EXPANSION LINK

BASINGSTOKE and DISTRICT MODEL ENGINEERING SOCIETY

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Editor Austin Lewis

Editorial

Whilst writing these few words in July, the temperature outside is 32°C and my grandson has just fallen out of his paddling pool with a bump. We should have had the pool last Sunday at the members' running day (July) as it became very hot and we had at least six grass fires under the open track by the Indian Restaurant, the owner of which provided us with two buckets of water but no curry. As with the mainline, steam was suspended and we ended the day as we started, with the club loco. We had a good summer of public running with many visitors returning week after week.

Club sweat shirts and polo shirts – can you please let me know if you would be interested in a club shirt so that I know rough numbers to place an order and get a competitive price, thanks.

I hope you enjoy this edition of Expansion Link and as always articles will be very gratefully received on any subject e.g. technical, models, mainline, clocks what have you, in fact anything that has the slightest engineering link.

Back on the tracks after a 22 year refit

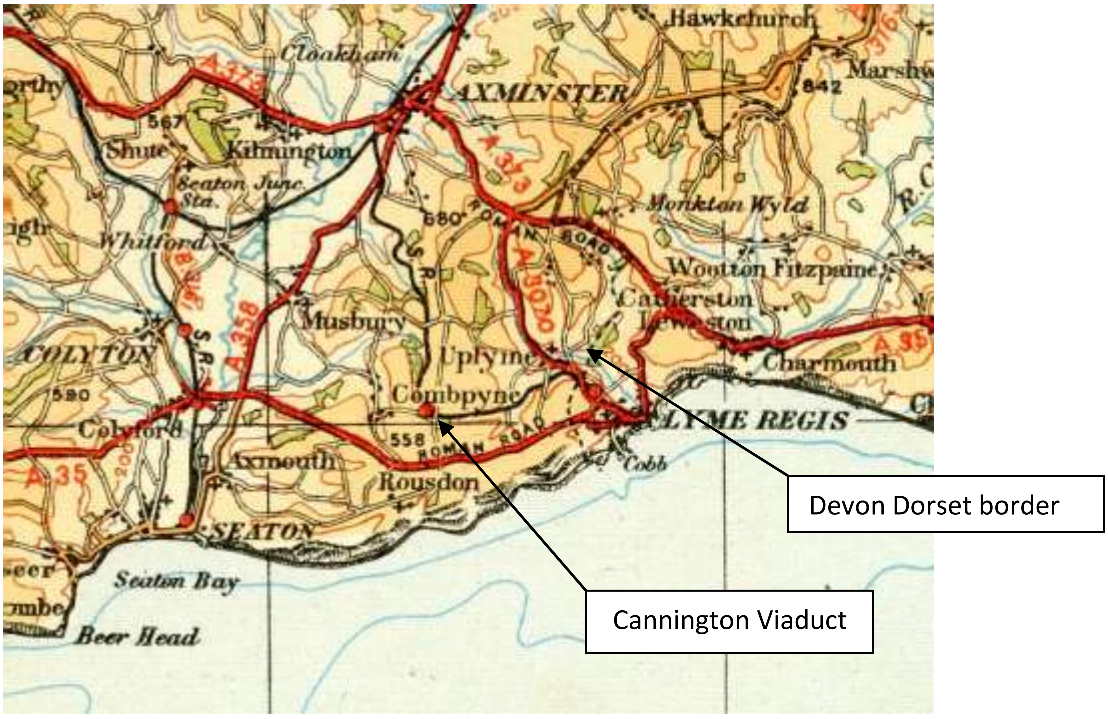
Dave Andrews steamed his very nice Great Western pannier tank 1506 during July's members' running day, the engine last ran on club metals in 1991. The time lapse was as a result of other demands on Dave's time but he has undertaken some repairs and modifications to the loco which is LBSC's GWR 1500 Class – Speedy. Basic dimensions are: length 35.1/4", cylinder bore 1.9/16" and driving wheel diameter 4.7/8". It was great to see it in steam and running well.

Axminster to Lyme Regis Branch Line
The Cannington Viaduct

by Austin Lewis

This article was held over from the June Expansion Link. On the 1st March this year my wife and I spent the weekend in Devon, a Christmas present from our children and of course my wife insisted that on the way down we went to see something to do with railways! This is in fact quite true, as her sister had been walking in this area only a few weeks earlier and had recommended it to us – great, off we go.

The location for our walk was the disused Axminster to Lyme Regis branch line which ran near the border of Devon and Dorset. All of the track and most of the track bed has disappeared so our focus was the Cannington Viaduct which is to the east of Combpyne and just in Devon as you can seen on the map below.

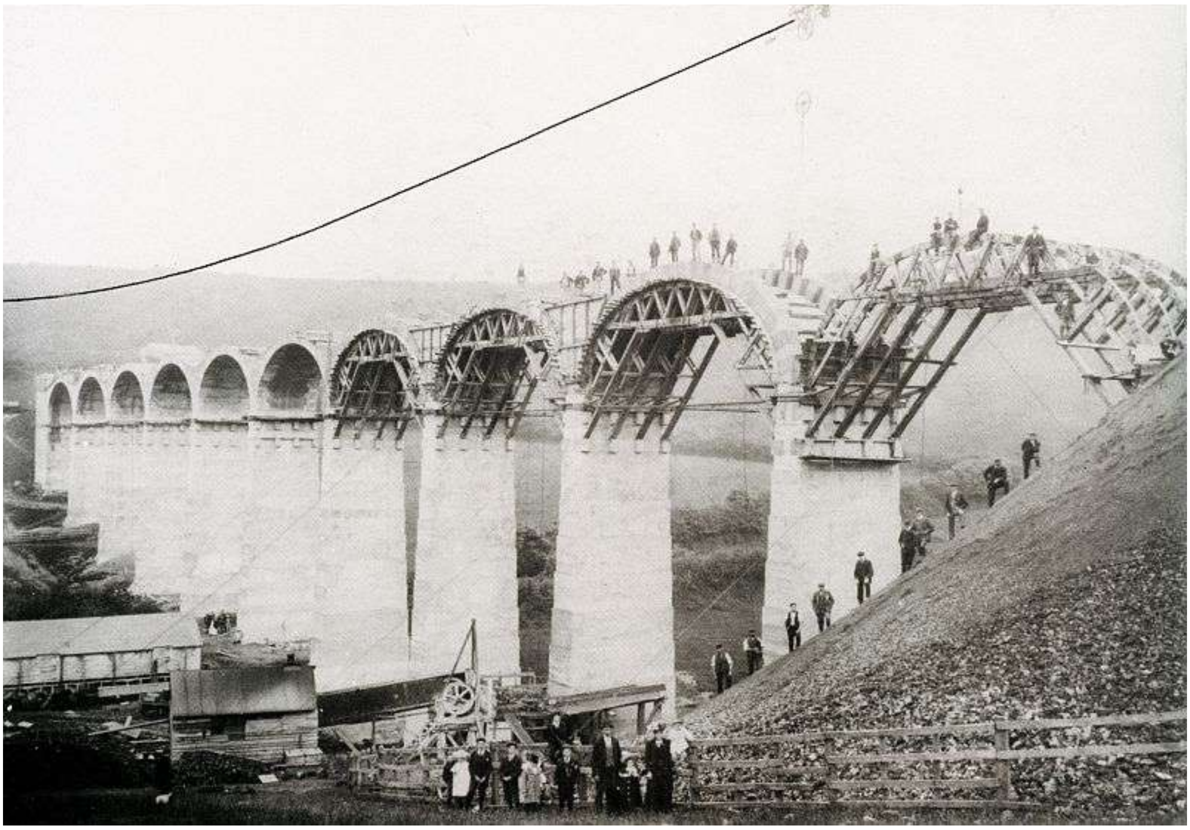


Ordinance Survey Quarter Inch Map 1934

We parked the car near to the viaduct looking north and walked along a footpath going east to Lyme Regis. The land climbs away from the road towards a small ridge which provides a good vantage point for photos but before we get to the viaduct of today, let's take a brief look at the building of the viaduct and the one of the types of locomotives which ran over it.

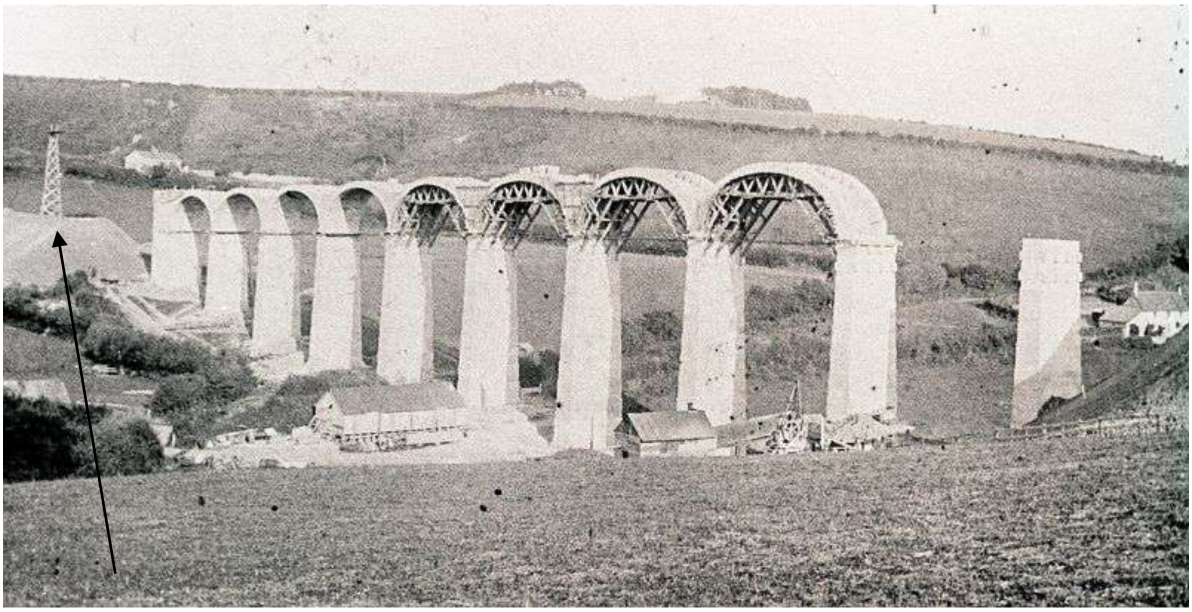
The Cannington viaduct was built around 1900, of poured concrete with ten elliptical arches on tall rectangular piers and with projecting blocks at a very imposing level. There is a concrete parapet with recessed panels and breaks over the piers.

At the time of building the third arch from the west end had to be reinforced by an infilling of brick to create a 'jack arch'. This was needed due to subsidence during the construction of the viaduct and can be clearly seen in picture (3) below. The Axminster and Lyme Regis Light Railway was authorised in 1899, built from 1900 and opened on the 24th August 1903. At the start of the line the London and South Western Railway had a significant financial stake which resulted in them receiving 55% of the revenue. Owing to its poor financial results the company was taken over entirely by LSWR on 1st January 1907. Steam services continued until goods services were withdrawn on 3rd February 1964 and after a period of diesel operation, passenger services ceased on 29th November 1965.



(1) Middleton Press

The Cannington Viaduct was constructed by "Concrete Bob" McAlpine, in about 1900. Note the overhead rope way used to deliver the concrete for pouring into the shuttering. In the photo below you can see one of the temporary wooden towers erected to take the 1000ft long cableway.



(2) Wooden cableway tower Middleton Press

*All black and white photos and table are courtesy of the **Middleton Press** and taken from their excellent book **"Branch Line to Lyme Regis"** by Vic Mitchell and Keith Smith.*

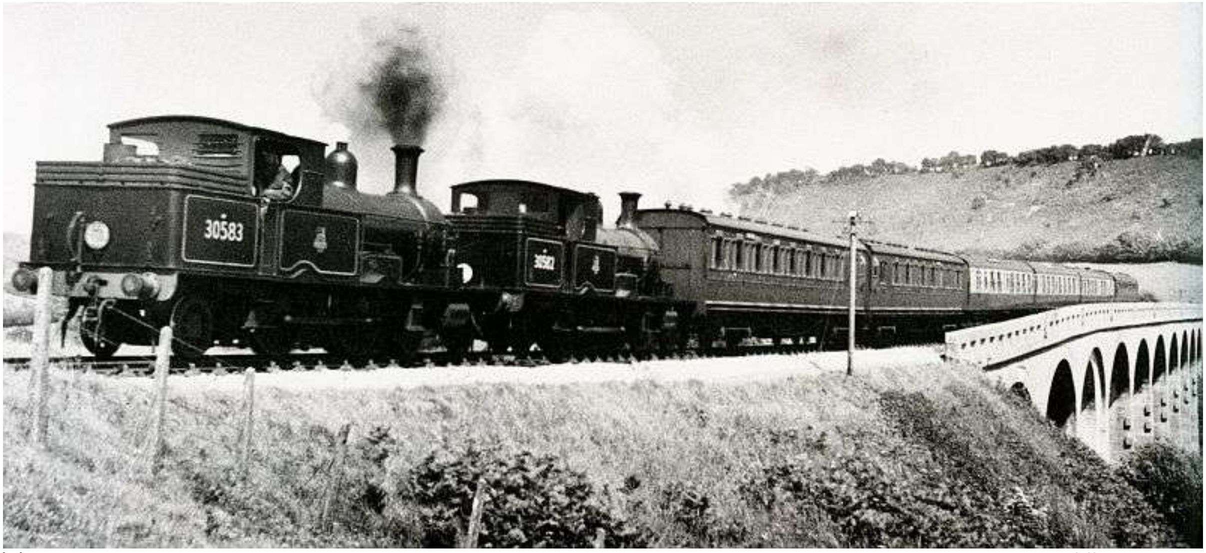
Several types of locomotives ran on the Axminster branch but my favourite is the Adams radial tank which is illustrated below. There were three locos which were the mainstay of the branch motive power for over 30 years although number 3488 did not arrive until 1946 and has survived to this day being purchased for preservation by the Bluebell Railway in early 70s.

(3) Sunken portion of track Middleton Press

Adams 415 radial tanks can be seen about to travel over the viaduct with the sunken portion supported by the jack arch, clearly visible at the far end.

The three radial tanks used were:

BR number	SR number	LSWR number	Builder	Disposal
30582	3125	125	Stephenson	Scrapped 1962
30583	3488	488	Neilson	Bluebell Railway 1971
30584	3520	520	Dubs & Co	Scrapped 1961



(4) Middleton Press

30583 and 30582 leave the west end of the viaduct on their way to Combpyne and then on to Axminster.

The following photos were taken in March and show various details of the viaduct including the brick built ‘jack arch’.

The above photos show the viaduct's situation in the local countryside around Combpyne

The remains of the track bed and tunnel under the road to Musbury

415 still lives on with, SR number 3488, at the Bluebell railway (next page) and in the many 5” and 7¼” gauge models having been built.

GLR Kennions Ltd

"COMBPYNE" *Drawings and castings copyright owned by GLR Kennions Ltd*

New phone number: 01279 792859

L.S.W.R 415 Class 4-4-2T Radial Tank by W.Adams 1885 GLR drawings by K.S. Moonie, based on Dubs built engines 1885. The above model is in 5” gauge and has slide valves with Stephenson valve gear.
Other model engineering suppliers are available

Adams 415 at the Bluebell Railway and a 9F which happened to be running on the day of my visit

THE CORROSION OF METAL – Part 1

by Richard Holt

ABSTRACT

Corrosion is an ever present problem. Its effects can range from creating cosmetic damage so spoiling the aesthetics of an artefact to severe damage which could threaten the strength of a component and therefore the structural integrity and safety of the total project.

The aim of this article is to explain the underlying processes that cause corrosion to occur by technical explanation and practical example.

INTRODUCTION

A basic understanding of the corrosion process may help to demonstrate why metallic objects can show sign of corrosion. In the longer term this understanding may assist in being able to reduce the severity of corrosion.

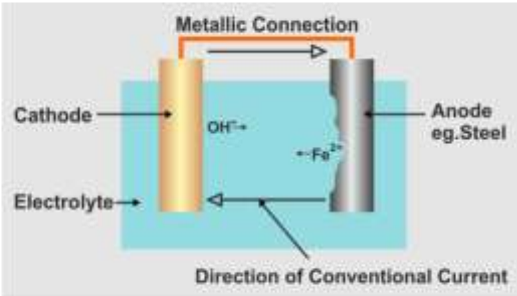
Failure due to corrosion
Figure 1

Corrosion can cause complete failure as illustrated here.

BASIC CORROSION

It has long been understood that when metallic objects are exposed to water they are subject to corrosion.

An understanding of the electrochemical process is best seen by reference to the basic corrosion cell (Figure 1). The open ended arrows in the diagram denote the direction of conventional current flow. Electrons, it should be noted, flow in the opposite direction.



The Basic Corrosion Cell
Figure 2

In the basic corrosion cell four different components are always present. These are an anode, a cathode, an electrical connection between the anode and cathode and finally an electrolyte. These conditions are easily fulfilled when steel is exposed to moisture.

The typical anode reaction is the oxidation of the metal. The example is for a bivalent metal.

$$M \Leftrightarrow M^{2+} + 2e^{-}$$

Equation 1

The typical cathode reaction is the reduction of oxygen

$$H_2O + \frac{1}{2}O_2 + 2e^- \Leftrightarrow 2OH^-$$

Equation 2

Equation 1 shows corrosion taking place at the anode site with the release of electrons into the bulk metal. Equation 2 shows the reduction of oxygen, using the released electrons, at the cathode. This process leads to the surface becoming more alkaline, which has different implications for different materials. For steel the alkaline condition helps to make it less susceptible to corrosion by making it more passive, however, for aluminium it would cause additional chemical attack on the surface, with the evolution of hydrogen. Exposing steel, even when of homogeneous composition, still has the capacity for corrosion because of a random distribution of anodes and cathodes on the surface, which will change as the steel weathers. This can be seen in Figure 3 where the profile of the nut and square washer is starting to disappear.

General Corrosion
Figure 3

GENERAL CORROSION

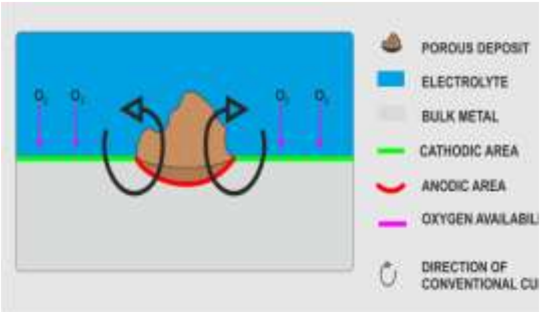
It will be seen in Figure 3 that corrosion is not evenly distributed on the surface of the metal. The build-up of the corrosion deposit (rust) does not serve to prevent further attack. Loss of material may be calculated and a 'corrosion allowance' can be designed in to account for the loss of material during the lifetime of the work piece.

Corrosion Allowance
Figure 4

It is probable that in the design of the World War II bollard, placed on Lepe Beach, Figure 4, that extra material was used in its construction to ensure its survival. In general the addition of a corrosion allowance is not guaranteed to provide the required design life due to the uneven effects of the corrosion process.

PITTING CORROSION

One of the most aggressive forms of corrosions occurs in the formation of pits. Here corrosion rates in steel can exceed 8mm per year. The formation of a pit will occur when there is a porous foreign object on the surface of the bulk metal. This may be in the form of scale. Because the diffusion of oxygen, necessary for the cathode reaction, will be reduced under the porous deposit this area will become anodic to the general surface of the bulk metal. This small anode area now balances a very much larger cathode area. This causes the anode to form in a deep pit (Figures 5).



Pitting Corrosion
Figure 5

The practical result of pitting corrosion is can be seen in Figure 6.

Pitting and General Corrosion
Figure 6

CORROSION PREVENTION

Referring back to the diagram of the corrosion cell (Figure 2). It can be seen that if we can omit one of the four constituent elements we could prevent corrosion occurring. The easiest element to exclude will be the electrolyte and the simplest way to achieve this is by applying a coating to the surface of the metal. The application of a coating system has the capacity to reduce exposure to oxygen and the electrolyte.

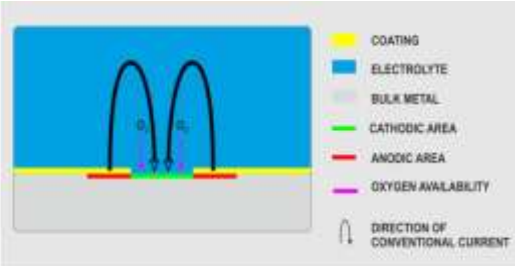
Sadly most coating systems do not completely exclude the electrolyte. In reality most paints are semi-permeable, which means that water can still penetrate to the surface of the metal. The result, as shown in Figure 7, is the appearance of rust spots.

Pinhole Corrosion
Figure 7

As the corrosion proceeds it will start to cause the coating system to loose adhesion to the metal surface and areas of the base metal become exposed as illustrated in Figure 8.

Severe coating breakdown
Figure 8

The explanation of why a coating system can fail is illustrated in Figure 9.



Coating System Failure Mechanism
Figure 9

Where a hole occurs in the paint coat oxygen is able to diffuse easily to the exposed metal surface. Around the edge of the hole, the diffusion of the oxygen is inhibited. This causes the area immediately around the edge of the hole to become anodic. The anodic area will be quite small compared to the cathode. At the anode the bulk metal will be oxidised, for example iron will be oxidised to ferrous ions. It is generally true that the oxidation product of a metal will be larger than the bulk metal it is derived from. The adhesion of the paint coat to the bulk metal will be lost. The net result is that the paint coat will start to lift away from the bulk metal around the edge of the hole in the paint coat. This allows the electrolyte to penetrate further below the paint coat, and the corrosion will progress beneath the paint coat. This is often seen as an 'orange peel' defect in the paint coat. Obviously as the area of coating disbondment increases there will come a point where the coating simply falls away as seen in Figure 10.

Hinge meets door skin
Figure 10

Surface preparation always holds the key to a good paint finish. Certainly in salt laden environments a problem can occur when the surface has small cavities that can hold salt crystals. As already mentioned, the paint coat is effectively a semi-permeable membrane, so when the paint is exposed to an electrolyte, the water will be drawn through the coating to form a dilute salt solution (Figure 11).

Semi permeable membrane
Figure 11

Osmotic pressure increases inside the cavity, which will eventually burst the paint coating. Once this occurs then general corrosion can take place on the exposed base metal (Figure 12).

Coating Breakdown
Figure 12

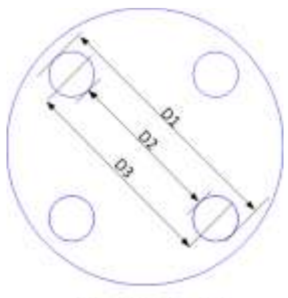
Part 2 in December's edition of Expansion Link

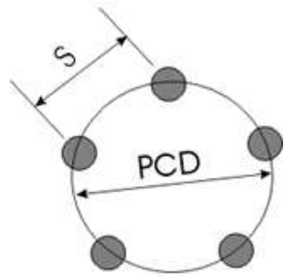
Ever wondered how to work out PCD - Pitch Circle Diameter?

by David Mitchell

The answer is a useful piece of maths to help solve this problem. I had to make up metal circular plug with 4 holes drills equally apart and didn't know what the PCD was, or have the original drawings for it. Luckily for me as it had an even number of holes (4), equally spaced apart, allowed me to measure the outer (D1) and inner (D2) diagrams between two holes, using quick bits of maths to work out the PCD (D3) and therefore drill the holes in the correct location. Hopefully the diagram below will help to explain this – **Method 1**.

Method 1





Method 2

This method does not work with an odd number of holes. Using another piece of maths can help again - measure the distance between the centres of two adjacent holes (can use the above method to calculate this as well), and record this as "S" – **Method 2**.

Then complete the following equation:

PCD Calculation Formula

4 Stud PCD = S/0.7071

5 Stud PCD = S/0.5878

6 Stud PCD = S/0.5

I used both methods (just to double check) and successfully calculated the PCD and drilled the required holes. The measurements can either be metric or imperial but not a mixture of both.

Visit to Colchester in June

A LITTLE FACTORY PRAYER

Grant me the serenity to accept the things I cannot change
The courage to change the things I cannot accept
And help me to be careful of the toes I step on today
As they may be connected to the back side I might have to kiss tomorrow.
Help me to always give 100% at work

12% on Monday
23% on Tuesday
40% on Wednesday
20% on Thursday, and
5% on Friday

And help me to remember when I'm having a really bad day
It takes 42 muscles to frown but only 4 to extend my fingers to wish the foreman good night!

From John H *(edited)*

In Next Quarter's Issue

Issues from the AGM
Sweet Pea to Sir Galtbe - Part 3 by Graham Blissett
The Corrosion of Metal – Part 2 by Richard Holt, and
Photos of this year's track running
Plus any articles you may wish to send to me - thanks

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Jon Evans
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