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JOURNAL OF THE  
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Anticorrosive properties of Mimosa (Wattle) tannin *A. J. Seavell*

Subjective comparisons of gloss—What does influence you?

*W. E. Craker and S. P. Smart*

New water-soluble compositions

*A. M. Naser, A. Z. Gomma and M. Moustafa*

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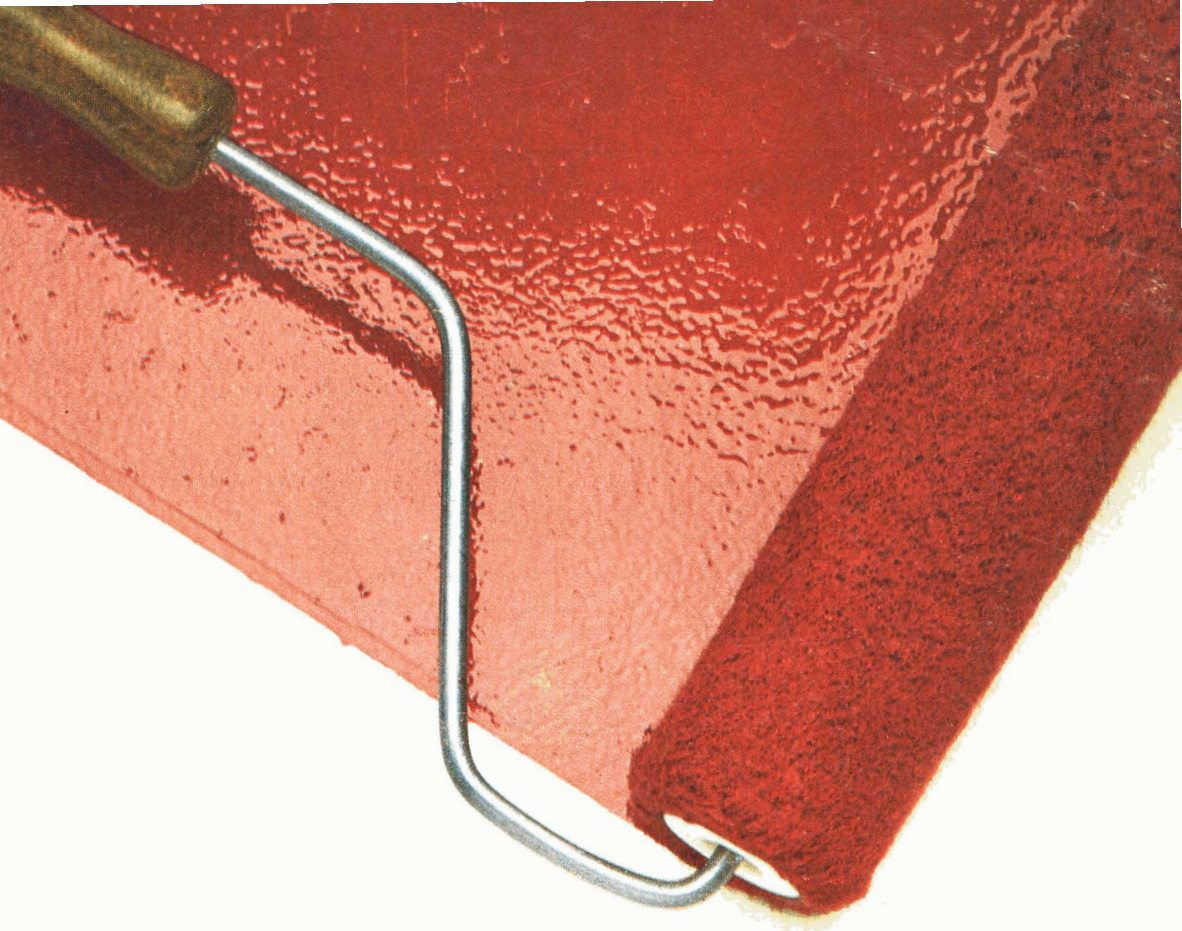
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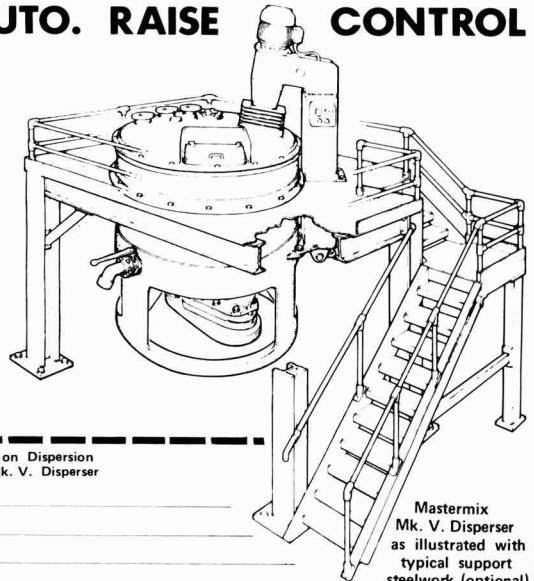
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# Anticorrosive properties of Mimosa (Wattle) tannin

By A. J. Seavell

African Territories Wattle Industry Fund Ltd, PO Box WA1 4ET, London W1

## Summary

A wash primer treatment for steel, suitable for use on new structural work or for maintenance work, has been tested over a period of four years under widely differing site conditions.

The treatment is based on Mimosa tannin (*Acacia mearnsii*) acidified with phosphoric acid. By the formation of iron tannate, this greatly enhances the durability of an air-drying paint system, especially when the site conditions make the complete removal of all rust costly or impracticable and when painting is delayed for periods of from one to eight weeks after surface preparation. Similarly, if the painting has to be done during a period of high

relative humidity, a preliminary application of the Mimosa-based wash primer has invariably shown a considerable advantage in delaying the onset of blistering and thus increasing the durability of the paint system as a whole.

The formation and the protective role of iron tannate has been studied in a concurrent investigation by Ross and Francis<sup>28</sup> and, as a result of their conclusions, it has been possible to qualify more precisely the advantages, which field trials have shown, from the use of Mimosa-based wash primer.

## Keywords

### *Types and classes of coatings and allied products*

anticorrosive coating  
corrosion resisting coating  
primer  
rust inhibiting coating  
wash primer

### *Types and classes of structures or surfaces to be coated*

steel

### *Processes and methods associated with surface preparation before coating*

passivation  
pretreatment  
surface treatment

## Les caractéristiques anti corrosions du tannin de Mimosa

### Résumé

Une peinture primaire réactive pour acier, qui est convenable pour être utilisée sur les structures neuves, ou pour les travaux de manutention, a été soumise aux essais pendant quatre ans sous des conditions d'usage fort divers.

La peinture est basée sur le tannin de Mimosa (*Acacia mearnsii*) acidifié par l'acide phosphorique. La formation du tannate de fer améliore fortement la durabilité d'un système de peinture séchant à air, autant que les conditions au pied d'oeuvre rendent trop coûteux ou impraticable l'enlèvement total du rouille, ou que le peinturage est différé pendant des périodes d'une à huit semaines après la préparation de la surface. Egalement, dans le cas où on est

obligé d'appliquer la peinture pendant une période où l'humidité relative est élevée, une application préalable de la peinture primaire réactive basée sur le tannin de Mimosa se montre sans exception avantageux en retardant le commencement de cloquage, et par conséquent en augmentant la durabilité du système entier de peinture.

La formation et le rôle du tannate de fer ont été étudiés par Ross et Francis<sup>28</sup> au cours d'une investigation simultanée, et à la suite de leurs conclusions il a été possible de qualifier plus précisément les avantages, mis en évidence par les essais sur place, qui résultent de l'utilisation d'une peinture primaire réactive basée sur le Mimosa.

## Antikorrosive Eigenschaften von Mimosen- (Wattle-) Tannin

### Zusammenfassung

Vier Jahre lang wurde unter ganz verschiedenen Anwendungsbedingungen auf den Bau-etc. Plätzen eine Waschprimerbehandlung für neuen Konstruktionsstahl oder für dessen Unterhaltung geprüft.

Die Behandlung beruht auf Mimosentannin (*Acacia mearnsii*) angesäuert mit Phosphorsäure. Durch Bildung von Eisentannat wird die Dauerhaftigkeit eines lufttrocknenden Anstrichsystems wesentlich verbessert. Das ist besonders der Fall, wenn durch Umstände an der Baustelle die völlige Entfernung allen Rostes teuer oder unpraktisch ist, und wenn Malerarbeiten für Zeitspannen von ein bis acht Wochen nach Vorbereitung der Oberflächen aufgeschoben werden; ebenfalls, wenn der Anstrich während

einer Periode hoher relativer Luftfeuchtigkeit ausgeführt wird. In letzterem Fall zeigte ein vorbereitendes Auftragen von Waschprimer auf Mimosenbasis unweigerlich einen beträchtlichen Vorteil dadurch, dass der Beginn von Blasenbildung verzögert, und auf diese Weise die Dauerhaftigkeit des ganzen Anstrichsystems erhöht wurde.

Die Bildung sowie Schutzwirkung von Eisentannat wurde in einer gleichlaufenden Untersuchung von Ross und Francis<sup>28</sup> studiert, und es war als Resultat ihrer Schlussfolgerungen möglich, die in praktischen Versuchen aufgezeigten Vorteile der Verwendung von Waschprimern auf Mimosenbasis zu bestätigen.

## Introduction

Ref. 28

There is rapid reaction between iron, in the Fe<sup>3+</sup> (hexaquo) state, and the natural tannins, the product being a chelated complex. This complex formation can be used to disturb the

kinetics of reactions involved in corrosion. The present paper is concerned with the anticorrosive properties of acidified Mimosa tannin when used as a wash primer, either to provide added protection under a conventional air-drying maintenance paint system for mild steel, or as a short-term protection in its own right.

This paper, based on observations from about nine hundred test-panels, draws on three related fields of investigation: corrosion chemistry, tannin chemistry and thirdly, a fundamental investigation into the formation of iron tannate on rusted mild steel, carried out on behalf of African Territories Wattle Export Fund Ltd, by R. Francis<sup>28</sup> at the Corrosion and Protection Centre Laboratories, University of Manchester Institute of Science and Technology.

In the following sections chemistry, from these three fields, relevant to the present investigations is briefly outlined.

## Corrosion chemistry

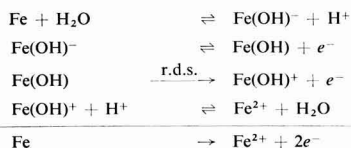
*Refs. 1-14*

Under normal atmospheric humidity, mild steel reacts with water and oxygen to form a hydrated iron (III) oxide:

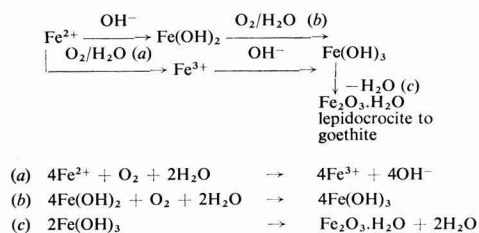


Whilst the natural tendency of this system to give the oxide cannot be altered, various measures can be taken to alter its kinetics. It is well established that the reaction is galvanic in nature, adjacent localities on the heterogeneous surface of mild steel acting as anodic or cathodic areas.

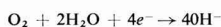
At anodic areas, iron atoms leave the metal lattice, the reaction steps probably being<sup>1,2</sup>:



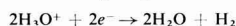
If the relative humidity is above 68 per cent,  $\text{Fe}^{2+}$  (hexaquo) ions react, in the "aqueous" phase above the metal lattice, with  $\text{OH}^-$  ions formed at cathodic areas. Oxidation of the iron (II) hydroxide and of the  $\text{Fe}^{2+}$  (hexaquo) also occurs giving iron (III) hydroxide. Subsequent dehydration leads to the formation of stable iron (III) oxide, as a deposit of rust:



At cathodic areas oxygen, in the presence of moisture, functions as oxidant<sup>3,4</sup>:



In addition, hydronium ions, present in acidic environment will, under conditions of restricted aeration, accept electrons with the formation of free hydrogen.

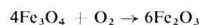


Other reactions can be significant depending on environment (especially sulfur dioxide concentration), pH, the formation of occluded cells in rust pits<sup>5</sup> and the ingress of moisture and oxygen. Thus, when available oxygen is limited,

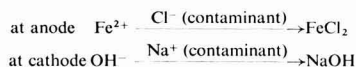
there can be some reduction of iron (III) oxide to magnetite<sup>6,7,8</sup>:



This might later be re-oxidised:

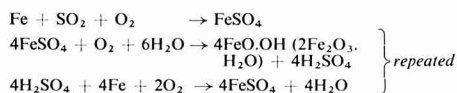


Because of ion migration the oxide layer is not adherent to the metal lattice, thus it provides no barrier to the kinetics of corrosion. The presence of contaminant ions giving soluble products enhances this effect through diffusion away from the metal lattice, i.e.:



These products will diffuse before interaction takes place so that the end product, hydrated iron (III) oxide, is deposited away from the site of the original  $\text{Fe}^{2+}$  (hexaquo) formation.

Attention is being increasingly drawn to the role of sulfur dioxide in promoting corrosion, through the formation of iron (II) sulfate. It is thought<sup>9,10</sup> that this is oxidised and hydrolysed with sulfuric acid as a reaction product, so that a repeated cycle is set up causing further erosion of the iron substrate:



The iron (II) sulfate concentrates in crystalline form and is located deep within the rust layer. After wire-brushing or mechanical abrasion to remove loose rust, deposits of iron (II) sulfate still remain in shallow rust cavities and deep rust pits, where they quickly promote further rusting<sup>11</sup>.

Even after grit blasting to visual brightness, residual sulfate can remain to act as a centre for renewed corrosion.

Diffusion of oxygen, through a paint film to the metal substrate, is retarded more than the diffusion of water<sup>12</sup>, but nonetheless, the observed rate of corrosion under a paint film is *less* than it could be even when calculated on the basis of oxygen permeability<sup>13,14</sup>. It follows that the processes of corrosion chemistry outlined above are retarded, but not altered or stopped by a paint film, so that in time fresh rust develops below the protective film leading eventually to blistering, loss of adhesion and ultimately, to film breakdown. It must also be remembered that any data calculated from measurements on detached films, are complicated in a protective attached paint system, by the localised irregularities of the substrate itself.

## Tannins

*Refs. 15-18*

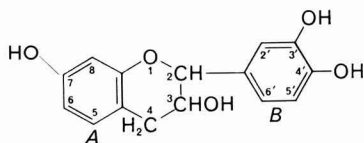
The term "tannin" is applied to an extract of certain plants, which is capable of cross-linking with the protein, collagen, in hides, thus preventing putrefaction. Chemically these extracts fall into two categories, which are largely unrelated apart from the fact that both contain polyhydric phenols within their structure. These two types of tannins are referred to as hydrolysable tannins and condensed tannins. The former (e.g. gallotannic acid, often called simply tannic acid, Myrabolam, etc.) are readily hydrolysed into sugars or



related polyhydric alcohols and phenolic carboxylic acids. Condensed tannins (such as an extract of the bark of the Mimosa tree—*Acacia mearnsii*) do not hydrolyse and contain only small amounts of carbohydrate.

The present paper is concerned with the condensed tannin, Mimosa—*Acacia mearnsii*. The work of D. G. Roux at the University of the Orange Free State has enabled the structure of tannins to become more precisely understood during recent years<sup>15,16,17</sup>. The author is also indebted to Dr Slabbert of the Leather Industries Research Institute for his comments on the structural chemistry of the Mimosa extract (also known as Wattle extract), and of the metal complexes formed by chelation with Mimosa tannin<sup>18</sup>.

Mimosa tannin has a polymeric structure of molecular weight 300-3000 containing on the average four flavanoid units, whose structure is typified by the formula below:



3,7-dihydroxy-2-(3',4'-dihydroxyphenyl) chroman

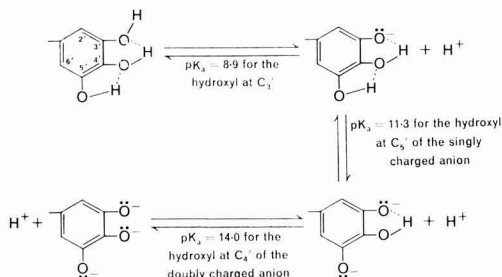
A typical flavanoid unit

Cross linking of the flavanoid units takes place at the carbon atoms in the 4 and 6 positions, or if a hydroxyl group is present on the 5 position, crosslinking occurs at the carbon atoms in the 4 and 8 positions.

If the benzenoid part of the chroman group is denoted as *A* and the phenyl ring as *B* and one of the oxygen atoms of the *A* ring becomes the oxygen of the chroman component, then analysis<sup>17</sup> shows that the nature and percentage of the flavanoid units in Mimosa tannin to be as follows:

Resorcinol ( <i>A</i> ) and pyrogallol ( <i>B</i> )	.. 56 per cent
Resorcinol ( <i>A</i> ) and pyrocatechol ( <i>B</i> )	.. 24 per cent
Phloroglucinol ( <i>A</i> ) and pyrogallol ( <i>B</i> ) or pyrocatechol ( <i>B</i> )	.. 20 per cent

The *o*-dihydroxy phenolic groups of the *B* ring are capable of chelating with Fe<sup>3+</sup> (hexaquo) giving, under acid conditions, a highly stable, insoluble violet coloured complex. There is no reaction in acid solution with the Fe<sup>2+</sup> (hexaquo) ion. The structure of the iron tannate complex is influenced firstly, by the ease with which the hydroxy groups ionise (which, in turn, is probably governed by the intramolecular hydrogen bonding) and secondly, by the stability of the complex product itself. Pyrogallol ionises according to the following scheme:

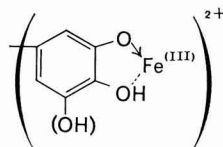


Similarly for pyrocatechol:

$$pK_a = 9.3 \text{ for the hydroxyl at } C_3'$$

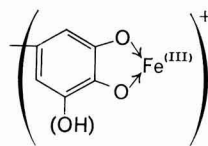
$$pK_a = 13.7 \text{ for the hydroxyl at } C_4' \text{ of the singly charged anion.}$$

It might be expected that the Fe (III) complex would contain the structure:

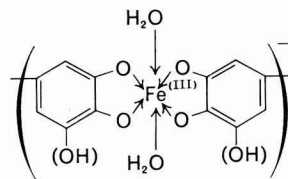


i.e. only one of the hydroxyl groups is ionised.

However, despite the high  $pK_a$  value for the hydroxyl group at the  $C_4'$  position of the singly ionised anion, the greater stability of the doubly ionised chelate leads to the formation of an *o*-diphenol complex of the type:

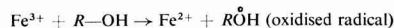


The violet iron (III) tannate formed between Fe<sup>3+</sup> (hexaquo) and Mimosa tannin under acid conditions is the bis-chelate:



The tris-chelate is not likely to form, except under alkaline conditions.

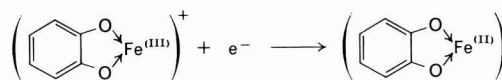
The tannin structure acts as a strong reducing agent, readily reducing potassium permanganate in acid solution. A redox reaction is, therefore, possible between Fe<sup>3+</sup> (hexaquo) ions and acid solutions of Mimosa:



(*R* . . . . . flavanoid unit)

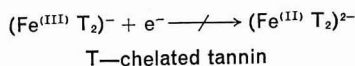
However, the Fe<sup>2+</sup> (hexaquo) formed is readily oxidised by aeration to Fe<sup>3+</sup> (hexaquo), so that this reaction is probably ineffective in influencing the overall iron (III) tannate formation under normal conditions when access to air is unrestricted.

Similarly a *mono*-complex could undergo a redox process:



Once formed there is, however, little likelihood of the Fe (III) *bis*-chelate complex gaining an electron, as it already

carries a negative charge, i.e. complexing stabilises the higher valency state with respect to the lower.



These considerations leave, therefore, little doubt about the nature of the complex formed between Mimosa tannin and the  $\text{Fe}^{3+}$  (hexaquo) ion.

The remaining water ligands in the bis-chelate structure probably play an important part in explaining certain features of the behaviour of iron (III) tannate formed over rusted mild steel. These are discussed in later sections.

### The mechanism of corrosion inhibition by Mimosa tannin

*Refs. 5, 7, 19-30, 37*

It has been known for some 25 years that useful anticorrosive qualities are shown by both the hydrolysable and the condensed vegetable tannins, especially at 10-30 per cent non-volatiles in acid solution.

In accelerated and in field trials, acidified tannin solutions have been brush applied to bright mild-steel and to mild-steel which has rusted and then been cleaned to remove loosely adherent rust. A protective layer of blue black iron tannate develops over the metal surface and the presence of some residual rust on any test-piece invariably hastens reaction and gives a more corrosion resistant tannate layer. From this observation it was always tacitly assumed that acidified tannin reacts with the residual rust.

It became clear that tannin solutions acidified, usually, with phosphoric acid could be used either as a short term protective system (for a period of approximately 8 weeks in average weather conditions) or as a pretreatment, allowing 12-24 hours before applying a maintenance or general air-drying paint system, the durability of which, it has been claimed is significantly extended<sup>19-27</sup>.

Tests carried out by Ross and Francis<sup>28</sup> and preliminary trials by the author, using Mimosa tannin, have confirmed the anticorrosive potential of this condensed tannin. However, whereas earlier work was based on conjecture about the reaction between rust and tannin and between iron and tannin (which generally speculated on the conversion of rust and probably of iron into iron tannate), R. Francis<sup>28</sup> has demonstrated a very different mechanism; salient points from his work are outlined below. This, in turn has led to a rational explanation of the results from field-trials. In some of the earlier work, *apparent* contradictions made it difficult to be precise in assessing the potential role of tannins in the anti-corrosive field.

Infrared spectrophotometry on samples of iron tannate, made from reaction between acidified Mimosa and iron, has confirmed, by reduced absorption of the  $3600\text{cm}^{-1}$ - $2600\text{cm}^{-1}$  band (due to inter and intra molecular bonding of —OH groups) that the formation of iron tannate involves chelation with the —OH groups of the Mimosa tannin structure. No other significant structural change is involved.

When black iron (III) tannate is formed by brushing acidified Mimosa on to bright steel or lightly rusted steel, the X-ray diffraction pattern of the tannated substrate, taken

within hours of drying out, shows no evidence of any change in crystalline form.

As may be seen by visual inspection, there is no immediate reaction on *bright* steel (as there is on *rusted* steel) but, due to surface irregularities and cathodic oxidation, the blue-black iron (III) tannate slowly forms as a non-adherent layer. X-ray diffraction analysis of this tannate shows that the pattern due to Mimosa itself (a steady curve, typical of an amorphous organic solid) remains almost unchanged in character or intensity.

On a lightly rusted panel, where the formation of tannate is rapid, the peaks due to  $\alpha$ - and  $\gamma$ - $\text{Fe}_2\text{O}_3 \cdot \text{H}_2\text{O}$  and to  $\text{Fe}_3\text{O}_4$  in the rust, remain virtually unchanged indicating that: (a) the iron (III) tannate undoubtedly present (its black appearance being unmistakable) has *not* converted all of the rust into some other structure, and (b) the iron (III) tannate formed has no characteristic crystalline structure by which it can be identified. A slight decrease in intensity of the rust peaks has been noted, which could be due to some slight reaction or simply to absorption by surface layers, of unreacted Mimosa.

It was also noted that, using Mimosa acidified with phosphoric acid, no peaks occurred due to the presence of phosphates, indicating that the part played by the phosphoric acid is essentially, to solubilise the iron or rust as  $\text{Fe}^{2+}$  (hexaquo).

In order to investigate whether or not some very slow change occurs in a layer of iron (III) tannate, a panel coated with acidified tannin was examined by X-ray diffraction techniques after intervals of 3 months, up to 16 months, whilst maintained at a relative humidity of 78 per cent. Readings show changes in the nature of the rust itself. After 3 months, the proportion of lepidocrocite decreases appreciably. The proportion of magnetite increases over the same period and then drops to about half its original value. A possible mechanism for the reduction of iron (III) oxide is suggested. The proportion of goethite shows a steady and continued increase. Untreated rust shows a similar overall trend but *without* the increase of magnetite over the first 3 months.

It has been stated that an adherent layer of the stable magnetite structure is a preventative against further corrosive attack on the iron substrate<sup>7,29,30</sup>. While the boost in magnetite content might well contribute to short term protection by acidified Mimosa, it must be borne in mind that the magnetite is not necessarily formed *on* the metal lattice. Also the performance of pretreatments claiming to reduce lepidocrocite and goethite to magnetite do not always substantiate the claims made in respect of magnetite formation.

R. Francis found that there is *no* similar increase in magnetite when Mimosa acidified treatment on a rusted panel is followed within 24 hours, by a full paint system. Tentative reasons for this are suggested.

Whilst, therefore, field trials show that acidified Mimosa contributes to the anticorrosive properties of the paint system, no correlation can be assumed between this and the magnetite content of the rust.

More positive information on the function of the acidified Mimosa treatment was obtained through electron probe analysis<sup>37</sup>. Tannate itself cannot be detected, as the atomic mass of its component atoms is too small. However, phos-

phorus from the phosphoric acid is detectable and the assumption is made that the presence of the phosphorus component may be equated with the presence of tannate. The consistency of results under various conditions, support the reasonableness of this assumption. A typical concentration profile of a panel treated (after removal of loose rust) with phosphoric acidified Mimosa, is shown in Fig. 1a. Fig. 1b shows the type of profile which would result if acidified Mimosa penetrated with rust but no interaction of any sort took place.

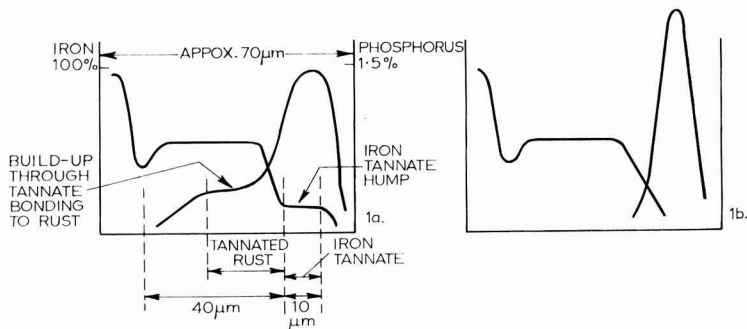


Fig. 1

Iron tannate contains only a small percentage of iron (one Fe (III) to four units of flavanoid structure represents approximately 2.5 per cent iron), so that the small hump having a depth of about  $10\mu\text{m}$  on the surface of the rust and containing approximately 10 per cent of iron is strong evidence of iron (III) tannate formation, although it could not be detected by X-ray analysis.

The presence of 0.3 to 0.7 per cent of sulfur was also detected, spread fairly evenly through the rust, with pockets of up to 5.0 per cent at the metal interface. Tannin treatment has no effect on the distribution of this sulfur.

When the structural and profile evidence from instrumental analysis is coupled with the known chemistry of tannate formation then a fairly accurate understanding of the protective treatment becomes possible. Thus, it is known that tannin chelates with  $\text{Fe}^{3+}$  (hexaquo) but not with  $\text{Fe}^{2+}$  (hexaquo), and it is readily observed that hydrogen is released when acidified Mimosa reacts with a rusted surface under restricted access of air. The absence of any significant reaction between acidified Mimosa and detached rust, and its slow action with bright steel, are both readily demonstrated.

It, therefore, becomes clear that Mimosa tannin functions by reacting with the  $\text{Fe}^{3+}$  (hexaquo) ion and *not* by direct reaction with either iron or rust. Before treating with the acidified Mimosa (used either as short term protective or pretreatment) the rusted surface must be sufficiently cleaned to expose some of the underlying metal. Attack by moisture and phosphoric acid forms the  $\text{Fe}^{2+}$  (hexaquo) ion which is readily oxidised to the Fe (III) state.  $\text{Fe}^{2+}$  (hexaquo) and  $\text{Fe}^{3+}$  (hexaquo) ions are absorbed by the Mimosa wetted rust, where reaction takes place, thus stifling any anodic reaction by insolubilising dissolved iron. Reaction possibly also enhances the formation of any membrane of corrosion products thus helping, especially at rust pits, to inhibit the diffusion of dissolved oxygen to underlying metal<sup>5</sup>.

The tannate is physically bonded to the rust which is,

therefore, covered with blue-black tannate and *appears* to have been converted into tannate. The rust serves two functions; it holds the iron (III) tannate as an adherent layer, the absence of any such bonding on to bright steel, explains the less adherent and less effective nature of tannate on this substrate. The rust also serves as a "retainer" or reaction site for electrons released from the anodic areas. The electrons are initially taken up by hydronium ions, leading to the formation of hydrogen and subsequently by the absorbed oxygen and moisture system, giving hydroxy ions.

The layer of iron tannate covering the tannate impregnated rust, has a thickness of  $10\text{--}25\mu\text{m}$ . Electron microscopy shows this layer to have a reticulated structure. The broken character of this layer is, on the one hand, a point of weakness; it is at the cracks that rust first breaks through and starts to reform. At first this is on a micro-scale but, as it develops, the tannate ceases to be protective. On the other hand, a proprietary treatment which *does* have a continuous outer layer has proved inferior to the acidified Mimosa treatment both as a short term protective and as a pretreatment, (*see* Test 6b). Certainly, under a paint system the reticulated surface provides a key and, as reported by R. Francis, this pattern is still clearly visible when a follow-on paint system is removed after a period of weathering.

## Experimental

Refs. 31, 32

Results from field-trials, which have extended over several years, are recorded in two sections; the first covering preliminary investigations and formulation; the second reviewing a later and more comprehensive scheme of weathering trials.

Comparisons have been made with other marketed materials claiming to remove or treat rust and to act as pretreatments or protectives in their own right. Also, all tests have incorporated untreated panels as controls.

A number of features (type of panel, environment, conditions of exposure etc.) are common to both preliminary work and to more extended trials. These are outlined below.

## Panels

Mild-steel panels approximately  $26\text{cm} \times 12\text{cm}$  and  $2.5\text{mm}$  thick have been used in all exposure trials. The exact specification of the low carbon steel used is not certain but, as this will have little effect on the nature of the rust formed after a

year's unprotected exposure, this detail is unimportant. The panels are flat and, whilst not therefore presenting "difficult" sections, they are holed so that the paint-work inevitably has some irregularities, (see Fig. 2).

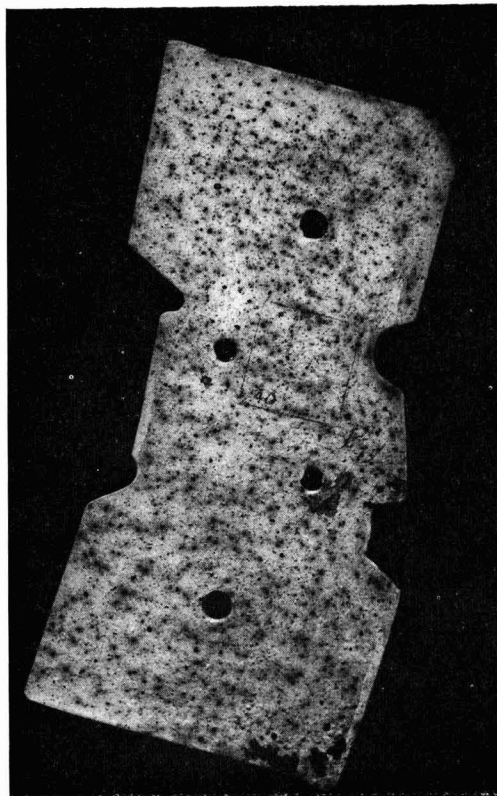


Fig. 2. Photograph of a complete panel

Rusted metal surfaces were prepared by exposing these panels (originally hot-rolled), for at least 12 months to an industrial atmosphere, so that rust penetration would probably be at least  $125\mu\text{m}$  (5 mil)<sup>31</sup>. During this time the panels were left almost horizontal and at ground level on a gravelled surface. Before use as "rusted" panels they were cleaned to one of four stages:

*Stage I:* hand wire-brushed to remove little more than loose rust.

*Stage II:* mechanical abrasion with aluminium oxide paper ( $1\frac{1}{2}$ -P40, E OP) giving patches of clean steel and a smoother but still generally rusted surface, leaving the more adherent rust, shallow rust cavities and pits.

*Stage III:* mechanical abrasion with aluminium oxide paper ( $1\frac{1}{2}$ -P40, E OP) down to clean steel, but still leaving small, fairly evenly spread centres of rust in cavities and pits.

*Stage IV:* grit blasted panels (prepared in a Guyson grit blasting machine model 250/20, using Guyson

Thornite Beads) cleaned to visual brightness and free of any residual rust.

With all stages of cleaning, edges were buffed to avoid sharp corner effects.

#### Painting schedules and paints used

From laboratory measurements of adhesion and cohesion it was found that an acidified Mimosa treatment generally hardened and became more water resistant over a period of 12-24 hours. A minimum of 12 hours was, therefore, allowed as standard practice before applying any paint system over the tannated panel. (See *Drying conditions*).

The Mimosa treatment (or any other rust treatment assessed for comparative purposes) was always applied immediately after cleaning the rusted panel. This was considered an important requirement, since any fresh steel surface exposed as a result of abrasive cleaning, is in a particularly active state<sup>32</sup>.

All pretreatments and paintings were applied out of doors but under cover, allowing approximately 24 hours between coats.

When acidified Mimosa was assessed as a short term protective, the test-panels were exposed for 7 days, for 28 days, or other chosen period before subsequent painting, with a specified metal primer, followed by a conventional undercoat and topcoat system\*. No preparation was given to the protected panel before painting, other than a quick wipe with a stiff brush to remove accumulated dirt and grime. When proprietary short term protectives were used these were applied in strict accordance with the maker's directions.

The time-tabling of tests was such that periods of short term protection ran during late winter to early spring or late autumn to early winter.

Since the thickness of any paint system appreciably affects durability, all painting was done by weight and within close limits:

undercoat	$2.6g \pm 0.1g$ wet paint per panel
topcoat	$2.2g \pm 0.1g$ wet paint per panel

In the case of primers†, a common weight was impracticable because of their widely differing specific gravity. The practice was therefore adopted of applying a good coat and ensuring that each individual primer was always applied at the same weight per panel:

Primer	Wet wt. per panel (g) $\pm$ 0.1g
red lead (BS 2523 Type B)	3.9
zinc phosphate	3.4
calcium plumbate	3.3
metallic lead	4.5
zinc chromate	1.9
red lead/graphite	2.7
iron oxide	2.5
retailed metal primer	2.9

\*Undercoats and topcoats used were the Brand products:—  
"Dulux" manufactured by Imperial Chemical Industries, England—  
"Permoglaze", manufactured by Blundell Permoglaze Ltd, England.

†These, except for the retailed metal primer, were supplied by International Paint Building Paints, Res. and Dev. Lab. Felling, England.

The Mimosa wash primer, as defined later, was generally applied at 0.9g (wet weight) per panel prepared to stage II cleaning, i.e. at a spreadage of approximately 30m<sup>2</sup> per litre.

In a number of trials the paints were deliberately thinned before application, adding 16g of white spirit per 100g of paint. This, in general, gave 2/3 to 1/2 the normal dried film weight per panel and the effect of irregularities in the surface profile was, therefore, accentuated, an expedient which provided accelerated conditions of natural weathering and a severe test of any pretreatment. For the same reason several tests were deliberately run in unfavourable mid-winter conditions.

#### Conditions of exposure

The exposure site was a rough earth patch, covered with gravel, and located in a chemical industrial, and coastal, area. Panels were set at an angle of approximately 5° to the horizontal and at 1 to 2cm off the ground. This provided fairly aggressive conditions with heavy dew during most of the year. Site conditions were such that drying off, after rain or dewfall, was generally slow. The almost horizontal exposure was chosen as this would give maximum retention of water droplets and, therefore, maximum rusting at any points of failure (either in short-term protection or in a paint system), by differential aeration, the centre of droplets becoming anodic whilst the outer parts, richer in oxygen, are cathodic areas<sup>33</sup>.

Similarly, panels being exposed to provide rusted test-pieces, were always exposed just off horizontal, as these gave more rust cavities and pitting than panels exposed vertically or at 45°.

It is recognised that results from any one exposure site, however "average" or however aggressive, cannot be universally acceptable<sup>34</sup>. For this reason comparative *trends* have been sought in assessing Mimosa wash primer and most of the results reported from exposure trials are presented on this basis.

#### Controls

With all sets of exposure trials, control-panels coated with primer, undercoat and topcoat, but no pretreatment, were included. Results from each trial are related to the performance of its control-panels. When control-panels, cleaned to stage II or III, were exposed for 7 or 28 days so that fresh rust developed, they were lightly scuffed before priming to remove loose rust and any dirt or grime.

As a second measure of control, reproducibility was checked by always including *three* test-panels and three control-panels coated with red lead (BS 2523 Type B), as primer. Any significant difference within either of these two sets of three panels, would clearly invalidate the test. No special importance is attached to the use of red lead primer for this reproducibility check—any primer could have been selected.

## Section I

### Preliminary investigations and formulation

*Refs. 11, 28, 35-37*

Formulation of the acidified Mimosa treatment was, in the first instance, based on accelerated tests. Mild-steel panels (13cm × 6cm) were lightly rusted by immersion for 15 min in a slightly acidified salt solution (containing chloride and

sulfate ions and wetting agent). The panels were then washed, dried and immediately coated with acidified Mimosa tannin at various dilutions, pHs and levels of wetting agent. Grit blasted panels were also coated at different levels of dilution, pH and wetting agent.

At chosen intervals the black or brown layer of tannate or tannate plus unreacted tannin, was tested for adhesion using the cross-hatch test, for cohesion by wiping under steady pressure or with a cello tape strip off, and for resistance to water immersion, by noting the time for the coating to soften.

An optimum basic formula was established from these tests; a 20 per cent solution acidified to a pH of 2 with phosphoric acid, and containing 0.25 per cent wetting agent. This formula was reassessed by outdoor weathering trials using the acidified Mimosa as a short term protective on rusted panels cleaned to stages II, III and IV. A three to six month exposure endorsed the findings from accelerated tests. It also confirmed that the tannate formed on grit blasted steel had very little adhesion or cohesion. This is, of course, in accordance with R. Francis's work, in which he showed the need for some rust to provide physical bonding of the tannate layer.

It was tacitly assumed that the formula which gave maximum resistance to the onset of renewed rusting, would be the best for pretreatment, as well as for short term protection, when followed by a full paint system. Extended observations have shown the validity of this assumption.

#### Modifications to the basic formula

Several modifications were examined, these included:

- (a) The removal of the 5 per cent gum content of Mimosa tannin.
- (b) The addition of barium salts to precipitate sulfates.
- (c) The use of a compatible binder.
- (d) Additions of formaldehyde to harden the tannate layer.
- (e) Additions of furfuryl alcohol as bonding agent.

#### (a) Removal of gums

Removal by sedimentation of the natural gums (which include high molecular weight carbohydrates) was shown to be a distinct disadvantage. Doubtless, they contribute to the bonding of tannate to rust. The isolated gums give, in fact, a very hard resinous product in the presence of cobalt drier. When the tannate from a gum-free Mimosa treatment is examined with the scanning electron microscope<sup>28</sup> its surface is found to be highly reticulated with curling at the edge of grains. This leads to a fall-out of loosened grains and the development of new rust at the unprotected sites. A surface profile of this sort readily explains the advantage to be gained from retaining the natural gums.

#### (b) The addition of barium salts

In order that precipitation of barium sulfate should occur, thus removing the corrosive sulfate ions, the wash primer was acidified with nitric acid; phosphoric acid would preferentially precipitate barium ions as phosphate. However, no advantage was gained by addition of barium ions and this is undoubtedly accounted for by the fact the acidified Mimosa penetrates only the upper half of the rust, whereas sulfates

have been shown by electron microprobe analysis<sup>28</sup> and by direct analysis<sup>11,35,36</sup>, to be concentrated in the lower layers. Thus only greater penetration is likely to insolubilise sulfate contamination. The use of different wetting agents or additions of water miscible solvents to achieve greater penetration has so far proved ineffective, and the use of excessive wetting agent is detrimental, probably due to the very open cracks in the reticulated patterns of the tannate surface caused by the use of wetting agents in excess of 0.5 per cent by weight. These cracks, along with some powdered tannate, are clearly shown by the scanning electron microscope. There is evidence that deeper penetration of barium salts can be achieved by using approximately 10 per cent solutions of tannin. This also gives a less reticulated profile. However, underlying rust is very near to the surface and overall no advantage is achieved by this expedient.

(c) *The use of a binder*

The addition of small amounts of methyl methacrylate emulsion was effective in increasing short term protection. The amounts used were sufficient to help "cement" the tannate rather than to function as a true binder. However, no advantage was gained when acidified Mimosa, modified with binder, was used as pretreatment under a paint system; also the shelf-life was reduced to about 6 months.

(d) *Additions of formaldehyde*

Apart from the use of binder, the alternative of inducing polymerisation within the tannate, through the addition of formaldehyde, was examined, although it was realised that this could hinder penetration unless polymerisation was a very slow process. No advantage was found in respect of short term protection, and shelf-life is shortened to several months, after which time polymeric material throws out of solution.

(e) *Additions of furfuryl alcohol*

This alcohol, which can sometimes increase the bond between phenolic resins and inert material is ineffective, probably because it adds little to the strong physical bond already formed between tannate and the rust structure. Shelf-life is reduced, and there is no effect on the reticulated surface profile.

Results from these modifications show that the simple basic formula gives the best all round results as a short term protective. It has also become clear that reasonable tolerances in formulation are acceptable and, despite any natural or seasonal variations which might occur in the Mimosa itself, no differences have been apparent in batches made from different samples of Mimosa over the period of investigation.

This simple formula (20 per cent Mimosa solution acidified to pH2 with phosphoric acid and containing 0.25 per cent wetting agent) is referred to in the following sections of this paper as "*Mimosa wash primer*".

R. Francis has shown that this formula arrived at initially by trial and error, is essentially the composition giving maximum rust penetration with maximum thickness of outer iron (III) tannate layer.

**Conditions of application**

*Refs. 27-29, 37*

Earlier investigators have pointed out the importance of brushing, to "work in" tannin treatments. Preliminary tests with Mimosa wash primer endorsed the influence of conditions

of application on performance, and the effect of the following variants on overall performance have also been examined in some detail:

- (a) Application by brush, spray, dip, etc.
- (b) Different spreading rates.
- (c) Application on thick rust.
- (d) Application on damp rust.
- (e) Drying conditions.

(a) *Application by brush, spray, dip or electrolytic methods*

After cleaning rusted panels to stage II and III, application must be done by stiff brushing. Spray and especially electro-deposition gives a tannate layer with poor adhesion and, in the case of electrodeposition, it is porous and soft. Dipping gives no reaction while the panel is immersed, as no oxidation is possible. Once lifted out of the Mimosa wash primer, the tannate forms but lacks adhesion. Electron probe analysis shows that spray, dipping etc. give appreciably less penetration than does brushing.

The formation of hydrogen while the rust is covered with wet Mimosa wash primer is clearly visible under the microscope. Accumulation of hydrogen polarises the cathodic rust areas and so hinders tannate formation; its removal by brushing is obviously advantageous. This method of application is used throughout the extended test programme, described in Section II.

(b) *Different spreading rates*

Electron microscope pictures of the surface replica show that a generous or heavy application of Mimosa wash primer (approx. 20m<sup>2</sup> per litre, on a rusted surface cleaned to stage II), leads to a reticulated surface with wide cracks; these provide sites for the growth of new rust which spreads under the tannate layer<sup>28,37</sup>. Short term protection tests confirm that too low a spreading rate, even with brush application, can cause blistering. A double coating (each of normal spreadage) tends to leave an outer layer of unreacted tannin. This does not dissolve or fuse together the reticulated pattern of the first coating. A double application extends the life of the Mimosa wash primer as a short term protective, probably through the slow interaction of unreacted tannin with Fe<sup>3+</sup> (hexaquo) ions, as moisture and oxygen continue to permeate to the underlying metal. However, the advantage to be gained does not outweigh the cost of a second application. Also, for small scale maintenance work, tests show that much more advantage is to be gained from a quick touch up with Mimosa wash primer two to three months after a first application (an expedient which can be useful under retail or "Do it Yourself", D.I.Y. conditions), when painting is to be left till spring or summer.

Surprisingly good results have been obtained by a very thin application (i.e. a spreading of approx. 60m<sup>2</sup> per litre on a rusted surface cleaned to stage II). The protective layer is thinner and the electron microscope shows that this layer is much less reticulated and has only very fine breaks. These still provide mechanical key for a subsequent coating of paint and, being very fine, they doubtless account for the slower development of new rust along crack lines when the tannate is used as a short term protective. The rust is, however, barely covered by the very thin outer layer and, even though it can sometimes be unexpectedly good, its protective value compared with that from a normal application (30m<sup>2</sup> per litre) is less assured against surface irregularities.

*(c) Application on thick rust*

Over thick rust and on panels prepared to stage I, the short term protection is greatly reduced; Mimosa wash primer is not an excuse for poor preparation. At one time it was thought that tannin reacted with rust so that it would have seemed sufficient to merely remove loose rust. It is now known<sup>28</sup> that thick rust merely reduces penetration, and reduces tannate formation by hindering access to metal ions. As a result, much of the tannin remains unreacted. In addition, electron microscope pictures show that, with excessive residual rust, reticulation is severe and fresh rust growth is fairly rapid, the wide cavities allowing unchecked access of corrosive agents.

*(d) Application on damp rust*

Mimosa wash primer can be applied over damp rust without any detriment either to its short term protection or to its function as a pretreatment. This is perhaps not surprising since the primer is an aqueous system. Both preliminary and extended field-trials have shown that, whereas coating damp rust with a primer induces quicker blistering, a damp (not wet) tannated rust may be coated with primer or undercoat without the usual damaging effect of a damp substrate. In all probability the gel-like structure of the tannate can retain moisture which is released too slowly to lead to blistering; it might even solubilise and cause reaction with unchelated tannin.

*(e) Drying conditions*

The development of a reticulated surface pattern takes place within minutes of application. The nature of the slower changes which, after 12 hours, lead to greater adhesion and hardening are not fully understood.

In all likelihood some water, held in the octahedral iron (III) complex, is lost, causing a change in the gel structure. The physical bonding of tannate to residual rust might also undergo some gradual change and it has been speculated that intermolecular condensation possibly occurs. Whatever the nature of these changes, it is advantageous to allow Mimosa wash primer, when used as a pretreatment, at least 12 hours before coating up with any paint system.

It has also been demonstrated that drying in a moist atmosphere can lead to a reticulated profile with finer crack lines. Even if application is on hot steel (as in summer painting) the cooler night air or dew-fall can reduce the depth of reticulation and so render the surface more uniform, whilst still providing ample mechanical key. It seems, therefore, that 12 hours hardening, especially "overnight" as is normal practice, represents ideal conditions.

## Section II

### Weathering trials

With optimum formula and conditions of application established, the Mimosa wash primer has been evaluated, both as pretreatment and as short term protective, in a series of field-trials, using the wash primer under "typical" conditions and under a number of adverse conditions.

Results are expressed as bar graphs and the scheme shown in Fig. 3 is used as an abbreviated specification of test conditions.

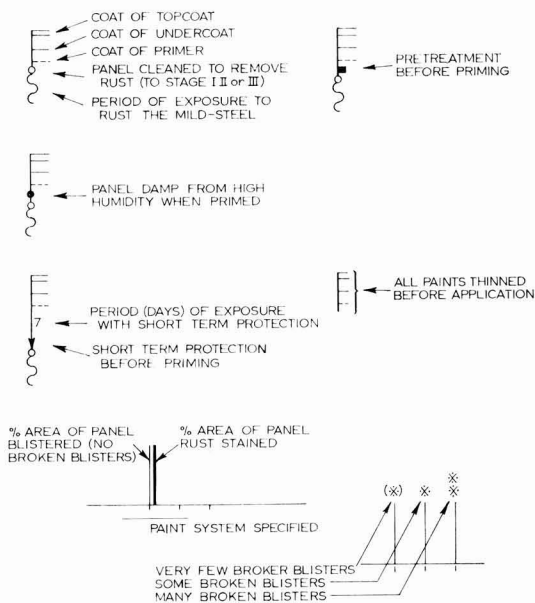


Fig. 3. Key to symbols used in charts showing results as bar graphs

### Data used in recording results

Recording of film performance in terms of blistering, rusting, flaking etc., have been made at intervals of three months or six months according to the season, so that the history of each panel has been noted. However, the conditions of the panels after 2.5 years' exposure, or in some cases after one year, gives a simpler but adequate overall measure of performance. This is particularly so since minor differences are of little practical importance; only major effects and the end results are of consequence.

Blistering is recorded as the percentage of the panel area which is blistered. This is measured by placing a transparent graticule over the surface. The graticule is marked with a 1cm × 1cm square and subdivided into 2mm squares. With experience and placing the graticule at ten random localities on the surface it is possible to make a fairly accurate measurement of the percentage area blistered. Rust staining is similarly recorded as the percentage of the area affected; film failure due to broken blisters (i.e. rust spots), is also recorded.

### Test 1

#### Mimosa wash primer as a pretreatment under different primers

Rusted control-panels were cleaned to stage II, coated with one of the six primers used in this test and then undercoated and topcoated. The test-panels were given a Mimosa wash primer treatment before priming. Each set included three panels primed with red lead primer (BS 2523 Type B) and an additional two panels cleaned to stage III, coated with the red lead primer, undercoat and topcoat. (The purpose of the three stage II panels being to assess reproducibility.)

The percentage of blistering etc. on these panels after exposure for 2.5 years is shown in Chart 1.

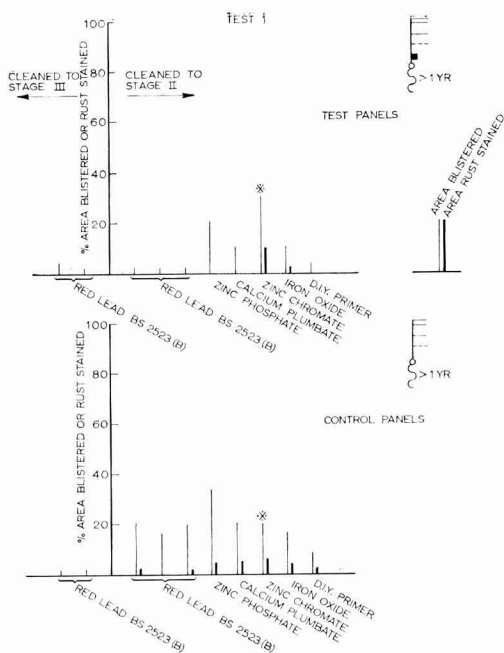


Chart 1

As might be expected, very thorough preparation has given excellent results, so that nothing is gained by the use of a pretreatment. With stage II preparation the pretreatment shows to greatest advantage under red lead primer and there has been generally improved performance with the iron oxide, zinc phosphate and a retailed D.I.Y. metal primer. Plate I, panels 1, 2 and 5, 6, compares treated and untreated panels primed with red lead and iron oxide primers respectively. Results over these primers confirm earlier trials covering considerably larger surface areas.

Photographic reproduction of results is generally confined to panels coated with red lead and with iron oxide primer. These have not been singled out on a performance basis, but simply because red lead to BS 2523 Type B is traditionally well recognised and iron oxide is widely used, even though it is not necessarily chemically anticorrosive.

Plate I, panels 3, 4 and 7, 8, also shows comparative panels on which the Mimosa wash primer was applied at low spreading and high spreading rates. This variable made little difference; if anything, low spreading under red lead and high spreading under iron oxide gave the best results. This is doubtless the combined effect of surface profile and the extra brushing which necessarily accompanies maximum spreading. Several hundred test-panels treated in this way over many trials show that no generalisation can be made in predicting the effect of spreading, except that it is generally best to avoid either excessively generous or excessively brushed out application.

Chart I (controls) shows marked differences between paint systems based on different primers, but otherwise identical within experimental limits. These same differences are reflected in the pretreated test-panels.

It is important that in this, and other charts, no conclusions should be drawn which lie outside the scope of the present investigation. Thus no comparison must be made among the primers themselves. Differences *do* occur, but to generalise on the merits of the pigments used in these primers could be misleading, since pigment performance depends on the binder present, the choice of extender, on surface condition and on the conditions for which the primer was intended.

Throughout this investigation conclusions are drawn *only* from the comparison between a test-panel and its appropriate control. In this way the Mimosa wash primer is evaluated as an isolated variable.

In a separate set of panels, duplicating Test I (i.e. evaluating Mimosa wash primer as a pretreatment), but exposed under unusually severe winter conditions, film failure was exceptionally rapid. Rust developed at a pace such that normal protection was afforded neither by the primer, undercoat/topcoat system, nor by the pretreatment, primer, undercoat/topcoat system. Panels were also exposed during this period, where preparation had been taken to stage III. With this better surface preparation the pretreated system showed to obvious advantage. See Plate II, panels 9-12.

Where preparation was taken only to stage I, the life of the paint system under severe conditions was greatly shortened with all primers and little advantage was gained from the use of Mimosa wash primer. This is to be expected, since penetration into the outer layers would leave a great deal of the underlying rust and contaminant.

## Test 2

### Mimosa wash primer as a short term protective under different primers

#### (a) Period of exposure before painting—7 days

The control set of panels was cleaned to stage II and left exposed for seven days before painting with one of the eight primers used in this test. Undercoat and topcoat were applied at 24 hour intervals. The test-panels were coated with Mimosa wash primer immediately after cleaning and, alongside the control panels, they were left exposed for seven days before painting. As in all tests, consistency was assessed by including three similarly prepared panels in each set, these three being primed with red lead.

Each set also included a further two panels cleaned to stage III and primed with red lead before undercoating and topcoating. Chart 2a shows the appearance of these panels after 2.5 years exposure.

Short term protection has shown to greatest advantage under red lead and iron oxide primers (see Plate II, 13-16 and Plate III, 17 and 18). It is particularly effective over the well prepared panels cleaned to stage III and subsequently primed with red lead (see Plate III, 19 and 20). In view of current legislation, panels prepared to Stage III have, in more recent tests, been coated with zinc phosphate primer following a Mimosa wash primer pretreatment. This extension to the original programme has been added to all of the tests (i.e. Tests 1-9, but excluding Test 6) as part of a continuous evaluation of the wash primer.

The effect of a generous and of a well brushed out application of the wash primer under red lead is also shown in



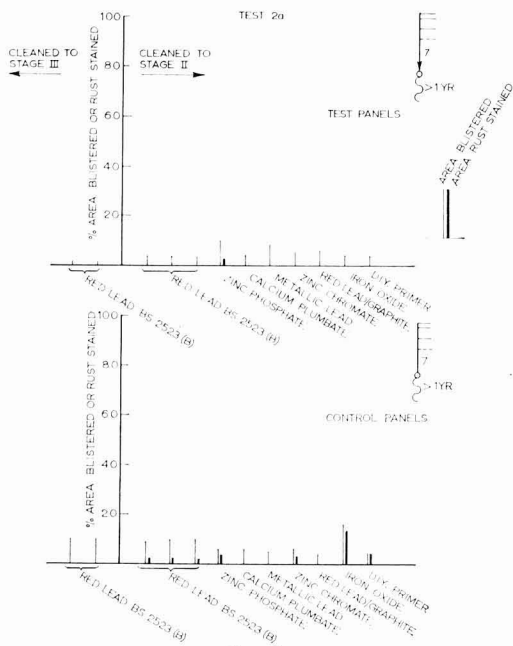


Chart 2a

Plate II, 13–16. Over all other primers, this variable had no significant effect.

(b) Period of exposure before painting—28 days

This field trial started at the same time as the previous one, but a 28 days exposure was allowed between panel preparation

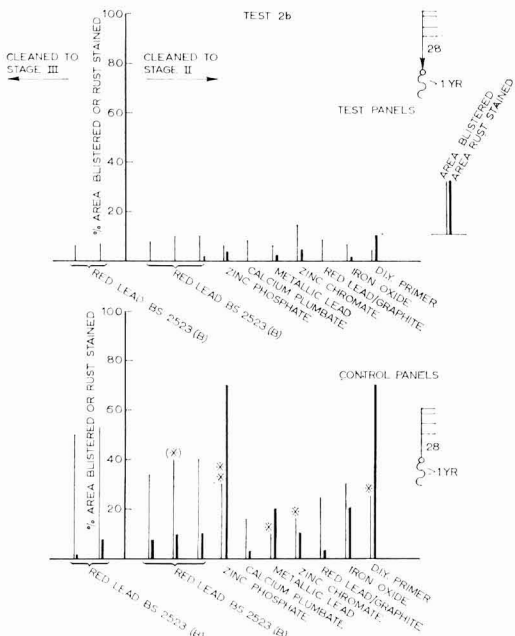


Chart 2b

and painting or between treating with Mimosa wash primer and painting. As in Test 2a, eight primers were used.

The difference between the control-panels and the test-panels has become much more marked with the longer period of exposure, and the advantage from short term protection is considerable, irrespective of the nature of the primer (see Chart 2b).

Plate III, 21–24 and Plate IV, 25–30 show the advantage of short term protection under red lead, iron oxide and a D.I.Y. retailed metal primer respectively, with 28 days delay before painting. The advantage of better surface preparation is, of course, completely lost after 28 days delay in coating, but an immediate application of Mimosa wash primer has gone a long way towards retaining the better durability expected from more thorough surface preparation (see Plate IV, 31 and 32). With such a long delay, the short term protection after stage III cleaning is naturally less effective than it was with the shorter seven day delay (compare Plate III, 19 and 20 with Plate IV, 31 and 32).

With the 28 day exposure, the advantage of vigorous “working in” is frequently apparent. Presumably this causes better mechanical penetration which, over this longer period, off-sets the thinner layer, inevitable with stiff brushing and high spreading rate (Plate III, 24; Plate IV, 28).

Over panels cleaned to stage III, heavy application caused excessive blistering. The lack of physical bonding doubtless explains this.

Comparing Charts 2b and 2a, it is clear that, whereas the controls show decreased durability with prolonged delay in coating cleaned panels, panels protected by Mimosa wash primer show little difference due to any enforced delay in painting.

It will be noticed that panels painted without any delay after cleaning (Chart 1, controls) have proved less durable than those painted after a further seven days rusting (Chart 2a, controls).

This apparent anomaly is associated with different climatic conditions, both during exposure of the painted panels and during the initial rusting period. It is because of these variables that each field test has its own control panels.

Test 3

Mimosa wash primer as short term protective under different primers—all paints thinned

Period of exposure before painting—7 days

This test repeats the conditions of Test 2a, except that all paints were thinned thus giving less film build and reduced protection. The durability of the control set of panels is such that even after one year, rust staining is severe with all primers (see Chart 3). Also many of the blisters are broken given rust spots.

Panels protected for seven days with Mimosa wash primer are, except for the zinc phosphate and lead primed panels, very much better. Possibly the latter two primers are particularly susceptible to the effects of overthinning. Plate V, 33, 34 and 37, 38 show the condition of panels with red lead and iron oxide primer. There is still some rust staining, but

very few blisters are broken. The advantage of short term protection is particularly marked over the better prepared panels (see Chart 3 and Plate VI, 41 and 42).

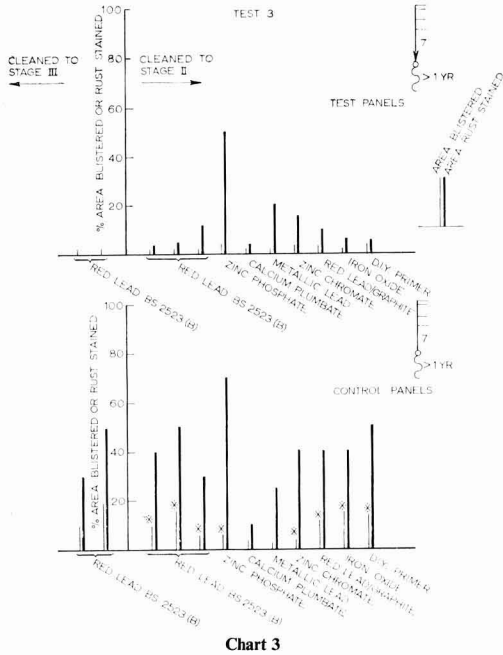


Chart 3

**Test 4**

**Mimosa wash primer as a short term protective under different primers**

*Period of exposure before painting—7 days*

*Conditions—high relative humidity*

In Test 4 late autumn painting brought moist atmospheric conditions so that, when control-panels were painted early in the day, the rust was damp, though not obviously so. On panels treated with Mimosa wash primer it was the iron tannate/rust system which retained atmospheric moisture, and this has led to much improved durability (see Chart 4a and Plate VI, 45–48).

The performance of the test-panels when compared with the controls shows that the Mimosa wash primer has, in some way, accommodated the damp conditions, possibly by taking up part of the moisture within its gel structure or by reactivation and further reaction with Fe<sup>3+</sup> (hexaquo) ions.

The effect is even more marked when the paints are thinned; this lead to a very much shorter durability and considerable rusting even after one year, in the absence of Mimosa wash primer (see Chart 4b and Plate V, 35, 36 and 39, 40, Plate VI, 43, 44).

In addition to evaluating Mimosa wash primer as a short term protective under damp conditions, it has also been used as a pretreatment in winter painting conditions. Whilst winter painting of rusted mild-steel, however well cleaned, is best avoided, this is not always possible. Plate VII, 49–52 shows

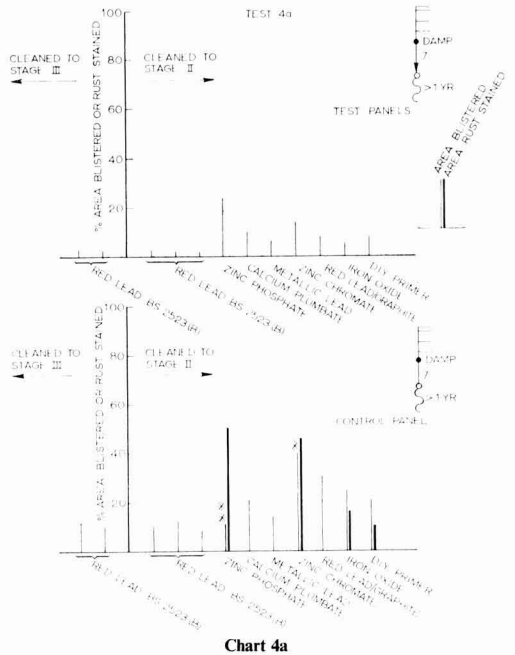


Chart 4a

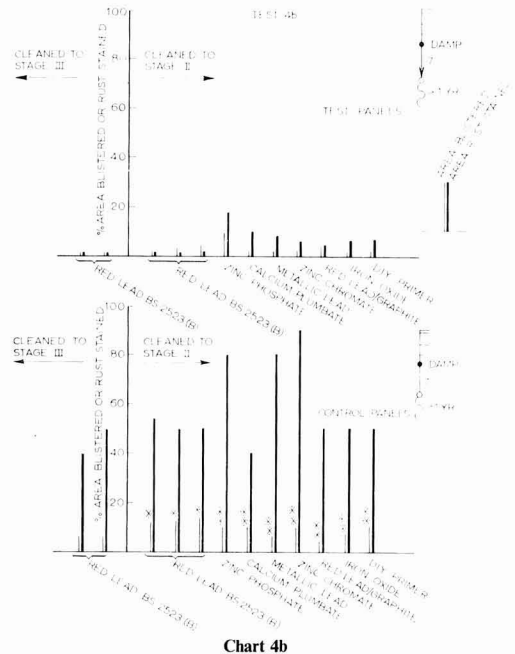


Chart 4b

four panels which have been cleaned to stage III and painted under these conditions, two with Mimosa wash primer pretreatment and two without pretreatment. The pretreatment has clearly been effective under these conditions, i.e. painting residual rust, retaining moisture from a damp winter atmo-

there, even after stage III cleaning has given poor durability, whereas painting tannated rust, under similar conditions, has proved far less damaging. Where surface preparation was taken to only stage II, the difference between painting "damp" rust or "damp" tannated rust, was less marked, presumably because of the deeper layer of damp rust still left under the tannate.

**Test 5**

**Mimosa wash primer with different undercoat and topcoat paints**

Previous tests have shown that the effectiveness of Mimosa wash primer can vary according to the choice of primer.

In Test 5, the wash primer was used as pretreatment and as short term protective under four different primers and three brand paints: Dulux, Permaglaze and Household, the latter manufactured by Donald Macpherson and Co. Ltd and currently marketed as Cover Plus. Results show, beyond any doubt, that the pattern of performance is entirely related to the choice of primer (see Chart 5). Although only three undercoat and topcoat systems were used, it is reasonable to assume that similar results would be obtained with any reputable paint system. In other trials using one coat of undercoat and two coats of topcoat the same pattern was observed.

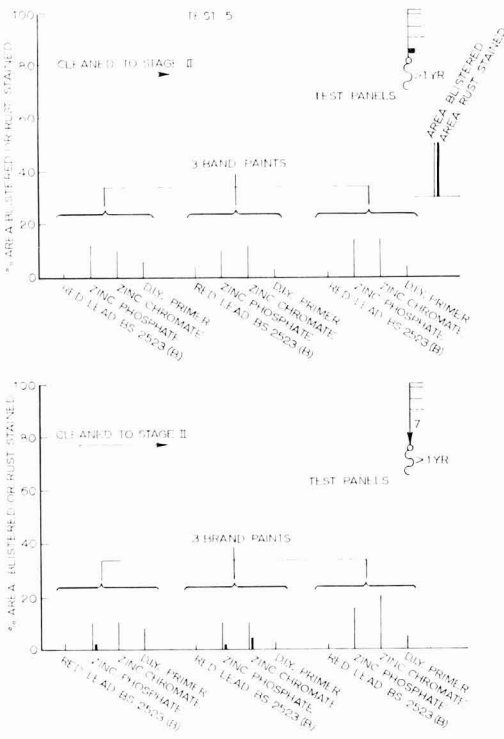


Chart 5

**Test 6**

**Mimosa wash primer compared with other rust treatments**

(a) As pretreatments under red lead, zinc phosphate, zinc chromate and a D.I.Y. metal primer (no undercoat or topcoat)

Mimosa wash primer was compared with a range of ten proprietary rust treatments. Each was applied to four panels

cleaned to stage II. After 24 hours one of the treated panels was primed with red lead, one with zinc phosphate and the remaining two with zinc chromate and a D.I.Y. metal primer. This choice was based primarily on giving a wide range of primer pigments, rather than on their performance when used over Mimosa wash primer.

All panels were exposed without undercoat or topcoat and the condition of the primers recorded, at regular intervals. In no case was there any lack of adhesion. Failure eventually occurred, first as rust staining and then as breakthrough of rust at isolated pockets over the surface of the primer. Without exception the panels with red lead over the pretreatments had the best durability, but there was little to choose between any of the rust treatments in their effect on the protection afforded by the four primers used in this test, and weathered without further painting. No chart is therefore shown against Test 6a.

(b) As short term protectives followed by a full paint system

Not all rust treatments claim to give short term protection, but most do claim that they prevent or retard the onset of renewed rusting. It seems reasonable, therefore, to compare the short term protection of Mimosa wash primer with the preventative performance of these rust treatments. Each rust treatment on test was used on four panels, as a short term protective for 28 days. As in Test 6a, one panel was then primed with red lead, one with zinc phosphate, one with zinc chromate and one with a D.I.Y. metal primer. Priming was followed at 24 hour intervals by undercoating and topcoating.

Chart 6b (red lead) shows the condition, after 2 years of panels primed with red lead; Charts 6b (zinc phosphate), 6b

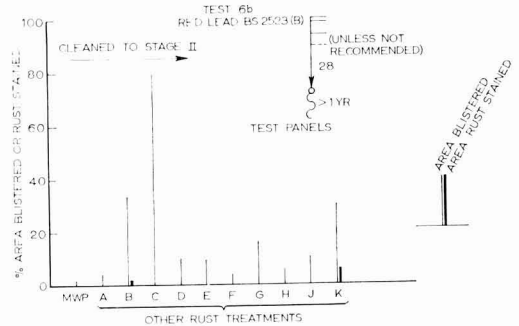


Chart 6b (red lead)

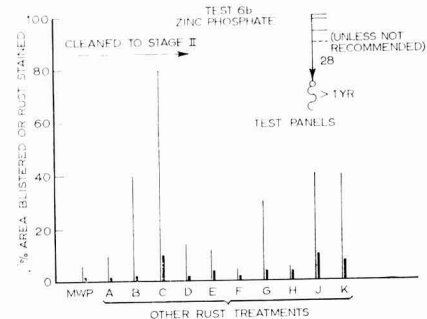
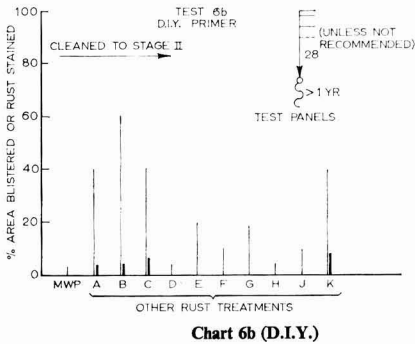
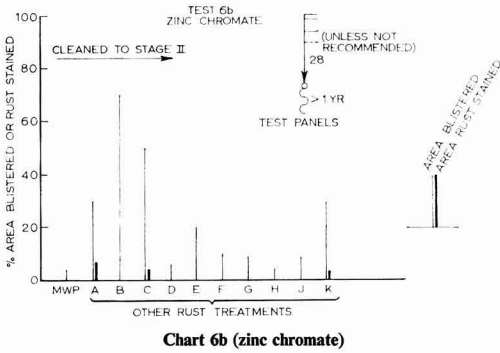


Chart 6b (zinc phosphate)



(zinc chromate) and 6b (D.I.Y.) show the conditions of panels with the remaining three primers.

The treatments used, except for the Mimosa wash primer, are referred to as A, B, C, etc; each was used strictly in accordance with the supplier's instructions, so that, where it is stated that no primer is required, this has been omitted (i.e. all four panels with any such treatment have an identical paint system).

There is no evidence to pick out any one of the four primers as being the most suitable over rust treatments generally. There is however, a clear indication that the Mimosa wash primer has been one of the most effective treatments, for prolonging the durability of the paint system.

**Test 7**

**Patch touch-up and maintenance**

When flaking of old paint work has led to patches of rust these, after cleaning, can be treated with Mimosa wash primer, especially if painting is likely to be delayed. The wash primer will obviously smear over adjacent sound paint and be left as a dried layer of unreacted tannin.

This condition has been deliberately created on 20 panels. On 10 panels the surplus tannin smeared over sound paintwork, was washed off; it was left on the remaining 10. After 2 months the panels were completely repainted applying red lead primer where the original paint had flaked, and undercoat and topcoat over the whole panel. In no case was there

any lack of adhesion or other film weakness where tannin had been smeared and it seems, therefore, unnecessary to remove this surplus.

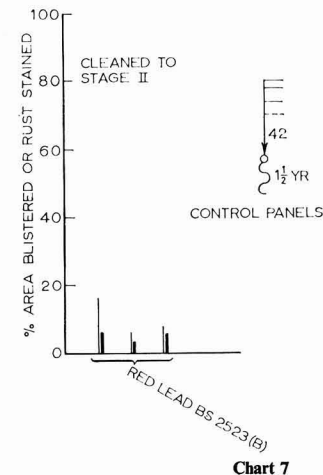
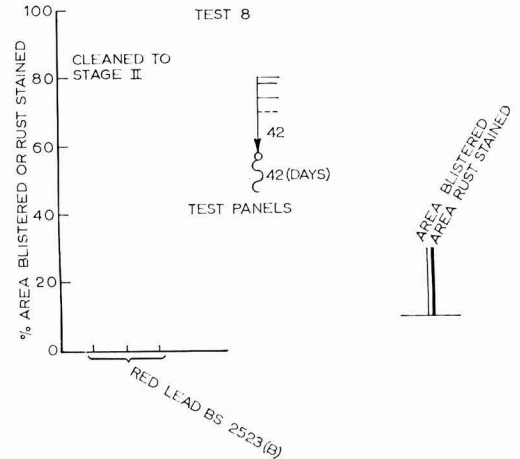
**Test 8**

**Mimosa wash primer on newly formed rust**

*Refs. 11, 28*

It has been shown by R. Francis<sup>28</sup>, that the tannin treatment does not affect any sulfate contamination. It seems likely, therefore, that if Mimosa wash primer could be applied before newly formed rust absorbed appreciable amounts of sulfur dioxide, then the wash primer might be more effective as a short term protective.

Prompt treatment of newly formed rust is more feasible in domestic maintenance work than in site painting schedules and, anticipating these D.I.Y. conditions, several panels were treated after only a few weeks rusting. Tests for iron (II) sulfate following the "in situ" method used by Dasgupta and Ross<sup>11</sup> gave negative response, no panels used for this test were, however, examined by the electron microprobe.



**Chart 7**

Exposure trials show the considerable added advantage to be gained from *prompt* protection with Mimosa wash primer (see chart 7). The same advantage would of course, derive from prompt priming, but the use of wash primer has the merits of being quick, easy and applicable under damp conditions. It seems reasonable to assume that the improved performance after subsequent painting might, in part, be due to the absence of sulfate within the rust layer, i.e. the tannate has not only retarded the onset of rusting, but it is likely that the formation of sulfate is also retarded.

Plate VII, 53 and 54 shows the comparison between two panels, one rusted for 14 days, cleaned to remove loose rust and given short term protection for 2 months before painting. The other panel, also given short term protection for 2 months, was cleaned to stage II from rust which had developed for 6 months. The second panel required appreciably more mechanical abrasion to give a "comparable" substrate but despite this, it has proved to be a less favourable substrate, than the panel protected at an *early stage*, by Mimosa wash primer. Chart 7 shows the performance of panels with longer periods of rusting; 42 days and 1.5 years respectively.

**Test 9**

**Repeated treatment with Mimosa wash primer**

Effective short term protection can last for 4 to 12 weeks according to the prevailing weather, site conditions, and the degree of preparation. It is sometimes convenient, especially in D.I.Y. maintenance work, to leave touch up work until summer painting.

A set of panels, rusted for two months was cleaned to stage II, and exposed during the winter months to simulate these conditions. They were treated with Mimosa wash primer immediately after cleaning and then given a quick brush over with wash primer at intervals of 8 weeks during the winter. This, of course, would not be feasible in commercial maintenance, but it presents no problem in D.I.Y. work, or the patching over of rust spots on a car body etc.

By checking the onset of rusting, subsequent painting, done in the summer gives much greater durability than is obtained by the conventional practice of allowing winter rust to develop, and then painting in the summer, after cleaning to stage II. Chart 8 shows specimen results and Plate VII, 55 and 56 compares a panel given continued wash primer protection with one which was, following general practice, allowed to rust and then cleaned and painted, with no wash primer.

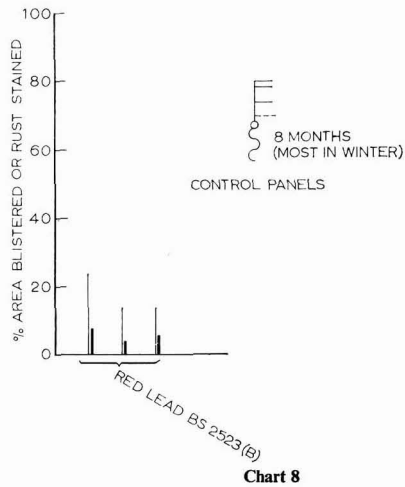
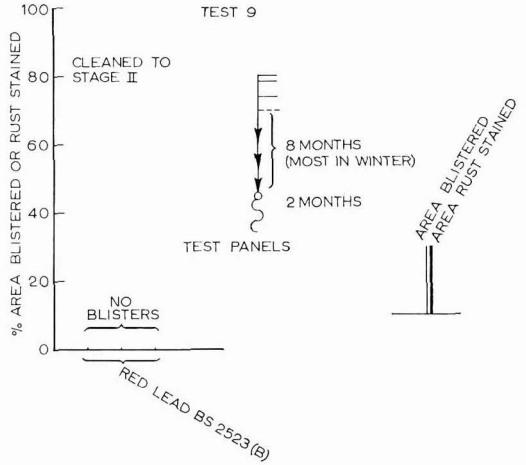
Plate VIII compares a panel given renewed protection (after cleaning to stage II), with one which had a single treatment which was then allowed to weather off completely, so that it became totally ineffective. In this instance painting was done (after stage II preparation) on early spring morning when the panels doubtless retained absorbed moisture. Under these conditions, the merits of continued protection are outstanding.

**Conclusions**

Mimosa wash primer can serve two essential functions:

- (1) It can serve as a short term protective where there is any delay between surface preparation and subsequent painting.

- (2) It can serve as a pretreatment, and is especially useful for this purpose when painting is done under conditions of higher relative humidity.



The wash primer functions best over mild-steel which has rusted, and where cleaning by abrasion has been sufficient to expose some areas of clean steel. It is essential that small amounts adherent rust be left to provide a reaction site and adequate bonding.

As a short term protective the wash primer can lead to substantially improved durability from the applied paint system; there is evidence that this is especially so if it is applied after cleaning down the rusted surface, while the rust is still fairly new. If protection is required for several winter months then, in D.I.Y. maintenance, one or two touch ups will provide a much better substrate than is normally obtained by mechanical abrasion after allowing cavities and pits to develop containing sulfate contamination.

Short term protection can be particularly useful if painting, even after a few days delay, is likely to be done in conditions where residual rust would retain a high level of atmospheric moisture. This same level of moisture retention in tannated

rust is far less damaging to the durability of the final paint system.

Whereas short term protection is effective for 6 to 12 weeks according to weather conditions, treated panels set out of doors but under cover, have shown that the onset of new rust can be checked for several years where there is structural protection from direct weathering as, for example, on roofing members, parts of car bodies, or warehouse equipment.

The usefulness of Mimosa wash primer as a pretreatment depends on prevailing weather conditions and surface preparation. Applied under ideal dry summer conditions and on a well prepared surface most good paint systems perform satisfactorily but, under humid conditions, from late summer to late spring in the UK, where substrate dampness is inevitable, the pretreatment provides a basis for much improved film durability. If conditions are particularly severe after painting, then maximum advantage is achieved only after good surface preparation.

Mimosa wash primer is no panacea against corrosion, nor is it an excuse for poor surface preparation, but as previous workers have shown, and as the present investigation coupled with R. Francis's fundamental work has shown, Mimosa wash primer can make a valuable contribution to the durability of anti-corrosive paint systems, commonly used both for maintenance and for the painting of new work, not already protected by etch priming or prepainting.

### Acknowledgments

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The author also wishes to record his appreciation to the African Territories Wattle Industry Fund for permission to

publish this paper and for its continued interest and encouragement which has made this investigation possible.

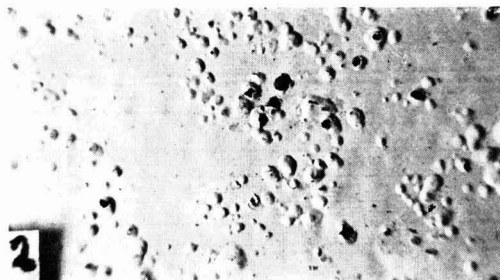
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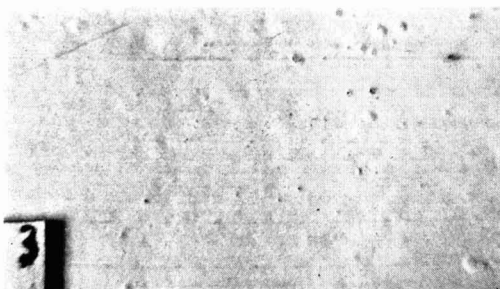


M.W.P. pretreatment

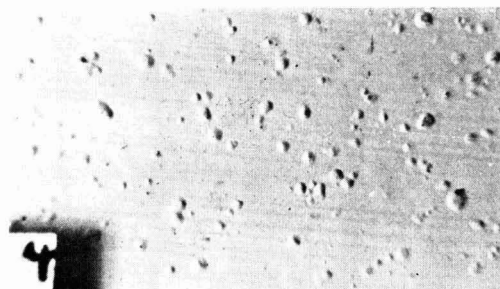


Red lead primer

No pretreatment

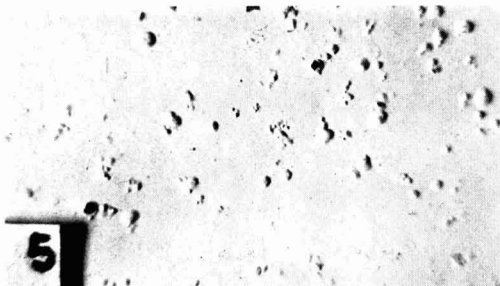


M.W.P. pretreatment (low spreading)

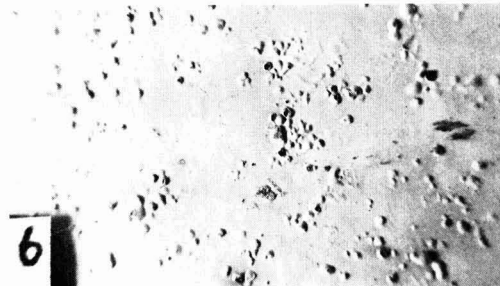


Red lead primer

M.W.P. pretreatment (high spreading)

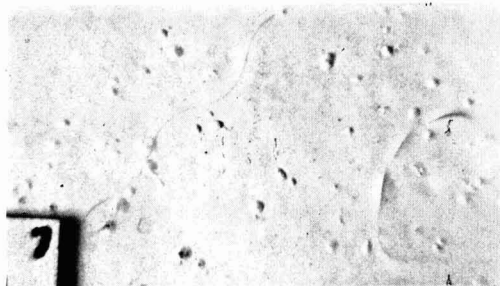


M.W.P. pretreatment

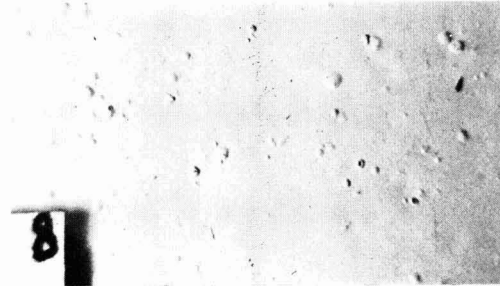


Iron oxide primer

No pretreatment



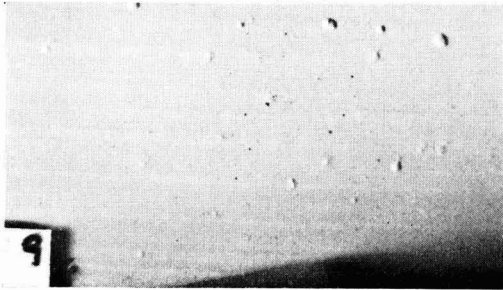
M.W.P. pretreatment (low spreading)



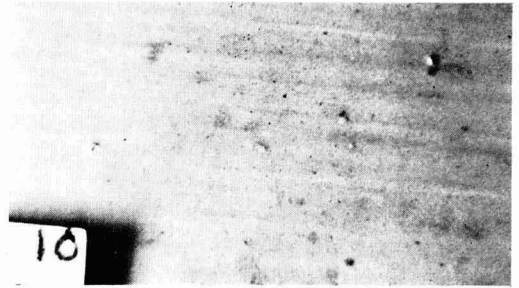
Iron oxide primer

M.W.P. pretreatment (high spreading)

PLATE I—Magnification approx  $\times 3$

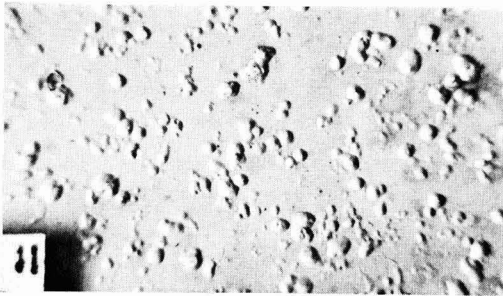


M.W.P. pretreatment—Red lead primer

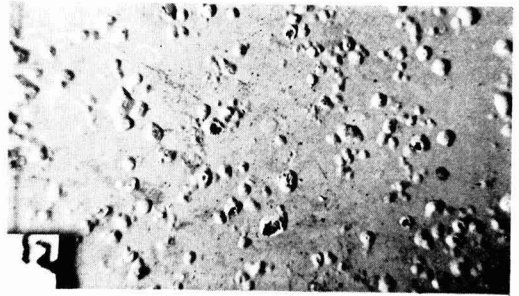


M.W.P. pretreatment—Iron oxide primer

*Surfaces stage III clean. Exposure—severe winter*

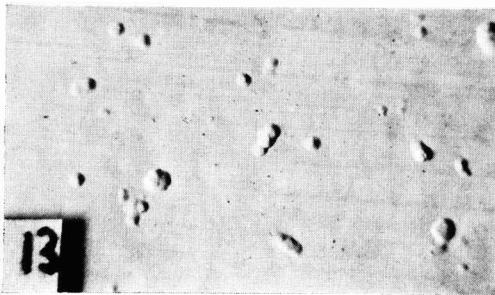


No pretreatment—Red lead primer

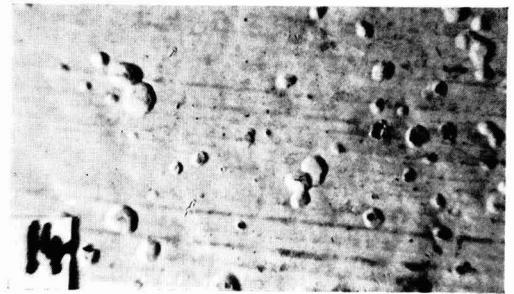


No pretreatment—Iron oxide primer

*Surfaces stage III clean. Exposure—severe winter*

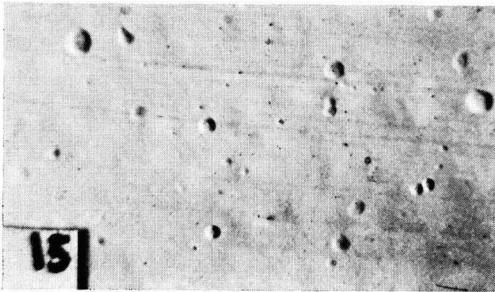


Short term protection, 7 days with M.W.P.

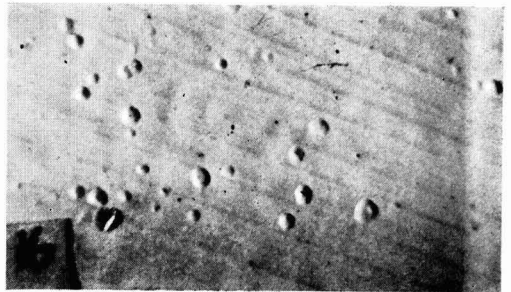


No protection over 7 days

*Red lead primer*



Short term protection, 7 days with M.W.P. (low spreading)

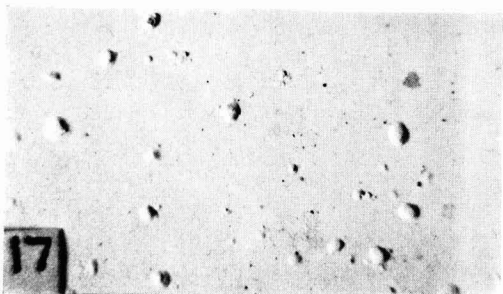


Short term protection, 7 days with M.W.P. (high spreading)

*Red lead primer*

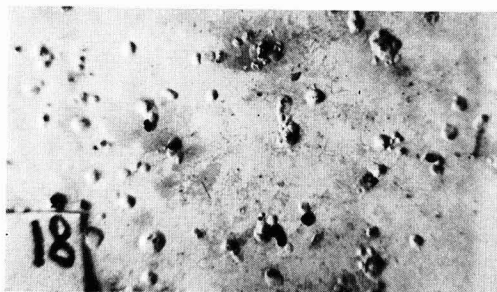
**PLATE II—Magnification approx  $\times 3$**



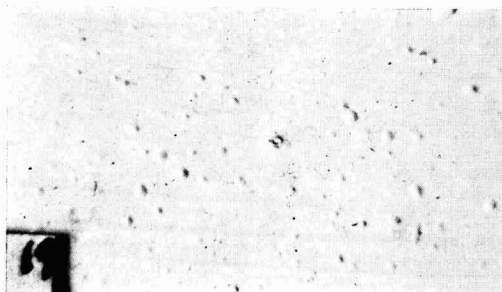


Short term protection,  
7 days with M.W.P.

*Iron oxide primer*

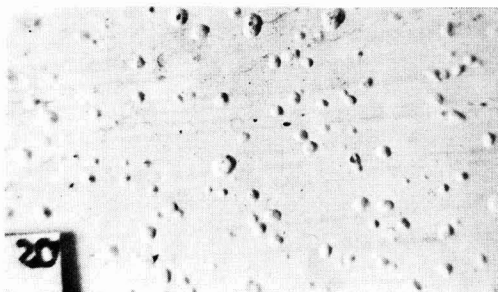


No protection over  
7 days

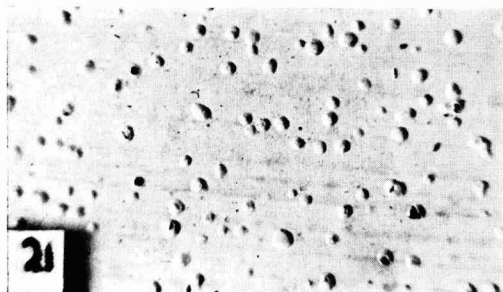


Short term protection,  
7 days with M.W.P.

*Surfaces stage III clean  
Red lead primer*

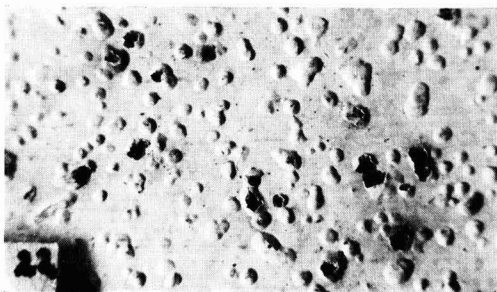


No protection over  
7 days

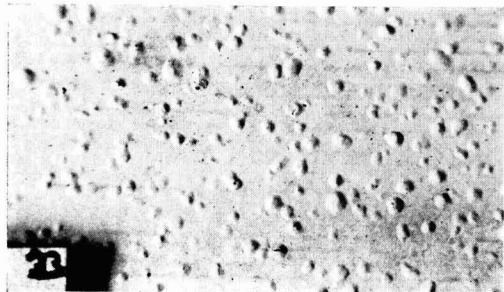


Short term protection,  
28 days with M.W.P.

*Red lead primer*

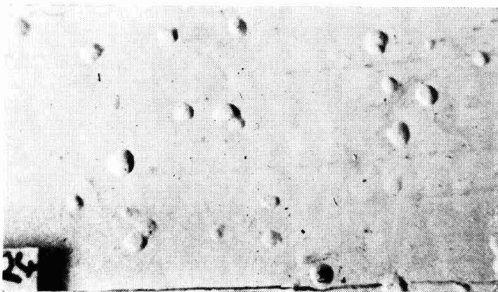


No protection over  
28 days



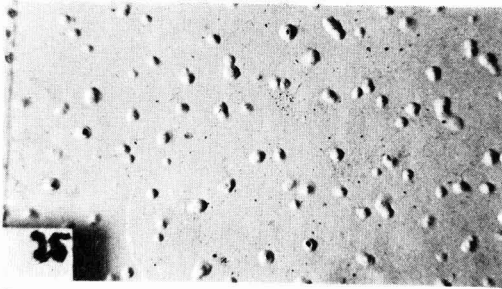
Short term protection, 28 days  
with M.W.P. (low spreading)

*Red lead primer*

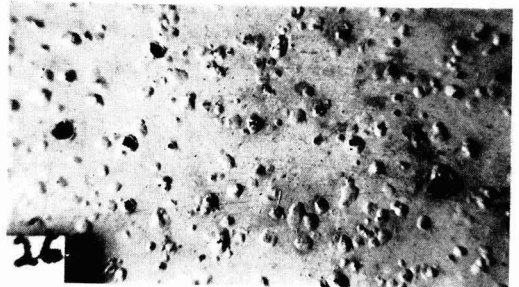


Short term protection, 28 days  
with M.W.P. (high spreading)

PLATE III—Magnification approx  $\times 3$

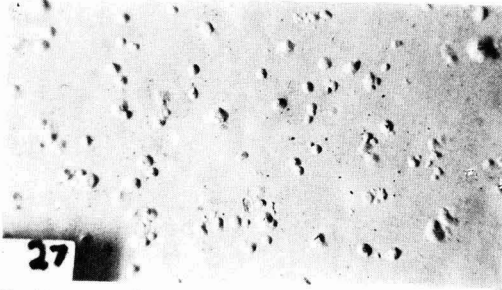


Short term protection,  
28 days with M.W.P.

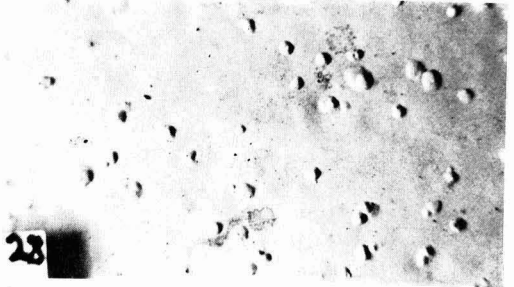


*Iron oxide primer*

No protection over  
28 days

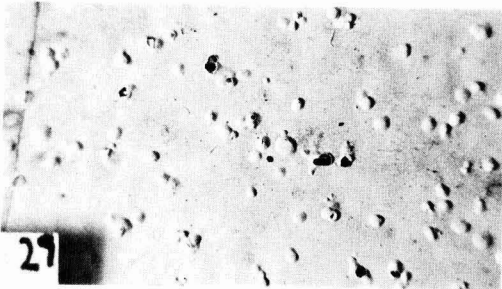


Short term protection, 28 days  
with M.W.P. (low spreading)

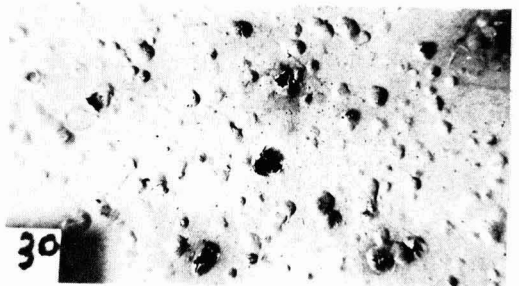


*Iron oxide primer*

Short term protection, 28 days  
with M.W.P. (high spreading)

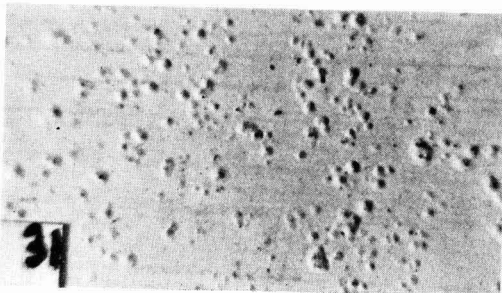


Short term protection,  
28 days with M.W.P.

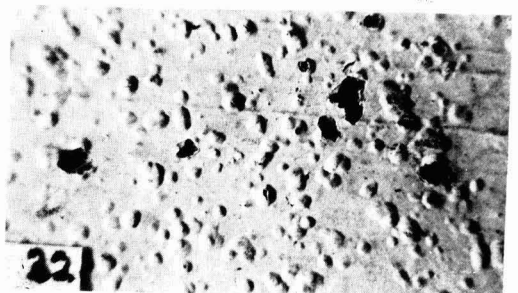


*D.I.Y. Metal primer*

No protection over  
28 days



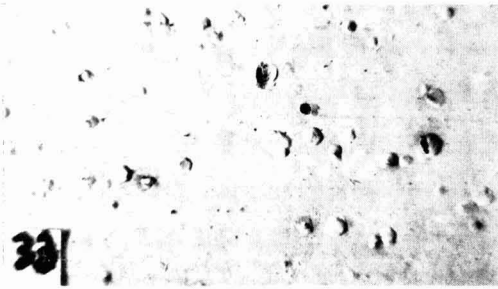
Short term protection,  
28 days with M.W.P.



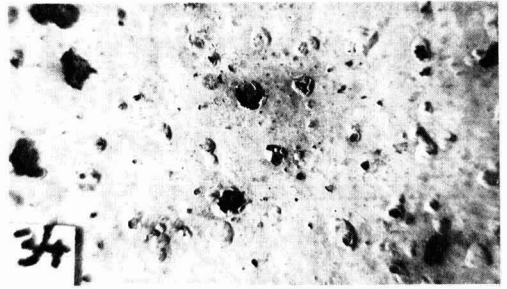
*Surfaces stage III clean  
Red lead primer*

No protection over  
28 days

PLATE IV—Magnification approx  $\times 3$

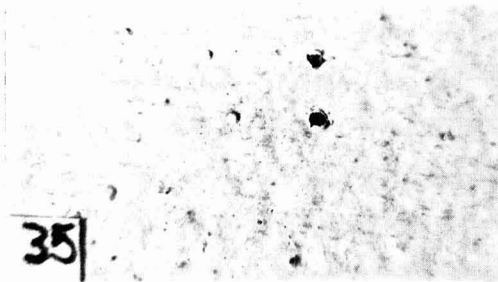


33 |  
Short term protection,  
7 days with M.W.P.

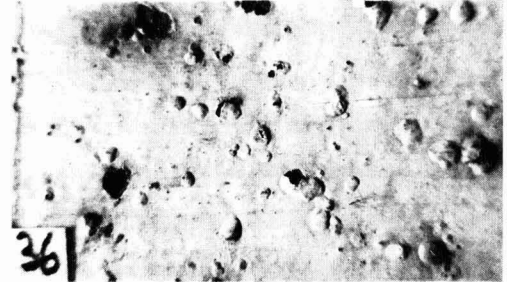


34 |  
*Paints thinned  
Red lead primer*

No protection over  
7 days

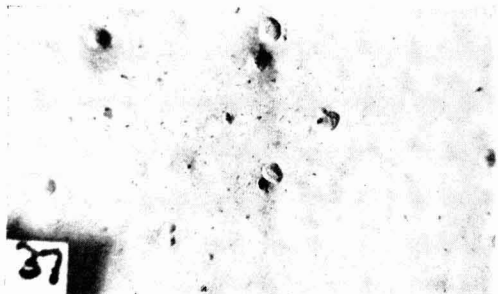


35 |  
Short term protection,  
7 days with M.W.P.

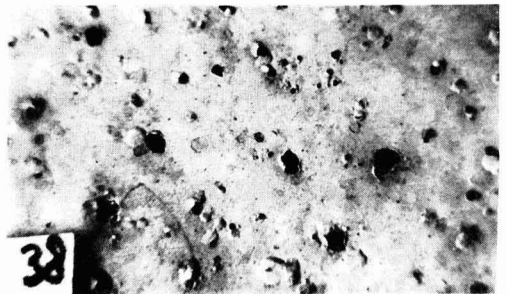


36 |  
*Paints thinned  
Red lead primer  
applied under conditions of high humidity*

No protection over  
7 days

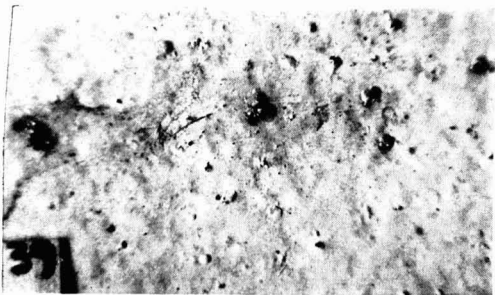


37 |  
Short term protection,  
7 days with M.W.P.

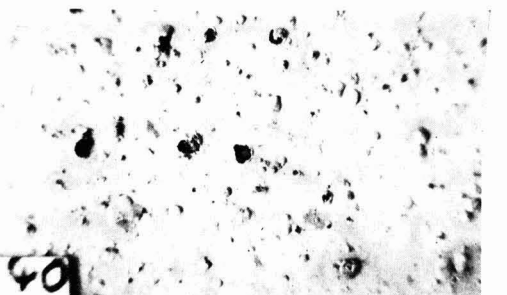


38 |  
*Paints thinned  
Iron oxide primer*

No protection over  
7 days

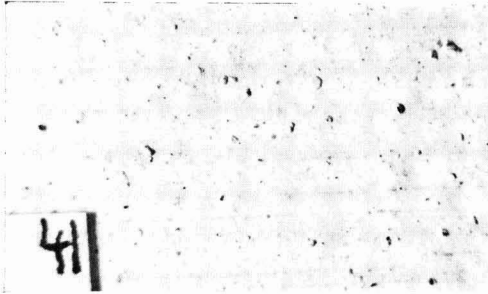


39 |  
Short term protection,  
7 days with M.W.P.

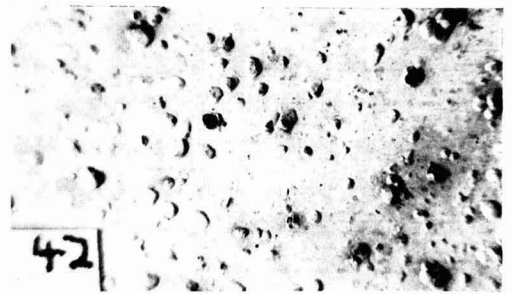


40 |  
*Paints thinned  
Iron oxide primer  
applied under conditions of high humidity*

No protection over  
7 days

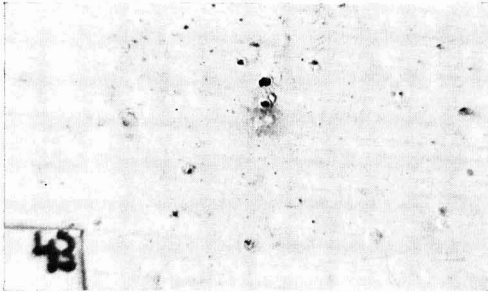


Short term protection,  
7 days with M.W.P.

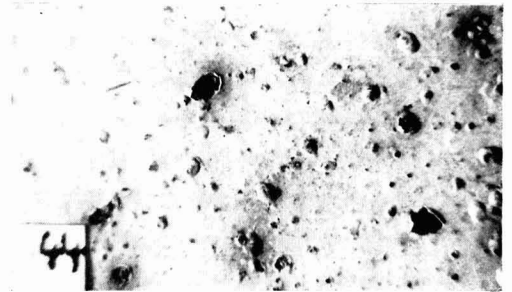


No protection over  
7 days

*Surfaces stage III clean  
Paints thinned  
Red lead primer*

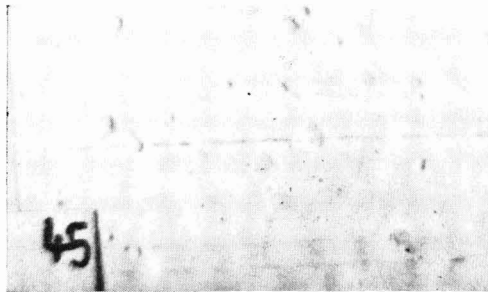


Short term protection,  
7 days with M.W.P.

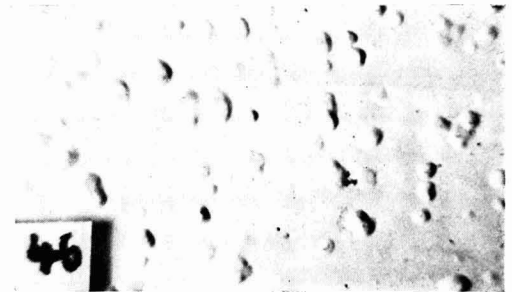


No protection over  
7 days

*Surfaces stage III clean  
Paints thinned  
Red lead primer  
applied under conditions of high humidity*



Short term protection,  
7 days with M.W.P.

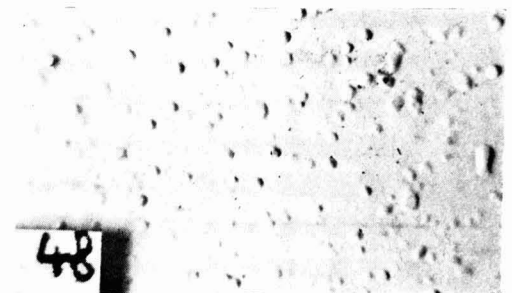


No protection over  
7 days

*Red lead primer  
applied under conditions of high humidity*



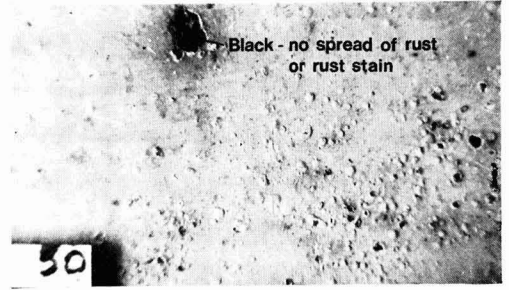
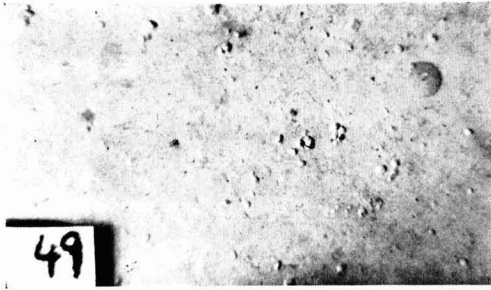
Short term protection,  
7 days with M.W.P.



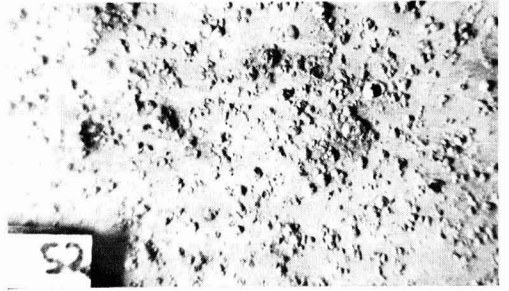
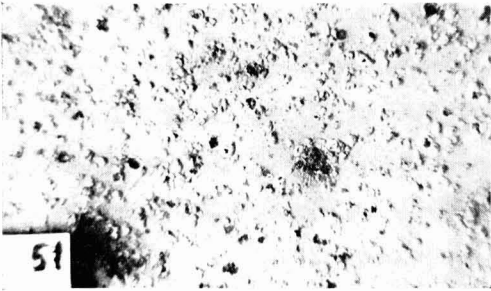
No protection over  
7 days

*Surfaces stage III clean  
Red lead primer  
applied under conditions of high humidity*

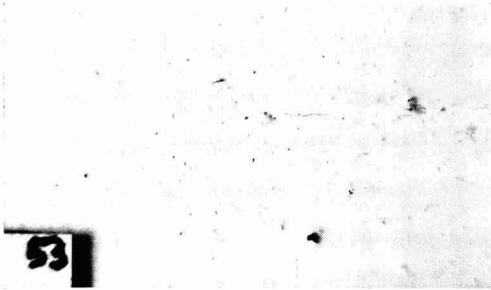
**PLATE VI—Magnification approx  $\times 3$**



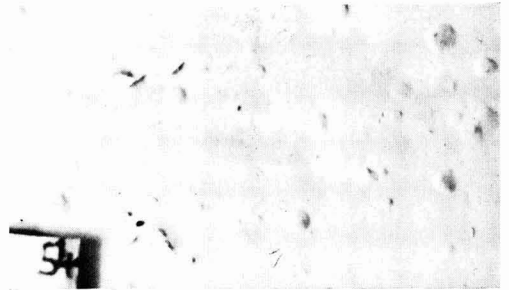
M.W.P. pretreatment. Red lead primer applied under conditions of high humidity  
*Surfaces stage III clean*



No pretreatment. Red lead primer applied under conditions of high humidity  
*Surfaces stage III clean*

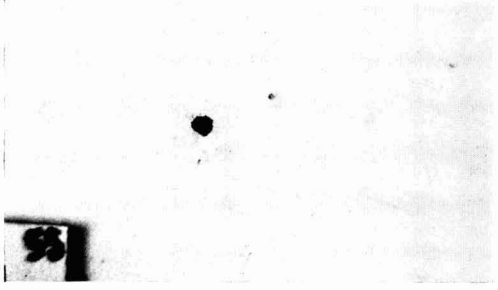


Rusted 14 days  
Cleaned

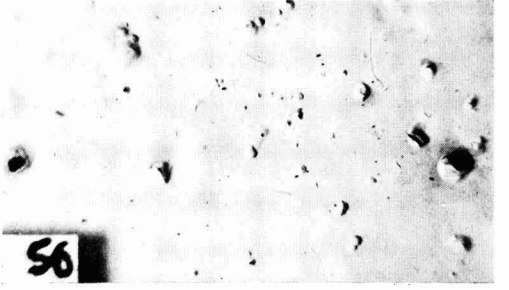


Rusted 6 months  
Cleaned

Short term protection with M.W.P. over 2 months  
*Red lead primer*



New rust treated with M.W.P. Short term  
protection renewed over winter months



No protection of new rust over winter  
months. Cleaned to stage II

*Red lead primer*



New rust treated with M.W.P. Short term protection renewed over winter months

*Red lead primer applied under conditions of high humidity*

Ineffective protection of new rust over winter months. Cleaned to stage II

PLATE VIII—Magnification approx  $\times 3$

# Subjective comparisons—What does influence you?\*

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## Summary

The influence of light reflected at a paint film/air interface on the subjective comparison of paint film appearance is discussed.

It is shown that subjective gloss is related not only to the total energy in the specular beam, but is also influenced, and can be dominated, by other factors such as image contrast, definition and/or colour.

Further, it is demonstrated that subjective assessments of paint

film colour are also influenced by the energy which is diffusely scattered and specularly reflected by the paint film/air interface. Some observers are so strongly influenced by this energy that when they are deprived of it they completely reverse their judgements.

The need for controlled viewing conditions is stressed; without such control it is possible to identify wrongly the nature of a particular paint film problem.

## Keywords

*Properties, characteristics and conditions primarily associated with materials in general*  
colour

*dried or cured films*  
gloss  
sharpness of image  
reflectance

## Les comparaisons subjectives de brillant—Qui sont les facteurs qui exercent une influence sur vous ?

### Résumé

On discute l'influence sur l'aspect du feuil de peinture qu'exerce la lumière réfléchie à l'interface peinture/air.

On démontre que l'appréciation subjective de brillant est en rapport, non seulement à l'énergie totale du faisceau spéculaire, mais d'ailleurs il est sensible à et même peut être dominé par d'autres facteurs, tels que la netteté et la couleur de l'image et son contraste avec la surface réfléchissante.

D'ailleurs on démontre que l'énergie diffusée ou réfléchie dans une

manière spéculaire par l'interface peinture/air exerce également une influence sur l'appréciation subjective de la couleur d'un feuil de peinture. Cette énergie exerce une influence si profonde sur certains observateurs, qu'ils renversent totalement leur originale appréciation, lorsqu'ils en sont dépourvus.

On souligne la nécessité pour le contrôle des conditions sous lesquelles on fait les observations, sans un tel contrôle, il est possible de donner une fausse attribution à la nature de certains défauts de feuil de peintures.

## Subjektive Vergleiche von Glanz—Was beeinflusst Sie ?

### Zusammenfassung

Besprochen wird der Einfluss von an der Grenzfläche Lackfilm/Luft reflektiertem Licht auf das subjektive Vergleichen von Anstrichfilmen.

Es wird gezeigt, dass subjektiver Glanz nicht nur mit der gesamten Energie im spiegelnden Strahlenbündel in Beziehung steht, sondern von anderen Faktoren wie z.B. Bildkontrast, Definition und/oder Farbe beeinflusst und sogar dominiert wird.

Weiterhin wird vorgeführt, dass subjektive Beurteilung der

Farbe eines Lackfilms beeinflusst wird von der Energie, welche von der Lackfilm/Luft Grenzfläche diffus gestreut und spiegelnd reflektiert wird. Manche Beobachter werden von dieser Energie so stark beeinflusst, dass sie bei Wegfall derselben, ihre eigene Beurteilung völlig umdrehen.

Die Notwendigkeit kontrollierter Beobachtungsbedingungen wird betont, da andernfalls die Natur eines besonderen Lackfilm-problems falsch identifiziert werden könnte.

## Introduction

In many parts of the surface coating industry it is customary to use skilled operators to make subjective comparisons of gloss, colour, chalking, etc. Despite the spread of excellent objective methods, such subjective comparisons are important because the ultimate customer rarely has the facility and the skill to use instrumental methods—he is the "man in the street".

The human eye is a very sensitive instrument in an absolute sense comparing favourably with photographic emulsions and a wide range of objective detectors. In a comparative situation it is at least as good as all but the most advanced equipment. A major advantage is that in addition to developing an

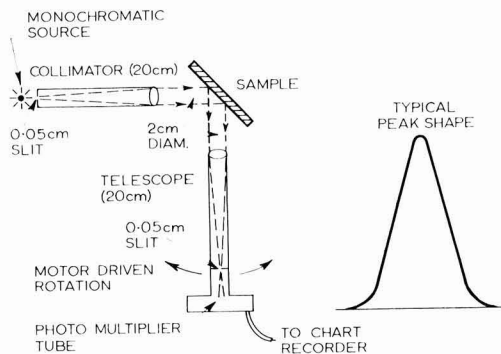
integrated signal from the coating as a whole, the eye can scan rapidly and select areas for detailed comparison, especially if they share a common boundary. That is, a trained operator working in carefully controlled conditions is a very powerful comparator.

However, the standards of comparison, and the preferences, of one operator will be different from those of another. Still worse, an individual may change from time to time without realising that change. A further problem is that even skilled operators are not always able to relate their total subjective assessment to parameters which can be measured objectively. Therefore, it is informative to examine the way subjective judgements are made; in particular this paper deals with the influence of the paint/air interface on those judgements.

\*Based on a lecture presented to the Hull Section on 5 December 1977

**Factors affecting subjective gloss**

A standard 45° gloss head was used as one objective instrument. The other was a spectrophotogoniometer which is essentially a spectrometer so modified that a collimated monochromatic beam can be directed on to the sample and the specularly reflected beam scanned, so that the shape of the energy distribution can be recorded (Fig. 1.). As with conventional gloss measurements, a standard black tile was used to calibrate the response and all parameters are referred to that tile. The greater the peak height for any given area, that is the sharper the peak, the closer the surface approaches an optical flat. Hence, by measuring such parameters as peak area, peak height, peak width at half height and ratio of area over height, it is possible to examine different aspects of the specular reflection process.



**Fig. 1. Spectrophotogoniometer**

**Assessing a wide range of gloss**

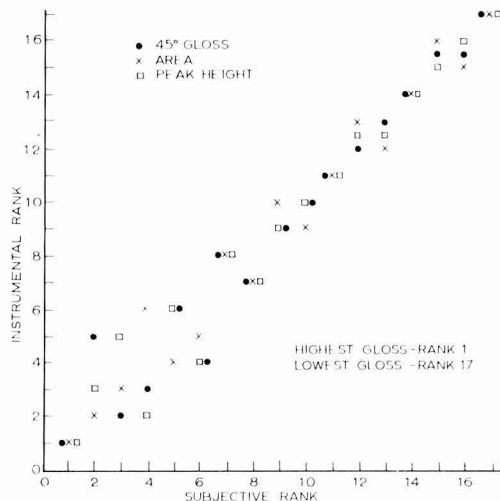
Seventeen white paint panels were prepared with glosses ranging from 8 per cent to 90 per cent, as measured by the 45° gloss. These were ranked subjectively by 41 operators, using a paired comparison ranking method, and also ranked objectively using the 45° gloss values the spectrophotogoniometer (SPG) peak area and peak height. The data are presented in Table 1 and the correlations between the rankings are:

- Subjective rank and
  - the 45° gloss rank  $r = 0.977$
  - the peak area rank  $r = 0.985$
  - the peak height rank  $r = 0.979$

*Table 1*  
*Ranking of a wide range of gloss levels*

Subjective Rank	S.P.G. Rank		EEL Rank	EEL %
	Area	Peak Height		
1	1	1	1	90
2	2	3	5	60
3	3	5	2	68
4	6	2	3	63
5	4	6	6	56
6	5	4	4	81
7	8	8	8	45
8	7	7	7	48
9	10	9	9	42
10	9	10	10	37
11	11	11	11	27
12	13	12.5	12	24
13	12	12.5	13	21
14	14	14	14	15
15	16	15	15.5	12
16	15	16	15.5	12
17	17	17	17	8.5

These are all highly significant and demonstrate clearly that there is very good agreement indeed between the subjective rank and the three objective ranks. All of these panels gave well defined triangular peaks, although some are a little narrower than others, so the area and the height are reasonable measures of the total specular energy. Thus it appears that subjective gloss is well defined by the total specular energy. Other workers have found it necessary to introduce some measure of image definition and this is supported by a closer examination of the rankings. There is slightly less unanimity of ranking at the higher glosses (Fig. 2); the correlations are still significant but are also significantly lower than those for the lower glosses.



**Fig. 2. Instrumental rank versus subjective rank**

This suggests that when the gloss is above about 50 per cent some factor, other than total specular energy, begins to influence the observer.

**Assessing very high glosses**

Ten paints were prepared by different milling methods and panels were prepared with glosses ranging from 94 per cent to 125 per cent as measured by the 45° gloss. These panels were then examined on the SPG and peak area, peak height, peak width at half height and the ratio of area divided by height were obtained. Twelve experienced observers then used a paired comparison ranking method and a subjective ranking was established. All rankings are presented in Table 2 and the correlations between the various rankings are:

- Subjective rank and
  - the 45° gloss rank  $r = 0.406$
  - the peak area rank  $r = 0.382$
  - the peak height rank  $r = 0.806$
  - the half height width  $r = 0.855$
  - the ratio area/height  $r = 0.830$



Table 2  
Ranking of high gloss panels

Subjective Rank	SPG Ranks					EEL %
	Area	Height	Half Width	Area/Height	EEL Rank	
1	5	4	2	3	8	94
2	2	3	4	4	3	104
3	9	2	1	1	4	102
4	1	1	3	2	1	125
5.5	7	7	7	7	5	101.5
5.5	4	5	6	5	6	100.5
7	3	6	8	8	2	105
8.5	10	9	5	6	10	84
8.5	6	10	9	10	9	92
10	8	8	10	9	7	100

There is no significant correlation between the subjective rankings and the objective ones which depend on total specular energy. However, those which are related to the "sharpness" of the peak have a good correlation with the subjective ranking. This confirms the impression gained from the rankings reported above; the higher the gloss the more important are factors other than just the quantity of energy. Image sharpness is one such dominant factor, and can be more important than the energy actually reflected.

Assessing glossy surfaces of different brightness

Subjective gloss increases as the energy in the specular beam increases, but as the surface becomes good enough to use as a mirror the sharpness of the mirror image becomes increasingly important and ultimately dominant. From this it can be expected that image contrast becomes important when high gloss surfaces are being compared. To examine this a range of ten grey panels were prepared and each one given a very thin clear varnish coat. These panels were ranked subjectively by ten operators, using a paired comparison method, and then objectively using the 45° gloss head and the SPG peak height. The rankings are presented in Table 3 together with that obtained by measuring the panel brightness (L value). It is noteworthy that the operators had no difficulty carrying out the ranking. The correlations below are obtained:

- Subjective rank and
  - panel brightness rank  $r = -1.0$
  - 45° gloss rank  $r = -0.87$
  - peak height rank  $r = -0.14$

Table 3  
Ranking of panels having different brightness

Subjective Rank	Brightness Rank	SPG Height Rank	EEL Rank	"L" Values	EEL Gloss %
1	10	1.5	6	5.6	91
2	9	10	10	11.1	89.6
3	8	7.5	6	22.3	91
4	7	4.5	8.5	27.1	90.5
5	6	4.5	8.5	32.9	90.5
6	5	9	6	40.2	91
7	4	6	4	56.8	92
8	3	1.5	1.5	69.4	94
9	2	7.5	3	81.9	93.5
10	1	3	1.5	87.0	94

The correlation of subjective rank with brightness is perfect at  $-1.0$ . This means that the brighter the panel, i.e. the higher the energy which is diffusely scattered from the body of the paint and hence the lower the contrast between this and the energy in the specular beam, the lower the gloss. As would be expected from this panel preparation, the 45° gloss values and

the peak heights have a very narrow range of values. However, the subjective rank is completely unrelated to the peak height rank and is negatively related to the 45° gloss rank. This is in direct contradiction to all of the information presented up to now. The explanation is simply that the panel preparation has fortuitously produced surfaces which tend to have high 45° gloss values when they have high brightness. The observers are paying no attention to the relative image sharpness, nor to the amount of energy in the specular beam. Their ranking depends only on the contrast between the specular energy and the background diffuse energy. The lower this contrast the more the operators see the specular image as being ill defined; they are ranking on an image definition criterion.

Assessing surfaces having different spectral selectivity

Accepting that subjective gloss is related to the quality of the image produced by the surface under consideration, then the extent to which that image is coloured could affect the operators. By changing milling methods and PVC it proved possible to produce paint panels with glosses changing as the wavelength of the incident light changed. Six such panels were prepared from white paints and the 45° gloss measured in red, green and blue light in addition to being assessed subjectively by six skilled operators. The data are presented in Table 4 and graphed in Fig. 3. The graph uses a gloss undertone which is defined as:

$$\text{Gloss undertone (G.U.)} = \frac{\text{Red Gloss} - \text{Blue Gloss}}{\text{Green Gloss}} \times 100$$

and plots this against the average of the three values. Against each point the subjective gloss ranking is marked.

Table 4  
Ranking of surfaces with different spectral selectivities

Subjective Rank	"EEL" Gloss Values %			Average Gloss %	Gloss Undertone
	Blue	Green	Red		
1	73	75	82	76.7	12
2	64	65	68	65.7	6.2
3	64	65.5	72	67.2	12.2
4	60	63	70	64.3	15.9
5.5	57	60	68	61.7	18.3
5.5	51	53	58	54.0	13.2

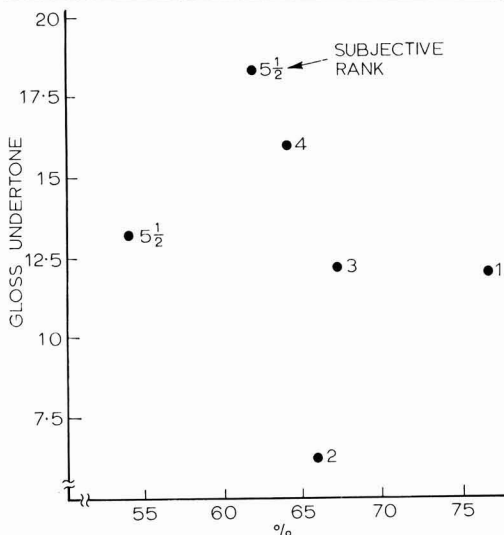


Fig. 3. Presentation of gloss, gloss undertone and subjective rank

With the two lowest ranked panels the operators have problems; they are unable to distinguish between these two panels even though they are separated by about 8 per cent in gloss. However, they can distinguish between panels with glosses of 64.3 per cent, 65.7 per cent and 67.1 per cent, but actually reverse the order of the last two. These apparent anomalies can be explained once the colour of the image is taken into account. The higher the gloss undertone the more the colour of the image differs from that of the object. This colouring is interpreted as a lack of definition and the panel downgraded in subjective gloss. Comments by the operators reinforce this in that large undertones were reported as being "less sharp", "more hazy", "less clear" etc., even when the differences in reflectivity were small.

### Summary of the factors affecting subjective gloss

In all of the subjective rankings reported there was very good consistency within an operator's assessments and very good agreement between operators. That is, despite what is said about the way judgements are reached, the operators all appear to use the same criteria—the quality of the image formed by specular reflection from the surface of the paint. This quality increases as the total amount of specularly reflected energy increases, but in cases where panels have identical energy, other factors are used to discriminate. The sharper the image appears the higher will the panel gloss be rated subjectively. This sharpness is increased when the diffuse energy scattered from the paint as a whole is lower—i.e. when the image contrast is increased. If the panel surface is such as to give a coloured image, because the surface reflectivity changes with wavelength, then the panel is downgraded.

When making gloss comparisons, operators take into account all of the above factors and give a judgement on the basis of an integration over all of them. However, in a particular set of comparisons the judgement could be dominated by the geometric sharpness of the reflected image, whereas in others it could be dominated by the colour of the image, and so on, possibly leading to confusion in critical comparisons.

### Factors affecting paint film appearance

Because the paint/air interface scatters some of the incident radiation an observer viewing the paint film always receives some of this surface scattered energy and could, depending on the viewing angle, receive some specular energy (Fig. 4a).

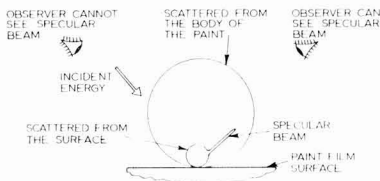


Fig. 4a. Energy leaving a paint film surface

The influence of surface energy on the subjective assessments of total paint film appearance has been studied using two nearly identical pigments, *A* and *B*, in a typical vinyl silk formulation. Ten very different paints were prepared from each pigment; the paints had glosses of about 45 per cent—too low for the surface to be used as a mirror. The pigments were compared by making parallel draw-downs on white card, the only difference between the two paints on a draw down being the pigment used.

### Constrained viewing of the films

Under these conditions the operators were forced to stand in one place and view the panel without touching it. Natural daylight came from behind the operator and the panel lay in a grey enclosure open at the top and the front. Thus the operators could not use the specular beam.

The choices of six skilled operators are presented in Table 5a. It is clear that operators 1, 3 and 6 agree that pigment *B* gives the best paint appearance. Operator 2 can see no difference between them, whilst operators 5 and 7 show only random judgements. There is no statistically significant consensus because the operators have different personal preferences, but overall there is a tendency to prefer paints based on pigment *B*, with 28 judgements in its favour as against 17 for *A* and 15 for no difference.

Table 5a  
The effect of pigment on paint film appearance. Subjective evaluation of pigments *A* and *B*—Constrained viewing

Operator	Result of comparing 10 paints		
	For <i>A</i>	No Difference	For <i>B</i>
1	2	1	7
2	2	7	1
3	2	0	8
5	3	5	2
6	3	0	7
7	5	2	3
Totals	17	15	28

### Free viewing of the same paint film

Under these conditions the operators were given complete freedom in their method of viewing the draw-downs. Natural light, through a window, provided the main source of illumination. The panels were recoded to reduce the chance that the new assessment was influenced by memory of the old one.

The choices of the same six operators are presented in Table 5b. It is clear that operators 1 and 3 prefer the paint films based on pigment *A* whereas operator 5 is against *B* rather than for *A* or "no difference". Operators 2, 6 and 7 are in good agreement that there is a difference but do not favour either pigment. Again there is no consensus because of the operators personal preferences, but the tendency is to prefer paints based on *A*, with 36 judgements in favour, then pigment *B*, with 18, and finally only 6 judgements claiming no difference between them.

Table 5b  
The effect of pigment on paint appearance. Subjective evaluation of pigments *A* and *B*—Free viewing

Operator	Result of comparing 10 paints		
	For <i>A</i>	No Difference	For <i>B</i>
1	8	0	2
2	5	1	4
3	8	0	2
5	5	5	0
6	4	0	6
7	6	0	4
Totals	36	6	18

### Comparison of the two sets of assessments

Whilst it is not surprising that operators have differences in their preferences, it is surprising, at first sight, that some can reverse their judgements when viewing conditions are changed. An explanation is that these operators are strongly influenced by the surface energy, especially if that surface has some spectral selectivity.

If an operator uses the geometrically reflected beam in some unconscious way, then under constrained viewing conditions, when he is deprived of this beam, he will have great problems differentiating between the films. When he is allowed to use the beam he has more information and could change his judgements.

When a surface has spectral selectivity then a reddish specular beam implies a bluish tint to the energy diffusely scattered from the surface and vice versa (Fig. 4b). In constrained viewing it is the diffuse component which the operator sees and in free viewing he can see the specular beam. If the operator has a colour preference, then the change in viewing conditions could change the judgement because the observed colour does change.

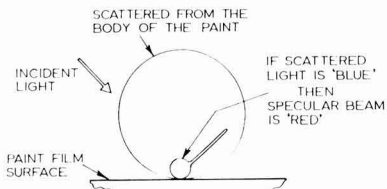


Fig. 4b. Effect of specular selectivity

### Effect of cleaning the paint film surfaces

The paint system used is known to have a slight "bloom" problem so the films were all cleaned by wiping with a damp soft tissue. After drying they were again assessed under the two different viewing conditions and the judgements obtained are presented in Table 6. Whilst the operators still do not

Table 6

*Subjective evaluation of the 10 drawdowns after surface cleaning*

Operator	Constrained viewing choice			Free viewing choice		
	A	No Diff.	B	A	No Diff.	B
1	2	1	7	4	1	5
2	2	3	5	5	2	3
3	6	0	4	8	0	2
4	2	1	7	7	1	2
5	5	0	5	5	2	3
7	6	0	4	5	2	3
Totals	23	5	32	34	8	18

agree with each other, there is only one major reversal of choice with change of viewing conditions—operator 4. Operators 1, 2 and 3, who previously showed marked changes with viewing conditions now do not. Clearly, for these operators the cleaning has removed something which was having a major effect on their assessments.

Even so, the constrained viewing conditions tended to produce a slight bias in favour of pigment B (23 for A, 32 for

B and 5 "no difference") whereas the free viewing conditions reverses this to give a slight bias in favour of A (34 for A, 18 for B and 8 "no difference"). Because a slightly different set of operators was used, the two surface conditions cannot be compared directly; what is important is that the same change of bias takes place with the change of viewing conditions.

### Effect of a clear film over the paints

Using a draw-down machine the two paint films on each card were given a one micron thick coat from a clear cellulose solution. When dry the films were again compared by six skilled operators and the results are presented in Table 7.

Table 7

*Subjective evaluation of the 10 drawdowns after cleaning and coating with a thin clear layer*

Operator	Constrained viewing choice			Free viewing choice		
	A	No Diff.	B	A	No Diff.	B
1	6	1	3	4	0	6
2	2	4	4	3	3	4
4	3	0	7	5	0	5
5	6	1	3	5	0	5
6	3	1	6	4	1	5
8	4	3	3	4	3	3
Totals	24	10	26	25	7	28

Whilst there are still differences in preference between the operators, there are no significant reversals with the change in viewing conditions. The deliberate attempt to produce a new paint film "surface", which is constant and independent of the pigment in the paint, appears to have removed the problems caused by the original surfaces. There is now not even a tendency for the overall bias to change with viewing conditions; the judgements are 24 for A, 10 'no difference', 26 for B, in constrained viewing and 25, 7, 28 in free viewing. That is, the operators can see a difference between the films, but cannot form a consensus in favour of one or the other pigment.

### Discussion of all of the assessments

The three surface conditions represent deliberate attempts to move from a paint/air interface which is dependent on the pigment to one which is constant, independent of the pigment. The two viewing conditions are designed to change the extent to which the operator can use the energy from the paint/air interface. It is clear that the various combinations have caused some operators to change, in some cases to reverse, their decisions. Other operators are much less influenced by the deliberate changes used (Table 8).

It is evident that the paint/air interface is important to some operators when they are assessing paint film appearance. Most operators commented on the appearances of the paint films in terms of colours. For example, "more grey", "bluer", "red tone", etc.). None of the operators commented on the surfaces in a way which indicated the important role the surfaces could play. Some even commented that they were ignoring the surfaces.

However, for some operators the 1 per cent to 2 per cent of incident energy which interacts with the paint film surface dominated their assessments of paint films without them being aware of it.

Table 8

Summary of the effect of altering the surface and changing the viewing conditions

Operator	Choice of Pigment	Surface state and viewing condition					
		As dried		Cleaned		Coated	
		C	F	C	F	C	F
1	A	2	8	2	4	6	4
	No Diff.	1	0	1	1	1	0
	B	7	2	7	5	3	6
2	A	2	5	2	5	2	3
	No Diff.	7	1	3	2	4	3
	B	1	4	5	3	4	4
3	A	2	8	6	8		
	No Diff.	0	0	0	0		
	B	8	2	4	2		
4	A			2	7	3	5
	No Diff.			1	1	0	0
	B			7	2	7	5
5	A	3	5	5	5	6	5
	No Diff.	5	5	0	2	1	0
	B	2	0	5	3	3	5
6	A	3	4			3	4
	No Diff.	0	0			1	1
	B	7	6			6	5
7	A	5	6	6	5		
	No Diff.	2	0	0	2		
	B	3	4	4	3		
8	A					4	4
	No Diff.					3	3
	B					3	3

C = Constrained

F = Free

## Conclusions


Subjective assessment of gloss is influenced by factors other than the simple quantity of light reflected in a specular manner. At high gloss the image definition and image colour becomes more important than simple image brightness. Image contrast, which is strongly influenced by the optics of the whole surface coating, also influences the observer. However, there is good agreement between operators when making subjective gloss assessments, demonstrating that they are using the same criteria.

On the other hand, there is not good agreement when operators are asked to compare paint film appearance. There is conclusive evidence that personal preference plays a major part, even when the operators share a common technological training. Further, for some operators the paint/air interface plays a significant role, and they are unaware of it. Because of this it is necessary to control viewing conditions when paint film appearance is under examination. Equally important, it is necessary to know if the operator is influenced by the surface energy, because he could be detecting differences arising from surface problems, but reporting them as differences between the paint films as a whole.

## Acknowledgments

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[Received 27 June 1978]

A man in a dark suit, white shirt, and red tie is wearing a tall top hat. Bright green paint is smeared all over his face, including his forehead, cheeks, and chin, and is dripping down his neck. The paint is also smeared on the top of his hat. He has a neutral, slightly weary expression.

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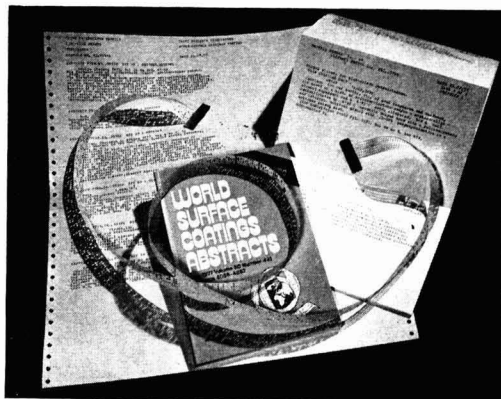
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# New water-soluble compositions

by A. M. Naser, A. Z. Gomma and M. Moustafa

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## Summary

Water-soluble formulations based on the recently introduced polyestaramides and alkyd-polyestaramide coatings have been

prepared. An evaluation of these materials as water-thinnable vehicles has yielded promising results.

## Keywords

*Raw materials  
binders (resins, etc.)*

polyestaramide  
water soluble resin

*Processes and methods primarily associated with  
drying or curing of coatings*

drying  
air drying  
stoving

*Properties, characteristics and conditions primarily associated  
with dried or cured films*

water resistance  
acid resistance  
alkali resistance

## Nouveaux véhicules solubles à l'eau

### Résumé

On a préparé des systèmes solubles à l'eau à partir des produits, qui ont été introduits tout récemment, à base des polyestaramides et de leurs mélanges avec des alkydes. L'évaluation de ces produits

en tant que véhicules solubles à l'eau a rendu des résultats prometteurs.

## Neue, wasserlösliche Produkte

### Zusammenfassung

Auf den unlängst eingeführten Polyesteramiden und Alkyd/Polyesteramiden basierende, wasserlösliche Vorschriften für Beschichtungsmittel wurden angefertigt. Eine Bewertung dieser

Erzeugnisse als wasserverdünnbare Bindemittel ergab vielversprechende Resultate.

## Introduction

*Refs. 1-5*

Recently, solvent type coatings based on polyestaramide and alkyd/polyestaramide resins have been described<sup>1-5</sup>. The application of these resins in the field of water-thinnable resins has not hitherto been attempted. For this reason, it was felt of interest to explore their application in this field.

The chemistry, advantages, disadvantages, and type of the various water-soluble resins have been described in many articles published in this and other journals and require no elaborate repetition.

200°C and maintained at this temperature until the formation of both monoglyceride and dihydroxyamide was completed. This was achieved by testing the solubility of samples removed from the reaction mixture in twice its volume of absolute methanol.

The reaction mixture was then cooled at 100°C and phthalic anhydride (PA) was added followed by a gradual increase of the temperature to 150°C. The amount of PA added depends on the desired excess of hydroxyl in the resin prepared (0, 20 and 30 per cent excess hydroxyl contents).

The reaction was stopped at different acid values in order to obtain resins of various acidity.

The course of preparation was followed by measuring the acidity of samples removed from the reaction mixture after various time intervals.

## Experimental

### Resin preparations

*Ref. 4*

All resins were prepared by charging the ingredients in a 250 ml 4-necked flask, equipped with an efficient stirrer, thermometer and inert gas inlet and a syphoning device for removing samples periodically from the reaction mixture without interrupting the reaction. Heating was performed by means of a heating mantle.

### Preparation of polyestaramide resins

It involves the following steps:

(a) *Preparation of dihydroxy-diethyl linseed amide (HELA)\*:* A mixture of DEA (0.15 mole), LO (0.05 mole) and zinc oxide (0.0012 mole) was heated at 200°C until the completion of the oil aminolysis. The reaction was followed by a TLC technique. Then the HELA was separated by washing the ethereal solution with NaCl solution.

### Preparation of alkyd/polyestaramide resins

A mixture of linseed oil (LO, one mole) diethanolamine, (DEA, two moles) and zinc oxide (0.024 mole) was placed in the reaction vessel. The mixture was heated gradually to

(b) *Resin formation.* Condensation of PA and HELA was carried out as described in the preceding item.

#### Preparation of 30 per cent excess hydroxyl alkyd resin

A mixture of LO (0.56 mole), glycerol (0.86 mole) and lead oxide (0.06 mole) was heated at 200°C until the monoglyceride formation was complete. The reaction mixture was cooled to 100°C and PA (1.00 mole) was added and the reaction continued as described above.

The analytical and evaluation techniques used in this work were by standard methods.

### Results, discussion and conclusions

In order to achieve water solubility, the resins should possess sufficient hydrophilic properties. Carbonyl and hydroxyl groups are amongst the groups that confer a hydrophilic character to the resin. For this reason, it was felt desirable to determine the optimum acidity of the resin to achieve water solubility. Higher and lower acidities greatly affect the chemical resistances, storage stability, solubility characteristics and viscosity of the resultant varnish.

Three series of resins were prepared corresponding to 0, 20 and 30 per cent excess hydroxyl contents. Within each series, resins of different acid values were prepared by terminating the reaction after various periods of time.

The results obtained indicate the following generalisations:

- (i) The most suitable temperature for the preparation of various alkyd/polyesteramides, polyesteramides and alkyds is 150°C ( $\pm 5^\circ\text{C}$ ). At this temperature, the esterification proceeds smoothly and can be terminated at any required acidity and the amount of unreacted anhydride is low. At higher temperatures, the reaction is difficult to control.
- (ii) As the percentage excess hydroxyl content of the resin increases, so the optimum acid value of the three types of resins can be arranged in the following order: Alkyd/polyesteramides > Polyesteramides > Alkyds.
- (iii) The rate of esterification in the case of polyesteramide resins is about the same as alkyd/polyesteramide resins and proceeds rapidly. The esterification rate in case of alkyd resins proceeds at slower and smoother rate. This fact is illustrated in Figure 1.

Table 1 illustrates some constants of the various resins prepared.

Table 1  
Alkyd constants of the resins

Resin	Excess -OH %	$e_A$	$e_B$	Acid value, mg KOH/g	
				Initial	Final
Alkyd/polyesteramide	0	3.55	3.55	281.29	40
	20	3.11	3.51	290.87	40
	30	2.744	3.344	306.32	35
Polyesteramide	0	0.2	0.199	217.6	50
	20	0.2	0.239	190.4	50
	30	0.2	0.259	179.3	50
Alkyd	30	2.563	3.163	365.9	60

Where:  $e_A$  = number of acid equivalents.  
 $e_B$  = number of hydroxyl equivalents

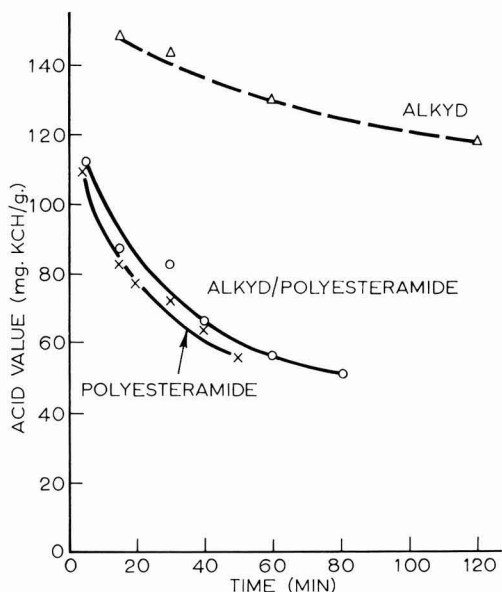


Fig. 1 The reaction rates of various 30% excess hydroxyl alkyd/polyesteramide, polyesteramide and alkyd resins at 150°C

### Film performance

After preparation of the various alkyd/polyesteramide, polyesteramide and alkyd resins, water soluble vehicles were formulated, whose composition is given in Table 2.

Table 2  
Water soluble varnish composition

	Per cent
Resin	30
Water/NH <sub>4</sub> OH solution*	40
Ethyl alcohol	30
Manganese acetate (metal/resin)	0.03

\*to bring the solution to pH 7

The drying characteristics of the various compositions were determined and the results are given in Table 3. The data were rated according to the following:

HD means hard dry

VST means dry with very slight tackiness

ST means dry with slight tackiness

T means tacky films.

Table 3  
Drying characteristics

Resin	Excess hydroxyl %	Hard dry time (hr.)	Stoving					
			at 110°C			at 130°C		at 150°C
			1 hr	2 hr	3 hr	1 hr	1 hr	1 hr
Alkyd/polyesteramide	0	48	T	T	ST	T	HD	
	20	48	T	T	ST	T	HD	
	30	48	T	T	ST	VST	HD	
Polyesteramide	0	24	T	T	ST	VST	HD	
	20	24	T	T	ST	VST	HD	
	30	24	T	T	ST	HD	HD	
Alkyd	30	22	T	ST	VST	HD	HD	

The optimum baking schedule was found to be one hour at 150°C. Alkyd and polyesteramide resins air-dry within 24 hours whilst alkyd/polyesteramide resins require longer drying times.

The work was extended to show the effect of the acid value on the drying characteristics. For this reason, resins of various acid values were prepared and the corresponding varnishes formulated. The results indicated the interdependence of the drying time on the acid value of the resin tested within the limits used (40-90 mg KOH/g).

The water, acid and alkali resistances of the various varnishes were performed and the results obtained showed that all films exhibited excellent water and acid resistance (air dried or stoved). On the other hand, their alkali resistance is poor. This is to be expected because of the residual acidity of the resin.

#### Study of the film properties of the resins

In order to determine the resistance of the films towards various chemical and physical effects, baked and air-dried films were subjected to water and acid resistance tests until complete film failure had occurred. The data obtained are shown in Table 4.

Table 4  
Water and acid resistances

Resin	Excess OH %	Water resistance (days)					Acid resistance (days)				
		1	2	5	10	15	1	2	5	10	15
Alkyd/polyesteramide	0	Ex	G	F	F	F	Ex	F	F	P	—
	20	Ex	G	F	F	F	Ex	F	F	P	—
	30	Ex	G	F	F	F	Ex	F	F	P	—
Polyesteramide	0	Ex	G	F	F	F	Ex	F	F	F	F
	20	Ex	G	F	F	F	Ex	G	G	F	F
	30	Ex	G	F	F	F	Ex	G	G	F	F
Alkyd	30	Ex	G	F	F	F	Ex	G	G	F	F

Where: *Ex* means excellent, almost no change,  
*G* means good, very slight change,  
*F* means fair, partially attacked and  
*P* means poor, complete film failure.

It should be noted that baked films show satisfactory durability regarding water and acid resistances during the test period.

Films of resins of various acid values were subjected to resistance tests and the following generalisations can be made:

- (i) As the acid value of the resin decreases, the resistances to water, acid and alkali attack are improved. These results are in agreement with theoretical considerations.
- (ii) In general, the film properties are greatly improved by stoving for one hour at 150°C.
- (iii) The stability of the films towards chemical attack depends upon the percentage of excess hydroxyl present. 30 per cent excess hydroxyl resins showed better resistances than those of 0 per cent and 20 per cent excess hydroxyl resins.

All films examined showed satisfactory flexibility when subjected to the bend test.

#### Stability of the resin solution

Addition of ethanol, as a water miscible alcohol, to the neutralised resin solution was found to be necessary to bring the solutions the desired workable viscosity. It also improves the transparency and stability of the aqueous solution. The optimum alcohol ratio depends on the type of resin present. Alkyd resins showed limited solubility at 50 per cent or lower water/alcohol mixture ratio.

The characteristics of the prepared varnishes are given in Table 5.

Table 5  
Characteristics of varnish solutions

Resin	Excess hydroxyl %	Colour (Gardner)	Viscosity, seconds (Ford Cup No. 4)
Alkyd/polyesteramide	0	14	15
	20	14	19
	30	14	30
Polyesteramide	0	14	22
	20	14	23
	30	14	Gel-like
Alkyd	30	17	16

The results given in Table 5 indicate that compositions based on alkyd/polyesteramides and polyesteramides have a paler colour than those based on alkyds. This is attributed to the longer reaction times required for alkyd preparations. The viscosity of the aqueous solutions also depends on the percentage excess hydroxyl of the resin. The viscosity reduction by alcohol was also studied and the results obtained are shown in Figures 2, 3 and 4. It should be noted that resins having similar constants were also prepared by thinning with xylene/petroleum fraction (60-80°C) to give equal solids contents and are included in this investigation for comparison.

The conclusions drawn from these studies are:

- (1) As the alcohol percentage increases, so the viscosity decreases.
- (2) The rate of viscosity reduction proceeds rapidly until 40 per cent solids is reached. Further alcohol addition then affects the viscosity of the resin solution only slightly.

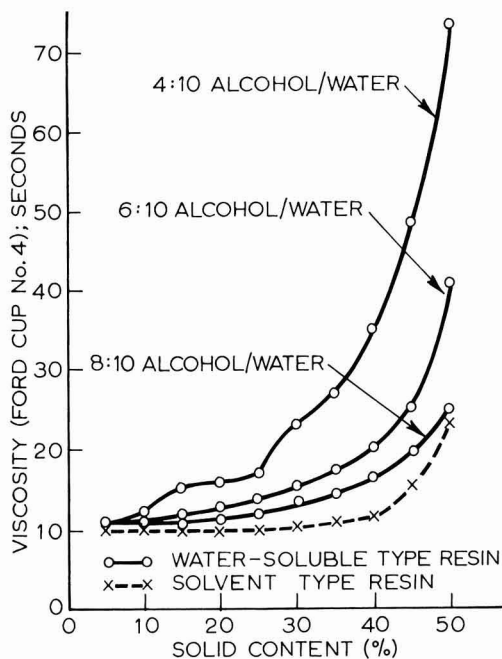


Fig. 2 Viscosity/dilution curves of 30% excess -OH polyesteramide resin

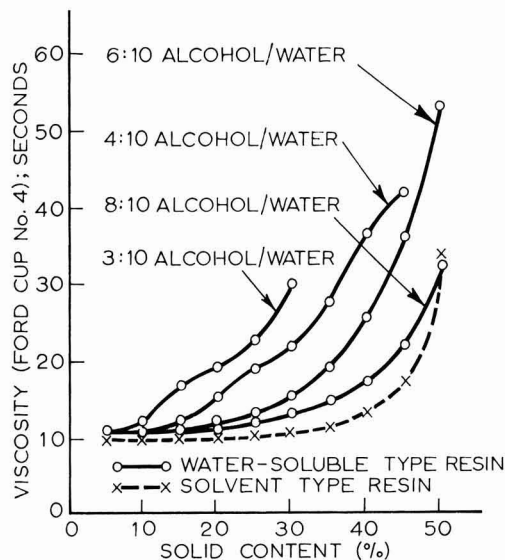


Fig. 3 Viscosity/dilution curves of 30% excess -OH alkyd/polyesteramide resin

(3) Solvent type resins have lower viscosities than the aqueous types. This is attributed to the thixotropic behaviour of the solutions.

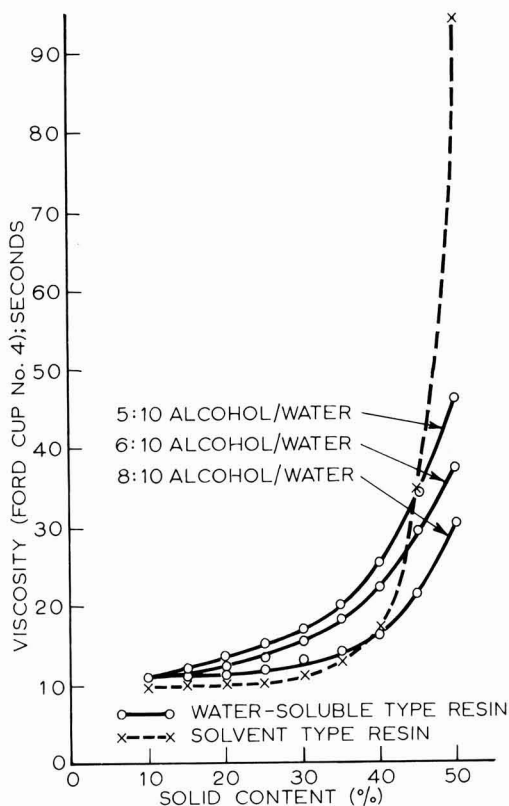


Fig. 4. Viscosity/dilution curves of 30% excess -OH alkyd resin

The work was also extended to study the storage stability of the various aqueous solutions at 30 per cent solids. The results are given in Table 6. The following trends were observed:

- (1) The storage stability of the resins depends on the pH of the solution, as well as on the percentage excess hydroxyl of the resin. The stability decreases by increasing either of them.
- (2) The storage stability, at pH 8, is in the following order:

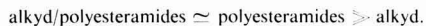


Table 6  
Storage stability data

Resin	Excess -OH %	Storage stability (days) at pH		
		8	9	10
Alkyd/polyesteramide	0	>280	<200	<120
	20	>280	<150	<90
	30	<180	<90	<90
Polyesteramide	0	>220	<90	<30
	20	>190	<90	<90
	30	>190	>60	<120
Alkyd	30	<30	<4	<1

[Received 14 August 1978]

## References

1. Gast, L. E., Schneider, W. J. and Cowan, J. C., *J. Am. Oil Chem. Soc.*, 1966, **43**, 418.
2. *Ibid.*, 1968, **45**, 534.
3. Gast, L. E., Schneider, W. J., McMains, G. E. and Cowan, J. C., *J. Am. Oil Chem. Soc.*, 1969, **46**, 360.
4. Naser, A. M. and Gomma, A. Z., *J.O.C.C.A.*, 1978, **61**, 23.
5. Naser, A. M., El-Azmiry, M. A. and Gomma, A. Z., *J.O.C.C.A.*, 1977, **60**, 18.

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## Next month's issue

The Honorary Editor has accepted the following papers for publication, and they are expected to appear in the January 1979 issue of the *Journal*:

**Measurement of the electrical properties of typical tank coatings: Some preliminary investigations of the effects of seawater and cargoes on such properties** by *W. M. Groenewoud*

**The realistic prediction of primer performance—A case history** by *J. B. Harrison*

**Protection by organic coatings** by *K. S. Rajagopalan, S. Guruviah and D. N. Roy*

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## Errata

### Synthesis of some modified phthalocyanine compounds suitable as pigments

On page 370 of the October issue of *JOCCA*, the last line in the third paragraph under the heading "Results, discussion and conclusions" should read as follows: "... since polymers of pyromellitic anhydride would contain peripheral *carboxyl* groups and would be soluble".

### Recent aspects of some coloured urea/dibasic acid fusion adducts

On page 374 of the October issue of *JOCCA*, the following

amendments should be made to Table 3:

No. III b, x = 29-27 and No. IV, y = 27-53

### Electrical resistance of electrodeposited rubber per unit coulomb

Since the publication of this paper in the November issue of *JOCCA*, the author has amended Tables 2 and 3 on page 429 and the corrected Tables will be included in the *Journal* as soon as possible.

### The role of the Diels-Alder reaction in the curing of drying-oil alkyd-melamine systems

Sir,

In my recent contribution to the *Journal (JOCCA, 1978, 61, 356)* entitled "The role of the Diels-Alder reaction in the curing of drying-oil alkyd-melamine systems", the Diels-Alder reaction was claimed to play a role in the acid-catalysed curing process.

After the manuscript had been submitted for publication, a paper dealing with catalysis of the Diels-Alder reaction has reached my attention (Rubin, W., Steiner, H. and Wassermann, A., *J. Chem. Soc.*, 1949, 3046). In this work it is shown that general acid catalysis is operative in at least some Diels-Alder reactions. This is a finding which could be taken into

account when trying to explain the mechanism of the acid catalysed curing of alkyds and melamine resins. Indeed, it seems to enhance the probability of the Diels-Alder reaction being of importance for the crosslinking of the system.

Yours faithfully,

KRISTER HOLMBERG

*Berol Kemi AB,  
Division SOAB,  
Box 55,  
431 21 Molndal,  
Sweden.*

9 October 1978

## Section Proceedings

### Irish

#### Aqueous based printing inks

At a meeting of the Irish Section at the Clarence Hotel, Dublin on Friday 20 October 1978, Mr R. Millard of the Harlow Chemical Company gave a lecture entitled "Aqueous based printing inks". Mr K. O'Callaghan was in the chair and nineteen members and visitors were present.

Mr Millard outlined the circumstances which had contributed to the increased interest in water based inks, such as the shortage of solvents during the oil crisis and the increasing legislation regarding atmospheric pollution. He discussed the development of such inks and gave a frank assessment of the problems still to be solved.

He followed with a detailed description of the flexographic and gravure printing processes, suggesting that aqueous inks could well be used in greater quantity here.

Mr Millard then described the technology of aqueous acrylic polymers, particularly the carboxylated types, stating that high solids, low carboxylated versions are the most suitable, particularly for gravure applications.

The lecture, which was well illustrated by slides, was well received by the audience and provoked some lively discussion afterwards.

At the end of the discussion and questions, the vote of thanks was proposed by Mr D. Allan.

D.P.

### Manchester

#### Theory and practice of pigment dispersion

Seventy-five members and guests were present on Friday 13 October 1978 at the Manchester Literary and Philosophical Society to hear Dr W. Carr of Leeds University Colour Chemistry Department deliver the above lecture.

Predictably, Bill Carr's eighty-five minute presentation was excellent in both content and presentation, further enhanced using twin screen slide projection and continuous dialogue. As the lecture has been published (*JOCCA 1978, 11, 397*), reference to the question period is more appropriate and could be summarised as follows:

Q Flocculation—remedial treatment.

A Modification of the system followed by re-milling.

Q Pigment manufacturers' role in improving dispersion properties.

A Easily dispersed and micronised pigments have helped considerably, but the resin manufacturers boast of tailor made properties—Why don't they build groups in resins to attach to pigments?

Q Can increased dispersion improve gloss retention?

A Yes, reduction of particle size to less than 0.3 microns gives much better gloss retention, especially on coatings not exposed to daylight.

Further subjects discussed were the effect of Van der Waals forces in relation to condensation within films on porous substrates and the commercial advantages of milling in high toluene content millbases.

The lecture was concluded by a vote of thanks proposed by Mr A. E. Peters and enthusiastically supported by all present.

#### Students Seminar—Emulsion paints



Some delegates at the Manchester Section Student Seminar on emulsion paints.

A Manchester Section Student Seminar on emulsion paints was held on Friday 15 September 1978 at the Woodcourt Hotel, Sale, Cheshire. The Seminar commenced at 10.00 a.m. and was very well supported, total attendance being 85. The official welcome was by Mr A. McWilliam, Section Chairman. Mr G. Flood organised the seminar and Mr F. Arnold took the Chair.

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For lacquers  
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Does not affect taste,  
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## DYNAPOL® L

DYNAPOL L-lacquer raw materials are high molecular weight, linear, saturated polyesters containing terephthalic acid.

They produce extremely adhesive and highly elastic lacquer films that can be punched or deep-drawn.

DYNAPOL L-lacquer films are scratch and impact resistant. They are resistant to weathering and do not yellow.

DYNAPOL L-lacquer films are adjustable from high gloss to matt and can be pigmented in all colours. With some formulations coatings can be produced that will withstand sterilization. These are generally recognized as safe by legislation governing foodstuffs and comply with BGA and FDA recommendations.

DYNAPOL L is available in different grades of elasticity and viscosity meeting the varying industrial requirements.

### Main applications:

Coil and can coating for packs (internal and external lacquer coatings), food packs for sterilization, facades and construction elements, laminates, printing inks.

## DYNAPOL® LH 812

DYNAPOL LH 812 is a linear, saturated polyester resin containing hydroxyl groups.

Combined with cross-linking resins it produces high-grade industrial enamels with increased solid contents.

DYNAPOL LH 812-lacquer films possess special flexibility and formability. They have excellent adhesion on metal, particularly aluminium, steel and galvanized steel.

The high surface hardness and resistance to weathering and chemicals ensure a wide field of use for DYNAPOL LH 812-lacquer films, especially outdoors.

DYNAPOL LH 812 is highly compatible with the high molecular weight, lacquer polyesters of the DYNAPOL L range. Its properties can be widely varied.

### Main applications:

Coil coating with high flexibility and formability enamels for bodies and appliances and coating material for outdoor use, especially in building.

Further proven products for surface finishes:

### DYNAPOL® H

Branched polyester resins for coil coating and industrial spray lacquers.

### DYNAPOL® P

Copolyester for powder coating.

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Polyvinylidene fluoride for powder coating.

### Nitrocellulose

### DYNASIL®

Binder on silicic acid ester base for zinc powdered paints.

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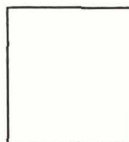
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Yes, I would like special detailed information about raw and additive materials for protective surface treatment.

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Four papers were presented entitled as follows:

- (1) Acrylics—The route to quality decorative paints, by Mr D. Kerrison, Rohm and Hass Co.
- (2) Titanium dioxide pigments in decorative emulsion paints, by Mr J. Valpola, Kemira Oy, Finland.
- (3) The colouration of decorative aqueous finishes, by Mr J. M. Hill, Ciba-Geigy, Pigments Division.
- (4) The principles of emulsion paint formulation and manufacture, by Mr W. Phillips, Crown Decorative Products Ltd.

A discussion period followed each lecture and an excellent lunch was provided for delegates. The Seminar was finally closed at 5.30 p.m.

F.B.W.

## Scottish

### The practical problems of painting and maintaining large industrial plants

The first meeting of the Session was held at The Albany Hotel, Glasgow, on Thursday 12 October, when members and guests received a paper by Mr D. Bayliss of BIE Anti-Corrosion Ltd on "The practical problems of painting and maintaining large industrial plants".

Mr Bayliss referred to three main factors in his paper: design of such plants, surface preparation and the problems encountered and quality control and the importance that should be attached to this often neglected area. These aspects were further illustrated by colour slides. Comment was made with regard to the problems which occur when coating galvanised surfaces and welded joints.

A lively discussion followed and a number of controversial points raised by Mr Bayliss were debated. One point in particular that was made was the fact that it was felt by those on site that insufficient data on the application of paint was

given by the paint manufacturers and this could contribute to mistakes being made at the point of application.

The evening was rounded off when Mr T. Humphrey proposed the vote of thanks.

W.L.M.

## West Riding

### Instrumental colour control in the paint industry

A meeting of the West Riding Section was held on Tuesday 3 October 1978 at the Mansion Hotel, Leeds. Mr R. P. Best of Instrumental Colour Systems Ltd gave a talk on instrumental colour control.

The speaker traced the historical development of colour control both in measurement and data handling aspects. The theories of Kubelka and Munk were briefly discussed, but the time consuming work involved in solving the various equations prevented wide scale adaption of the technique.

The advent of computer technology has changed the situation and modern minicomputers are available at relatively modest cost. As a consequence, systems have been developed with the spectrophotometer and computer electronically linked. It is now taken for granted that modern instrumental methods are able to match the entire gamut of paint colours. Whilst production control appears to be a simple matter, comparison of predicted formulations for both the standard and for the batch can lead to problems. These were discussed by Mr Best who outlined the solutions to many of these difficulties. Modern computer software programmes have been developed which reduce the operation to a relatively simple level. The advantages of using colourists to operate modern systems, so that the new generation of operator-system dialogue software may be used to the benefit of both employer and employee, were pointed out.

Mr Best's talk stimulated many questions which illustrated the wide interest in this subject. Mr K. Smith proposed the vote of thanks.

R.A.C.C.

## Information Received

### Haefner expansion

A new blending, grinding and processing plant for pigments has been brought on stream at the Chepstow site of H. Haefner & Co. Ltd. The new facility will enable Haefner to offer a much wider range of pigments and iron oxides than previously, and has a present capacity of around 4,000 tonnes p.a. To enable Haefners to cope with the foreseen expansion of their business they have also recently purchased two further warehouses in Chepstow.

### Corrosion protection

B.I.E. Anti-Corrosion Ltd and B.I.E. Pipelines Ltd of Watford have come to an informal arrangement with P.I. Corrosion Engineers Ltd on technical matters in order to provide a more comprehensive service in respect of corrosion protection. P.I. Corrosion Engineers are a well known specialist firm in cathodic protection and corrosion monitoring and B.I.E. Anti-Corrosion Ltd and B.I.E. Pipelines Ltd, both members of the British Inspecting Engineers Group, are amongst the world

leaders in coating inspection and consultancy.

### Major plant expansion

The Specialty Chemicals Division of the Allied Chemical Corporation has doubled the production output of its broad line of high density oxidised polyethylenes with new facilities at their new Baton Rouge Plant which came on-stream in September.

### Change of address

Abbey Chemicals Ltd, jointly owned by NL Industries Inc., and The Steetley Co. Ltd, has moved to new premises at Livingston, West Lothian, Scotland. Abbey Chemicals manufactures the Bentone range of rheological additives which are widely used as thixotropic agents in the paint, ink, oil based lubricants and cosmetic industries.

### Carbon Black Committee

The European Carbon Black Centre has formed a Committee to be known as European Committee for Biological Effects

of Carbon Black to act as a forum for the acquisition and dissemination of information relevant to any actual, potential or alleged biological effects of carbon black.

### Change of address

British Chemical Products & Colours Ltd have moved to 253 Cranbrook Road, Ilford, Essex.

### Para-aminophenol plant

A new para-aminophenol plant for Hartington Chemicals Ltd, designed and constructed by Woodall-Duckham Ltd, will be in production early in 1979. Production is based on a licensed process from Howard Hall & Co. and involves the continuous selective and controlled hydrogenation of nitrobenzene. Para-aminophenol and many of its derivatives are used in a wide variety of applications in pharmaceuticals, agrochemicals, dyestuffs, photographic chemicals, anti-oxidants and resins, and the products will be marketed by Staveley Chemicals Ltd.

### Marketing agreement

Under a recent agreement, Hercules Inc. have assumed responsibility for the marketing and sale of carboxymethyl cellulose manufactured by Svenska Cellulosa AB of Sweden. Hercules currently produces and markets a wide range of cellulose and other water soluble products.

### Formation of new company

Scott Bader Co. Ltd and PVO International Inc., U.S.A., have announced that they are to set up a new company, Pacific Scott Bader Inc., to produce and market Scott Bader products to the paint industry. The new company is building a manufacturing facility on the PVO International site in Los Angeles, California and it is expected to come on stream early in 1979.

### New Products

#### Accelerated testing cabinet

The Atlas Electric Devices Co. of Chicago has available the UVCON Testing Cabinet designed to expose materials to alternate cycles of fluorescent ultraviolet light and condensation. This equipment is now specified in ASTM Standard G.53. The unit is capable of rapidly screening coatings, plastics, pigments and all types of materials to the UV portion of the sunlight spectrum along with moisture penetration. Whilst not intended as a replacement for more complete accelerated weathering systems, it can be used as a supplement where rapid UV screening is desired. The UVCON is available in the UK through Westlairs Ltd.



The new UVCON testing cabinet available through Westlairs Ltd.

#### New inks

A new ink series called Polymell Matt has been introduced by Lorilleux Bolton Clapham (Liquid Inks) Ltd with applications in printing on polythene by the flexographic process. The new inks have good heat resistance which enables carrier bags, etc. to be heat-sealed without damaging the print.

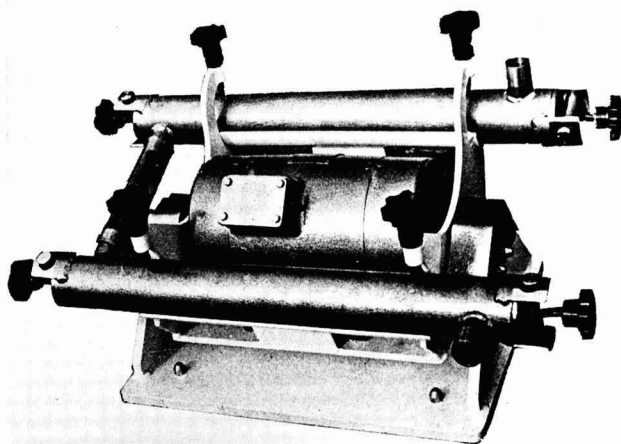
#### Digital thermometer

Channel Electronics (Sussex) Ltd have introduced the 7500 series of mains powered digital thermometers which incorporate

thermocouple and platinum resistance inputs and offer a temperature measurement capability from  $-220^{\circ}\text{C}$  up to  $1750^{\circ}\text{C}$ .

#### Improved grinding mill

Larger, newly-designed grinding chambers and higher energy are announced for the Megapact vibratory ball mill available from Pilamec Ltd. The new mill has more



The improved Megapact vibratory mill with increased capacity from Pilamec Ltd.

than twice the capacity of the standard unit and incorporates stainless steel chambers with quick-release end covers to permit easy cleaning. The oscillation frequency is 2,800 cycles per minute, with an amplitude of approximately 50 per cent greater than previous mills.

#### Corrosion-resistant filter system

A new corrosion-resistant tubular filter system offering continuous filtration at rates up to  $250\text{m}^3/\text{hr}$  and particle retention down to a nominal 1 micron, is being marketed by filter and pump specialists, Durco Europe. The tubular filters are available lined with either polyolefins for temperatures up to  $65^{\circ}\text{C}$  or fluorocarbons for temperatures up to  $95^{\circ}\text{C}$ . The filter elements are backwashable and available in corrosion-resistant materials and a wide variety of micron retentions.

#### New vibratory sizers

Mogensens Sizers Ltd have available a new range of totally enclosed vibrating screens to be known as the 'Five' series which are designed for screening up to six fractions simultaneously. The 'Five' series is an extension to an existing range of open frame vibrating sizers which provides a greater range of screen width.

#### New dyes for printing fabrics

A new range of dyes, Proclene PC liquid dyes, representing a major technological advance in the economic and reliable printing of high quality polyester/cellulose fabrics, has been launched by ICI. The technical advance made by Proclene PC dyes on currently available systems results from combining the unique properties of two ranges of ICI speciality dyes, Dispersol PC dyes and Procion T. dyes, in one con-

venient and careful balanced liquid dye.

### Conferences, Courses etc.

#### Safety when product painting

The Paintmakers Association of Great Britain Ltd has published a booklet giving practical safety advice for all engaged in industrial finishing which describes require-

ments for safe working procedure for the storage, handling, use and disposal of all types of paints and industrial finishes arising from the Health and Safety at Work Act. Aspects covered include fire and explosion risks, ventilation, extraction and health considerations.

#### Degussa publication

Degussa Ltd have published a technical bulletin on the physiological behaviour of highly dispersed oxides of silicon, aluminium and titanium.

#### Colour control brochure

Instrumental Colour Systems Ltd has published a new brochure which describes their range of colour control instruments and their industrial application. The brochure is entitled "Colour difference measurement systems".

#### Anti-corrosion standards symposium

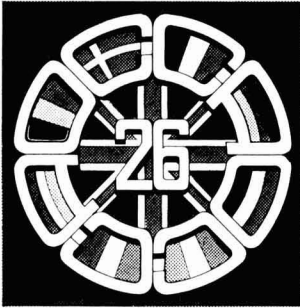
The North West Branch of the Institution of Corrosion Science and Technology is organising a one-day symposium on "Interpretation and applications of published standards for anti-corrosion" to be held on Thursday 8 March 1979 at the Runcorn Eurocrest Hotel, Wood Lane, Beechwood, Runcorn, Cheshire. The aim of the symposium is to review in broad terms and to discuss in detail the impact of far-reaching effects that published standards used in anti-corrosion have on industry.

#### Adhesives and sealants booklet

The Original Equipment Manufacturers Division of Loctite (UK) Ltd has published a new edition of its OEM Brochure which describes the range of Loctite Superfast Adhesives and Sealants currently available.

# "The OCCA"

The annual technical exhibition of the Oil and Colour Chemists' Association (known to many simply as "The OCCA") has become the world's most important event for all those connected with the paint, printing ink, polymer, adhesive, colour and allied manufacturing industries. The OCCA exhibition is held every year in London, England. The symbols for the 1974-79 exhibitions were specially designed by Robert Hamblin, Director and Secretary of the Association, to emphasise the very wide coverage which all the Association's activities attract:



The motif for OCCA-26 used the flags of the enlarged EEC converging on the British flag to symbolise the welcome extended to visitors from overseas to the Exhibitions for more than 25 years. (1974)

## The INTERNATIONAL Focal Point for the Surface Coatings Industries



The motif for OCCA-31 emphasises the unique aspect of the OCCA Exhibitions, which annually provide an international focal point for the surface coatings industries.



The 1974 theme continued at OCCA-27 by showing the world-wide interest aroused by the Association's annual Exhibitions in London which attract visitors from all parts of the globe.

The OCCA Exhibitions provide a unique annual focal point for the surface coatings industries, and bring together technical personnel to meet in an informal atmosphere allowing a free interchange of ideas and the rapid dissemination of knowledge of new products and new developments of existing products.

In recent years, visitors to the OCCA Exhibitions have regularly come from over fifty overseas countries and at the 1978 Exhibition, admissions by season ticket of over 10,000 were recorded at the turnstiles in the hall.

The Exhibition provides an ideal opportunity for organisations to display and discuss their products and services to a wide spectrum of visitors from all over the world.

Organisations wishing to receive further details should contact the Director & Secretary, Mr R. H. Hamblin, Oil & Colour Chemists' Association, Priory House, 967 Harrow Road, Wembley, Middlesex HA0 2SF, England (Tel: 01-908 1086, Telex: 922670 OCCA G).



The motif for OCCA-30 used the symbol of a moving indicator on a calendar to emphasise the importance of the continuous dialogue year by year between suppliers and manufacturers.



The motif for OCCA-28 emphasised that the target for 1976 was London where all the Exhibitions have been held, and continued the theme of its international aspect.



In 1977 the motif for OCCA-29 used inward pointing arrows to show the many places from which people came to the Exhibition, and these arrows formed outward pointing arrows to show the subsequent spreading of knowledge.



Applications to exhibit at OCCA-31 had been received from organisations in fourteen countries by the closing date on 31 October. A full list of Exhibitors will be published in the January issue of the *Journal* following the Committee Meeting to allocate the space and the notification of Stand areas to Exhibitors. Applications for space received after the initial allocation has taken place will be considered, and allocated any space remaining, but any organisation wishing to exhibit at the Exhibition not already having sent in an application should do so as soon as possible so that their preferences may be carefully considered and the maximum publicity given to their exhibits. Information on the exhibits to be shown at the Exhibition will be featured in the *Journal* in the months leading up to the Exhibition Preview issue (March 1979).

The interest shown in the OCCA-31 Exhibition as a direct result of the highly successful OCCA-30 Exhibition held in April this year has been considerable, and many companies from that Exhibition, as well as many companies who were not present at OCCA-30 and organisations new to the Exhibition, have made applications to be present at OCCA-31.

Visitors to the OCCA-31 Exhibition are known to have come from over 50 overseas countries, and admissions by season ticket of over 10,000 were recorded at the entrance during the four days.

The OCCA Exhibition, which is known as the international focal point for technical and commercial display and discussion in the surface coatings industries, is the most important annual event of its kind in the industries, and it offers an unparalleled opportunity for personnel in the manufacturing industries to meet and discuss their requirements with their counterparts in the supplying industries.

Many young technologists and scientists who visited earlier Exhibitions have now risen to high positions within their organisations, and the advantage to exhibitors of keeping in constant contact with them needs hardly be stressed.

The thirty-first annual Exhibition organised by the Association, OCCA-31, will be held at Alexandra Palace, London on the following dates:

Tuesday 3 April ..	09.30 to 17.30 hrs.
Wednesday 4 April ..	09.30 to 17.30 hrs.
Thursday 5 April ..	09.30 to 17.30 hrs.
Friday 6 April ..	09.30 to 16.00 hrs.

# OCCA-31 Exhibition

Alexandra Palace, London, 3-6 April 1979

The international focal point  
for the  
surface coatings industries

## Good support from 14 countries

### Theme of the Exhibition

The aim of the Exhibition is the presentation of technical and commercial information relating to advances in the surface coatings industries. The Committee stipulates that a technically trained person who has knowledge of the products displayed be available on the stand throughout the Exhibition.

Whilst the Committee naturally encourages the showing of new products, it does not stipulate that a new product has to be shown each year, since it fully appreciates that this is not possible. Accordingly, the Committee draws attention to the fact that new technical data on existing products is regarded as acceptable subject matter.

### Facilities at Alexandra Palace

The Association has full use of the facilities at Alexandra Palace during the period of the Exhibition which include a restaurant, bars, a cafeteria and a private exhibitors' bar. Another facility which is of considerable benefit to those travelling to the Exhibition by car is the ample free car parking space within the Palace grounds.

For visitors travelling to the Exhibition on the underground system, the Association will once again be running a free bus shuttle service to and from the Exhibition, this year from Wood Green Station on the Piccadilly Line. The extension of the Piccadilly Underground Line to the Heathrow Central terminal was opened in late 1977, and this now provides a direct link for travellers arriving at the airport to both central London and to Wood Green Station and the bus shuttle service to the Exhibition.

### Improvements at Alexandra Palace

In July 1978 work was started on a comprehensive refurbishment of the facilities at Alexandra Palace, and much of this has now been completed. The floor of the Great Hall, in which the Exhibition is held, has been resurfaced and the walls and pillars have been redecorated. The West Corridor and the restaurants and bars have also been completely refurbished, and the work to the exterior of the building is scheduled to be completed by the time of the Exhibition next year. These improvements will add to the pleasantness of the venue, set in extensive parklands, and will provide an excellent setting for this international focal point for the surface coatings industries.

### Information in foreign languages

As in previous years, the Association will be circulating information leaflets in six languages which will contain application forms for those wishing to purchase copies of the *Official Guide* and season admission tickets before the Exhibition. Interpreters will once again be in attendance at the Information Centre at the Exhibition to assist foreign exhibitors and visitors with their queries.

### Official Guide

This unique publication contains descriptions of all companies and their exhibits at the Exhibition and is issued to each member of the Association at home and abroad as well as to all visitors to the Exhibition with their admission tickets. Copies are also sent to members of relevant trade associations; foreign embassies and all organisations exhibiting receive complimentary copies.

Members are asked to ensure that they bring their tickets, enclosed in their copies of the *Official Guide*, to the Exhibition since otherwise the charge for admission will be made and no refund will be applicable in these cases.

The *Official Guide* is published several weeks in advance of the dates of the Exhibition to allow visitors the maximum opportunity to plan the itinerary of their visits. In 1978, for the first time, the *Official Guide* contained a chart classifying the products on show into the various types, and it is intended to produce a similar chart for the *Official Guide* to OCCA-31. This chart is invaluable to visitors, especially those who have only a limited amount of time available, as it provides a quick, easy reference of all the companies present who are displaying the products in which they are interested.

### Advertising facilities

Advertising space is available in the *Official Guide*, both to companies who will be exhibiting at the Exhibition, and also to other organisations. This important publication is constantly referred to both before the Exhibition and afterwards as a convenient record of the latest developments in the industry. Consequently, organisations wishing to take advertising space in the Guide should book their requirements as soon as possible in order to ensure a prominent position. Details of the advertising rates and media data are available from Mr D. M. Sanders at the Association's address.



# OCCA CONFERENCE 1979

The Stratford Hilton Hotel, Stratford-upon-Avon,

Warwickshire, England

20-23 June 1979

## The challenge to coatings in a changing world

As already announced in the *Journal*, the next Biennial Conference of the Association will take place at Stratford-upon-Avon from Wednesday 20 to Saturday 23 June 1979. The headquarters will be the Stratford-upon-Avon Hilton Hotel, with overflow accommodation at the Alveston Manor Hotel and the Swan's Nest Hotel. The title for the Conference will be "The challenge to coatings in a changing world". Summaries of most of the papers and biographies of the lecturers are given below. The provisional programme for the technical sessions is as follows:

### Thursday morning session

Chairman: Mr C. N. FINLAY, ATSC (Hon. Research & Development Officer)

**The challenge to coatings in a changing world—Predestination or prophecy?**

By Dr J. B. Harrison (Consultant)

**Surface coatings for the nuclear industry**

By Mr P. Walker, ATSC (Ministry of Defence) and Dr A. Highton, (CEGB)

**Original and maintenance painting systems for North Sea oil and gas platforms**

By Dr D. Atherton, FTSC (Sigma Coatings Ltd)

**Solvent loss from paint films**

By Dr J. Ramsbotham (Shell Research BV, Netherlands)

### Thursday afternoon session

Chairman: Mr A. G. NORTH (Managing Director, Cray Valley Products Ltd)

**Water-borne industrial thermosetting systems**

By Dr H. J. Luthardt and Mr W. Burckhardt (Deutsche Akzo Coatings GmbH)

**The influence of light intensity on photoactivity in TiO<sub>2</sub> pigmented systems**

By Dr T. A. Egerton and Miss C. J. King (Tiioxide International Ltd)

**Engineering for corrosion protection (Paper presented on behalf of FSCT)**

By Dr H. L. Gerhart (Carnegie-Mellon University, USA)

### Friday morning session

Chairman: Dr G. D. PARFITT, FTSC (Manager, Research and Development, Tiioxide International Ltd)

**The technologist in chains**

By Mr A. R. H. Tawn, FTSC (Chief Scientist, Coates Group of Companies)

**The changing role of polymer chemistry in organic coatings technology (Paper presented on behalf of FATIPEC)**

By Ir M. F. Kooistra (Akzo Research, Netherlands)

**Characterisation of the interactions between pigments and binder solutions using rheological measurements (Paper presented on behalf of SLF)**

By Mr A. Saarnak (Scandinavian Paint & Printing Ink Research Institute)

**Aqueous coil coatings**

By Dr E. J. Percy and Mr F. Nouwens (Synres International BV, Netherlands)

### Friday afternoon session

Chairman: Mr T. R. BULLETT (Manager, Sponsorship Development, Paint Research Association)

**Aluminium compounds as major components of surface coatings**

By Mr J. H. W. Turner, FTSC (Consultant) and Mr W. K. H. Lakin (Manchem Ltd)

**Dispersion of pigments: What is the ultimate?**

By Mr D. M. Varley and Mr H. H. Bower (Ciba-Geigy Plastics & Additives Co, Pigments Division)

**Dry on wet—A new concept in low pollution coatings utilising cellulose acetate butyrate**

By Mr B. P. Windibank and Mr R. W. Mahar (Kodak Ltd)

As in previous years, the Association will organise a comprehensive programme of social events and further details will be announced in due course.

### Conference preprints

Preprints of the papers are now being prepared and it is expected that these, together with details of accommodation, badges, programmes etc. will be sent to those who have registered in May 1979. It is a feature of the Association's Conferences that preprints are sent well in advance of the function, in order to enable delegates to read them before the Conference, at which the lecturers illustrate their topics, but do not read the papers in their

entirety. This allows for a much longer discussion period than at many other conferences, and has proved of immense value to those attending previous Association Conferences.

### Registration fees

Forms of registration will be despatched shortly to all Members of the Association attached to the Sections in the UK, Ireland and General Overseas Section, and it is expected that registration forms will also be included in the December issue of the *Journal* for the benefit of non-members.

Council has fixed the registration fees for the Stratford Conference at £60.00 (plus

Value Added Tax at the standard rate) for Members, £80.00 (plus VAT) for non-members, and £20.00 (plus VAT) for wives. A daily registration fee for Members of the Association of £35.00 (plus VAT) and of £20.00 (plus VAT) for Registered Students of the Association has been set.

**Non-members wishing to avail themselves of the preferential Conference fee for Members should request application forms from the Association's offices and these should accompany registration forms.**

Further information may be obtained from the Director & Secretary at the address on the Contents page of this issue (Tel: 01-908 1086; Telex 922670 OCCA G).

*Note:* Dr L. H. Gerhart has now withdrawn through illness—a further notice concerning the details of the paper to be presented on behalf of the FSCT will appear in a later issue of the *Journal*.

The papers to be presented, together with summaries and biographies of the authors are given below

## The challenge to coatings in a changing world— Predestination or prophecy?

By J. B. Harrison

An attempt is made to predict how the world will change on the basis of how change has taken place in the past. From the turn of the century is taken as a reasonable starting date and the last 75 years are analysed. The rapidity of change is the most remarkable feature. Changes are highlights to a steady constant scene. Some of the failures of change are instanced, and the need to constantly reassess the effect of change is emphasised.

Time and change bring constraints in their train which can add to the difficulties of surface coating development.

It is attempted to assess how surface coatings will contend with a changing world. There will be demands for special products, demands largely generated by the user and the past 25 years of demand are analysed. It is contended that the user will be the mainspring of demand for new products and techniques. It is regretted that the surface coatings supplier has not a better record in the new development field. It is unfortunate that as new products come along there is a tendency to retain the old, resulting in proliferation of products in the surface coatings fields.

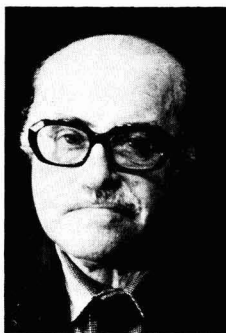
Industrial and heavy industrial paint developments are foreseen as the most prolific area of new product demand which the supplier of surface coatings will meet from his wealth of knowledge and experience of the past demands.

The past is then analysed in the context of the development of adverse trends that have developed insidiously. There are many constraints to progress from the anti-pollutionists and ecologists. Membership of EEC has not eased the situation. We live in an age of bureaucratic interference and there is a marked tendency to over elaboration by specifiers and the providers of Codes of Practice. BS.5349:1977 is taken as a typical instance.

Past failures are ruthlessly analysed, the major one of which is a failure to follow through the record of performance, and accuracy of prediction of new developments and ensure their frequent unbiased reporting and the need for the setting up of some official organisation charged with ensuring that this accuracy of recording is ensured. Only in this way will the future be truly assessable as an era of advancement and progress.

Dr J. B. Harrison graduated from the University of Leeds in 1932 with a 1st Class Honours Degree in Pure Chemistry, and followed on to carry out research in Organic Chemistry, and in 1934 was awarded a PhD degree with the Cohen Prize for work on the Isomeric Thiophthens.

Subsequently, he saw service as a development chemist with the Anglo Iranian Oil Company (1934-1937) and then as Research Chemist in the field of synthetic resins with I.C.I. (Dyestuffs Division) (1937-1946).



J. B. Harrison

He then held the position of Director of Laboratories of the Factice Research and Development Association (1946-52), working in the fields of vulcanised oils used as processing ingredients in the extrusion and spreading of rubber.

He joined the paint industry in 1952 as Research Manager to Goodlass Wall & Co Ltd, a subsidiary of Lead Industries Group Ltd. Subsequently and successively, he was Chief Chemist and Technical Manager of Goodlass Wall & Co. Ltd, and in 1970 was appointed as the Technical Liaison Officer of the overseas paint companies of Lead Industries Group Ltd. He retired June 1977 and now functions as a consultant in the field of protective surface coatings for the prevention of corrosion of steel structures.

He introduced and developed the use of zinc phosphate pigment as a non-toxic anticorrosive pigment.

He has been a member of the Oil & Colour Chemists' Association for 33 years and held the office of Hon. Research and Development Officer in the period 1958-1963.

## Surface coatings for the nuclear industry

By P. Walker and A. Haighton

The painting of nuclear installations and other areas in which radioactive nuclides are handled presents special problems. In addition to the normal decorative and protective properties expected of coatings, the added dimensions of radiation resistance, radioactive contamination and decontamination are of paramount importance. The potentially dangerous, yet invisible, nature of radioactivity requires not only that surface coatings absorb the minimum amount of contamination, but also that they should be easily and rapidly decontaminated. Consequently, the coatings need to be resistant to a variety of aggressive reagents.

The accumulative affect of these hostile environments together with their normal service exposure, places a great strain on the ingenuity of the paint formulator working in a field where precise data on the effect of such factors as formulation varia-

bles and the age of the coating before exposure is both sparse and expensive to obtain.

Information on the mechanisms of radiological contamination, radiation damage, the state of the art in the formulation, testing, assessment and effect of ageing on coatings for nuclear environments is given. Finally, opinions on future demands on surface coatings for nuclear industry are advanced.



P. Walker

Mr P. Walker entered the paint industry in 1947 and is now a Principal Scientific Officer in the Ministry of Defence with responsibility for the development of surface coatings and adhesives. He is the holder of the Insignia Award in paint technology from the City and Guilds of London Institute, and is a Fellow of the Institute of Corrosion Technology and an Associate in the Technology of Surface Coatings. He has presented papers to OCCA, FATIPEC, the American Paint Society and elsewhere on paint adhesion, space stable paints, coatings for radioactive areas and metal pretreatment, and is the author of several papers on these subjects.



A. Haighton

Allan Haighton graduated from the University of Leeds in 1974 with a PhD in Physical Chemistry. He joined the Research Division of the CEGB and was concerned with the contamination and decontamination aspects of surface coatings. In 1977 he transferred to the Scientific Services Department of the CEGB's North West Region and now works on radioactive waste disposal. In

1978 he became Chairman of a joint nuclear industry working party concerned with the production of a code of practice on radioactive decontamination.

### Original and maintenance painting systems for North Sea oil and gas platforms

By D. Atherton

Protective coating systems for mobile and fixed off shore oil or gas drilling or production structures usually consist of zinc rich primers followed by high build chlorinated rubber, vinyl, or epoxy coatings, or combinations of these. The products defined by oil companies and/or their consultants tend to be based on formulations inspired by laboratory work on chemical resistant coatings, and these very frequently do not survive the very adverse cold and wet conditions of application during construction and service in North Sea conditions. Offshore experience with a variety of such systems will be described together with suggestions on how they can be adapted or modified to meet the prevailing construction and operation conditions.



D. Atherton

Donald Atherton graduated in chemistry in 1937 and in 1940 received PhD after vegetable oil research with Prof. T. P. Hilditch. This led to research on drying oils, then on alkyd resins and to general surface coating technology with I.C.I. (then Dyestuffs Division) until 1954, when he joined John S. Craig & Co. Ltd in Glasgow as Technical Director. He became Technical Director of Sigma Coatings Ltd after the merger in 1971, and now also undertakes technical supervision of Sigma's worldwide marine and offshore operations. He has served on OCCA Committees in Manchester and Glasgow and was Chairman of the Scottish Section from 1966 to 1968.

### Solvent loss from paint films

By J. Ramsbotham

Over the last ten years, the use of organic solvents in paint formulations has come under increasing pressure from legislative and environmental bodies. Not surprisingly, this has led to developments in water-based and solvent-free/reduced systems. However, because of the many technical advantages which solvents have to offer, they will

feature in paint formulation for many years to come. A challenge facing paint technologists, therefore, is to exploit to the full knowledge of the mechanism of paint film formation when formulating solvent blends. This paper reviews some recent developments in solvent volatility measurement and examines how and where such data can and cannot be used in practical paint formulation.



J. Ramsbotham

Dr J. Ramsbotham graduated from Nottingham University in 1968 where, after a short period at Massachusetts Institute of Technology, he returned to complete research studies on rutile surface chemistry. He subsequently joined Shell Laboratories in Amsterdam in 1971, and his current responsibilities include research, development and technical service work related to solvent formulation.

### Water-borne industrial thermosetting systems

By H. J. Luthardt and W. Burckhardt

Various binder types are used in water-borne thermosetting coatings systems, usually crosslinked by methoxylated melamines. In aqueous solution short-oil alkyds at a variety of concentrations under different conditions were investigated. The influence of co-solvents on their behaviour and their rheology was studied. These alkyds were also utilised as protective colloids when acrylic monomers were copolymerised to form dispersions. The behaviour and film properties of those hybrids were studied. The melamines used showed a two-fold reactivity at low and high temperature, involving solvent co-solvent interaction.

The ease of application by hand spray or electrostatic is demonstrated and their advantage concerning saving of energy explained.

Dr H. J. Luthardt studied chemistry at the Universities of Wurzburg and Heidelberg. After having graduated in Organic Chemistry in 1967 he was Hon. Research Assistant at the University College London (Chemistry Department) in 1967/68, before joining the research department of Glanzstoff AG (after merger, Akzo Research Laboratories, Obernburg).

He was transferred to Sikkens B. V. Sassenheim, Netherlands, in 1971 working on new developments in decorative paints and in 1975 delegated to Akzo Coatings Resin Research, c/o Synthese B. V., Bergen



H. J. Luthardt

op Zoom, Netherlands. Since Autumn 1978 he has been in charge of the resin laboratory of Deutsche Akzo Coatings GmbH, Stuttgart, F.R.G. (formerly Lesonal).

Dr Luthardt has a special interest in the chemistry and physical chemistry of water-soluble polymers, especially thermosetting binders for industrial paints.



W. Burckhardt

Mr W. Burckhardt studied chemistry and biology at the University of Stuttgart. He joined the former Lesonal-Werke (after merger, Deutsche Akzo Coatings GmbH.) in 1959. At present he is the head of the department of "Less-polluting paint systems" (water-borne and high-solids-systems) and project manager for water-borne industrial paints for the Akzo Coatings Division.

### The influence of light intensity on photoactivity in TiO<sub>2</sub>-pigmented systems

By T. A. Egerton and C. J. King

The correlation between natural weathering and different accelerated test methods has been discussed for many years, and it is usually assumed that the rate of paint degradation is proportional to the intensity of the incident ultraviolet radiation.

Results from studies of isopropanol photo-oxidation on TiO<sub>2</sub>, a reaction known to correlate well with the weathering of paints, indicate that under the light intensities normally encountered, the oxidation rate is proportional to the square

root of light intensity. This conclusion is shown to be a consequence of the processes occurring in the TiO<sub>2</sub> crystal when illuminated by UV light.

The implications for the weathering testing of paints will be discussed.



T. A. Egerton

Dr T. A. Egerton graduated from Imperial College in 1965, and after research in surface chemistry and teaching, in both Africa and the UK, joined Tioxide International in 1974. He is presently working on solid-state studies of rutile pigment and problems of accelerated weathering.



Miss C. J. King

Miss C. J. King graduated in 1976 from the University of Manchester, with an honours degree in physics. She then joined the Research and Development Department of Tioxide International as a Technical Officer, and has recently been involved with both computer modelling and photocatalysis.

### The technologist in chains

By A. R. H. Tawn

Health, safety and welfare at work are united with consumer protection and the laws of product liability in constraining the technologist's attempts to achieve 'progress'. When he is additionally required by society to consider environmental protection and the conservation of natural resources the technologist may legitimately cry, "Where will it all end?". Do these pressures fuel the fires which threaten to destroy creativity and invention? Or do they provide a new challenge to the innovator? Fear and hysteria are powerful forces. It is suggested that they should not be allowed to run riot, and that technologists, informed as they are on the basic

concepts of risk-benefit analysis, might do well to communicate their knowledge more effectively to the public if they hope, as technologists, to go on eating.



A. R. H. Tawn

Alec Tawn is Chief Chemist of the Coates Group of Companies. There, after a few years in the oil industry and a (*sic*) undistinguished sojourn in H.M. Forces, he embarked on printing ink research under the late Dr F. A. Askew in 1947.

His interest in polymer science led to an appointment with Cray Valley Products Ltd, the Synthetic Resin Division of the Group, with whom he was Research Manager for over 20 years. As such, he was active in the development of most of the products for which CVP is now internationally known, and he is a prolific writer and patentee in these areas. Since taking up his present appointment some five years ago, he has been increasingly involved in technico-legal matters and his dislike of amateurs in professional circles has led to his reading for the Bar.

He holds, or has held, many appointments in OCCA, IUPAC, SBPIM, IMF, PRA, CAP/ITB, The Royal Society and other organisations concerned with science, technology and education. He has lectured extensively to learned societies and educational institutions in UK, USA and Europe, and is an Honorary Member of OCCA's sister Societies in Germany and Switzerland.

He confesses to being something of a perfectionist (or should it be fetishist?), in the art of scientific communication.

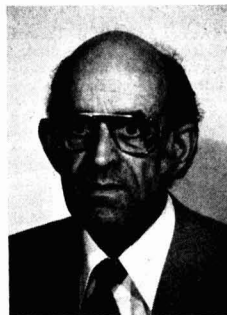
### The changing role of polymer chemistry in organic coatings technology

By M. F. Kooistra

Modern organic coatings of the "High solids" and "Solvent-free" types are characterised in general by a lower molecular weight of the resin vehicles at application, as compared to conventional coatings. For specific coatings, performance properties during curing ultimately produce macromolecular resin structures of similar molecular weight, which implies that a great part of the polymer chemistry involved in producing cured coatings films is shifting from the resin preparation towards the coatings curing phase.

The importance of reaction chemistry, reaction kinetics, molecular weight distribution and molecular weight control in

relation to film formation, crosslink density and coatings performance properties will be demonstrated for a number of solvent-based "High solids" coatings as well as for "Solvent-free" coatings. Coating performance properties will be compared to those of conventional coatings, highlighting the polymer chemistry relationships as well as the potential value of such modern organic coatings.



M. F. Kooistra

M. F. Kooistra (54) took his university degree as a chemical engineer in 1950 at Delft Technical University. In the same year he joined Sikkens Paint Company at Sassenheim, Holland, and he has been involved in coatings research ever since. After having worked in different research positions with Sikkens, which eventually became part of Akzo Coatings, he became Corporate Research Co-ordinator within Akzo Research, Corporate Research Laboratories at Arnhem, Holland.

Internationally he also is known as the present FATIPEC president, and as the president of ISO-TC35, the worldwide organisation on standardisation in the field of coatings.

### Characterisation of the interactions between pigments and binder solutions using rheological measurements

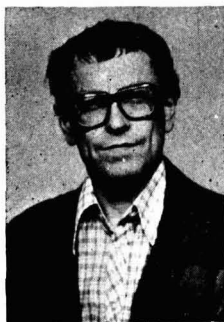
By A. Saarnak

The rheology of dispersions of some inorganic and organic pigments in binder solutions was investigated using an automated rotational viscometer. The state of the dispersion was evaluated by optical microscopy. In some cases adsorption measurements were carried out.

Well dispersed inorganic pigments showed an ideal behaviour i.e. near-Newtonian flow and an almost constant relative viscosity (constant pigment concentration) independent of the binder solution. Flocculated systems had non-Newtonian structures and higher relative viscosities. The possible interactions in the pigment dispersions are discussed in relation to their rheology.

Ago Saarnak was born in Estonia 1933 and came to Sweden 1944. He obtained his Master of Science (Dipl.ing.) at Chalmers Technical University 1956 and has held various positions in the plastics and paint





A. Saarnak

industries in Sweden. Since 1971 he has been assistant director of the Scandinavian Paint and Printing Ink Research Institute, Copenhagen, a Member of OCCA and SLF. Mr Saarnak is a past president of the Danish Varnish and Paint Chemists' Association.

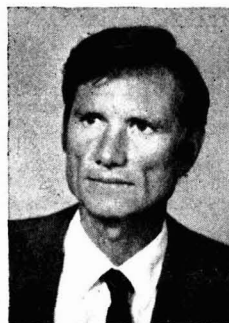
### Aqueous coil-coatings

By E. J. Percy and F. Nouwens

A major development in industrial coating has been the *painting of metal coil or strip* before it is cut and formed into its final shape. This process is attractive because the coil can be efficiently coated on one site in large quantities before it is distributed to the metal fabricators. The advantages of this will become even more important in the future.

So far, only 8 per cent of coil-coatings are water-borne, but very high growth-rates are predicted because of the energy saving and pollution reduction which can result from their use.

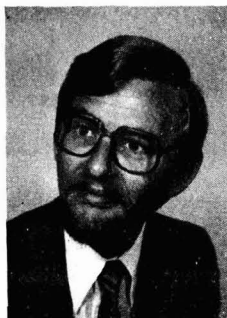
The paper will compare aqueous systems with *organic-soluble systems*. Formulation differences, application differences and performance differences will be discussed. Weathering test results obtained from QUV, Atlas Weather-O-Meter, Xenotest, Emmaque (Arizona) and Florida exposure will be shown.



E. J. Percy

Dr E. J. Percy is an OCCA member and a graduate chemist from the University of London. His PhD was awarded in 1961 for research on the inhibition of olefin oxidation for the Natural Rubber Producers

Research Association. After working with BP Chemicals, the National Research Corporation, 2<sup>nd</sup> Cray Valley Products, Dr Percy joined Synres in 1977 as Research and Development Director at the Synres International B.V. laboratories in Holland.



F. Nouwens

Ing F. Nouwens is a chemical engineering graduate from HTS Dordrecht who has worked in the Dutch paint industry for many years. While with Mobil, Wagemakers and Sigma Coatings, he was involved in the development of automobile, domestic appliance, coil and can-coatings, furniture, marine and maintenance finishes. In 1976, he joined the Coatings Laboratory of Synres International BV.

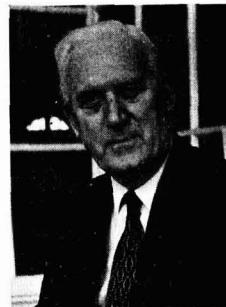
### Aluminium compounds as major components of surface coatings

By J. H. W. Turner and W. K. H. Lakin

The paper presented by the authors to the Scarborough conference in 1975 explained the theory of film formation by co-ordination reactions involving aluminium compounds, but the practical results presented were limited to air-drying alkyd gloss paint formulations containing no more than 2 per cent Al (as metal) on the alkyd weight. The present paper follows on to explore the other end of the compositional spectrum, in which the aluminium compound is the predominant component and alkyd and the other "conventional" ingredients may be regarded as "additives".

Applications used to exemplify the properties and potential of these compositions, clear and pigmented, will include coatings for metal and wood substrates, traffic marking paints and liquid ink media.

Mr J. H. W. Turner's industrial career began as a paint chemist with Griffiths Brothers and Co. London Ltd in 1933, continued in resins and plastics with British Resin Products Ltd and, finally, in chemicals as Research Director of Hardman and Holden Ltd, later to become part of the RTZ group. Here he was able to develop his interest in metal/organics in a variety of ways. In particular he has developed many derivatives of aluminium alkoxides and pioneered their use in applications ranging from lubricants, through paints, plastics and cosmetics, to pharmaceuticals. Now operating as an independent company concerned with the evaluation and development of new tech-



J. H. W. Turner

nology, he continues his association with RTZ as consultant to Manchem Limited in the area of metal/organics.

He has been closely associated with Paint Research Association as a member of Council and as an Officer and for many years with Paintmakers Association as a PRA member of its Technical Committee. A member of OCCA for most of his career, he represented the Bristol Section on Council. He has presented a number of papers on resins, polymer emulsions, driers and other metal/organic compounds to OCCA Conferences, Section meetings and other learned societies and trade associations at home and overseas. In 1972, in a paper to FATIPEC Congress in Florence, he anticipated the development of unique compositions to which he gave the name *Alumedia*, in which derivatives of aluminium alkoxides featured as major components. As OCCA representative, he presented a related paper at the 1974 meeting of the Federation of Societies for Paint Technology. His close association with the introduction of this new technology continues.

Mr W. K. H. Lakin entered the surface coating industry in 1949 as a paint chemist with Blundell Spence & Co. Ltd in Hull. He continued with Coates Brothers & Co. Ltd with particular emphasis on resin development and manufacture. His interest in metal organic compounds and their effect on surface coatings began in 1963 at Grindley & Co. Ltd, Poplar and continued at Hardman & Holden Ltd, whom he joined in 1967.

He has been a member of OCCA for the majority of his career and has read papers on the effect of metal organic compounds at OCCA Conferences, Section meetings and other societies overseas.

### Dispersions of pigments: What is the ultimate?

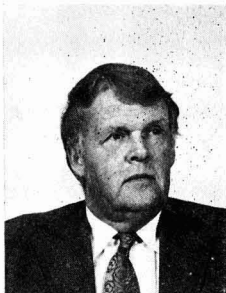
By D. M. Varley and H. H. Bower

There have been many presentations made with the dispersion of pigments and how to achieve better performance. It still remains a fact that many users of pigments do not obtain the best value out of the products currently in use.

This paper will look at some of the properties of pigmented systems which can be improved by obtaining better dispersions.

It is possible for either the pigment maker or the pigment user to be the controlling

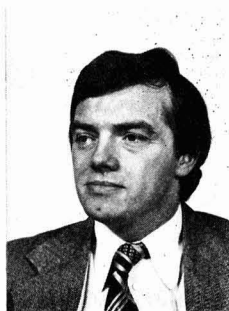
factor in determining the level of dispersion achieved in practice. Whilst identifying areas in which the pigment user can improve his efficiency, the potential advantages to be obtained from using more specific dispersions, particularly for non aqueous paint applications, will be discussed. General purpose stainers will be looked at in comparison with specially developed qualities for individual applications.



**D. M. Varley**

Mr D. M. Varley graduated in Colour Chemistry at Leeds University in 1946. He joined ICI where he worked primarily on Technical Service on Pigments to the paint and printing ink industries. In 1963 he moved to Ciba in charge of the Service Laboratories and subsequently became Technical Sales Manager. On the merger with Geigy he remained in the Marketing Department for four years before moving to his present position of Head of Applications and Technical Service Department. Whilst still maintaining the contact with all pigment using industries, he is now deeply concerned with the identification and development of new pigments and pigment elaborations for paint, printing inks and plastics.

Mr H. H. Bower also graduated in Colour Chemistry at Leeds University in 1967. He joined Geigy where, after one year in the Research Department in Paisley, he has worked in the Applications and Technical Department ever since, firstly in the printing ink area and more recently in the Paint Section. He is primarily concerned with new pigments and for the last few years has



**H. H. Bower**

worked extensively on the establishment of new dispersion products for paint outlets.

### **Dry on wet—A new concept in low pollution coatings utilising cellulose acetate butyrate**

**By B. P. Windibank and R. W. Mahar**

The paper describes a novel method of producing low pollution coatings whereby a clear powder coating is applied over a thin, pigmented, solvent-containing base coat, the two being stoved together without any form of intermediate stoving. The system overcomes the twin major deficiencies of powder coating of inability to make rapid colour changes and to produce attractive metallic finishes. Furthermore, the dry-on-wet system is a marriage of two existing and well proven technologies and unlike some of the alternative proposals for low polluting coatings, does not require expensive and largely untried equipment or use toxic ingredients.

Formulation, application and physical property details of the proposed system are given in the paper, together with the advantages over other low polluting forms of coating.

Mr B. P. Windibank studied at the National College of Rubber Technology and gained



**B. P. Windibank**

the ANCRT and APRI qualifications in polymer technology. From 1960 to 1966 he worked for the International Synthetic Rubber Company in Southampton and followed this by a period of five years as a lecturer at the Singapore Polytechnic.

In 1971 he joined Kodak Ltd Chemicals Division at Kirkby, Liverpool and has been part of their coatings research team since 1973, where he is currently head of the Eastman Coatings Applications Laboratory.



**R. W. Mahar**

Mr R. W. Mahar studied at the Liverpool College of Technology (now Polytechnic) where he gained BSc (Hons) in Applied Chemistry.

He initially worked for Unilever Research Ltd at Port Sunlight before joining Kodak Ltd at Kirkby, Liverpool in 1968. He has since worked in a number of production areas, both in a development and in a supervisory capacity before joining the Eastman Coatings Research Team in 1977.

## **Register of Members**

The following elections to membership have been approved by Council. The Section to which each new Member is attached is given in italics.

### **Ordinary Members**

- BANCKEN, E. L. J., Sikkens BV, Rijksstraatweg 31, Sassenheim, Netherlands  
*(General Overseas)*
- BRIGGS, KEITH, 8 Whitley Spring Crescent, Towngate, Ossett WF5 0RE  
*(West Riding)*
- CRAWLEY, JAMES STUART, LRIC, SA Tioxide (Pty) Ltd, Private Bag X504, Umbogintwini 4120, South Africa  
*(Natal)*
- HARRIS, EDWARD MURRAY, 509 Clark Avenue, Webster Groves, Missouri 63119, USA  
*(General Overseas)*
- INGALL, GEORGE PETER, BSc, 2 Meadow Vale, Ripon, N. Yorks  
*(West Riding)*
- KELLY, IAN, 7 Cairn Drive, Bamford, Rochdale, Lancs  
*(Manchester)*
- MAUREL, PAUL ROLAND, Mauvilac & Co Ltd, Pailles Road, Pailles, Mauritius  
*(General Overseas)*

- NICHOLS, CHRISTOPHER JAMES, GRIC, 26 Moorside View, Drighlington, BD11 1HN  
*(West Riding)*
- SKIDMORE, IAN KEITH, BTech, BP Chemicals, Sun Alliance House, Wellington Road North, Stockport  
*(West Riding)*
- WEAKLEY, ALAN PETER, MA, 88 Spencer Road, Seven Kings, Ilford, Essex  
*(London)*

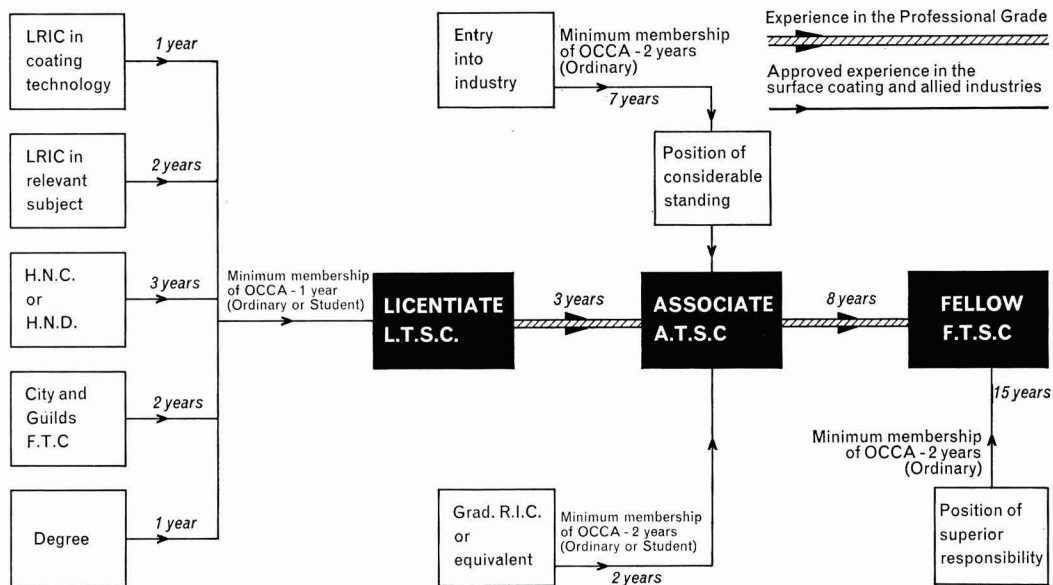
### **Registered Students**

- CONWAY, PHILLIP MICHAEL, Hoechst UK Ltd, United House, 48 Seymour Grove, Old Trafford, Manchester  
*(Manchester)*
- GERK, DEREK MARTIN, 88 Floriston Avenue, Hillingdon, Middlesex UB10 9EB  
*(Thames Valley)*
- PRATT, PETER NIGEL, Alliance Dye & Chemical Co, Treefield Industrial Estate, Gelderd Road, Gildersome, Morley, Leeds LS27 7JU  
*(West Riding)*
- LITTLE, JOHN DOUGLAS ELGOOD, 5 Oakbank Avenue, East Calder, West Lothian  
*(Scottish—Eastern Branch)*

# Optional Professional Grade for Ordinary Members

The innovation of the Professional Grade has proved to be most successful, as evidenced by the impressive list of names in the December 1978 issue of the *Journal*. For the convenience of potential applicants, a chart indicating different routes to the various grades is shown below.

## Routes to the Professional Grades



*Note:* At present there is no restriction on Students up to 21; between 21 and 25 a certificate from the employer or college confirming the course being taken is required.

## Regulations for admission to the Professional Grade

*Note:* For the sake of simplicity, reference is made only to UK examinations etc., but equivalent qualifications overseas will naturally be accepted.

### A. Licentiate

1. Shall be an Ordinary Member of the Association and have been an Ordinary Member or Student of the Association for not less than one year.

2. Shall have attained the age of 22.

3. (a) Shall be a Licentiate of the Royal Institute of Chemistry in Coatings Technology (*viz.* Higher National Certificate + Endorsement in coatings technology + 1 year approved experience in the science or technology of coatings after passing the endorsement examination).

OR (b) Shall be a Licentiate of the Royal Institute of Chemistry in another relevant subject such as advanced analytical chemistry, colour chemistry or polymer science, and shall

have two years' approved experience of coatings since so qualifying.

OR (c) Shall hold the Full Technological Certificate of the City and Guilds of London Institute in a relevant subject as approved by the Professional Grade Committee and shall have two years' approved experience in the science or technology of coatings since gaining the FTC.

OR (d) Shall have passed Higher National Certificate or Higher National Diploma with three years' approved experience in the science or technology of coatings since qualifying, but two years' approved pre-qualification experience shall be deemed equivalent to the third post-qualification year.

OR (e) Shall be graduate in relevant subject with not less than 1 year's approved experience.

OR (f) Shall have passed such other qualifications as approved by the Professional Grade Committee from time to time.

4. Shall be required to satisfy the Professional Grade Committee, or some other body approved by the Professional Grade Committee in a *viva voce* examination and submit a dissertation on a topic previously approved by the Professional Grade Committee.

5. Shall normally be sponsored by three Ordinary Members of the Association in the professional grade (either Associate or Fellow) at least one of whom must be a Fellow.

6. Shall have paid the fee stipulated by the Council and have paid the current subscription payable by an Ordinary Member.

**B. Associate, being already a Licentiate**

1. Shall, since his election to the Licentiate-ship, have practised the science or technology of coatings for not less than three years.
2. Shall provide evidence acceptable to the Professional Grade Committee of his superior professional skill and maturity.
3. Shall hold the City & Guilds of London Institute Insignia Award OR shall submit a thesis or dissertation of comparable level on a topic previously approved by the Professional Grade Committee OR shall have published work which, in the opinion of the Professional Grade Committee, is of comparable merit.
4. MAY be required to satisfy the Professional Grade Committee or some other body as approved by the Professional Grade Committee in a *viva voce* examination.
5. Shall normally be sponsored by three Ordinary Members of the Association in the professional grade (either Associate or Fellow) at least one of whom must be a Fellow.
6. Shall have paid the fee stipulated by the Council and have paid the current subscription payable by an Ordinary Member.

**C. Associate, not already a Licentiate****EITHER**

1. Shall be not less than 24 years of age.
2. Shall be an Ordinary Member of the Association and have been an Ordinary Member or Student of the Association for not less than two years.
3. Shall hold the Graduateship of the Royal Institute of Chemistry or Council of Physics or a University or Council of National Academic Awards degree recognised by the Royal Institute of Chemistry or Institute of Physics as giving full exemption from the Graduateship examination.
4. Shall have not less than two years' approved post-graduate experience in the science or technology of coatings.
5. Shall normally be required to satisfy the Professional Grade Committee or some other body approved by the Professional Grade Committee, at a *viva voce* examination.
6. Shall normally be sponsored by three Ordinary Members of the Association in the professional grade (either Associate or Fellow) at least one of whom must be a Fellow.
7. Shall have paid the fee stipulated by the Council and have paid the current subscription payable by an Ordinary Member.

**OR**

8. Shall be not less than 30 years of age.
9. Shall be an Ordinary Member of the Association and have been an Ordinary Member of the Association for not less than two years.

10. Shall have been engaged in practising the science or technology of coatings for not less than seven years and shall have attained a position of considerable standing in the industry.
11. Shall normally be required to satisfy the Professional Grade Committee in *viva voce* examination of his professional competence.
12. Shall normally be sponsored by three Ordinary Members of the Association in the professional grade (either Associate or Fellow) at least one of whom must be a Fellow.
13. Shall have paid the fee stipulated by the Council and have paid the current subscription payable by an Ordinary Member.

**D. Fellow**

*Note:* This is the senior award of the professional grade and signifies that the holder has made outstanding contributions to the science or technology of coatings or has reached a position of eminence in the industry through the practice thereof. The Professional Grade Committee will require substantial evidence of professional maturity in the science or technology of coatings although commercial experience will be taken into account in assessing the merits of candidates.

1. Shall be not less than 33 years of age.
2. Shall have been an Ordinary Member of the Association for not less than two years.
3. Shall be engaged in a position of superior responsibility in the coatings industry.
4. EITHER (a) shall have been an Associate of the professional grade for at least eight years;  
OR (b) shall have not less than fifteen years' experience of the science or technology of coatings in a position of superior responsibility.
5. Shall submit, with his application, an account of his experience, with due reference to scientific and technological interests, achievements and publications.
6. Shall normally be sponsored by three Ordinary Members of the Association in the professional grade, all of whom must be Fellows.
7. Shall have paid the fee stipulated by the Council and have paid the current subscription payable by an Ordinary Member.

*The fees payable with applications are as follows:*

Fellow—£10.00	Associate—£6.00
Licentiate—£3.00	
(Plus VAT at standard rate)	

**Application**

Completed application forms should be returned, together with the appropriate remittance, to the Director & Secretary at the Association's offices (except in the case of those Members attached to the Auckland,

South African and Wellington Sections who should address their forms to their Section Hon. Secretaries).

The Committee wishes it to be known that Members rejoining the Association after a period in other industries may include length of service as an Ordinary Member before their resignation as part of the qualifying periods for entry into the Grade.

Students wishing to apply for entry into the Professional Grade must first make application in writing for upgrading to Ordinary Membership, giving the reasons for their eligibility for such regrading. Applications, together with the appropriate remittance, should be addressed as for application for admission to the Professional Grade.

Potential applicants are recommended to give the fullest possible details of their appointments, including the number and type of staff under their control, and indicating to whom the applicant is responsible, as this aids the committee considerably in its deliberations.

It is felt that applicants for admission to the Licentiate grade might wish to have further information on the pattern which it is suggested should be followed for dissertations, the subjects of which have first to be approved by the Professional Grade Committee.

The dissertation should be preceded by a short summary and commence with a brief introduction and some account of the current state of knowledge. Where practicable it should follow the general format of a paper in *JOCCA*.

The dissertation may be a review of a subject, a theoretical treatment, descriptive of practical work or a combination of these. It must indicate that the candidate has a reasonably wide and up-to-date knowledge of his chosen subject and understands the basic scientific principles underlying it, and that he is able to think critically and constructively.

Where practical work is described, some attempts should be made to draw theoretical conclusions or to form some provisional hypothesis, together with an outline of what further work would be required to confirm the views put forward or further to advance the knowledge of the subject.

Where the dissertation is a review or a theoretical treatment, there should be an attempt to contrast and compare any opposing views expressed in earlier works, to examine the views critically, to suggest any compromise interpretation, to account for all the known facts and to outline any further work by which the opposing views could be tested.

Where applicable, references should be given to published work, graphs, diagrams etc. to be appended.

Length: Text should be approximately 5 000 words.

Applicants should refer to the paper by Moss which appeared in the January 1973 issue; the Professional Grade Committee feels that candidates for the Licentiate grade could with advantage use this paper as a model for their dissertations.

# Optional Professional Grade for Ordinary Members

## Routes to the three Grades

Anyone who had allowed his membership of the Association to lapse and now desires to rejoin the Association is reminded that previous service as an Ordinary member (or Registered Student) can be counted towards the qualifying period of membership set out in the regulations.

The attention of senior members of the Association is particularly drawn to the Licentiate Grade and they are asked to encourage younger technical personnel to take advantage of this important Association activity. Several Colleges are now willing to help suitable candidates with the preparation of dissertations and a list of Colleges was given on page 334 of the August 1978 issue of the *Journal*.

Reprints of the regulations covering the Professional Grade are obtainable from the Association's offices, together with application forms.

## List of successful candidates

As laid down in the report of the Working Party on Education, Training and Qualifications which was adopted in the institution of the Professional Grade, a list of all those Members who have entered the Grade will be published in the December issue of the *Journal* each year. The seventh such list appears below and includes the names of members resident in 36 countries.

The Section to which the Member is attached is given in italics.

The certification fees at present are: Fellows £10.00 + VAT, Associates £6.00 + VAT, and Licentiates £3.00 + VAT. The amended regulations for admission to every grade appear on page 485 of this issue of the *Journal*.

## Fellows

Anderson, George (*Scottish*)  
 Apperley, Thomas William James (*West Riding*)  
 Archer, Harold (*Manchester*)  
 Arnold, Michael Henry Miller (*London*)  
 Ashworth, Norman (*Manchester*)  
 Atherton, Donald (*Scottish*)  
 Austin, Denis Leonard (*Bristol*)  
 Bailey, John Noel (*Newcastle*)  
 Banfield, Thomas Arthur (*London*)  
 Bayliss, Derek Arthur (*London*)  
 Beachen, John Frederick (*Auckland*)  
 Beere, Andre Jaimie (*Thames Valley*)  
 Bell, Sydney Hector (*London*)  
 Bennett, Norman Arthur (*General Overseas—Malta*)  
 Bhumkar, Chidanand Jayram (*General Overseas—India*)  
 Birrell, Peter (*Ontario*)  
 Bishop, Eric Harold Abbott (*West Riding*)  
 Bohringer, Eberhard (*London*)  
 Boroky, Joseph Stephen (*General Overseas—Australia*)  
 Bourne, John Robert (*Midlands—Trent Valley Branch*)  
 Brooks, Leo James (*London*)  
 Brown, Arthur Ernest Girdlestone (*London*)  
 Butcher, George Alfred (*Midlands*)  
 Butcher, Kenneth William George (*Manchester*)  
 Butler, Cecil (*West Riding*)

Caldwell, David George (*Wellington*)  
 Campbell, George Alexander (*Manchester*)  
 Carr, William (*Manchester*)  
 Carter, Eric Victor (*Midlands*)  
 Chatfield, Herbert Walter (*London*)  
 Chessman, Clifford Reginald (*Transvaal*)  
 Clarke, Harry James (*Midlands*)  
 Colborn, Douglas Charles (*Thames Valley*)  
 Cole, Derek (*General Overseas—Australia*)  
 Cole, Reginald Joseph (*London*)  
 Collier, Claude William (*Midlands—Trent Valley Branch*)  
 Collings, Arthur Geoffrey (*London*)  
 Cook, Harold Gilbert (*London*)  
 Coupe, Raymond Richard (*London*)  
 Coverdale, Peter Frederick Muir (*Midlands*)  
 Cutter, John Outram (*London*)  
 Davidson, John Dixon Wilson (*Scottish*)  
 Davidson, Sigismund Leonard (*General Overseas—USA*)  
 Duckworth, Samuel (*Manchester*)  
 Dunkley, Frederick George (*Midlands—Trent Valley Branch*)  
 Durrant, George Geoffrey (*Hull*)  
 Easton, James Douglas (*Ontario*)  
 Ellinger, Marianne Livia (*London*)  
 Entwistle, Thurston (*Newcastle*)  
 Ernst, Joel (*London*)  
 Faulkner, Raymond Noel (*London*)  
 Finn, Stanley Russell (*Hull*)  
 Fullard, John Edward (*Transvaal*)  
 Gate, Peter Atholl Jackson (*Transvaal*)  
 Gay, Philip James (*Hull*)  
 Gellay, Victor Peter (*London*)  
 Gellman, Alexander (*London*)  
 Ghosh, John Kumar (*General Overseas—India*)  
 Giesen, Mathias Franz (*General Overseas—Germany*)  
 Gillan, James Graham (*Manchester*)  
 Gollop, Percy Lionel (*London*)  
 Gosling, Harry (*Manchester*)  
 Graham, Thomas (*Manchester*)  
 Grainger, William Alan (*Irish*)  
 Gray, Denis Roy (*West Riding*)  
 Grover, Donald Henry (*London*)  
 Hamburg, Herman Rudolf (*London*)  
 Hanson, Robert Philip (*Newcastle*)  
 Hawkey, John Albert Lawrence (*London*)  
 Hess, Manfred (*London*)  
 Hill, Lawrence Albert (*General Overseas—Australia*)  
 Hipwood, Hubert Allan (*London*)  
 Hodgson, Kenneth Vickerson (*Newcastle*)  
 Holbrook, Gordon Leonard (*London*)  
 Holt, Alfred Gordon (*Thames Valley*)  
 Hutchinson, Geoffrey Herbert (*Scottish—Eastern Branch*)  
 Inshaw, John Leslie (*Thames Valley*)  
 Jacob, Basil (*Thames Valley*)  
 Johannsen, Ralf Peter (*Cape*)  
 Jolly, Anthony Charles (*Manchester*)  
 Kalewicz, Zdzislaw (*General Overseas—France*)  
 Kane, Joseph Richard (*London*)  
 Keenan, Henry Wilfred (*London*)  
 Kotwal, Hoshidar Peshotan (*General Overseas—Pakistan*)  
 Kut, Siegmund (*London*)  
 Landmann, Axel Wolfgang (*London*)  
 Lasser, Howard Gilbert (*General Overseas—USA*)  
 Lewin, John Buckingham Grey (*London*)  
 Lewis, Fred (*Manchester*)  
 Ley, John Barry (*London*)  
 Lomas, Harold (*Ontario*)  
 Long, Denis Terence (*Irish*)

Lunt, Walter Richard (*West Riding*)  
 McKelvie, Archibald Neil (*London*)  
 McLean, Angus (*Scottish*)  
 McQuirk, Peter John (*London*)  
 Mell, Cedric Charles (*Hull*)  
 Mitchell, John Edmund (*Manchester*)  
 Mole, Seymour Lloyd (*Ontario*)  
 Moll, Ivor Stuart d'Anvers (*Manchester*)  
 Monk, Cyril James Henry (*Bristol*)  
 Moon, William Robert (*Manchester*)  
 Morgans, Wilfred Morley (*London*)  
 Munn, Raymond Henry Edward (*London*)  
 Newnham, Herbert Alan (*London*)  
 Newton, Dennis Sydney (*London*)  
 Newton, Donald Stringer (*Bristol*)  
 Nutt, William Owen (*London*)  
 Oostens, Emile Elie Eugene (*General Overseas—Belgium*)  
 Parfitt, Geoffrey Derek (*Newcastle*)  
 Penfold, Arthur de Ramon (*General Overseas—Australia*)  
 Piggott, Kenneth Elliot (*Natal*)  
 Polaine, Sidney Alan (*London*)  
 Raaschou Nielsen, Hans Kristian (*General Overseas—Denmark*)  
 Ray, Stanley Arthur (*Midlands*)  
 Rechmann, Heinz (*General Overseas—Germany*)  
 Rileigh, Albert Kenneth (*General Overseas—Australia*)  
 Roe, David Edwin (*London*)  
 Rose, Charles (*Manchester*)  
 Rouse, Robert Earnshaw (*Transvaal*)  
 Rubin, Wallace (*London*)  
 Rudram, Arthur Thomas Stephen (*London*)  
 Saunders, Laurence Frederick (*Natal*)  
 Seymour, Norman Henry (*Manchester*)  
 Shepherd, Joseph (*Newcastle*)  
 Simon, Raymond (*Irish*)  
 Slade, Harold Aitken (*Midlands*)  
 Slinn, Thomas Walter (*Wellington*)  
 Smethurst, Jack (*Manchester*)  
 Smith, Francis Mark (*Manchester*)  
 Smith, Harry (*Manchester*)  
 Smith, John George Nixon (*Newcastle*)  
 Sowerbutts, Frank (*London*)  
 Stoodley, Keith Herbert (*London*)  
 Stoyle, Francis Wilbert (*Irish*)  
 Talbot, Ernest Alexander (*Thames Valley*)  
 Tatton, William Henry (*Thames Valley*)  
 Tawn, Alec Richard Hornsey (*London*)  
 Taylor, John Roberts (*Bristol*)  
 Taylor, Maurice David (*Wellington*)  
 Thorpe, William Frederick Albert (*Midlands*)  
 Tickle, Trevor Cyril Kenneth (*Manchester*)  
 Tooke-Kirby, John Theodore (*London*)  
 Tooth, John Henry Collins (*London*)  
 Touchin, Herbert Roy (*Manchester*)  
 Turner, John Harry Wallice (*Manchester*)  
 Unsworth, Alfred Kenneth (*London*)  
 Valentine, Leslie (*London*)  
 Walker, Alan Gordon (*Newcastle*)  
 Wall, Dennis Charles (*Manchester*)  
 Warner, Eric Albert Andrew (*Wellington*)  
 Watkinson, Leonard James (*West Riding*)  
 Westwood, George Ernest (*London*)  
 White, Robert Arthur (*Auckland*)  
 Whiteley, Peter (*London*)  
 Whitfield, Thomas (*Auckland*)  
 Wilkinson, Thomas William (*Hull*)  
 Willis, Gervase Hewitson (*Manchester*)  
 Wood, George (*London*)  
 Woodbridge, Richard John (*Bristol*)  
 Worsdall, Herbert Charles (*London*)  
 Yorath, Robert Stanley (*Wellington*)

**Associates**

- Acey, John Arthur (London)  
 Adams, John Charles (Midlands)  
 Adams, Terry Ernest (London)  
 Aidenbrooke, Brian John (Midlands)  
 Aitken-Smith, Frank Joseph (Auckland)  
 Allavena, Antonio  
 (General Overseas—Switzerland)  
 Anthony, Alan Sydney (London)  
 Armstrong, Edward (Hull)  
 Armstrong, Herbert Walter Maynard  
 (London)  
 Arnold, Frank (Manchester)  
 Assink, Jo (Auckland)  
 Awan, Mumraiz Khan  
 (General Overseas—Kuwait)  
 Baker, John (General Overseas—USA)  
 Baldwin, George William (Manchester)  
 Bannington, Donald Bertram (London)  
 Bargrove, Kenneth Laurence (London)  
 Barnes, Peter James (London)  
 Barton, James Francis (London)  
 Batch, Alan James Edward (London)  
 Bax, John Charles (London)  
 Beckly, Albert Henry (London)  
 Bell, Brian Robert (Midlands)  
 Belsham, Barry Michael  
 (General Overseas—Cyprus)  
 Bentley, Major Gordon (West Riding)  
 Bird, George Donald Chaplyn (Midlands)  
 Bloomfield, Kenneth Vincent (London)  
 Bluck, Ross Steele (Wellington)  
 Bolam, Ion Barrow (Newcastle)  
 Bose, Sunil Kumar (London)  
 Bowler, Kenneth Ernest (Midlands)  
 Boxall, John (Thames Valley)  
 Braund, Valerie Mavis (Bristol)  
 Brockman, Andrew Leonard Sloane  
 (General Overseas—Australia)  
 Brooke, Leslie John (Bristol)  
 Brown, Peter Thomas (London)  
 Caffery, George Francis (London)  
 Calder, Robert Malcolm (Auckland)  
 Campbell, Douglas Shaw (Transvaal)  
 Campey, Leslie John Randall  
 (Ontario)  
 Canterford, Barry Albert (London)  
 Cartwright, Jeffrey (London)  
 Catchpole, David Thomas (Scottish)  
 Catherall, Kenneth David (Midlands)  
 Chambers, Anthony (London)  
 Chebsey, Maurice (Manchester)  
 Chellingsworth, Horace Thomas  
 (Midlands)  
 Chippington, Kenneth Alan (Bristol)  
 Churchman, Anthony Edward (London)  
 Clark, Laurence Norman (London)  
 Clark, Michael Denis Thomas  
 (Wellington)  
 Clarke, Raymond John (London)  
 Clayton, David Walter Norbury  
 (Manchester)  
 Clement, Donovan Harry (Midlands)  
 Coates, John Allen (Manchester)  
 Cole, Francis William (Midlands)  
 Constantinides, Erricos (London)  
 Cordwell, Terrence Allan  
 (Midlands—Trent Valley Branch)  
 Cowie, Edward Bruce  
 (General Overseas—Kenya)  
 Cox, Garth Anthony (West Riding)  
 Cunnington, Robin Roy Carol (London)  
 Daggett, Wilfred Francis (London)  
 Dalton, Frank  
 (General Overseas—Denmark)  
 Davies, Frank Watkin (Manchester)  
 Davis, Reginald Albert (Bristol)  
 de Waal, Tielmann Johannes  
 (Cape)  
 Delorette, Gustav Otto Hans Jurgen  
 (Transvaal)  
 Dennis, Reginald Herbert (London)  
 Donkersley, Brian (London)  
 Dowsing, George Frederick (London)  
 Drew, Harold Henry Lennox (Midlands)  
 Dunn, Paul Alan (London)
- Durant, Leslie Arthur William (London)  
 Durley, Alan James (Newcastle)  
 Dury, Ian Clifford James (Thames Valley)  
 Eaton, Michael George (Thames Valley)  
 Ebdon, James William (Transvaal)  
 Eltringham, James Norman (Auckland)  
 Fairless, Joseph (London)  
 Fell, Alan William (Thames Valley)  
 Fernandes, Larry Raphael Francis Joseph  
 (London)  
 Field, Lawrence Edward (Natal)  
 Finlay, Cecil Newton (Newcastle)  
 Fisher, Leslie Alexander  
 (General Overseas—Malaysia)  
 Flood, Geoffrey Terence (Manchester)  
 Ford, Keith Sydney (Manchester)  
 Formanek, Leopold  
 (General Overseas—Czechoslovakia)  
 Frazee, Jerry Daniel  
 (General Overseas—USA)  
 Fry, Jack Ian (Wellington)  
 Garratt, Peter Garth  
 (General Overseas—Austria)  
 Gay, Alan Stanley (Midlands)  
 Geddes, Kenneth Raymond  
 (Manchester)  
 Gibson, Frank (Manchester)  
 Gibson, John Carrington (Hull)  
 Goodman, Robert John  
 (General Overseas—Spain)  
 Green, Basil Ray  
 (General Overseas—Trinidad)  
 Green, Brian James (London)  
 Greenall, Brian John (Wellington)  
 Greenfield, Eric (Midlands)  
 Griffiths, Henry James (Midlands)  
 Grime, David (London)  
 Gunn, Reginald (Thames Valley)  
 Hackney, Thomas (Auckland)  
 Hamilton, Alexander (Scottish)  
 Harrison, Cyril Geoffrey (Hull)  
 Harty, David Basil  
 (General Overseas—Australia)  
 Hasnip, John Anthony (Hull)  
 Heald, Desmond (Manchester)  
 Hefler, Victor George (Manchester)  
 Herriott, Charles Edward (London)  
 Hickman, Edwin Peter (Midlands)  
 Hill, Gilbert Victor Geoffrey  
 (Thames Valley)  
 Hill, Raymond Forsyth (Scottish)  
 Hitchmough, Rex Henry (London)  
 Hodge, Robert Alexander Paul  
 (Auckland)  
 Holden, William Desmond (Manchester)  
 Holt, Clifford (West Riding)  
 Homden, Kenneth James Arthur  
 (London)  
 Honiball, Alan Edward (Manchester)  
 Hopper, Derek Edgar (Midlands)  
 Hossack, James (Scottish)  
 Howard, Eric (Manchester)  
 Howells, Barry John (Hull)  
 Howes, Edward John (London)  
 Hughes, Anthony Harold (Manchester)  
 Hughes, Gilbert William (Manchester)  
 Humphrey, Thomas Lawson Myles  
 (Scottish)  
 James, Tudor Herbert (Irish)  
 Jangbahadur, Shyam Sharan  
 (General Overseas—Iran)  
 Jenkins, Brian Gordon Allan (Auckland)  
 Johnsen, Svend  
 (General Overseas—Denmark)  
 Johnstone, James William (Manchester)  
 Jones, Derek Frederick Arthur  
 (Thames Valley)  
 Jones, Geoffrey Peter (Wellington)  
 Judah, Jack Everard (Thames Valley)  
 Kenna, Frank William (Manchester)  
 Kerr, Michael Anthony (Manchester)  
 Khan, John Mohammed (London)  
 Khidher, Abdul Monim  
 (General Overseas—Iraq)  
 King, Charles William Henry (Midlands)  
 King, Raymond John (Midlands)
- Kirlow, Charles Wesley  
 (General Overseas—USA)  
 Kitchen, John Robert  
 (Midlands—Trent Valley Branch)  
 Knight, Richard Charles (London)  
 Laker, Bernard George (London)  
 Lakshmanan, P. R.  
 (General Overseas—USA)  
 Lander, Wilfred Terence (London)  
 Lang, Robert (Scottish)  
 Langford, Henry (London)  
 Langley, Robert (Scottish)  
 Lawton, Cyril Victor (Midlands)  
 Leathley, George Derek (Auckland)  
 Le Maistre, Paul Francis (Midlands)  
 Lewis, Geoffrey John (Midlands)  
 Lewis, John David (Thames Valley)  
 Low, Charles (Transvaal)  
 Macdonald, Alan (Auckland)  
 Macdonald, Arthur Gillings (Newcastle)  
 Malik, Javed Haider  
 (General Overseas—Pakistan)  
 Mandelson, Jack (Scottish)  
 Maple, Donald Peter (London)  
 Marsden, Chris Eyre (Manchester)  
 Martin, Christian Pierre  
 (General Overseas—France)  
 Maynard, Albert William David  
 (Overseas)  
 McCallum, Ian Robert (Scottish)  
 McCapra, Ronald (Auckland)  
 McDonald, Kenneth Roy (Natal)  
 McDonnell, Christopher Robin Stack  
 (West Riding)  
 McFetridge, John Henry (Wellington)  
 McKay, Alan Gordon (London)  
 McKean, James Newlands (Auckland)  
 McMillan, James (Manchester)  
 Mepham, Brian Edwin (London)  
 Mickucki, Wiktor (London)  
 Mills, Thomas Nelson (Natal)  
 Mitchell, Seward John (Midlands)  
 Moore, Frank Roden (West Riding)  
 Moore, James (Manchester)  
 Moore, Ronald Henry (West Riding)  
 Moore, William Alexander (Auckland)  
 Moreham, Frank Joseph (Newcastle)  
 Morpeth, Frederick Johnson  
 (Manchester)  
 Morris, David (London)  
 Moss, Noel Sydney (London)  
 Munro, Hugh Anderson (Scottish)  
 Murray, David John (Manchester)  
 Murray, Robert Frederick (London)  
 Myers, Gordon (Transvaal)  
 Nelson, John George (Auckland)  
 Ness, Robert Alexander (Auckland)  
 Nolan, Michael Melvyn (Irish)  
 Norton, Douglas Kent (Midlands)  
 Oakley, Ernest (Newcastle)  
 O'Connor, Eugene Daniel (Manchester)  
 Oldring, Peter Kenneth Thomas  
 (Bristol)  
 Orpwood, John Leonard (London)  
 Oswitch, Stanley (Midlands)  
 Pace, Graham (Thames Valley)  
 Parry, Martin Gerald (London)  
 Patrick, Alan Clive (Irish)  
 Pemberton, Joseph James (London)  
 Peng, William Yeo Kok  
 (General Overseas—Singapore)  
 Perry, Leonard C. (Bristol)  
 Pessall, Robert George (Midlands)  
 Piper, Norman William (Manchester)  
 Pobjoy, Reginald Claude  
 (General Overseas—Zambia)  
 Poborca, Stefan (Midlands)  
 Proudley, Philip Miles (West Riding)  
 Provan, Andrew Wilson (Wellington)  
 Quorn, Peter James (Cape)  
 Rackham, John Michael (Newcastle)  
 Rampley, Dennis Neil (London)  
 Redman, Frank Benson (Manchester)  
 Reeve, Frank Nicholson (Transvaal)  
 Robinson, Arthur Graham (Manchester)  
 Robinson, Francis Derrick (Hull)  
 Rothwell, Gerald William (London)

Rout, Peter George (*West Riding*)  
 Routley, Alan Francis (*London*)  
 Russell, Frederick Charles (*London*)  
 Rycroft, Christopher Peter (*London*)  
 Scheinost, Bernd (*Natal*)  
 Semple, James William (*London*)  
 Sharp, Peter Frank (*Auckland*)  
 Sharpe, David (*London*)  
 Sheikh, Saeed  
 (*General Overseas—Pakistan*)  
 Shoham, Joseph  
 (*General Overseas—Israel*)  
 Silsby, Denys John (*Midlands*)  
 Silverwood, David (*Manchester*)  
 Smith, Brian James (*London*)  
 Smith, David Dorman (*Scottish*)  
 Smith, Harry Bertram (*London*)  
 Soman, Chettiparambil  
 (*General Overseas—Spain*)  
 Sowerby, Alan Hope (*Auckland*)  
 Spaargaren, Albert Arend (*Natal*)  
 Spargo, Robert (*Auckland*)  
 Speding, George (*London*)  
 Springett, Robert Arthur Edward  
 (*London*)  
 Sreeves, John Ernest (*Midlands*)  
 Staples, Peter Graham (*London*)  
 Stephenson, Robert Perry (*Auckland*)  
 Stone, James Bryan (*London*)  
 Stott, Raymond (*Manchester*)

Stretton, Elizabeth (*Manchester*)  
 Stubbings, Alec Walter George (*London*)  
 Surinphong, Julian Suriya  
 (*General Overseas—Thailand*)  
 Sutton, Peter Michael (*London*)  
 Talwalkar, Vinayak Sakharan  
 (*London*)  
 Tape, Brian William Charles  
 (*General Overseas—USA*)  
 Taylor, Richard Anthony John (*London*)  
 Taylor, Terence (*Manchester*)  
 Thomas, Anthony  
 (*General Overseas—Brazil*)  
 Tillyer, Richard Brian (*London*)  
 Topping, George David (*London*)  
 Trevitt, Edwin William (*London*)  
 Triggs, Francis Cyril (*London*)  
 Troparevsky, Alejandro  
 (*General Overseas—Argentina*)  
 Tye, Terence Thomas (*Thames Valley*)  
 Van Londen, Anton Matthijs  
 (*General Overseas—Holland*)  
 Venus, Norman (*Transvaal*)  
 Walker, Peter (*Thames Valley*)  
 Weineck, Terence Graham (*Natal*)  
 Westbrook, Ernest Louis Edward  
 (*London*)  
 Whalley, James (*Irish*)  
 Whatling, Allan (*Manchester*)  
 Wheatley, Kenneth Valentine (*Irish*)

Whetstone, Peter John (*London*)  
 Whiteside, Alexander Edward  
 (*General Overseas—USA*)  
 Williams, Adrian Arthur Owen (*London*)  
 Williams, Cyril (*Manchester*)  
 Windsor, Frederick Barry (*Manchester*)  
 Woof, John Clifford (*London*)  
 Woolf, Frederick James (*London*)  
 Wu, Andrew Chi Kit  
 (*General Overseas—Hong Kong*)  
 Young, Hugh (*West Riding*)  
 Zissell, Martin John (*London*)

## Licentiatees

Downham, Stephen Airey (*Manchester*)  
 Elliott, Peter (*London*)  
 Hemmens, Anthony John (*Bristol*)  
 Lodge, David William (*London*)  
 Ohene-Kwadade, Kofi  
 (*General Overseas—Ghana*)  
 Rogers, Michael Ambrose  
 (*General Overseas—Trinidad*)  
 Rowntree, Randal Peter (*Manchester*)  
 Saggarr, Anoop Kumar  
 (*General Overseas—Kenya*)  
 Sawyerr, Olatunji Pekun  
 (*General Overseas—Nigeria*)  
 Schierbaum, James Helmut (*Midlands*)

## Report of Council Meeting

A meeting of the Council of the Association was held on 11 October 1978 at the Great Northern Hotel, King's Cross, London N1 at 2 p.m. There were 23 members present.

The Chairman of the Bristol Section, Mrs E. Harper, had been in hospital for a few days during the previous week and flowers and good wishes had been sent to her on behalf of the Council. Mrs Harper had been discharged from hospital and had expressed her thanks to the Council.

It was reported that the President Designate, Dr F. M. Smith, and Mrs Smith, would be attending the Conference of the Federation of Scandinavian Paint and Varnish Technologists which would take place on 15–17 October 1979 at Stockholm, and it was further reported that Mr D. M. Varley would be presenting a paper to the Conference, which would be nominated as this Association's contribution.

It was noted that the British Standards Institution had changed the name of the Committee BLCF/18 to *Building Protection and Maintenance*, and that Dr L. A. O'Neill had been appointed the Chairman of the

### Committee PVC/3 Paint Media and Related Products.

Dr W. Morgans was appointed to serve on the Association's Technical Education Committee.

The President reported on a special meeting of the President's Advisory Committee which had taken place on 2 June. The Hon. Secretary reported on the arrangements for the Stratford Conference and recruitment publicity. The Hon. Treasurer reported on the half-year accounts, the registration fees proposed by the Finance Committee for the Stratford Conference, and that the total number of names of members removed from the register for non-payment subscription had been very much lower than for the two previous years. Discussion took place on the arrangements for the 1979 Exhibition and Council approved the formation of an Exhibitors' Liaison Group. The Hon. Editor reported on papers for the Journal and other publications. The Hon. Research and Development Officer reported on the arrangements for the technical sessions at the Stratford Conference and reminded

Council that applications for the Jordan Award should be submitted before the end of 1978. It was reported that six Fellows and seven Associates had been admitted to the Professional grade at a meeting earlier in the day, and that a number of candidates for the Licentiate grade had submitted dissertations for approval.

The Council agreed to make a Commendation Award for services to the Association to Mr J. T. Tooke-Kirby (*London Section*).

Reports were received from Sections on their activities since the last meeting. The President stated that a special meeting of the President's Advisory Committee would be held to discuss the international structure of the Association.

Members were pleased to learn that during the summer recess the interior of Priory House had been redecorated and that an insignia, to be worn by the President's Lady on official functions, had been obtained.

There being no other business, the President thanked members for their attendance and declared the meeting closed at 3.45 p.m.

## Manchester Section

### 1978 Golf Tournament

Fifty-five members and their guests competed in this year's competition held at Stockport Golf Club on Wednesday 13 September 1978.

Scoring was by the system invented by Dr Stableford and, despite overcast skies, golfing inadequacies could definitely not be blamed on the weather.

Keith Sellars, a London Section Member, won the OCCA Trophy (L. H. Silver Cup



Mr K. Sellars (*London Section*) with the OCCA Golf Trophy which he won with a score of 38 points.

and Replica) with a score of 38 points. The Manchester Section Jubilee Trophy and Tankard were won by John Everett with 36 points and David Schofield was the victor on the Target Hole Competition.

Due to financial wizardry it was then possible for the Section Chairman, Tony McWilliam, to present all competitors with a prize, including a mystery prize—a box of Manx kippers!

Future arrangements are that the London Section are entitled to organise the 1979 Tournament; the Manchester Section are planning a Section Golf Match with emphasis on competing with other Northern Sections.

F.B.W.

## Association Notices

### Binding of Journal

Members will be pleased to know that J. S. Wilson & Son, 14a Union Road, Cambridge CB2 1HE, will undertake the binding of back volumes of the Association's *Journal* sent in by individual Members at a cost of £7.00 (including postage and packing) per volume.

Members wishing to avail themselves of this facility should send the parts, securely wrapped, direct to J. S. Wilson & Son, enclosing a remittance of £7.00 (including postage and packing) per volume, and ensuring that notes bearing their names and addresses are enclosed with the parcels. It is particularly important that packets are sufficiently wrapped to negate the possibility of damage in the post.

### 1979 Members' subscriptions

Members are reminded that 1979 Membership subscriptions to the Association are payable on 1 January 1979. Forms were despatched to all Members in October or November, depending upon address.

The Commissioners of Inland Revenue have approved of the Association for the purpose of the 1970 Income and Corporation Taxes Act Section 192, so that a Member subject to United Kingdom income tax is entitled to a deduction from the amount of his emoluments assessable to income tax under Schedule E for the whole of the annual subscription to the Association, provided the subscription is defrayed out of the emoluments of his office or employment and that the interests covered by the

objects of the Association are relevant to such office or employment.

Members resident in the United Kingdom are reminded that if there is any change in the standard rate of Value Added Tax announced before they send in their 1979 subscription, the VAT payable on membership subscriptions is the amount which applies on the date of payment.

### 1979 library subscriptions

The *Journal* subscription rate to non-Members, including libraries, for 1979 will be £30.00 (\$70) post free by surface mail, home and abroad. Individual copies can be purchased for £3.00. Remittance should be sent with order to the Association's offices.

## Forthcoming Events

Details are given of Association meetings in the United Kingdom and Ireland up to the end of the month following publication and in other parts of the world up to the end of the second following publication.

### December

#### Monday 4 December

*Hull Section:* "The manufacture of self adhesive labels" by R. Couch of Harlands of Hull Ltd. *Details to be announced.*

#### Tuesday 5 December

*West Riding Section:* "Pencil manufacture" by D. W. Tee of The Cumberland Pencil Company Ltd, to be held at the Mansion Hotel, Roundhay Park, Leeds, 8, commencing at 7.30 p.m.

#### Wednesday 6 December

*Scottish Section—Eastern Branch:* "Scientific aspects of carton printing" by D. Lawson, from Wm. Thyne Ltd, at the Murrayfield Hotel, 18 Corstorphine Road, Edinburgh at 7.30 p.m.

#### Thursday 7 December

*Thames Valley Section:* "Accelerated weathering tests—objectives and choice of methods" by Dr M. L. Ellinger of Ault & Wiborg Paints Ltd, to be held at the Beaconsfield Crest Motel (White Hart), Aylesbury End, Beaconsfield, Bucks, commencing at 6.30 p.m. for 7.00 p.m.

*Scottish Section:* "Biodeterioration in surface coatings" by Dr D. Allsop of University of Aston to be held at the Albany Hotel, Glasgow, commencing at 6.00 p.m.

*Newcastle Section:* "Paint Research Association and the surface coatings industry" by D. Dasgupta of the Paint Research Association to be held at St. Mary's College, Elvet Hill Road, Durham, commencing at 6.30 p.m.

#### Friday 8 December

*Manchester Section:* "Long-life paint systems—sensible methods of test at last" by F. Timmins of British Rail Ltd, at Manchester Literary & Philosophical Society, George Street, Manchester, commencing at 6.30 p.m.

*Irish Section:* "Dispersion techniques" by R. Ward of Torrance & Sons Ltd, to be held at the Clarence Hotel, Dublin, commencing at 8.00 p.m.

#### Wednesday 13 December

*Ontario Section:* Ladies' Night, *details to be announced.*

### January 1979

#### Tuesday 2 January

*West Riding Section:* Chairman's Lecture to be held at the Mansion Hotel, Roundhay Park, Leeds 8, commencing at 7.30 p.m. *Details to be announced.*

#### Thursday 4 January

*Newcastle Section:* Management paper, to be held at St. Mary's College, Elvet Hill Road, Durham, commencing at 6.30 p.m. *Details to be announced.*

#### Monday 8 January

*Hull Section:* "Training" by T. A. Fillingham of Marfleet Refining Co. Ltd, to be held at the "George Hotel", Land of Green Ginger, Hull, commencing at 6.30 p.m.

*Manchester Section:* "Titanium dioxide in coloured stoving enamels" by Dr R. Schwindt of Kronos Titanium Pigments Ltd, to be held at the Woodcourt Hotel, Sale, commencing at 6.30 p.m.

#### Friday 12 January

*Scottish Section:* Ladies' annual evening to be held at the Albany Hotel, Glasgow, commencing at 6.00 p.m.

#### Wednesday 17 January

*Ontario Section:* MacLean Hunter Tour by S. P. Wyszowski.

#### Thursday 18 January

*London Section:* "Permeability of paint films to chloride ions" by Mr A. Roberts, CEGB, Scientific Services Dept. at the Princess Alice, Romford Road, E.7, commencing at 7.00 p.m.

*Scottish Section:* "New developments in azo pigments" by A. G. Abel of Hoechst UK Ltd, to be held at the Albany Hotel, Glasgow, commencing at 6.00 p.m.

#### Friday 19 January

*Irish Section:* Ladies' evening—Wine/cheese at the Clarence Hotel, Dublin, commencing at 8.00 p.m.

*Midlands Section:* Dinner Lecture in conjunction with Trent Valley Branch "Protection of structures involved in North Sea oil operations" by Mr J. R. Bourne of Mebon Ltd and Mr F. H. Palmer of BP Ltd, to be held at Chamber of Commerce & Industry, Harborne Road, Birmingham.

#### Wednesday 24 January

*Manchester Section:* Student Lecture "Paints for electrodeposition" by W. G. Topham of Goodlass Wall Ltd, at Manchester Literary & Philosophical Society, George Street, Manchester, commencing at 4.30 p.m.

*Scottish Section—Eastern Branch:* "Dispersion techniques" by J. Davidson, at the Murrayfield Hotel, 18 Corstorphine Road, Edinburgh at 7.30 p.m.

#### Thursday 25 January

*Thames Valley Section:* "Quinacridone pigments" by Dr R. Zabel of El du Pont de Nemours & Co. Inc., to be held at the Beaconsfield Crest Motel (White Hart), Aylesbury End, Beaconsfield, Bucks, commencing at 6.30 p.m. for 7.00 p.m.

#### Friday 26 January

*Bristol Section:* "Water reducible printing inks" by Mr R. C. Coates of Coates Brothers Inks Ltd, to be held at the Royal Hotel, College Green, Bristol, commencing at 7.15 p.m.

### February

#### Wednesday 14 February

*Ontario Section:* TBP by Mr L. Horn of Lawter to be held at the Saturn Room, Constellation Hotel, Toronto, commencing at 6.00 p.m.



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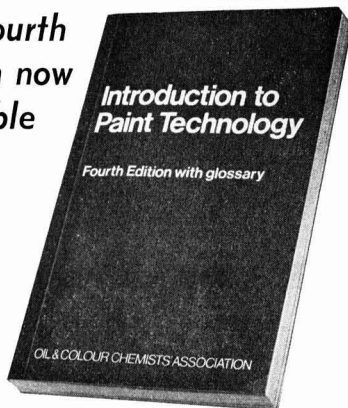
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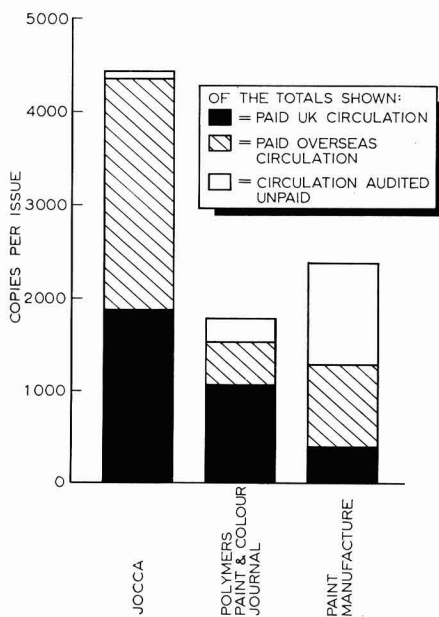
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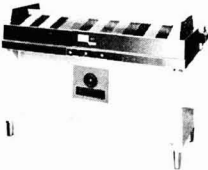


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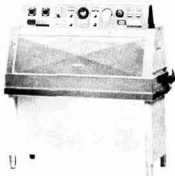
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