JOURNAL
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Association Officers and Committees and Section Programmes. Reports of Annual General Meeting and Scottish Symposium

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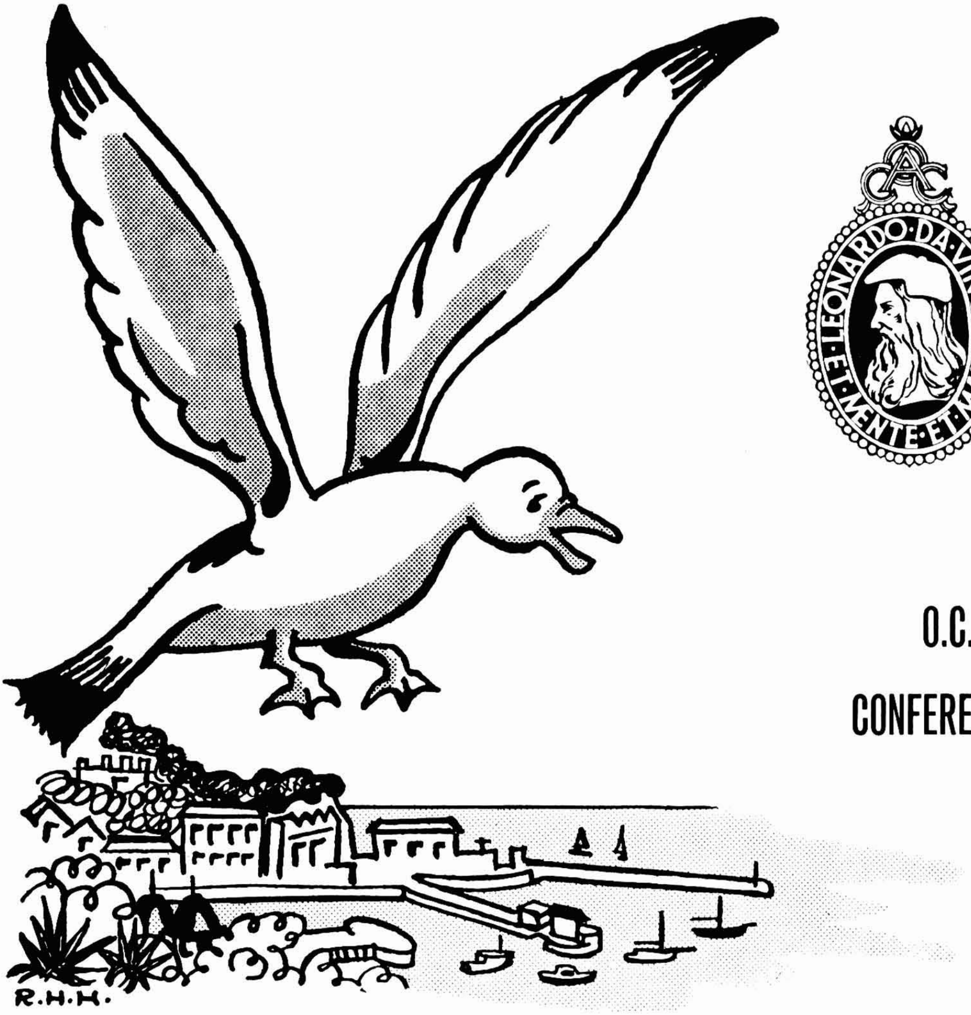

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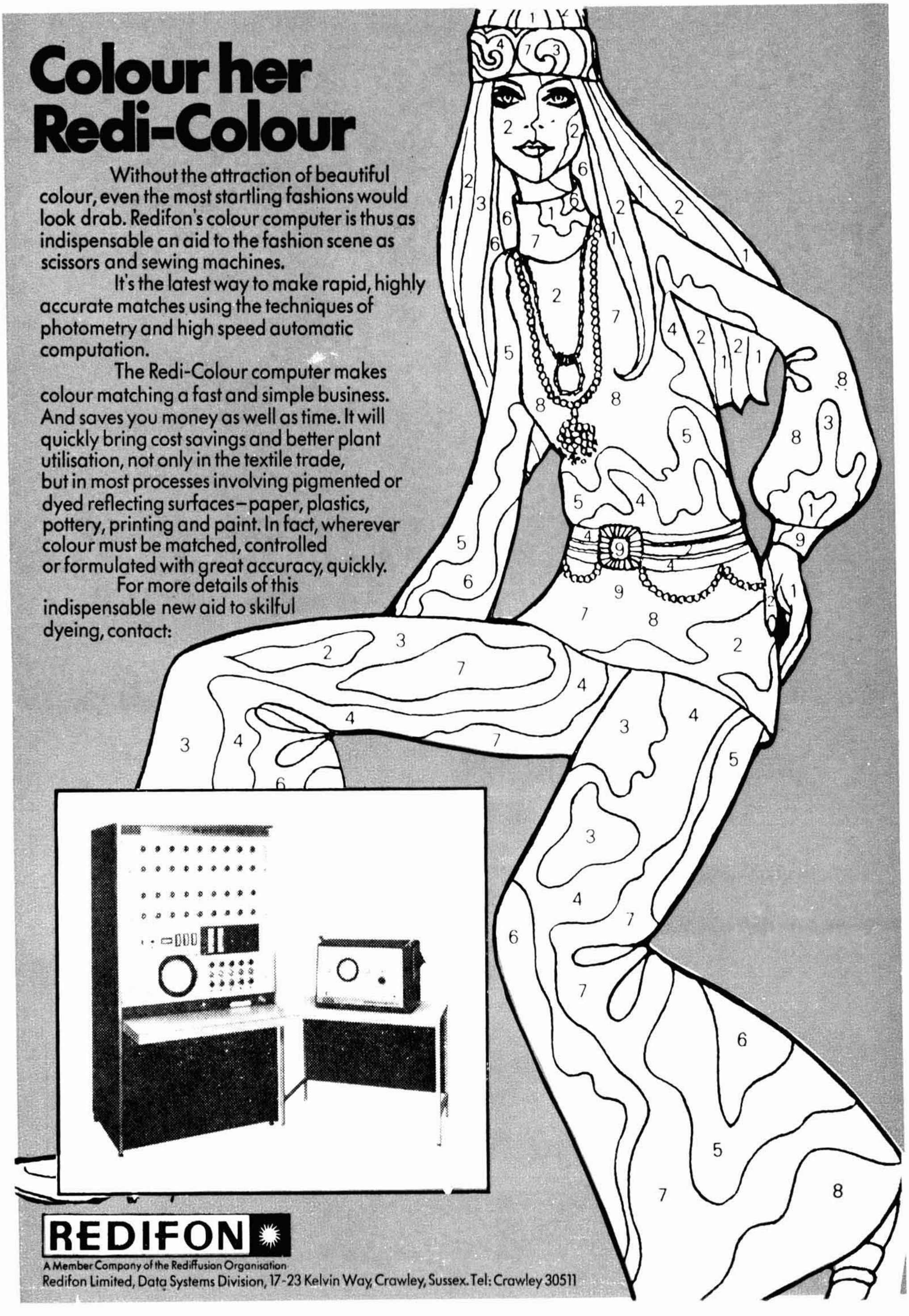

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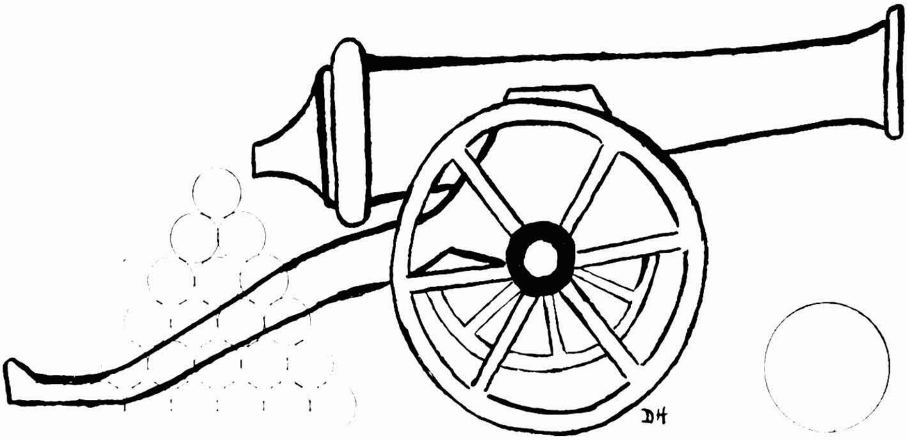
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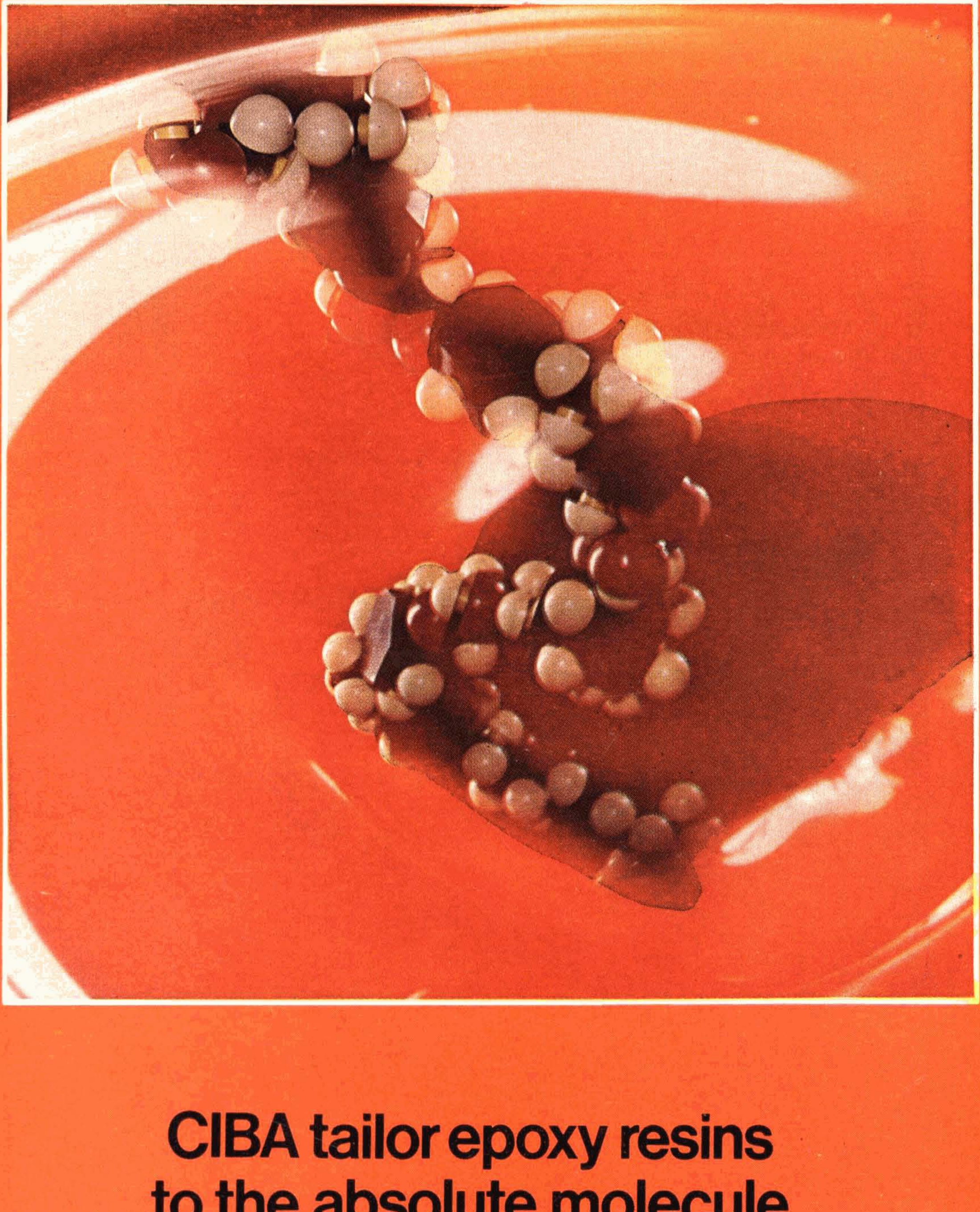

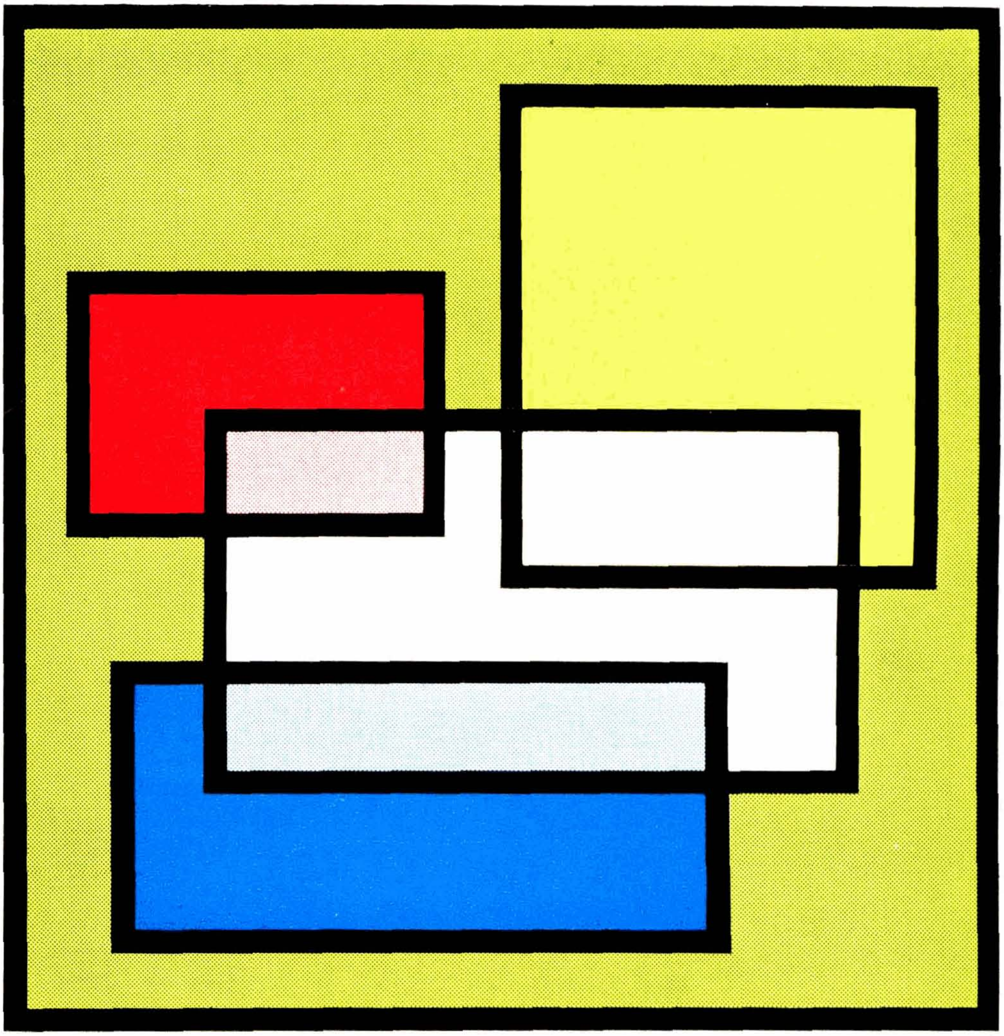

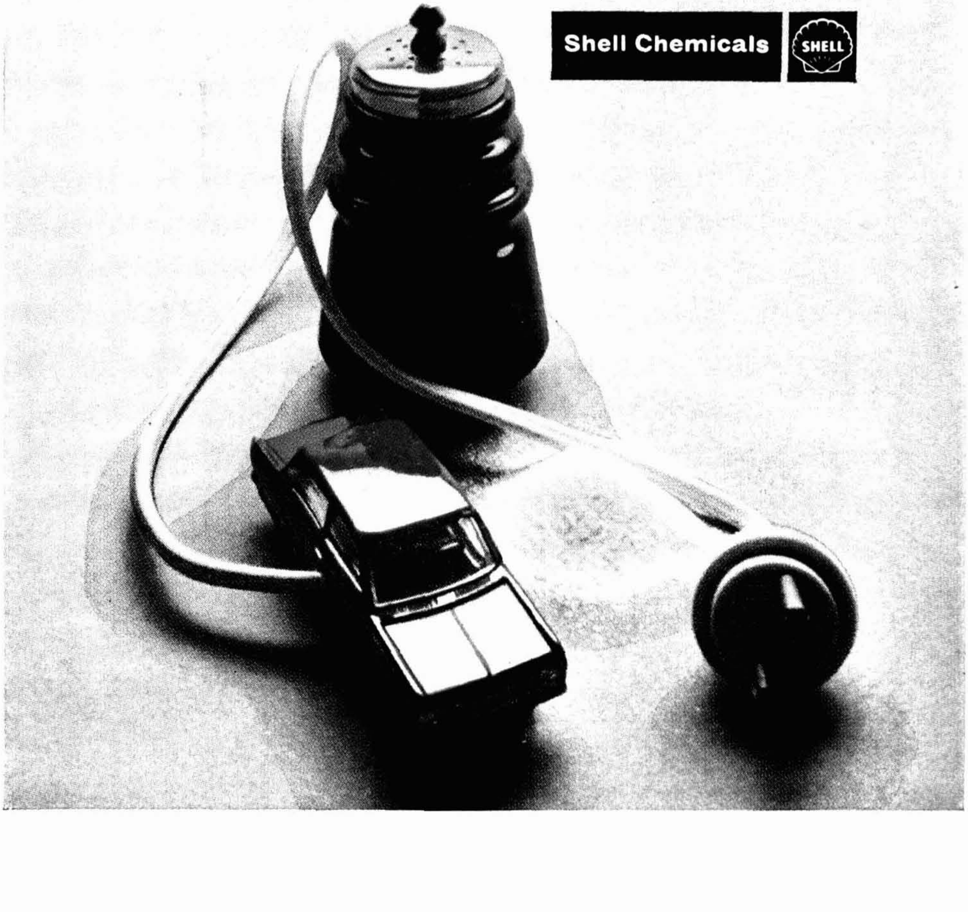

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Transactions and Communications

Some aspects of the protection of exterior joinery*

By R. Dooper

Paint Research Institute TNO, Delft, The Netherlands

Summary

Timber used for exterior joinery requires a protective treatment, either by painting or by preservation or staining.

An effective protection by paints can be achieved only when internal condensation of water vapour is prevented by an adequate difference in permeability of the paint systems on the inside and on the outside, provided of course that entry of liquid water at joints and glazing has been excluded. As it was found in practice that the desired moisture regulation is rather difficult to obtain, some calculations have been carried out showing the influence of the interior and exterior climate on the moisture transport. However, even with properly formulated paint systems the penetration of moisture into wood cannot always be prevented, and for that reason an additional protection by a preservative treatment prior to painting seems to be advisable.

As such a pretreatment should not have an adverse effect on painting and paint performance, it was considered necessary to study the interactions between wood, preservative and paint more closely.

The test programme concerned is described and a survey is given of the results so far obtained. From these results it can be concluded that the paintability of preservative treated wood is determined mainly by the absorption of the wood and less by the composition of the preservatives and paints concerned.

The demand for low-cost protective systems has led to an increasing use of non film-forming stains.

Some properties of these products are discussed, showing that the use of stains involves special provisions at an early stage of the design.

Key words

Types and classes of surface
red wood
spruce

Properties, characteristics and conditions primarily associated with dried or used films
permeability

Types and classes of coating
primer
sealer
stain

Biologically active agents
preservatives

Certains aspects de la protection de la menuiserie pour l'usage à l'extérieure

Résumé

Le bois de menuiserie destiné à l'usage à l'extérieure exige un traitement protecteur, soit par peinture, soit par préservation ou teinture. On peut achever une protection éfficace par des peintures seulement dans le cas où la condensation interne de vapeur d'eau est empêchée à cause d'une différence suffisante de la perméabilité de la peinture sur la surface intérieure en comparaison de celle de la peinture sur la surface extérieure, étant donné évidemment que

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l'on a empèché l'entrée de l'eau liquide aux joints entre les éléments des châssis et également entre ceux-ci et le masticage. Puisqu'on l'a trouvé assez difficile en pratique d'obtenir le règlement de l'humidité que l'on désirait, on a effectué quelques calculs pour démontre l'influence qu'exercent les climats extérieure et intérieure sur le transport de l'humidité. Pourtant, même dans le cas des systèmes de peintures bien formulées, on ne peut pas empècher toujours la pénétration de l'humidité dans la boiserie, et pour cette raison, on conseille l'application d'un traitement préservatif avant de la peinture, afin d'assurer une protection supplémentaire.

Puisqu'un tel pré-traitement ne devrait pas porter un effet adverse sur la facilité de l'application et le rendement de la peinture, on l'a considéré nécessaire à etudier plus soigneusement les interactions de la boiserie, du préservatif et de la peinture.

On décrit le programme des essais dont il s'agit, et l'on donne un résumé des résultats obtenus jusqu'à présent. On peut conclure à partir de ces résultats que la perméabilité du bois après traitement avec préservatif est déterminé plutôt par sa porosité que par la composition des préservatifs ou des peintures utilisés.

La demande pour des systèmes protecteurs à bon marché a provoqué un usage croissant des teintures non-filmogènes.

On discute quelques caractéristiques de ces produits, et l'on met en évidence que l'utilisation des teintures exige des prévisions spéciales au stade primitif du projet.

Einige den Wetterschutz von Bauholz Angehende Gesichtspunkte

Zusammenfassung

Holz, das für Zimmerarbeiten die dem Wetter ausgesetzt werden sollen, bestimmt ist, benötigt zu seinem Schutze Vorbehandlung durch Anstrich, Imprägnierungsmittel oder Beizen.

Anstrichmittel können nur wirksam schützen, wenn durch ausreichende Unterschiede in der Durchlässigkeit an den Innen-und Aussenseiten des Anstrichsystems interne Wasserdampfkondensation verhütet wird; vorausgesetzt natürlich, dass der Eintritt flüssigen Wassers an den Verbunden und der Verglasung ausgeschlossen wurde. Da man fand, dass es praktisch ziemlich schwierig ist, die Feuchtigkeit wie gewünscht zu regulieren, wurden eine Anzahl Berechnungen vorgenommen, um die Einflüsse der innen und aussen herrschenden Klimata auf die Feuchtigkeitsbewegungen aufzuzeigen. Da jedoch selbst bei richtig rezeptierten Anstrichsystemen das Eindringen von Feuchtigkeit ins Holz nicht immer vermieden werden kann, empfiehlt es sich, vor dem Mahlen eine zusätzliche Imprägnierung mit einem Holzschutzmittel vorzunehmen.

Da eine derartige Vorbehandlung keinen nachteiligen Einfluss weder beim Anstrichauftrag noch auf die Leistungsfähigkeit des Anstriches haben darf, hielt man es für nötig, die gegenseitige Beeinflussung von Holz, Schutzmittel und Farbe näher zu untersuchen.

Das Prüfprogramm wird geschildert und ein Überblick von den bisher erzielten Resultaten vorgelegt. Aus diesen kann geschlossen werden, dass die Eignung von imprägniertem Holz mit Farbe überstrichen zu werden, hauptsächlich vom Grad der Absorptionsfähigkeit des Holzes und weniger von der Zusammensetzung des betreffenden Schutzmittels oder des Anstrichmittels bestimmt wird.

Die Nachfrage nach billigen Schutzsystemen führte zu gesteigerter Anwendung von nichtfilmbildenden Holzbeizen.

Einige Eigenschaften dieser Produkte werden besprochen und dabei aufgezeigt, dass die Anwendung von Beizen besondere Vorsorgemassnahmen schon im frühen Entwurfasstadium nötig macht.

Некоторые вопросы касающие защиты наружных столярных работ

Резюме

Лесоматериал применяемый для наружных столярных работ требует предохранительной обработки в виде окрашивания, консервирования или крашения.

Эффективная защита красками может быть получена только если внутренняя конденсация водяных паров предотвращается достаточной разницей в проницаемости красочных систем, как внутри так и снаружи, при условии конечно что исключена возможность проникновения воды в стыках и в стеклянных соединениях. Так как было обнаружено что желаемую регулировку влажности трудно добиться на практике, был проведен ряд вычислений иллюстрирующих влияние внутреннего и наружного климата на перенос влажности. Однако даже в правильно формулированных красочных системах, проникновение влаги в дерево не всегда возможно предотвратить и по этой причине является желательным дополнительное предохранение обработкой консервирующим средством до окраски.

Так как такая предварительная обработка не должна оказывать неблагоприятного влияния на процесс окрашивания и функцию краски, считалось необходимым изучить более подробно взаимодействие между деревом, консервирующим средством и краской. Описывается программа проведенных испытаний и дается обзор доселе полученных результатов. Из этих результатов можно придти к заключению что окраска дерева обработанного консервирующим средством определяется главным образом абсорбцией дерева и в меньшей степени составом или структурой консервирующих средств или красок.

Спрос на дешевые проедохранительные системы привел к более распространенному потреблению красителей не образующих пленку.

Обсуждаются некоторые свойства этих продуктов и указывается что применение красителей предусматривает специальные меры предосторожности в ранней стадии расчета.

Introduction

In the building industry, several materials are used which have to be protected by one method or another.

Among these materials, wood always has been, and still is, a very important one, and is used in rather large quantities.

As interior timber work is treated mainly for decoration and less for protection this paper will deal only with exterior joinery.

How can this joinery be protected?

Up to now the most commonly used method has been painting, but in recent years some other procedures have come into the picture, viz. preservation followed by painting or staining.

To avoid misunderstandings it seems desirable to define or describe these methods concisely beforehand.

Painting can be defined as the application of a thin layer of an originally liquid material, which, after drying, gives a solid layer on top of the substrate concerned.

This painting can be done for decoration or protection, or for both.

Preservation is a treatment with a liquid agent with fungicidal properties, intended to penetrate into the the wood without giving a film on top of it.

Preservation is always carried out for protective purposes only; it does not aim at decoration.

Staining is rather difficult to define exactly, because the name "stain" stands for several quite different products, at least in the Netherlands.

Most frequently, it refers to a treatment with a non film-forming material which, in distinction to a preservative, contains a small amount of a pigment to give a transparent colour.

As contrasted with preservatives, these stains do not necessarily have to contain fungicidal agents, but if they are intended for a treatment of wood species with a low durability, they generally do.

In addition to this type of stain, there are also products called stains which have film forming and hiding properties to a certain degree and which, in this respect, are therefore similar to paints. As a clear distinction between such stains and paints scarcely exists, they will not be considered further here.

Painting

After the second world war, it was found frequently in the Netherlands that the durability of paint systems on exterior joinery was far from satisfactory, even in cases where good quality paints had been used. The failures consisted of blistering and peeling off, especially on bottom rails and sills.

In collaboration with the Foundation for Paint Application, whose constituent members are the Association of Paint and Varnish Manufacturers in the Netherlands and the Corporation of Painters, the Paint Research Institute TNO made an inquiry into the causes of these failures. The successive results of these studies have been published not only in Dutch periodicals but also in the well-known European technical journals in this field, including *JOCCA*[1].

As would be expected, it was found that the problem was rather complicated and that several different factors were involved; however, the moisture content of the wood always appeared to be of a primary importance. The explanation seems to be that wood with a high moisture content will shrink when drying out and as in this case the substrate is far from homogeneous, this shrinkage will be irregular, resulting in an irregular surface with stresses in the paint layer and consequent cracking and peeling.

The shrinkage and swelling of wood are phenomena which are not wholly reversible; therefore, an originally smooth surface, obtained by application of a knifing putty and careful sanding, will show a raised surface after a comparatively short period. It will therefore be understood that drawing up a specification requiring a perfect smooth surface, without specifying an adequate moisture content of the wood concerned, does not make much sense.

As already stated, the early breakdown of the paint systems on exterior joinery was caused, as a rule, by excessive moisture. The question arises, where did this moisture originate?

As in the years immediately after the war facilities for proper drying of wood were not available, it seems likely that the timber used had been wet from the beginning.

Even in 1961, when the first edition of "Quality requirements for timber" was published, the requirements relative to the moisture content (maximum 17 per cent) could not always be met. Last year a second edition was issued, specifying two wood qualities, viz. a first quality with maximum 14 per cent moisture at the surface and maximum 18 per cent at the interior, and a second quality with not more than 21 per cent moisture. As the average moisture content of exterior joinery on a centrally heated building will ultimately be about 15 per cent, it goes without saying that first class paint work will be obtained only when using the first quality timber. However, if the joinery is dried to an acceptable level, which can only be achieved artificially, this dry condition must be maintained in the workshop as well as on the site prior to use, otherwise satisfactory performance will not be achieved.

It has been found that one coat of a commonly used primer is insufficient in this respect; for a reasonably effective protection in this stage of the building process, at least two coats must be applied. It must be realized, however, that, after erection of the building and application of the full alkyd resin based protective system, a complete seal against the penetration of water has not been obtained, because although such a paint film is more or less impermeable to liquid water, it is not impermeable to water vapour. As, under normal service conditions, the water vapour pressure on the inside is generally higher than on the outside, it will be understood that an accumulation of moisture in the wood can be avoided only if the permeability of the interior paint system is less than that of the exterior one, thus balancing the amount of water entering the wood from the inside to that being lost on the outside. This has been called the "principle of the relative moisture isolation" and the validity of this principle has been demonstrated by measuring the moisture distribution in window frames of a blister hut painted with various paint systems[2].

At first sight, it seems to be quite simple to meet the requirements of the aforesaid principle; by applying one more coat of the same paint on the inside than on the outside surfaces the problem should be solved. Unfortunately, it has turned out to be somewhat more complicated. In a series of tests, including the painting of the exterior joinery of new buildings in a manner as indicated above, it was found that the expected moisture control had not always been obtained; on the contrary, the moisture content of the wood sometimes increased regularly to a very high level. These disappointing results have given rise to a more theoretical approach of the problem of water vapour transport through paint layers on wood. Calculations of this transport have been carried out, assuming varying conditions of temperature and relative humidity on both sides of the wood. For the sake of convenience the thickness of the paint film was assumed to be constant and the temperature gradient throughout the wood to vary regularly. As these conditions are certainly not met fully in practice, it will be understood that the results of these calculations must be considered as indicative only.

The temperature gradient throughout wood can be calculated by means of the equation:

$$q = \frac{\lambda}{d}(t_1 - t_2) = \frac{t_i - t_e}{R}$$

where q = heat flow J m^{-2} s^{-1}
λ = thermal conductivity of the wood concerned. (J m^{-1} s^{-1} $°C^{-1}$)
d = thickness of the wood (m)
t_1 = surface temperature on the inside (°C)
t_2 = surface temperature on the outside (°C)
t_i = temperature of the interior (°C)
t_e = temperature of the exterior (°C)
R = resistance to heat conductance J^{-1} m^2 s °C

The results obtained for spruce with a thickness of 8cm and 1cm respectively, are shown in Fig. 1.

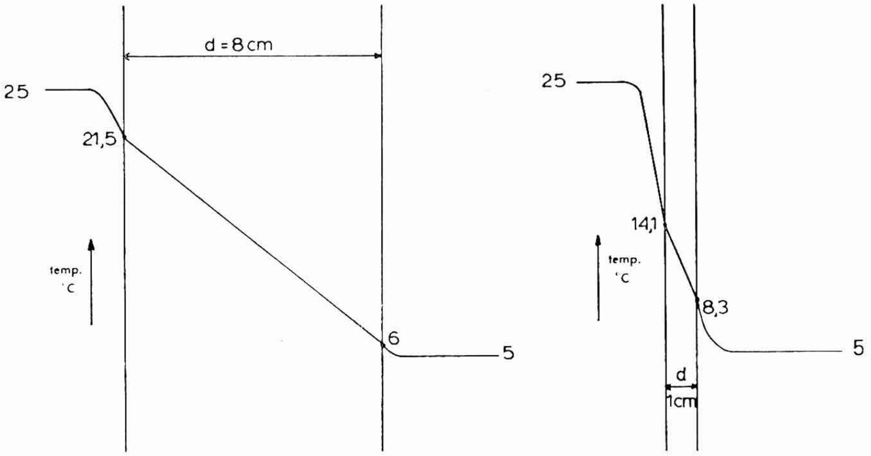

Fig. 1. Temperature gradient through wood of different thickness

The surface temperatures, especially on the inside, are quite different, resulting in a difference in the maximum vapour pressure and, consequently, in a difference in the maximum permeability of the same paint layer on top of these panels. If the permeability coefficient of the paint concerned is known, the maximum vapour transport can be calculated, provided, of course, that the temperature and relative humidity of the environment are known too.

The equation is:

$$G = \frac{P.t.S.p.}{d}$$

where G = water vapour transport
P = permeability coefficient
t = time
S = area
p = difference in vapour pressure
d = thickness of the paint film

Some results of such calculations for an alkyd resin based enamel are summarised in Table 1.

Table 1

Maximum moisture transport related to the thickness of the wood

Number of paint layers (30 micron each)	Maximum moisture transport in mg/50cm^2/24hr			
	Blister box panel (1cm)		Window frame (8cm)	
	in	out	in	out
1	100	85	168	49
2	50	43	84	25
3	33	28	56	16
4	25	21	42	12

The results obtained indicate that the difference in maximum water intake and loss is obviously much more critical for window frames than for the thin panels used for the blister box tests.

As the exterior climate varies with the season, it will be evident that the maximum moisture transport on the outside varies accordingly. Fig. 2 summarises the results of similar calculations for test conditions on the outside as actually met in practice during a whole year.

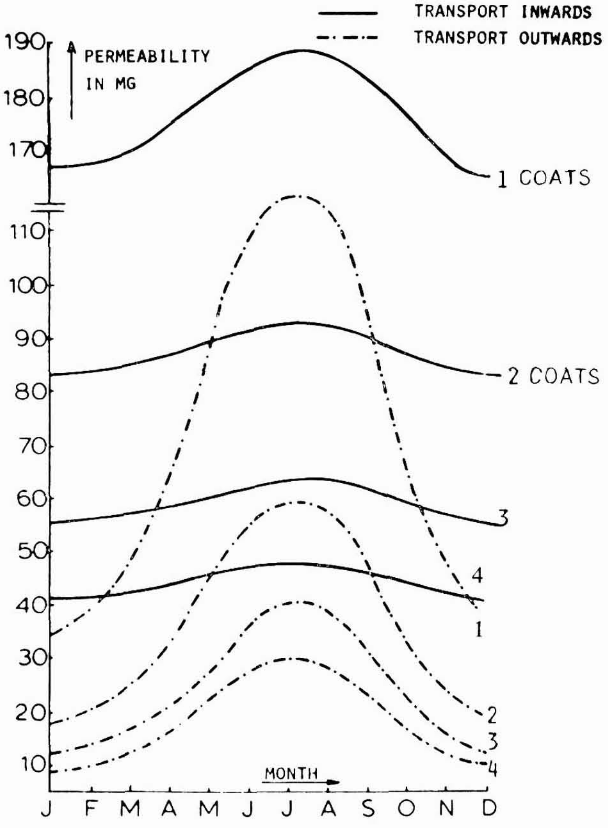

Fig. 2. Maximum moisture transport through a paint film on window frames related to the season

From this graph it can be seen that the maximum moisture transport outwards varies widely with the season; the highest values are obtained in summer. Furthermore, it appears that with a difference of only one paint coat the maximum permeability on the outside is, almost throughout the year, less than the maximum permeability on the inside; under these conditions the moisture content of the wood will probably increase. With a difference of two coats the circumstances become favourable in summer, but are still unfavourable in winter. With a difference of three paint coats, e.g. four on the inside and one on the outside, the permeability values concerned are favourable for nearly all the year.

Although from a theoretical point of view such a paint system would be adequate, it is nevertheless not desirable, because it has been found in practice that the protection of exterior joinery with only one coat of a commonly used alkyd paint is generally insufficient. Thus, it seems to be advisable to use at least a two coat system, consisting of specially designed paints with a rather high water vapour permeability.

Up till now, the interior climate was assumed to be constant, the temperature being 25°C and the relative humidity 100 per cent. As a relative humidity of 100 per cent is extremely high and seldom met in practice, it is quite evident that the calculated values for the maximum permeability inwards are exaggerated to a greater or lesser extent. The way in which they change when the relative humidity of the interior climate varies is shown in Fig. 3.

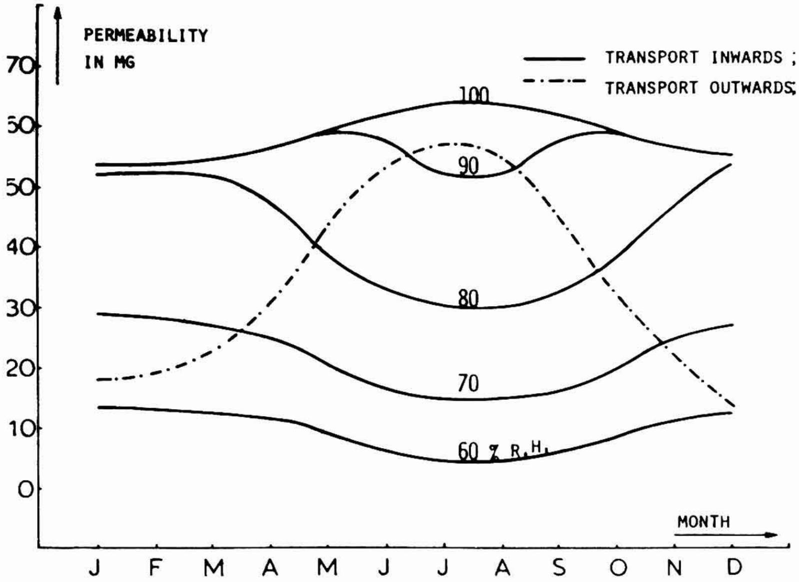

Fig. 3. Maximum moisture transport inwards related to the interior climate

In this case, the interior paint system consists of three coats and the exterior one of two coats. This small difference appears to be sufficient during the whole year for a relative humidity of the interior of 60 per cent, and even with a relative humidity of 70 per cent the conditions are favourable during a great part of the year. However, when the relative humidity exceeds 70 per cent the desired moisture control becomes somewhat risky.

There is still another factor which influences the maximum permeability of the interior paint system, namely the original moisture content of the wood. If that moisture content increases, the maximum permeability decreases, because the difference in water vapour pressure on the two sides of the paint film decreases. Fig. 4 gives a summary of some calculations in this field, showing the distinct influence of the moisture content of the wood as well as of the relative humidity.

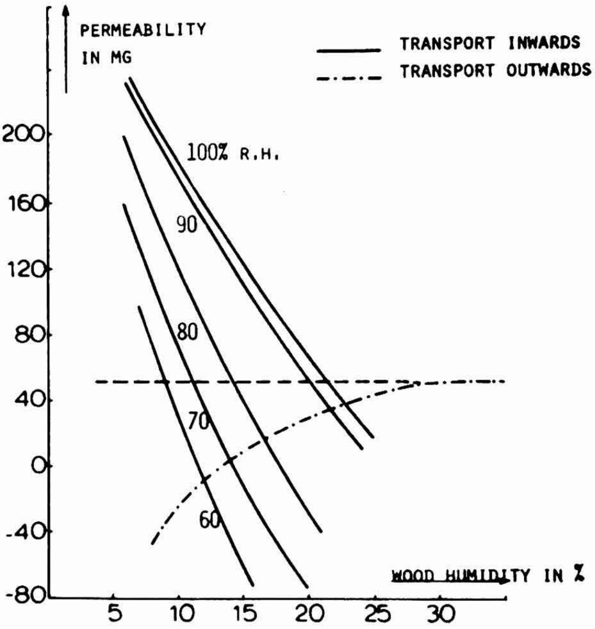

Fig. 4. Relation between maximum permeability and moisture content

The significance of all the above more or less theoretical considerations on relative moisture insulation must, of course, not be overestimated, because the permeability of a paint film is only one of a series of factors governing the moisture content of exterior joinery. Other very important factors in the prevention of excessive water absorption are for example:

the design of the construction,
the sealing of joints,
the use of water resistant glues,
the use of a suitable putty, especially of a good quality back-filling putty etc.

If one or more of these factors is neglected or insufficiently taken into account, the moisture content of the wood will increase sooner or later and perhaps reach a critical value with danger of complete failure through decay by wood destroying fungi.

It will therefore be understood that in many cases an additional protection is desirable and for that reason preservation comes into the picture. However, before discussing the advantages and disadvantages of preservatives, something should be said about the use of special types of paint which can be applied in a very thick coat in one operation, e.g. high build epoxies or high build chlorinated rubber paints. Such paint films are almost completely impermeable, even to water vapour. The question therefore arises as to what will happen with wood which has been sealed with such a paint system, supposing, of course, that the original moisture content was below the critical value of about 20 per cent.

As the temperature within exterior joinery will usually vary, in a manner as described before, the relative humidity in the wood will vary too, resulting in a displacement of the water. Taking into account the relationship between relative humidity and equilibrium moisture content of wood, it can be calculated, and it has been confirmed experimentally, that the moisture on the cold side may increase and exceed the critical threshold value. In such cases, the moisture content is therefore high enough to favour decay by fungi, but fortunately the temperature is rather low and perhaps too low for a severe attack. To date, no experience in this field is available, so definitive conclusions about the suitability of the paint systems concerned must be postponed.

Preservation

It must be possible, at least in principle, to avoid wood decay by a combination of high standards for design, building and painting practice. Nevertheless, it has been found rather frequently that exterior joinery has been attacked by wood destroying fungi, even in comparatively new buildings. This decay must, of course, be stopped one way or another and, therefore, a preservative treatment of the wood prior to painting seems to be a favourable method of increasing the service life. However, this preservation should not have an adverse effect on paint application and paint performance and as, in this respect, insufficient experience was available, it was thought necessary to investigate the interactions between preservatives and paints more closely.

Accordingly, an ad hoc committee was appointed, consisting of representatives from the Foundation for Paint Application and from the Centre for Wood Research. This committee started a rather extensive programme some years ago, including variations in the wood species as well as in type of preservatives and paints.

Table 2 shows a survey of this programme.

Table 2

Summary of variables included in the test programme

Variables		
Wood	Preservative	Paint
Species	*Type*	*Primer*
Spruce	Organic solvent based	Alkyd resin based
Redwood	Water-borne	Acrylic emulsion
Moisture content	*Methods of treatment*	*Top coats*
14%	Immersion	Alkyd resin based
18%	Vacuum-pressure	Dark green
	Drying time	White

The preservative treatment and the subsequent painting operations, consisting of the application of primer, knifing putty, under-coating and top coat, were all carried out indoors at room temperature. The test panels so obtained were exposed to the atmosphere inclined at 45° facing South.

The main results are summarised below.

Within a series of test panels, the uptake of preservative varies widely, depending on the amount of sapwood and possibly also on the characteristics of the sapwood concerned. Spruce panels without sapwood, after an immersion time of 10 minutes in an organic solvent based preservative, absorb 75-100 $g.m^{-2}$ of the solution concerned, but if they consist partly of sapwood, the uptake may increase to 300 $g.m^{-2}$ or even more. Some indications have been gained that sapwood attacked by bacteria shows a rather excessive absorption.

If the painting of preservative treated wood gives rise to special troubles, these troubles always occur on the sapwood and not usually on the heartwood. However, if the heartwood is treated in such a manner that the uptake is very high, e.g. by an extremely long immersion time or by a vacuum/pressure procedure, the painting of this wood may also become rather troublesome; sooner or later the paint system will then fail.

Of the three types of wood tested, Baltic spruce, Swedish spruce, and redwood, redwood appeared to have the highest absorption and consequently showed the most paint failures. The best results were obtained with Swedish spruce. It must, however, be realized that the immersion times have always been the same, e.g. 10 minutes for pentachlorophenol or tributyl tin oxide based preservatives, which may be adequate for spruce, but which is rather long for redwood.

A distinct influence of the moisture content of the wood could not be observed within the limits chosen.

In cases of an excessive absorption, all pentachlorophenol based preservatives cause trouble, e.g. delay of drying, softening, yellowing and sometimes blistering. Difficulties sometimes arise after the application of the primer, but it may be that priming and filling do not show adverse effects and the topcoat fails nevertheless. When testing the paintability of preservative treated wood it is therefore not sufficient to study the behaviour of primers only; the whole paint system has to be applied. The addition of paraffin as a water repellent agent impairs the paintability; the more paraffin the more difficulty. Other ingredients of the preservatives concerned e.g. the anti-blooming agents have some influence but, generally speaking, this influence is of a minor importance.

Substitution of pentachlorophenol based preservatives by tributyl tin oxide has a favourable effect on the paintability, provided no paraffin has been added to achieve water repellency. It must be emphasised that this statement only applies to painting and paint performance; whether tributyl tin oxide equals pentachlorophenol in toxic properties is quite another question and has not been investigated in this case. In view of laboratory tests carried out by various investigators it might be expected that tributyl tin oxide, in practice, will give the wood sufficient protection against decay, but before reaching a final conclusion some additional evidence should be furnished by field tests.

The same is, to some extent, true for the paintability over zinc naphthenate based preservatives as for tributyl tin oxide. Generally speaking, zinc naphthenate causes less trouble than pentachlorophenol, but somewhat more than tributyl tin oxide. It must again be emphasised that this statement only applies to painting and paint performance; the fungicidal properties have not been investigated and are therefore not taken into consideration.

The main failure of copper naphthenate based preservatives is due to bleeding. If this bleeding is limited to the primer and does not occur in the topcoat, it may be accepted, provided that the final painting will be carried out shortly after the priming. However, when the original moisture content of the wood appears to be rather high, the painting is sometimes carried out in accordance with a special scheme that includes the postponing of the application of undercoat and finishing coat until the wood has dried, which may be one year or even more. In such cases bleeding through the primer is quite obviously not acceptable.

The use of water soluble preservatives results in swelling of the wood and consequently in an irregular surface. As for interior work, including the inside of window frames, where a smooth surface is frequently required, the filling operations have to be carried out very carefully. Leaving this inconvenience out of consideration, it can be said that the application of paints and paint systems on water-borne preservative treated wood has not given rise to special problems.

However, after exposure for some time, paint defects such as blistering and peeling appear, notably on panels pretreated with non-fixing salts. Although there is no transport of water through test panels on outdoor exposure, as contrasted with exterior joinery, the impression has been gained that the water soluble salts ultimately move to the surface with detrimental effects on the adhesion of the paint to the substrate.

A long drying time after preservation prior to painting, which allows the solvent portion of the preservative to evaporate completely, has a favourable effect on the paintability. However, the failures described earlier cannot be eliminated completely in this manner; moreover, a long drying time does not fit in with modern production schemes.

Some indications have been obtained that the alkyd resin based red lead primer gives slightly better results than the others but, generally speaking, it can be said that all commonly used primers behave in a similar way. As similar results have been obtained in additional investigations using alkyd resin based primers with and without reactive pigments such as red lead or white lead, it may be concluded that all commonly used primers behave similarly in this respect.

With regard to the influence of the final finishing systems, it was found that some failures arise earlier in the dark coloured paint systems than in the white ones. This is probably caused by a difference in temperature on outdoor exposure, as the dark coloured panels become much warmer than the white ones, due to their higher absorption of radiation.

Summarising all these conclusions, it can be said that, of the three main factors concerned, namely the wood, the preservative, and the paint, the wood is the most important one. The paintability of preservative treated spruce is, in fact, almost entirely determined by the absorptive properties of the wood.

If the preservation does not result in an excessive absorption, the subsequent paint application and paint performance will not cause specific troubles, provided of course that both preservative and paint are of a good quality. However, if the quality of the wood is such that, under normal conditions, the uptake of preservative will exceed a certain level, troubles may arise, both in the application stage of the paints and after weathering for some time.

Further research will therefore be necessary and for that reason additional programmes have been set up and are now in progress. First of all, it seems necessary to determine the critical limits for the uptake of preservatives, viz. the minimum quantity which is required for a reliable preservation, and the maximum amount which can be allowed from the painting point of view. This investigation has not yet been completed, so definite conclusions cannot be drawn. However, some indications have already been obtained that the gap between the critical limits is rather narrow for pentachlorophenol based preservatives, and more tolerant for tributyl tin oxide and for zinc naphthenate based products.

A second point of the new programme is to investigate the possibilities of painting wood which has already absorbed an excessive amount of preservative and for that reason cannot be treated in the usual way. The idea is to use a special type of primer to isolate the pretreatment agents with a suitable sealer, in the same way as wood extractives in tropical hardwoods can sometimes be isolated. These tests, too, are not yet finished, but some products look promising, e.g. chlorinated rubber paints and polyurethane lacquers.

Obviously, some problems have to be solved before the painting of preservative treated wood may be considered as wholly satisfactory. The question therefore arises whether in the meantime preservation should be omitted, thus eliminating the risks of early paint failures. As failures by decay, caused by wood-destroying fungi, are rather frequent and, moreover, remedial measures in such cases are very expensive, it seems advisable to accept the risks of a pretreatment.

Staining

In the past, the protection of exterior joinery by non film-forming stains was carried out only on a rather small scale in special cases. However, the increasing demand for low-cost finishing and maintenance schemes has aroused more interest in these products and has led to their utilisation on a larger scale.

The main advantage of staining is the ease of application, enabling unskilled labourers to carry out the treatment, As, in paintwork, labour costs exceed material costs to a large extent, the use of stains is very attractive from an economic point of view. Unfortunately, stains also have some disadvantages, so a critical survey seems to be desirable.

A decorative finishing system has to protect joinery against wood-destroying fungi and, moreover, confer a certain degree of dimensional stability. When using stains the first requirement can be met by a preservative treatment. The second requirement involves the prevention of swelling and shrinkage, and hence, the prevention of variations in humidity.

The penetration of liquid water can be avoided by the use of suitable water repellents, but this does not hold true for water vapour, as can be seen from the results of laboratory tests. See Fig. 5.

This graph shows the increase in humidity of window frames with an initial moisture content of 14 per cent, treated with stains or paints and subsequently exposed in a room with a relative humidity of 90 per cent.

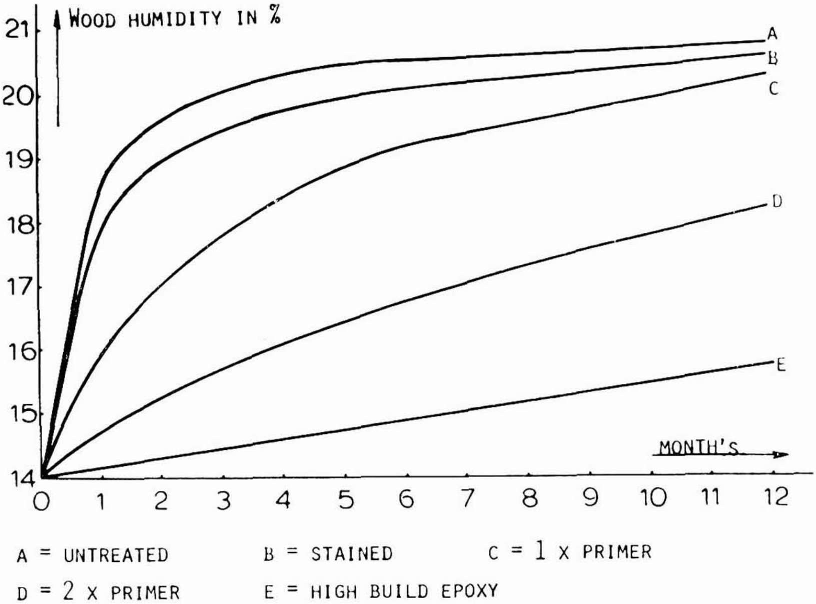

Fig. 5. Increase in moisture content of window frames under damp conditions

From these results it can be concluded that the stains concerned do not affect the water vapour penetration appreciably and consequently give an insufficient dimensional stability. It will therefore be understood that swelling and shrinkage of stained wood cannot be avoided, but that these disadvantages may perhaps be reduced to an acceptable level by using small units. Attention is drawn to the fact that the use of only one coat of a conventional primer is also far from satisfactory in this respect.

A second point which has to be considered is the question of glazing. In current painting practice, rebates are always primed before glazing to prevent the penetration of the binder of the back-filling putty into the wood. When using stains this priming is omitted and, therefore, special types of back-filling putty have to be used which do not lose their binder on a porous substrate with consequent brittleness and, ultimately, leakage.

Furthermore, it should be realized that using stains virtually excludes the use of glazing putty, because this putty has to be painted afterwards. Careful painting of the putty strip is, of course, possible, but would be very time consuming and for that reason not acceptable. Therefore, staining involves the use of glazing beads which, of course, should be taken into account at the initial design.

Another problem is the protection of stained joinery in direct contact with brickwork or concrete. In traditional painting schemes, these parts are sealed with one or two layers of a red lead or other suitable primer, with appropriate alkali resistant properties.

Timber to be stained can be treated in the same way, at least in principle, but such a treatment has to be carried out very carefully, ensuring that visible parts of the construction will not be contaminated by paint afterwards. This careful painting would again be time consuming and expensive, and for that reason the priming is often omitted. As the contacting surfaces are entirely inaccessible later, the insertion of a seal will not be possible. This will probably become a serious disadvantage if at any time the initial protective system has to be replaced by a paint system. However, as up to date experience in this field does not exist, a final conclusion to this problem must be postponed.

Reconsidering all the aforesaid advantages and disadvantages, it seems likely that non film-forming stains are not always suitable as substitutes for paints, but can be used only on specially designed buildings.

The decision whether stains or paints will be used for the protection of the exterior joinery of a new building cannot be delayed until after the erection, but has to be taken at a much earlier stage when an adjustment to the ultimate protection is still possible.

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Discussion at London Section

MR R. N. WHEELER said that the differences in absorption clearly represented a serious hazard to the joinery manufacturer. Was there no method of test which could identify this highly absorbant timber?

MR R. DOOPER replied that sapwood and heartwood showed a great difference in absorption, but unfortunately with spruce it was rather difficult to detect whether a particular piece consisted of heartwood or of heartwood and sapwood. One needed a new method to be developed, e.g. penetration of a suitable dyestuff.

MR J. L. HAWKEY commented that staining techniques were used to assess the absorbency of paper, but in this case it was possible to assume that a sample was typical of the bulk.

MR DOOPER said that the dyestuff used would need to be very fugitive, so that the colour disappeared completely in a short time, otherwise bleeding could occur.

It had been found that even a dyestuff which was no. 1 of the blue scale for assessing light fastness was not satisfactory in this respect.

MR K. GILBERT asked whether there were any economic treatments to stabilise wood against change in moisture content by the use of internal cross-linking agents.

MR DOOPER said that tests had been done in which wood was impregnated with a monomer which was subsequently polymerised, but up to date the cost was far too great.

MR H. A. HIPWOOD referred to the list of primers investigated and asked why an aluminium primer had not been included. In this country aluminium primers were often recommended to seal wood treated with preservative.

MR DOOPER said that in the Netherlands, also, aluminium paints were sometimes used for sealing purposes, but in this case they had simply been forgotten; they should be included in the next programme.

MR R. H. E. MUNN asked how failures were assessed. In the tables shown, the per cent failures were quoted. In his experience it was difficult in such exposure work to allocate true failures and true passes as there were almost always "degrees of failure".

Mr Dooper replied that he had used a "go/no go" assessment in which any failure was included. It did not necessarily follow that such failures would be unacceptable.

Mr W. B. Banks asked whether the greater trouble with Baltic compared with Swedish spruce was due to the higher percentage of bacterially attackable wood in the former.

Mr Dooper agreed that this was so.

Dr S. W. W. Morgan said that Mr Dooper had said he would not recommend painting over non-fixed water-borne preservatives. Would this also apply to timber diffusion-treated with boron salts?

Mr Dooper said that the laboratory tests concerned had been carried out with test panels treated by a vacuum/pressure procedure and the results obtained were rather disappointing. On the other hand, field tests with houses using timber diffusion treated with boron salts had not shown paint failures up to date.

Mr P. Whiteley remarked that moisture transport through wood was assumed to be determined by the absolute vapour pressure difference from inside to outside. Wood was hygroscopic and tended to an equilibrium moisture content proportional to the relative humidity. Conditions could occur in which the relative humidity gradient was the reverse of the absolute humidity gradient. In these conditions could not transport be expected in the reverse direction?

Mr Dooper answered that the calculations were based on the differences in the water vapour pressure on both sides of the paint film concerned. At a temperature of 5°C the actual water vapour pressure was always rather low, even in cases when the relative humidity was high. However, only the maximum transport values had been calculated, not the actual ones.

If the pressure gradient was negative, which was certainly possible, the water transport would be reversed.

Dr L. Valentine asked whether Mr Dooper had examined methods of application other than impregnation, to see if the differential absorption of preservatives between sapwood and heartwood could be reduced.

Mr Dooper said that this had not been done, because of the requirements of standards in the Netherlands.

Mr J. E. Pooley asked whether fungal attack on timber always started from the surface, and if so what depth of penetration of preservative was necessary to prevent attack on the unpreserved timber underneath the preserved layer?

Mr Dooper replied that the attack started mostly at joints where the water was coming in. Sometimes there was attack at the sides, but this generally indicated some defect in the wood before the application of the paint system. The penetration, obtained on immersion, was only a matter of some millimetres.

Mr R. W. Yonge enquired whether there was a critical time to allow impregnated timber to dry before painting.

Mr Dooper said the longer the time the better, but even after very long periods failures sometimes occurred. Vacuum drying for two days still gave trouble. Specifications of the Dutch Timber Development Association required a minimum drying time of three days at room temperature.

J. Oil Col. Chem. Assoc. 1970, 53, 669-679

The relationship between the permeation of oxygen and water through paint films and corrosion of painted mild steel

By S. Guruviah*

The Paint Research Station, Teddington, Middx.

Summary

Four iron oxide paints based on alkyd, epoxy, and chlorinated rubber were prepared. The permeability to oxygen and water of the paint films was measured. Painted panels were exposed in salt spray and humidity cabinets for 1,000 hours. Corrosion rates and condition of the paint after exposure were recorded. The amounts of oxygen and water able to diffuse through the paint films were calculated and the relationship between permeability to oxygen and water of detached paint films and the corrosion of the painted metal panels was studied. The theoretical amount of corrosion was calculated for the painted metal assuming oxygen permeability limitation. The low corrosion rate of painted panels was explained by the slow diffusion of oxygen through the film.

Key words

Types and classes of surface
steel

Binders—resins etc
alkyd resin
chlorinated rubber
epoxy resin

Prime pigments and dyes
iron oxide pigment

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

Processes and methods primarily associated with service or utility
corrosion

Le rapport entre la pénétration de l'oxygène et de l'eau à travers les feuils de peinture et la corrosion d'acier doux

Résumé

On a dosé la perméabilité à l'égard de l'oxygène et de l'eau des feuils de quatre peintures contenant du pigment de l'oxyde de fer et à base respectivement des résines alkyde, époxyde, et de caoutchouc chloré. Les éprouvettes peintes ont été exposées pendant 1,000 heures dans des appareils à l'air humide et au brouillard salin. On a noté le taux de corrosion et l'état de la peinture après ces expositions.

On a calculé les quantités d'oxygène et d'eau qui se sont diffusées à travers les feuils de peinture, et l'on a étudié le rapport entre la perméabilité à l'oxygène et à l'eau des feuils de peinture détachés d'un part et la corrosion des éprouvettes de métal peint d'autre part. On a calculé la quantité théorique de corrosion du métal peint en tenant compte d'une limitation de la perméabilité de l'oxygène. On a expliqué le taux faible de corrosion des éprouvettes peintes sous termes de la faible vitesse de diffusion de l'oxygène.

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*Permanent address: Central Electrochemical Research Institute, Karikudi-3, India.

Die Beziehungen zwischen der Durchlässigkeit von Anstrichfilmen für Sauerstoff und Wasser und der Korrosion von Gestrichenem Eisenblech

Zusammenfassung

Es wurden vier auf Alkydharz, Epoxyharz und Chlorkautschuk basierende Eisenoxidfarben angefertigt. Die Sauerstoff- und Wasserdurchlässigkeit der Filme wurden bestimmt. Gestrichene Tafeln wurden 1,000 Stunden lang dem Salzsprühnebel- und der Schwitzkammerprüfung unterworfen. Danach wurden Verrostungsgrad und Zustand des Anstriches festgestellt. Die Mengen Sauerstoff und Wasser, welche durch die Anstrichfilme diffundierten, wurden berechnet, und die Beziehungen zwischen Durchlässigkeit für Sauerstoff und Wasser abgelöster Filme zu der Korrosion der gestrichenen Metalltafeln untersucht. Die theoretisch mögliche Korrosionsmenge wurde für die gestrichenen Metalltafeln berechnet unter Annahme begrenzter Sauerstoffdurchlässigkeit. Das geringe Mass an Korrosion der gestrichenen Tafeln wird mit der langsamen Sauerstoffdiffusion durch den Film erklärt.

Зависимость между проникновением кислорода и воды через красочные пленки и коррозией окрашенной низкоуглеродистой стали.

Резюме

Приготовлялось четыре железисто-окисных красок основанных на алкидном, эпоксидном и хлорированном каучуке. Измерялась проницаемость красочных пленок по отношению к кислороду и воде. Окрашенные панели подвергались действию брызг соленой воды и выдерживались в камерах влажности в течение 1000 часов. Скорость коррозии и состояние краски регистрировались после выдержки. Высчитывались количества кислорода и воды проникающих через красочные пленки и изучалась зависимость между проницаемостью отдельных красочных пленок по отношению к кислороду и воде и коррозией окрашенных металлических панелей. Высчитывалось теоретическое количество коррозии для окрашенного металла, предполагая ограниченную проницаемость кислорода. Низкая скорость коррозии окрашенных панелей объяснялась медленной диффузией кислорода через пленку.

Introduction

The use of organic surface coatings for protecting metal against corrosion has long been practised. The corrosion process requires a metal in contact with oxygen and water. It has been estimated by Mayne and Evans[1,2] that normal paint coatings of 0.1mm thickness allow the permeation of 190-1122 mg.cm^{-2}. year^{-1} of water and 4-53 mg.cm^{-2}. year^{-1} of oxygen. Mayne[1] has shown that the average rate of corrosion of steel is 70 mg.cm^{-2}. year^{-1}, which requires only 11mg of water and 30mg of oxygen.cm^{-2}. year^{-1}. Little published data is, however, available for comparing the permeation of both oxygen and water through the same paint with the corrosion resistant property of the painted metal.

In the present paper, oxygen permeability measurements on iron oxide paints based on four different media were made using an apparatus adapted from the ASTM method. Water permeability was measured by the Payne cup method. Painted panels were exposed in both salt spray and humidity cabinets for 1,000 hours to establish the relationship between permeability and corrosion rate.

Experimental procedure

Preparation of paints and films

Calculated amounts of resins, iron oxide pigment and solvent were placed in porcelain pots with porcelain balls $\frac{1}{2}$in and $\frac{1}{4}$in diameter. The paints were ball milled for 48 hours and checked for satisfactory grind using a Hegman gauge. The paint formulations are given in Table 1. The paints were spread on polyethylene sheets to obtain films of uniform thickness, air dried for 10 days and stripped. These films were used for oxygen and water permeability measurements. The film thickness was measured with a micrometer.

Table 1

Paint composition

No.	Vehicle	Synthetic iron oxide PVC	Solvent	Driers
1	Linseed penta alkyd 78% non vol.	15	White spirit	0.5 Pb 0.05 Co
2	,,	35	,,	,,
3	Epoxy/coal tar (4:1)	—	—	—
4	Epoxy/polyamide (1:1)	35	Isobutanol Xylene Toluene Isopropanol	—
5	Chlorinated rubber	35	Xylene	—

Preparation of painted panels for accelerated tests

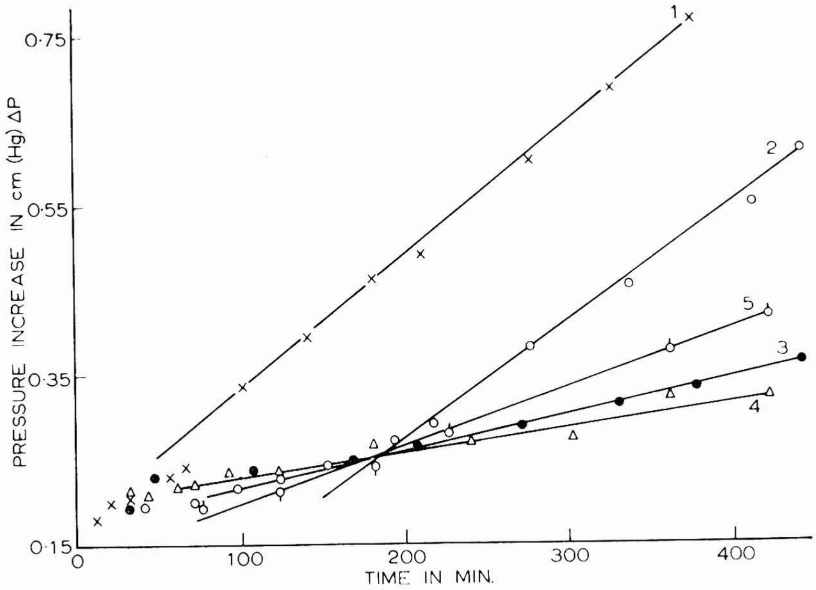
Cold rolled mild steel panels of size 6in × 4in were abraded with emery paper, degreased in white spirit and weighed. Mild steel panels, in duplicate, were given two coats of paint (refer to Table 1) with an interval of 24 hours between coats, and dried for ten days. The thickness of dry paint was measured with an Elcometer instrument. Duplicate panels for each paint were placed in the salt spray cabinet and the humidity cabinet. Synthetic sea water was used for continuous salt spray tests (BS 3900: part F4, 1968). The humidity cabinet conformed to BS 3900: part F2, 1966 with a RH of 100 per cent and temperature cycle 42-48°C. Both sets of panels were examined periodically during the test period of 1,000 hours. The paints were then stripped, the panels derusted in Clark's solution[3] for 5-10 minutes, and the weight losses measured.

Liquid water permeability measurements

The experiments were carried out by using aluminium Payne cups of 10cm^2 area and 1.5cm in height. Each cup contained 5ml distilled water and was sealed by the paint film. The cups were weighed, inverted, placed in a desiccator containing phosphorus pentoxide, and kept in a constant temperature room at 25°C. The cups were reweighed after 24 hours and the weight loss recorded. This was repeated for seven days. By knowing the thickness of the films, the specific permeability was calculated. This was expressed as mg of water passing through one cm^2 of film of 1mm thickness per day. Experiments were repeated in duplicate sets.

Oxygen permeability measurements

A pressure-differential method similar to ASTM 1434-66 was used. Briefly, a large chamber is isolated from a much smaller chamber by means of the paint film under test. The large chamber contains oxygen at a pressure of 10 or 5cm of mercury and the small chamber is evacuated initially to 2×10^{-5} cm of mercury. In operation, the oxygen permeates through the paint film into the smaller chamber where the pressure rise recorded in a small capillary is observed by a cathetometer. The working area of the paint film, the volume of the small chamber, the rate of pressure change (obtained from the slope of pressure change with time curve by experiment (see Fig. 1), and the pressure difference are measured in order to calculate the permeability. The permeability coefficient, C, is expressed as cm³ at STP/cm thickness/cm²/sec/cm Hg. The formula used in the calculation for permeability constant was



No.	Paint film	Thickness in cm.	Pressure of O_2 applied (P) cm (Hg)	Temp. °C (average)
1	Alkyd 15% PVC	0.0087	10.1	21
2	Alkyd 35% PVC	0.0125	10.35	20
3	Epoxy/coal tar	0.0325	10.2	23
4	Epoxy/polyamide 35% PVC ..	0.0375	10.45	28
5	Chlorinated rubber 35% PVC ..	0.03	5.0	23

Fig. 1. Pressure increase with time

$$C = \frac{273 \times V \times l \times \Delta P}{T \times P \times a \times t \times 76}$$

where V is the volume of the vacuum chamber, T is the temperature in degrees

Absolute; P is the pressure on the higher pressure side of the cell; a is the area of the film, l is the thickness of the film, ΔP is the increase in pressure on the low pressure side of the cell in time t. The results are reproducible in the range of $\pm$ 20 per cent.

Corrosion of mild steel calculated from oxygen permeability coefficient

The atmospheric oxygen partial pressure is 15.2cm of Hg. The oxygen passing unit area of film (from oxygen permeability calculation) is:

$$\text{volume oxygen (cc)} = \frac{15.2 \times C \times t}{l}$$

where C is the permeability coefficient, t is the time in sec and l is the film thickness in cm.

In the presence of water and oxygen, corrosion occurs according to the following equation:

$$4Fe + 3O_2 + 2H_2O \longrightarrow 2Fe_2O_3.H_2O$$

i.e. 224g iron requires 67,200cc of oxygen or 1cc of oxygen $\equiv$ 3.3mg of Fe

The theoretical amount of iron corroded on exposure was calculated from the expression:

$$\text{Fe(mg)} = 15.2 \times 3.3 \times \frac{C \times t}{l}$$

and for 1,000 hours (the duration of the salt spray and humidity tests)

$$= \frac{1{,}000 \times 60 \times 60 \times 15.2 \times 3.3 \times C \times t}{l} \text{ mg of iron}$$

Knowing the thickness of the films on the painted metal and their oxygen permeability C, the rate of corrosion of mild steel could, therefore, be calculated as $mg.cm^{-2}$.

The weight of oxygen transmitted per year was calculated from the permeability co-efficient for $1cm^2$ film of 0.1mm thickness under a pressure gradient of 15.2cm of Hg.

Results

The average oxygen permeability coefficient and specific water permeability were measured for various paint films and the results are shown in Table 2. Fig. 1 shows the change of pressure with time in the oxygen permeability apparatus for the paint films studied. After a short time, a linear relationship was obtained with all the films. From this, the rate of permeation was obtained and the permeability coefficient calculated from the formulae given above. Chlorinated rubber paint films had the highest oxygen permeability and the epoxy coal tar film the lowest (see Table 2). Little difference in diffusion of oxygen was observed among alkyd iron oxide films of different pigment volume concentration.

It will be seen from the Table 2 that a large amount of water passed through the epoxy polyamide paint film compared with other films. However, as the PVC increased from 15 to 35 per cent the permeability of the alkyd film to

Table 2

Average oxygen and water permeability of paint films

Paint No.	Oxygen permeability Coefficient (P) ($cm^3\,cm^{-1}\,cm^{-2}\,sec^{-1}\,cm(Hg)^{-1} \times 10^{-11}$)	Specific water permeability ($mg.cm^{-2}\,mm^{-1}\,day^{-1}$)
1	3.68	0.2372
2	4.35	0.2065
3	2.2	0.1070
4	3.4	0.4962
5	9.1	0.3484

water also decreased. The lowest permeability to water was obtained for the epoxy/coal tar film. The ratio of water permeability between the epoxy/polyamide paint, chlorinated rubber paint, alkyd paint and epoxy/coal tar paint at 35 per cent PVC was of the order 5 : 3.5 : 2 : 1.

From the data in Table 2, the amount of oxygen and water passing through the films per year for 0.1mm thick. cm^{-2} was calculated and is given in Table 3. It is seen from the table that the amount of oxygen passing through the film is very low compared with water.

Table 3

Weight of oxygen and water which would pass through paint films of thickness 0.1mm (calculated from permeability measurements)

Paint No.	mg of oxygen cm^{-2} $year^{-1}$	mg of water cm^{-2} $year^{-1}$
1	2.51	839.5
2	2.97	751.9
3	1.50	390.5
4	2.32	1810
5	6.2	1272

The results obtained from salt spray exposure and humidity cabinet tests for 1,000 hours are shown in Table 4. Epoxy/polyamide painted panels showed large blisters all over and the surface was also rusted. No blisters were observed in the case of the other paints (see Fig. 2), and the metal surface also remained bright. In the case of the alkyd paint (15 per cent PVC), a few scattered rust spots were seen on the surface. The weight loss was higher in the case of the epoxy/polyamide paint than with other paints. The weight losses were calculated assuming that oxygen permeability was the rate controlling factor, and those from the oxygen permeability data for the painted metal exposed in salt spray for 1,000 hours are given in Table 4. These values are slightly higher than the observed weight losses.

Table 4

Laboratory corrosion tests and corrosion rate calculated from oxygen permeability

No.	Iron oxide paint	Salt spray cabinet 1,000 hours				Humidity cabinet 1,000 hours			
		Film thickness (cm)	Nature of film and surface after 1,000 hr	Weight loss $mg.cm^{-2}$ Observed	Calculated	Film thickness (cm)	Nature of film and surface after 1,000 hr	Weight loss $mg.cm^{-2}$ Observed	Calculated
1	Alkyd 15% PVC	0.004	No blisters. Few rust spots scattered on the surface	0.1	1.6	0.007	No blisters. Few rust spots. Surface rusted.	1.1	0.9
		0.0045		0.2	1.4	0.007		1.4	0.9
2	Alkyd 35% PVC	0.012	No blisters bright surface	nil	0.6	0.009	Fine blister all over. Surface rusted	2.1	0.8
		0.012		nil	0.6	0.009		2.2	0.8
3	Epoxy/coal tar (no pigment)	0.005	No blisters bright surface	0.2	0.7	0.013	No blisters bright surface	0.1	0.3
		0.004		0.2	0.9	0.0145		0.1	0.2
4	Epoxy/polyamide 35% PVC	0.0105	Large blisters all over. Surface rusted	1.0	0.5	—	—	—	—
		0.012		1.1	0.5	—	—	—	—
5	Chlorinated rubber 35% PVC	0.0062	No blisters bright surface	0.1	2.0	0.009	Fine blisters all over. Surface rusted	2.5	1.8
		0.0055		0.1	2.6	0.009		2.5	1.8

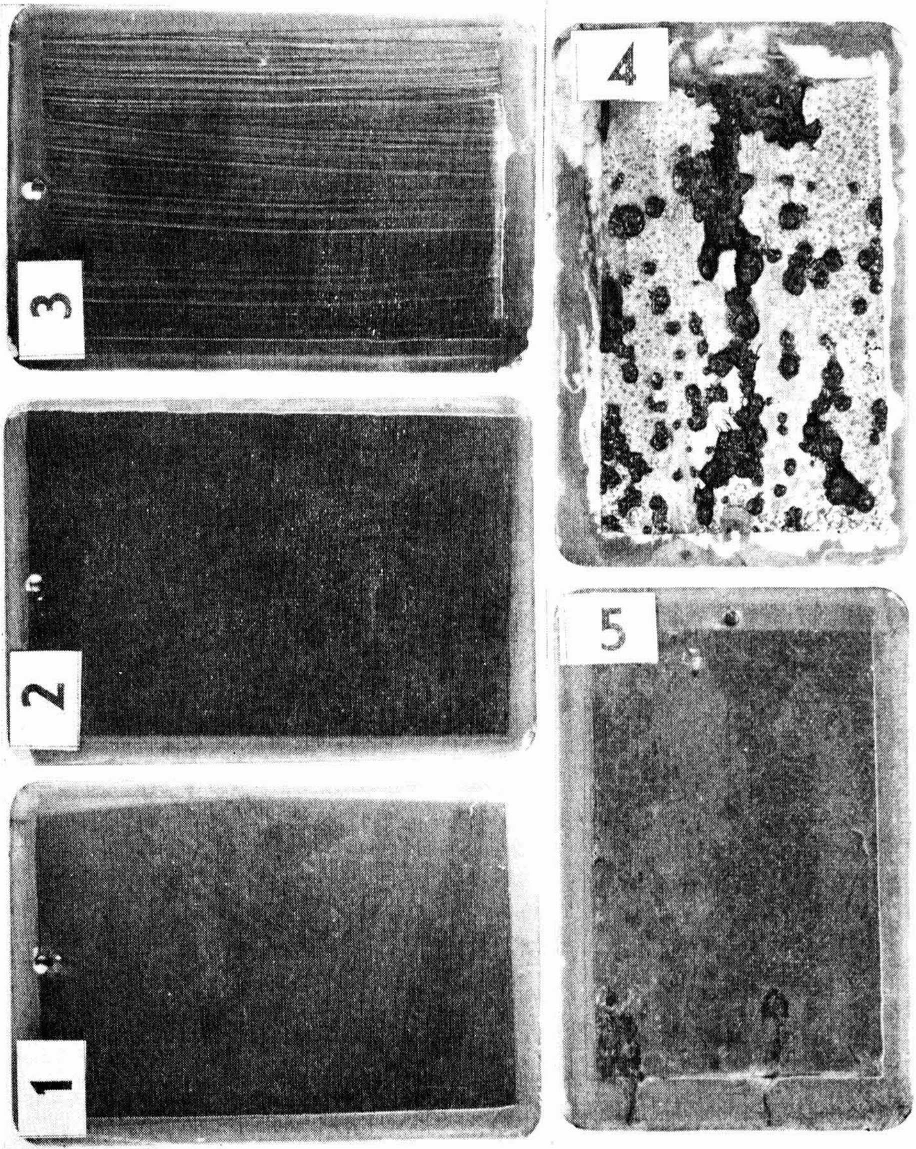


Fig. 2. Painted panels exposed in salt spray for 1,000 hours

No.	*Paint*
1.	Alkyd 15% PVC
2.	Alkyd 35% PVC
3.	Epoxy/coal tar
4.	Epoxy/polyamide 35% PVC
5.	Chlorinated rubber 35% PVC

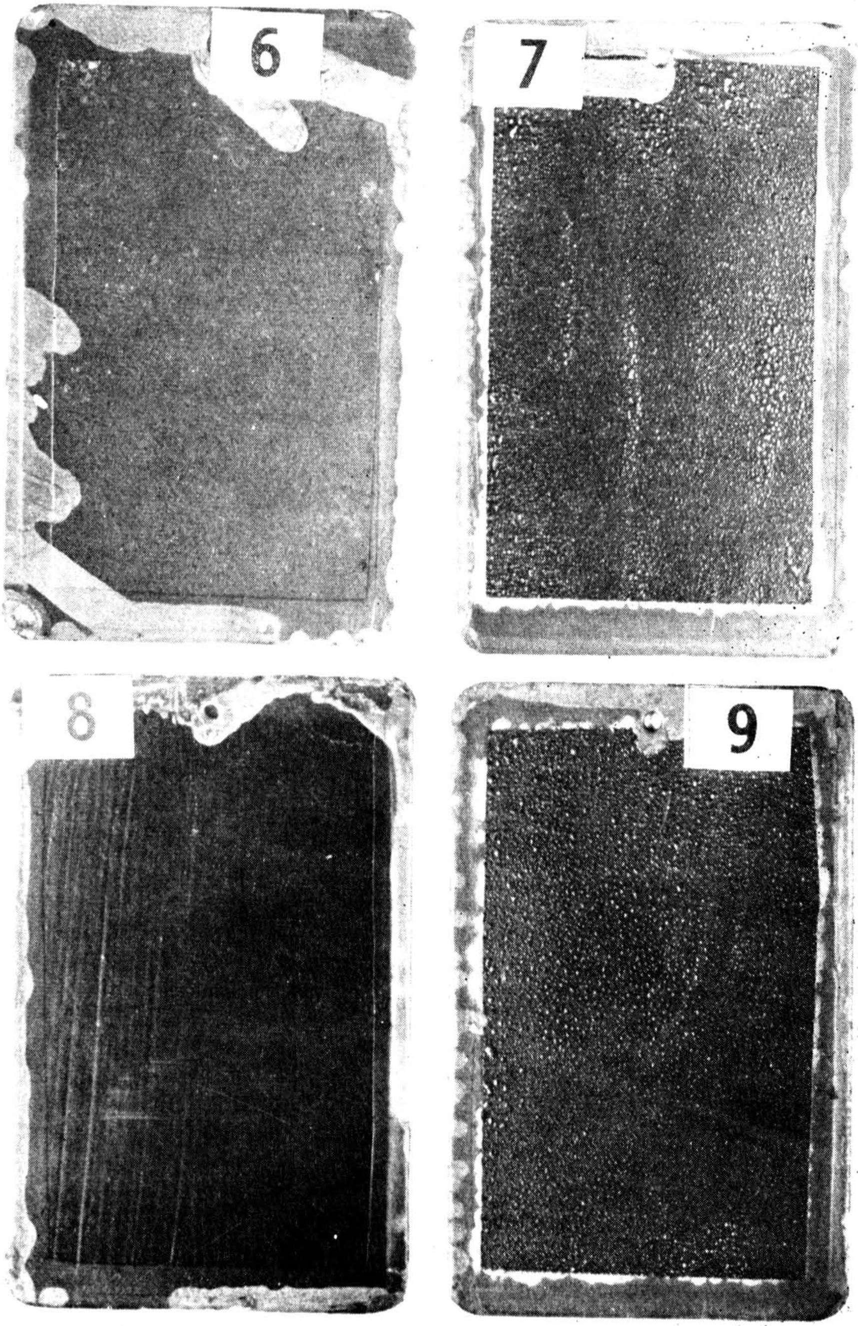


Fig. 3. Painted panels exposed in humidity cabinet for 1,000 hours

No.	*Paint*	*No.*	*Paint*
6.	Alkyd 15% PVC	7.	Alkyd 35% PVC
8.	Epoxy/coal tar	9.	Chlorinated rubber 35% PVC

The painted panels exposed in the humidity cabinet (Table 4) showed fine blisters all over the surface, except with coal tar/epoxy paint (see Fig. 3). The surface of the panels coated with epoxy/coal tar paint was bright. All the other painted panels were rusted. The calculated weight loss for the painted panels was lower than the observed value for all but the coal tar/epoxy paint.

Discussion

It is seen from the results that the epoxy/polyamide paint and the chlorinated rubber paint allowed more water and less oxygen to diffuse through them. The quantity of oxygen which diffused through all the films was much lower (see Table 3) than the amount of oxygen required for corrosion of bare mild steels as calculated by Mayne[1] (i.e. 30mg.cm^{-2} year^{-1}). This explains the results observed in the salt spray tests, where all the painted panels were in good condition and the steel after removing the paint was bright (see Fig. 2), but it cannot explain the observed corrosion under the epoxy/polyamide paint. A possible explanation may be that this film could have had ionogenic properties, allowing the free diffusion of chloride ion, which resulted in attack of the steel. It has been shown by Mayne and Cherry[1] that an epoxy/polyamide film with a pH below eight is positively charged and with a pH above this is negatively charged.

All the painted panels exposed in the humidity cabinet (except the epoxy/coal tar) showed more corrosion than would have been expected on the grounds of oxygen permeability. The most likely explanation is that the oxygen permeability measurements used for the calculations were made at 25°C, whilst the humidity cabinet tests were made at 42-48°C, at which temperatures oxygen permeability might be expected to be higher. It may also be significant that the epoxy/coal tar paint was least permeable to water, which is the major influencing factor in the humidity cabinet.

The electrochemical process of corrosion depends not only on the presence of water, but also on that of oxygen. The rate of corrosion will be governed largely by the slower of the two diffusion processes. So the low diffusion of oxygen through the paint film explains the low rate of corrosion observed in the case of all the painted mild steel panels.

Conclusion

Permeation of oxygen and water through iron oxide pigmented paint films based on different vehicles was measured. The permeability to oxygen of all the films was much less than to water. The weight loss calculated from the oxygen permeability data for painted metal and the observed corrosion rate from the accelerated tests were in fairly good agreement. The low corrosion rate could be explained by the low permeability to oxygen of the films.

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Formulation of fungus-resistant paints: VI. Addition of barium metaborate

By E. Hoffmann and A. Saracz

Division of Building Research, Commonwealth Scientific and Industrial Research Organization, Melbourne, Australia

Summary

The addition of barium metaborate (BMB) to latex and alkyd paints to make the coatings more resistant to the growth of fungus has been investigated. Panels coated with these paints were exposed at Lae, New Guinea, and assessed for fungus growth, and the stability of the BMB in the coatings was also determined.

The BMB was quickly lost from latex paint films exposed to rain, and no worthwhile increase in mould resistance was observed. Paint films protected from rain may show a greater fungus resistance than the blank, as in this case the BMB disappears only slowly. In interior application, a latex paint containing BMB shows increased fungus resistance. Barium metaborate is more stable in alkyd paint films than in latex paints and the growth of mould is consequently lower, even if the panels are exposed to rain.

Keywords

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

Biologically active agents
barium metaborate
zinc oxide

La mise au point des formules de peintures résistantes à végétation mycélienne

6ème. Partie. L'addition du métaborate de baryum

Résumé

On a étudié l'emploi de métaborate de baryum (BMB) en peintures-émulsions et en peintures alkydes pour augmenter leur résistance à végétation mycélienne. Des éprouvettes revêtues de ces peintures ont été exposées à Lae, Nouvelle Guinée, la croissance de végétation mycélienne était notée, et la stabilité du BMB dans les revêtements était également déterminée.

Le BMB se perdait rapidement à partir des feuils des peintures-émulsions qui étaient exposés à la pluie, et on n'a pas noté d'augmentation réelle en ce qui concerne la résistance à la moisissure. Les feuils de peinture à l'abri de la pluie peuvent démontrer une résistance à la moisissure augmentée en comparaison de celle du blanc, étant donné que dans ce cas, le BMB ne disparait que lentement. Aux applications à l'intérieure, une peinture-émulsion contenant du BMB démontre une résistance augmentée à végétation mycélienne. Le métaborate de baryum est plus stable en feuils de peinture alkyde qu'en peintures-émulsions et par conséquent la croissance de moisissure est plus faible, même où les éprouvettes sont exposées à la pluie.

Rezeptur für Pilzbeständige Anstrichfarben: VI. Zusatz von Bariummetaborat

Zusammenfassung

Der Zusatz von Bariummetaborat (BMB) zu Latex- und Alkydharzfarben um diese widerstandsfähiger gegen das Anwachsen von Pilzen zu machen, wurde geprüft. Mit solchen Farben gestrichene Tafeln wurden in Lae in Neu Guinea exponiert, und das Ausmass des Pilzwachstums auf diesen bewertet. Die Beständigkeit des BMB in den Anstrichen wurde ebenfalls bestimmt.

Das BMB wurde schnell von dem Regen ausgesetzten Latexfarbfilmen verloren, und keine nennenswerte Verbesserung hinsichtlich Pilzbeständigkeit beobachtet. Filme, die vor Regen geschützt waren, mögen grössere Pilzbeständigkeit als die Blindprobe aufweisen, da in diesem Falle das BMB nur langsam verschwindet. Bei Innenanstrich zeigen BMB enthaltende Latexfarben bessere Pilzbeständigkeit. In Filmen von Alkydharzfarben ist BMB beständiger als in Latexfarben, das Pilzwachstum ist infolgedessen darauf geringer, selbst wenn die Tafeln dem Regen ausgesetzt werden.

Формуляция красок устойчивых против плесени

VI: Добавление метаборнокислого бария

Резюме

Изучалось добавление метаборнокислого бария МББ к латексным и алкидным краскам, для получения покрытий более устойчивых против плесени. Панели покрытые этими красками подвергались действию атмосферы в Лае, в Новой Гинее и оценивались с точки зрения роста плесени и также определялась устойчивость МББ в покрытиях. МББ быстро утеривалось из латексных красочных пленок подверженных действию дождя и не наблюдалось существенного увеличения в сопротивлении против плесени. Красочные пленки защищенные от дождя обнаруживают более высокое сопротивление против плесени так как в этом случае МББ исчезает лишь медленно. Для внутреннего применения латексная краска содержащая МББ обнаруживает более высокую устойчивость против плесени. Метаборнокислый барий более устойчив в алкидных красочных пленках чем в латексных красках и рост плесени поэтому более низкий, даже если панели подвержены действию дождя.

Introduction

Barium metaborate (BMB) has been recommended as an additive to paint to increase its fungus resistance[1] and, although it has been widely tested by the trade in Australia, there is no agreement as to its usefulness. Some paint technologists believe it to be of value in latex paints; others dispute this. A similar difference of opinion exists, also, as to the effectiveness of this additive in alkyd-based paints.

This paper deals with the effect of barium metaborate on the mould resistance of latex and alkyd paints exposed at Lae, New Guinea. In accordance with the general pattern of work being done at the Division of Building Research on fungus-resistant paints, the stability of the additive in the paint film was also examined.

Experimental

Analytical work

Latex and alkyd enamel paints L1, L3, L5, L7, G1 and F1 in Table 1 were brushed out on sheets (12in × 6in) of polyethylene terephthalate polyester film, which were then attached to asbestos cement panels and exposed at Lae, New Guinea. The panels, which had the painted film attached to both sides, were mounted at 45° and facing 31° east of true north. The films were analysed for boric acid by extracting the BMB from the paint film with acid, bringing the extract to a pH of 7, adding mannitol, and then titrating with standard N/10 or N/100 sodium hydroxide solution to the phenolphthalein end point. This simple method of analysis is applicable only if there are no metallic salts (iron, zinc, lead, etc.) present in the coating. In these cases the extraction is best carried out with mannitol[2].

The results are summarised in Figs. 1 and 2.

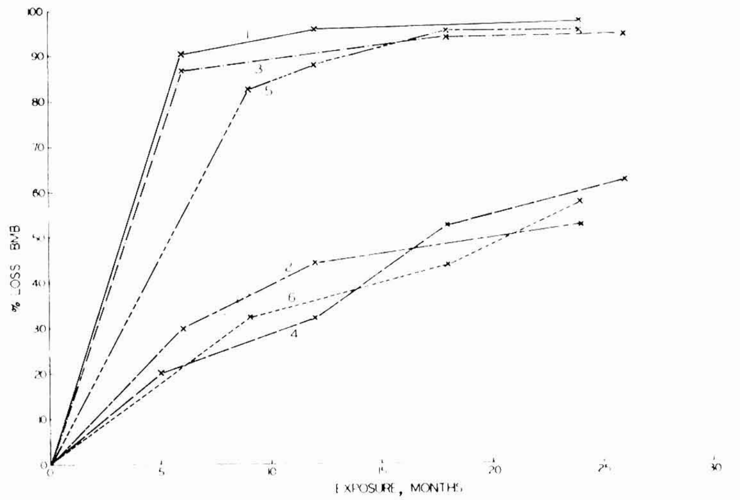

Fig. 1. Loss of barium metaborate from latex paints

1. Paint L1, upper side
2. Paint L1, under side
3. Paint L5, upper side
4. Paint L5, under side
5. Paint L7, upper side
6. Paint L7, under side

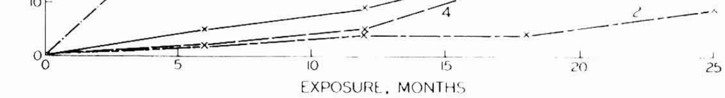

Fig. 2. Loss of barium metaborate from gloss and flat enamel paints

1. Paint G1, upper side
2. Paint G1, under side
3. Paint F1, upper side
4. Paint F1, under side

Exposure

A separate set of asbestos cement panels painted with the latex and enamel paints and the corresponding blanks were exposed at Lae, New Guinea. The intensity and extent of mould growth was assessed at intervals of about three months. The results are summarised in Tables 2a and b and 3a and b.

Table 1
Paints tested

No.	Type	PVC %	Resin	Pigment Vol. % on total vol. of solids r.TiO_2	Pigment Vol. % on total vol. of solids ZnO	BMB Vol. % on total vol. of solids	BMB Weight % on total weight of solids	Extender Vol. % on total vol. of solids
L1	Latex	40	Vinyl acetate-acrylate copolymer	19	—	21	31.6	
L2	Latex	40	do	40	—	nil	nil	
L3	Latex	40	do	18.5	8	13.5	19	
L4	Latex	40	do	19	21	nil	nil	
L5	Latex	25	do	14	—	11	19.8	
L6	Latex	25	do	25	—	nil	nil	
L7	Latex	35	Acrylate copolymer	12	—	14	23	$CaCO_3$ 9
L8	Latex	35	do	13	—	nil	nil	$CaCO_3$ 22
G1	Gloss alkyd enamel	20	Long soya pentaerithrytol alkyd	12.5	—	8.5	18	
G2	Gloss alkyd enamel	20	do	20	—	nil	nil	
F1	Flat alkyd enamel	47	—	20	—	11.5	18	Kaolin, diatomaceous earth 15.5
F2	Flat alkyd enamel	47	—	20	—	—	—	27

Note: Each paint with an even number (L2, L4, etc.) is the blank for the paint with the preceding odd number (L1, L3, etc.)

Table

Assessment of mould growth on paint films

Paint	Replicate	6m		9m		12m		15m		18m	
		I	C	I	C	I	C	I	C	I	C
L1	1, 2, 3	0	100	0	100	0	100	3	75	2	100
L2	1, 2, 3	0 0	100 100	0 1	100 25	1–2 3	20 80	1–2 3	20 80	1–2 1–2	100 100
L3	1, 2, 3	0	100	0	100	0	100	9	75	4	75
L4	1, 2, 3	0	100	0	100	0	100	0	100	0	100
		2m		5m		8m		11m		14m	
L5	1, 2, 3, 4	0	100	3–4	80	2–3	100	2–3	100	2–3	100
L6	1, 2, 3, 4	2–4	100	2–3	100	3–4	100	3–4	100	3–4	100
L7	1, 2, 3, 4	0	100	0	100	1–2	100	1	100	2	100
L8	1, 2, 3, 4	0	100	1–2	100	2–3	100	2–3	100	3	100

Each panel was assessed by noting the percentage area C covered by mould and by the panel is free of mould.

Table

Assessment of mould growth on paint films

Paint	Replicate	6m		9m		12m		15m		18m	
		I	C	I	C	I	C	I	C	I	C
L1	1, 2, 3	0	100	0	100	0	100	0	100	0	100
L2	1, 2, 3	0	100	0 Tr.	100	0 Tr.	100	0 Tr.	100	1 1	100 100
L3	1, 2, 3	0	100	Tr.		0	100	0	100	0	100
L4	1, 2, 3	0	100	0	100	Tr.		Tr.		3–9	10
		2m		5m		8m		11m		14m	
L5	1, 2, 3, 4	0	100	0	100	0	100	0	100	0	100
I6	1, 2, 3, 4	7–8	60	7–9	90	2–9	100	3–6	100	6–7	100
		3m		7m		9m		12m		16m	
L7	1, 2, 3, 4	0	100	0	100	0	100	0	100	0	100
L8	1, 2, 3, 4	0	100	0	100	0	100	0	100	1	100

Each panel was assessed by noting the percentage area C covered by mould and by the panel is free of mould.

2a
exposed outdoors at Lae: upper side of panels

21m		24m		27m		30m		33m		35m		39m		43m	
I	C	I	C	I	C	I	C	I	C	I	C	I	C	I	C
2–3	100	2–3	100	3	100	3–4	100	4–5	100	4–5	100	8	100	8	100
1–2 1–2	100 100	2 2	100 100	2 2	100 100	2–3 2–3	100 100	1–2 2–3	100 100	2–3 3–4	100 100	3 3	100 100		
2–3	100	2	100	2–3	100	2–3	100	2–3	100	4–5	100	6	100	6	100
Trace		1–4	100	1–4	100	1–4	100	1–2	100	1–2	100	2	100		
16m		19m		23m											
3–4	100	3–4	100	5	100										
3–4	100	3–4	100	5	100										
3	100	3	100	3–4	100										
3	100	5	100	7–9	100										

colour intensity I according to the scale 9 (black) → 0 (white). Tr = trace; I = 0, C = 100 means that the

2b
exposed outdoors at Lae: under side of panels

21m		24m		27m		30m		33m		35m		39m		43m	
I	C	I	C	I	C	I	C	I	C	I	C	I	C	I	C
2	5	2	5	2	5	2	5	2	5	2	5	1	100	1	100
1 1	100 100	1 1	100 100	1–2 1–2	100 100	1–3 1–3	100 100	2–3 2–3	100 100	2–3 2–3	100 100	3 3	100 100		
0	100	2	5	2–3	5	2	5	2	5	2	5	2	100	2	100
3–9	10	3–9	10	1–4	100	1–4	100	1–4	100	1–4	100	3–5	100		
16m		19m		23m		25m									
0	100	0	100	2	100	8 2	10 90								
6–7	100	6–7	100	4–8	100										
19m		21m		24m											
1	50	1	100	1	100										
1	100	1	100	2	100										

colour intensity I according to the scale 9 (black) → 0 (white). Tr = trace; I = 0, C = 100 means that the

Table 3a

Assessment of mould growth on paint films exposed outdoors at Lae: upper side of panels

Paint	Replicate	3m		7m		9m		12m		16m		19m		21m	
		I	C	I	C	I	C	I	C	I	C	I	C	I	C
G1	1, 2, 3, 4	0	100	0	100	1	100	1	100	1	100	1	100	2	100
G2	1, 2, 3, 4	0–2	10	1–2	100	2–3	100	2–3	100	3	100	4	100	3–9	100
		2m		5m		9m		12m		14m		17m			
F1	1, 2, 3, 4	0	100	0	100	1	100	1	100	1	100	2	100		
F2	1, 2, 3, 4	1–2	100	2–3	100	3	100	3	100	3	100	3	100		

Each panel was assessed by noting the percentage area C covered by mould and by the colour intensity I according to the scale 9 (black) – 0 (white). Tr = trace; I = 0, C = 100 means that the panel is free of mould.

Table 3b

Assessment of mould growth on paint films exposed outdoors at Lae: under side of panels

Paint	Replicate	3m		7m		9m		12m		16m		19m		21m		24m	
		I	C	I	C	I	C	I	C	I	C	I	C	I	C	I	C
G1	1, 2, 3, 4	0	100	0	100	0	100	0	100	2	5	5	5	5	5	1–3	100
G2	1, 2, 3, 4	2–3	10	4–5	100	5–6	100	5–6	100	7	100	5	100	5	100	3	100
		2m		5m		9m		12m		14m		17m					
F1	1, 2, 3, 4	0	100	0	100	0	100	0	100	0	100	1	100				
F2	1, 2, 3, 4	3–4	75	3–5	100	2–5	100	3–5	100	3–5	100	4–5	100				

Each panel was assessed by noting the percentage area C covered by mould and by the colour intensity I according to the scale 9 (black) – 0 (white). Tr = trace; I = 0, C = 100 means that the panel is free of mould.

Discussion

Latex paints

Curves 1 and 2 in Fig. 1 show the loss of BMB from a paint film containing an initial concentration of 31.6 per cent BMB. The loss from the upper side of the panel (curve 1) was very rapid, 90 per cent being lost in only 6 months. On the under side (curve 2) the loss was much smaller at only 52 per cent in 24 months. The solubility of BMB in water is about 0.2 per cent, and the losses are due to the leaching action of rain and dew. The loss of BMB from the paint film was slower on the undersides of the panels where the leaching action of rain would not be as high. The relationship between loss of BMB and the growth of fungus on the paint film is borne out by the data in Table 2a and b. On the upper side of the panel, paint L2 (blank) stayed practically free of mould for 9 months, whereas paint L1 stayed free for only 12 months, thus indicating the small effect of BMB. At the same time it can be noted that, after 30 months, the paint film which originally contained BMB (L1) supported a stronger mould growth than the blank. This is understandable, since the loss of BMB from the film would produce microholes which probably allow nutriment for the mould to accumulate.

On the under side of the panel (Table 2b) the paint film containing BMB (L1) showed a much better performance than the blank (L2). It was free of mould for 18 months and then showed approximately 5 per cent of its surface covered by mould up to 35 months, and from then on a very weak mould growth occurred over the whole surface. The blank was free of mould or had only traces of it for 15 months. Weak mould growth was recorded over the whole panel for up to 30 months, and from then on the mould growth was much stronger than on paint L1.

It has been proposed that zinc oxide should be used with BMB to increase the fungus resistance. As the loss of BMB will scarcely be influenced by the zinc oxide, it can be expected that paint L3 will behave on the upper side like a paint containing only zinc oxide. As has been shown[3], the amount of zinc oxide in the paint film is fairly critical and quantities of less than 14 vol per cent zinc oxide on total volume solids (40 per cent by weight on total solids) are not sufficient to increase the fungus resistance.

This conclusion is borne out by the observations summarised in Table 2a and b. Paint L3, containing zinc oxide and BMB, stayed free of mould for only 12 months on the upper side, whereas paint L4, containing zinc oxide as the only fungus-inhibiting pigment, stayed free of mould or showed only traces for 21 months. In the later stages, L3 supported a considerably higher growth of mould than L4.

On the under side, L3 behaves similarly to L1, as in this case the BMB disappears much more slowly.

The behaviour of coatings formulated to 25 per cent PVC is illustrated by paints L5 and L6. Curves 3 and 4 (Fig. 1) show that the loss of BMB from the upper and lower sides of the panels follows the general pattern of other latex paints. The data in Tables 2a and b show that there is scarcely any difference in the performances of the two paints on the upper side, and that the paint containing BMB (L5) did not support mould growth on the under side of the panel for 19 months.

Paints L7 and L8 were formulated to 35 per cent PVC with a different resin and also with calcium carbonate as an extender. The loss of BMB from L7 is shown by curves 5 and 6 in Fig. 1, and the mould resistance of the two paints is compared in Tables 2a and b. On the upper side of panels the growth of mould was first recorded at 7 months for L8 and 9 months for L7, but very little mould growth was supported by either paint on the underside of panels. It has been found by the authors (unpublished data) that paints formulated with vinyl acetate copolymer and containing calcium carbonate as extender showed an increased mould resistance on the underside of panels. It is therefore likely that in this case the comparatively high mould resistance was due to the presence of calcium carbonate.

The contradictory results obtained by the various investigators as to the effectiveness of BMB as a fungicide in latex paints seem to be due mainly to insufficient attention being given to the conditions of exposure of the paint film. If the test panels are at least partly protected from rain, the loss of BMB will be slow and an inhibiting effect will be observed, but if rain has access to the panels there will be little or no retardation of mould growth. This also explains the observation reported by some technologists that panel exposures do not always correlate with the behaviour of the tested paints applied to the exteriors of houses. In this case the difference is due to the amounts of rain or dew received by the test panels and by the house on which the paint is applied. If the panels are fully exposed to rain and the walls of the house are relatively protected, the fungus resistance of the paint on the house will be much higher than that on the panels, and the converse will apply.

The foregoing is a good illustration of the importance of carrying out an analysis for the stability of a fungicidal or fungistatic additive in a paint film, since this is the only way by which a rational interpretation of the observations is possible.

Alkyd paints

Two alkyd enamel formulations were tested, one a gloss finish (G1, G2) and the other flat (F1, F2). The curves in Fig. 2 show that the rate of loss of BMB from both formulations was much lower than from the latex paints. The data in Tables 3a and b show that paints containing BMB (G1; F1) are more resistant to mould growth than the blanks (G2, F2), and that the growth of mould was less prolific on the lower sides of the panels.

The appearance of mould growth on the gloss enamel paint after 21 months cannot be ascribed only to loss of additive, but it could be due to adaptation of the mould to conditions prevailing on the surface. If this is so, a wash with hypochlorite solution would kill the resistant mould species and the surface could be expected to become fungus-resistant again.

Results of experiments with the gloss enamel paint on test panels are sufficiently encouraging to take the investigation a step further and to try gloss enamel paints containing BMB for exterior decoration on houses. The cheapest way to do this is to divide the walls of the house into vertical strips and apply the blank and the paint containing BMB to them in some suitable order, as described in a previous paper[4].

As already mentioned, opinions as to the effectiveness of BMB in alkyd paints are divided, and it may well be that the performance of BMB will vary with the type of alkyd used. To explain the comparative stability of BMB in alkyd paints it could be surmised that the hydroxyl groups in an alkyd resin form weak bonds with the borate (it has been shown that BMB reacts with compounds containing hydroxyls[2]) and this slows down the rate of leaching by water.

Every alkyd has a different hydroxyl content and the distribution of the hydroxyl groups will also be characteristic for each resin, and it is therefore possible that the performance of alkyd-based paints will vary, some being more resistant than others.

Interior decoration with a latex paint

A latex paint (D) containing 22.5 per cent by weight on total solids (14 vol per cent on total volume of solids) of BMB was compared with a latex coating

Fig. 3. Effect of barium metaborate on mould growth on the wall of dye works

D. Latex paint containing barium metaborate

E. Latex paint containing calcium carbonate in lieu of barium metaborate

(E) in which the BMB was replaced by calcium carbonate. Under interior conditions the loss of BMB by leaching should be small, and paint D would be expected to show a higher fungus resistance than paint E. The existing mould on the walls of a dye works was removed with hypochlorite solution and the two paints were applied in alternate strips, as shown in Fig. 3. This photograph was taken 18 months after the paints were applied, and it is evident that the paint formulated with BMB has a less prolific growth of mould than the other, although it is not entirely free. How long the effect will last depends on the amount of water vapour condensing on the wall. The BMB will eventually be leached out if condensation is high.

Another possible source of loss of BMB should be mentioned. Solutions of BMB in water have a high pH value, and any solution forming on the surface by condensation and leaching must consequently react with the carbon dioxide of the air to form barium carbonate and boric acid. Boric acid is probably fungistatic, but has a higher solubility in water than BMB and can readily be removed by leaching.

That this reaction occurs has been proved with paint films exposed at Lae, where it was found that approximately 20 per cent of the total BMB had reacted to form barium carbonate on the upper side of the panel.

On the other hand, extracts of alkyd paint films containing BMB show a pH of less than 8, and reaction with carbon dioxide does not occur. The low pH value indicates that the BMB is not extracted as such. The aqueous extract of a latex paint containing BMB contains barium oxide and boric acid in the ratio of 1:2.3, that is, the same as in a solution of the commercial product. The aqueous extract of an alkyd paint contains barium oxide and boric acid in the ratio 1:3.4 to 1:4, and it is very likely in this case that the BMB reacts with the acidic groups in the alkyd, so that part of the barium becomes fixed to the resin.

Conclusions

Barium metaborate does not increase the fungus resistance of latex paints if they are exposed to rain, which may remove the additive by leaching. The additive is more stable where the paint film is partly protected from rain, and fungus resistance is increased.

The leaching of barium metaborate from gloss alkyd paints is slow and the additive inhibits the growth of mould even when the paint film is exposed to rain.

Latex paints containing barium metaborate have a better resistance to fungus growth in interior applications.

[*Received 15 December 1969*

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Erratum

In the paper by F. M. Heertjes and J. de Jong in the June issue of the Journal, reference 10 was incorrect. This should have been Kossen, N.W.F., Thesis, Delft 1965.

J. Oil Col. Chem. Assoc. 1970, 53, 691-710

Reactivity of titanium dioxide pigmented vinyl chloride/vinyl acetate copolymer surface coatings*

By F. D. Robinson

Laporte Industries Limited, Stallingborough, Lincs,

Summary

There are a number of surface coating systems which exhibit a lack of stability when pigmented with certain titanium dioxide pigments. One such system is based on vinyl chloride/vinyl acetate copolymers, particularly, acid modified copolymers designed to give increased adhesion to clean metal surfaces.

Whilst titanium dioxide pigments are normally regarded as inert materials, there are modifications to the surfaces of these pigments which affect the stability of such coatings.

The instability is seen as an increase in the viscosity of the stored paint, leading to a full gelation in some instances. Even in the samples which retain a workable viscosity, but are more viscous than when first prepared, the adhesion of the paints is adversely affected.

Keywords

Types and classes of coating	*Binders—resins etc*	*Prime pigments and dyes*
vinyl coating	vinyl copolymer resin	anatase titanium dioxide rutile titanium dioxide

La réactivité des revêtements à base des copolymèrs de chlorure de vinyle/acétate de vinyle pigmenté avec le dioxyde de titane

Résumé

Il y a plusieurs systèmes de revêtements qui démontrent un manque de stabilité en presence de certains types du pigment de dioxyde de titane. Un tel système s'agit des copolymères à base de chlorure de vinyle/acétate de vinyle, surtout ceux qui sont modifiés par acide pour assurer une adhérence augmentée aux surfaces métalliques propres.

Tandis que les pigments du dioxyde de titane sont considérés en principe inerts, il y a des modifications aux surfaces de ces pigments qui peuvent influencer la stabilité de ces copolymères.

Le manque de stabilité se révèle comme une augmentation de la viscosité de la peinture après une période de stockage, et en certains cas une gélation complète. Même lorsque les échantillons restent utilisables en dépit de leur état visqueux, il y aura un effet adverse sur leur adhérence.

Reaktivität von mit Titandioxid Pigmentierten Anstrichmitteln, die Vinylchlorid/Vinylazetat—Mischpolymere Enthalten

Zusammenfassung

Eine Anzahl von Anstrichmittelsystemen weisen, wenn mit gewissen Titandioxiden pigmentiert, Mangel an Stabilität auf. Eines dieser Systeme basiert auf Vinylchlorid—Vinylazetat Kopolymeren, besonders säuremodifizierten, welche für den Zweck verbesserter Haftung auf reinen Metallflächen vorgeschlagen werden.

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*Presented to the Hull Section on 6 October 1969.

Während Titandioxidpigmente normalerweise als inerte Materialien gelten, gibt es solche mit Modifikationen der Pigmentoberflächen, welche die Stabilität von Anstrichfarben beeinflussen. Der Mangel and Stabilität äussert sich im Anstieg der Viskosität der Farbe beim Lagern, der schliesslich mitunter zur völligen Gelierung führen kann.

Selbst bei Mustern, deren Viskosität sie als noch verarbeitbar erscheinen lässt, obwohl höher als nach Anfertigung, kann es sich herausstellen, dass die Haftfähigkeit des Anstrichmittels gelitten hat.

Реактивность двуокисно-титановых пигментированных хлористовиниловых винилацетатных сополимерных поверхностных покрытий.

Резюме

Имеется ряд систем поверхностных покрытий которые проявляют недостаток устойчивости при пигментировании некоторыми пигментами двуокиси титана. Одна из этих систем основана на хлористовиниловых-винилацетатных сополимерах, в частности кислото-модифицированных сополимерах расчитанных для получения повышенного сцепления с чистыми металлическими поверхностями. В то время как двуокисно-титановые пигменты обычно рассматриваются как инертные материалы, все-же существуют модификации поверхностей этих пигментов которые влияют на устойчивость таких покрытий.

Неустойчивость проявляется как увеличение вязкости краски при хранении, приводящей в некоторых случаях к полному застудневанию. Даже в образцах сохраняющих рабочую вязкость, но являющихся более вязкими чем в исходном состоянии, сцепление красок подвергается неблагоприятному влиянию.

Introduction

Titanium dioxide pigments are regarded as inert, non-reactive surface coating raw materials. This statement is true for the majority of products pigmented with titanium dioxide, covering a wide range of industrial and decorative applications. There are, however, a limited number of coating systems, where it can be shown that some aspects of the modification of the pigment's surface leads to instability. This instability is seen as an increase in the viscosity of the paint during storage.

The author's technical service department undertook a programme to study the viscosity increases in undercoat formulations, which highlighted the contribution made to the viscosity increase due to modifications of the pigment surface. The instability in this case, however, was more a function of variations in the resin. Where non reactive resin batches were used, all modifications of the pigment surface gave stable products. But, with a reactive resin batch, the different forms of titanium pigment coating gave a range of stabilities. The viscosity increases were a function of the type and the level of surface treatment. In the course of this study, it was demonstrated that, where reactivity occurred, it was accelerated by the presence of moisture. The moisture could be the amount on the pigment surface that is in equilibrium with the atmospheric moisture, or water as added to the formulation. The study of a second example of reactivity in an undercoat formulation based on a vinyl toluenated alkyd confirmed the part played by moisture. In all the cases where pigment medium reaction occurred, the addition of water increased the reaction rate.

In any investigation involving viscosity increases, where titanium dioxide pigments are dispersed in a reactive non-aqueous surface coating medium, the role played by moisture is one of the first variables to be considered.

Vinyl chloride/vinyl acetate copolymer resins

Non-aqueous solution coatings of vinyl chloride/vinyl acetate copolymer resins are neutral and non-oxidising. Films produced from these solutions are permanently thermoplastic, non toxic and chemically resistant. Their toughness and flexibility make them ideal polymers for a wide range of applications.

The solution coatings may be applied by spraying, roller coating, dipping or brushing. They find general application in coatings for leather, concrete, tin sheeting, aluminium foils, and textile and paper finishes. They are also used in many special applications.

Generally, the restrictions on the type of pigmentation are very slight, as long as the pigment gives the desired decorative quality, hiding power, and ultraviolet light protection for the vinyl resin. Restrictions are placed upon the types of pigment that may be used with acid modified vinyl chloride/vinyl acetate copolymers. Special precautions must be taken to avoid the use of basic pigments which react to form a gel. Only neutral pigments are recommended in this area of application. Titanium dioxide is classified as a neutral pigment in this type of formulation.

The vinyl resins are supplied as a wide range of copolymers, differing in the vinyl chloride/vinyl acetate ratio, and in the degree of polymerisation. The copolymers can be grouped into three distinct classes.

Class I

In this class are the pure vinyl chloride/vinyl acetate resins. The monomer ratio is varied over a limited range. Typical compositions are 85 per cent-95 per cent vinyl chloride, and 15 per cent-10 per cent vinyl acetate. The resins are polymerised to give low, medium, or high molecular weight grades. Typical resins in this group are:

Vinylite VYHH; VYHD; VYLF; VYNS. (Union Carbide Corporation).

Vinnol H40; E 15/45 (Wacker Chemie).

Class II

In this group are the partially hydrolysed copolymers. The hydroxyl groups present give a wider resin compatibility, increase the adhesion of the coating to metal substrates, and provide points on the resin chain at which cross-linking with melamine and urea formaldehyde resins can occur.

In this group are the resins Vinylite VAGH and VAGD.

Class III

To increase the adhesion of vinyl solution resins to clean metal surfaces, a small proportion of a dibasic acid, generally maleic acid, is interpolymerised into the resin structure. The carboxylic acid groups so incorporated also serve as points of reactivity with cross-linking resins, and thus improve the chemical resistance of stoved films.

The carboxyl groups react with basic pigments to give unstable paints. During storage, the viscosity of the paints increases rapidly, leading to a full gelation in many cases.

Typical resins in this class are:

Vinylite VMCC: VMCH.
Vinnol E15/45M.

Experimental

Coating formulations

Vinyl solution coatings are soluble in ketones, certain esters and chlorinated hydrocarbons. A solvent solubility list is usually provided by the resin suppliers covering their ranges of resins.

The main object of the testing programme was to investigate the role of titanium pigments, representing all the possible commercial modifications, with respect to the viscosity stability for all classes of the vinyl resins. For this purpose, a standard formulation was used throughout the investigation. All the resins were pre-prepared as 16.7 per cent w/w solutions in a mixture of equal weights of ketone solvent and hydrocarbon diluent. Where different resin concentrations were prepared, these are specifically mentioned in the text.

Resin solution

Vinyl chloride/vinyl acetate resin	100g
Methyl isobutyl ketone	250g
Toluene	250g

Ball mill formulation

All the pigment dispersions were prepared by ball milling the pigment with the copolymer solution for 16 hours. After milling, a plasticiser was added.

Titanium pigment	50g	ball mill for 16 hours
Copolymer solution	180g	
Add: dioctylphthalate	20g	

Storage conditions and viscosity measurements

The paint samples were stored in a constant temperature room at 25°C. The viscosity measurements were made at room temperature, 21°—23°C.

Viscosity was measured on a 0-15 poise ICI Rotothinner. The cans were opened for as short a time as possible to prevent evaporation of the more volatile solvent. Inevitably, some solvent was lost during the storage period, but the changes in viscosity resulting from this loss were small compared to the large viscosity changes which have been recorded. The effect of solvent loss is regarded as insignificant.

Materials

The effects of the variables listed below were studied.

Copolymers: Vinyl chloride/vinyl acetate resin grades: Classes I, II and III.

Titanium pigments variables: Anatase pigment—no surface modification. Anatase pigment—inorganic hydrous oxide modified. Rutile pigment—no surface modification. Rutile pigment—inorganic hydrous oxide modified. Pigment concentration. Level of inorganic hydrous oxide modification. Zinc-containing pigments. Addition of zinc oxide to zinc free pigment. Rutile pigment —inorganic hydrous oxide with organic surface modification.

Additives: Moisture. Organic additives.

Table 1
Classification of titanium dioxide pigment studied

Titanium Dioxide	Crystal form	Minimum TiO_2 content %	Surface treatment chemicals	Characteristics
Pigment A	Rutile	93	Al, Si, Zn	General purpose
,, B	Anatase	98.5	Nil	,, ,,
,, C	Rutile	98	Nil	,, ,,
,, D	Anatase	96	Al, Si	Good dispersion
,, E	Rutile	91	Al, Si, Zn	Emulsion paint grade
,, F	Rutile	84	Al, Si, Zn	Emulsion paint grade. High opacity at high PVCs
,, G	Rutile	93	Al, Si, Zn	High opacity
,, H	Rutile	93	Al, Si, Zn, organic	Premium quality
,, I	Rutile	93	Al, Si, Zn, organic	Universal pigment
,, J	Rutile		Al, Si, Zn, organic	Premium quality
,, K	Rutile		Al	Premium quality

Results

The results of the storage stability tests are plotted in graphical form. The scale of ordinates is the same for all the graphs, to facilitate comparison between pigments. It is considered that a system showing an increase in viscosity of less than 0.5 poise over a period of three months at 25°C, should be classified as non-reactive. This figure is a liberal estimate, based on the results for the unmodified anatase and rutile pigment grades. These pigments are regarded as non-reactive in vinyl solution coatings.

In the initial stages of the programme, it was discovered that the effect of additional water in those systems containing "reactive resins" was highly significant. It was the practice to make additions of water to the paints at the milling stage when investigating the majority of the variables studied. The levels of water were 0.5 per cent, 1 per cent and 2 per cent by weight, calculated on the pigment content. The blank paints were prepared using commercially available pigments with a surface moisture content in equilibrium with the surroundings. Moisture contents in the range 0.2 per cent—0.6 per cent are typical of the determined values found for the pigments in Table 1.

Vinyl chloride/vinyl acetate resin grades

For the initial tests of the effect on storage stability of the various types of resin, the following were chosen from the three classifications.

Class I Vinylite VYLF—low molecular weight
Vinylite VYHH—medium molecular weight

Class II Vinylite VAGH—medium molecular weight (—OH groups present)

Class III Vinylite VMCH—medium molecular weight (—COOH groups present)

Pigmentation was with Pigment A. Paints were prepared with no water addition, and also with 0.5 per cent, 1 and 2 per cent added water as described above. The viscosity changes during storage over a period of six months were measured, and are recorded in Figs. 1, 2 and 3.

Fig. 1 shows the stability data for the four different resins where no water additions had been made to the paint. Vinylite resins VYLF, VYHH, and VAGH gave completely stable paint systems. Vinylite VMCH gave a progressive increase in viscosity rising to twice the initial viscosity in six months.

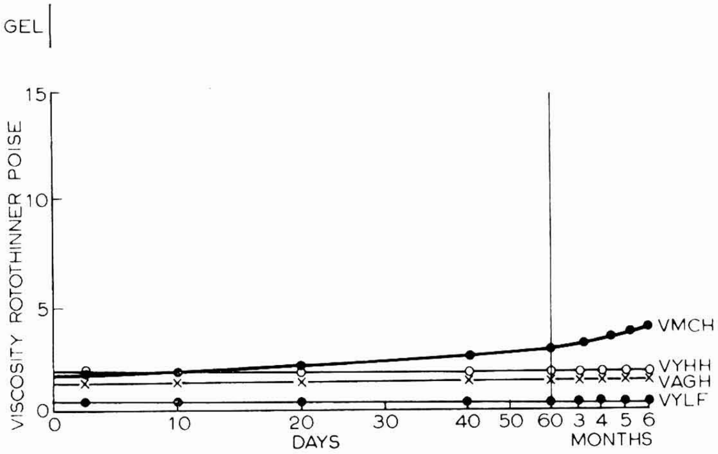


Fig. 1. Stability curves

White Vinylite paints
TiO_2 PVC = 21%
Pigment: rutile pigment A

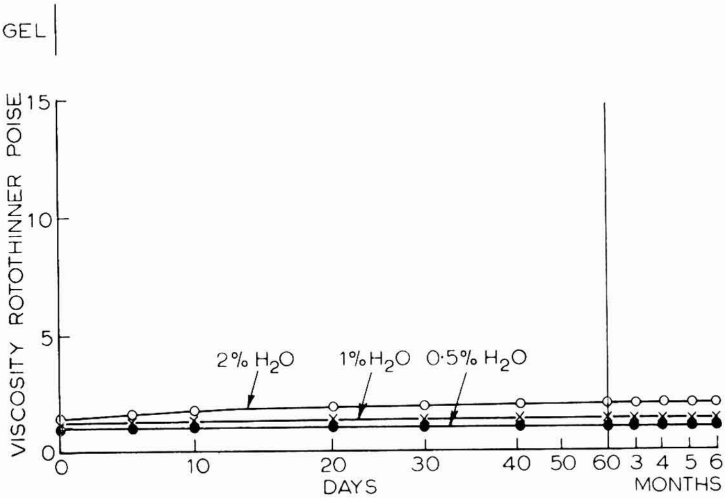
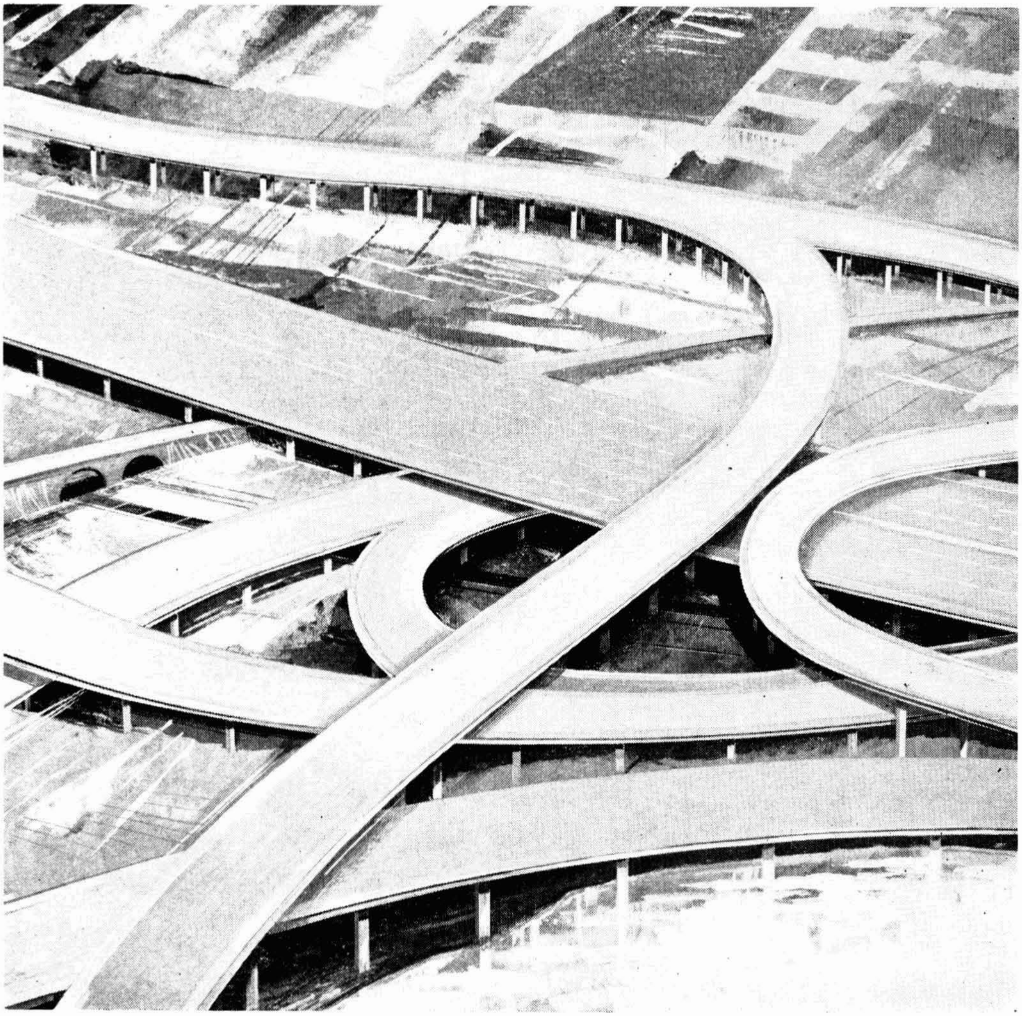


Fig. 2. Stability curves: effect of moisture

Resin: Vinylite Vagh
Addition: water ½; 1; 2%
Pigment: rutile pigment A



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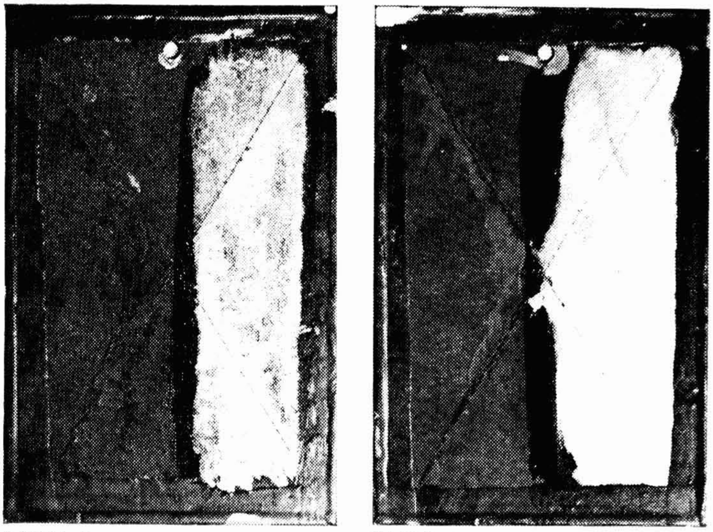
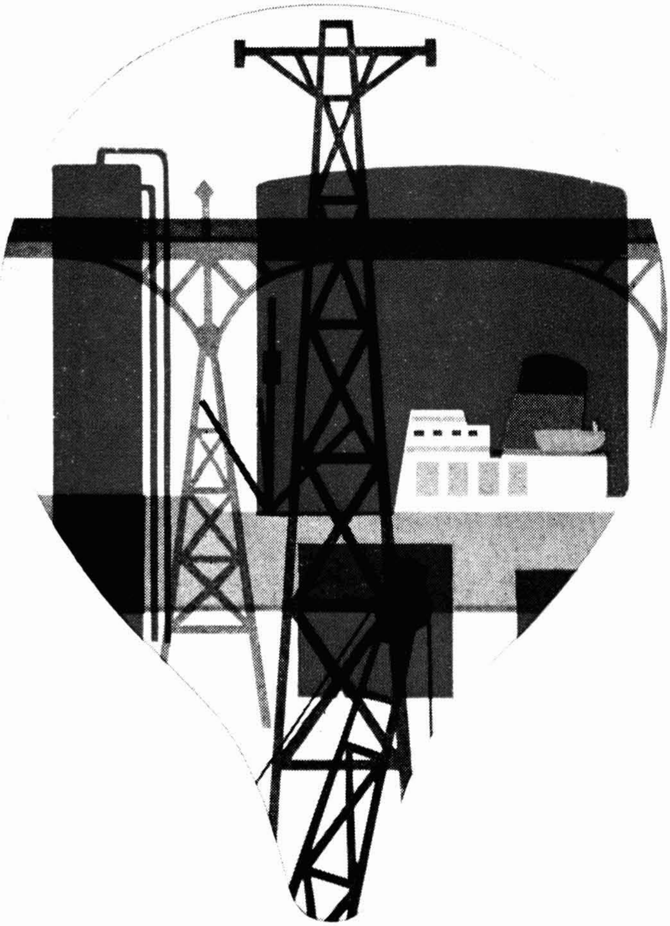


PANEL A

PANEL B



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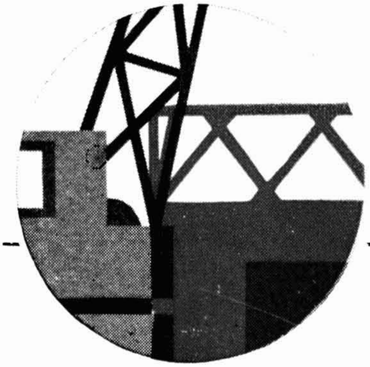

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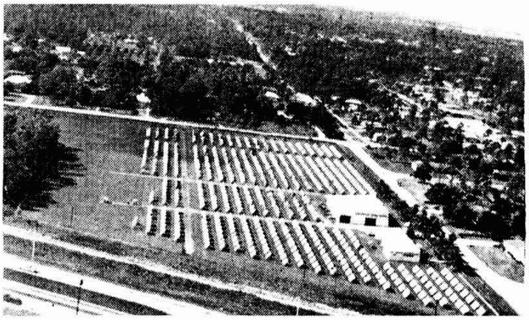

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Where water was added to the paint, the behaviour of the resins was significantly different. Vinylite VYLF and Vinylite VYHH gave stability/time curves identical with the blank paints. In the case of the Vinylite VAGH resin, a moisture increase had a small, but significant, effect on the stability, see Fig. 2. The acceleration of the reaction of the pigmented Vinylite VMCH in the presence of water is demonstrated in Fig. 3. Quite clearly, water makes a very positive contribution to instability. The 0.5 per cent addition has given a tenfold viscosity increase. The 1 and 2 per cent water additions have gelled the paint within three days.

When examining the different resin modifications that are commercially available, only the maleic acid modified grade showed complete instability under the specific conditions. The reactivity of the Class III polymer is clearly demonstrated. No further work was undertaken with the Class I and Class II resins.

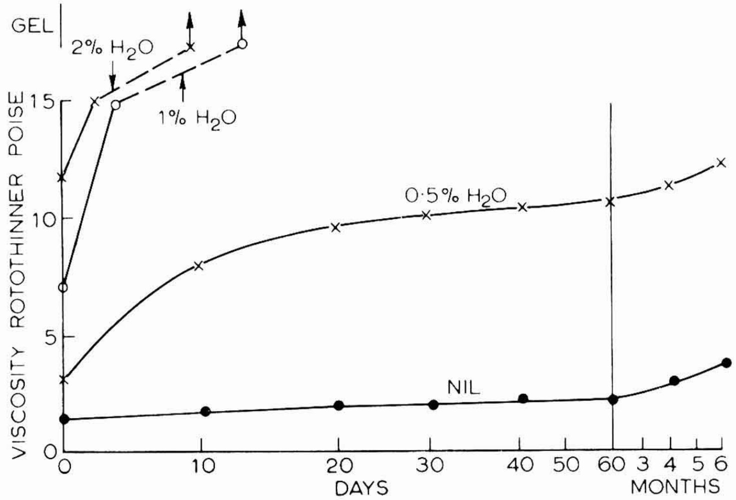


Fig. 3. Stability curves: effect of moisture

Resin: Vinylite VMCH

Pigment: rutile pigment A

Addition: water ½; 1; 2%

Titanium pigment variables

Non modified: Fig. 4 and Fig. 5 indicate the stabilities of Pigments B and C in a Vinylite VMCH solution coating. Both of these pigments are untreated grades, one having the anatase, and the other the rutile, crystal form. Even in the presence of 2 per cent moisture, these systems have not increased significantly in viscosity. The pattern is consistent with the results from experiments with undercoat formulations.

One point of interest is that there is no difference in reactivity between the zinc-free anatase pigment and the zinc-containing rutile pigment. The "reactivity" of zinc-containing titanium dioxide pigments is periodically cited in support of zinc-free products. There is no evidence in this system that the

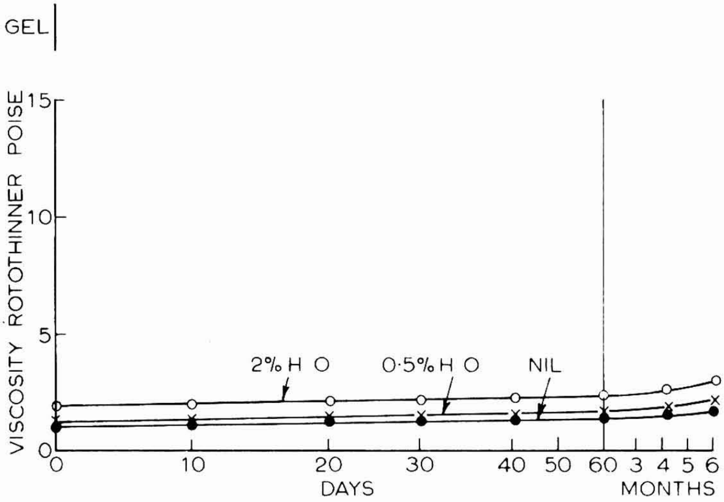


Fig. 4. Stability curves

Pigment: anatase pigment B
Resin: Vinylite VMCH
Addition: water ½% and 2%

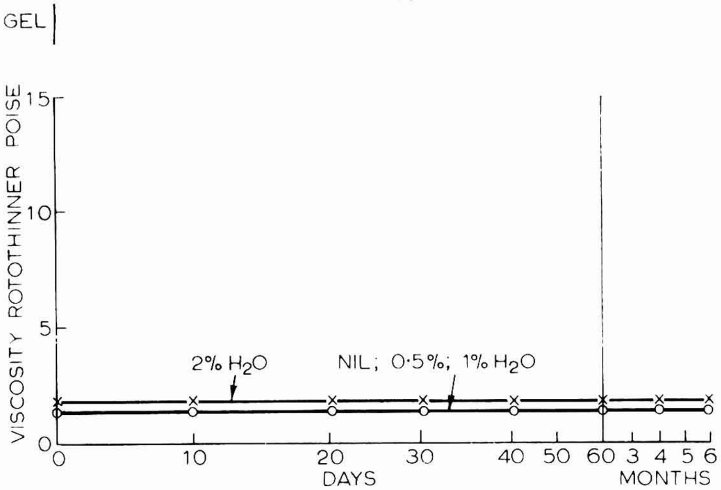


Fig. 5. Stability curves

Pigment: rutile pigment C
Resin: Vinylite VMCH
Addition: water ½%; 1%; 2%

inclusion of zinc has had any deleterious effect on the stability, when compared to unmodified titanium pigments.

Modified (*inorganic oxides*): Some important properties of titanium dioxide pigments are greatly improved by modifying the pigment's surface with inorganic oxides. Such properties as dispersibility, durability, colour and colour stability, and hiding power are significantly superior to those of the untreated types. The modifying oxides are mainly alumina and silica, as indicated in Table 1.

Fig. 6 shows the stability of a modified anatase pigment. With no additional water the paint remained stable for six months. In the presence of 2 per cent moisture the paint gelled in 20 days. This result is similar to that shown in Fig. 3. for a treated rutile pigment. Irrespective of the crystal base form, the reaction is identical and must, therefore, stem from the surface modifying agent.

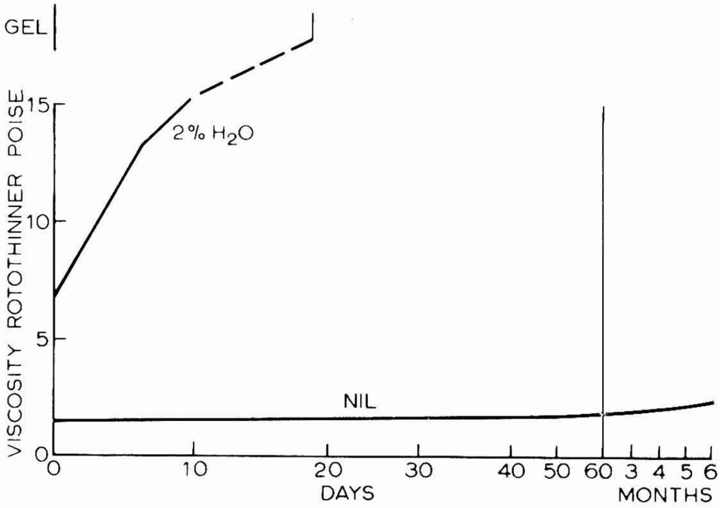


Fig. 6. Stability curves
Pigment: anatase pigment D
Resin: Vinylite VMCH
Addition: water 0% and 2%

Pigment concentration

The effect of pigment concentration for Pigment A, in the absence of additional moisture, is shown in Fig. 7. The pigment volume concentration in the paints, calculated to include the solvent fraction, ranges from 1.1 per cent to 10.9 per cent. The paint stability decreases with the increase in pigment content. In the presence of 1 per cent water, as shown in Fig. 8, the acceleration of the reactivity increases with titanium dioxide pigment content. The 2 per cent PVC level has produced only a small change in viscosity over the six month period, whereas increasing the PVC leads to an escalation in reactivity. Gelation occurs within the six month period studied, for PVC levels of 8.4 per cent and above.

Reaction must therefore be occurring between the inorganic surface treatment on the titanium dioxide pigment surface and the carboxyl groups of the vinyl solution polymer. The reaction is one involving three components. These are:

vinyl copolymer with pendant reactive carboxyl groups,

inorganic oxide modification of the titanium pigment surface,

presence of moisture.

In the absence of any one of these parameters, the system remains completely stable.

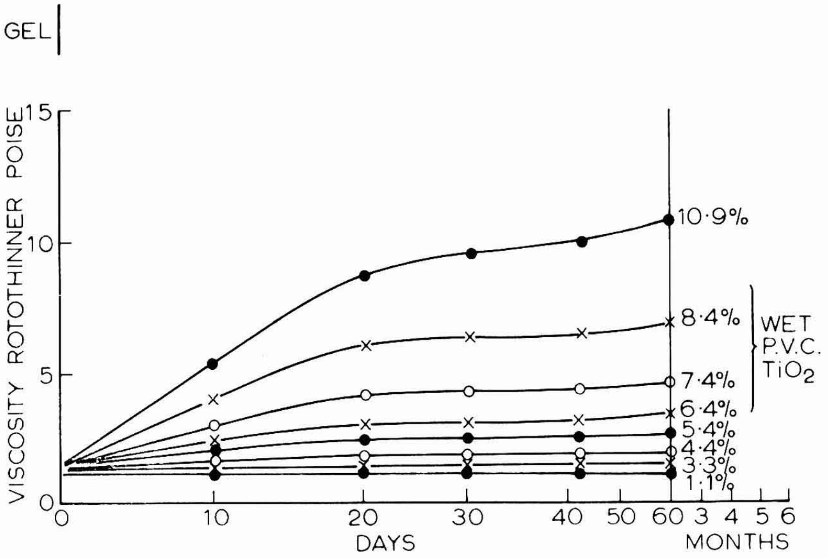


Fig. 7. Stability curves

Pigment: rutile pigment A
(concentration series)
Resin: Vinylite VMCH
Addition: nil

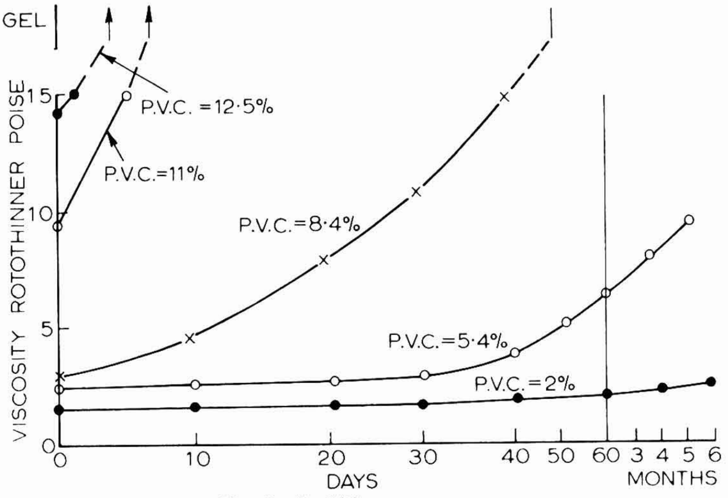


Fig. 8. Stability curves

Pigment: rutile pigment A
Resin: Vinylite VMCH
Addition: water 1%

Level of inorganic surface treatment

The total amount of inorganic surface treatment on titanium pigments which are commercially available ranges from 1 per cent-10 per cent. Pigments A, E, F and G were selected to represent examples over this range. The high treatment levels are designed to give the pigments improved performance in aqueous based systems, and would not be recommended for use in vinyl coatings. By extending the total treatment range tested, the individual roles of hydrous alumina and hydrous silica, with respect to the reactivity, can be studied.

Figs. 9 and 10 indicate the increase in reactivity with increase in the total treatment level for the normal paints (no moisture addition), and for paints with 1 per cent moisture added, respectively. A plot of the percentage of hydrous silica, the percentage of hydrous alumina, and the percentage of total inorganic hydrous oxide content against the increase in viscosity of the paints after ten days' storage at 25°C is given in Fig. 11. The correlation between the hydrous

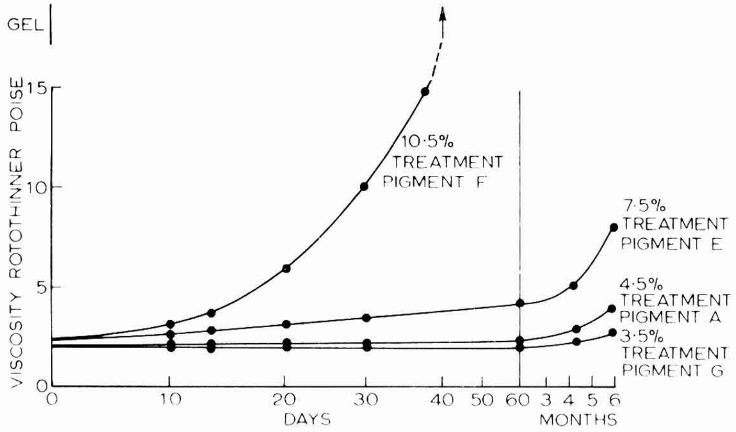


Fig. 9. Stability curves

Pigment: rutile, increasing surface treatment
Resin: Vinylite VMCH
Addition: nil

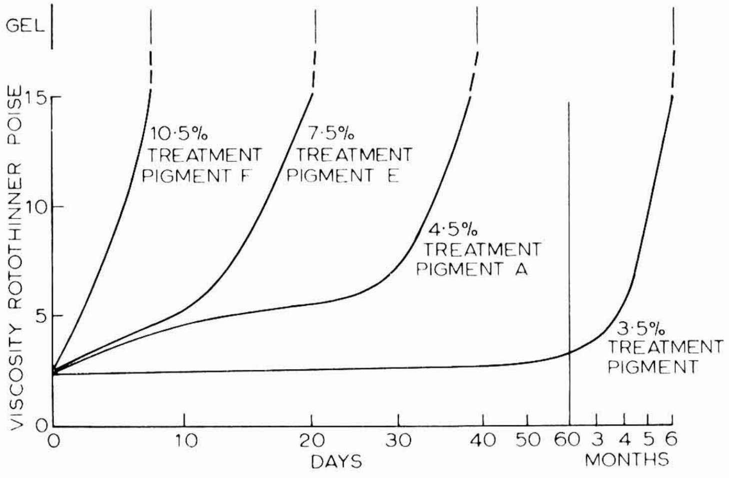


Fig. 10. Stability curves

Pigment: rutile, increasing surface treatment
Resin: Vinylite VMCH
Addition: 1% water

silica and the viscosity increase is linear. The relationship between the hydrous alumina and reactivity is not so significant. The total oxide curve is a combination of the effects of silica and alumina.

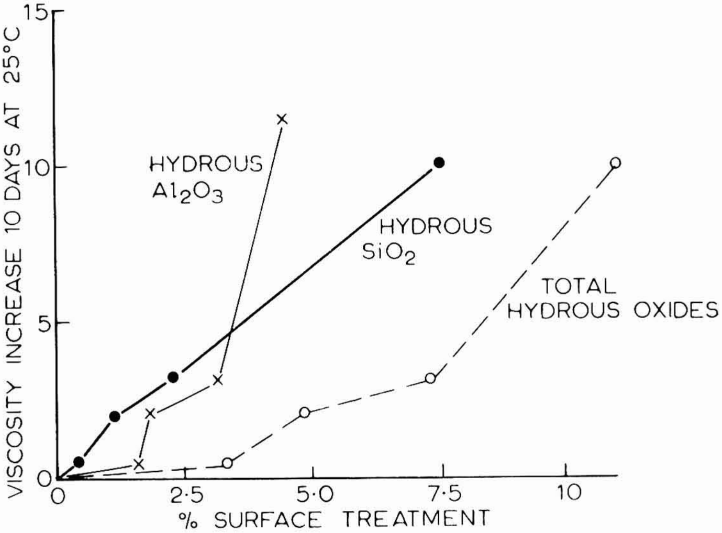


Fig. 11. Stability/surface treatment level

Contribution of zinc to the reactivity

Customer reaction to the non-stability of vinyl solution coatings has, in the past, raised the possibility of the contribution of zinc being the element responsible for the lack of stability. It is generally considered that zinc-containing pigments are more reactive that their zinc-free counterparts.

It has already been demonstrated that, in the absence of surface modifications, the presence of zinc has no effect on the viscosity of the paint, see Fig. 5, rutile pigment C. The same stability was found for different non surface-treated rutile pigments, modified with zinc and non-modified. The amount of zinc present, expressed as ZnO, was in the range 0.5-1.0 per cent.

When surface treatment is present, the effect of the zinc component is linked with other contributing factors. With surface treatment in the presence or absence of zinc, provided the pigment is at its equilibrium surface moisture level—0.2-0.4 per cent moisture—then the systems are stable for long periods. (Fig. 12.) When moisture is added, the pigment containing zinc is slightly more reactive than the zinc-free pigment. The additional reactivity directly attributable to zinc is significant, but very small, when compared to that produced by moisture, or the hydrous silica coating oxide.

On the other hand, the inclusion of pigmentary White Seal zinc oxide, as distinct from the zinc oxide calcined into the titanium dioxide pigment crystal, had a considerable effect on the viscosity increase. Table 2 gives the results of tests after three months. Where the paint has gelled during this time interval, the time to the gel stage is given in parenthesis.

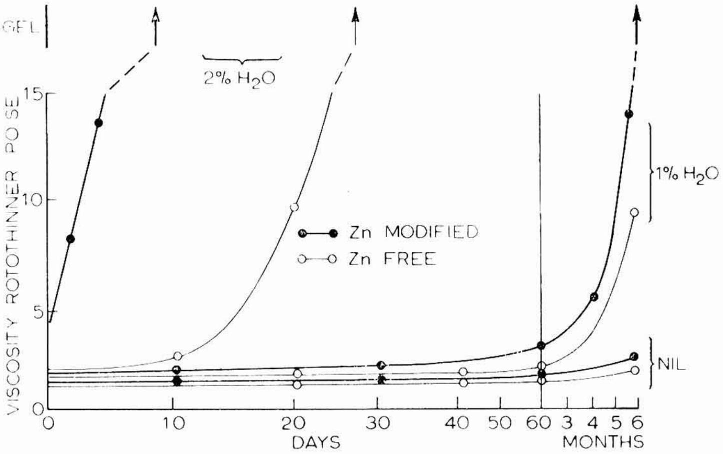


Fig. 12. Stability curves
Pigment: rutile, Zn modified + Zn free
Resin: Vinylite VMCH
Addition: water 1%; 2%

Table 2
Viscosity increase—3 months at 25° C

Pigment	Dry	0.5% H_2O	1% H_2O	2% H_2O
Pigment K (Zinc free)	+ 0.2 poise	+ 0.3 poise	+ 0.6 poise	Gelled (28 days)
Pigment K + 0.3% ZnO	Gelled (3 months)	Gelled (2½ months)	Gelled (36 days)	Gelled (10 days)
Pigment K + 0.6% ZnO	Gelled (2½ months)	Gelled (45 days)	Gelled (30 days)	Gelled (6 days)
Pigment K + 1.0% ZnO	Gelled (32 days)	Gelled (28 days)	Gelled (12 days)	Gelled (5 days)
Pigment G (0.8% Zn)*	+ 0.1 poise	+ 1.5 poise	+ 2.3 poise	Gelled (6 days)

*Pre-calcination addition.

The table shows the wide disparity in viscosity behaviour between the zinc oxide contents introduced into the system by the two different routes. In the case of the White Seal zinc oxide additions, all the paints have gelled within three months. The reaction has been accelerated significantly by the presence of water.

Titanium pigments surface modified with organic treatment

Apart from inorganic hydrous oxide coatings, some titanium pigments are further modified by the addition of an organic compound during the final stages of pigment processing. The additives are principally chosen from either aliphatic organic amines, or from aliphatic organic polyols.

Figs. 13 and 14 show examples of titanium pigments surface treated with an amine. Fig. 13 gives a direct comparison between pigment G, having no amine treatment and pigment I, having on its surface approximately 0.4 per cent amine. Even in the absence of moisture, the amine treatment has increased the reactivity when compared with the non amine-treated pigment. Inclusion of water, in the presence of the amine, has further increased the reactivity, gelling the paint within 20 days at all the three levels of water. The blank paint remained relatively stable throughout the six months, with the exception of the sample containing 2 per cent water.

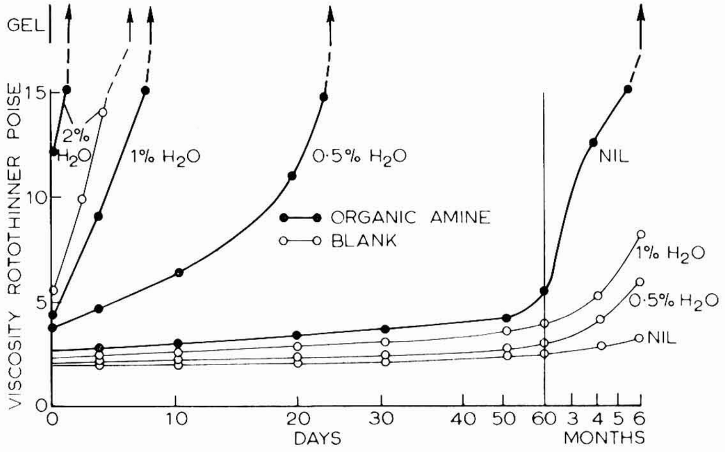


Fig. 13. Stability curves

Pigments: rutile G—inorganic treatment
rutile I—inorganic + amine treatment

Resin: Vinylite VMCH
Addition: water $\frac{1}{2}$%; 1%; 2%

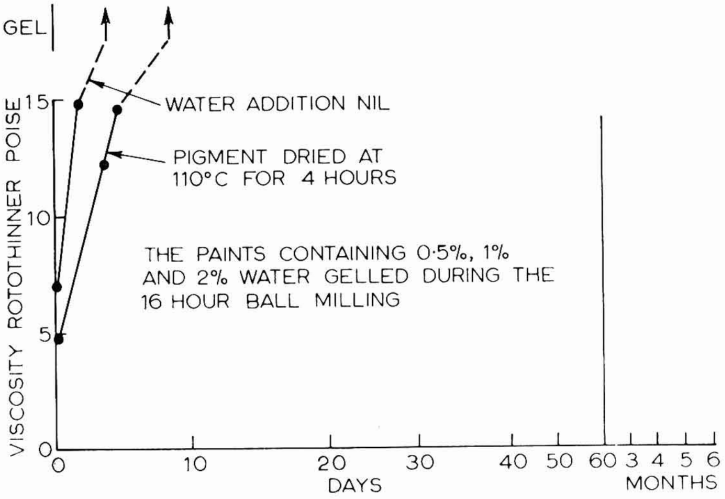


Fig. 14. Stability curves

Pigment J: rutile, inorganic and organic (amine) treatment
Resin: Vinylite VMCH
Addition: $\frac{1}{2}$%; 1%; 2% water

Where the inorganic surface treatment contains a larger proportion of hydrous silica, as well as an amine treatment, as shown by pigment J in Fig. 14, the reactivity is such that the paints containing 0.5, 1 and 2 per cent moisture gelled during the 16 hour ball milling period. One paint was prepared from a dry sample of pigment. Even this sample gelled within five days.

To confirm the effect of the amine on the viscosity increase, 1 per cent of triethanolamine was added to a paint showing poorer stability characteristics over a period of six months. This gave a rapid viscosity increase, to a gel stage within three-five days of paint making, as shown in Fig. 15. This indicates that the amine is reacting with the hydrous oxide pigment coating and the carboxylic resin groups in a similar manner to that obtained with the water addition.

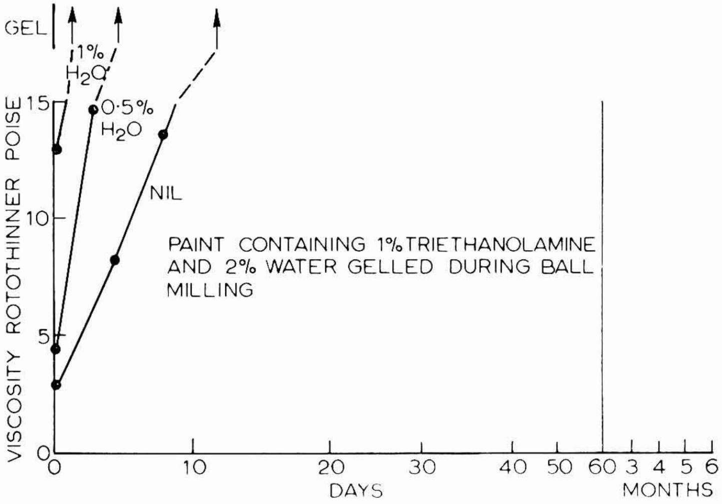


Fig. 15. Stability curves

Pigment: rutile pigment K
Resin: Vinylite VMCH
Addition: 1% triethanolamine, ½%; 1%; 2% water

The second main type of organic treatment and its effect on paint stability is reproduced in Fig. 16. The organically treated pigment, in this case treated with a polyol has reduced the reactivity compared with that of the blank pigment. In all cases, with or without the addition of moisture, the paint stability is improved. This is in marked contrast to the results found for the amine treatment.

Organic additives

The increase in reactivity caused by water added to the system has been demonstrated throughout this investigation. The reaction involves the COOH group in the resin, hydrous inorganic oxide at the pigment surface, and the presence of water. It is considered that the carboxyl group ionises in the presence of water and reacts with the pigment surface. This same mechanism is proposed when the water is replaced by amine. In the case of the polyol treatment, where the reactivity is reduced, the organic molecule is regarded as a stabiliser.

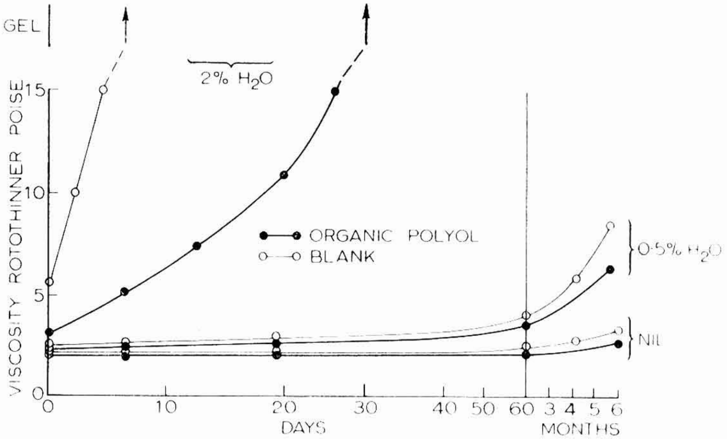


Fig. 16. Stability curves

Pigments: rutile G—inorganic treatment
rutile H—inorganic and organic polyol
Resin: Vinylite VMCH
Addition: water $\frac{1}{2}$%; 2%

The effect of other simple organic molecules containing a hydroxyl group was studied. Pigment A was chosen, and this pigment gave a measurable change in viscosity in the presence of water within two weeks. Fig. 17 shows the viscosity increases for simple alcohol additions and for bifunctional and trifunctional alcohols.

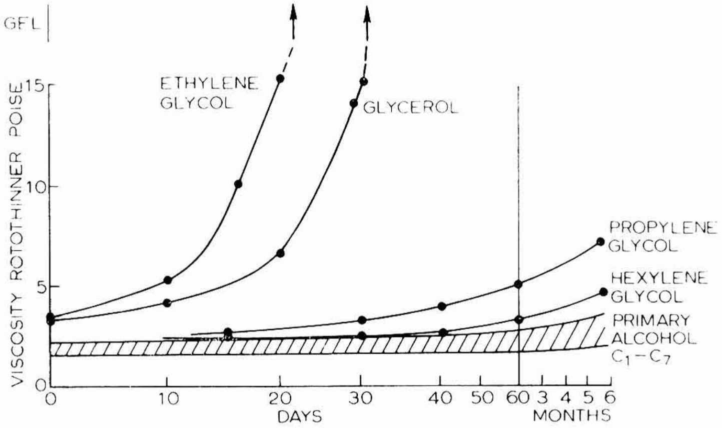


Fig. 17. Stability curves

Pigment: rutile pigment A
Resin: Vinylite VMCH
Addition: alcohols; polyols 2%

The simple alcohols do not affect the reaction rate and, in this respect, behave quite differently from water. The reactivity with glycols decreases in the series from ethylene glycol to hexylene glycol. The trifunctional glycerol is also reactive.

Ethylene glycol and glycerol are similar to water and amine in that they accelerate the reaction.

The addition of maleic or citric acid has a pronounced effect on the reactivity. These results are shown in Figs. 18 and 19 respectively. Maleic acid, at 0.1 and 0.2 per cent, increases the reaction rate in the presence of 1 per cent water. At 0.4 and 0.8 per cent it decreases the reaction rate.

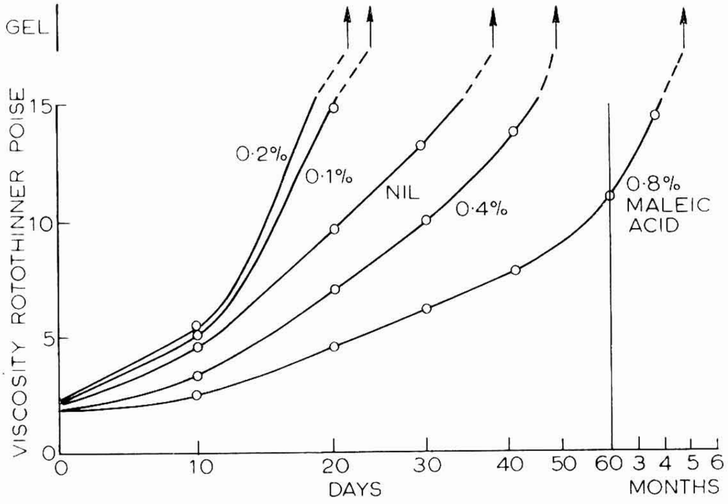


Fig. 18. Stability curves
Pigment: rutile pigment A
Resin: Vinylite VMCH
Addition: water 1% + maleic acid

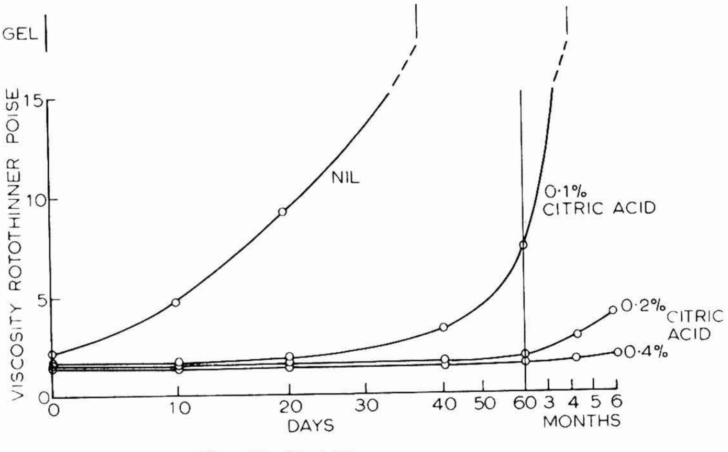


Fig. 19. Stability curves
Pigment: rutile pigment A
Resin: Vinylite VMCH
Addition: water 1% + citric acid

Citric acid is an effective stabiliser. In the presence of 1 per cent of water the addition of 0.1 per cent citric acid, calculated on the pigment weight, has a significant stabilising action. At 0.4 per cent, the system remains completely stable over the six month period.

The use of citric acid as a stabiliser will ensure long term can stability in vinyl solution coatings requiring stabilisation, when certain titanium dioxide pigments are used in the pigmentation.

Alternative acid-modified polymers

Vinylite VMCC: is a low viscosity version of the Vinylite VMCH copolymer. Solution coatings made at the same resin concentration, 16.7 per cent solid resin content, are much more stable than VMCH paints (see Fig. 20). At increased resin solids of 23 per cent, which give the same initial paint viscosity as the systems based on Vinylite VMCH, reactivity develops and is similar to the latter resin. Increasing the resin concentration, that is, increasing the number of reactive carboxyl groups in the system, increases the reactivity.

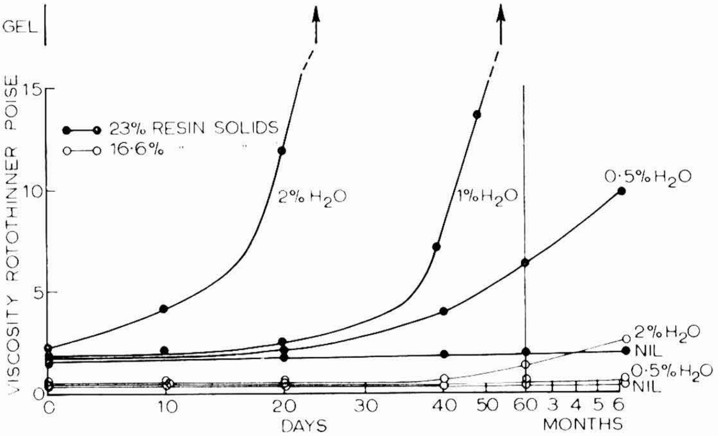


Fig. 20. Stability curves

Pigment: rutile pigment A
Resin: Vinylite VMCC
Addition: water ½%; 1%; 2%

An alternative supplier of vinyl solution resins is Wacker Chemie GmbH. Their grade Vinnol E15/45M contains interpolymerised maleic acid, and in this respect is similar to Vinylite VMCH. The manufacturing technique of the two suppliers is different. Union Carbide carry out a solution polymerisation, whereas Wacker Chemie employ an emulsion polymerisation technique.

Fig. 21 indicates the complete stability obtained when Vinnol E15/45M is pigmented with a reactive pigment in the presence of water. At both resin concentrations, 16.7 and 23 per cent, the viscosities remained completely stable throughout the six month period. The initial rise in the 23 per cent resin solid paints is accounted for by the solubility of this resin at the higher concentration. The resin solution itself was of high viscosity, and although apparently in solution when used, did increase in viscosity in the can over the first few days of storage, owing to more complete solution.

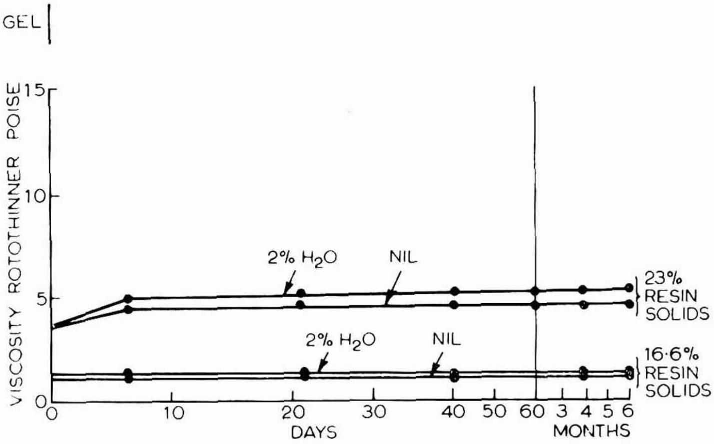


Fig. 21. Stability curves

Pigment: rutile pigment A
Resin: Vinnol E15/45 M
Addition: 2% water

The stability of this resin, containing the same proportion of carboxylic groups as the VMCH resin, yet behaving completely differently in practice, can be reconciled by considering the difference in manufacturing methods. Emulsion polymerisation will lead to a polymer of different distribution of molecular weight, with a different number of carboxyl groups per polymer unit. Also, the stabiliser additives required for an emulsion polymerisation process will be retained in the final dry product, and could be released in solvent solution to terminate any reactivity between the carboxyl groups, water, and a hydrous oxide modified titanium pigment.

Stability in the can is not the only property required from a solution vinyl coating. The selection of the resin, for overall adhesion and film integrity, must be balanced against the choice of a titanium pigment, for opacity, dispersibility, colour retention and durability. Interaction between the resin and the pigment should be at a minimum to guarantee an acceptable material retaining after many months of storage all the required characteristics that were designed into the formulation. A compromise may be necessary. The outline of reactivity presented here should enable formulators to understand the individual roles of the pigment and the resins and the part that is played by trace additions. These additives may be part of the formulation as in the case of a citric acid addition, or may occur accidentally, for example where the moisture contents of raw materials are above normal, owing to poor storage conditions.

Conclusions

It is shown that only one class of vinyl solution coating resins is reactive with certain surface modified titanium dioxide pigments. This resin class contains resins with interpolymerised maleic acid.

The method of manufacture of the maleic acid modified resins may influence their reactivity, since one emulsion polymerised resin gave stable paints, whereas two solution polymerised resins produced "reactive" paints.

Paint viscosity increases occur when three components are present:

a reactive resin,

a surface modified titanium dioxide pigment, particularly a pigment modified with hydrous silica,

moisture, amines, certain polyols.

In the absence of any one of these components, the systems are completely stable.

The increase in viscosity on storage can be retarded, or, in some cases, prevented, by the addition of citric acid to the formulation.

Non surface-modified anatase and rutile titanium pigments are non-reactive, even in the presence of added water.

A correlation between the viscosity increase and the amount of hydrous silica in the inorganic hydrous oxide coating has been established.

Zinc-free titanium dioxide pigments are intrinsically more stable than zinc-modified titanium pigments when their surfaces are modified with hydrous oxides. The reactivity attributable to the zinc modification is small compared to that when hydrous silica and moisture are present.

[Received 27 November 1969

Next month's issue

The Honorary Editor has accepted the following papers for publication and these are expected to appear in the September issue:

"Instrumental measurement of colour" *by J. Beresford.*

"Formulation of fungus-resistant paints. Part VII. Addition of metal 8-hydroxy quinolates" *by E. Hoffmann and A. Saracz.*

"Behaviour of polymeric coatings on steel during deep drawing" *by A. J. Duke and A. Gage.*

"A critical assessment of the precision of measurement associated with the use of the ICI pneumatic micro-indentor" *by R. G. J. Morris.*

Review

TRADE DESCRIPTIONS—PROSECUTIONS, ENFORCEMENTS AND COMPLAINTS

BY BOWES EGAN. London: LRS Publishers, 1970. Pp. 53 + index (vi). Price £3 5s 0d.

This book, as its title implies, gives a comprehensive account of the prosecutions, enforcements and complaints that have arisen as a result of the Trade Descriptions Act 1968. It is divided into eleven chapters, each dealing with some aspect of the subject, such as the physical description of goods; packaging, advertising and catalogue descriptions; false and misleading pricing; weights and measures authorities, etc.

It is of interest to note that only two instances have arisen with paint. One in which a paint was described as "white leadless," but in fact was just within the Ministry of Health limit of 1 per cent, and the other in which a material was described as "black undercoating," but was dark grey in colour. Admittedly, it was suitable as an undercoat for a black gloss paint. A prolonged controversy arose over the description of a mixture of white spirit and kerosene as a "turpentine substitute."

The book makes interesting reading for the general reader and should be helpful to those concerned with the description or pricing of goods. The price appears high in relation to the size of the book, but its compilation has, obviously, required a great deal of investigation.

S. R. FINN

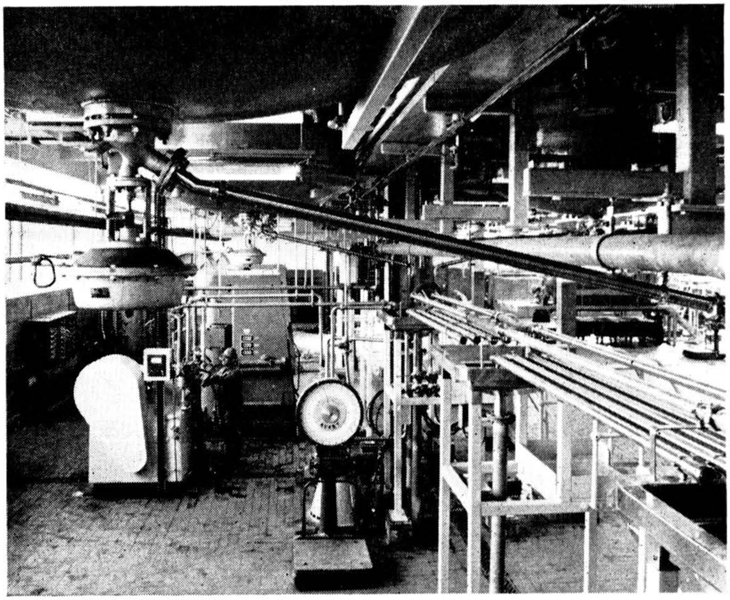
Information Received

(In case of difficulty regarding addresses, members and subscribers to the JOURNAL *should apply for details to Director & Secretary of the Association at the address shown on the front cover.)*

Geigy (UK) Ltd., Pigments Division, has further extended its 40 acre manufacturing unit at Paisley by the completion of a new £$\frac{3}{4}$ million "pigments elaboration plant," which was officially opened on 5 June by the Secretary of State for Scotland.

The purpose of the plant is to meet the increasing demand for "elaborated" or predispersed pigments by the paint, plastics, printing ink, paper and man-made fibre industries. It is anticipated that many of the dispersions made in the plant will be prepared to suit the particular needs of individual customers, according to the system into which the dispersion is to be incorporated. It is also expected that about 40 per cent of the output is likely to be exported.

Emphasis in the construction has been placed upon self containment and for this reason it has its own control laboratories and warehouse. Stainless steel has been largely used in the construction of the plant in order to obtain high quality products and to facilitate cleaning and washing down operations, especially where a change of colour of the product is involved. Almost all handling operations are carried out mechanically and are so designed as to give the maximum safety to operatives.



A view of the new plant

Following the opening ceremony a luncheon was held to celebrate the 21st anniversary of the Division at its Paisley site. Fundamental research is carried out in the Paisley laboratories in conjunction with Basle. The technical service laboratories are based on the Manchester factory.

Business Intelligence Services Ltd. is carrying out a syndicated survey and analysis of the industrial paint market in the United Kingdom, it has recently been announced. This follows an earlier study in the decorative field. The survey will be the result of some 600 interviews with paint manufacturers, specifiers and users in the industrial field.

The consumption in various sectors will be assessed, and it is hoped to obtain a view of technical developments in perspective. The study will also deal with the expectations of users in terms of commercial and technical services and the extent to which these are being met by existing suppliers.

A new catalogue describing the electrostatic spraying process and illustrating the *AEG* high production electrostatic paint spraying plant, has recently been prepared by **Mechanical Coatings Limited,** from whom copies are available on request.

A new paraxylene plant, with a capacity of 140,000 tons per year, has been commissioned at Wilton by **ICI Limited,** Heavy Organics Division. The plant, which is claimed to be the largest in the world, uses mixed xylenes feedstock from HOC Division's North Tees works, and operates by the ICI process for both the isomerisation of the feedstock, and separation of the paraxylene. Whilst most of the paraxylene will be used for ICI's polyester production, a considerable proportion is available for sale externally.

The Mond Division of ICI has recently issued a disc-guide for use in the selection of specialist paint systems to combat various problems in corrosion resistance. Seven different systems are given, and how each performs with respect to ten different criteria shown.

Johnson Matthey Chemicals Limited has recently issued a booklet entitled "Analytical services," giving full details of the company's facilities for elemental analysis of a wide range of materials.

It has recently been announced that **International Colloids Limited** is marketing vacuum packed Texas channel blacks manufactured by the **Sid Richardson Carbon Co.,** of the USA. International Colloids claim that there is a particular demand for grade *MC-74*, for use in high quality paints and printing inks.

"Berk today" is the title of a booklet issued by **Berk Limited** in this, its centenary year. The booklet gives a detailed picture of the company's broad operations throughout the world; copies are available from Berk on request.

The Du Pont Company is to build two new plants in the USA, it has recently been announced. A highly automated plant is being erected at Linden, New Jersey, for the manufacture of *Ludox* colloidal silica. The capacity of the plant is to be more than 100,000 tons per year, and, ultimately, it may double the company's capacity for colloidal silica.

The second plant, which, it is claimed, will be the world's biggest single integrated plant for the manufacture of aniline, is at Beaumont, Texas, and is expected to come on stream in 1972.

In view of the increase in the range of pigments and pigment dispersions now marketed by **Badische Anilin- & Soda-Fabrik AG,** this company has introduced a new, more rational, nomenclature system, based on four digit numbers derived from the colorimetrical data of defined dyeings. Range names will be unchanged. A booklet describing the new system is now available.

BASF has also added four new products to its product ranges. *Heliogen Blue 7100* is a new β-modification type, claimed to have clean shade and high transparency, particularly in cellulosic inks, and to have high colour strength in letterpress inks and paints. Two new phosphomolybdate lakes, *Fanal Violet PM 6110 N* and *Fanal Green PM 8330*, have been added to the *Fanal* range. *Euthylen White X22 C5* granules has been added to the *Euthylen* range of pigment dispersions, and is recommended for use in polyethylene or polypropylene film.

Johnson Pump AB, of Sweden, has recently introduced a new centrifugal pump specifically designed for the chemical industry. The internal parts of the pump are made of heat resistant pvc, and the pump shaft can be supplied in acid resistant steel or titanium, or if required, a model in which the shaft is fitted with a pvc sleeve is available.

The pump can be used with most corrosive materials, and provides an even, pulsation-free flow. Two models are available, the *C6* being larger than the *C3*, both having capacities of up to 300 litres per minute and a maximum pump pressure of 21 psi.

"Technical information sheet no. 14," from **Morris Ashby Limited,** gives further information on the *Merlin* melamine tinting pastes introduced at OCCA 22. The range now comprises four black pastes: *50M14 High Colour Channel Black*, *50M18 Medium High Colour Channel Black*, *51M37 Standard Colour Channel Black*, and *51M50 Vegetable Tinting Black;* and three coloured pastes: *51M44 Yellow Oxide*. *51M45 Red Oxide*, and *51M46 Phthalocyanine Blue*.

A new range of fungicidal paints which are completely non-poisonous to human and animal life has been introduced by **A. Leete & Co. Ltd.** The *Asipo* range, which includes gloss and emulsion types, is said to prevent all types of mould and fungus growth by an in situ reaction in the dry film.

Blundell-Permoglaze Ltd. has recently announced that *Timbercote*, a synthetic resin based clear timber finish containing a UV absorbing ingredient, is now available in the UK. Originally marketed in Australia, *Timbercote* has undergone extensive exposure testing at Hull to ensure that its properties were equally applicable to UK conditions. As a result of these investigations, the company is prepared to provide a written five year guarantee, by arrangement, in the case of suitably defined projects.

Technical information sheets are available from Blundell-Permoglaze.

Annual Report of the Council for 1969

Adopted at the Eighth Annual General Meeting of the Incorporated Association, held at the Ballerup Hall, East Kilbride, Lanarkshire, on 21 May 1970.

General

The most important development in 1969 was undoubtedly the successful registration as a charity of the Association. Certain amendments to the Memorandum were notified to members and were adopted at an Extraordinary General Meeting held immediately following the termination of the Annual General Meeting at the Grand Hotel, Eastbourne, on 20 June. Registration as a charity, which took effect early in July, in no way impedes the activities and future development of the Association, but substantial benefits will be gained, including remission of taxation on investment income, remission of Selective Employment Tax and relief on rates.

In the Report of the Council for 1968, information was given on the departure that year of Mr F. Sowerbutts (the then President of the Association) and his wife on a private sea cruise, during which they took the opportunity of visiting the Association's Sections in South Africa and New Zealand, as well as the newly formed Oil and Colour Chemists' Association Australia. At the Council meeting in February, members received Mr Sowerbutts' report which indicated that he had been able to give a great deal of information to the overseas Sections about the working of the Association and the financial aspects involved and had discussed matters of mutual interest which he hoped would be of ultimate benefit.

Mr and Mrs Sowerbutts were very appreciative of the friendliness and hospitality extended to them, particularly in view of the fact that their original plans had to be changed owing to a mechanical fault which developed in s.s. "Northern Star" involving a good deal of extra work for Section Officers in the alteration of certain meetings and social functions specially arranged to coincide with their visit.

Reports and photographs of the tour have subsequently appeared in the *Journal*, as well as in the Australian Association's publication *Proceedings and News*.

The Twenty-First Technical Exhibition (24-28 March) was held at Alexandra Palace, London, N22, and a report appears later under the Exhibition Committee's Report. A review of the Exhibition appeared in the May issue of the *Journal*.

The Association's Biennial Conference was held at the Grand Hotel, Eastbourne 17-21 June and was attended by nearly 350 members, non-members, guests and their ladies. The theme of the Conference was "Film formation and curing" and during the three morning technical sessions nine papers were presented. Three workshop sessions were arranged during one of the afternoons, the subjects being "The futility of artificial weathering," "The use of instrumentation in colour measurement" and "Surface preparation in relation to the application of paint" and all these sessions provoked lively and informative discussions.

The usual social functions and activities were held, details of which appeared, with photographs, in the Conference Diary in the August 1969 issue of the *Journal*. The papers presented at the Conference, together with the discussions which took place, were published in the September, October and November issues.

The Seventh Annual General Meeting of the Incorporated Association took place on Friday 20 June at the Grand Hotel, Eastbourne, when Mr A. S. Fraser was elected President. The following Vice-Presidents were elected:

Dr D. Atherton
Mr L. J. Brooke
Mr K. M. Engelbert
Dr H. A. Hampton
Mr A. H. McEwan
Mr W.J. McWaters
Mr H. Meyer

The Honorary Officers were elected as follows:

Honorary Secretary	Mr D. S. Newton
Honorary Treasurer	Mr A. W. Blenkinsop
Honorary Editor	Mr S. R. Finn
Honorary Research and Development Officer	Mr A. R. H. Tawn

The report of the Auditors on the scrutiny of the postal votes was received and it was announced that the following members had been elected to the Council for the years 1969-71:

Mr I. C. R. Bews
Mr R. N. Wheeler
Mr H. C. Worsdall

Votes of thanks to the retiring President, Council Members and Honorary Officers were carried with acclamation and on behalf of the Association the President presented a gold watch to Mr I. C. R. Bews who was retiring after his terms of service as Honorary Editor and then Honorary Secretary of the Association, and a tape recorder to Mr A. T. S. Rudram who was relinquishing his appointment as Honorary Research and Development Officer, having arranged the programmes for the Association's Conferences in 1965, 1967 and 1969.

The Annual General Meeting concluded with the presentation of certificates to the first recipients of the Jordan Award and a report appears later under the Jordan Award Committee's Report.

Immediately following the termination of the Annual General Meeting, the Extraordinary General Meeting (as reported in the opening paragraph) took place.

Full details of the proceedings of the Annual General Meeting and the Extraordinary General Meeting, with photographs, are contained in the August 1969 issue of the *Journal.*

At its meeting in January, Council was pleased to institute a Commendation Award for the purpose of according recognition to members for outstanding and long service to the Association, particularly at Section level. The first recipient of this Award, which takes the form of an illuminated scroll, was Mr W. J. McWaters who had served as the Honorary Treasurer of the Bristol Section for over 20 years, and the presentation was made to Mr McWaters by Mr L. J. Brooke (Vice-President) at the Bristol Section's Dinner Dance in February. A report of this presentation, with photographs, appeared in the May issue of the *Journal.*

A second Commendation Award was approved by Council at its meeting in October to the first recipient thereof overseas, namely Mr P. B. Hunt in recognition of his service to the Auckland Section. Mr Hunt received his scroll from Mr A. H. McEwan (Vice-President attached to the Wellington Section) at the Auckland Section's Ladies' Night in December. It is hoped that an account of this function will appear in an early 1970 issue of the *Journal.*

As well as technical meetings, all Sections held social functions during the year and some arranged works visits.

In conjunction with the Association's Technical Exhibition at Alexandra Palace in March, the London Section arranged its European Liaison Lecture which, on this occasion, was given by Dr K. H. Frangen and entitled "Progress in electrodeposition in Europe."

In September the Manchester Section held a very successful Symposium on "Recent advances in water-borne coatings" during which 13 papers were delivered by lecturers from the United Kingdom and overseas and which over three hundred people attended.

In October the first Symposium arranged by a Section on "Training and management in the surface coatings industry" was held in Birmingham by the Midlands Section and was attended by 100 people.

The Transvaal Branch of the South African Section, in collaboration with the South African Paint Manufacturers' Association, occupied and manned a stand at the first South African Chemical Industries Exhibition held in Johannesburg in July. The object of this was to encourage technical training and to attract technically trained personnel to the paint industry. This was the first time that this Association had participated in an exhibition in the Republic, which was considered particularly appropriate since 1969 was the twenty-first anniversary of the formation of the South African Section.

The New Zealand Sections again held a successful Convention in June at Wairakei.

Arising from a suggestion made by the Scottish Section Committee, Council sought the views of other Section Committees in connection with the provision of a Badge for Past Chairmen of Sections and, as a result of information received, approved the adoption of such a Badge at its meeting in February. The design of a lapel badge, with a brooch fitting, was duly accepted and it is hoped that these will be available for presentation by Sections to their Past Chairmen in the early part of 1970.

On the evening of 1 October, Members of Council had the pleasure of receiving seven Past Presidents, one Founder Member and eight Past Honorary Officers at the Reunion Dinner at Wax Chandlers' Hall. After Dinner the President gave the customary review of the Association's activities and followed this with a short history of the Tennant family, who founded and built up the Scottish pigment manufacturing company, Charles Tennant & Co. Limited. A full report and photograph appeared in the December issue of the *Journal.*

Council was saddened to learn of the deaths of two Past Presidents during the year; Mr J. A. Frome Wilkinson (President 1932-34) and Mr W. E. Wornum (President 1940-44), who died in February and April respectively. These members will be missed at future Association functions, particularly the Past Presidents' Dinner and it was as recently as at the Annual General Meeting at Scarborough in 1967 that Honorary Membership was accorded to the late Mr Wornum. Obituary notices appeared in the April and July issues of the *Journal* respectively.

Another Honorary Member who died in February was Mr A. H. Whittaker, who in 1933 was the prime mover in the formation of the Scottish Section and rendered service to that Section in several capacities. An obituary notice appeared in the April issue of the *Journal.*

The President of the Birmingham Paint, Varnish and Lacquer Club, Mr D. V. Woodfield, who had been a member attached to the Midlands Section of the Association for many years, died in office during the year. An obituary notice appeared in the November issue of the *Journal.*

In October, Mr A. Z. Molteni, a Founder Member of the Association, died. An obituary notice will appear in the *Journal* early in 1970.

From overseas, Council was sorry to learn of the death, in August, of Mr F. G. Adams who did much towards the formation of the original Australian Section of the Association and eventually served as Chairman of the New South Wales Section. Mr Adams' pioneering spirit was maintained by his work towards the formation of OCCA Australia.

Dr J. E. O. Mayne attended a meeting in May at Bad Ems of the Gesellschaft Deutscher Chemiker Fachgruppe Antrichstoffe und Pigmente and conveyed greetings from the Council. Also, the Chairman of the Bristol Section, Mr J. R. Taylor, conveyed greetings from the Council when giving a lecture to the Association Francaise des Techniciens des Peintures et Vernis—Ile de France Section.

During the year the secretariat have been pleased to help members when they visited the Association's office and of the members from overseas they were particularly pleased, in May, to meet Mr D. M. D. Stewart, the then incoming President of the Oil and Colour Chemists' Association Australia.

The Council wishes to place on record its sincere appreciation of the outstanding service rendered to the Association by the Director & Secretary, Mr R. H. Hamblin, and the members of his staff.

Membership of the Association

There were 273 elections during the year compared with 260 in 1968. The table shows the total strength of the Association as at 31 December 1969.

Section	*Ordinary*	*Associate*	*Honorary*	*Student*	*Total*
Bristol	75	22	—	3	100
Hull	71	8	—	2	81
Irish	50	22	—	12	84
London (including Southern Branch)	658	96	5	18	777
Manchester	363	58	1	25	447
Midlands (including Trent Valley Branch)	201	36	1	3	241

Newcastle	138	12	—	16	166
Scottish (including Eastern Branch)	113	37	—	37	187
Thames Valley	124	14	—	3	141
West Riding	66	15	—	17	98
Auckland	50	36	—	6	92
Wellington	49	19	—	—	68
South African	181	49	—	5	235
General Overseas	338	24	2	—	364
Total 1969	2,477	448	9	147	3,081
Total 1968	2,436	451	10	170	3,067
Net increase/decrease during 1969	+41	3	1	−23	+14

The Council

During the calendar year the Council has met six times, the average attendance being 22. All meetings were held in London.

Committees of the Council

The Committees of Council met as set forth below:

Exhibition Committee	2
Finance Committee	2
Jordan Award Committee	1
Liaison Committee	1
President's Advisory Committee	6
Publications Committee	1
Working Party on Education, Training and Qualifications	2

Exhibition Committee

Chairman—The Honorary Treasurer, Mr A. W. Blenkinsop

The Twenty-First Technical Exhibition was held 24-28 March at Alexandra Palace, London, N.22 and despite difficulties caused by an industrial dispute involving a ban on overtime by standfitters, the Exhibition opened on time.

The demand for space by exhibitors was so great that the Exhibition Committee, in a number of cases, was forced to allocate less than the space requested; nevertheless the Exhibition covered a larger floor area than any previous Exhibition.

It was not possible to assess the total number attending since the entrance feature (which incorporated electronic counters on previous occasions) was dispensed with in order that all effort could be channelled into work on the stands, but representatives from thirty-three overseas countries visited the Information Bureau and exhibitors commented on the large increase in the number of overseas visitors.

The Exhibition Luncheon was held at the Savoy Hotel, London, WC2 on 24 March and was attended by 250 members, exhibitors and other guests. The Principal Guest on this occasion was Lord Kings Norton. In his address, the President referred to important features in the preceding year's activities of the Association, which covered the Fiftieth Anniversary of the Association and the memorable Jubilee Celebrations. Mr Sowerbutts also referred to the Working Parties set up to consider the future of the Association and to study the educational, training and qualification needs in relation to the Industrial Training Act and its implications for the industries served by the Association.

Of the Exhibition, Mr Sowerbutts reminded his audience that this was the last to be held at Alexandra Palace and on behalf of the Exhibition Committee he thanked exhibitors for their patience and forebearance during the years which saw the difficulties of siting following a natural and inevitable growth which had earlier proved too great for the Royal Horticultural Society's Halls. Mr Sowerbutts felt certain that the continuing support and co-operation of exhibitors would help and successfully launch the Association's Exhibition in 1970 at Olympia.

Lord Kings Norton, in his reply, was clearly in harmony with the Association's endeavours in the world of education and training and he recounted his part in the evolution of degree level awards for students of technical colleges who achieved the necessary standards. Lord Kings Norton was glad that the Association was alive to the merits of sandwich courses and hoped that the Working Party would look hard and long in that direction.

On arriving at Alexandra Palace after the Luncheon, Lord Kings Norton performed the official opening ceremony and made a tour of the stands accompanied by the President, the Chairman of the Exhibition Committee and the Director & Secretary.

The theme of the Technical Education Stand on this occasion was "Polymer chemistry in paint" and once again it was staffed by representatives from technical colleges and the paint and printing ink industries. Parties of sixth form science students visited the Exhibition and before touring the stands were given an introductory talk by Mr G. H. Hutchinson on the variety of scientific interests involved in the industry and the opportunity for careers.

A review of the Exhibition appeared in the May issue of the *Journal* and the Exhibition Committee is particularly grateful to Mr J. A. L. Hawkey (Past Chairman of the London Section) who organised the reporting and collated the reports and comments received from a team of some 45 reporters.

Finance Committee

Chairman—The Honorary Treasurer, Mr A. W. Blenkinsop

During the year the Finance Committee has been following a policy of building up the Association's investments with a view to the possible purchase of a building for the Association's headquarters upon the expiration of the present lease on Wax Chandlers' Hall at the end of 1972. Accordingly further funds have been invested in equities and certain of the fixed interest stocks have been redeemed and the money realised transferred to equities. The result of the transfers from government securities into equities was a small surplus of £229, which is shown on the Income and Expenditure Account. For some years the Finance Committee has been recommending to the Council that the presentation of the Income and Expenditure Account to the members should be in a different format so as to show the apportionment of the administrative expenses between the various major activities of the Association and it is felt that members will appreciate the different way in which the accounts are set out this year. This shows rather more clearly the way in which income is derived and the proportions in which it is expended on the various activities.

It will be seen from the Balance Sheet that the holdings in government securities which the Association retained at the end of the year stood at £1,535 below their purchase price, whereas the market value of other quoted investments held at the end of 1969 showed an increase of £3,781 over their purchase price.

As already mentioned in the General part of the Annual Report, the registration of the Association as a charity has conferred substantial financial benefits upon the Association, not only for the future, but in enabling the Association to recover all the Selective Employment Tax paid since the inception of this Tax in the Autumn of 1966.

Jordan Award Committee

Chairman—The Honorary Research and Development Officer, Mr A. R. H. Tawn

The Committee appointed by Council to consider the applications received for the Jordan Award met in April and decided to divide the prize equally between Mr M. J. B. Franklin for his paper "The effect of zeta potential on the optical properties of paint" published in the June 1968 issue of the *Journal*, and Mr R. J. King for a dissertation on "Efficient film forming from thermosetting acrylic resins." As indicated in the general part of this Report, the President presented the certificates and cheques for £50 each to Mr Franklin and Mr King at the Annual General Meeting in Eastbourne on 20 June. Details of the presentations with photographs, appeared in the August issue of the *Journal*.

Liaison Committee

Chairman—The President

On the final evening at the Eastbourne Conference advantage was taken of the unique opportunity afforded by having the Presidents of all four societies (Fédération d'Associations de Techniciens des Industries des Peintures, Vernis, Emaux et Encres d'Imprimerie de l'Europe

Continentale, Federation of Societies for Paint Technology, Federation of Scandinavian Paint and Varnish Technologists and Oil and Colour Chemists' Association) present to hold a meeting of the Liaison Committee, at which matters of common interest were discussed.

The Director and Secretary reported that the Oil and Colour Chemists' Association Australia would very much like to join the Liaison Committee, but that it was felt it would be better at the present time for the Australian Association to be informed of activities, visiting members, etc. through the Oil and Colour Chemists' Association. This idea had been discussed with Mr D. M. D. Stewart, the in-coming President of the Oil and Colour Chemists' Association Australia during his visit to London and accepted by him. The other Presidents concurred with this and felt it would be a perfectly satisfactory arrangement.

Other items discussed concerned the exchange of information in respect of functions and the possibility of visiting members presenting papers at technical meetings, conventions, etc; the organisation of courses and the exchange of educational publications.

Light Fastness Committee

Chairman—Dr S. H. Bell

Although no meetings of this Committee have been held during the period under review co-operation has been maintained with other committees in this field.

President's Advisory Committee

Chairman—The President

It will be recalled that in the Report for 1968 reference was made to the setting up of the President's Advisory Committee comprising the Honorary Officers of the Association together with three Section Chairmen. Upon his election as President, Mr A. S. Fraser invited the Chairmen of the Manchester Section (Mr W. F. McDonnell), the Scottish Section (Mr J. Miller) and the Thames Valley Section (Mr K. R. W. Chitty) to serve on this Committee for the session 1969-70.

Publications Committee

Chairman—The Honorary Editor, Mr S. R. Finn

At the Annual General Meeting in June, Mr A. R. H. Tawn relinquished the position of Honorary Editor, which he had held since 1965. Council recorded its thanks to Mr Tawn for his work in the position, and Mr S. R. Finn was elected to take his place.

During 1969, forty-five papers were published, compared with 43 in 1968. The large increase in the overall size of the *Journal*, to 1212 pages compared with 1062 pages in 1968, was matched by an increase in the number of pages covered by Transactions and Communications to 750 (61.9 per cent) as against 638 pages (60.1 per cent) in 1968.

The Committee was pleased to see the inclusion of papers from the Eastbourne Conference, as well as those from the Symposium organised by the South African Section and the results of the Hull Section's Co-operative Research Project. Papers from the Symposia organised by the Manchester and Midlands Sections are in hand and, with papers from other sources, have provided enough material for the *Journal* for a large part of 1970.

An encouraging sign was the increase in the correspondence with the Honorary Editor published in the *Journal*, a total of sixteen items appearing in all. It is felt that this both reflects the interest in papers published and emphasises the importance of the *Journal* as an organ for dissemination and discussion of the latest developments in the science and technology of surface coatings. The Committee hopes to see this trend continued in 1970.

A total of twenty-five book reviews have appeared during the year and it is considered that these have been of an adequate standard. The Committee wishes to thank all those members who have undertaken the work of reviewing.

The Student Review section, introduced in 1968, contained eight papers in 1969, but no further material is now in hand. This section is considered most worthwhile for younger personnel in the industries, and papers of a basic nature suitable for inclusion would be most welcome.

Survey of published papers:

Section	1967	1968	1969
Bristol	—	2	1
Hull	—	6	1
Irish	—	—	—
London	7	4	6
Manchester	4	1	2
Midlands	1	—	—
Newcastle	2	1	—
New Zealand	—	—	—
Scottish	1	1	—
South African	—	—	3
Thames Valley	—	—	—
West Riding	—	2	—
Direct			
United Kingdom	8	11	9
Overseas	9	13	14
Conference	11	—	9
Foundation Lecture	—	1	—
	46	43	45

The Resins, Drying Oils, Varnishes and Paints Report for 1968, reprinted from the Annual Reports of the Society for Chemical Industry, was published in November, and the authors have agreed to prepare the Report for 1969.

The Committee received and approved a new version of the leaflet "Notes for Authors, Reviewers, Reporters and Lecturers." In view of the adoption of SI units by many industries, this edition is to be considered as an interim version, since the impending metrication, and possible adoption of SI units, might necessitate further modification within the next two years.

The second editions of Parts I and II of the Paint Technology Manuals were published in January.

At the Council meeting in November the Honorary Editor felt bound to report that the manuscript of Part VII of the Manuals needed considerable modification, and that it would not be ready for the publishers by the date originally anticipated. Subsequently, a meeting was held with Mr C. J. A. Taylor, Editor-in-Chief of the Manuals, at which a number of modifications were agreed, and a few sections have since been re-written. It is hoped that the manuscript can be submitted for publishing early in 1970.

Sales of the remaining Volumes continue satisfactorily, and it is now considered that the possibility of re-printing Parts III, IV and VI will not arise in the near future. Stocks of Part V are now low, and the Committee is investigating the possibility of the revision and re-printing of this Volume.

The Committee received an invitation from Dr J. S. Long, of the University of Southern Mississippi, to supply authors for various subjects in Volume IV ("Formulation") of the "Treatise on protective coatings" which Dr Long is editing in conjunction with Dr R. Myers of the Paint Research Institute. Members had contributed to an earlier Volume of the series, and the Committee is pleased to note that Mr A. R. H. Tawn, Mr R. H. E. Munn, Mr D. M. James and Mr J. B. G. Lewin have agreed to write chapters for Volume IV.

Technical Education Committee

Chairman—Dr H. W. Keenan

It will be recalled that in 1968 it was reported that the Technical Education Committee was being retained with a membership comprising only the President, Honorary Secretary, Honorary Editor and Dr H. W. Keenan until such time as the deliberations of the Working Party on Education Training and Qualifications (of which Dr Keenan is also Chairman) were complete. Mr C. J. A. Taylor, as Editor-in-Chief of the Paint Technology Manuals, who was formerly a member of the Technical Education Committee, is now serving as a member of the Publications Committee and details of the current position of the Manuals are given in the report of that Committee.

The Association was represented on other organisations, as follows:

Technical Training Board for the Printing Ink and Roller Making Industry: Mr. H. C. Worsdall and Dr C. H. Wisbey.

Paint Apprenticeship Council: Dr H. W. Keenan and Mr G. Copping.

Paint Trade Benevolent Fund: Mr G. Copping and Mr D. E. Roe.

The Parliamentary and Scientific Committee: The President and the Director and Secretary.

The British National Committee for Chemistry: Dr S. H. Bell.

City and Guilds Advisory Committee No. 9—Technology of Pigments, Paints Varnishes and Lacquers: Dr J. G. Gillan.

East Ham Technical College Advisory Committee: Mr R. M. W. W. Wilson.

Association of Exhibition Organisers: The Director and Secretary.

Programme Liaison Committee: The Honorary Programmes Officer of the London Section and the Director and Secretary.

The Paintmakers Association Training and Technical Education Committee: Dr H. W. Keenan and the Director and Secretary or the Honorary Secretary.

The Society of Dyers and Colourists Terms and Definitions Committee: Dr F. M. Smith and Dr J. Toole.

The Society of Dyers and Colourists Review of Coloration Progress Committee: Dr F. M. Smith.

The Colour Group (Great Britain): Mr R. Smith.

The British Colour Council Colour Institute Committee: The Director and Secretary.

Joint Society of Chemical Industry/Plastics Institute/Institution of the Rubber Industry/Society of Dyers and Colourists and Oil and Colour Chemists' Association Conference Committee: The Honorary Research and Development Officer and the Director and Secretary.

Institution of Corrosion Technology Education Committee: Mr F. G. Dunkley and the Hon. Secretary.

British Standards Institution:

PVC	Pigments, Paints and Varnishes Industry Committee	Dr J. B. Harrison
PVC/1	Pigments	Mr A. S. Lewis
PVC/1/9	Black Pigments	Mr J. S. Marsh
PVC/1/11	Extenders	Mr S. A. Ray
PVC/1/18	Zinc Dust Pigments	Mr D. S. Newton
PVC/3	Oils, Varnishes, Putty etc.	Mr G. H. Hutchinson
PVC/4 and PVC/4/1	Lac	Dr B. S. Gidvani
PVC/6	Cement Paints	Mr W. O. Nutt
PVC/8	Plastic Wood	Mr V. P. Gellay
PVC/10	Test Methods for Paints	Mr A. N. McKelvie
PVC/15	Water Paints and Distempers	Mr T. W. Wilkinson
PVC/16	Ready Mixed Paints	Mr G. A. Newell
PVC/19	Bituminous Paint	Dr H. B. Footner
PVC/20	Calcium Plumbate Priming Paints	Mr A. G. Walker
PVC/23	Zinc Rich Paints	Dr D. Atherton
PVC/24	Water Thinned Priming Paints	Mr J. E. Pooley
PVC/25	Organic Finishes for Aluminium Windows	Dr J. B. Ley
LGE/9	Artificial Daylight for Colour Matching	Miss D. L. Tilleard
C/17	Viscosity	Miss D. L. Tilleard
C/17/2	Revision of BS.188 (Drafting)	Miss D. L. Tilleard
CHE/43	Test Sieves	Mr M. J. F. Meason
CHE/50	Test Methods for Powder Properties	Mr D. S. Newton
CIC/4	Solvents and Allied Products	Dr L. A. O'Neill
OFFA/6	Glycerine	Mr M. R. Mills
OFFA/7	Sampling Oilseeds, Oils and Fats	Mr M. R. Mills
OFFA/12	Vegetable Oils	Mr M. R. Mills

OFFA/24	Analysis of Oilseeds, Oils and Fats	Mr M. R. Mills
ELE/16/53/6	Varnishes	Mr J. McGowan
ACE/44	Aircraft Finishes	Mr J. B. G. Lewin
BLCP/18	Code of Practice: Painting	Mr P. J. Gay
M/36	Artists' Materials	Mr J. A. L. Hawkey
RDE/25	Road Marking Compounds	Mr T. R. Bullett
OC/20/4/12	Chemistry and Chemical Technology	Mr J. Orpwood

Reports from the above representatives may be seen by members at the Association's offices.

The Association was also represented on overseas organisations as follows:

Natal Association of Scientific and Technical Societies: Mr H. A. J. van der Merwe.

Educational Administrative Committee of the Natal Technical College: Mr K. R. McDonald.

New Zealand Paint Manufacturers' Association Technical Committee: Mr T. Whitfield and Mr G. J. Juster.

New Zealand Corrosion Association: Mr P. B. Hunt.

New Zealand Standards Association: Mr T. Whitfield.

Appendix

Report of the Council in accordance with the Companies Act 1967.

1. The Council presents herewith the audited accounts of the Association for the year ended 31 December 1969.

2. *Results*

   The results for the year and the appropriation thereof are set out in the Income and Expenditure Accounts on pages 14–16.

3. *Principal Activities of the Association*

   The Association has continued in its work of furthering the development of the science and technology of the oil and colour industries.

4. *Changes in fixed assets*

   The movement in fixed assets during the year is set out in the table on page 15. There were no significant changes during the year.

5. *The Council*

   The following were members of Council at 31 December 1969:

A. S. Fraser	
F. Sowerbutts, BScTech	
D. S. Newton, AMCT, CGIA, FInstCorrT	
A. W. Blenkinsop	
S. R. Finn, BSc, FRIC	elected 20 June 1969
A R. H. Tawn, FRIC, FInstPet	
D. Atherton, BSc, PhD	
L. J. Brooke	
K. M. Engelbert	
A. H. McEwan	elected 20 June 1969
W. J. McWaters	elected 20 June 1969
H. Meyer, MSc	
H. A. Hampton, BSc, PhD	
T. A. Banfield, BSc, PhD, DIC, ARCS, FRIC	
A. E. Claxton, BSc, ARCS	
I. S. Moll, BSc	
I. C. R. Bews, BSc, ARIC	
R. N. Wheeler, BA, ARIC	
H. C. Worsdall	elected 20 June 1969
J. R. Taylor, BSc, FRIC	
E. A. Brown	
S. McWade	elected 18 April 1969
J. E. Pooley, BSc, ARIC	
W. F. McDonnell, FRIC, AMBIM	
D. J. Morris	
D. H. Tate	elected 2 Oct. 1969
J. Miller	
K. R. W. Chitty	
L. J. Watkinson, MSc, PhD, ARIC	
N. F. Lythgoe	elected 1 April 1969
W. A. Grainger	elected 18 April 1969
J. Tooke-Kirby	elected 24 April 1969
F. M. Smith, BSc, PhD, ARIC	
R. F. Hill, BSc, ARIC, ACT, API	elected 25 April 1969
A. A. Duell, ARIC	elected 3 April 1969
D. Rowley	elected 11 April 1969
B. Jacob, BSc	elected 9 April 1969
Mrs K. Driver	elected 22 April 1969
P. A. Draper	
T. W. Slinn	
G. J. Juster	

A. Lowe, MSc, PhD	elected 27 Nov. 1969
G. Willison, FRIC	elected 20 June 1969

In addition the following were members of Council at 1 January 1969 and served during the year; the date shown after each name denotes when service on Council terminated:

P. J. Gay, BSc	(20 June 1969)
S. G. Tinsley, BA, BSc, FRIC	(20 June 1969)
A. T. S. Rudram	(20 June 1969)
F. Cooper, BSc	(20 June 1969)
J. Smethurst, AMCT	(20 June 1969)
J. A. L. Hawkey	(20 June 1969)
P. Birrell, BSc, FRIC	(11 April 1969)
E. A. Armstrong, AMBIM	(1 April 1969)
R. Adam	(18 April 1969)
G. Y. Blomeley	(18 April 1969)
D. J. Silsby	(25 April 1969)
D. M. James, BSc, FRIC	(3 April 1969)
J. A. Willey, BSc, ARIC	(2 Oct. 1969)
A. G. Holt	(9 April 1969)
L. H. Silver	(22 April 1969)

6. *Auditors*

The auditors, Cooper Brothers & Co., will continue in office in accordance with Section 159(2) of the Companies Act, 1948.

By Order of the Council
ROBERT HAMBLIN
Director and Secretary.

1 January 1970.

Oil and Colour Chemists' Association

BALANCE SHEET as at 31 December 1969

1968 £	*1968* £		£	£
		ACCUMULATED FUND—		
		Balance at 31 December 1968	35,887	
		Add Surplus for the year	6,972	
35,887				42,859
		CURRENT LIABILITIES—		
	5,820	Creditors and Accrued Liabilities	7,047	
	30,933	Receipts in Advance ..	37,240	
	572	Provision for Technical Activities	573	
	407	Provision for Paint Technology Manuals ..	482	
	444	Provision for United Kingdom Corporation Tax	363	
38,176				45,705
£74,063				£88,564

A. S. FRASER
President

A. W. BLENKINSOP
Hon. Treasurer

R. H. HAMBLIN
Director and Secretary

1968 £	*1968* £		£	£
		FIXED ASSETS—		
		Furniture, Fittings, Car and Office Machines		
	6,747	at cost	7,303	
	4,471	*Less* Accumulated Depreciation	4,962	
2,276				2,341
		QUOTED INVESTMENTS—		
	15,275	British Government and Local Authority Securities at cost: (Market value £11,673)	13,208	
	13,151	Other investments—at cost (Market value £30,701)	26,920	
		UNQUOTED INVESTMENTS—		
	3,240	British Government Securities at cost ..	300	
31,666				40,428
		CURRENT ASSETS—		
	761	STOCK OF UNSOLD PUBLICATIONS—At cost ..	616	
	1,168	PAPER—Stock in hand at cost	1,299	
	13,248	DEBTORS AND PAYMENTS IN ADVANCE	12,958	
	24,944	Cash and Bank Balances in United Kingdom and Overseas Sections ..	30,922	
40,121				45,795
£74,063				£88,564

REPORT OF THE AUDITORS TO THE MEMBERS

Annual accounts submitted by the United Kingdom and Overseas Sections have been incorporated in these accounts, but the assets, liabilities and expenditure included therein have not been verified by us. With this reservation in our opinion the accounts set out on pages 13 to 16 give a true and fair view of the Association's affairs at 31 December 1969 and of its results for the year ended on that date and comply with the Companies Acts 1948 and 1967.

COOPER BROTHERS & CO.
Chartered Accountants.

London, 3 April 1970.

INCOME & EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31 DECEMBER 1969

1968 £			£	£
		INCOME		
		Membership and general income		
	14,669	Subscriptions	14,698	
	125	Entrance Fees	142	
	888	Sundry publications	1,046	
	2,408	Investment income (gross)	2,701	
	—	Surplus on sale of investments	229	
	—	Refund of S.E.T. for prior years	1,194	
	63	Differences on exchange and devaluation	—	
	15	Profit on sale of furniture	—	
18,168				20,010
		Journal receipts		
	14,638	Advertising	13,026	
	9,590	Sales	10,295	
	1,676	Capitation fees OCCA Australia	1,961	
	1,260	Reprints	1,253	
27,164				26,535
35,274		Exhibition receipts		40,506
£80,606				£87,051
		EXPENDITURE		
		Membership and general expenses		
	7,563	Administration expenses (Note 4)	7,844	
	8,231	Journal	8,855	
	3,485	Postage, printing and stationery	4,052	
	1,133	Publications	1,028	
	1,898	Section expenditure (Note 5)	1,447	
	200	Past Presidents Dinner	239	
	1,072	United Kingdom taxation	686	
	200	Provision for Paint Technology Manuals	100	
	—	Eastbourne Conference	247	
	—	Recruitment circular	179	
	425	Deficit on South African Convention	—	
	1,416	History of Association and Register of Members	—	
	877	50th Anniversary celebrations	—	
	1,946	General expenses	1,894	
28,446				26,571
		Journal expenses		
	7,562	Administration expenses (Note 4)	7,844	
	10,059	Printing and publication	10,821	
	901	Reprints	928	
	1,435	Postage and stationery	1,755	
	98	Provision for bad debts	180	
	486	General expenses	473	
20,541				22,001
		Exhibition expenses		
	20,758	Direct expenses	23,190	
	7,562	Administration expenses (Note 4)	7,844	
	486	General expenses	473	
28,806				31,507
£77,793				£80,079
£2,813		Surplus for the year		£6,972

NOTES ON THE ACCOUNTS

1. *Fixed Assets*

	£	£
Cost		
At 31 December 1968	6,747	
Additions	636	
	7,383	
Less Disposals	80	
		7,303
Depreciation		
At 31 December 1968	4,471	
Charged to Income and Expenditure Account	555	
	5,026	
Less Disposals	64	
		4,962
Net book value at 31 December 1969		£2,341

2. *Foreign Currencies*

(a) Foreign currencies and liabilities have been converted at the following rates:

New Zealand	$2.1425
South Africa	Rands 1.714

(b) Overseas section expenditure has been converted to sterling at the above rates.

(c) The basis of conversion of New Zealand and South African membership subscriptions is the sterling rate of £5 5s 0d per full member and £1 1s 0d per student member. Entrance fees have been converted at 10s per member.

3. The Ethel Behrens Fund and the Jordan Award Fund have not been incorporated in the Association's Income and Expenditure Account and Balance Sheet but have been shown as separate accounts. When the Association was registered as a charity in July 1969, the Ethel Behrens Fund was not accepted for charitable status and, as a consequence, the tax on investment interest is now shown on this account instead of the main account.

4. *Administration Expenses*

Administration expenses have been equally apportioned between the three main headings of expenditure in the Income and Expenditure Account on the basis of staff time involved. These expenses are:

1968 £		£
16,308	Salaries	17,347
770	Temporary staff	692
653	Welfare	657
4,173	Rent, rates, lighting, telephone	3,918
145	Audit fee	263
80	Provision for dilapidations	100
558	Provision for depreciation	555
£22,687		£23,532

The charge to each heading is therefore £7,844 (1968 £7,562).

5. *Section Expenditure*

The section expenditure is as follows:

1968 £		£
96	Bristol	92
12	Hull	47
108	Irish	214
306	London (Southern Branch £44)	515
320	Manchester	(459)
180	Midlands (Trent Valley Branch £81)	220
68	Newcastle	117
210	Scottish (Eastern Branch £65)	247
102	Thames Valley	97
93	West Riding	66
134	Auckland	82
77	Wellington	114
192	South Africa	95
£1,898		£1,447

Ethel Behrens Fund

INCOME & EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31 DECEMBER 1969

1968 £	*Expenditure*	£	*1968* £	*Income*	£
95	S.L.F. Congress—Travelling expenses	—	*135*	Interest on Investment (Gross)	135
328	President's Travelling expenses in Australia	—	*288*	Deficit for Year	—
—	Tax on Investment Interest	28			
—	Surplus for year	107			
£423		£135	*£423*		£135

BALANCE SHEET as at 31 December 1969

1968 £	*Liabilities*	£	*1968* £	*Assets*	£
2,442	Accumulated Fund	2,442	*2,442*	British Government Securities at cost	2,442
—	*Add* Surplus	107	*224*	Balance at Bankers	107
224	Creditor	—			
£2,666		£2,549	*£2,666*		£2,549

Jordan Award Fund

INCOME & EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31 DECEMBER 1969

1968 £	*Expenditure*	£	*1968* £	*Income*	£
—	Awards	100	*65*	Interest on Investments (Gross)	66
—	Illuminated Addresses	5	—	Deficit for Year	39
65	Surplus for Year	—			
£65		£105	*£65*		£105

BALANCE SHEET as at 31 December 1969

1968 £	*Liabilities*	£	*1968* £	*Assets*	£
1,128	Accumulated Fund	1,128	*1,000*	British Government Securities at cost	1,000
—	*Less* Deficit for year	39	*128*	Balance at Bankers	89
£1,128		£1,089	*£1,128*		£1,089

Proceedings of the Annual General Meeting

The Eighth Annual General Meeting of the Incorporated Association was held on 21 May 1970 at 5.30 p.m. at the Ballerup Hall, East Kilbride, Lanarkshire, with the President (Mr A. S. Fraser) in the Chair.

The notice convening the meeting was read.

Apologies

Apologies for absence were received from Mr L. J. Brooke, Mr F. Cooper, Dr H. A. Hampton, Mr G. H. Hutchinson, Mr I. S. Moll, Mr L. H. Silver, Mr L. J. Sim, Mr F. Sowerbutts and Mr R. N. Wheeler.

Minutes

The President asked the meeting to take as read the Minutes of the Seventh Annual General Meeting and the Extraordinary General Meeting held on 20 June 1969, as printed and circulated in *JOCCA* pp. 767-774 inclusive, August 1969. There being no comments the adoption of the Minutes was put to the Meeting and carried unanimously. The President then signed the Minutes.

Report of the Auditors to the Members

The Report of the Auditors to the Members was read.

Mr A. W. Blenkinsop—President Designate

Mr F. Cooper—Hon. Treasurer

Annual Report of the Council for 1969

Mr D. S. Newton (Honorary Secretary) moved the adoption of the Annual Report of the Council and the Statement of Accounts for 1969.

Mr A. W. Blenkinsop (Honorary Treasurer) seconded the adoption of the Annual Report of the Council and Statement of Accounts for 1969.

The Chairman asked if any member wished to comment on the Annual Report of the Council and the Statement of Accounts.

Mr W. F. McDonnell asked three short questions concerning the possibility of the Association purchasing a property on the expiration of the lease on the present offices, the surplus achieved by the Manchester Section in 1969, and the present position resulting from the deliberations of the Working Party on Education Training and Qualifications. The Director & Secretary gave replies to these points to the satisfaction of Mr McDonnell.

There being no further comments or questions on the Annual Report of the Council and Statement of Accounts, these were formally adopted by the meeting.

Appointment of President Designate

The President stated that, as indicated on the Agenda, Mr A. W. Blenkinsop (Honorary Treasurer) had been appointed by Council (in accordance with Article 65(A)) as President Designate of the Association for the forthcoming session.

Election of Vice-Presidents of the Association

The President read the nominations of the Council, as printed on the Agenda and asked the meeting to accept them en bloc. This was agreed. The following were then elected as Vice-Presidents:

(*a*) Vice-Presidents who have not been President:

(*i*) Mr A. H. McEwan
(*ii*) Mr W. J. McWaters
(*iii*) Mr I. S. Moll
(*iv*) Mr C. H. Morris
(*v*) Mr F. Schollick
(*vi*) Mr L. H. Silver

(*b*) Vice-President who has been President:

Dr S. H. Bell

Election of Honorary Officers of the Association

It was unanimously agreed to elect the Honorary Officers as follows:

Honorary Secretary	Mr D. S. Newton
Honorary Treasurer	Mr F. Cooper
Honorary Editor	Mr S. R. Finn
Honorary Research and Development Officer ..	Mr A. R. H. Tawn

Appointment of Honorary Members

The President stated that Council was pleased to confer Honorary Membership of the Association on two Past Presidents, Dr H. A. Hampton and Mr F. Sowerbutts, but unfortunately neither of these Members was able to attend this meeting to receive their Scrolls of Honorary Membership. Dr Hampton's health would not permit him to make the long journey from Hampshire to East Kilbride, and Mr Sowerbutts was unable to leave his wife who had, the day before the meeting, returned home after undergoing a major operation in the London Clinic.

Mr Fraser took the opportunity, however, of reading to the meeting the citation in each scroll, and indicated that these would be presented to Dr Hampton and Mr Sowerbutts at another suitable Association function later in the year.

The citations read as follows:

HONORARY MEMBERSHIP

was this day conferred upon

HORACE ARTHUR HAMPTON

Bachelor of Science
Doctor of Philosophy

In recognition of his distinguished service to the Association as Honorary Publications Secretary of the Manchester Section (1943-47), Chairman of that Section (1948-50), Elective Member of Council (1945-47), Vice-President (1951-53 and 1968-70), Representative on the Council of the South African Section (1951-69), Honorary Treasurer of the Association (1957-60), President Designate (1960) and President (1961-63) and as an Editor of the History of the Association published at the time of the Association's Fiftieth Anniversary Celebrations, and to express the admiration of the members for the way in which he discharged the duties of these offices and for his constant endeavours to further the aims and activities of this Association.

Signed A. S. Fraser, President.
D. S. Newton, Honorary Secretary.
21 May 1970. *R. H. Hamblin, Director & Secretary.*

HONORARY MEMBERSHIP

was this day conferred upon

FRANK SOWERBUTTS

Bachelor of Technical Science

In recognition of his distinguished service over a period of forty-five years during which he was connected with the foundation of the Manchester Section, of which he was the Honorary Treasurer for fifteen years (1927-42), and the Midlands Section, of which he was the Founder Chairman (1948-50); Elective Member of Council (1932-34, 1936-38, 1941-43, 1951-53 and 1956-58), Vice-President (1952-54 and 1958-60), Honorary Treasurer of the Association (1960-66), Chairman of the Exhibition Committee (1962-66), President Designate (1966) and President (1967-69) and to express the admiration of the members for the way in which he presided with distinction over the Association's Fiftieth Anniversary Celebrations in 1968, was indefatigable in visiting the Sections and also in maintaining the liaison with kindred associations both in this country and overseas.

Signed A. S. Fraser, President.
D. S. Newton, Honorary Secretary.
21 May 1970. *R. H. Hamblin, Director & Secretary.*

Announcement of election of three Elective Members to Council 1970-72

The President read the following report which had been received from the Auditors:

> *We have scrutinised the voting papers for the three elected members of the Council received from the members in the United Kingdom and General Overseas Sections, and certify that the votes cast show that the following obtained the largest number of votes:*
>
> *J. E. Mitchell* *A. G. Holt* *D. M. James*
>
> *Four voting papers were rejected as not being in order.*
>
> *London,*
> *14 May 1970.*
>
> *Cooper Brothers & Co.,*
> *Chartered Accountants.*

The President then declared these three members listed elected to Council for the sessions 1970-72.

Chairmen of Sections for the coming session

The names of the Section Chairmen for the coming year were given as follows:

Auckland	Mr O. E. Rutledge
Bristol	Mr J. R. Taylor
Hull	Mr N. F. Lythgoe
Irish	Mr S. McWade
London	Mr J. E. Pooley
Manchester	Dr F. M. Smith
Midlands	Mr H. J. Griffiths
Newcastle	Mr D. H. Tate
Scottish	Mr R. G. Gardiner
South African	Mr L. F. Saunders
Thames Valley	Mr B. Jacob
Wellington	Mr T. W. Slinn
West Riding	Dr L. J. Watkinson

Reappointment of Auditors and fixing the remuneration thereof

It was proposed by Mr L. Hopwood that Cooper Brother & Company (Chartered Accountants) be reappointed Auditors of the Association and that their fee be 250 guineas. This was seconded by Mr H. R. Touchin and carried unanimously.

Vote of thanks to retiring Council Members

The President called upon Mr J. A. L. Hawkey to propose a vote of thanks to the members retiring from Council.

Mr Hawkey referred to all the Members who were retiring from Council and, from personal experience, stated that Members who served in this way found themselves in circumstances similar to the crew of a boat right from their first meeting. No decision was reached without a good deal of consideration and discussion and, in proposing this vote of thanks, Mr Hawkey wished to include appreciation for all that these Members had done at Section Committee level as well as on Council and make it clear how much their efforts were valued.

This was carried with acclamation.

Vote of thanks to the Honorary Officers of the Association

Mr D. J. Morris stated that the work undertaken by the Honorary Officers of the Association was reflected in the current high standards within the Association. He referred to Mr A. W. Blenkinsop who had served as Honorary Treasurer and was now elevated to President-Designate, and felt sure that he would bring to his new office the same qualities which had made him such an able Honorary Treasurer. He was very pleased to know that the new Honorary Treasurer was Mr F. Cooper, who for many years had been an active Member of the Association, attached to the Midlands Section.

The Honorary Secretary, Mr D. S. Newton, was well known to most Members at the meeting, and Mr Morris expressed thanks for the work he undertook in that office.

The results of the activities of Mr S. R. Finn as Honorary Editor were shown in the *Journal*, and it was obvious that he was following the high standards already set for this publication.

It was unfortunate that Mr A. R. H. Tawn (the Honorary Research and Development Officer) was unable to attend the meeting but he too could be expected to set a high standard and was a very fine Honorary Research and Development Officer, whose services Mr Morris hoped the Association could retain for some time to come.

The vote of thanks was carried with acclamation.

Vote of thanks to Chairman of the meeting

The Director & Secretary called upon Dr D. Atherton to move a vote of thanks to the President as Chairman of the meeting.

Dr Atherton reminded the meeting of the service Mr Fraser had given as Treasurer and later as Chairman of the Scottish Section, which had been followed by his term of office as Honorary Treasurer of the Association and now as President. Mr Fraser had always given a great deal of energy to his work for the Association and had combined his firmness with tact and good humour. The Scottish Section was delighted that his term of office should have coincided with the current highly successful Symposium at East Kilbride and Dr Atherton stated that it gave him the greatest of pleasure in proposing a vote of thanks to Mr Fraser, not only for conducting this meeting but also for the achievements of his first year of office, and he took the opportunity of wishing Mr Fraser every success in his second year as President of the Association.

The vote of thanks was carried with acclamation.

There being no other competent business, the President declared the meeting closed at 5.50 p.m.

Midlands

Trent Valley Branch

Operating and design principles of high speed dispersers

A meeting of the Trent Valley Branch of the Midlands Section was held on Thursday 23 April in the T1 Main Lecture Theatre, Applied Science Building, Nottingham University, when Mr Frederick K. Daniel, of Daniel Products Co., spoke very fully on the above subject to an audience of 104 members and guests, under the chairmanship of Mr E. Hare.

Mr Daniel opened his talk by outlining the three main functions of impellers, namely to wet out dry pigments, to disperse agglomerates and to circulate the batch.

This was followed by a very detailed survey of operating principles and design features. The latter was dealt with at some length to cover the numerous types of impellers that were in use and those which have proved to be the most satisfactory when used under varying conditions. Mr Daniel did emphasise, however, the importance of correct training of personnel to operate high speed dispersers. A fully trained operator could and should command a high wage, but, on the other hand, efforts made by the manufacturer to encourage full and correct training of personnel for this function produced worthwhile results.

A very lively discussion period followed, when a number of points were dealt with in detail, including the correct method of loading the pigment, the best types of pigments to use with this type of machinery, operating temperatures, and mill and container design.

Mr Daniel's lecture was very well illustrated throughout by slides.

A vote of thanks was proposed by Mr Burns for this most interesting paper which it is hoped will be available for publication in full in the Journal in due course.

J.R.T.

Scottish

Eastern Branch

Science, art and prehistory

The fourth ordinary meeting of the session was held in the Carlton Hotel, Edinburgh on Wednesday 25 February, with Mr P. A. Gower in the chair, when Dr H. McKerrel, of the Royal Scottish Museum, spoke on "Science, art and prehistory."

Dr McKerrel said that the three main functions of his laboratory were preservation, checking authenticity and research.

Preservation

Much of the preservation work was concerned with waterlogged wood and crumbling stonework. When waterlogged wood dried out, the wood shrunk and split. The most satisfactory method of avoiding this splitting was to replace the water with a resin of the polyethylene glycol type. This involved a very costly operation requiring repeated applications of the resin solution over a period of anything up to 20 years.

The major cause of crumbling stonework was salt crystallisation. Over the centuries stonework absorbed water containing salts. When the water evaporated, the salts crystallised and cracked the stone. This problem was much more prevalent today, as many ancient buildings were now centrally heated, thus causing much greater water evaporation than had occurred in the past. The best solution at present was to use pva emulsions to give some binding to the crumbling stonework.

Authenticity

Verifying authenticity was a steadily increasing problem as forgeries became more and more difficult to detect, and many sophisticated techniques were employed. A further problem was sampling, where obviously only the minutest samples could be taken. For metals, a micro-drill was used which drilled a hole finer than a human hair.

Metals were subjected to spectrophotometric analysis, and the evidence of certain trace elements could give an indication of the object's authenticity. This was because the trace elements present in precious metals today were different to those found in metals used in ancient times.

The corrosion/metal interface was also examined. In genuine articles, the corrosion spread unevenly along the crystal interfaces, and this effect could not be reproduced in fakes.

Earthenware pots could be examined by a very sensitive test called thermoluminescence. When a pot had been buried in the ground for many centuries, it absorbed radioactivity which was present in the ground. When the pot was heated in a vacuum, the radioactivity was given out in the form of light energy. The measured amount of light given off could be related to the radioactivity present in the soil where it had been discovered, and the length of time the article had lain in the earth calculated.

Research

Many interesting research projects were being carried out, and Dr McKerrel showed how the sophisticated techniques of modern science could help historians to obtain a clearer picture of the past. For example, examination of old silver to determine its origin had shown that the silver in some Viking brooches had originated in Turkey.

The lecture was very well illustrated with a great number of excellent slides.

J.H.S.

Reflections of a professional football player

The fifth ordinary meeting of the session was held in the Carlton Hotel, Edinburgh, on Wednesday 25 March, with Mr P. A. Gower in the chair, when Mr A. Glen, of Isaac Spencer Ltd., spoke on "Reflections of a professional football player." This talk was preceded by the AGM of the Branch.

Mr Glen, a Member of the Branch, played football for many years for Aberdeen FC and was capped several times for Scotland in the late 1950s. The speaker traced his career from just after the war till his retirement in 1960, amplifying his talk with many interesting and amusing anecdotes.

J.H.S.

Science and the rule of thumb approach

The last ordinary meeting of the session was held in The Carlton Hotel, Edinburgh, on Wednesday 22 April, with Mr P. A. Gower in the chair, when Mr G. H. Hutchinson, of A. B. Fleming & Co. Ltd., spoke on "Science and the rule of thumb approach."

Mr Hutchinson discussed the two approaches, the scientific and the "rule of thumb," against a background of his experiences in the pitch, oil processing and refining, and printing ink industries.

For many years, the production of pitch by the distillation of wood tars had been carried out in crude distillation equipment and the grading of the pitch was carried out by the "chewing test." Here the pitch was chewed in the mouth until soft, held between the teeth and pulled out with the fingers. A soft pitch forms a long string while a hard pitch breaks off short. The speaker did not indicate how many fillings were pulled out at the same time!

The "chewing test" was replaced by scientific tests such as softening point, needle penetration, creep tests, and tests to determine resistance to impact stresses. The viscosity of various pitches over a range of temperatures (15°C-175°C) was measured using a penetrometer for the very high viscosity (at 15°-50°C) and a torsion viscometer for the low viscosities in the range 100°C-175°C. These quality control tests related to the use of pitch as adhesives for brush-making, textile reed manufacture, and optical lens grinding, and attempted to simulate the effects of mechanical stresses and temperatures to which the products were subjected in the various applications. It was emphasised that the application of scientific methods made possible the manufacture of more consistent products, provided a better understanding of technical service problems and stimulated the development of new and improved products.

Science replaced the art in the development of the paint and printing ink industries, and a review of trends in varnish making was made. The old varnish-makers' pots were contrasted with today's temperature controlled stainless steel reaction vessels. Traditional methods used in the production of printing ink vehicles—including the addition of onions and breadcrusts to the "boiling" linseed oil as a means of temperature assessment—and conditioning of varnish were described and the benefits of these rule of thumb methods discussed.

An example was then given of the application of scientific methods of viscosity control in the manufacture of stand oils which led to better quality, more consistent products, and could be used to predict viscosities at any time during a temperature-controlled process and allowed for heat-up and cooling period. It was stressed that advances in knowledge of the chemistry of drying oils had provided industry with a better understanding of its oil media.

Although science had played a very important part in the development of the printing ink industry there were still many unsolved problems that defied an adequate scientific explanation. Examples given were the problems concerning a precise definition of the "tack" of an ink and its relationship to other rheological properties; there was still much to learn about ink/paper relationships.

Finally, the lecturer said that the rule of thumb approach often had to be applied when gaps in knowledge of a particular problem existed or where certain phenomena could not be explained adequately.

J.H.S.

Thames Valley

Adhesives and adhesion

The final technical meeting of the Thames Valley Section was held at the Manor Hotel, Datchet, on Wednesday 25 March, when Mr N. C. Macdonald, of Evode Ltd., gave a very interesting and informative talk on the above subject.

He began by saying that adhesion was essentially a physical phenomenon in which two bodies adhered if they came into sufficiently close proximity to allow interaction between them. This interaction might be entirely physical, that is, "hook-like," although chemical processes could also be involved.

Mr Macdonald went on to outline the three principal theories of adhesion; the electrical theory, which involved electrical double layers; the diffusion theory, which suggested the mutual diffusion of polymer chain segments in an interweaving network; and the absorption theory. The latter was preferred in Western Europe and the United States. It required the acceptance of intimate wetting as an essential prerequisite so that Van der Waals forces might operate effectively.

The classification of adhesives was then explained, and details given of the three main groups; low-strength adhesives, including natural glues and pressure sensitive materials; medium strength adhesives, which were mainly materials that required loss of a liquid carrier for adhesion, such as synthetic rubber/phenolics, polychloroprene contact adhesives, and p/f resins etc., but also included the solvent-free hot-melt types; and heavy duty, or structural adhesives, commonly two-pack systems that formed cross-links, such as epoxides and nitrile-phenolics, as well as the more recent polyimides and polybenzimidazoles, which gave high temperature stability owing to the ladder structure of their polymer molecule.

Mr Macdonald then turned to a consideration of adhesive bond design, which he said was primarily influenced by the method of manufacture of the article or assembly and by the minimum performance needed from the assembly. He expanded on this by describing in some detail the parameters that were involved in, for example, the design of an adhesive for a packaging requirement.

Where structural capability was involved, the mechanical design of the joint itself became important. In recent years there had been much work in the analysis of the complex stresses of joint geometries, from which a useful rule of thumb summary might be stated as: avoid direct tension in the stressed joint; use lap configuration; avoid peeling stress if possible; use a resilient system when peeling stress was unavoidable.

The speaker enumerated some problems attaching to good adhesive design. He quoted the example of pvc and showed how the problems caused by migratory plasticisers and staining could be avoided by choice of suitable adhesives systems, or in some cases by other, indirect, means.

This concluded a very enlightening talk which was followed by a lively question session and a vote of thanks from Mr W. Arnott, a past chairman of Thames Valley Section.

R.E.G.

Scottish Symposium

The Chairman of the Scottish Section, Mr R. G. Gardiner (standing) opens the Symposium, watched by (left to right) Mr E. M. Burns (Secretary, Scottish Section), the Provost of East Kilbride (Mr W. W. Niven), Mr G. Wallace (Chairman, East Kilbride Development Corporation), and the President (Mr A. S. Fraser)

Ceud mile failte

This phrase, which translates from the Gaelic as "A hundred thousand welcomes," captures exactly the atmosphere of the Symposium on "Dispersion in theory and practice" which was organised by the Scottish Section at East Kilbride on 21-22 May. The phrase was prominently displayed at the Assocation's dinner on the night of Thursday 21 May, and at subsequent technical sessions, and its sentiments were strongly supported by all the Members of the Section who so ably organised the Symposium, and to whom the thanks of the Association are due.

The venue of the Symposium was a suitably forward-looking setting for a subject and an Association which are both oriented to the future. East Kilbride is one of the five new towns established in Scotland, is the oldest and largest, and is felt by many to be the most successful. It has a population of 65,000, with a projected growth to 100,000 by 1990. In the past 22 years, 4½ million square feet of factory space has been built, and a further ½ million square feet will be produced in the next 18 months. In most cases, this space has been bought or leased before completion.

The technical sessions were held in the Ballerup Hall in the town's imposing Civic Centre, and the Symposium headquarters was at the nearby Bruce Hotel, where many of the delegates were housed. Such was the demand for places at the Symposium—nearly 300 delegates and ladies attended—that not only the Bruce but also available rooms in other hotels in East Kilbride were filled, and the Section was forced to place delegates in hotels over a wide area around the town, including some in Glasgow itself. Although this presented several difficulties, these were overcome by the use of a private bus to ferry delegates back and forth for technical sessions and the dinner on Thursday evening. This system appeared to work remarkably well, and there was always a Scottish member with a car in reserve in case of emergency.

Civic reception

The first function of the Symposium was a civic reception by the Burgh of East

Kilbride for lecturers, overseas visitors and Association officers, which about 40 delegates attended. After a short reception, at which the delegates astounded the Provost of East Kilbride, Mr W. W. Niven, by their punctuality, and dinner, Mr Niven welcomed the Symposium to East Kilbride, expressing his pleasure that OCCA should have chosen a place which, although not as yet well known, would play a large part in Scotland's future.

The Chairman of the Scottish Section, Mr R. G. Gardiner, replied on behalf of the Section, and payed tribute to the help that they had had from the Burgh. Finally, Dr H. W. Talen replied on behalf of the overseas visitors, saying that he was sure that all the people from overseas would be most interested to have the opportunity to see at first hand the way that Scotland was planning for the future in its new town developments.

Following the dinner, delegates were invited to see the impressive council chamber of the civic centre.

Technical Sessions

On the morning of Thursday 21 May, in the Ballerup Hall, Provost Niven gave an address of welcome to delegates. He felt that the new town character, and modern facilities, of East Kilbride gave it many advantages as a centre for international symposia, and wished success to the Scottish Section, and the Association, in its venture.

The Chairman of the East Kilbride Development Corporation, Mr G. Wallace, in his opening address, continued the theme of East Kilbride as a venue for international conferences, and stressed that a new luxury hotel and conference centre with room for 750 people was being planned. Speaking of the Association, Mr Wallace thought the adoption of Leonardo da Vinci for the insignia particularly appropriate. However, even such a brain as Leonardo's could not now encompass the knowledge held by Members, as modern technology was faced with an information explosion. It was for this reason that symposia such as this were necessary, and, in declaring it open, he wished the Association every success.

Mr Gardiner, before introducing the chairman of the first session, thanked Mr Wallace and Mr Niven, and their respective staffs, for the large amount of assistance they had provided in the preparation and holding of the Symposium.

Four technical sessions were held, two on each day, with lunch at the Bruce Hotel between. Attendance was high at all sessions, and the interest shown in the papers was reflected in the vigorous discussions. A list of the papers is given below. It is hoped that all papers will be

A view of the Ballerup Hall, showing the high attendance which was maintained for all lectures

printed in full in this *Journal* at a later date, together with the discussions which followed, and, therefore, no attempt will be made to report them here.

Thursday 21 May

"Some aspects of pigment dispersion, with particular emphasis on carbon black" by W. M. Hess and M. D. Garret.
(Chairman, P. Gower)

"Dispersion in aqueous media" by W. Carr.
(Chairman, D. Atherton)

"The influence of non-aqueous media on dispersions" by K. Pond.
(Chairman, J. F. McVay)

Friday 22 May

"Some aspects of dispersion in relation to titanium dioxide" by R. Amberg.
(Chairman, D. M. Stead)

"The influence of interfacial activity in paint films on their properties" by W. Funke.
(Chairman, A. McLean)

"Dispersion machinery" by J. B. Slinger.
(Chairman, J. Miller)
Summing up by S. H. Bell.
(Chairman, R. G. Gardiner)

Exhibition

A small exhibition of dispersing machinery was held in the Civic Centre for the period of the Symposium. A list of companies participating is given below.

D. H. Industries Limited, Durham Raw Materials Limited, Elsevier Publishing Co. Limited, A. Gallenkamp & Co. (Northern) Limited, Marchant Brothers Limited, The Mastermix Engineering Co. Limited, Millroom Accessories & Chemicals Limited, Silverson Machines Limited, Torrance & Sons Limited, Winkworth Machinery Limited.

Association AGM

The Annual General Meeting of the Association was held after the technical session on the afternoon of Thursday 21 May, in the Ballerup Hall. A full report appears elsewhere in this *Journal.*

Association Dinner

The Annual Dinner of the Association was held on Thursday 21 May in the Carrick Suite at the Bruce Hotel. A true Scottish atmosphere was given to this event, as can be seen from the menu, in Gaelic and English, which is shown below.

Broit Circe
Cock a Leekie Soup

Taigeis Agus Neap
Haggis with turnip

Bradan Slaopta as an Abhainn "Tay"
Poached Tay Salmon Hollandaise

Buntata ur a Siorrachd "Ayr"
New Ayrshire Potatoes

Currain Ghealla
Parsnips

Flummery Blar-a 'Ghobair
Blairgowrie Flummery

Caraidh Le Arannilis Na Gaidhealtachd
Coffee with Highland Shortbread

Drama Buidhe
Drambuie

Delegates and their ladies were greeted by the skirl o' the pipes as they entered the suite, and the bagpipes, played by the pipe major of the Burgh of East Kilbride, accompanied by his drum major, made a further appearance later, in the traditional piping in of the haggis. This was cut open by the President, Mr A. S. Fraser, with a dirk provided by the pipe major, and the event was celebrated with a dram for the chef and the pipers. All guests were given a small bottle of whisky, and the serviettes were adorned with a child's ABC in Gaelic, for those ignorant enough not to speak it. This nationalism, which may be unique in that the Sassenach is made to feel certainly different, and possibly inferior, to the Scot, whilst made to feel completely welcome and at home, was carried on into the speeches.

Pipers welcoming delegates to the Association's Dinner

After the loyal toast, Provost Niven welcomed the Association to East Kilbride. The town represented, in his view, the way in which Scotland should develop in the future, and he hoped that the visitors, particularly those from overseas, would be interested in the town, and enjoy their stay.

In his reply, the President welcomed the Association's guests; Mr W. W. Niven, Provost, Burgh of East Kilbride; Mr D. McGuire, Senior Magistrate, Burgh of East Kilbride; Mr W. Gordon McNay, Town Clerk, Burgh of East Kilbride; and Mr G. Young, General Manager, East Kilbride Development Corporation. He went on to thank the Scottish Section Committee, both present and past, for their work in organising the Symposium, work which had begun three years ago.

In his response, the Chairman of the Scottish Section, Mr R. G. Gardiner, thanked the lecturers for their work in preparing the papers on which the Symposium depended. He went on to pay tribute to the help that the Committee had received from the Burgh of East Kilbride, and from the East Kilbride Development Corporation, before proposing the toast to the ladies and guests.

Replying on behalf of the guests, Mr G. Young, General Manager of the East Kilbride Development Corporation, made a witty and amusing speech, based on the intricacies of the Gaelic language.

After the final technical session on Friday 22 May delegates dispersed. The general opinion was that the symposium had been a great success and that the hospitality offered by the Scottish Section could not have been surpassed.

R.W.

Association Dinner Dance 1970

The three speakers at the Association Dinner Dance, with their ladies (Right to left) Dr E. S. Paice (President, Research Association of the British Paint, Colour and Varnish Manufacturers), Mrs Paice, The President (Mr A. S. Fraser), Mrs Fraser, Mr G. Isserlis (President, Institute of Metal Finishing) and Mrs Isserlis

The Biennial Dinner and Dance of the Association was held at the Savoy Hotel, London, on the evening of Friday 29 May, when over 300 members and guests were present. Before dinner the President, Mr A. S. Fraser, and Mrs Fraser received members, guests and their ladies.

The Association's guests were; Dr E. A. Paice, President of the Research Association of British Paint, Colour and Varnish Manufacturers, and Mrs Paice, Mr G. Isserlis, President of the Institute of Metal Finishing, and Mrs Isserlis, Dr T. P. Hoar, President of the Institute of Corrosion Technology, and Mrs Hoar, Mr A. G. Cameron, President of the Paintmakers Association, and Mr R. K. Fourness, President of the Society of Dyers and Colourists, and Mrs Fourness.

This was one of the first Association events at which Past Chairmen of the Sections could wear the new insignia presented to them during the last session. It was pleasing to see the number of Past Chairmen present, and the medallions received favourable comment from the guests from other societies.

After the dinner and the loyal toast, Dr E. S. Paice proposed the toast to the Association. Dr Paice developed the theme of the co-operation which had taken place between OCCA and the Paint Research Station. He also spoke on his own long membership of the Association, and the benefits he had acquired therefrom.

The President, Mr A. S. Fraser, in his reply, thanked Dr Paice for his kind remarks, and indeed all the Association's guests for their presence at this function. He welcomed all members, guests, and particularly the ladies, to the Savoy, and went on to propose a toast to the ladies and guests.

Mr G. Isserlis, replying on behalf of the ladies and guests, thanked the President, and went on to stress the relationship which existed between OCCA and the Institute of Metal Finishing.

After the speeches, dancing continued to the Jerome Orchestra until 1.00 a.m., with a break at 11.30 p.m. for refreshments, after which the company was entertained by a cabaret.

West Riding Section Seminar

Future trends in surface coatings

The West Riding Section is to organise a two-day Seminar at Bodington Hall, Leeds, on 3-4 September 1970.

The theme of the Seminar, "Future trends in surface coatings," was chosen to demonstrate the use of film as a supplement to lectures and discussion in the presentation of information. The organisers have endeavoured to show some of the trends of surface coating technology over the next decade.

Although it is impossible to forecast the whole future of technology, it is felt that this Seminar will point out some of the future trends. A panel of speakers of recognised authority has been assembled from home and overseas to cover the various aspects of discussion. There will be discussion periods after each paper.

A folio containing a precis of each paper will be sent to all registrants; brief notes are given below.

Paper 1: Mr R. A. B. Durant, Director of the British Industrial and Scientific Film Association, sets the scene with a talk and two short films. He will show the audience how film can, and should, be used for the imparting of information.

Paper 2: Dr D. R. Sayers, of ICI Ltd., Mond Division, will present a paper on "Chlorinated rubber." This has been known as a paint resin for many years, but new uses for its exceptional properties are continually being discovered.

One of the most recent advances is the high build coating based on chlorinated rubber. This development will be discussed and reference will be made to possible new advances which are at present under investigation.

Paper 3: Mr A. G. North, of Cray Valley Products Ltd., will talk on "Recent advances in thixotropic systems."

Thixotropic alkyds have received general acceptance in decorative systems to control rheology. Their use in industrial coatings has been limited by sensitivity to hydroxylic solvents and elevated temperatures.

A new class of resin has now been developed for stoving finishes of all types and this will be discussed in detail, together with air drying industrial systems based on thixotropic polyurethanes.

Paper 4: Dr W. Carr, of Geigy (UK) Ltd., will present a paper entitled "Measurement of particle size of organic pigments."

The importance of, and the need for, accurate assessment of pigment dispersion is outlined.

Measurement of pigment particle size is the only absolute method of measurement but this is difficult experimentally.

Possible techniques are critically assessed. Centrifugal sedimentation is the most promising. The difficulties encountered in applying this technique to commercial pigmented systems, and the extent to which they have been overcome, are described.

Paper 5: Mr D. D. Aronson, of British Titan Products Co. Ltd., will talk on "Some aspects of film formation in emulsion paints."

Current work with latex paints in the company's technical service department has been aimed at gaining a greater understanding of the processes involved during drying.

Colour microphotography has shown how stresses that development during drying of paints are either absorbed in deformation or relieved by cracking.

Various means of overcoming such cracking have been studied so that the most effective remedy (without harmful side effects) may be suggested.

Paper 6: Mr G. Rossa, of Shell Research Ltd., will submit a paper entitled: "Solvent-free 'Epikote' systems and their application with two-component spray equipment."

The current trend for anti-corrosion, marine, and chemical resistant coatings is towards high build, high performance paints. Solvent-free 'Epikote' systems have been formulated for use particularly with newly developed two-component heated spraying equipment. The design and use of the commercially available Graco-Hydracat unit will be illustrated.

All papers will be accompanied by a film strip or short film.

Two short films will also be shown during the seminar.

Film no. 1: "Adventure in colour," by Hoechst Chemicals Ltd., is designed to show the layman how colours are achieved and used.

Film no. 2: This is a Russian film produced by Professor P. A. Rehbinder of The Institution of Physical Chemistry—USSR Academy of Science, Moscow.

The film shows the influence of surface tension on the three component system: solid metal phase, mercury-water solutions of surface active substances.

Venue

Bodington Hall, the largest Hall of Residence of the University of Leeds, is situated on a spacious site in pleasant rural surroudings, 4½ miles north of the City centre, just off the Leeds-Otley road (A660).

Catering arrangements

Lunch will be served each day to all Registrants in the Refectory at Bodington Hall. Morning Coffee and Afternoon Tea will also be served. The cost of these is included in the Registration Fee.

Seminar Dinner

An informal dinner has also been arranged at Bodington Hall for the Thursday evening. Registrants wishing to attend are asked to fill in the relevant section of the application form.

Transport

Leeds is easily reached by air, coach, rail and car from all the main centres in the United Kingdom.

Excellent bus services are available from Leeds City Station direct to Bodington Hall.

The M1 extends into the City. Drivers should follow the Otley sign (A660) to Bodington Hall. The Hall is ½-mile north of the Leeds Ring Road. Fuller details and a local map will be included in the folio.

Private transport will be available from Leeds and Bradford Airport. Travellers requiring these facilities should complete the relevant section of the application form which has been sent to all members.

Programme

Thursday 3 September

10.00 Welcome to all registrants to the Seminar by Dr L. J. Watkinson, Chairman, OCCA West Riding Section.

10.30 "Setting the scene."
Mr R. A. B. Durant, of BISFA.

11.30 "High build chlorinated rubber coatings," by Dr D. R. Sayers—Mond Division, ICI Ltd.

12.30 Lunch.

12.45 "Recent advances in thixotropic systems" by Mr A. G. North—Cray Valley Products Ltd.

15.00 Film: "Adventure in colour." Hoechst Chemicals Ltd.
Film: "Influences in surface tension." Professor P. A. Rehbinder.

Friday 4 September

09.30 "Measurement of particle size of organic pigments," by Dr W. Carr—Geigy (UK) Ltd.

11.00 "Some aspects of film formation in emulsion paints" by Mr D. D. Aronson—British Titan Products Co. Ltd.

12.30 Lunch.

14.00 "Solvent-free 'Epikote' systems and their application with two-component spray systems," by Mr G. Rossa—Shell Research Ltd.

15.45 Summing up by Mr A. R. H. Tawn—Cray Valley Products Ltd.

The fees for the Seminar and other events are shown below:

Seminar

For Ordinary and Associate Members of the Association	£5 0s 0d
For Student Members of the Association	£1 10s 0d
For non-members	£7 10s 0d

Seminar Dinner

Members and non-members	£2 10s 0d
Student Members	£1 5s 0d

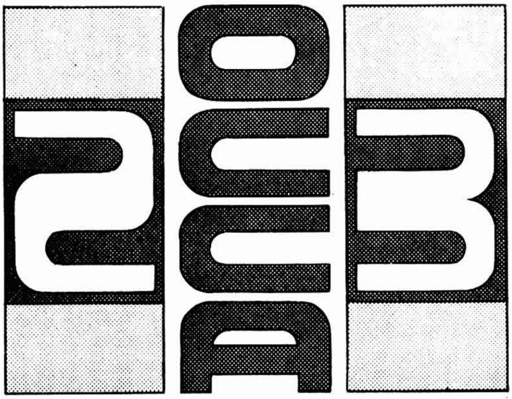
Overnight accommodation

Accommodation is available in the Hall of Residence at Bodington Hall. The rooms are single study bedrooms with a high standard of comfort. The cost of bed and breakfast for these rooms is £1 12s 0d plus 10 per cent per night.

The Seminar officers are shown below. All those interested should contact Mr Morris at the address shown; closing date for applications is 15 August.

Chairman: Dr L. J. Watkinson (Chairman, OCCA West Riding Section).

Secretary: Mr D. Morris,
Silver Paint & Lacquer Co. Ltd.,
513 Bradford Road, Batley, Nr. Leeds.
Telephone: Batley 3451.



Technical Exhibition

21-25 June 1971

Following the success of OCCA 22 earlier this year, the Association's next Technical Exhibition of raw materials, plant, and machinery will once again be held at the Empire Hall, Olympia, London W14, from 21 to 25 June 1971.

The special motif for OCCA 23 (which, as for many years past, has been designed by the Director & Secretary) is reproduced above in black and white, but the colour scheme will be dark green, light (Chartreuse) green and white.

The Exhibition will be open on the following dates and times:

Monday 21 June ..	15.00-18.30
Tuesday 22 June	09.30-18.30
Wednesday 23 June ..	09.30-18.30
Thursday 24 June ..	09.30-18.30
Friday 25 June	09.30-16.00

The last Exhibition, in which 180 companies, research organisations etc. participated, was open on four days and attracted 14,500 visitors, including representatives from nearly 40 overseas countries.

The Invitation to Exhibit is now being despatched to companies both in the United Kingdom and overseas, and any company intending to exhibit must return a completed application form not later than 1 December 1970.

Copies of the *Official Guide* to the Exhibition will be sent individually to chemists and technologists in the paint and allied industries in Western Europe, to consuming firms in this country and to all members of the Association wherever resident. Copies can also be obtained free of charge from the Association's offices; admission to the Exhibition is free.

Each copy of the *Official Guide* will contain a form of application for tickets for the Exhibition Luncheon, which will be held at the Savoy Hotel, London WC2, on Monday 21 June 1971.

Also being prepared for distribution on the Continent is a leaflet in English, French, German, Italian, Russian and Spanish, containing information on the Exhibition, and copies can be obtained without charge from the Association's office.

Any companies wishing to apply for stand space at OCCA 23 who have not previously exhibited should write to the Director & Secretary at the Association's offices. The Exhibition is believed to be unique in that it is entirely technical, and is aimed at ensuring that technical advances are passed on as quickly as possible to the technical personnel in the paint, printing ink and allied industries. The technical advances may relate to new products, new knowledge of existing products and their uses, or, in suitable cases, existing knowledge which has not been available to the consuming industries.

Report of Meeting of Council

A Meeting of the Council was held on 17 June at Wax Chandlers' Hall, Gresham Street, London EC2, when 24 members of Council were present. In the unavoidable absence of the President, Mr A. S. Fraser, the Chair was taken by Mr F. Sowerbutts, Past President and the Representative of the Auckland Section.

On behalf of the President, Mr Sowerbutts extended a welcome to those Members attending for the first time and to members who were serving once again on Council in different capacities.

The dates of the Council Meetings for the forthcoming session were agreed and the date of the Annual General Meeting was confirmed as the afternoon of Friday 7 May 1971 at the Palace Hotel, Torquay, during the Association's Conference.

The Committees and Working Parties of the Council for the forthcoming session were appointed and these are listed elsewhere in this issue of the *Journal*.

In appointing the Working Party on Education, Training and Qualifications, it was pointed out that there had been a divergence of opinion within the Working Party on the recommendations to be made to Council. Furthermore, the Haslegrave Report had recently been published and, if this were to be implemented, it would change the pattern of technical education, so that the Working Party was now considering the implications of this Report before making further recommendations to Council.

In accordance with the practice of previous years, the President of the Oil & Colour Chemists' Association Australia was co-opted to the Council, and it will be of interest to members to know that in order to complete the liaison between the two Associations, the President of OCCA is co-opted to the Australian Federal Committee.

The appointment of the Association's representatives on other organisations for the forthcoming session was also confirmed.

Reports were received on:

(a) *Annual General Meeting & Dinner* during the successful Scottish Section Symposium at East Kilbride 21-22 May, and the congratulations of the Council were extended to the Scottish Section on the excellent arrangements which had been made. Council noted with regret that the two new Honorary Members (Dr H. A. Hampton and Mr F. Sowerbutts) were prevented from attending the AGM and receiving their Scrolls of Hon. Membership, but it is hoped that the presentations can be made at the Dinner following the Foundation Lecture at the Painter-Stainers Hall on 8 October.

(b) *The Dinner Dance on 29 May at the Savoy Hotel*, which was attended by over 300 members and guests—a larger number than the comparable occasion in 1966 but naturally not as high as the 1968 function which was held in conjunction with the Fiftieth Anniversary Celebrations.

(c) *The Foundation Lecture 1970*, which will be given by Sir Paul Chambers, KBE, CB, CIE, who has chosen for his subject "Human relationships and communications in industry." A leaflet was inserted in copies of the July issue of the *Journal* sent to members and it is felt the function will attract a good response, as in previous years. This year the function will be combined with the Past Presidents' Dinner, following the practice commenced during the Fiftieth Anniversary celebrations in 1968.

(d) *The 1970 Technical Exhibition*, which was the first held by the Association at Olympia and which proved to be highly successful, 14,500 people passing through the turnstiles during the 3½ days, as compared with the 4½ days which the Exhibition was open during the Alexandra Palace period. There were visitors from 38 overseas countries, and a full report appeared in the June issue of the *Journal*.

(e) *The 1971 Exhibition*, the arrangements for which were already well in hand. The dates for the Exhibition will be later than usual next year, since this was the only booking which could be obtained several years ago when it became imperative to make arrangements to find a venue other than Alexandra Palace. The Exhibition will take place 21-25 June 1971 and already a considerable number of requests for space have been received, either from companies who have already exhibited and are seeking additional space, or from companies who have not shown for several years and wish to show again in 1971, together with a number of requests from overseas companies who have not shown previously. The Council was very pleased to learn of the interest which the Exhibition has aroused both at home and, particularly, overseas and it was stressed that the success of the enterprise was due to the untiring efforts of the Director & Secretary (Mr R. H. Hamblin) and his staff.

It was pointed out as a measure of the work which was undertaken by Mr Hamblin in this sphere that he had already, in his spare time, prepared the first 14 original drawings/lay-outs for the 1971 Exhibition. Council felt that members of the Association should know of the amount of work undertaken by the Director & Secretary in this way, since it may not be fully appreciated that the lay-out of the Exhibition, the unique symbols and the colour scheme for each year, which are carried throughout the whole plan (from the first invitation to exhibit to the signs outside the exhibition hall, the *Official Guide*, and the facia of each stand, etc), were entirely his work. Many distinguished visitors at Exhibition Luncheons had commented on the way in which the Exhibition had achieved such a pleasant identity in this way.

(f) *Paint Technology Manual, Volume VII (Works Practice)*, the final part of the manuscript of which had now been received. It was hoped to pass the manuscript to Chapman & Hall Ltd., who publish the Manuals on behalf of the Association, in the near future.

(g) *1971 Conference Papers*, the full list of which will be given in the *Journal* during the Autumn. It will be recalled that, as well as the technical sessions, an additional session has been arranged on a management theme, together with the Workshop Sessions, so that the programme for the three days of the Conference will be a full one.

(h) *FATIPEC Congress, Montreux*, at which the President had been represented by Mr A. R. H. Tawn, Hon. Research & Development Officer. Mr Tawn reported that the paper presented at the Plenary Session on behalf of OCCA by Dr W. Hughes, a Member attached to the Newcastle Section, was excellent and well received, and that he had taken the opportunity of conveying the greetings of the Association to FATIPEC.

The meeting then received reports on the activities of the various Sections and Branches; it was noted that Mr P. B. Hunt, of the Auckland Section, and first overseas recipient of the Commendation Award, would be visiting the UK in the forthcoming months and it was hoped that he would be able to have meetings with the Director & Secretary and the Auckland Section's representative on Council, Mr F. Sowerbutts.

Foundation Lecture

Human relationships and communications in industry

As previously announced in the *Journal*, the 1970 Foundation Lecture is to take place on Thursday 8 October at the Painter-Stainers Hall, Little Trinity Lane, London, EC4, at 7.00 p.m. The speaker will be Sir Paul Chambers, KBE, CB, CIE (Chairman of ICI Ltd. 1960-68, Past President of the Institute of Directors, President of the Advertising Association and Chairman of the Royal Insurance Co. Ltd.). The title of his lecture is to be "Human relationships and communications in industry."

Admittance to the Lecture will be by ticket only. It will be followed by a short Informal Reception, and Dinner will be taken in the Dining Hall of the Painter-Stainers Company at 8.00 p.m. Informal dress will be worn, but it is particularly requested that Past Presidents', Section Chairmen's and Past Chairmen's badges, where applicable, are worn.

The inclusive charge for dinner, together with wines with the meal and drinks at the reception, is £3 15s 0d per head; details of the menu are set out below. Application forms are included in this issue, and application should be made as soon as possible, and in any case not later than 18 September, to the Director & Secretary, at the Association's offices.

Application for the inclusive tickets (Lecture, Reception and Dinner) **is restricted to Members.** Members wishing to attend the Lecture only, should write to the Director & Secretary, who will inform them after 18 September if accommodation is still available. This will naturally depend upon the demand for the inclusive tickets for the Lecture, Reception and Dinner.

Menu

Alsatian Sylvaner 1966	Consomme Madrilene
	River Trout Amandine
Bordeaux: Chateau Latour Camblanes 1964	Roast Saddle of English Lamb
	Brussels Sprouts, Parisienne Potatoes
Port: Quinta do Noval LBV	Fruit Melba
Brandy: Hine VSOP	Coffee

Association Conference, 4-8 May 1971

Surface properties and appearance

As previously announced, the Association's Conference in 1971 will be held in the Palace Hotel, Torquay, from 4-8 May. Four technical sessions are planned, on the three mornings of the Conference and one afternoon, having the title "Surface properties and appearance." Also, in response to increasing interest in the industry to the application of management sciences, a session of papers on the theme "The management of innovation" will be held, running parallel with the afternoon technical session. Three workshop sessions will be held, and the final afternoon of the Conference will be taken up with the Association's Annual General Meeting.

So far ten papers have provisionally been arranged, and these are: "Relationship between measured gloss and dispersion in acrylic paint films," by Dr J. Dunderdale, of Laporte Industries Limited, "Effect of pigment dispersion on the appearance and properties of paint films" by Dr W. Carr, of Geigy UK Ltd., "Influence of surface reflectances on the opacity of roller coatings" by Mr D. G. Dowling and Mr D. R. Tunstall of British Titan Products Co. Ltd., "Colour specification by visual means," by Mr K. McLaren, of ICI Ltd., Dyestuffs Division, "Gas chromatographic investigation of interaction forces between binder and solvent in paint films" by Dr K. H. Reichert, of the *Forschungsinstitut für Pigmente und Lacke*, "Film appearance and its dependence on solvent formulation" by Mr L. A. Tysall, of Shell Research Ltd., "Appearance and performance factors in coatings for buildings" by Mr P. Whiteley, of the Building Research Station, and papers for which the titles have not been decided, by Mr J. R. Taylor, of BP Chemicals (UK) Ltd., and Mr Bates, of National Lead Company, together with the Keynote Address.

Further offers of papers are in hand, and a full list will be published in due course. Any interested person who feels that he could supply a paper which would be of interest should submit a synopsis of about 500 words to the Honorary Research and Development Officer (Mr A. H. R. Tawn, 34 Crest View Drive, Petts Wood, Kent) as soon as possible, as it may still be possible to find space for a paper of sufficient merit. Papers will be required in final draft **by 1 September 1970.**

Full details concerning the registration fees, and forms of application, will be sent to all Members before the end of the year; non-members wishing to receive these details, when available, should apply in writing to the Director & Secretary at the Association's offices.

Jordan Award

This award was instituted by the late Mrs M. R. Jordan in memory of her husband Dr L. A. Jordan, who was President of the Association 1947-1949 and who died in December 1964.

The Committee invites applications for the second award of £100 which it is hoped to present at the Torquay Conference 4-8 May 1971.

The rules of the Award are appended below.

1. The Award will be made for the best contribution to the science or technology of surface coating by a member of any nationality working in either the academic or industrial field who is under the age of 35 at the date of application.

2. The final date for submission of applications will on this occasion be 1 January 1971.

3. The selection of the recipient of the Award will be made by a Committee

under the Chairmanship of the Association's Hon. Research and Development officer.

4. There will be two methods of application. First, by the submission of a paper describing original work by the candidate which is offered for publication in the *Journal* or has been so published during the two years prior to the closing date for application. The alternative method will be by recommendation by a superior for work which for reasons of commercial secrecy cannot be published; in this case the candidate will be expected to submit a dissertation on a topic relating to his work and demonstrating his superior knowledge of the principles thereof. The Award is for *individual* merit and clear evidence of the candidate's own contribution will be required if a paper is offered under joint authorship.

5. Applications should be addressed to the Director & Secretary at the Association's offices.

News of Members

Dr J. E. Arnold, an Ordinary Member attached to the London Section, and President 1963-65, has recently placed his personal advisory services, and the facilities of Welkyn Productions Limited, of which he is managing director, at the disposal of Arnold Services, for the development of electronic manufacturing aids for the process industries.

Mr W. P. J. Baily, an Ordinary Member attached to the London Section, has been appointed research director of Vinyl Products Limited.

Mr D. Biesty, an Ordinary Member attached to the Midlands Section, has joined the automotive division of Carrs Paints Limited as a sales and technical representative. Mr Biesty was previously supervisor of the plant process laboratory at Rootes Group.

Mr J. G. Campbell, an Ordinary Member attached to the Scottish Section, has been appointed a director of Charles Tennant & Co. Limited.

Mr D. H. Deacon, an Associate Member attached to the Thames Valley Section, has been appointed manager of the newly formed Inspection Division of BIE (Anti-Corrosion) Ltd.

Mr G. A. Newell, an Ordinary Member attached to the London Section, will be joint manager of the Consultancy Division, formed at the same time, which will be known as BIE Coating Consultants.

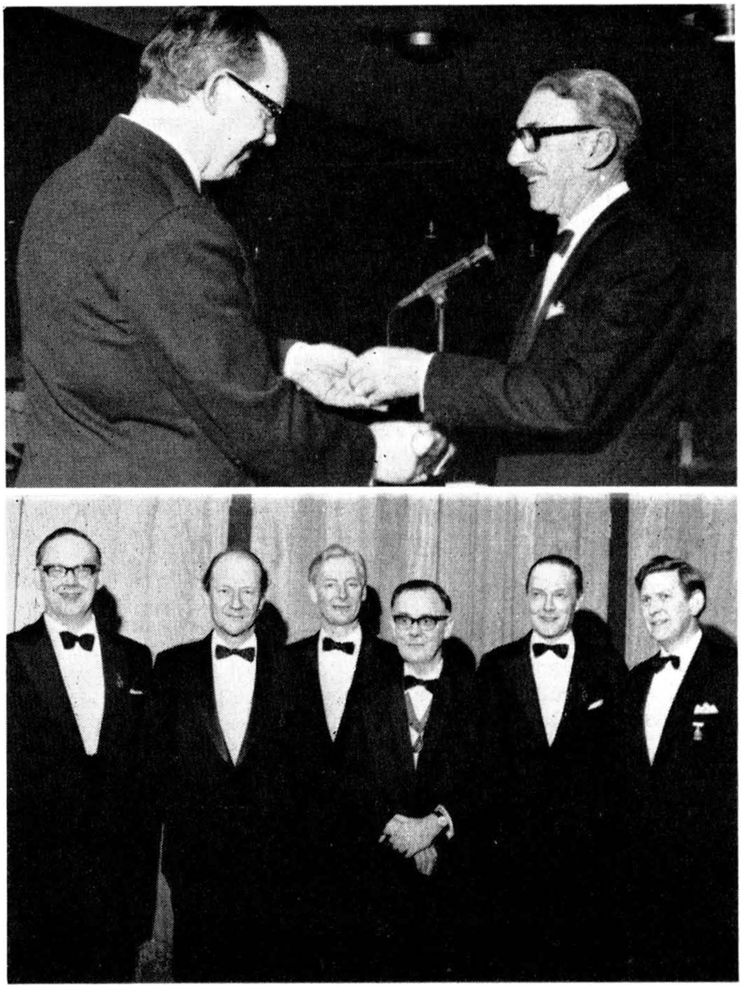
Dr J. Bowler-Reed, an Ordinary Member attached to the Thames Valley Section, will act as a consultant for mastics and sealants for BIE Coating Consultants, and Mr F. G. Dunkley, an Ordinary Member attached to the Midlands Section, will act in a similar capacity on corrosion prevention and painting methods.

Mr R. K. Fourness, an Ordinary Member attached to the West Riding Section, and President of the Society of Dyers and Colourists, was recently presented with the gold medal of the SDC.

Mr D. J. Holmes, an Ordinary Member attached to the Midlands Section, and a Committee Member of the Trent Valley Branch, has been appointed technical service manager of Joseph Mason & Co. Ltd., with responsibility for the entire Joseph Mason organisation.

Mr J. Miller, an Ordinary Member attached to the Scottish Section, and Immediate Past Chairman of the Section, has recently retired from his position as Area Sales Manager of Vinyl Products Limited for Scotland and Northern Ireland. Mr Miller, who served with Vinyl Products for 19 years, intends to move to St. Andrews when he has completed his term as Immediate Past Chairman.

Bristol Section



Bristol Section Dinner Dance. Above, Mr M. J. McWaters (right) presenting Mr L. J. Brooke with his Past Chairman's Medallion. Below, the five Past Chairmen of the Section with the present Chairman (left to right) Mr L. J. Brooke, Mr V. C. Thompson, Mr A. B. Lock, Mr J. R. Taylor (Chairman), Mr D. S. Newton, Mr R. J. Woodbridge

Annual Dinner Dance

The Annual Dinner Dance of the Bristol Section was held on Wednesday 11 March 1970, at the Mayfair Suite of the Bristol Entertainments Centre. Some 140 members and guests were welcomed by the Section Chairman, Mr J. R. Taylor. Guests present included Mr R. H. Hamblin, Director & Secretary; Mr J. T. Tooke-Kirby, Chairman of the Southern Branch, and Mrs Tooke-Kirby; Dr L. J. Watkinson, Chairman of the West Riding Section, and Mrs Watkinson; Mr D. Penrice, President of the Birmingham Paint, Varnish and Lacquer Club, and Mrs Penrice; and Mr J. E. Pooley, Chairman of the London Section, and Mrs Pooley.

Following an excellent dinner, five former chairmen of the Bristol Section were presented with medallions by Mr M. J. McWaters, a Vice-President of the Association, in recognition of their services. Presentations were made to Mr V. C. Thompson (1946-48); Mr A. B. Lock (1959-61); Mr L. J. Brooke (1963-65); Mr R. J. Woodbridge (1965-67); and Mr D. S. Newton (1967-69).

West Riding Section

Golf Tournament

This will be held at Sand Moor Golf Club on 11 September and not at Ilkley, as previously announced.

Rheology conference

The British Society of Rheology is to hold a conference entitled "Rheology in industry" at the Royal Military College of Science, Shrivenham, from 7-10 September. Full details can be obtained from Dr K. M. Beazley, 44 Brockstone Road, Boscoppa, St. Austell, Cornwall.

SDC symposium

"Colour and processing challenges in the 1970's" is the title of a symposium to be held by the Society of Dyers and Colourists at Aviemore, Scotland, from 15-17 September 1971. Offers of papers, with synopses of up to 300 words, should be submitted to the General Secretary and Editor of the SDC by 31 August 1970, and manuscripts will be required by 31 March 1971.

Register of Members

The following elections to membership have been approved by Council. The Section to which the new members are attached is given in Italics.

Ordinary Members

AITKEN, MALCOLM, 36 Sutherland Road, Bolton, Lancashire, BL1 5LR. (*Manchester*)

BATTEN, SAMUEL VEALE, 3 St. Oswald's Crescent, Billingham, Teesside. (*Newcastle*)

BULL, STUART ANTHONY, BSc, Shell Chemicals Ireland Ltd., 33-34 Westmoreland Street, Dublin 2, Ireland. (*Irish*)

HATTON, RAYMOND VINCENT, LRIC, "St. Mabyn," Station Road, Honeybourne, Nr. Evesham, Worcs. (*London*)

JULIER, GEOFFREY FRANCIS, 76 Hyde Road, Sanderstead, Surrey. (*Manchester*)

LEWIS, DAVID JOHN, BSc, Hedley Cottage, Gosforth, Newcastle upon Tyne, 3. (*Newcastle*)

MADDOX, JAMES MARTIN, LRIC, British Steel Corporation, Shotton Works, Deeside, Flintshire, CH5 2NH. (*Manchester*)

NEOGI, AMAR NATH, BChE, MScChE, Chemical Engineering Department, University of Washington, Seattle, Washington, 98105, USA. (*Overseas*)

ROBINSON, BRIAN, 14 Coldstream, Wentworth Park Estate, Ouston, Birtley, Co. Durham. (*Newcastle*)

SHEPHERD, GRAHAM PHILIP, BSc, DIC, 6 Rouse Gardens, Alleyn Park, London, SE21. (*London*)

STONE, JAMES BRYAN, MSc, ARIC, Beech Dell, Stonehouse Road, Halstead, Sevenoaks, Kent. (*London*)

WOTTE, JOHAN, Klokhuisplein 5, Haarlem, Holland. (*Overseas*)

Associate Members

MILLS, GRAHAM ARTHUR, 8 Aston Close, Pangbourne, Berks. *(Manchester)*

MOSHI, HERMAN O., PO Box 2692, Dar-es-Salaam, Tanzania, East Africa. *(Overseas)*

WOOD, MICHAEL JOHN, 326 Milnthorpe Lane, Sandal, Wakefield, Yorks. *(West Riding)*

YULL, GEORGE WATKINSON, Sumitomo Shoji Kaisha Ltd., P & O Building, Leadenhall Street, London, EC3. *(London)*

Student Members

HALES, MELVYN ARTHUR, 38A Sundorne Road, Charlton, London, SE7. *(London)*

HARES, GRAHAM ANTHONY, 38 Masefield Road, Penarth, Glamorgan. *(Bristol)*

SMITH, JOHN, Associated Trappinex Ltd., 176 Acre Lane, London, SW2. *(London)*

QURESHI, JANAID BARKAT, 5 Salisbury Street, Blackburn, Lancs. *(Manchester)*

Section programmes for 1970-71 session

(Programmes for the London and West Riding Sections are not yet available. It is hoped that they will be published in the September issue.)

Main Association events

1970

Tuesday 8 October

Foundation Lecture "Human relations and communications in industry" by Sir Paul Chambers. To be held at the Painter-Stainers Hall, London, EC4, at 7.00 p.m.

1971

Tuesday 4—Saturday 8 May

Association Biennial Conference. "Surface properties and appearance." To be held at the Palace Hotel, Torquay.

Thursday 6 May

Association AGM, to be held at the Palace Hotel, Torquay.

Monday 21—Friday 25 June

OCCA 23 Technical Exhibition. To be held at the Empire Hall, Olympia, London.

Bristol

All meetings will be held at the Royal Hotel, Bristol, at 7.15 p.m., unless otherwise stated.

1970

Friday 25 September

"Colour measurement" by Mr R. P. Best, of Instrumental Colour Systems Limited.

Friday 30 October

"Powder coatings" by Mr G. T. Bassett, of Berger J & N Paints. Joint meeting with the Birmingham PVL Club; to be held at the Hawthorns Hotel, Bristol.

Friday 27 November

"Industrial training" by Mr H. R. Peel, of the Chemical & Allied Products Industry Training Board.

1971

Friday 29 January

Ladies evening. "Cosmetics" by Mr A. Foster, of Revlon Overseas Corporation.

Friday 26 February

"The glass transition temperature of paint films" by Mr J. L. Prosser, of the Paint Research Station, to be held at the Angel Hotel, Cardiff.

Wednesday 10 March

Annual Dinner Dance, to be held at the Mayfair Suite, Bristol Entertainments Centre.

Friday 26 March

"Aerosols" by Mr D. T. Trist, of Swallowfield Serta Limited.

Friday 30 April

Annual General Meeting.

Hull

All meetings will be held at the Bullock Lecture Theatre, Hull College of Technology, at 7.00 p.m., unless otherwise stated.

1970

Monday 5 October

A panel discussion evening. Three short lectures will be followed by questions and a discussion. To be held at the Queens' Hotel, George Street, Hull.

Friday 9 October

Annual Dinner Dance, to be held at the Hotel Eden, Willerby.

Monday 2 November

"Protective coatings for gas pipe lines and storage vessels" by Dr J. T. Harrison, of the Gas Council.

Monday 7 December

"The value of gel permeation chromatography for the design of alkyd resins" by Mr H. Olley and Dr L. A. O'Neill, of the Paint Research Station.

1971

Monday 4 January

"The preservation and waterproofing of joinery timber prior to painting" by Mr R. R. Hill, of the Timber Research and Development Association.

Monday 1 February

"The use of instrumentation in the evaluation of paint performance" by Mr D. M. Bishop, of British Rail.

Monday 1 March

Ladies Evening: A talk on wine making by a member of the Hull and District Winemakers Guild. To be held at the Queens Hotel, George Street, Hull.

Thursday 8 April

Annual General Meeting, to be held at the Queens Hotel, George Street, Hull.

Irish

All meetings will be held at the Clarence Hotel, Wellington Quay, Dublin, at 8.00 p.m., unless otherwise stated.

1970

Friday 18 September

"Solvents" by Mr L. A. Tysall, of Shell Research Ltd., to be held at the International Hotel, Belfast—preceded by a Works Visit, to be arranged.

Friday 16 October

"The role of chlorinated rubber in modern anti-corrosive systems, including its use in printing inks" by Mr P. A. Herbert, of ICI Ltd.

Friday 20 November

"Urethanes" by Mr A. C. Jolly, of Synthetic Resins Ltd.

Friday 11 December

Ladies Night.

1971

Friday 15 January

"Modern dispersion equipment" by Mr H. Wadham, of Torrance & Sons Ltd.

Thursday 21 January

Annual Dinner Dance, to be held at the Clare Manor Hotel.

Friday 19 February

"Paper production" by Dr P. Sherry, of Clondalkin Paper Mills Ltd.

Friday 19 March

Annual General Meeting, followed by an "Open forum."

London

(A full programme is not yet available. However, it has been decided that the venue for 1970/71 will be the Borough Polytechnic, at 6.30 for 7.00 p.m.)

Southern Branch

All technical meetings will be held at the Pendragon Hotel, Clarence Parade, Southsea, at 7.00 p.m.

1970

Tuesday 13 October

"Driers" by Mr J. Turner, of Hardman & Holden Ltd.

Tuesday 10 November

"Modern adhesives" by Dr W. A. Leef, of Borden Chemicals Ltd.

1971

Tuesday 9 February

"New developments in the field of shop and wash primers" by Mr Lampe, to be presented by Dr Lehmann, of Farbwerke Hoechst AG.

Tuesday 16 March

"Metal rich coatings." Joint paper by speakers arranged by the Lead & Zinc Development Association.

Friday 16 April

AGM & Social Evening. Reception at Abbey House, Winchester, by the Mayor of Winchester.

Manchester

All meetings will be held at the Manchester Literary & Philosophical Society, 36 George Street, Manchester 1, at 6.30 p.m., unless otherwise stated.

1970

Friday 9 October

"Industrial espionage" by Major R. B. Matthews, of Management Investigations Ltd.

Friday 23 October

Annual Dinner Dance, to be held at the Piccadilly Hotel, Piccadilly Plaza, Manchester, 1.

Friday 13 November

"Olefine route to new paint latices" by Mr J. A. Wall, of BP Chemicals Ltd., to be held at the Bolton Institute of Technology, Deane Road, Bolton, at 6.30 p.m.

Friday 11 December

"Chloride titanium dioxide pigments—their value" by Mr J. S. Jordan and Mr F. D. Robinson, of Laporte Industries Ltd., to be held at the Liverpool Building and Design Centre, Hope Street, Liverpool 1, at 6.30 p.m.

1971

Friday 8 January

"Printing inks for web-offset" by Mr D. E. Bisset, of Coates Bros. (Inks) Ltd.

Friday 12 February

"Present and future trends in motor car finishing" by Mr H. L. Quick, of Rootes Motors Ltd.

Friday 12 March

"The utilisation of isocyanates in seamless flooring systems" by Dr A. Lowe, of ICI Ltd., Dyestuffs Division, to be held at the Liverpool Building and Design Centre, Hope Street, Liverpool 1, at 6.30 p.m.

Student Lectures:

1970

Wednesday 16 September

"Modern machinery for the manufacture of paint and printing inks" by Mr D. P. Sullivan, of D. H. Industries Ltd., to be held at 4.30 p.m.

Wednesday 14 October

"Some aspects of paint formulation" by Mr T. W. Wilkinson, of Laporte Industries Ltd., to be held at 4.30 p.m.

1971

Wednesday 13 January

"The use of carbon black in paints, plastics and printing inks" by Mr B. E. Thomas, of Columbian Industrial Ltd., to be held at 4.30 p.m.

Wednesday 7 April

"The problems of painting timber" by Mr G. W. Rothwell, of the Building Research Station, to be held at 4.30 p.m.

Midlands

All meetings will be held at the Chamber of Commerce House, 75 Harbourne Road, Birmingham 15, at 6.30 p.m., unless otherwise stated.

1970

Friday 25 September

"Wood protection" by Mr G. L. Holbrow, of the Paint Research Station.

Friday 16 October

"Polymer developments—the seventies and beyond" by Mr A. R. H. Tawn, of Cray Valley Products Ltd.

Friday 20 November

"Gloss and semi-gloss latex paints" by Mr G. Willison, of British Titan Products Ltd.

1971

Friday 15 January

Annual Dinner Lecture. "Microscopic examination of pigment-vehicle interaction during film formation" by Dr Jettmar and Dr Apel, of BASF AG, to be held at Winston Restaurant, Birmingham 5.

Friday 19 February

"Developments in automobile finishing" by Mr H. L. Quick, of Rootes Motors Ltd.

Friday 19 March

Annual "J. Newton Friend" Lecture. "Forensic science" by Mr P. J. Cobb, of the West Midland Forensic Science Laboratory.

Trent Valley Branch

All meetings will be held at the British Rail School of Transport, London Road, Derby, at 7.00 p.m., unless otherwise stated.

1970

Thursday 1 October

"Metrication and paint packaging in the future" by Mr R. B. Beazley of the Metal Box Company Ltd.

Thursday 12 November

"Electro-painting" by Mr J. R. Bourne of Mebon Ltd. A Joint Meeting with the Institute of Metal Finishing. To be held at the Department of Transport Technology, Loughborough University, at 7.30 p.m.

Thursday 3 December

"Safety in the paint industry" by Dr L. E. Eninton, HM Medical Inspector of Factories.

1971

Thursday 21 January

"The future of water-thinnable coatings" by Mr A. J. Becalick, of Lennig Chemicals Ltd.

Thursday 4 March

"Solvent-free coatings" by Dr F. Blomeyer, of Bayer Chemicals Ltd.

Thursday 1 April

Annual General Meeting, followed by "Perfumes" by Mrs L. Verney.

Newcastle

All meetings will be held at the Royal Turks Head Hotel, Grey Street, Newcastle upon Tyne, at 6.30 p.m.

1970

Thursday 1 October

"Painting of timber," by Mr R. Hill, of TRADA.

Thursday 12 November

"Addition copolymers of the vinyl esters of branched chain fatty acids for cure with isocyanates" by Mr P. de Carpentier, of Koninklijke/Shell Plastics Laboratorium—Delft.

Thursday 3 December

"Coal tar based surface coatings" by Dr D. McNeil, of The Coal Tar Research Association.

1971

Thursday 7 January

"Discounted cash flow and investment appraisal—a managment technique" by Mr K. W. Blackburn, of Sunderland Polytechnic.

Thursday 4 February

"Flooring compositions" by Mr A. C. Jolly and Mr E. Stonley, of Synthetic Resins Ltd.

Thursday 4 March

"Mechanical behaviour of polymers under low temperature high frequency cycling" by Mr J. L. Prosser, of the Paint Research Association.

Thursday 1 April

AGM.

Student Group

All meetings will be held at Newcastle Polytechnic, Ellison Place, Newcastle upon Tyne, at 3.00 p.m.

1970

Wednesday 7 October

Works Visit to Dufay Paints, Shildon, Co. Durham.

Wednesday 11 November

"Flame retardant paints" by Mr A. G. Walker, of Associated Lead Manufacturers Ltd.

Wednesday 9 December

"Marine fouling" by Dr A. O. Christie, of the International Paint Company Ltd.

1971

Wednesday 13 January

"Modern management techniques" by Mr N. D. Harris, of the Department of Management Studies, Newcastle Polytechnic.

Wednesday 10 February

"Modern methods of paint application" by Mr K. Baxter, of British Paints Ltd.

Wednesday 10 March

Film Show.

Scottish

All meetings will be held in the St. Enoch Hotel, Glasgow, at 6.00 p.m., unless otherwise stated.

1970

Thursday 15 October

"Some aspects of coil coating" by Mr J. Hortensius, of Synres International NV, and Mr L. Tasker, of Laporte-Synres Limited.

Thursday 12 November

"Applications of silicas and silicates in the surface coating industry" by Dr L. Muller-Fokken, of Degussa.

Thursday 10 December

"Development of gloss paints in the twentieth century" by Mr I. R. McCallum and Mr M. Devine, of P. W. Hall Ltd.

1971

Friday 15 January

Annual Dinner Dance.

Thursday 21 January

"Handling of solvents" by Mr I. M. Fotheringham, of Shell Chemicals (UK) Ltd., "Hazards of solvent fires" by Mr A. D. Clarke, of the Fire Prevention Section, Glasgow Corporation Fire Department.

Thursday 11 February

"Colour consciousness" by Dr F. M. Smith and Mr D. Malin, of Geigy (UK) Ltd., to be held at 6.45 p.m.

Thursday 11 March

"Some thoughts on the early development of industry in the Clyde valley" by Mr A. S. Fraser, of Charles Tennant & Co. Ltd.

Friday 9 April

Annual General Meeting, followed by The Smoker.

Eastern Branch

All meetings will be held in the Carlton Hotel, North Bridge, Edinburgh, at 7.30 p.m., unless otherwise stated.

1970

Wednesday 21 October

"Analysis of materials for paint & ink" by a speaker from ICI Ltd.

Wednesday 4 November

"Metrication" by Mr F. Munday. Joint Lecture with BPBMA. To be held at 6.45 p.m.

Wednesday 16 December

"Modern developments in titanium" by Mr G. Willison, of British Titan Products Company Ltd.

1971

Wednesday 20 January

"Money go round" (30min film) and talk on commercial practice by a speaker from the Scottish Stock Exchange.

Wednesday 17 February

"Layout of machinery and plant" by Mr D. P. Sullivan, of D. H. Industries Ltd.

Wednesday 24 March

"Combustion hazards in industry" by Mr Murray, of the Fire Prevention Dept.

Wednesday 21 April

"Human relations" by Mr Young, of Hewlitt Packard Ltd.

Thames Valley

All meetings will be held at the Beech Tree Hotel, Beaconsfield, Bucks., at 7.00 p.m.

1970

Thursday 24 September

"Management principles, and can a small firm survive" by Mr J. R. Webster, of Business Operations Research Services Ltd.

Thursday 22 October

"Corrosion" by Dr T. P. Hoar, of the University of Cambridge.

Thursday 19 November

"Wallpaper" by Mr A. O. Sutherland, of ICI Ltd., Paints Division, ICI Wallpapers.

1971

Thursday 21 January

"Special problems of paints and mastics with reference to building techniques" by Mr E. L. French, of Taylor Woodrow Construction Ltd.

Friday 5 February

Buffet Dance at the Great Fosters, Egham.

Thursday 18 February

"Where paint and ink meet" by Mr R. G. Kinsman, of Winstones Ltd.

Thursday 18 March

"Additives for paint and printing inks" by a speaker from Hardman & Holden Ltd.

Thursday 15 April

AGM, followed by a talk "Special effects in the film industry and how they are produced by Mr C. Culley, of Pinewood Studios.

Forthcoming Events

Details are given of meetings in the United Kingdom up to the end of the month following publication, and in South Africa and the Commonwealth up to the end of the second month.

Tuesday 25 August

Auckland Section. "Dyes and additives in the paper industry" by Mr R. P. McCulley, of NZFP Ltd., to be held at Shell House at 7.30 p.m.

Friday 11 September

West Riding Section. Golf Tournament, to be held at Sand Moor Golf Club.

Wednesday 16 September

Manchester Section—Student Group. "Modern machinery for the manufacture of paint and printing inks" by Mr D. P. Sullivan, of D. H. Industries Limited, to be held at the Manchester Literary & Philosophical Society at 4.30 p.m.

Thursday 24 September

Thames Valley Section. "Management principles" and "Can a small firm survive" by Mr J. R. Webster, of Business Operations Research Services Limited, to be held at "The Beech Tree," Maxwell Road, Beaconsfield, at 7.00 p.m.

Friday 25 September

Bristol Section. "Colour measurement" by Mr R. P. Best, of Instrumental Colour Systems Limited, to be held at the Royal Hotel, Bristol, at 7.15 p.m.

Midlands Section. "Wood protection" by Mr G. L. Holbrow, of the Paint Research Station, to be held at the Chamber of Commerce House, Birmingham 15, at 6.30 p.m.

Tuesday 29 September

Auckland Section. A lecture by Mr J. Smallfield, of Flexible Adhesives Ltd., to be held at the CT Club at 12.15 p.m.

Tuesday 27 October

Auckland Section. "High speed dispersion techniques" by Mr W. Blane, of Morrison Pim Ltd., to be held at Shell House at 7.30 p.m.

An important announcement from English China Clays Ltd.

Golden Valley Colours Ltd.

It is our intention to cease production of pigments at the Wick Works of Golden Valley Colours Ltd., in the near future. We regret this action, but we have found (over the last year or so) that the factory is intrinsically uneconomic, and that even if we were to impose a very large price increase, our activity there would continue to show a loss.

In order to assist customers in changing to another source of supply, English China Clays hope to be able to continue limited production, and can therefore continue, where possible, to accept orders provided that we can complete them before our closure date of 31st August, 1970.

Supplies of Spanish Red Oxide from Oxigos Rogos de Malaga S.A., and African Yellow Ochre from African Golden Ochre (Proprieties) Ltd. Moffell Bay will either be supplied direct to customers or through other channels at present being arranged.

English China Clays Ltd.

English China Clays group

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St. Austell
Cornwall

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introduction to paint technology

second edition with additional chapter

The sales of this Association publication now exceed 13,000, and because of continuing high sales of the second edition, and the need for a work of reference to be constantly abreast of the latest developments in its field, the Council of the Oil and Colour Chemists' Association has authorised the addition of an eleventh chapter to the 'Introduction to Paint Technology.' Entitled 'Recent Developments,' the Chapter incorporates up-to-date information on the latest advances in the technology of the paint and allied industries.

This addition will help the 'Introduction to Paint Technology' to maintain its position as an invaluable aid to young entrants into the industries and to marketing and other personnel requiring a basic knowledge of the principles and techniques of surface coating production and application.

new chapter

The new chapter is subdivided to three sections

resins and media

Including polyester, epoxy, polyurethane resins and developments in water based paints, vinylics, etc.

application techniques

Including electrodeposition, powder coatings, strip-coating, aerosol spraying.

instrumental testing and control methods

Including colour measurement, viscometers, brushability, hardness, film thickness, weatherometers, and use of computers.

The book contains 204 pages including 11 line diagrams, 8 photographs of common paint defects, and comprehensive index. Copies can be obtained from the Oil and Colour Chemists' Association, Wax Chandlers' Hall, Gresham Street, London E.C.2, price 20s. (post free).

CLASSIFIED ADVERTISEMENTS

Classified Advertisements are charged at the rate of 10s per line. Advertisements for Situations Wanted are charged at 2s 6d per line. A box number is charged at 1s 0d. They should be sent to the Director & Secretary, Oil & Colour Chemists' Association, Wax Chandlers' Hall, Gresham Street, London EC2. Telephone: 01-606 1439.

SITUATIONS VACANT

Deputy Director

South African Paint Research Institute

Applications are invited for the post of Deputy Director of the Institute. Candidates should be between 35 and 50 years of age, and have had some experience in the organisation, control and management of research.

The appointment is subject to a probationary period of 6 months. The appointee will be expected to succeed the present Director on his retirement in approximately 18 months time.

The salary offered for the post of Deputy Director will not be less than £4070 and the passage of the successful candidate, his family and effects will be on an assisted basis. The Institute, which is a small research group, is pleasantly situated on the campus of Natal University overlooking Durban Bay. The Director is a Professor of the University with a seat on the Senate and full academic status.

The Institute works a 5 day week. Annual leave amounts to 30 working days per annum. Fringe benefits are: a compulsory Medical Benefit and Pension scheme, assistance with housing. The Director has a car placed at his disposal.

Applications, which should be accompanied by a Curriculum Vitae and any other relevant information, should be addressed to: The Director, S.A.P.R.I., P.O. Box 16, Congella, Natal, South Africa, from whom further information may be obtained.

INK TECHNOLOGIST

For the Canada Printing Ink Company Limited (Division of Reichhold Chemicals Canada).

Qualifications:

1. GCE (General Certificate of Education)
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3. Five years' experience after obtaining City & Guilds Certificate.

Experience in:

Flexo and Gravure

Salary—$8,500 to $10,000; plus assistance with passage to successful candidate.

Please reply back to D. M. Henry, Research Director, The Canada Printing Ink Co. Ltd., Box 265, Stn. "N", Toronto 14, Ontario, Canada.

SITUATIONS VACANT

CHIEF CHEMIST

GIANT INDUSTRIES LIMITED, Paint and Surface Coatings Manufacturers, invite applications for the post of Chief Chemist to their manufacturing plant at Wellington and Christchurch.

The position requires a fully qualified chemist able to initiate research, control the technical staff and maintain the high quality of the company's products.

This calls for a man of reasonable maturity and experience in the practical aspects of paint manufacture and formulation. Salary, allowances and other benefits will be in line with the experience and potential of the successful applicant. All applications will be treated in entire confidence and interview arranged with those suitably qualified.

Address replies to:—

General Manager
Giant Paints Ltd.,
P.O. Box 1772
Wellington, NEW ZEALAND.

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To $12,000, depending on qualifications.

THE MAN:—

He will have, of course, extensive knowledge and years of experience in flexography and gravure. More important, he will be eager to advance his own technical competence and that of his department. Professional attitude, integrity, dedication to work, and ability to get along with people are a must.

Personal interviews will be arranged with promising candidates. Reply in confidence giving complete details of education, experience and training to: Box No. 319.

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U.S. AGENCY OFFERED

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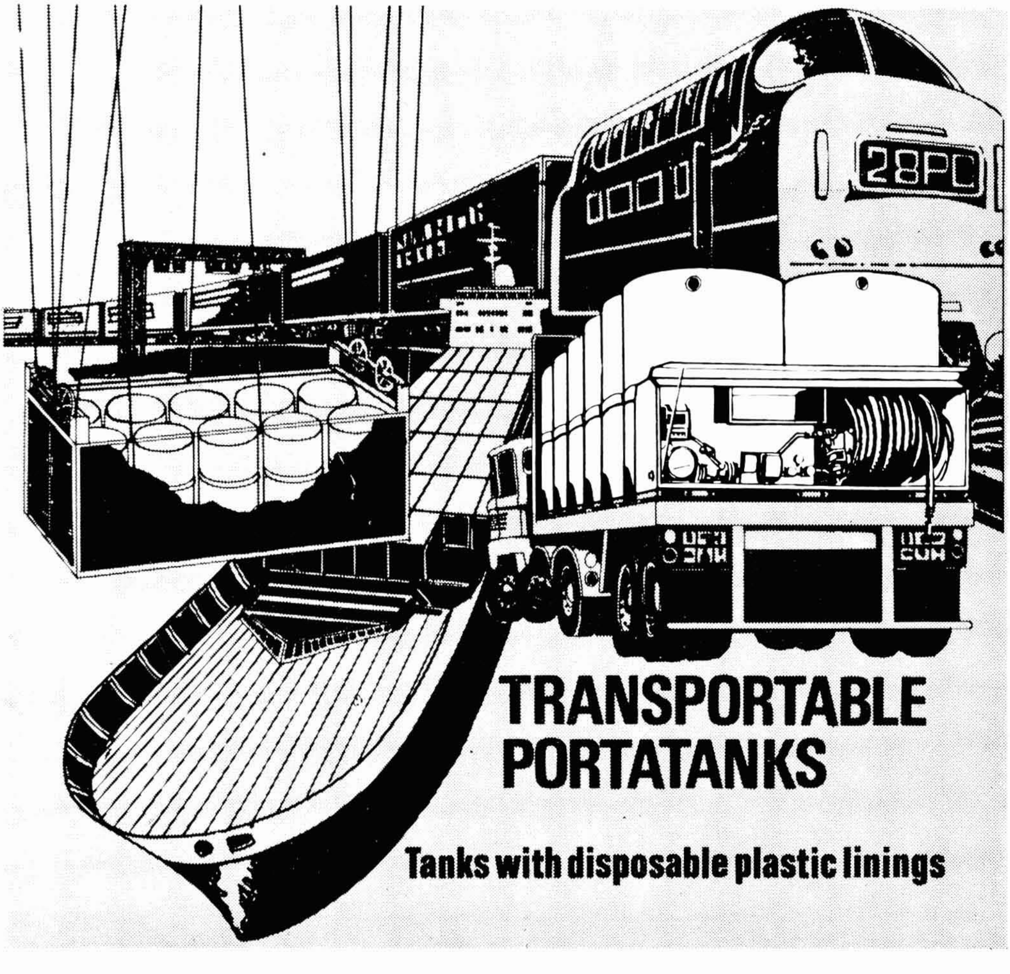
CONFERENCE

Conference: "Advances in Polymer Science & Technology No. III" William Beveridge Hall, University of London, W.C.1. Tuesday 29 September — Thursday 1 October

The programme for the conference, which is organised jointly by the Institution of the Rubber Industry, the Society of Chemical Industry and the Plastics Institute, supported by the Oil & Colour Chemists' Association and the Society of Dyers and Colourists, has been divided into three parts: "Short chain polymers and their uses", "New polymer structures", and "Polymer structure and colouration". There will also be two plenary lectures, one to commence, and the other to complete the programme. The final plenary lecture, to be given by Dr. W. Cooper at 3.35 p.m. on Thursday 1 October, will be open to all members of the five associated bodies free of charge.

The Conference dinner will be held at the Criterion Restaurant, Piccadilly, on Wednesday 30 September at 7.30 for 8.00 p.m. The Guest of Honour will be Sir Harry Melville.

Programmes and application forms were circulated in the June issue of this Journal; further copies are available from the Association's offices.



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