

WOODWORK, RESTORATION AND RESEARCH

Presented by I.L. Stewart

Prior to Mr Les Stewart presenting his paper he explained that although his was representing Wellington Tramway Museum at the conference, having been moved to Wellington from Auckland by his employer a few years back, the term "we" in his paper refers to his involvement in the Western Springs Tramway at MOTAT.

INTRODUCTION:

The topic I have been asked to talk to you, this morning, on is "Woodwork, Restoration and Research", a very wide subject covering almost every aspect of restoring a tram body. However, as the bulk of my experience in tram restoration has been in interior woodwork restoration my paper, perhaps, deals more with this aspect of tram restoration rather than the structural woodwork side. This also would appear an appropriate approach when I look at the workshop subjects that follow morning tea, as I see these workshops as a forum to compare methods and perhaps even solve each others problems.

STARTING OUT:

Restoration really starts before the tram is brought into the workshop.

The first step is the decision to actually restore the tram, but the decision is not just which tram to restore, it also includes the decision as to which era or period to restore it to. This latter decision will depend very much on historical documents, such as plans and photographs, that are available and on your museum's collection policy and forward plans. The decision to restore a particular tram to a particular period, while in the first instance, is probably made by your organisation's governing body, I believe it should always be confirmed by your members in a general meeting. This means that all have had the chance to partake in the decision making process and no member can morally opt out of assisting in the restoration on the grounds that he disagreed with the decision.

However, this is still bound to happen in any democratic organisation and there is nothing much anyone can do about it. We have to live with it.

If a restoration project is to proceed smoothly it must be organised. One member, or a group of members, each one responsible for a different area of restoration, for example, interior work, structural work, electrical work etc., should be appointed to "drive" the project to completion. Most members in organisations such as ours are not self-starters, they come into the workshop, sure, but someone has to put something into his hand and say, "Here, use this to do that to this piece of whatever." These organisers are not only responsible for always seeing that work is always available for the willing, but also for quality control.

Quality control is most important to ensure that the tram leaves the workshop to the desired standard and requires checking at all points along the way. Jobs such as taking adequate notes during the dismantling process are all part of the quality control process.

RESEARCH:

The three most important items to study in some detail during the research phase of the project are:-

- (i) the tram itself
- (ii) photographs of the tram to be restored
- (iii) plans and other written documents relating to the tram.

Let us look at each one of these items separately:

(i) The Tram

The tram body, as it is dismantled and re-assembled will yield a vast amount of information about its past. I will indicate areas of particular interest that should be noted as we proceed through the paper. This information is most useful in confirming or counter-acting information inferred from photographs or plans.

(ii) Photographs

Every conceivable photograph of the tram, or of trams of the same or similar design, should be obtained from all sources; your museum archives, the collections of private individuals, and local and national libraries and museums. Photographs can be very useful in that they can be blown up to reveal the finest detail, although it must be remembered that the further the photograph is blown up the more grainy it becomes with less definition. It is also possible to play around with print exposures to reveal light or dark objects.

As an example I will show you a photograph of an early Wellington combination tram which we had a portion "blown up" to try and examine in detail the long handrails on the open compartment of the tram for comparison with those we were going to install on our double saloon car No 135. We were very lucky that one of our own members was a camera operation for a commercial printing house in Auckland and was able to do this for us at no cost. With the aid of a magnifying glass a lot more detail can be picked up.

(iii) Plans and Other Written Documents Relating to the Tram

It can be of great assistance if you can obtain the original plans to the tram. Other documents relating to the tram, such as specification documents can also be extremely useful. As regards plans, it is unfortunate that plans detailing original structural components are often no longer in existence. This was particularly the case with No 135's centre section and detailed plans of the centre seat castings were unavailable and those were reconstructed mainly from photographs.

Great care must be taken to ensure that you do not over rely on plans because the trams were often built slightly different or modified later without altering the plans. Thus plans should always be used in conjunction with photographs and evidence obtained from the tram itself.

In New Zealand, under the Tramways Act 1908, tramway promoters were required to submit plans for any new trams to the then Public Works Department, now the Ministry of Works and Development, for approval.

To assist us in the restoration of Wellington Double Saloon 135, we obtained copies of the plans of Wellington Double Saloon Trams. While this is possibly an exaggerated case, these plans illustrate that trams were often never built to their original plans.

Firstly, the plans we were interested in were simply plans of trams 92 - 99 with this number range crossed out and re-labelled 101 onwards. Trams 92 - 99 were the first series of double saloons but were one foot shorter, six inches on each motorman's platform, than the later series. This difference in length was merely denoted on the plans by crossing out the original measurements and writing in the new ones without actually re-drawing the tram to scale. The plans also showed the addition of stiffening plates at the point where the platform bearers were bolted onto the main frame. Notwithstanding other minor differences between the two series of trams, such as the lack of roof guttering on the later series, there were no other changes made to the plans.

However, the most glaring inaccuracies shown by the plans were the clerestory roof and rocker panels with a convex curve rather than a concave curve. The rocker panel is the lower side panel and the plans showed this curving outwards rather than inwards. The point to note that neither the early series nor the later series of double saloons had either of these features, although earlier combination trams (either one third or two thirds saloon and the rest open) had clerestory roofs.

I must state that there was one plan amongst the set which was drawn for the series 101 onwards showing details of the motorman's platform and the underframe. This plan reflected changes made in the design to cater for the use of Brill 69E bogies on the later series whereas the earlier series were equipped with Brill 22E bogies. From all this, I can only conclude that the Public Works Department were primarily concerned with the structural strength of a tram when approving plans.

The research and the conclusions reached during the restoration of tram 135 could be the subject of a paper in its own right and I could go on for some length on the subject; however, I think I have shown that it would not pay to rely on one source of information - all sources of information must be obtained and compared with each other.

One of the most interesting facts - now that I have lived in Wellington a few years and know what the climate is like - when researching 135 was that, from photographic evidence, all the combination cars and the early series of double-saloons had the blinds in the centre section coming right to the floor, however all photographic evidence of the series 101 - 160 showed that the centre section blinds only came to seat level. It must have been a pretty breezy affair when the blinds came to the floor, but I would hate to imagine what it was like when they only came to the seats. There was one photograph we found that showed tram 160 with blinds to the floor. This might have been an experiment for the next series of double saloons to follow.

DISMANTLING THE TRAM:

Having covered some of the more theoretical aspects of tram restoration, we shall now move onto the more practical side starting with the dismantling of the tram.

While many would suggest that this is the easiest part of the restoration project and can be completed in a couple of days, I would suggest that if this attitude is adopted then the rest of the restoration will not go as smoothly as it could have and, in fact, the restoration could be hampered by lack of information and damaged parts. In particular, the reassembly task will be extremely difficult - like piecing together a giant jig-saw puzzle without the specimen picture on the front of the jug-saw box to help you.

If care is taken during the dismantling phase, the tram body can reveal a wealth of information about its past, but you must be prepared to take time to look carefully at every detail at every stage of the job. Paint lines, screw, nail and bolt holes can all indicate some previous feature that has long since been removed. In the case of Wellington tram 135, the exact positions of the centre section pillars were revealed by the mortices and the cut off bolts still present in the cant rails. The shape of the lower portion of these pillars was imprinted in an old paint line that was covered by the 1930 replacement pillars and a piece of hardboard that was used to help hide this paint line.

The other important part of the dismantling job is the labelling of all parts as they are removed. Labels must be descriptive - both as to what the part does and to where it goes. Describing what the part does is, perhaps, the easiest part of labelling an item because most items can simply be identified by a generic name such as a window, door archway, door head board etc. However, where there are many identical parts such as is the case with the parts just mentioned, describing its position can be more difficult.

When describing a part's position it must be described relative to the tram itself and not relative to its outside environment. This is necessary in order to avoid confusion at a later date should the tram be assembled in a place other than where it was dismantled, or the place of work is physically altered during the process of restoration.

I remember, during the restoration of Wellington Fiducia 257, reading a number of labels stating "Zip End" and "Door End", "Zip End" referring to the "Zip" water heater above the sink unit at one end of the workshop and "Door End" referring to the main workshop doors at the other end. Tram 257 was positioned over the pit on the number 1 road in the workshop. If at a later date 257 had been shifted to the number 2 road, the usual road for restoration, and positioned at the end of the workshop where the small access door is located, it is conceivable that "Zip End" and "Door End" could have been interpreted as the same end because the small access door and the "Zip" water heater are at the same end of the workshop. I think you can imagine the confusion that could have arisen particularly if reassembly took place some time after the relocation of the tram. Needless to say, the labels were quickly amended.

Fortunately, the tramway promoters and builders used what appears to be an almost standard numbering system to describe the positions of identical parts. As most of you are aware, in order to differentiate between identical ends, the ends of trams were labelled No. 1 or No. 2. On some systems,

they were referred to as the 'A' end or 'B' end; Wellington is an example of such a system. In the case of a tram fitted with air brakes, the ends are labelled so that the compressor is on your right hand side when you are facing the No. 1 or 'A' end. Don't ask me what happens in the case of a tram without air brakes because I have yet to work out a system.

The numbering system depends on this labelling of ends as a reference point. Identical parts are each given a number to represent each part's position on the tram. Starting from the centre position of the No 1 (a) end and the parts are numbered in a clockwise manner. This means that both the lowest numbered part, No 1 and the highest numbered part are both situated at the No 1 end unless we are looking at items that run down the centre line of the tram such as compartment doors, door arches, etc. The No 1 part is thus usually to the right of the centre line and the highest numbered part to the left.

However, world politics being what they are, it is little wonder that this is not quite a standard system worldwide. Auckland tram No 11, built by Brush of England, while using the No 1 end as the reference point to start numbering, actually numbers items in an anti-clockwise direction. Tram No 44 in the lower tram barn also uses this anti-clockwise numbering system although it was built in Auckland but No 44 is a copy of the early Brush four-wheelers, so it was probably just copied from them. Perhaps it has something to do with the different direction water swirls down plug holes in the two hemispheres.

Although this is not quite a standard system, provided you check the direction of numbering by removing a few select items before dismantling starts in earnest, you have a simple and effective method of labelling identical parts. The direction of numbering should be displayed prominently on the workshop notice board.

I know that some museums have developed their own labelling systems for identical parts, but I believe that we should all attempt to use the original labelling system for the tram being worked on. This is for two reasons; firstly, you do not end up with two sets of numbers or letters stamped on the item which could lead to confusion at a later date, and secondly, members moving from one museum to another do not have to learn an entirely new system, although there may be differences in the numbering direction.

When starting to dismantle a tram you must make the decision of how much to dismantle at once. As far as the interior woodwork is concerned, I would recommend that all items should be removed to prevent damage. However, there must be adequate clean and dry storage for all the pieces and special racks built under the benches used for varnishing are ideal for this purpose. Any area set aside for storage of interior panels should be considered sacred ground to prevent other members using the area for other purposes which could lead to the damage of panels - in other words beware of the grease monkeys with their greasy fingers. You all know what I mean by "grease monkeys" - steam tram fans are some of the worst that I know of.

On the structural side, it often pays to dismantle only that portion of the tram you intend to work on in the immediate future. Generally speaking, a tram body has at least two of everything - two platforms, two sides, etc. and by adopting the approach of only working on a limited area at any one time you always have a duplicate area to guide you.

One of the difficulties often encountered in dismantling structural woodwork are screws that are rusted solid. No matter what you do with a screwdriver, even an impact driver, you usually only succeed in ruining the head of the screw. Admittedly, you can drill the head off but this still leaves the shank embedded in the timber, often with little of it protruding. One of the best ways to remove rusted screws is to heat the screw with a large soldering iron. The expansion of the screw under the influence of heat followed by contraction on cooling, when the soldering iron is removed, breaks the seal caused by the rust and allows some movement of the screw. Also remember that the longer the screwdriver, the more force you are able to exert on the screw.

INTERIOR WOODWORK REFINISHING:

The refinishing of interior woodwork may be broken down into at least five distinct procedural steps;

- (i) stripping off paint and varnish
- (ii) bleaching
- (iii) grain filling
- (iv) repair of damaged areas and minor imperfections
- (v) varnishing

We shall now examine each of these procedural steps in turn and will then have a look at one or two of our problems in this area.

(i) Stripping off Paint and Varnish:

Before any item can be revarnished, it is almost always necessary to completely remove the old finish. This is usually due to one of two reasons - either the old varnish finish has crazed, that is the finish has cracked, bubbled and peeling; or, as so happened in the final years of tramway operations, the tramway promoters committed what might be the ultimate sacrilege, by painting over a beautiful varnish finish.

So, the first problem is to remove any old paint or varnish from the timber without damaging the wood in any way. There are two basic methods in removing any paint or varnish, either by using chemical strippers or by scraping. However, because scraping, either with a piece of steel or a piece of glass, requires additional expert skill which the average member does not possess, we at MOTAT prefer to use chemical strippers. This means a much wider group of members may assist with this task.

Chemical strippers fall into three basic categories:

- (1) Those using organic solvents, which may be washed off with water.
- (2) Those using organic solvents, which require surface scraping with final cleaning with further organic solvents.
- (3) Those manufactured in the form of a powder, which are dissolved in water before application.

The strippers falling into category 1 are generally used at MOTAT. Although the more expensive type of paint/varnish stripper, they are the easiest to use and they are the least messy in use. However, there are two sub-categories of this group of strippers:

- (a) those based on the solvent methylene chloride,
- (b) those based on phenol

We have found by experience and with a certain amount of horror at the time, that phenol based strippers often give the timber a pink tinge. However, we relaxed when this discolouration faded over a period of a couple of months. Needless to say phenol-based strippers are now banned in the workshop, just to be on the safe side.

I do not think there is any need to spend any time on discussing how to use paint/varnish strippers as I am sure that most of you have either used them or have seen others using them. However, I have one handy hint on stripping paint and varnish of open-grained timbers such as oak and mahogany. The grains of these timbers often get clogged with a mixture of old varnish and stripper that no scrubbing brush and water will remove. A clean wire brush, in good condition, used lightly in the direction of the grain will quickly remove this unsightly mixture from the grain of the timber. As a word of warning, I suggest that a wire brush be kept especially for this purpose, as you do not want any of those "grease monkeys" getting a hold of it!

(ii) Bleaching:

During the process of stripping off all the old paint and varnish, the timber will darken with a grey-black stain. These grey-black stains will also be apparent on timber where the old varnish or paint finish has deteriorated to such an extent that the surface of the timber is unprotected in places. This dark discolouration is due to moisture dissolving natural chemicals in the wood and depositing them on the surface as the wood dries out.

In order to remove these stains, it is necessary to use a very mild bleach; the easiest to use and the most effective being a saturated solution of oxalic acid. This solution is simply brushed onto the timber, allowed to stand for 5 minutes or so; in fact you will see the stains disappear as you watch; and then wash off the excess acid with plenty of water and wet the wood up to dry.

The main precaution to take when using oxalic acid, apart from the usual precautions of rubber gloves and eye protection that should be used when using any chemical that is likely to irritate and damage eyes or skin, is to mix it up and store it in a non-metallic container. If a metallic container is used, a green discolouration of the solution results which will cause dark stains on any timber it is used on.

Sometimes it is necessary to bleach the colour of the timber itself, and a case in point is Wellington Tram 135. The interior woodwork of this tram is constructed of Queensland Maple, a timber with similar appearances to the mahogany family of timbers. Queensland maple is generally golden yellow in colour, however, it was found that, after sanding, some pieces of woodwork from 135 were somewhat darker, having the red-brown colouring of mahogany. After noting this with a number of pieces, we concluded that these pieces had been bleached in order to give a more even colouring to all the interior woodwork.

We thus had a problem - how to bleach the darker pieces of timber to match the lighter golden yellow pieces. After reading a number of books on bleaching timber, we came up with the answer to our problem in the form of a chemical concoction that has come to be known as at W.S.T. as "Super Bleach". Made up of solutions of caustic soda and hydrogen peroxide, mixed together just prior to use, it is a very strong bleach and must not be left on the wood for too long. Thirty seconds to one minute is ample time, depending on the amount of colour that needs to be bleached, after which

it must be quickly neutralised with an oxalic acid solution. This bleach must be applied with a swab of cotton waste on the end of a long stick because if you try to brush it on with an old paintbrush, the bristles of the brush will dissolve in a few seconds.

"Super Bleach" was just the beginning, a whole family of bleaches based on alkaline peroxide has been developed for various purposes, depending on the amount of colour to be bleached. In fact "Super Bleach" led to "Super Dooper Bleach" when it came to varnishing the new centre pillars of Wellington Tram 135. Unable to obtain Queensland Maple in the right size and quantities, we opted for sapelle mahogany, one of the darkest of all mahoganies.

In this case the caustic soda solution was applied and allowed to dry overnight giving the timber a rhubarb colour. The hydrogen peroxide solution was then applied and also allowed to dry overnight. The next day, or the next time at the museum, the timber was neutralised with the oxalic acid. After this lengthy process the timber had the requisite golden yellow colour. If any further bleaching was required, a single application of "Super Bleach" was sufficient.

The Kauri timber used on most locally built Auckland trams darkens in colour so, after treating kauri with oxalic acid to bleach any water stains, a mild alkaline peroxide bleach of ammonia and peroxide is used to bleach the colour out slightly. However, as the peroxide bleach cannot be neutralised with oxalic acid, for obvious reasons, a mild solution of acetic acid was used.

For spot bleaching sodium hypochlorite solution - which is the basic household bleach, e.g. Janola or White Magic - is quite effective.

(iii) Grainfilling:

This area of interior woodwork finishing applies only to trams where an open grained timber such as Queensland Maple, Oak or Mahogany was used. It was standard practice, particularly on the older trams built, say, before 1925 to fill the grain of these timbers with a plaster of paris mix before varnishing. This had the effect of removing the visual impact of the grain giving a very even colour because the grain has an off-white colour rather than dark brown.

When stripping paint and varnish off open grain timbers, you should always be on the lookout for grain filler. After washing off each application of paint stripper and while the timber is still wet, inspect the grain, looking for white grain rather than dark brown grain. The presence of white grain, even in small patches would almost certainly indicate that the timber was originally grain filled. Here at MOTAT, Auckland tram No.11 has grain filled oak panels and garden seats, while Wellington Double Saloon No.135 has all her interior Queensland Maple woodwork, apart from the windows and kauri ceilings, grainfilled.

The paint and varnish manufacturers, "Wattyl" which is an Australian-based company, produce a pre-mixed grainfiller in a range of colours that are simple to use giving excellent results provided instructions on the can are followed. The blonde colour grain filler gives a very good match to the original plaster of paris filler.

(iv) Repair of Damaged Areas and Minor Imperfections:

During a tram's lifetime, its woodwork is bound to become damaged with scratches and other indentations. The odd, unwanted screw and nail hole are also present where advertising and other notices were attached to paneling during a tram's latter years in service.

It does not pay to worry about small nicks and scratches, as after varnishing, they will hardly be noticeable. Single screw and nail holes may be filled with a coloured wood-filler. We prefer to use ordinary linseed oil putty coloured with dry powder stains because it is possible to obtain just the right colour match with the timber being used. It is often very difficult to obtain a proprietary coloured filler that is the exact colour required.

If an oil based filler, such as linseed oil putty, is being used, the holes should not be filled until after the first coat of varnish has been applied otherwise the oil will soak into the surrounding wood leaving a dark oil mark. In fact, it pays to follow this procedure no matter what sort of filler is being used because most fillers will stain surrounding bare timber during application.

Major damage to a panel is more difficult to deal with. Often, particularly in places where advertising boards and panels were displayed, it is possible to have up to half a dozen screw holes in an area no bigger than a postage stamp. This is an excellent example of what I consider to be major damage. These relatively large and unsightly patches may be repaired by inlaying a small piece of the same type of wood. This, I admit is a skilled job that not all members will have the skills or the competence to undertake, as not only does the inlay job itself require precision, but timber colour and grain must also be matched. In heavily grained timbers the grain must follow the same direction, in all three dimensions, as the grain of the main board otherwise the inlay will be quite noticeable, even from a distance.

(v) Varnishing:

I do not intend to spend much time on this aspect of the refinishing process because, provided all the preparation work has been completed to a high standard, there should be no problems with the varnishing job. The most important part of varnishing is to ensure that you have a dust free environment. The best way of doing this is to create an area either separate from or with a physical boundary with the main workshop. An old tram body is ideal for this until such time as your organisation can afford or considers it desirable to build its own varnish shop.

RUST STAINING - A REAL PROBLEM:

Rust stains on woodwork must be considered a major problem in the area of interior woodwork. Rust stains arise from steel nails, panel pins and screws in the woodwork which go rusty. Generally speaking, steel screws and nails were never used in interior woodwork until latter years. There are many occasions where steel panel pins were used, mainly to secure beadings and other mouldings to panel work and windows.

Rust stains are typically grey-black in colour and grow quite large around a rusty nail, panel pin or screw. They are easily removed by oxalic acid, however, they reappear some six to nine months later. Thus, while you may be very satisfied with the varnishing when the tram leaves the workshop, six to nine months later might be a different story with unsightly rust stains in various places. Both No 11 and No 135 show the re-emergence of these stains.

I have a theory as to the reasons behind these mysterious reappearing stains but I must stress that it is only a theory and, to date, no research has been undertaken. As iron can exist chemically in two states, known as Ferrous iron and the Ferric ion, besides its metallic state. Rust is a common name for ferric oxide wherein iron exists as the ferric ion.

The ferrous compounds are very pale green in colour and in small concentrations almost colourless; on the otherhand, the ferric compounds have that classic rust colour. The action of a bleach such as oxalic acid on the ferric ion reduces it to the ferrous iron, thus "bleaching" the colour. However, the ferrous ion is not very stable and over a period of time in contact with oxygen, will revert to the ferric ion. Given that we do not usually seal the timber on all sides, oxygen will be able to move through the wood causing any rust stains to reappear over time.

We have found no way of completely removing rust stains chemically, however, we have had some success by removing rusty nail or screw with a pin punch and then ream the hole with a slightly larger twist drill. This enables all the rust particles to be removed from the surrounding area.

An example of this method is that one end of the open section of 135 has been treated in this manner, the other not. It is quite easy to see which end was treated and which was not. This same vehicle has also shown signs of staining in places of bare timber. This having been caused by the action of backs and bottoms over the years, however, the stains were removed with oxalic acid and right up until the time of re-assembly, the timber showed no signs of staining at all. But within a few months, sitting where it has for the last couple of years in quite bright sunlight on one side, the seats have developed dark stains again on some of the slats that were bare, this is obviously a light-induced reaction of some sort although we cannot actually confirm the exact process.

Other problems occur from "rush jobs". Our specifications called for after-varnishing or after-bleaching or anywater contact, timber must be left to dry for at least one week. If the wood is not allowed to dry for a certain time block stains will re-appear from the moisture bringing out chemicals within the wood again. Auckland tram No 248 is an example of such "rush jobs" on some of the end panels. The varnishing work here was done by workers on a PEP project and unfortunately you cannot always get these people to be patient and wait a week or two until they varnish things. Lack of attention to detail and specifications is also apparent in the centre section of 135 which was also rushed to completion. Instead of the specified four coats of varnish in places, it has only had two and as a result, the varnish is starting to lift, this being particularly noticeable on the seats.

STRUCTURAL WOODWORK:

A tramcar, by definition, is a light rail vehicle and, therefore, by definition, is of a light construction, unlike railway rolling stock which is of a very heavy construction. Just because it is light in construction, it does not follow that it is structurally weak. A tramcar's strength lies in the way the frame is put together and therefore, it is extremely important to follow the original design to the letter.

I have heard it said that "coach building is simply carpentry to machine shop standards" and this is quite true because to ensure strength, all joints must be tight and to ensure that windows and other fittings fit and operate perfectly, everything must be square to exact measurements.

Joints should never be glued and the only time glue is required is when it is necessary to laminate timbers together or to repairing rotten areas by cutting in new timbers. All joints in the wooden frame should be screwed up on a bed of thick wet red lead. Red lead not only seals the timber against water, thus preventing future rot, but also acts as a gap filler making the joint much tighter.

Timber used for structural work should be of a high grade, free of warps and knots. It must be remembered that the presence of knots in a piece of wood will structurally weaken the frame at that point.

Avoid soft timbers otherwise as the frame works the joints will loosen and the tram will lose structural strength. This rules out most fast growing timbers such as pinus radiata.

Where any of the structural frame must be varnished, it pays to spend that little extra time and money in obtaining the same type of timber as was originally used. If it is not possible for one reason or another to obtain, use a wood that closely resembles the original in appearance.

The side panels of a tram were originally a solid timber board, approximately 3/8" thick. Today's modern marine plys make a good substitute for the original and should last much longer as the original solid timbers often split very easily. Curved panels can be made by laminating two thin sheets of ply together, which may be done in position on the tram provided you have suitable clamps.

PAINT FINISHES:

On the W.S.T., all our trams are finished with enamel paint, we have experimented with spray painting as well as brush painting. I think both finishes will last the same length of time provided, of course, the tram is looked after, but unfortunately, some of our trams are showing signs of cracking paint because of the action of sunlight. No 248 is particularly bad, or was until a few weeks ago when it had a quick touch up, because this vehicle has been the mainstay of the outside service and has been exposed to strong sunlight on one side.

We have not actually experimented with varnishing over paint, and I would be particularly interested in hearing from any museums that do this as standard practice and how it protects the paint or improved the paint finish.

In conclusion, I would just like to reiterate some of the points made by Jim Walker and one or two other speakers yesterday about documenting the tram restoration process and would like to produce the documents that record the restoration of 135 virtually from start to finish. They are there for posterity.

Thank you very much.