timing and combustion processes can be evaluated in a timely manner. Leyland continued to utilise single cylinder testing and I can still remember a single cylinder test cell in use in the Research Department at Spurrier Works in the 1980s that was used by the Advanced Technology engineers. Even today there are still companies such as MAHL and AVL offering development services using single cylinder engines and they remain popular with universities for research purposes.

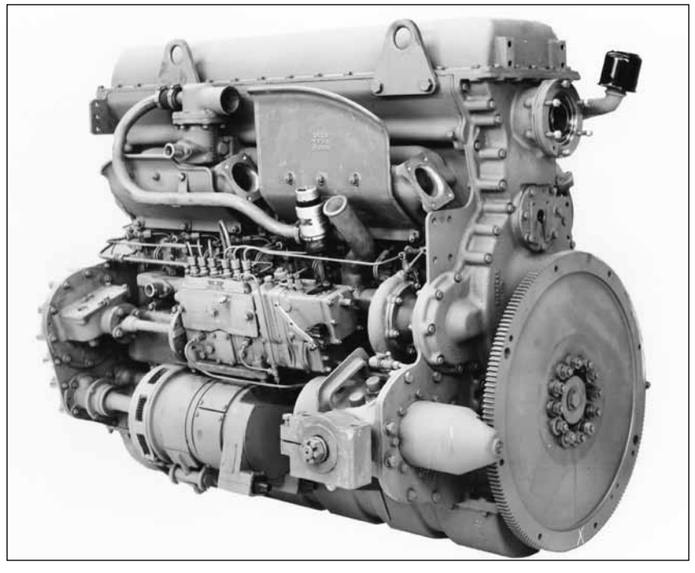
Following the initial design and development, the first prototype engine was made available for test in 1959. This was cutting things fine to say the least as the first prototype vehicle was supposed to be delivered for trials in 1960. As with most new engines and considering the relatively unorthodox design of the L60, it will come as no surprise that testing revealed a number of problems relating to the cooling system, fan drive, lubrication and excessive smoke (something that haunted the engine for most of its service life). One can only imagine the amount of pressure Leyland's engineers were under to resolve these issues and keep the programme on time.

Another problem identified during initial testing

Left hand view of a prototype FV 4201. The lettering on the sloped front of the hull although difficult to discern appears to read "FHL FV340243 LML". All fighting vehicle components carried FV part numbers so it could be the part number of the hull or casting. The turret design is different from the design seen on the Mark 1 Chieftain and the gun is possibly a mock up. The large circular object attached to the turret was called a light projector (searchlight).



A rear overhead view of the same tank. This photo was possibly taken from the bridge on the old test track at Spurrier Works. Further differences from the Mark 1 tank can be seen in the grille area above the transmission compartment.

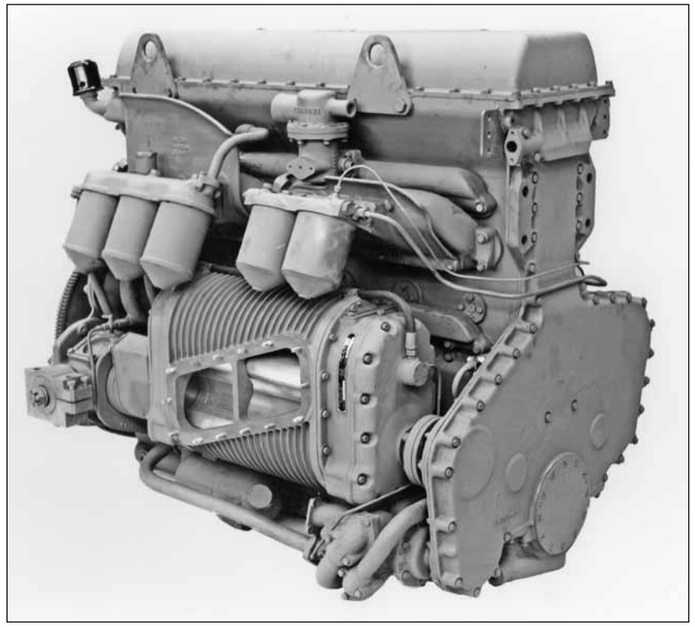


Left hand side of an early prototype L60 engine. This view is very interesting as the CAV fuel pump only has six delivery elements. Closer inspection of the photo shows that each injector pipe appears to split at the cylinder block end to feed two injectors per cylinder. The fuel pump fitted to the production version of the engine had twelve elements allowing for independent control of each injector, one injector per cylinder providing pilot injection to aid combustion to satisfy the multi-fuel requirement.

was the presence of excessive torsional vibration particularly at lower engine speeds. This is a common problem in internal combustion engines and affects the crankshaft (the L60 being an opposed piston engine design has two crankshafts). Vibrations are triggered by the firing and compression strokes creating pulsating torques rather than steady unidirectional torques. To compound this, two-stroke engines, due to greater stroke length and bearing arrangements, produce larger torsional vibrations. If remedial action isn't taken failure of the crankshaft or failure of auxiliaries driven by the crankshaft can occur. Leyland's answer to this was to fit viscous dampers to both crankshafts. Torsional vibration measurements would have been taken by Leyland's engineers, probably working in conjunction with engineers from the damper manufacturers who would then have designed dampers "tuned" to reduce the vibration to acceptable levels. Unfortunately,

as with many engineering solutions, this had the effect of creating another problem. Fitting the dampers added to the overall length and weight of the engine which required a redesign of the tank hull that added even more weight to the vehicle, estimated to be approximately one ton.

During my research I was fortunate to have access to a considerable amount of material including a folder titled "PHOTOGRAPHS MEDIUM TANK F.V.4201" issued by "Leyland Motors Ltd, Fighting Vehicles Division, Leyland, Lancashire". The two photographs of the prototype F.V.4201 (the name Chieftain only came into regular use in 1961) and the two photos of the early L60 engine are reproduced from this folder. I haven't seen these images anywhere else so it's likely that their appearance in this publication will be the first time they've been seen by a wider audience.



View of the right-hand side of the same engine showing the large Roots scavenge blower (without its intake ducting fitted). This view is also interesting in the light of the comments above regarding torsional vibration problems as neither the top or bottom crankshaft is fitted with a viscous damper, again suggesting that this is a very early version of the engine.

Whilst Leyland's engineers were wrestling with the problems identified during initial testing they were also having to overcome the challenge of making the L60 run on multiple fuels. It had already been recognised that two stroke engines offered benefits in this respect when compared with more conventional four stroke designs but there would still have been a need to optimise some areas of the engine's design. I have found several references to multi-fuel operation but none really explain what work was carried out to ensure that the engine could operate satisfactorily on a range of different fuels. However, based on what I have managed to discover and from my own experience of engine development and testing, two areas that engineers concentrated on are the fuel injection system and combustion optimisation.

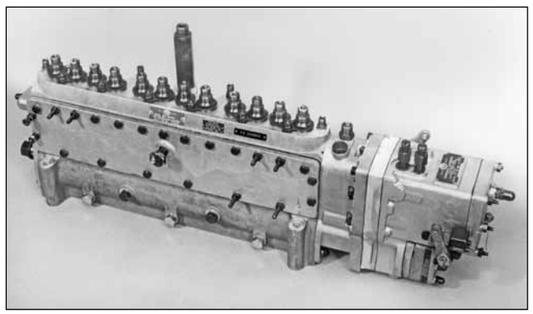
Fuel injection system

The following extract was taken from a technical publication and it gives an indication of the considerable challenges Leyland engineers were faced with: "The War Office specification requires that the engine should operate without sacrifice of power or reliability on a range of fuels comprising the following grades or a mixture thereof: (1) on diesel fuel of 47 cetane rating to specification DEF.2402; (2) on AVTAG, a wide cut aviation turbine gasoline, to D. Eng R.D.2486; (3) on service gasoline to DEF.2401; (4) on combat gasoline to DEF 2401. The gasoline's mentioned cover octane ratings of 74 to 80.

To develop an engine to deliver the desired performance and reliability for a military application is difficult enough even when you've only one fuel to contend with, but to try and achieve this with a wide variety of fuels with differing ignition characteristics and to achieve this with little or no adjustment to the engine must have been well nigh impossible. To give some background to fuel properties, a normal road diesel fuel at the time was blended to have a cetane number of around 48 to give good combustion in a diesel engine. Cetane number is an indication of the auto-ignition characteristics of a fuel when injected into an engine cylinder; higher cetane numbers give better combustion. Gasoline fuels are defined by their octane numbers, typical values being in the 90s and require a positive ignition system (spark plug and coil). Gasoline fuels with high octane numbers generally have low cetane numbers and therefore give poor performance in diesel engines and can damage the fuel injection equipment as anyone who has mis-fuelled their diesel car will tell you! Military grade gasoline is also poor quality so developing the L60 engine to meet these conflicting requirements would be very challenging today using modern electronic control systems, never mind trying to achieve this with a purely mechanical system available in the late 1950s. The multi-fuel requirement could be the reason behind the adoption of the two fuel injectors per cylinder, one injector giving a small pilot injection of fuel early in the engine cycle to increase the gas temperature and pressure in advance of the injection of the main fuel delivery. This gives the advantage of injecting the main fuel delivery into a higher temperature environment leading to better combustion which can improve combustion efficiency with poor fuels. However, this type of system requires careful optimisation - the penalty for getting the relative timings of the two injectors wrong can be higher smoke which was a known problem of the L60 engine.

During my research I have had access to two operating/service manuals, the first titled "User Handbook for Tank, Combat, 120-mm Gun, Chieftain, Mk1 and 2 1966" and the second titled "Technical Handbook for Vickers Main Battle Tank Mk1 105-mm Gun 1968". The Vickers MBT was developed as a private venture by Vickers-Armstrongs for export and was powered by a de-rated version of the L60 engine. It was also produced under license in India and known as the Vijayanta. Interestingly both manuals contain statements relating to the fuel injection equipment and the possibility of operation of the engine on fuels other than diesel.

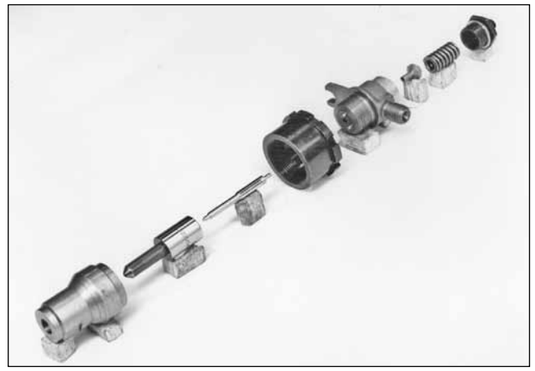
In the Chieftain manual it states "The fuel injection pump situated on the left-hand side of the engine is shaft driven from the rear gear train. The pump is designed to operate on a variety of fuels and is an adaptation of the camshaft type, diesel fuel injection pump in which a system of internal lubrication is embodied" and "The engine can be considered as a two stroke, compression-ignition engine, with multi-fuel capability. A change to a fuel other than the normal DERV will only be authorised on a Command/Theatre basis, when conditions make this necessary". The fuel pump was supplied to Leyland by C.A. Vandervell (CAV) who also supplied fuel pumps for Leyland's commercial engines.



CAV fuel pump, two delivery ports per cylinder, one for the pilot injector one for the main injector. The lighter coloured casting attached to the end is the hydraulic governor. Note that some of the adjustment screws on the governor have been wired together to prevent tampering.

The Vickers manual contains the following statement "The L60 engine must be run on diesel only, until use of one of the alternative fuels is sanctioned officially, as damage to the engine may result unless the fuel system has been adjusted to suit the new fuel".

In a Leyland Motors publicity brochure for the L60 engine issued in 1966 it states that the fuel pump has a "two position control", one position is for operation on diesel fuel and the other for petroleum fuel. It further states that "one set of nozzles (injectors) provides pilot injection in advance of main fuel injection to assist combustion propagation".



Exploded view of a fuel injector showing the nozzle, needle and spring. The spring tension could be adjusted to alter the opening pressure of the injector, determining the optimum opening pressure would have formed part of the fuel injection development.

It was difficult to track down further information on the fuel injection system but eventually I located a company called Peter Slater Fuel Injection Engineers and Peter was able to supply me with some information on the fuel pump and governor specification and modifications. Peter's company specialises in supplying spares and reconditioning of older types of diesel fuel injection equipment from the 1940s onwards and covers fuel pumps, injectors, governors, lift pumps and their associated parts.

Fuel pump type 217.
Produced to F.V.R.D.E. Specification.
Stage II plunger elements fitted (back spiral cut into the element plunger to aid lubrication with the different fuels it would encounter).
A.11 camshaft profile with a firing order anticlockwise 1-12-11-4-3-8-7-6-5-10-9-2.
Camshaft extended at No 1 end to suit closed circuit governor at No.2 end.
Oil seal at No.2 end incorporated to governor specification.
Control rod cover at No 1 end. The control rod is sealed by rubber bellows at No.2 end.
Lubricating oil is fed to the centre bearings by drilled gallery from the fuel pump.
The tappet assembly incorporates needle roller bearings.

Governor type L/R H 89 as standard unit but with extra additions.
Closed circuit having a chamber for use as an oil reservoir.
Built-in remote control excess fuel device.
Short manual operated control lever on pump in horizontal position on inspection cover side.
Governor to be filled with oil via hole incorporating a dip stick.
A high-speed gear pump fitted.
Two oil seals with "tell tale" leakage hole on camshaft.
Two rubber bellows fitted on control rod.
Orifice piston having two 3.85mm holes.
Stopping lever return spring omitted at customer request. Customer fitting external spring in lieu.
Three longer studs on LH side for fitting customer bracket.
All studs fitting governor housing, sandwich plate and oil chamber increased in length by 4mm.

Omitted from both manuals are any instructions on what adjustments might be needed to the fuel system should a situation arise where diesel fuel was unavailable, although in the Chieftain manual there are instructions on the precautions to take if filling the vehicle tanks with gasoline. I have read that far from being a simple process to swap from one fuel to another, it could take upwards of eight hours to effect the change! Unfortunately, I've not been able to ascertain what if any adjustments were indeed needed, or if it was just the case that the military had so little confidence that the engine would run reliably on any fuel other than diesel that it was to be avoided at all costs. Standard diesel fuel injection equipment relies on the lubricity of the fuel to avoid damage to the pump and injectors. Gasoline has inferior lubricity to diesel fuel so any operation of the engine on gasoline would have resulted in a high rate of wear to those critical components, significantly reducing operating time before serious damage occurs so, as stated in the Chieftain manual, operation on any fuel apart from diesel would only be permitted in an emergency situation. All the literature I've read during my research confirms that ironically while in service with the British Army the Chieftain tank never ran on anything other than diesel fuel!

Combustion design

"The ability of an engine to run on a wide variety of fuels, including those of low ignition quality, depends on many factors many of which are interrelated. Good basic combustion efficiency is a first essential. This must be coupled with low heat losses both during compression and the subsequent ignition period. This is necessary in order to maintain effective burning under all conditions of speed and load. A reasonably high compression ratio is also favourable but must enable component loads to remain within the limits of the engine structure. Thus, proper distribution of the fuel and air in the correct proportions must take place at a high combustion temperature" (extract from The Development of Multi-Fuel Engines 1960).

In a conventional four stroke diesel engine combustion takes place in the space between the underside of the cylinder head and the top of the pistons with a compression ratio of around 16:1 to 22:1, the high compression ratio raises the temperature of the inlet air sufficiently to spontaneously ignite the injected atomised diesel fuel. The timing of fuel injection and exhaust and inlet valve opening and closing is referenced to top dead centre (TDC), the point at which the piston is at the top of its stroke. The action of the pistons also promotes the induction of intake air and expulsion of exhaust gases.

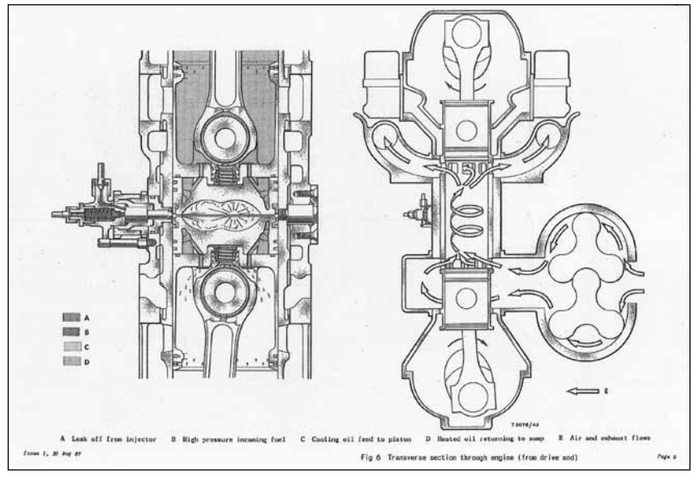
However, in the two-stroke opposed piston L60 engine there is no cylinder head and pressure is generated during the compression stroke in the space between the two opposing pistons as they approach each other. There are also no valves, inlet air and exhaust gases pass through ports in the cylinder liners as they are covered and uncovered by the pistons. The lack of a cylinder head reduces heat losses and thus helps to increase combustion temperature.

You might assume that each piston would reach TDC at the same time, but Junkers during the design and development of the Jumo 205 engine found that this was an unsatisfactory arrangement as it didn't promote good scavenging (scavenging is the process by which exhaust gas is simultaneously purged from the last cycle and fresh intake air is drawn in for the next cycle). Junkers answer was to time the upper piston (exhaust) to run eleven degrees ahead of the lower piston (air), which allowed the residual cylinder pressure to blow

Photo showing the complexity of an L60 cylinder liner. The rectangular shaped orifices either side of the centre of the liner are the exhaust and air ports, the two large threaded holes positioned in the middle land are for the two injectors and, although not obvious from the photo, the outside diameter of the liner is tapered. Obtaining a good seal between the liner and the cylinder block was a problem throughout the life of the engine, at various points along its length it had to contend with air, coolant and exhaust. As a critical engine component, the manufacturing process was subject to stringent quality control including crack detection.

the exhaust out of the cylinder ahead of the incoming air scavenging the cylinders before the exhaust ports were covered again prior to the compression stroke. In principle, the timing requirement is no different to a conventional engine for good gas exchange but due to the configuration of the L60 engine it had to be achieved in a different way. Leyland's engineers adopted a very similar arrangement but with a lead timing of 12 degrees. We can only speculate whether Leyland engineers came up with this solution during the development stage of the L60 or were influenced by the Junkers design?

Intake air is supplied to the engine via a Roots type blower driven from the gear train and fitted with either two or three lobe rotors depending on the Mk. of engine. As a rule, Chieftain engines were fitted with three lobed rotors and sales or export engines with two lobed rotors. Air is drawn through the air cleaner and forced into an air jacket where it is kept under constant pressure by the rotation of the rotors. Unlike a turbocharger that is driven by waste exhaust gas, Roots type blowers are gear driven, each rotor having its own gear so that a clearance is maintained at all times between the lobes. The boost pressure is therefore directly related to engine speed, giving more constant pressure over the speed range, but, being directly driven from the crankshaft this results in parasitic losses and reduces the overall power output. Interestingly, studies were made into changing the engine to a turbocharged configuration, but it is not known if this was ever tested. The engine efficiency would have been improved but possibly at the expense of low speed torque which is a key performance requirement to get a tank moving from standstill.



Transverse cross section through engine viewed from front. The left-hand schematic shows the pistons at the point of fuel injection. The right-hand schematic shows the flow of intake air via the three lobed Roots blower then in through the ports in the cylinder liner and the exhaust gas flow through the exhaust ports at the top of the liner.

Of further importance to promote good combustion is the design of the piston. Early testing of the engine indicated that "in-cylinder" temperatures of 650 degrees C were being reached, well in excess of the predicted 300 degrees C and this led to premature failures. To overcome this oil cooled pistons were introduced made up of a heat resisting steel crown and a cast iron body. A toroidal combustion chamber was machined into the piston crown to aid mixing of the atomised fuel and the hot compressed air. Introducing oil cooling was a double-edged sword, in-cylinders temperatures were reduced but this had a negative effect with regards the multi-fuel capability.

Other design features of note

Although the L60 engine has two crankshafts they are geared together to provide a single output that rotates at 1.25 times crank speed, in the Chieftain the output shaft was connected to a Self-Changing Gears TN12 transmission. Leyland Motors coincidentally wholly purchased Self-Changing Gears from Hawker-Siddeley in 1957. Although geared together a proportion of the power produced by the bottom crankshaft (air) drove the fuel injection pump, lubricating oil pumps, scavenge blower and generator with the upper crankshaft (exhaust) providing most of the main drive.

The lubrication system was of the dry sump type. Oil was stored in a separate tank and was drawn from the tank by a pump, circulated through a heat exchanger before travelling round the engine and dropping into a sump. The oil was then taken from the sump through use of a scavenge oil pump and returned to the storage tank.

For installation in the Chieftain the L60 was supplied as a power pack incorporating the following units:

- Fans and fan drives.
- Fan cowls and header tanks.
- Radiators.
- Panel type air cleaners.
- Heat exchanger for transmission.
- Hydraulic starter motor.

This configuration facilitated removal of the engine for maintenance purposes and a well-trained crew could change a power pack in 2 hours with the aid of an FV434 Armoured Repair Vehicle. This time was significantly less than that taken to change a Centurion engine that could take anything between 12 hours up to 2 days! The thinking behind the power pack concept was that it was thought that the longest tanks battles would not last longer than two hours and that this would be the maximum time the engine

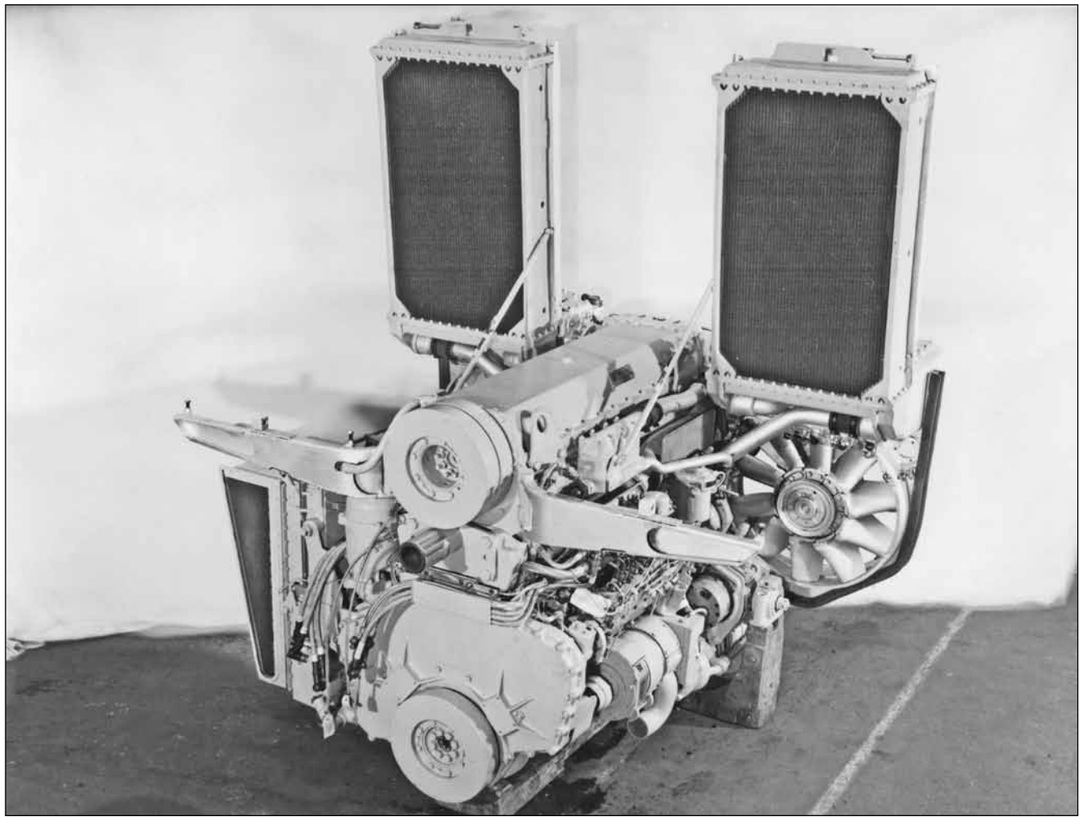
might be expected to run at full power. Hence it would prove beneficial if the power pack could be swapped out for a new pack in the shortest time possible.

When the specification for the Chieftain engine was first issued the target weight of the tank was 45 tons. However, following changes to the hull to accommodate the L60 engine, the weight of the engine itself, the fitment of a larger 120mm gun, changes to the track design and suspension, fitment of larger road-wheels and heavier armour, early Chieftains weighed in at a hefty 50 tons and this would eventually rise to 53 tons when battlefield ready (I've even seen figures of 55 tons quoted). It had been calculated using a power to weight ratio of 15.5 bhp per ton that a power output of 700 bhp would be required to provide sufficient power for the Chieftain, however using the same power to weight ratio between 775 bhp to 850 bhp would have been needed based on the eventual vehicle weight. This inevitably put a strain on the engine (and transmission) and undoubtedly contributed to its unreliability.

Following initial design, development and handover to the British Army the L60 engine went through a continual program of design changes, updates and upgrades over its production life, in an attempt to resolve 'in service' problems, increase power output and improve reliability. At each significant stage in the engines continued development it was given a new Mark number; I have listed these below and where possible have tried to expand on the work carried out and the reasons for it.

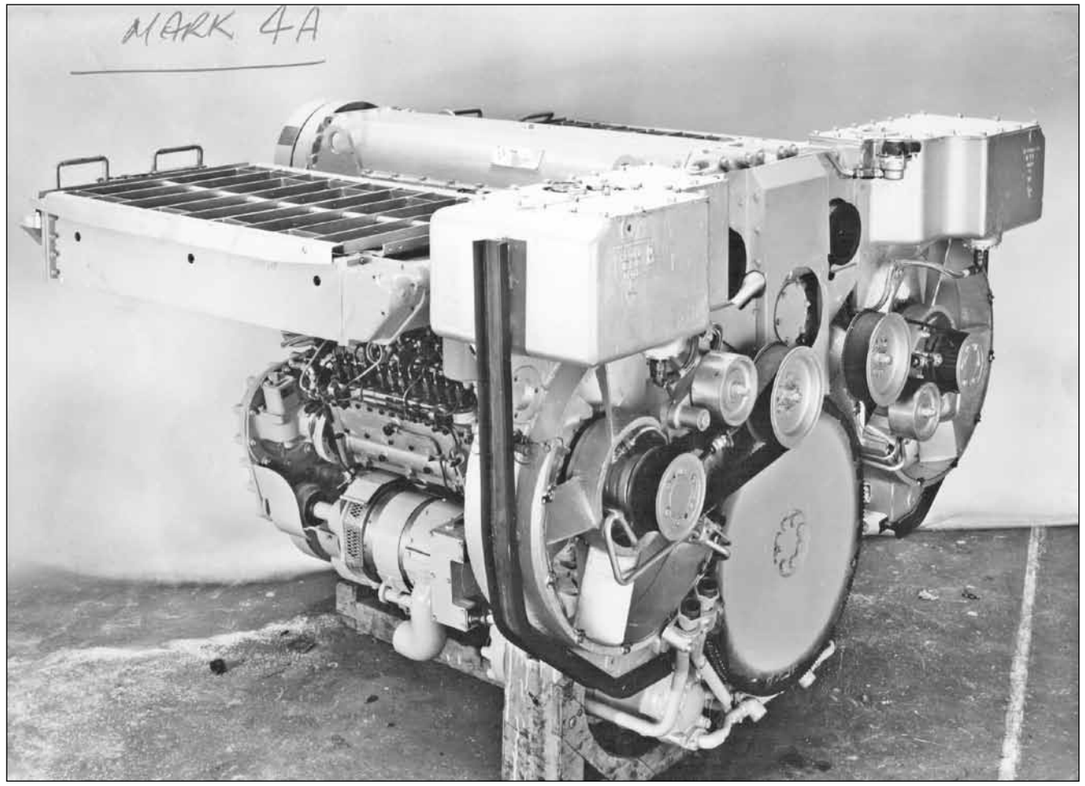
Engine Marks

- **Marks 1 to 4** – These were prototype engines built between 1959 and 1965, sixty were built. Testing on these engines highlighted numerous problems with oil and coolant leaks, white smoke, crankshaft torsional vibrations, air cleaner integrity etc. Mk. 2 engines were provided for trial in prototype Chieftains for the British Army on the Rhine (BAOR) in 1962 and further issues relating to unreliability and smoke were identified (water leakage past the cylinder liners into the exhaust was a contributing factor to the white smoke and sealing in this area remained a problem for much of the engine's life). The main complaint however was that the tanks were underpowered (I've read anecdotal evidence that said they were so underpowered they couldn't even climb the ramps onto the tank transporter!).



L60 engine in power-pack form. The two large radiators were hinged and folded down flat for installation into the Chieftain but raised for maintenance purpose to allow access to the engine.

- **Mark 4A** – This was the first production version built in 1965 developing 585 bhp. This engine was fitted into the Mk. 1 Chieftain. The power output was still well below that thought necessary to provide the Chieftain with the required on and off-road performance. (It would have been slower than the Rolls Royce Meteor powered Centurion it replaced). All the Chieftain Mk. 1's were used for training exercises.
- **Mark 4A2** – was effectively a Mark 4A engine with a new piston crown and developed 650bhp, it was released in November 1965.
- **Mark 4B** – A de-rated Mark 4A2 produced for the Vickers Vijayanta main battle tank that was built in India. At 39.5 tons the Vijayanta was considerably lighter than the Chieftain and performance at 540bhp (13.7 bhp/ton) would probably have been considered acceptable.
- **Mark 5A** – This engine, fitted to the Mk. 2 Chieftain, had a modified piston with oil cell and offset combustion bowl, new sump, pressure lubricated fan bearings and was produced in 1969 and developed 650 bhp.
- **Mark 6A** – Manufactured in 1970 incorporating a low loss two-stage air cleaner and developing 650 bhp. Fitted to the Mk3 Chieftain.
- **Mark 7A** – Built from 1971, incorporating modifications resulting from the Fleetfoot program, this program was intended to produce an engine that could reliably develop 750bhp. Modifications included three lobed scavenge blower, new cylinder block with repositioned fan belt deflectors, re-designed liners, new radiators and Belzona used on liner lip seals (Belzona was a form of metal paste). It developed 720 bhp. This Mark was for use by the British Army and was fitted to the Mk 3/2 and Mk 3/3 Chieftain.
- **Mark 8A** – The 8A engine was for sale in markets other than for the MOD i.e. export, as a general rule of thumb odd numbered Marks were for the



Mark 4A engine viewed from fuel pump side. Note the folded down radiators and large flywheel and starter ring. In the Chieftain two methods were available to crews to start the engine, either through a conventional electric starter motor or via a hydraulic starting pack powered by an auxiliary engine called the Generating Unit Engine or GUE, this engine was also a two-stroke opposed piston engine but with three cylinders. According to the operating manual the preferred method to start the main engine was to use the hydraulic pump, however the easier method was to use the electric starter which was fine if the engine started quickly, but on cold mornings it could quickly flatten the batteries leaving the tank immobile.

British Army and even numbered Marks for export. Modifications included two lobed scavenge blower, shot peened liner material and new pistons. Shot peening is a cold working process whereby small spherical shot is fired at the metal surface to improve its mechanical properties. It developed 750 bhp.

- **Mark 9A** – Modifications as a result of the Dark Morn program. New liner material, new pistons and piston rings with oil cooling and new fan drives and poly-vee fan belt. Several designs of belts i.e. vee-belts and toothed belts, had been trialled in previous programs but improving the reliability of the belts ironically only served to transfer the drive problems being experienced to the gear casing. At this time problems were also being experienced due to failures of the cylinder liner O-ring. Developed 750 bhp.
- **Mark 10A** – Essentially a Mk 9A but fitted with a two lobe scavenge blower. Produced for export. Due to the conditions these engines were expected to operate in i.e. desert environment, extra air filtration was provided.
- **Mark 11A to 12A** – Production began in 1978, these engines incorporated several modifications resulting from the Sundance program to address reliability issues. Block/liner sealing arrangement utilising an O-ring retained by interference fit liners, new injectors, CAV fuel filters, Poly-V fan drive belts. The interference or tight fit liners improved reliability significantly. Power increased to 840 bhp. (Note it is hoped to publish an article covering the Sundance program in more depth as I was able to uncover a wealth of information relating to it).
- **Mark 11A/N to Mark 12A/N** – Modified Mark 11A and 12A engines, interference liners no O-rings. Because the interference liners fitted with O-rings were proven in the Mk 11A engine it was decided to trial the same liner but without the O-ring and with an increased interference fit, this proved to be successful and provided the opportunity to reuse some of the old engine blocks. Note the new liners were known at NRTL liners (No O-ring tight fit liners).
- **Mark 13A to Mark 14A** – New marks allocated to 11A/N and Mark 12A/N engines. Developed 840 bhp.

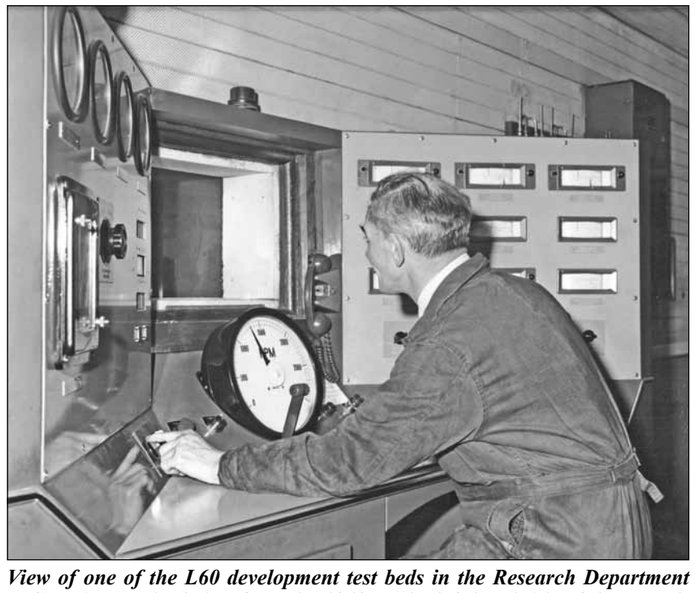
In all the documentation I've read, the Mk 14A was the last mark issued but in conversations with my friend John Farnworth he revealed that he was aware of a Mark 15 and Mark 17. New mark numbers were usually only issued following a major development program or if there had been significant component modifications or a power output increase, minor changes to engine build specifications being recorded as modifications. However, someone at the MOD in their wisdom decided that even small changes to the engine should be accorded a new mark.

- **Mark 15** – New design of starter motor.
- **Mark 17** – Revised air cleaner design.

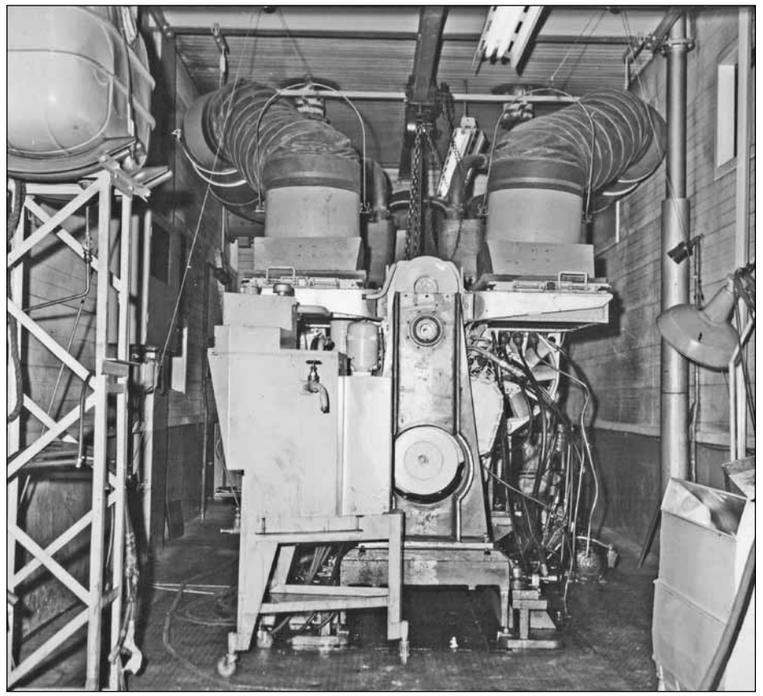
The fact that they're both odd numbered marks suggests that both modifications were for Chieftain engines and not applicable to sales (export engines).

Production and continued development of the L60 engine was carried out at Leyland's Spurrier Works. This factory opened in 1953 and was originally built and owned by the Ministry of Supply for the production of tanks and passed into Leyland ownership in 1956 and was renamed Spurrier Works in honour of Henry Spurrier the Second.

The main shop for the machining of L60 components and production assembly was known as Number 8 Shop, an enormous building that also contained the two main commercial engine assembly lines (400 and 600 lines) as well as machining facilities for the manufacture of components for these engines.



View of one of the L60 development test beds in the Research Department at Spurrier Works dating from the 1960s. The left-hand side of the console contained pressure gauges to monitor coolant and oil pressures and Leyland's own design of fuel meter, at that time fuel consumption would have been measured in lbs/h. The lever next to the testers left arm is connected hydraulically to the throttle lever on the fuel pump, the large white gauge in the centre displayed engine rpm. The gauges on the right-hand console are moving coil temperature gauges to monitor fluid and gas temperatures. Remarkably, even though a number of test beds in the Research Department were upgraded to computer control in the 1980s, this L60 test bed remained in this format right up to the department's closure in the mid 2000s and was used for testing reworked L60 engines for the Oman army.



View of an L60 engine installed onto the test bed, as you can see there wasn't a lot of room! The engine was mounted on a special stand and connected to the cell exhaust and fuel system. The two large diameter pipes coming down from the roof provided air from outside the test cell for cooling purposes. The large tank on the elevated stand on the left contained a form of Lanolin (a preservative grease obtained from wool bearing animals). While the engine was running a fuel tap was switched allowing Lanolin to enter the engine, eventually the engine would run out of fuel leaving the internals coated with the preservative. These cells were used for both development and durability testing, once heard, the sound of an L60 at full throttle was not easily forgotten.

Research and development activities were carried out in the Test Operations building sited adjacent to Number 8 Shop. In its heyday this facility boasted approximately 40 test beds and it supported the development of Leyland's commercial engines (400, 500, 600 and Bathgate 4.98 and 6.98) as well as providing support for Advance Technology projects and the development and testing of the L60 engine. Even after production of the L60 engine ceased some development activities continued in Test Operations to support the British Army, in addition engines from Chieftains based in Oman were reworked and tested.

Sadly, neither building still stands, Number 8 Shop was the subject of a serious fire in 2011 and had to be demolished, in its place now stands a large Amazon warehouse and the old engine research facility was demolished around 2015 and no trace remains although engine research and development still continues at the old Leyland Technical Centre site now owned by Millbrook Proving Ground.

The third article in this series will be an in-depth study of the Sundance program and will look at the modifications and upgrades that resulted and how Leyland marketed the "new" engine.

This is a photo of a wooden mock-up of part of the L60 engine. It is dated 17.09.59 and carries the ID F.V.D.E. 43352 2. It was common practice for components to be initially made in wood so that design engineers could check clearances, pipe runs and any assembly issues and this practice continued at Leyland well into the 1980s (there was a joiners shop at the Leyland Technical Centre). Although the details on the photo don't identify the location on the engine it is possibly part of the hydraulic system.

A BUSY SCENE IN MANCHESTER PICCADILLY

This photograph is included especially for Peter Greaves who has been seriously ill in hospital and is making a good but gradual recovery. Peter has been of great support to the Leyland Society over the years, in particular with his contributions to Odd Bodies and Food for Thought. He has also maintained an index of the bus photographs included in Torque and the Journal since they started over 20 years ago. This index now includes nearly 3500 photographs and it's invaluable as a reference for finding the pictures – if any reader would like a copy (in Excel format) please contact Mike Sutcliffe. The photo was clearly taken in Piccadilly, Manchester, in May 1935, and in the centre is BU 8255, a Leyland Tiger TS6 with unusual and attractive full-fronted Roe body. It was one of three purchased in 1934 and when sold in 1949, it went to Embee Motors, Preston and was re-bodied by Ormac C33F, and re-registered DRN 562. It later went to Baker, Quarrington Hill being withdrawn in October 1955. (Geoff Atkins – Simon Butler)

ODD BODIES !

Compiled by Gordon Brooke
All correspondence to Mike Sutcliffe

Thanks to John Bennett, Colin Brazier, Colin Bull, Philip Carlton, Maurice Doggett, Mike Elliott, Mike Fenton and Mike Sutcliffe .

Banfields Coaches, Leyland Tiger PS1/1, MRF 347 (Torque Nos.78-80)

This topic has grown so much that it deserves additional space, hence the 'Odd Bodies' Extra on pages 30-31.

Bengry, Leominster, Lion, WU 8270 (Torque Nos.79 & 80)

The concensus is that the body on **WU 8270** is by Mumford and not ECOC. It appears to be identical in every detail to the Mumford body on this Southern National LSC3 Lion, **UO 5816**. The additional AEC-style grill in front of the radiator certainly helps the appearance.

(CF Klapper – The Bus Archive)

Tye's, Mendlesham, Leyland Lion LT2, WE 8115 (Torque No.80)

John Bennett tells us that this was a Lion LT2, 50982, with a C32F body, new to A F Hancock, Sheffield in 4/30. It passed to A Kitson, Sheffield in 1/35 and on to Sheffield United Tours in 3/35. It was not numbered by SUT. It later went to R H Tye, Mendlesham, Suffolk and finally to Braybrooke, Swaffham, 6/49 to 11/52. There were three of these Lions **WE 8113-5**, chassis 50983/50984/50982. This picture of **WE 8114** shows a typical 1930 Burlingham coach body and it may be that all three had such bodies originally.

The body on **WE 8115** in the picture in Torque No.80 is very different and too different to be a rebuild of the original body. Mike Fenton suggests that it had a Waveney body fitted maybe whilst it was in the ownership of Tye's. Waveney were at Oulton Broad, Lowestoft, which was around 30 miles as the crow flies from Tye's base in Mendlesham.

(John Bennett collection)

A Rowe & Sons, Cudworth, Leyland Tiger TS7, HD 6313 (Torque No.80)

This was new to Yorkshire Woollen District in 1937 fitted with a Roe B32F body. However, when it was photographed in the early 1950s with A Rowe & Sons of Cudworth, near Barnsley its C33F body was clearly not the original. Mike Fenton doubts very much that it had a completely new body built by Rowe, as has been claimed but believes that it received a second hand c1936 centre entrance Burlingham body comprehensively rebuilt by Rowe's with a straight rather than stepped waist, sliding ventilators in place of half-drops and Windover-style rear wings, but the unusually spaced windows are a puzzle. He says 'centre entrance' because the first bay on centre entrance Burlingham bodies of the period was noticeably wider than those on forward entrance bodies.

This photograph was taken in August 1937 in Huntingdon Street bus station, Nottingham. For many years Yorkshire WD single deckers were built to what we would now call DP standard with luggage racks and very comfortable seating and were used regularly on express services when new.

(Geoff Atkins – Simon Butler)

Argosy Coaches, London SE15, Leyland TS2, TE 5711 & TS4, EK 8729 (Torque No.80)

John Bennett and Mike Elliott agree about the history of these two vehicles:

TE 5711 was new 11/28 as a Leyland demonstrator, chassis. 60102, with a Leyland B31x body. It was sold to Wright Bros, Burnley in May 1929 via O Tillotson, the Leyland dealer in Burnley. It was withdrawn 5/35 and sold to Hudson, Leeds and then passed to Smith (Argosy Coaches), London SE15 who had it from 5/48 to 7/52. It was probably rebodied c1937 by Plaxton when with Hudson. The front view in the last issue does not show clearly that it had a Plaxton body, but the view here makes this more apparent.

(WJ Haynes)

EK 8729 had chassis 1010. It was new 2/32 to Webster Bros, Wigan with a Burlingham C32F body. It passed to sister company James Smith, Wigan and was sold to Smith (Argosy Coaches) sometime in the late '30s. At some point the original body was replaced by a Harrington body of about 1934 vintage. John Bennett points out that a number of bodies of this style were sold off by North Western Road Car in the 1940s and this may be one of them.

East Kent, Leyland Tiger TS1, FN 9xxx (Torque No.80)

The photograph in Torque No.80 also appears on a website devoted to East Kent Buses and is said to be **FN9544**, a Tiger TS1 with Short O30/26R bodywork. How the exact identity is known is not apparent, but it also says that the photo was taken 'at Minster in the1930s', which makes the identification more convincing. Another clue is that if it had its original radiator, with oval tiger's head badge, it must be **FN 9544** as that badge was introduced in December 1928.

(Mike Sutcliffe collection)

It seems that there were three similar deliveries, but we've been given some incorrect registrations which sent us on a 'wild goose chase'. However, the website seems to give the definitive history: the first batch, **FN 9093-6** were delivered in mid-1928, the second delivery was of just one vehicle in May 1929, **FN 9544** (the one seen in the photograph), and the third, **JG 651-5,** was delivered in 1930. Altogether there would have been ten double deck Leyland Tiger TS1s.

Colin Brazier says that they were 27ft 6in long, so way above the later legal limit for double deckers, but he assumes the extra length was allowable because they were built prior to the 1930 Road Traffic Act, which regulated such things. Presumably as the licensing authorities prior to then, the Watch Committee and local Constabulary were happy to see such long vehicles in service and they must have somehow had 'grandfather rights'.

The majority were rebodied: **FN 9094** and **JG 652**, Park Royal L27/26R in 1942, withdrawn 1950 (Something surely wrong here as the TS1 had a 17ft 6in wheelbase – did they receive shorter frames?) **FN 9095, JG 651/3-5**, received Burlingham UB35F bodies in 1945, withdrawn 1949. The body of **FN9093** was destroyed by enemy action and the chassis was converted to a lorry which ran until 1952. **FN9096** was converted to a tree-lopper c1946, withdrawn 1951. **FN9544** went to the War Dept. and did not return.

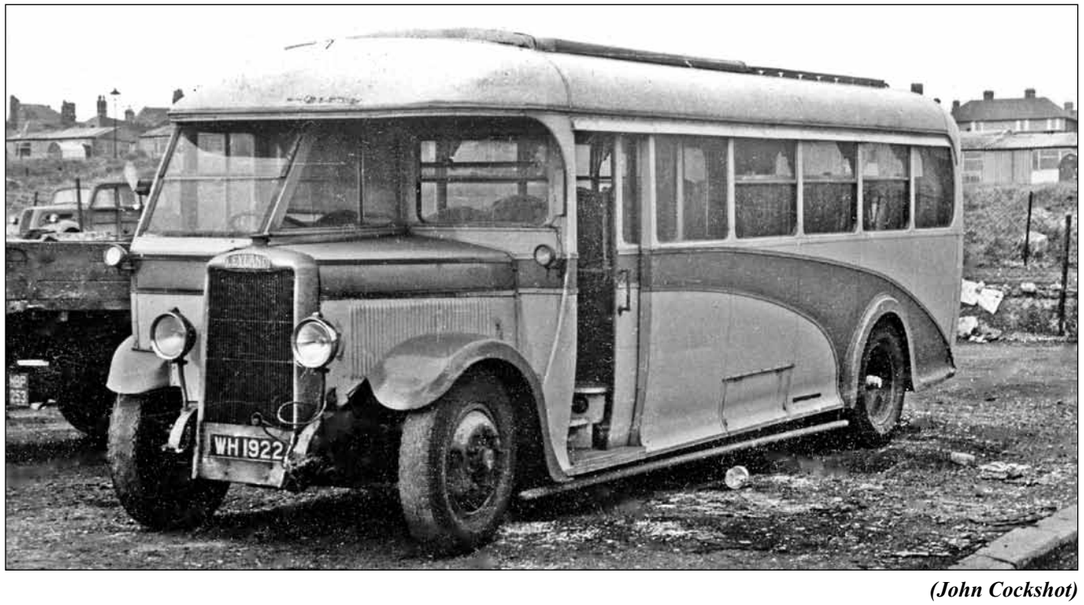
NEW ITEMS

Smith's Tours, (Wigan?), Leyland Tiger TS4, AG 8280

(BCVMT L032440)

There is not much to go on in this photograph. It's a coach on the wrong side of the road somewhere in the country. The body is obviously much later than the chassis and looks very smart. The chassis has been updated with a CovRad radiator and the front mudguards have been interfered with.

Leyland Tiger TS2, WH 1922



(John Cockshot)

This is a very neatly designed bus but there seems to be nothing to identify the owner. Looking at the entrance and what can be seen of the seats together with the lack of destination equipment suggests that it might have been used as a coach. Some of these older snapshots are not the best of quality but without them we wouldn't have these gems!

Mitchell, Kincardine, Leyland Tiger PS1, FDK 908

(Mike Sutcliffe collection)

Something just doesn't look right about the PS1. The body looks like a Ribble re-body of a pre-War Tiger but it also looks very long. What is known about its history? Like the Banfield Tigers, there's a big gap immediately behind the front mudguard!

Campbell, W Lothian, Leyland Tiger, EWA 543

(Roy Marshall – The Bus Archive)

Not the sharpest of photos but here is another nicely designed body only spoilt by somebody who thought they knew better than Leyland how to design attractive front mudguards. Does anyone recognise the bodybuilder?

The photo that confirmed it all. Note the treatment behind the front wheel and under the cab door (John Banfield collection)

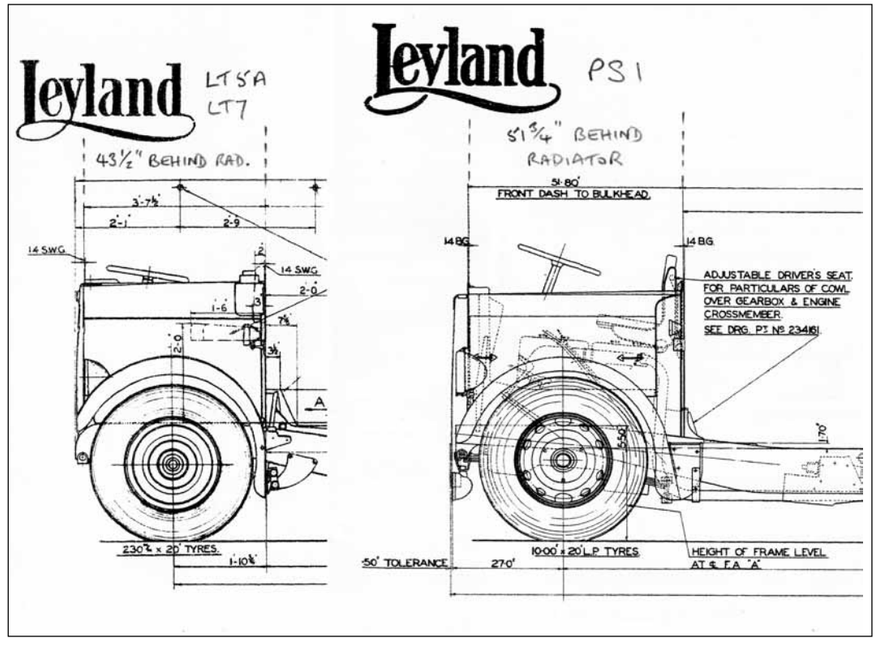
ODD BODIES EXTRA - BANFIELD'S TIGERS

In Torque No.78 we showed a photograph of a Tiger PS1, **MRF347**, which was fitted with a 6-bay Duple A body which clearly didn't fit comfortably. It had a very sloping driver's cab window and a large gap behind the front mudguard. Also, the pillar between the 4th and 5th bay was over the wheelarch, not further forward as one would expect – so, where did the body come from?

There was much speculation in Torque Nos.79 and 80 – was the body by Wilks & Meade, did it come from Wallace Arnold? – Answer, No! But Banfield had other PS1s with the same problem – four to be precise, and photographs were found photographs were found of the other three, kindly sent by **John Bennett** and by **John Banfield** from his father's collection.

After much head-scratching by **Mike Fenton** and **Mike Sutcliffe**, they jointly came up with the answer. In May 1956, Banfield bought four Lions (three LT5A and one LT7) from Wessex, Bristol. Three had originated with Devon General, one from Grocock

Two of the donor Lions. LT7, BDV 11 with Wessex and LT5A, KHT 643 with Banfield. Note the other Lion to the right (Wessex & John Banfield collection)



(SUT), Sheffield, and all four had been re-bodied by Duple, C33F, in 1946/47 when owned by Morning Star, Bristol. These bodies were still in good condition unlike the bodies on several second hand PS1 coaches which Banfield then owned. Four of these were chosen to have their bodies removed and to receive the bodies from the Lions. They were:

EUK 891, new 7/47 to Worthington with Mulliner C33F body

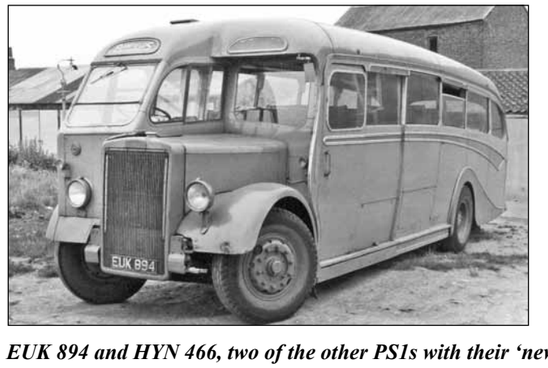
EUK 894, new 9/47 to Worthington with Mulliner C33F body

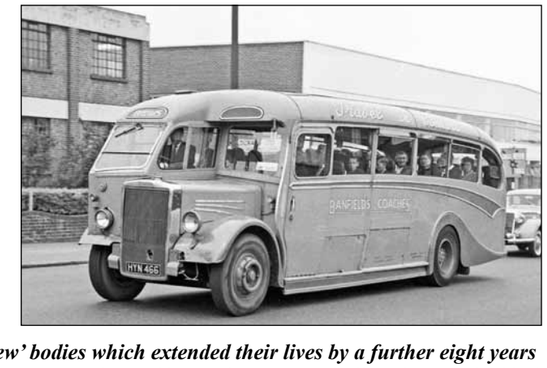
HYN 466, new 9/47 to Smith (Argosy) , SE15, with Harrington C33F body

MRF 347, new 1/47 to Milton Bus Service with Santus C33F body

The four Lion donors were **AUO 72**, **AUO 84**, **BDV 11** and **KHT 643** (which had been re-registered from **WJ 9969** on re-bodying). The only problem was that the bodies would not fit! The wheelbase of the Lions at 17ft 7in was one inch longer than the Tiger, but worse than that the Tiger's 6-cylinder engine was longer than the Lion's 4-cylinder engine by 8¼in – that meant that the front bulkhead would foul the engine. The only way to make it fit would be to place the body 8¼in further back. This now meant that the rear wheelarch was in the wrong position and the vehicles would be longer. Coupled with the fact that the Tiger's radiator was thicker by approx 2in, the overall length would now be about 28ft 4in (not a problem since the length regulations had been increased to 30ft).

The rear wheelarches of the bodies were therefore dismantled and moved forward by a firm called MTS & Co. This resulted in the driver's windscreen having to have a tremendous slope and, with the steering column being quite far forward, there was a distinct possibility that the driver could easily bang his head on it! The gap behind the nearside front mudguard was only about 4in due to the fact that the Tiger's mudguard was thicker than the Lion's. On the offside the gap behind the mudguard had to be panelled over. It was not until John Banfield came up with an offside photo that our theory regarding the body alterations could be confirmed. **MAS**





EUK 894 and HYN 466, two of the other PS1s with their 'new' bodies which extended their lives by a further eight years (K Jenkinson & Roy Marshall – The Bus Archive)

THE POST-WAR DOUBLE-DECK BODY

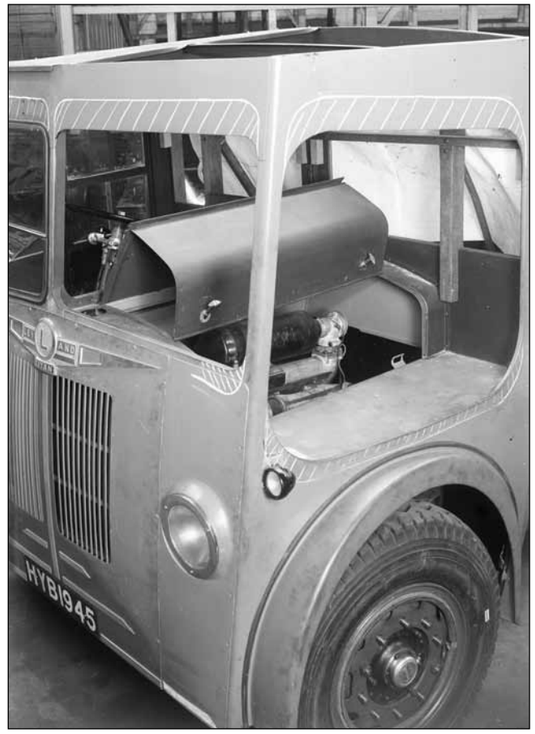
John Howie completes his review of Leyland's post-war bodybuilding activities.

Aspects of the Leyland body mounted on the PD1 and PD2 Titan chassis have been the subject of a number of articles over the years, but none have traced the full history. It is not the intention to repeat the content of previously published material but to 'fill-in the gaps' and provide some additional background, with reference to the contemporary Leyland General Manager's reports.

Bodybuilding at Leyland got off to a slow start after the War as the facilities within the factory were still engaged on 'war work', hence the first complete Leyland body did not emerge until June 1946, despite authority being given by the Ministry of Supply (MOS) a year earlier. In order to make progress, agreement was reached with Alexander to construct an initial batch of 50 'Hybridge' bodies at their works in Stirling. This arrangement was not without precedent as Alexander had completed a number of Leyland orders, using transferred parts, following Government instructions to cease civilian production at the start of World War 2.

However, in the event, this did not really speed things up as there were delays in sending the necessary drawings and obtaining permissions from the Ministry of Supply, who still exercised control over production, and difficulties in obtaining adequate materials, particularly steel. The bulk of the drawings arrived with Alexander in January 1945 but it was May before those for the cab were completed. A further cause of delay (self-inflicted?) was the idea to fit a full width cab design (a mock-up of which, was prepared in July but not pursued due to it 'not being to MOS specification'). It was therefore decided that future production would be half-cabs. The October GM Report stated that 20 body kits had been despatched to Stirling by road, but non-availability of the designated chassis meant that, in the meantime, Alexander had diverted their resources to other projects. Hence assembly did not start until December by which time the first body had been constructed at Leyland to test the jigs.

Above – Bolton Corporation took two batches of Titan PD2/4s during 1948-49 with unusual ventilators in the front dome. Here is one from each batch. Note the change in shape of the valence over the canopy which was altered to have its bottom edge at the same slope as the top of the cab side window. This change took place half way into the 'CWH' batch in early 1948 (Roy Marshall – The Bus Archive)



One of a series of mock-up full width cabs which were not proceeded with due to objections by the Ministry of Supply (BCVMT L027617)

Alexander had been commissioned to build a one-off body for the prototype TD9 (soon re-classified as PD1) which was inspected in October 1945 with delivery promised for the first week in November. It was fitted with a new ventilation scheme whereby a stream of cold air was directed through the front upper saloon panel adjacent to the lower edge of the front window and directed onto the inside of the roof; the ventilator slots were controlled by a hand mechanism. The complete bus was noted in the Leyland body-shop during November. It was next recorded in June, 1946 as being in service with Central SMT. (***The comprehensive history of this vehicle, registered CVA 430 has been covered in Leyland Society Journals 8 & 9 and David Harvey's book: 'Forgotten Double-deckers'***)

A visit to Stirling in January 1946 expressed the Leyland management's satisfaction with the construction of body shells but they were unhappy with the standard of finishing resulting in an inspector being left at Stirling to assist, and the first body was delivered to Blackburn Corporation (**ACB 203**) in April 1946.

Meanwhile progress was being made at the Leyland works with the first bodies supplied to Clyde Coast, Ardrossan, (**BAG 43**) and Leicester Corporation

Blackburn Corporation ACB 206 carried one of the first post-war bodies to be constructed. It was among a batch of 50 sub-contracted to Alexander as the Leyland body-shop was not available. Interestingly no front destination indicator was fitted but the vehicle was fully lined-out! (BCVMT L030530)

The interior lighting in Alexander built bodies was fitted in the roof rather than the cove panels used in all Leyland bodies. These can be seen in this view of DUT 127 of Allen, Mounsorrel. Compare with view of Rees & Williams' PD1, below (Allan Condie collection)

(**DJF 333**) in June 1946. These, like those from Alexander were 'Hybridge' as the drawings for the lowbridge variant had yet to be finalised, the objective being to obtain maximum commonality of parts between the two designs. By August the lowbridge drawings were available and the first body was assembled to 'test the jigs' (Wigan **JP 5500**). Some lowbridge bodies had fixed glazing along the entire offside of the upper deck.

DJF 337 was an early Leyland-built 'Hybridge' example for Leicester Corporation, being completed in June 1946. The wide lower deck back window can be clearly seen in this view, as can the lower one-piece rear panel (BCVMT L030375)

Wigan JP 5517 was an example of the lowbridge version available from August 1946. These were all built at Leyland (BCVMT L031670)

London Transport STD class vehicles nearing completion. These had PD1 chassis (BCVMT L031040)

A number of problems restricted the body-shop from achieving the targeted output of 15 bodies per week, plus a further 5 sub-contracted to other companies. Fundamental to these was the inability of the 'rate-fixers' to agree a productivity measure with the staff; a situation made more difficult due to the need for special modifications to meet the needs of individual customers. The Northern Ireland Road Transport Board (NIRTB) required a lower maximum height than the normal body, Burnley Colne & Nelson wanted special staircases and the 65 London Transport bodies (for PD1s) had significant variations from standard. Such was the demand for other 'special features', (bespoke indicators, seating, lighting etc) that the Drawing Office had no spare resources to undertake development work.

An urgent task was to prepare drawings for an 8ft wide model, to meet growing pressure from customers, and redesign work to fit the body to the wider PD2 chassis. There was also a 'hand to mouth' situation regarding raw materials as glass, steel and plywood which were in short supply due to post-war reconstruction. A second production line was being set up in September 1946, even though a shortage of skilled labour was limiting output to 7 to 8 bodies per week. Of note was the completion of two vehicles with right-hand entrances. These had been constructed by The Lancashire Aircraft Company (LAC), at Samlesbury, on Leyland's behalf, for a contract in Palestine but were later reassigned to Belgium, before eventual sale to Lisbon in 1947.

To ease the situation, simpler flush-fitting front windows were introduced on the upper deck front windows instead of window pans, starting with one vehicle in the order for Preston Corporation, and arrangements were made for

JUM 373 was the first body built by The Lancashire Aircraft Company (on chassis 460830) and it was delivered to Samuel Ledgard in May 1946. It was one of 10 built that year on behalf of Leyland, most of the others going to Isle of Man Road Services. A further 47 bodies were constructed in the following year, by which date the company had been renamed Samlesbury Engineering (Roy Marshall – The Bus Archive)

Hants & Sussex PD1, GAA 180, illustrates the 'simpler version of flush front upper deck windows' introduced to save construction costs (BCVMT L033247)

LAC to complete 57 bodies on shells supplied from Leyland. However, this delivery was protracted due to poor organisation at LAC, doubts about quality and the fact that LAC was being restructured at the time. (The Leyland Board was asked to invest in them but declined). The relevant vehicles were delivered (over a period of 18 months starting in May 1946) to: Lisbon (2), Isle of Man (11), Blackburn (10), Salford (10), Western SMT (10), East Kent (3) and Preston (6). A further 5 went to independents. Individual buses are described as either 'Lancashire Aircraft Company' or 'Samlesbury', depending on the date they were built. Other body orders were diverted to East Lancashire Coachbuilders but this practice ceased after a claim by a customer against Leyland Motors due to poor quality workmanship.

It is of interest that in 1961 Ledgard operated PD1s with bodywork by all three participants: new in 1946 were **JUM 374-8** (Leyland bodied) and **JUM 373** (Samlesbury), which had been joined by seven ex- Preston Corporation examples**; ARN 392 - 4** (Alexander), **BCK 621/4/6** (Leyland) and **BCK 633** (Samlesbury)

Industrial relations deteriorated to such an extent that the bodybuilders and painters went on strike on 30th January 1947. The main cause of this action was related

The classic interior of the Leyland body with mahogany inserts inside the single-skin front dome. This lowbridge example on a PD1 for Rees & Williams had sliding windows, an option introduced during 1947 (BCVMT L033270)

The lower deck front bulkhead of the Leyland body had two distinctive anodised aluminium circular ventilators and a brass badge showing its pedigree (BCVMT L032263)

Left - Todmorden JOC was the first operator of Leyland bodied PD2s, as depicted by FWT 186, one of a batch of eight delivered Aug-Sept 1947 (BCVMT L033346)

to the introduction of increased metal content in the products, but the effect was probably 'diluted' due to a national fuel shortage during February which severely affected all production throughout the Leyland works. Notwithstanding this, productivity was still low with the need for extra manpower required for those orders which differed considerably from the standard body. Board minutes indicate that most bodies to date had been sold at a loss and the body-shop was identified as a 'black spot' due to its labour and material problems, resulting in a management re-organisation. In July 1947 additional funds were approved to enable all 20 targeted vehicles to be produced 'in house'. Initially, half-drop windows were 'standard' but 'sliders' were now offered as an alternative.

1947 also saw the first PD2 body, delivered to Todmorden (**FWT 183**), and the first 8ft wide body (PD2/3) to Southport Corporation (**FFY 401)**; both had been engineered to use as many of the existing components as possible. Effectively the 8ft wide bodies had the same front as the 7ft 6in versions, but with a greater amount of tapering to the front, most noticeable at the side of the driver's cab with the wider front mudguard. PD2s comprised the bulk of the output after September 1947, although totals continued to be restricted due to high labour turnover. They also tended to have a narrower rear platform window

Below - Southport FFY 401 carried the original 8ft wide body. Note the famous Leyland 'S-shaped' drip moulding over the emergency exit, to reduce water falling over the platform area (BCVMT L033799)

although there were exceptions to this; there were also variations in the location of rear lights and number plates amongst early production models. PD2s had a two-piece rear lower panel (split vertically) from the start, though later PD1s also had this feature. However, there were no more Leyland bodies on PD1s after 1948 except for a batch of 24 for Central SMT in 1951.

Manually operated doors were offered from 1949; an option taken up by customers such as Sutherland of Peterhead (BCVMT L032267)

The situation improved during the following year; there was gradual progress in substitution of some steel parts by aluminium, a general 'time-study' reduced manpower by 12hrs per body and spray painting was introduced from July. The 'Farington' body was first mentioned in August 1948; it featured flush glazing on all windows and the Herzim system of separate sliders. There was no domed waist rail and all glazing was externally flush with Leyland dual-sliding windows; hence there were no external recessed window pans, the recessed pan was now on the inside of the bus. The first was exhibited at the 1948 Commercial Motor Show at Earls Court, then exported to South Africa (Bloemfontien) followed by a batch of six to Burnley, Colne & Nelson (**ACW 142-7**).

A front nearside view of the Farington body. This example was a PD2/1 for Leeds (BCVMT L039246)

And a front offside view of a Manchester PD2/3 with Farington body (Mike Sutcliffe collection)

It was anticipated that the 'Farington' body would be cheaper to produce than the existing standard body and orders were met for Leeds (60: **NNW 340-99**) and Sheffield (64: **LWE 64/65/88/89, LWE 104- 21/28/39-41/43/44, 212/3; LWJ 122/23, 624-55**) after which the project would be re-evaluated. In the event a further 85 examples were built; Southport (15: **GFY 396-410**), Manchester (35: **JND 666-700**), West Hartlepool (15: **EF 9585-99**) and Preston (20: **DRN 291-310)** before it was discontinued as the anticipated economies did not materialise. The design was American in origin and initially licenced to Colin Bailey in an individual capacity. When he left Leyland for Duple this went with him and, presumably, Leyland would have to negotiate to continue to use it. Hence, there were no further 'Farington' bodies produced; its successor is usually referred to as the 'final design' (qv).

This 'posed picture' is one of a series (probably with Leyland employees) showing the features of the 'Farington' body for Burnley, Colne & Nelson – the window style was based on contemporary American practice (BCVMT L037171)

A rear view of Southport Farington bodied GFY 397 in Lord Street (BCVMT L041127)

JUP 149 was part of the frustrated order for South Africa. Re-allocated to Stockton Corporation it retains all its opening windows which would probably never be used to their full potential! (BCVMT L036886)

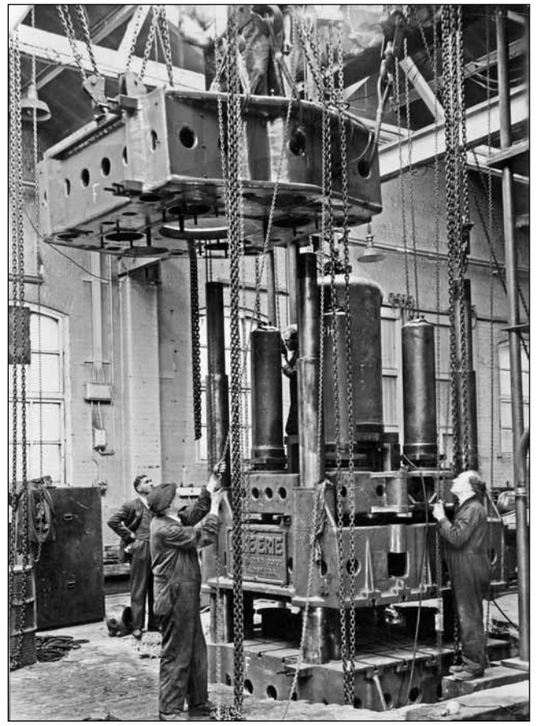
CIE took some of their deliveries as complete vehicles and others with chassis & body separate to minimise customs duties. Here a body is being loaded at Preston docks en route to Larne (BCVMT L034888)

On the standard body the metal drip moulding over the upper deck windows was discontinued, although not all earlier bodies had this feature. Another variant was a 'slot' in the front dome for Bolton and CIE deliveries. One batch of Ribble (lowbridge) also had a similar feature, part of a revised heating and ventilating system, which was not evident on any other vehicles. In these early post-War days, there was no need for demonstrators as the order books were overflowing, the only examples probably being **CVA 430**, the experimental PD2, and **MTA 747**, the lowbridge PD2/1 sent to Devon General to try to tempt them away from the AEC!

Other notable events during 1948 were the commencement of the London Transport order for 500 complete buses, with Leyland bodies built to LT design on Leyland 6RT chassis (the RTW class, and not really pertinent to this article) and deliveries of 100 (Bolton type) to CIE. A major problem was created by the cancellation of most of a large order for operators in South Africa due to withdrawal of finance by their Government; some vehicles had been completed whilst others were in an advanced stage of construction. It has been suggested that a contributing factor was the long delay in supply which gave the opportunity to establish a local bus bodybuilding industry. A total of 194 were re-allocated to operators in the UK and Ireland. Whilst most entered service in 'as built' condition they were later modified to reduce the number of opening windows (in the case of the Ribble this was done in stages) and destination screens adapted to company standards. Heaters were also fitted to Yorkshire Woollen District's examples.

During 1949 production had 'settled down' to an average rate of 16 bodies per week against the target of 20. Output for the year comprised 803, which included

Ribble 2635 (CCK 623) was originally built for South Africa but its export was frustrated due to changes to import regulations. Unlike other similar vehicles this batch of vehicles was equipped with standard Ribble destination indicators before leaving Leyland although it featured a full set of opening windows. These were gradually reduced during the life of the vehicle (BCVMT L036797)



The Hydraulic press purchased in 1950 to speed up production of doors, emergency windows and roof panels (BCVMT L042666)

213 for LTE. The reasons for the shortcomings continued to be blamed on the 'mix' of various body types under construction in parallel, especially the LTE and Birmingham models with their considerable differences from the 'standard' body. Even this had variations, as some still continued the earlier design of upper deck front windows (those built for South Africa) and a doored option was introduced. Plans were drawn up for a 27ft long body (actually 26ft 6in) with the original intention of concentrating on the 'Farington' style body once the longer version was in production.

The updated body, introduced in 1950, had a double-skinned front dome which superseded the wooden inserts. This is shown to good effect on Ribble 1307 (BCVMT L041597)

By February 1950 the 'holy grail' of 20 bodies per week had been achieved and greater future productivity was anticipated through the purchase of a hydraulic press to speed production of doors, emergency windows and front and rear roof panels. Modifications introduced included two-skin front and rear domes (the earlier single skin had the mahogany insert at the front), also new windows, comprising a pressed alloy window pan with double rubber mounted glazing incorporating the sliding ventilators. This allowed for half-drop windows as fitted to Southdown and Portsmouth vehicles. Unfortunately, this coincided with a reduction in enquiries due to municipalities having difficulties in obtaining loans from the Government. Only Sheffield, Sunderland and Derby were still expressing interest during January and, in April, the GM Report stated "future business for double-deckers does not appear to warrant further endeavours to step up production; we will therefore concentrate on economies in production costs".

Pressure continued to mount from operators wanting the 27ft body but its introduction was being delayed as the Company wished to incorporate a 'full-front'. They wanted to minimise modifications and retain the "most attractive features of standard and

Leicester PD2/12, 160, FJF 199 at Earls Court with the 'final design' Leyland body . It had double rear bumpers though though they're not visible here. You can just see the taper at the front to match the 7ft 6in 'standard' front (BCVMT L041147)

Lower deck of Ribble 1307 (BCVMT L041595)

'Farington' bodies to facilitate the production of one type of double-decker, in both 'Hybridge' and lowbridge versions". In July 1950, the first (a 'Hybridge' example, destined for Leicester on a PD2/12 chassis) was under construction for display at the forthcoming Commercial Motor Show. This had double rear bumpers.

Output continued to fall during the second half of 1950 due to a 'shrinking order book' resulting in over 300 redundancies, all of whom had been interviewed by Ministry of Labour personnel, to assist with finding new employment. The LTE order was completed and jigs and tools stored pending return to London. The only 'good news' was an order from the BET Group for 90 vehicles, production of which commenced in October with deliveries to Ribble and Potteries. Total output for the year was recorded at 859 double-decker bodies but production figures for 1951 and the following years are difficult to obtain directly as the single-deck bus and coach bodies are included in the totals. April saw the delivery of the first production PD2/12s (8ft wide) with eight going to Maidstone & District. This was later known as the 'final design' and replaced all previous ones, including the 'Farington'. It had rubber glazed windows, generally with eight 'sliders' on the upper deck and six on the lower deck, though variations in number and types (eg. half-drops) were provided to meet the requests of individual customers. Low demand restricted output to 10 per week, a situation not helped by an 8 to 10 week delay in the supply of aluminium. By October a shortage of chassis was causing a further problem but the output for that month was declared as 46 – possibly this represented the clearing of a backlog! Two buses were exhibited on London's South Bank during the 1951 Festival of Britain: Southdown **KUF 701** from 3rd May to 8th June, followed by Maidstone & District **NKT 876.**

Items deemed worthy of specific mention were the increased demand for the fitting of rear doors. These were initially of the hand-operated type but were superseded (in 1952) by a 4-piece powered version. Southdown vehicles were initially delivered without doors but they returned to Leyland a year later to have them fitted. There was little significant change during the next two years. Skilled labour remained difficult to retain and output declined from 12 bodies per week at the beginning of the year to an average of 8 towards the end of 1952, reducing still further in 1953. Apart from the labour problem, sales had proved difficult with the loss of an order from Sheffield (for 82 vehicles) and delays to the Manchester one (for 40), due to financial constraints. Further redundancies were effective from October 1952.

Cumberland 305 (KRM 254) was one of the few PD2s fitted with rear bumpers. These had been a feature in some fleets but the practice had largely died out by the date this bus was delivered. In later life they were removed.
(John Howie colllection)

Southdown MCD 478 displays the half-drop windows option available on the 'final design' body and also the four part electrically powered doors. Leyland at its best – RTs? – not a patch on these magnificent buses – Ed ! (BCVMT L046293)

By January 1953 the sawmill and sheet metal shops were supplying too many components for the body-shop to utilise; hence, authorisation was given to complete '20 bodies in the grey' to keep production going. These were built 'for stock' with common standard features such as indicators, destination screens etc, and trimmed in whatever material was available. It had become common practice to build some complete PD2/1 double-deckers for stock, in addition to those for specific orders, primarily to keep the body-shop fully employed, but it also had the advantage for operators in that they could take delivery without the customary long wait. ***(It is envisaged that we will prepare an article on the 'stock buses' in due course – Ed.)***

The most significant order was for 100 bodies for BMMO (Midland Red) on PD2/12 chassis which had

'In the grey' standard vehicles were built to maintain bodyshop production levels. HBD 100 was sold to York Brothers, Northampton (chassis 520060) in 1952 (BCVMT L044231)

BMMO classified their vehicles as LD8. These PD2/12s, apart from their 'tin front', carried a slightly modified final version of the body, with smaller emergency exit windows, as seen here on SHA 378 (BCVMT L045340)

a modified 'tin' front, to make them compatible with contemporary 'home-built' BMMO double deckers. Identified as their LD8 class (**SHA 378-477**), they had 'final-design' bodies including four-part electric doors. No other new Leyland bodied Titans had 'tin fronts' though Edinburgh Corporation rebuilt some of their Leyland bodied PD2/12s with this 'BMMO style' front (presumably made from fibreglass). Leyland went on to adopt the front for the PD2/20 and then again for the PD2/30 with the addition of air vents for cooling the brakes, but this was after the Leyland bodybuilding had ceased.

Uniquely, an order was accepted to rebody some TD5 chassis for Plymouth Corporation and is the only recorded example, in later times, of the fitting of new Leyland bodies on old chassis. However, there might have been instances of replacements being provided for accident victims but no definitive record has been found of this activity (the lack of body numbers makes confirmation impossible) but the December 1953 GM Report includes a note suggesting a rebuild of a West Riding vehicle. In August, the prediction was that 'at the present rate body production will continue until end of November.' Even so, drawings had been prepared for a four-bay derivative of the 'final' version and even a five-bay one for a potential 30ft model.

1954 must have been very unsettling for the workforce. A few orders were accepted and processed but there was no continuity. In total, about 80 bodies were recorded as worked on (some were probably modifications to previously built examples) as the area within the works was gradually transformed to accommodate increased truck cab manufacture (for which there was a high demand for ckd kits) to compensate for the reduction in demand for bus orders. The pent-up demand for new buses, caused by the War, was now over and the bus industry was about to enter a difficult period, compounded by the large increase in private car ownership. It is interesting to note the monthly comments in the General Manager's Reports for 1954, as follows:

January – At the start of the year there were 10 'Hybridge' vehicles in stock. Three further were added in January plus deliveries for Preston (3) and James (2).

February – saw a further five 'Hybridge' for stock plus Darwen (2) and Hardwick, Scarborough (1). Also recorded was an order for 20 complete PD2s from Plymouth Corporation (MCW had tried to obtain the order by saying that "Leyland are getting out of the bodybuilding business, so spares might be a problem"). A February entry states "a double-deck demonstrator is in service in Glasgow". This was probably **STC 887** which was first registered in February prior to its purchase by Scout in July. Another demonstrator was **NTF 9**, the only PD2/15 which, although built in 1951, did not appear on demonstration work until 1954, first on loan to Dundee, then later in Southampton and Plymouth but then on loan to Glasgow in mid-1955.

March and **April** – the Body-shop was primarily engaged in modification work to all 110 of Ribble's Royal Tiger buses but still managed to produce 10 new double-deck bodies. Other customers included Luton Corporation, Jersey MT, Greens of Haverfordwest and Smiths, Barrhead, also one vehicle simply referred to as "standard number 18" (whose subsequent identity has not been positively determined – it could be that this was PD2/12, **TTC 170**, first registered by Leyland as a demonstrator in June 1954. It was loaned to Merthyr Tydfil from June to December when they purchased it). As an indication that things were about to change, this monthly report noted that a 'run-out' programme for bodies had been submitted but no details have survived.

May – saw only two new vehicles (Stockton Corporation and Geddes, Brixham) but also, for the first time, recorded 80 lorry cabs.

June and **July** – More bodies for Stockton followed, four in June and two in July. Meanwhile there was more information regarding the Plymouth and Trent orders, with parts were being urged through the machine shop. It was stated that it was "very doubtful if these orders would be completed by the end of September". From this one could surmise that this was the original target date to cease bodybuilding.

August – saw eight vehicles completed for Central SMT and urgent requests to the 'Chorley Shop' for body parts to allow the closure of the South Works Body-shop to proceed.

September – Signs of significant changes are reflected in September when output is recorded as six, including two 'conversions'. No details are given as to what the latter entails but it is possible that this involved work on the 'stock vehicles' (most of which had 1953 chassis) as these appeared with operators at this time. Cab output had reached 100 per month and it was hoped to introduce the new Comet goods cab from mid-November. Reports for the rest of the year are very short;

October – output was 12 units (six of which were conversions),

November – nine, with two conversions,

December – records two new vehicles and the narrative **"body production has now finished".** A notice was displayed advising that job opportunities were available in South Africa for redundant bodybuilders. The last 'Hybridge' deliveries were to Trent but the last lowbridge was either to Caerphilly (chassis 541310) in September or West Mon (chassis 541228) which did not enter service until December.

Over 3000 bodies were constructed between 1946 and cessation nine years later, accounting for over 50% of the total PD1 and PD2 output over that period. There were just three basic designs: 'Standard', 'Farington' and 'final design'; the first two being produced simultaneously for a while (although there were just over 200 of the Farington style). Starting at 36% with Leyland bodies in both 1946 and 1947, the output of complete vehicles rose to above 60% for the period 1948 to 1952, peaked at 70% in 1953, and finally reduced to 20% of Titans in 1954. Apart from the initial 50 bodies from Alexander, the policy of sub-contracting, to boost capacity, proved unsatisfactory as LAC were not set-up for volume production and there were problems in obtaining the required quality, both with this contractor and East Lancashire Coachbuilders.

After 1947, there is no further reference to any labour difficulties. However, these might have contributed to any decision to cease bodybuilding, though there were other factors, such as reduction in total demand (as most pre-war vehicles had been replaced). It could also be that the company did not actively pursue new work and that the Plymouth and Trent orders were not solicited but done as a 'favour'. Any preparation work for a 30ft long body did not progress past the Drawing Office.

In conclusion, the contemporary documents do not give a definitive reason as to why bus bodying ceased but the increasing importance of goods cab production seems the most likely together with a lack of development using lighter materials. Although each monthly GM Report contained a note detailing current activity in the Body-shop, it should be noted that this department was insignificant in the overall business of the Company and most mentions are of a routine nature. Entries for the early months of 1954 indicate business operating as usual and there is no reference in the Board minutes indicating a policy decision to cease bus bodying or any reference to strike action.

West Mon, LWO 323, was the last lowbridge example to enter service, in December 1954 *(BCVMT L047028)*

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References & Sources:

Leyland General Manager's Reports, 1946 -1954

LETTERS ETC.

Southdown Titan TD4, CCD 940 – from Fraser Clayton

With regard to Tailpiece 'A Bus to Nowhere?' photo on Page 48 in Leyland Torque No.79, I enclose a photo taken at the same location on 8th June 2018. The location is Petworth in West Sussex. Nothing much has changed. The bus in the early photo is entering the one-way system (still in operation today) coming from the Duncton or Midhurst road. The 'no entry sign' refers to the road in which the photographer was standing, as I was still able to do that. The gates on the left have been moved further back from the road, the shop is now 'garden antiques' and the pram replaced by a pink flamingo! The manhole cover is now square rather than round.

Crosville Re-bodied Titan TD1s – from Peter Caunt

The Leyland Society magazines are of very high quality and of great interest. Regarding Odd Bodies in Torque No.80 and the NCME re-bodied TD1 at Crosville, as far as I know, one ex-Ribble TD1 did not enjoy any body swaps and I thought you might like to see the attached pics of **CK 4405**, TD1/Leyland L48R ex-Ribble. It was 1048 in the Ribble fleet, becoming L95 at Crosville, being re-numbered M569 at some stage. I saw it when on a PSV Circle visit to Crane Wharf in July 1958, the Crosville 'graveyard' where it stood, ready to be sold. I have the information from a Crosville Motor Services Handbook dated 1955 which I bought on leaving the RAF (National Service) in March 1958.

What an amazing survivor Peter, but it is not what it seems! Its TD1 chassis was that of FM 6416, new to Crosville as 554, later L67, and new in May 1931. It later became M40 and was re-bodied by ECW in 1949. On withdrawal in 1956 the ECW body was removed and fitted to an ex-London Transport Bristol K6A, FXT 420.

The Ribble TD1, CK 4405, was new in March 1931, being sold to Crosville becoming L95 in May 1946; it was also fitted with a Leyland 8.6 oil engine and re-numbered M569. In 1949 it was re-bodied by ECW, but that body was transferred to an ex-Sheffield TD4c, CWB 985, in Dec 1950. A 1930 Leyland L27/24R body was then fitted, originating from ex-Ribble TD1, CK 4217, but via ex-North Western TD1, DB 9401, also in the Crosville fleet. CK 4405's chassis was sold for scrap in Feb 1956 and its 1930 body was put onto the chassis of FM 6416!

So, FM 6416, now disguised as CK 4405, never ran as such; it was stored but not sold until it went to J Lyons, Chester, for scrap in Nov 1959. It must have only just missed the preservation movement! Thanks to the PSV Circle for these complicated records, extracted from the fleet histories – Ed.

Royal Tiger Doyen – from David Burnicle

It was great to receive this 'one off' of the two excellent magazines together. Congratulations to Ron McCullock and yourself for an excellent Royal Tiger article.

In the article it says that it is difficult to understand why Leyland ran a clinic so late in the proceedings. The reason was that we were ordered to do it by Mr David Andrews, the then chairman of Land-Rover Leyland. His background was in cars where clinics were the norm. We explained that we were much closer to our end users than car designers were, but it did no good! It caused a fair bit of disruption to our programme.

One other point, Bill Pitcher's article on the L60 engine is excellent. I look forward to the sequel, though I'm sure Rootes Group would rather remember their two-stroke engine as being the "Rocker engine" and not the Knocker though!

New South Wales Beaver – from John Thompson

Very many thanks for the two latest excellent publications just arrived, full of most interesting articles. Congratulations! I of course I enjoyed the ones dealing with the Fire Service! On that note, I have received an excellent image of the restored 1938 Leyland Beaver Recovery Vehicle (featured on page 46 of Torque No.80) operated by the New South Wales (Australia) Fire Service and this is attached. A fine restoration and I think all will agree.

Indian Leylands – from Richard Peskett

Herewith are three 'Indian' Leylands which I encountered in Madras in November 1977. The 'artic' is well laden and was different from those in Hyderabad in that there was more glazing to the lower deck. The single-decker is typical of those used on outer town services with high ground clearance / skirt panels to accommodate the rough terrain and flood waters. The double-decker was new (Ashok-Leyland PD3?), at the same time whilst in Bombay I am sure there were at least two rear engine double-deckers; I seem to remember seeing the back ends in a depot and I think there were major cooling problems with them. I hope these are of interest. ***(Yes, they certainly are Richard – can any reader tell us more about them please? – Ed)***

Leyland Royal Tiger Doyen – from Maurice Doggett

Athough the 'Doyen' was not one of my favourite coach designs, I was nevertheless interested in Ron McCullock's comprehensive article in Journal No.20. On page 20, he mentions the involvement of Eastern Coachworks who were employed to rectify the poor build quality of the Roe-bodied Doyens.

I have therefore set to from the ECW records to list all the Doyens which went to the factory in Lowestoft for the rectification work which was needed. Some vehicles required more work than others judging by the dates to and from the factory. The list is attached which I found easier to handwrite rather than type, but it does need some explanation. ***(The list goes to three pages and is too long to include here, but if anyone wants a copy, please contact the Editor)***

Although most coaches show an arrival date at ECW, the actual departures are not shown in the Company's records. Instead there is a 'closed' date which I assume was when the financial aspect was settled. There is, however, evidence in one or two cases that the coach was actually delivered several days before the 'closed' date and I felt that I could only record that date for consistancy.

One thing which puzzles me is that most of the dates new shown on the list on Journal page 33 are almost identical monthwise to the arrival dates shown on my list. Is this right as surely the coaches may have had a period in service before the defects would have been discovered?

I used to make four or five regular visits to ECW each year from about 1950 onwards but I only saw one Doyen at the Factory. Judging by the receipt date on my list and the date on the enclosed photograph of East Yorkshire's **B109 UAG**, which you may keep in your archives, it would seem that the coach had yet to be worked on. As no 'Leyland'-bodied Doyens are recorded as having visited Lowestoft, the standard of their construction was clearly superior.

Christy, Bolton – from Mike Fenton

Re the piece on Arthur Christy, I am aware that TS2s **WH 1517/1577** are widely recorded as bodied by Bromilow & Edwards, but I have doubts about this being correct as a piece in Coaching Journal, September 1931 states that the body on DK 7516, a Holt Bros Tilling-Stevens of September 1931, had the first B&E body. The two Christy Tigers dated from March 1929, over two years before this. Also, there are no other B&E bodies recorded pre-1932. To me they appear to have been bodied by Burlingham.

Starting Handles – from Anthony Tomlinson

He says "In Journal No.20 you asked how the owners of the Leyland Bull TSQ1 managed to get the starting handle to stay in that position – almost horizontal? (***or sometimes you see them in a vertical up-position - Ed***). In my experience with TSC8 Beavers fitted with E.36 petrol engines, they were fitted with a sprag type clutch within the front engine mounting and this gave a measure of protection should the driver fail to retard the ignition control. This was not required when the vehicle had an oil engine."

(BCVMT L011044)

ANOTHER FACE OF LEYLAND, No. 11

By Michael Plunkett

Why in April 1932 with shiny Titans and Cubs queueing for their portraits, was the photographer instructed to fold his tripod and get down to Boots asap? Had Leyland just sold a van to 'The Chemist to the Nation' with hope of further orders to follow – or had the Liardet's nanny run out of cod-liver oil?

Whatever the circumstances, the resulting picture of Boots' counter is a unique record of the current range of 'cure-alls' and the style of their display 'Parrish's Chemical Food' (tasting of rust), camphorated oil (a pleasantly smelling chest rub), liquid paraffin, (so gentle!) and if it failed – caster oil, (best sampled as exhaust fumes at motor trials!). And, 'For your small requirements, one pennyworth of almost any drug supplied with pleasure'.

These drugs, the 'kill or cure' variety lurked in the jars behind, to be made up to a doctor's prescription; dreadful white sedimented liquids or something pounded in pestle and mortar and delivered in a small white china pot.

Now only those who rode to school on TD1s will recall (with a grimace) the awful tastes and smells of ipecacuanha, Angiers' Emulsion or Friars' Balsam and all those other medicaments on offer in pre-NHS days! ***(I remember Friars' Balsam, cod liver oil, sulphur tablets (for Acne), Pontefract (Pomfret) cakes (to keep you 'regular') and liver salts during NHS days! – Ed.)***

COVER PICTURES

Front Cover

There were a few commercial vehicles displayed at the Festival of Britain at London's South Bank Exhibition Centre. Leyland Motors displayed two Leyland Titan PD2/12s with Leyland 'Hybridge' (final design) bodies. This must be one of the most perfect designs of double-decker - simple, elegant and well-finished, this particlar example being helped by Southdown's attractive green livery. SMS number 701**, KUF 701**, had chassis no.511262, line no.3063; it was the first in a batch of 24 delivered between June and July 1951, though 701 arrived a month earlier for display at the Festival. They had H32/26R bodies, though platform doors were fitted by Southdown in 1953/54. ***(Alan Lambert collection)***

Back Cover – upper

The London Brick Company had a trading name called '**Phorpres**' and this was carried on all of their well-turned-out lorries. Here we see part of their fleet of Leyland Lynx DZ3 lorries numbered in their 'B' class. They had Duralumin lightweight bodies, being under 50cwt and ew in 1938. These small lorries probably had a hard life carrying heavy loads of bricks, particularly going fully laden up Brogborough Hill, near Stewartby, in Bedfordshire.

(BCVMT L023373)

Back Cover – lower

LRB 766 was a Leyland Hippo 19.H3 tipper of the Hilton Gravel Co, Hilton, near Derby photographed hard at work in February 1948. ***(BCVMT L034375)***

TAILPIECE

SOME FANCY SIGNWRITING FOR A SCOTTISH OPERATOR

Photographed on a wet 23rd May 1932, the bodywork on this Leyland Titan TD2 was beginning to look rather dated. The location was at the junction of Balcarres Road and Sandy Lane, Leyland, just behind the roof of South Works which can be seen in the distance on the left, a favourite spot for the Leyland photographer, despite it being on a rainy day. The Leyland Day Continuation School was shortly to be built on the land behind the wooden fence. Labour was cheap in those days and there were a lot of good skills that have unfortunately disappeared nowadays – a signwriter at Leyland would have written this back panel in next to no time, even with the complicated blending of the colours in the shading of the letters; it probably took him no longer than a day and a half, having to allow time for paint to dry over night. Where could you get that done today? – let alone all the lining out, all done by hand with no tape! The enclosed staircase 'Titan' body sat 24 upstairs and 24 downstairs and this bus, **SN 5647**, chassis no.1331, was the second lowbridge TD2 supplied to Graham. The business was taken over by W Alexander & Sons in July 1938, the bus becoming R228 and lasting until 1950.

(BCVMT L011298)

LEYLAND TORQUE

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LYNX and HIPPO