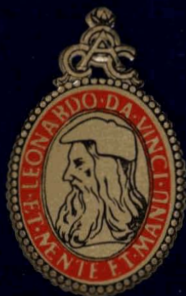


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Vol. 48 No. 12 ✓

December 1965

A tropical testing cabinet for fungicidal anticondensation paints

Photochemistry of vinyl chloride/vinyl-iso-butyl ether copolymer: part III

Electrodeposition: a current-time relationship

INDEX—1965

For fuller details of contents and page references see page xix

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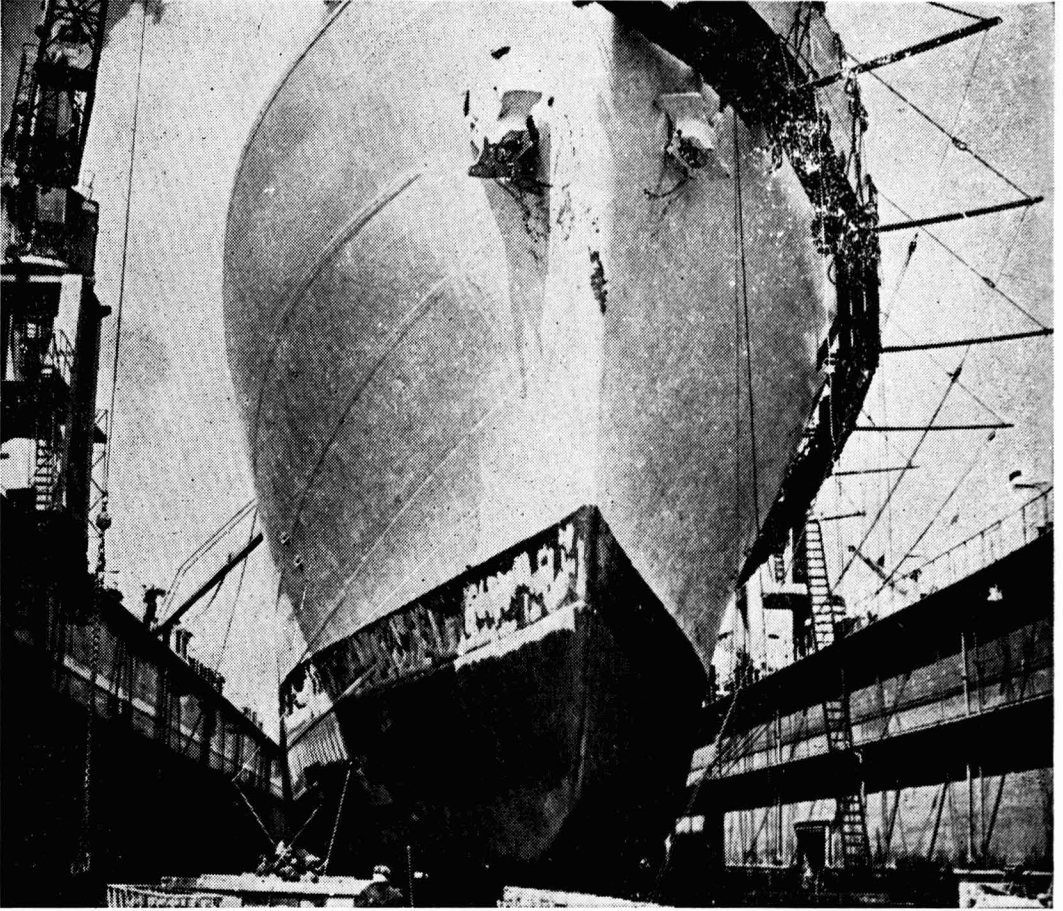
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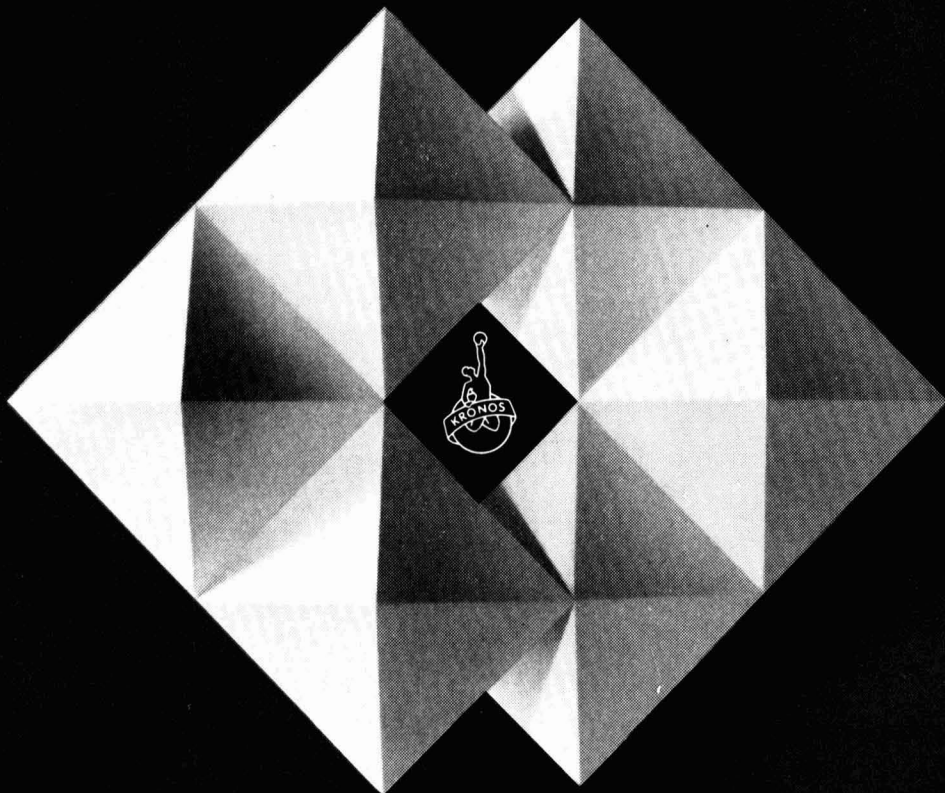
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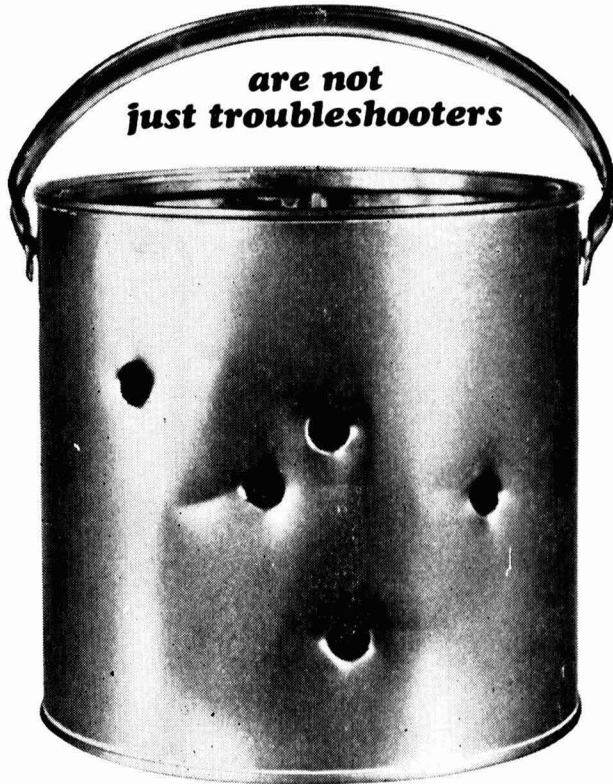
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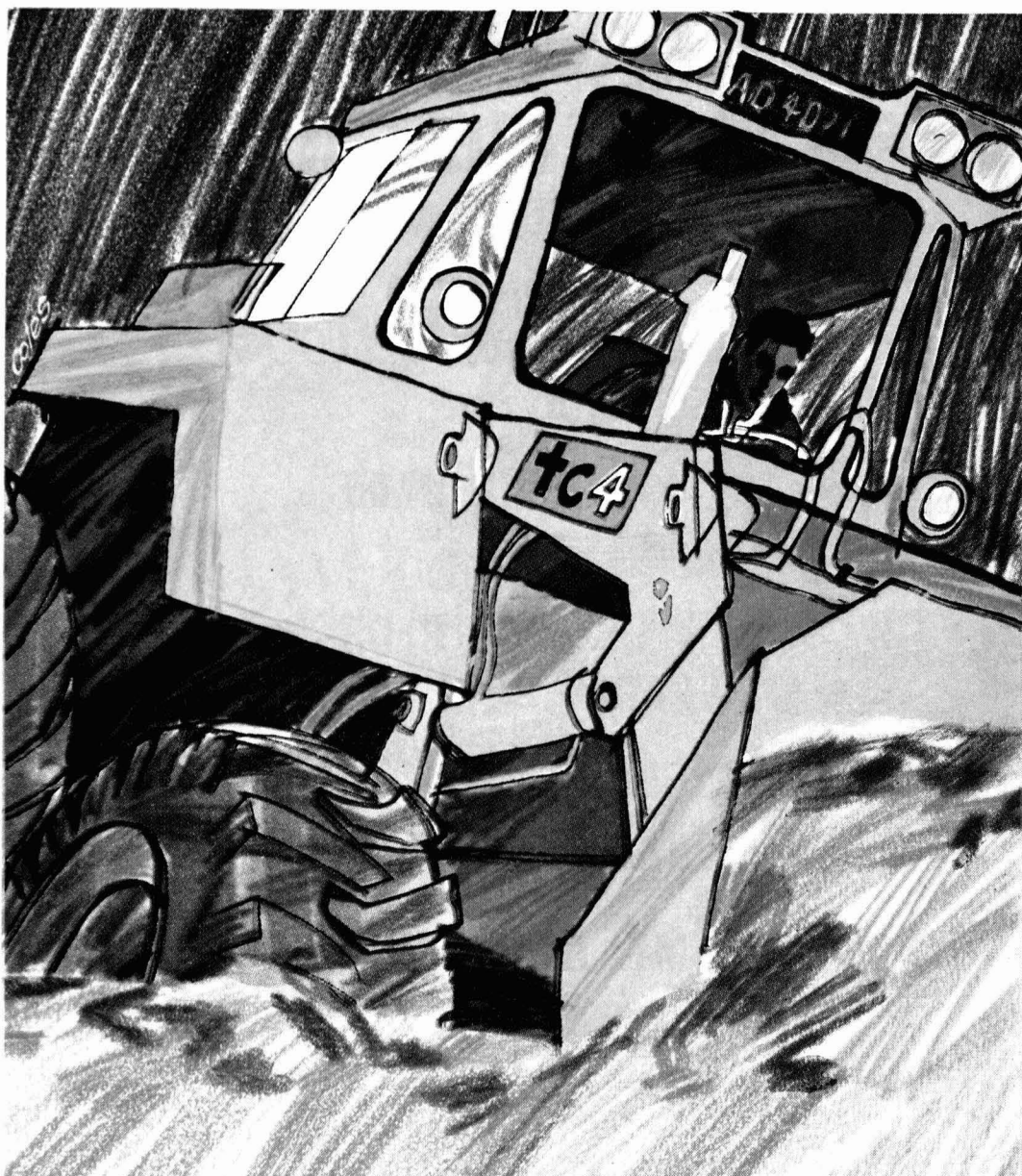
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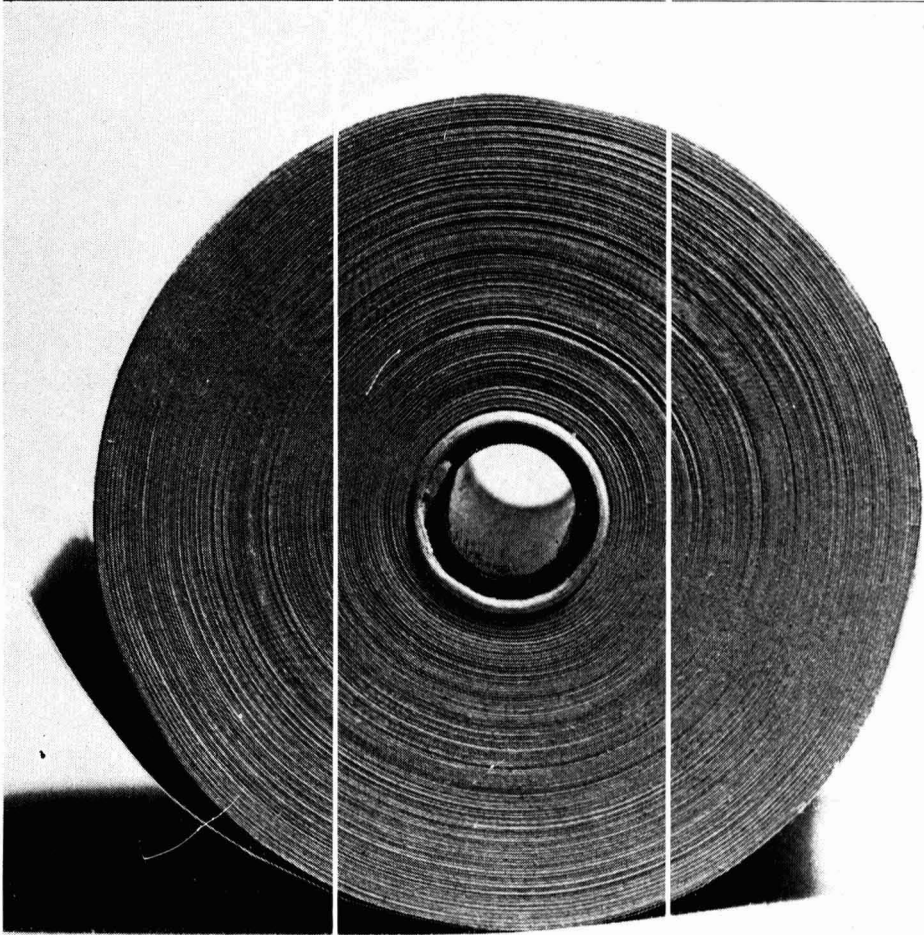
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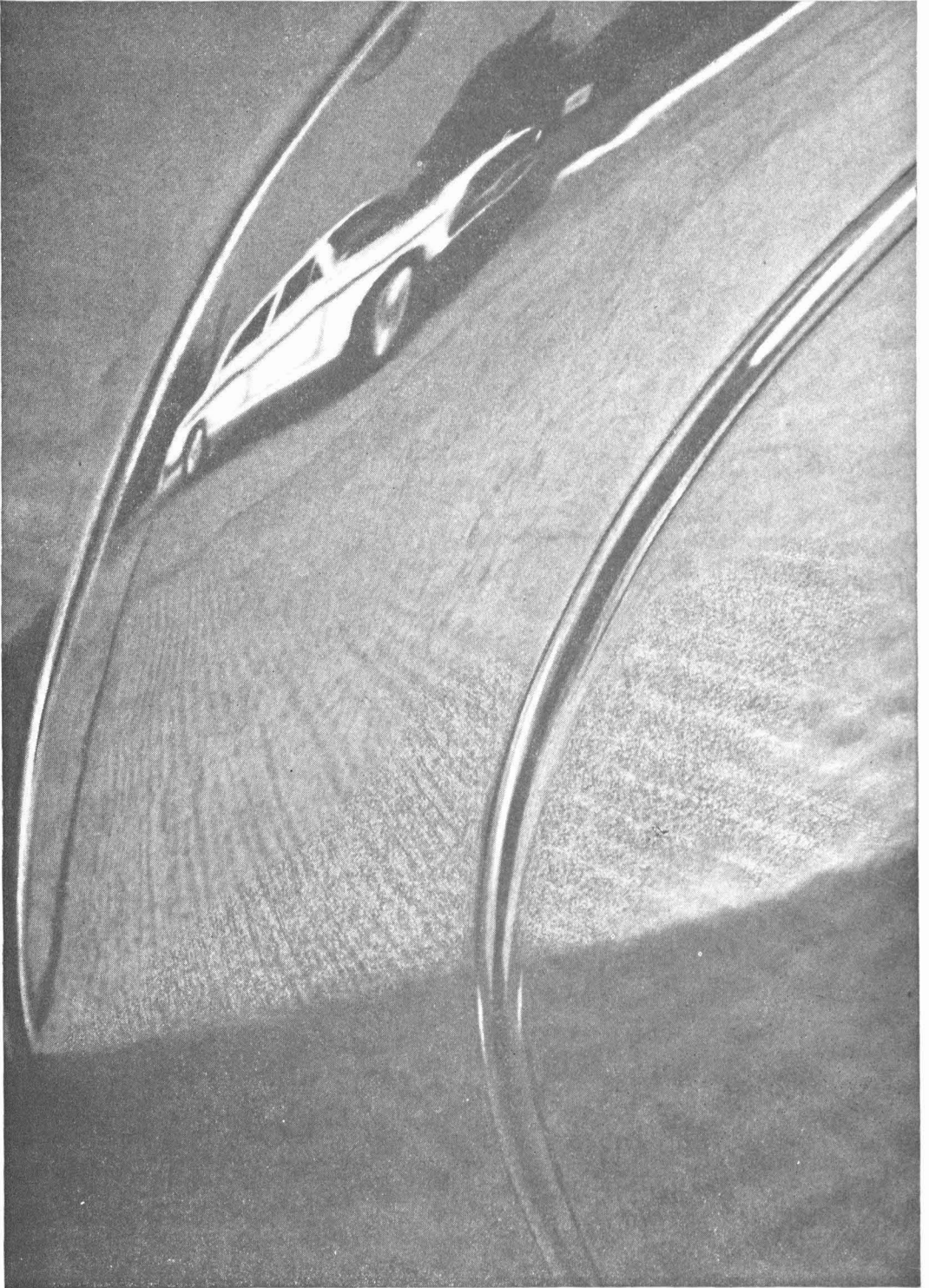
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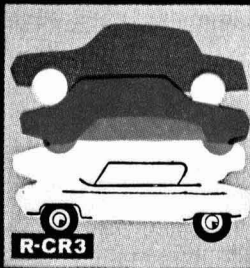
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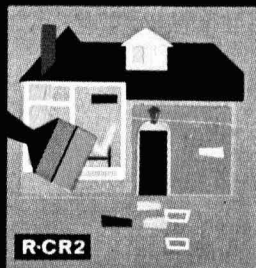
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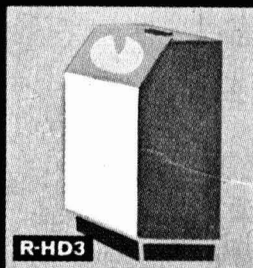
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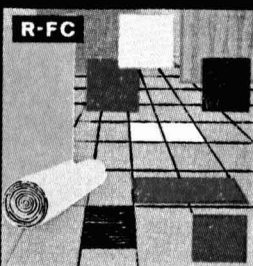
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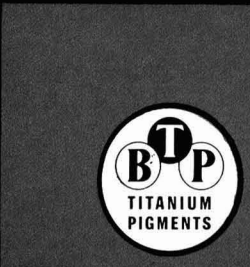
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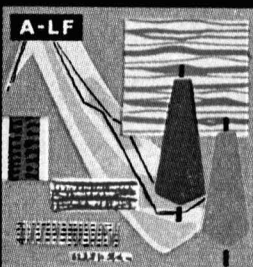


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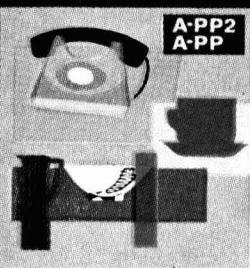


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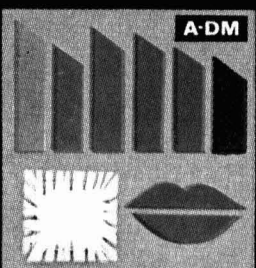
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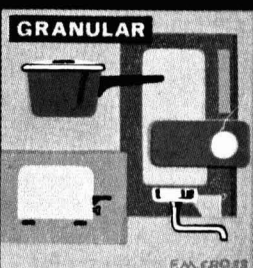
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A	
Alcoa International SA	x xi
B	
Badische Anilin- & Soda-Fabrik AG ..	xxi, Cover
Berk, F. W., & Co. Ltd.	iv
BIP Chemicals Ltd.	xxxii
British Titan Products Co. Ltd.	xvi
Butler Chemicals Ltd.	ix
C	
Ciba (ARL) Ltd.	vii
<i>Classified Advertisements</i>	xxxiv
Cory, Horace, & Co. Ltd.	xx
Crosfield, Joseph, & Sons Ltd.	xxii
D	
Degussa-Russe	viii
Distillers Co. Ltd., The	xxiii
Durham Raw Materials Ltd.	i
F	
Farbenfabriken Bayer AG	xxiv
G	
Geigy (UK) Ltd.	xiii
Golden Valley Colours Ltd.	xxx
H	
Hardman & Holden Ltd.	xxix
Hercules Powder Co. Ltd.	xxv
Heydon, Harold, & Co. Ltd.	Cover
I	
ICI Ltd. (Dyestuffs Division)	v
K	
Kronos Titanium Pigments Ltd.	iii
L	
Laporte Titanium Ltd.	Cover
Lonabarc Ltd.	xiv
M	
Metchim & Son Ltd.	xiv
Mitchell & Smith, W. A., Ltd.	xv
R	
Resinous Chemicals Ltd.	vi
S	
Shell International (Cardura Resins) Ltd.	xxvi
Spelthorne Metals Ltd.	xxvii
Steel, J. M., & Co. Ltd.	ii
T	
Titanium Intermediates Ltd.	xxviii
V	
Vinyl Products Ltd.	xviii
W	
Walker Chemical Co. Ltd., The	xxxi
Y	
Youngehusband Stephens & Co. Ltd. ..	xii

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Vol. 48 No. 12 December 1965

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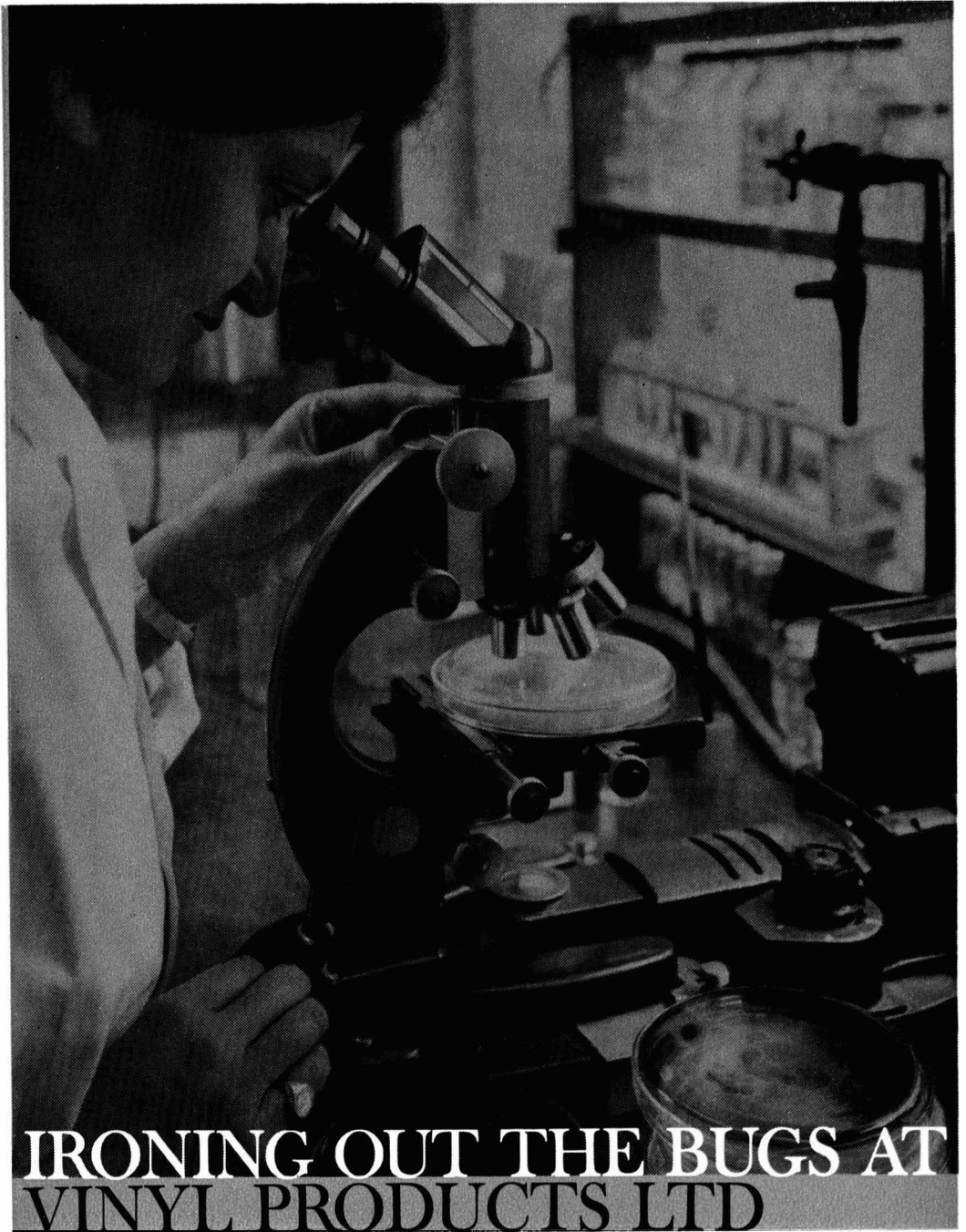
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Contents**Vol. 48 No. 12 December 1965***Transactions and communications*

A tropical testing cabinet for fungicidal anticondensation paints	1111
<i>N. I. Hendey</i>	
Photochemistry of vinyl chloride/vinyl-iso-butyl ether copolymer : Part III	1117
<i>Z. S. Hippe, H. T. Jabłoński and T. B. Krzyzanowska</i>	
Electrodeposition : a current-time relationship	1121
<i>S. R. Finn and J. A. Hasnip</i>	
<i>Reviews</i>	1136
<i>Editorial</i>	1139
<i>Correspondence</i>	1140
<i>Section proceedings</i>	1141
<i>Notes and news</i>	1148
<i>Register of members</i>	1157
<i>Forthcoming events</i>	1158
<i>Index to volume 48-1965</i>	1160

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A tropical testing cabinet for fungicidal anticondensation paints

By N. I. Hendey

Admiralty Materials Laboratory, Holton Heath, Poole

Summary

A Perspex testing cabinet is described which accommodates 24 tubular test specimens for assessing the fungicidal efficiency of anticondensation paints. Condensation on the painted surfaces is brought about by passing a stream of cold water through the specimens which are suspended in a warm, moist atmosphere. The painted specimens are inoculated by blowing spores into the cabinet with compressed air.

Une enceinte pour l'essai de peintures anticondensation fongicides dans des conditions tropicales

Résumé

Cet article est consacré à la description d'une enceinte d'essais Perspex renfermant 24 éprouvettes tubulaires permettant d'évaluer le pouvoir fongicide des peintures anticondensation. La condensation formée sur les surfaces peintes est obtenue en passant un courant d'eau froide à l'intérieur des éprouvettes suspendues dans une ambiance chaude et humide. Les éprouvettes peintes sont recouvertes de spores injectés dans l'enceinte grâce à une source d'air comprimé.

Ein tropfenfester Prüfschrank für fungizide Farben mit Antikondensationswirkung

Zusammenfassung

Ein "Perspex" Prüfschrank, der zehn röhrenförmige Proben zur Bestimmung der fungiziden Wirkung von Antikondensationsfarben aufnehmen kann, wird in diesem Beitrag beschrieben. Die Kondensation auf den gestrichenen Oberflächen wird durch Hindurchleiten eines Kaltwasserstroms erzielt, wobei die Proben in warmer, feuchter Luft aufgehängt werden. Die gestrichenen Proben werden durch Einblasen von Sporen mittels Pressluft im Schrank verseucht.

Introduction

Small-scale laboratory testing of the efficiency of fungicidal paints is usually carried out either by placing the painted specimen, after a suitable ageing process, on a mycelial mat previously developed in a petri dish, or by spraying the specimen with a spore suspension of the test fungus and estimating the amount of fungal growth by visual comparison at the end of an incubatory period of 14 or 28 days. Several materials have been used for this purpose including filter paper, glass slides or cover glasses, hardboard, aluminium foil and nylon filter cloth.

Large-scale experiments have been carried out using clay tiles, plaster bricks, wood or steel panels, or sheets of canvas. These larger experiments usually call for the use of a tropical room or hut. The small-scale experiments have the advantage of making possible the use of pure single strains of test fungi, whereas in experiments on the larger scale, contamination is inevitable and the resultant growth of mixed species often produces anomalous results due to the production of inhibitory exudates formed by the various species. The results obtained depend very largely on the humidity surrounding the specimen, the porosity of the specimen (i.e. whether it will permit access to the nutrient substrate) and the presence or absence of dust or other particulate matter on the paint surface that might be used as food by the fungus.

Tests carried out on permeable specimens such as filter paper or nylon often permit a vigorous growth of mould on the paint unless the fungicide is strongly toxic. On a rich medium, such as wort agar, fungal growths tend to encroach upon the edge of the painted specimen and may even spread over it for a considerable distance. The *hyphae* in direct contact with the paint may be killed by the fungicide, but others, fed by capillarity from the surrounding wort agar, may spread over the dead layer and eventually colonise the entire surface. In other words, the richness of the medium, particularly in tests involving a small (2 in \times 2 in) specimen, may overcome the toxicity of the paint.

Tests using permeable specimens, therefore, particularly where growth is evident on the surface of the specimen, may be more a measure of the resistivity of the fungus than an indication of the effectiveness of the fungicide. On the other hand, substrates such as glass or aluminium deny the mould access to the medium beneath, and any growth occurring on the surface of the paint is probably due to the nutriment derived directly from the paint. Growth on these impermeable materials is usually very slight and slow to develop, due very largely to the dryness of the surface as well as to lack of nutriment. In either case the petri dish method, while being reasonably rapid and convenient for screening fungicides, is far removed from conditions of natural infection and fungal growth. Moistening of specimens by dipping or spraying with water is, as a rule, inadvisable, as this may wash off spores from the paint surface.

The apparatus to be described attempts to simulate more closely the natural conditions of mould infection by allowing airborne spores to alight on a vertical surface and then to subject them to controlled "dewing" by condensed moisture alternating with periods of dryness at temperatures similar to those in tropical countries.

Description of the apparatus

Essentially, the apparatus consists of a bridge carrying 24 tapped nylon heads, each of which is fitted with a narrow bore (about 2 mm) stainless steel U tube, as shown in Fig. 1. The U tubes are connected at the top with rubber tubing to form one continuous system. One end of the tubing is connected to a small submersible pump in a 10-gallon water tank and the other returns to the water tank. A stainless steel water trough about 5 cm deep, 15 cm wide and 85 cm long fitted on the underneath side with three 100W pad heaters is supported

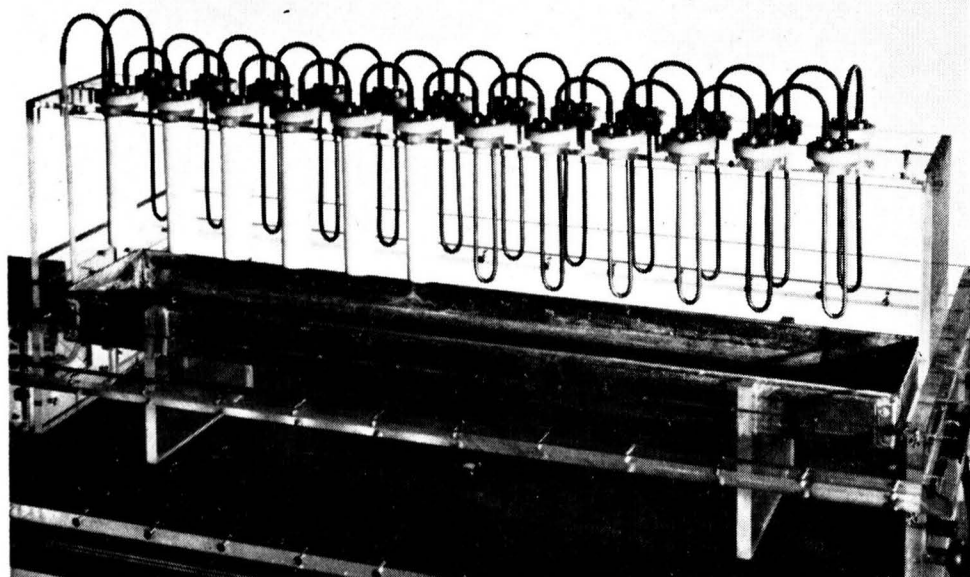


Fig. 1. Interior of testing cabinet. The heater above the tubes is not shown. $\times 1/5$

beneath the U tubes. The heat input is controlled by a *Sunvic* Simmerstat. The horizontal element of the bridge carrying the U tubes is detachable from the vertical side supports for ease of operation and cleaning. A small heater (not shown in Fig. 1) is fitted above the tubes so that the air in the cabinet may be heated without heating the water.

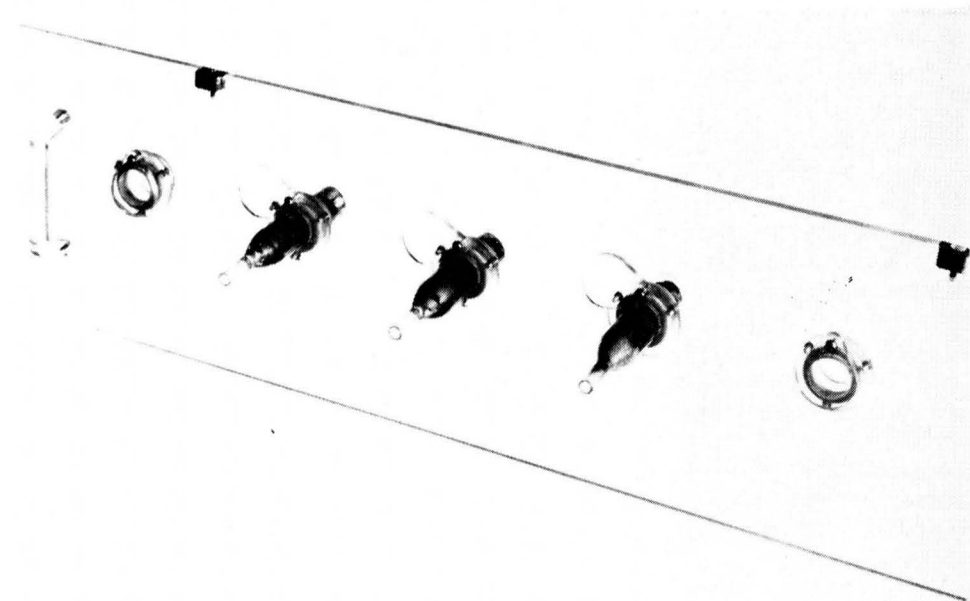
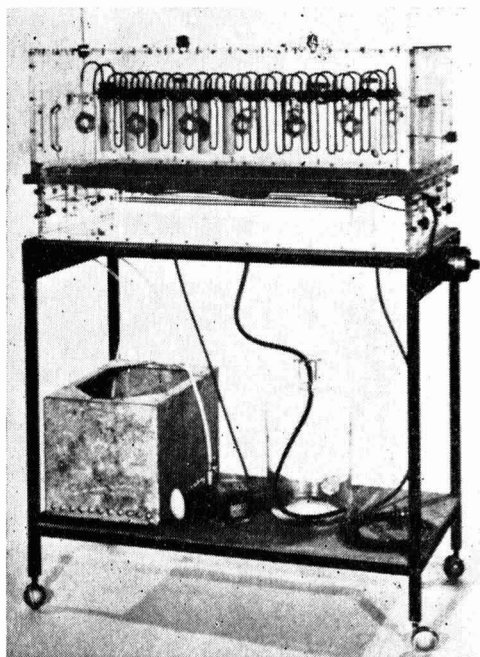


Fig. 2. View of the side panels from the upper portion of the cabinet showing five of the portholes with charged spore guns inserted in three of them. $\times 1/4$

The whole assembly is contained in a Perspex cabinet approximately 3 ft \times 1 ft 8 in \times 1 ft 8 in, the upper half of which may be lifted off. The two long sides of the upper half are fitted with removable panels, each of which has a line of six circular holes about 2.6 cm in diameter fitted with sleeves, as shown in Fig. 2. These panels are supported by a ledge and held into position by clips. The lower portion of the cabinet is fitted with supports to carry petri dish cultures. The cabinet is mounted on a trolley fitted with a lower shelf to support the water tank and an aspirator to serve as a drain for excess condensed moisture (as shown in Fig. 3).

Fig. 3. The complete tropical testing assembly showing six painted specimens in position on the left. $\times 1/12$



Preparation of test specimens

The test specimens consist of stainless steel tubes $5\frac{1}{2}$ in \times 1 in in diameter, closed at the lower ends and threaded at the upper ends so as to screw into the nylon heads illustrated in Fig. 1. The wall thickness of the tube is $\frac{1}{16}$ in and this allows them to be cleaned and used repeatedly. The outer surface is unpolished and is well rubbed down with wire-wool so as to provide a good base for the application of paint.

Paints under test, which may be applied either by dipping or brushing, are allowed to dry—in the case of emulsion paints—for 24 hours, after which a second coat is applied. The specimen is then allowed to dry for six days at room temperature, followed by leaching in tap water at 40°C for 48 hours. Each specimen is leached in not less than one gallon water, which is changed every three hours throughout the working day. Alternatively, the leaching may be carried out in running water at room temperature. After leaching, the specimens are allowed to dry at room temperature for two hours and are then placed in an oven at 40°C for 24 hours, after which they are leached again for a further two hours in tap water at 40°C. After this ageing treatment the specimen tubes are screwed into the nylon heads and subjected to test.

Preparation of equipment and method of test

The test cabinet is infected with fungal spores by means of spore guns which consist of thick walled glass tubes, 6 in long and 1 in diameter, tapered to $\frac{1}{4}$ in at one end. Sterile wort agar is poured into the previously sterilised gun and rotated between the palms of the hands to produce a uniform film over the whole of the inner surface. After allowing the agar to set in a sterile chamber, the surface is inoculated with the spores of the test fungus.

For the purpose of paint testing, it is advisable to choose a species that produces a large number of dry spores which immediately become airborne if disturbed, and for this reason *Penicillium* or *Cladosporium* are preferable. *Cladosporium sphaerospermum* Pensig, a common contaminant on ships' paint, has been found most satisfactory. The rolled cultures are allowed to develop for 10-14 days. When the cultures are fully fruiting, the spore guns are introduced into the apertures in the side of the cabinet, as shown in Fig. 2, and spores are blown towards the specimens by a jet of compressed air. Alternatively, a length of rubber tubing can be attached to the narrow end of the spore gun and the spores blown in by mouth.

Prior to placing the spore guns in position six sterile wort agar plates are placed on the stands provided for that purpose on each side of the cabinet. These are readily inoculated when the spore guns are blown and not only indicate whether the cultures are successfully fruiting, but also provide further spores should a second inoculation become necessary.

As experience has shown that fungi are most reluctant to develop on a perfectly clean painted surface under sterile conditions, a small amount of detrital organic material is first blown into the cabinet. For this purpose, rich garden soil is dried and finely powdered with a pestle and mortar, and rubbed through a 200 mesh sieve. The fine dust thus obtained is placed in a petri dish and sterilised in a hot air oven at a temperature of 130°C for three hours.

In carrying out the test, the painted specimen tubes are three-quarter filled with water and secured in the nylon heads as shown on the left-hand side of Figs. 1 and 3; the water trough is heated and the circulating pump operated, to bring about a faint dewing on the surface of the painted specimens. The pump is then turned off. Clean spore guns are placed in position carrying small quantities of the dry sterile dust. A quantity equal to about as much as will cover a sixpence is blown in from each side of the cabinet. The dust particles are allowed to dry on the surface of the paint for at least 24 hours before operation of the pump induces further dewing. Guns charged with spores are then introduced and the specimens inoculated with the test fungus.

Great care must be exercised in controlling the amount of condensation on the tubes as excess moisture tends to coalesce to form large beads of water that trickle down the tubes and wash off the spores before they have had time to germinate. It is therefore advisable to discontinue dewing for three or four days after the spores have been blown into the cabinet. After this period the heaters should be operated so as to maintain the temperature within the cabinet reasonably close to 30°C, and the operation of the pump curtailed so as to reduce the amount of condensation to a faint dewing on the surface of the painted specimens. It is only necessary to operate the heaters during the daytime, and the dewing needs only to be effected for about one or two hours each morning. Naturally, the actual duration of heating will vary according to the temperature of the laboratory in which the apparatus is operated. Maximum growth is obtained when the surface of the paint is just moist and this can only be judged by experience; too much moisture retards development and growth.

Operating temperatures will necessarily vary with the ambient, but in a laboratory usually at 22°C, it is necessary to raise the temperature of the water in the trough to 40°C to bring about the dewing and to maintain 30°C inside the cabinet. If, after turning off the trough heaters, the temperature in the cabinet drops too drastically, the heater above the specimens may be turned on independently so that the air temperature may be maintained without running the risk of reheating the water and increasing the dewing on the painted specimens.

Preliminary trials with this apparatus indicate that on oil bound flattings and pvc emulsion paints, growth is detectable on the tubes after four weeks. Fig. 4 shows a typical growth obtained after 12 weeks' incubation.

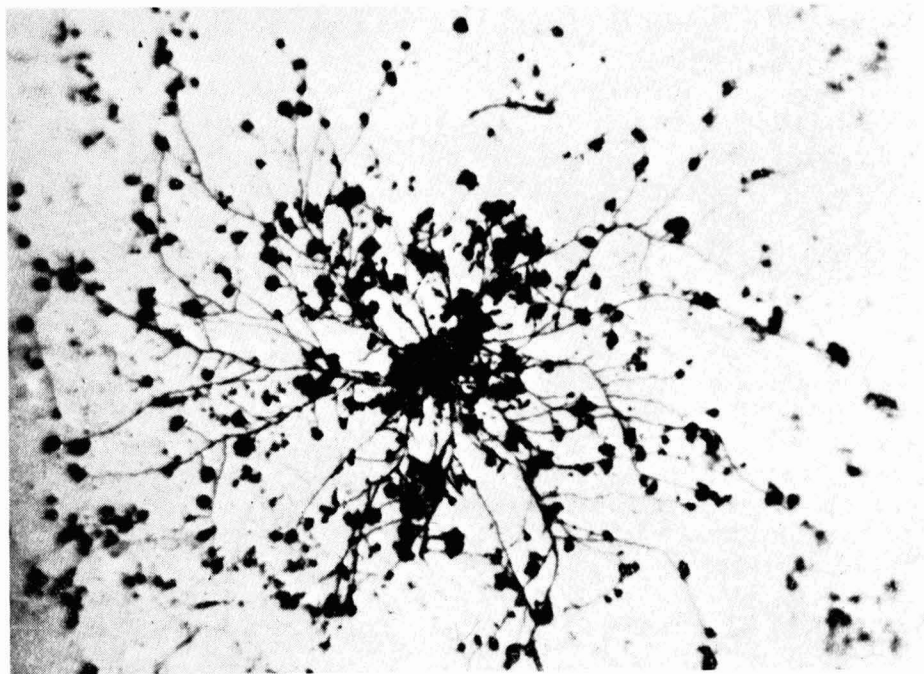


Fig. 4. A colony of *Cladosporium sphaerospermum* on the painted surface of a test specimen after 12 weeks' incubation. $\times 30$

Acknowledgments

This paper is published with the permission of the Navy Department, Ministry of Defence. The Author is also indebted to the Paint Research Station, Teddington, for suggestions improving the cooling water system and the application of sterile nutriment to the painted specimens. The results of extended trials of various paint systems using similar apparatus will be published by them in due course.

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Photochemistry of vinyl chloride/ vinyl-iso-butyl ether copolymer : Part III

The influence of some organic compounds on the rate of the copolymer photolysis

By Z. S. Hippe, H. T. Jabłoński and T. B. Krzyżanowska

The Paint Research Institute, Gliwice, Poland

Summary

Previous work had indicated that substances capable of absorbing ionising radiations might be expected to protect the copolymer films against photolytic degradation. This possibility is further discussed and the results obtained with a series of such compounds are described. It is shown that certain compounds do indeed have a protective effect but that the typical anti-oxidants phenol and hydroquinone are less effective than dibenzyl sulphone and stearic acid which appear to act as energy or radical scavengers. Surprisingly, nitrobenzene and oleic acid tend to promote the photolysis reaction.

Photochimie du copolymère ether de chlorure de vinyle/vinyle- iso-butyle : 3ème Partie

Résumé

Des études effectuées précédemment, il ressortait que les substances capables d'absorber les radiations ionisantes pourraient s'avérer protéger les pellicules copolymères contre la dégradation photolytique. L'article résumé ici analyse plus encore cette possibilité et donne une description des résultats obtenus avec une série de composés de ce genre. Il est démontré que certains composés exercent en effet une action protectrice, mais qu'en revanche la phénol et l'hydroquinone—désoxydants types—sont moins efficaces que le sulfone dibenzyle et l'acide stéarique qui s'avèrent agir comme supresseurs énergétiques ou radicaux. Il est surprenant de constater que le nitrobenzène et l'acide oléique tendent à faciliter la réaction dite de photolyse.

Die Photochemie von Vinylchlorid/vinyl-iso-butylester-copolymer: Teil 3

Zusammenfassung

Frühere Arbeiten haben gezeigt, dass man von Substanzen, die imstande sind eine Ionenstrahlung zu absorbieren, auch erwarten kann, dass sie Kopolymerfilme gegen photolytischen Zerfall schützen. Diese Möglichkeit wird erörtert, und die Ergebnisse, die mit einer Anzahl entsprechender Verbindungen erzielt wurden, werden beschrieben. Es wird gezeigt, dass bestimmte Verbindungen tatsächlich über eine Schutzwirkung verfügen, aber auch, dass die Typischen Antioxydationsmittel wie Phenol und Hydrochin weniger wirksam sind, als Dibenzyl-Suphon und Stearinsäure, die als wirksame Aufsaugemittel zu wirken scheinen. Erstaunlicherweise zeigen Nitrobenzol und Oleinsäure die Neigung, die photolytische Reaktion zu fördern

Introduction

The results previously reported for the mechanism and kinetics of vinyl chloride/vinyl-iso-butyl ether copolymer photolysis^{1, 2} suggested that the substances having the character of high-energy ionising radiation protectors would be able to improve the resistance of investigated copolymer against attenuated radiations, e.g. light.

Chemical compounds having functional groups, the presence of which in irradiated system lowers its reactivity, are called radiation protectors. The mechanism of such protection is not yet completely understood, but there are some theories concerned with this problem. One possible explanation, which should be taken into consideration, suggests that protective activity deals with energy transfer from the irradiated system to protectors³. For instance, compounds having single or condensed benzene rings constitute the most effective protectors. The resonance structure of the aromatic system has several energy levels, which enables the speedy distribution of adsorbed energy in a molecule without causing permanent chemical changes.

Fatty acids, especially stearic acid, are also radiation protectors. The stearic acid protection against polyethylene crosslinking induced by high-energy radiation was investigated by Charlesby, Davison and von Arnim³, who assume that the process relies also on direct energy transfer, or the transfer of either an electron or proton from the acid to polymer, and at that, the acid on the contrary to the protectors having benzene rings, decomposes.

For the confirmation of the assumption that the protectors of high-energy ionising radiation can have also protective activity in photolysis processes, the influence on the rate of photolysis of several substances of such type (nitrobenzene, oleic, stearic and salicylic acids, phenol, hydroquinone, aniline, thiocarbamide, dibenzyl sulphoxide, 8-oxyquinoline) were investigated. These substances were added in small quantities to the copolymer.

The effect of these compounds was evaluated by a spectrophotometric method determining⁴ the rise of absorption band 1,710-1,760 cm^{-1} (C=O groups) and the decrease of absorption band 1,100 cm^{-1} (C—O—C link), for it was previously established that the intensity changes of these bands are characteristic of the photolysis process in the investigated copolymer.

Experimental

The copolymer, as free films (thickness of about 20 μ), without and with addition 0.5 mol per cent of protective substances was irradiated with a dose of 8.5×10^8 erg cm^{-2} of polychromatic ultraviolet light.

The method of film preparation, the irradiation conditions and method of infrared analysis have been described previously¹.

Each film was analysed before and after irradiation. The intensities of carboxyl (at 1,740 cm^{-1}) and ether (at 1,100 cm^{-1}) groups absorption were determined by the base line method. The results calculated in the form of ratios

$$\frac{A_{\text{carboxyl}}^{\text{P}}}{A_{\text{carboxyl}}^{\text{O}}} \quad \text{and} \quad \frac{A_{\text{ether}}^{\text{O}}}{A_{\text{ether}}^{\text{P}}}$$

(where A^O is the absorption intensity of given functional group before irradiation, A^P after irradiation) are compared in Table 1.

Table 1

The values of relative infrared absorption intensities of C—O—C and C=O groups of vinyl chloride/vinyl-iso-butyl ether copolymer, containing different protective substances (after irradiation with dose 8.5×10^8 ergs/cm²)

Protective substance	C—O—C	C=O	
	$\frac{A_{C-O-C}^O}{A_{C-O-C}^P}$	$\frac{A_{C=O}^P}{A_{C=O}^O}$	$\frac{A_{C-O-C}^O}{A_{C-O-C}^P} + \frac{A_{C=O}^P}{A_{C=O}^O}$
Nitrobenzene	1.41	3.22	4.63
Oleic acid	1.36	3.12	4.48
Copolymer without additives	1.33	2.83	4.16
Phenol	1.91	1.89	3.80
Hydroquinone	1.29	2.26	3.55
Salicylic acid	1.30	2.11	3.44
Thiocarbamide	1.05	1.74	2.79
8-Oxyquinoline	1.13	1.65	2.78
Aniline	1.08	1.37	2.45
Dibenzyl sulphoxide	0.92	1.52	2.44
Stearic acid	0.92	1.38	2.30

Results and discussion

The total amount of retarding abilities of two principal processes acting during photolysis of vinyl chloride/vinyl-iso-butyl ether copolymer, i.e. breaking of the side chains, drop of absorption of C—O—C band and oxidation rise of C=O band, was accepted as the evaluational basis of the effectiveness of the substances to be investigated. According to the accepted scheme, the smaller the value of the sum of the absorption intensities, the more effective the protective action of investigated substances.

The results shown indicate that the applied compounds have a distinctive influence on the rate of photolysis of the investigated copolymer. Nitrobenzene and oleic acid act as stimulators of the photolysis reaction.

The ratios

$$\frac{A_{C-O-C}^O}{A_{C-O-C}^P} \quad \text{and} \quad \frac{A_{C=O}^P}{A_{C=O}^O}$$

for these substances and their sum are higher than for the irradiated copolymer without the additives. The remaining substances, however, increase the copolymer resistance to light, though their effectiveness varies considerably.

It should be noted that typical antioxidants, e.g. phenol and hydroquinone, appear to be less active than dibenzyl sulphoxide or stearic acid. The particularly strong activity of these compounds is probably connected with their properties as ionising radiation protectors. Dibenzyl sulphoxide has a big spatial share of phenyl rings in its total molecular volume and can, to a high degree, show the so-called sponge effect which is associated with intramolecular energy transfer or scavenging of radicals.

Dibenzyl sulphoxide is worthy of particular attention because of its strong corrosion inhibiting properties in acidic environment⁵ as well as in radiation field⁶.

The results obtained support our assumptions that the substances with the character of high-energy ionising radiation protectors increase the light resistance of vinyl chloride/vinyl-iso-butyl ether copolymer films.

It could be assumed that substances discussed above may be of use for protection of other vinyl polymers and copolymers from light.

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Electrodeposition : a current-time relationship

By S. R. Finn and J. A. Hasnip

Blundell-Permoglaze Ltd., Sculcoates Lane, Hull, Yorks

Summary

It is deduced that in electrodeposition the current should fall off in some regular manner with respect to time. It is shown that, theoretically, a plot of the reciprocal of the square of the current against time should be linear, provided that the specific resistance of the deposit remains constant.

This is confirmed experimentally in one case and it is suggested that when the relationship is non-linear the departure from linearity is a measure of the extent to which the film has become compacted during the process.

The method of calculation is extended to the behaviour on the two faces of a plate electrode by the use of a simple electrical analogue to represent the deposition circuit.

Dépôt électrolytique : un rapport direct courant-temps

Résumé

Il est établi que lors de dépôts électrolytiques le courant devrait être réduit d'une façon régulière à définir par rapport à la durée. Il est démontré théoriquement qu'un diagramme représentant l'inverse du carré du courant comparé à la durée devrait être linéaire pour autant que la résistance spécifique du dépôt reste constante.

Cette théorie est confirmée par l'expérience dans un cas et il est présumé que lorsque le rapport est non-linéaire, l'écartement de la linéarité est une indication du degré de compacité atteint par le film au cours de l'opération.

La méthode de calcul est également appliquée afin de déterminer le comportement des deux faces d'une électrode à plaque, grâce à l'emploi d'un simple dispositif électrique à analogie, représentant le circuit de dépôt.

Elektrobeschichtung : Eine Strom-Zeit Gleichung

Zusammenfassung

Es wird dargestellt, dass bei der Elektrobeschichtung der Strom in einer regelmässigen Beziehung zur Zeit abfällt. Es wird gezeigt, dass—theoretisch—eine Darstellung des reziproken Wertes der Quadratzahl des Stromes im Verhältnis zur Zeit linear sein müsste, vorausgesetzt, dass der spezifische Widerstand der Ablagerung konstant bleibt.

Dies ist experimental in Falle bestätigt worden, und es wird gefolgert, dass die Abweichung von Linearität ein Mass für die Komprimierung des Films bei diesem Vorgang ist, wenn die Gleichung nicht—linear ist.

Die Berechnungsmethode wird auf das Verhalten der beiden Flächen einer Galvanisierungselektrode ausgedehnt, indem man ein einfaches elektrisches Analogon zur Darstellung des Beschichtungsschaltkreises benutzt.

Introduction

It is well known that when a resin is electrodeposited from a solution on to the surface of an electrode, the current flowing falls off more or less rapidly, according to the conditions prevailing and the particular resin in use. This will occur whether or not the bath is stirred and when only a negligible proportion of the solids content of the solution is removed, and hence neither a local nor a general decrease of the resin present in the solution can be the major cause of the reduced current passing. The decrease must, therefore, be attributed to the increasing electrical resistance of the film deposited upon the appropriate electrode.

It has been demonstrated by several authors^{1, 2, 3} that the weight of deposit formed is, at least approximately, proportional to the number of coulombs of electricity passed in forming it, i.e. proportional to the integral of the current with respect to time during the deposition period. If the assumption is made that the specific resistance of the deposited film remains constant during deposition, then it is clear that the film resistance will be proportional to the weight of deposit. This assumption is not always valid, since various effects can occur which will modify the film, but it is made here to simplify the mathematical treatment, and it is possible that any departure from the equations derived by making this assumption can be considered as some measure of the change in the film after the initial deposition.

On this basis, therefore, it can be presumed that the current flowing at any instant is dependent upon the quantity of electricity which has passed previously. It would, thus, be expected that the current should fall off in some regular manner with respect to time, for example, exponentially.

General form of the equation

Let it be supposed that deposition occurs at the anode in a bath of resin, and further suppose that the anode and cathode consist of parallel plates of unit area and that only the sides of the electrodes facing each other are exposed, by coating the reverse sides and edges with some insulating layer.

Then let R be the resistance of the bath liquid in ohms; V be the potential applied between the electrodes in volts; c_0 the initial current flowing at time t_0 ; c_t the current flowing at some other time, t , and p the resistance of the film, in ohms, deposited upon the electrode by the passage of one coulomb of electricity.

Suppose now that the current passing at any time, t , is some function of the time, then the current can be written as $c=f(t)$, and suppose also that the coulombs passed at the same time, t , can be written as :

$$\int_0^t c \cdot dt = F(t) - F(t_0)$$

Then, by Ohm's law, the relation between the current at the same time, t , per unit area of anode and at the applied potential, V , will be :

$$c = f(t) = \frac{V}{R + p \cdot \int_0^t c \cdot dt}$$

$$= \frac{V}{R + p \cdot F(t) - p \cdot F(t_0)}$$

that is :

$$R + p \cdot F(t) - p \cdot F(t_0) = \frac{V}{f(t)}$$

Differentiating with respect to time - $p \cdot f(t) = \frac{-V \cdot f'(t)}{f(t)^2}$

where $f'(t)$ is the differential of $f(t)$. But $f(t) = c$ by definition, so that $f'(t) = \frac{dc}{dt}$ and therefore :

$$p \cdot c^3 = -V \cdot \frac{dc}{dt} \text{ or } \frac{dc}{c^3} = -\frac{p}{V} \cdot dt$$

this upon integration gives :

$$-\frac{1}{2c^2} = -\frac{p}{V} \cdot t + C_1$$

where C_1 is the constant of integration. Initially, when $t=0$, $c=c_0 = \frac{V}{R}$ so that then :

$$-\frac{1}{2\left[\frac{V}{R}\right]^2} = C_1 \text{ or } C_1 = -\frac{R^2}{2V^2}$$

therefore, the integrated equation becomes :

$$-\frac{1}{2c^2} = -\frac{p \cdot t}{V} - \frac{R^2}{2V^2}$$

$$= -\frac{1}{2V^2} \cdot \frac{2p \cdot V \cdot t + R^2}{1}$$

or $c^2 = \frac{V^2}{2p \cdot V \cdot t + R^2}$

and hence - $c = \frac{V}{(2p \cdot V \cdot t + R^2)^{\frac{1}{2}}}$

To check that this equation has the correct form, suppose that p tends towards zero, then $2p \cdot V \cdot t$ must also tend towards zero and hence the current tends to $\frac{V}{R}$. The same argument applies when t tends to zero and then c

approaches $\frac{V}{R}$, which is the initial current.

When p is relatively large, then c tends to $\frac{V}{(2p \cdot V \cdot t)^{\frac{1}{2}}}$ since R^2 is small in comparison with $2p \cdot V \cdot t$. The equation, therefore, appears to satisfy the known behaviour of current/time curves.

Rearranging the above equation we get :

$$\frac{1}{c^2} = \frac{(2p)}{V}t + \frac{R^2}{V^2}$$

If the assumption that p remains constant is true then a plot of $\frac{1}{c^2}$ against time should result in a straight line.

Fig. 1 shows the result of such a plot for a particular alkyd resin, electro-deposited from a 14 per cent ammoniacal solution at pH=9, at an applied potential of 54 volts. It will be seen that, in this instance, the above equation is followed reasonably closely.

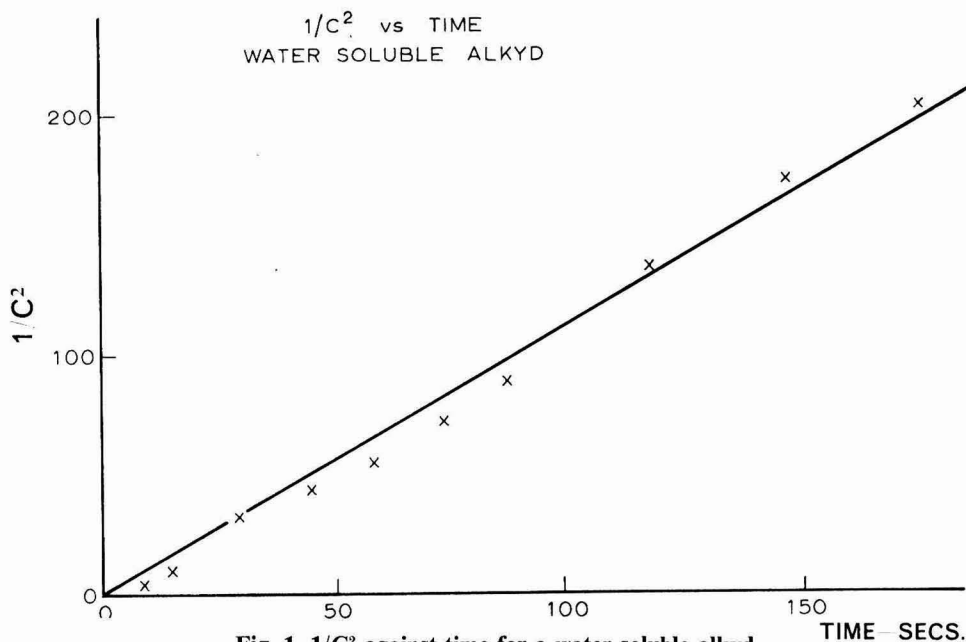


Fig. 2 represents the behaviour of a proprietary modified oil medium pigmented with carbon black. Here there is a marked departure from linearity, so that the assumption of constant specific resistance of the film is not justified ; the deviation is in the direction of a lower current than theoretically anticipated, that is, the film resistance has become greater than that of the initial deposit.

so that it is presumed that some compaction of the film has taken place concurrently with deposition. Such an effect is consistent with, for example, electro-endosmosis.

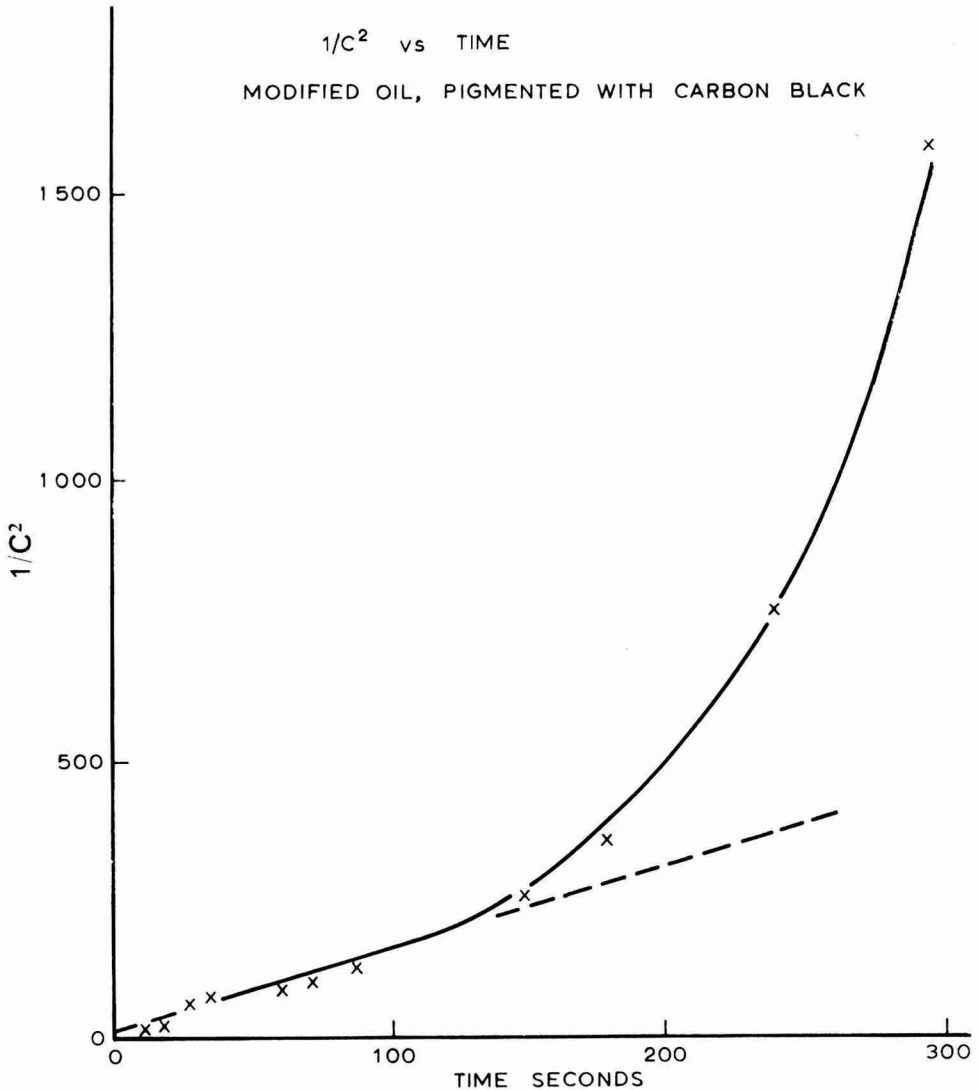


Fig. 2. $1/C^2$ against time for a modified oil pigmented with carbon black

Extension of the principle to two faces of an anode

In calculating the magnitude of the individual currents to the front and back of a plate anode it is assumed that the deposition cell can be represented by the resistance analogue depicted in Fig. 3. In Appendix I faces of unit area are considered and a relationship between current and time is derived. The

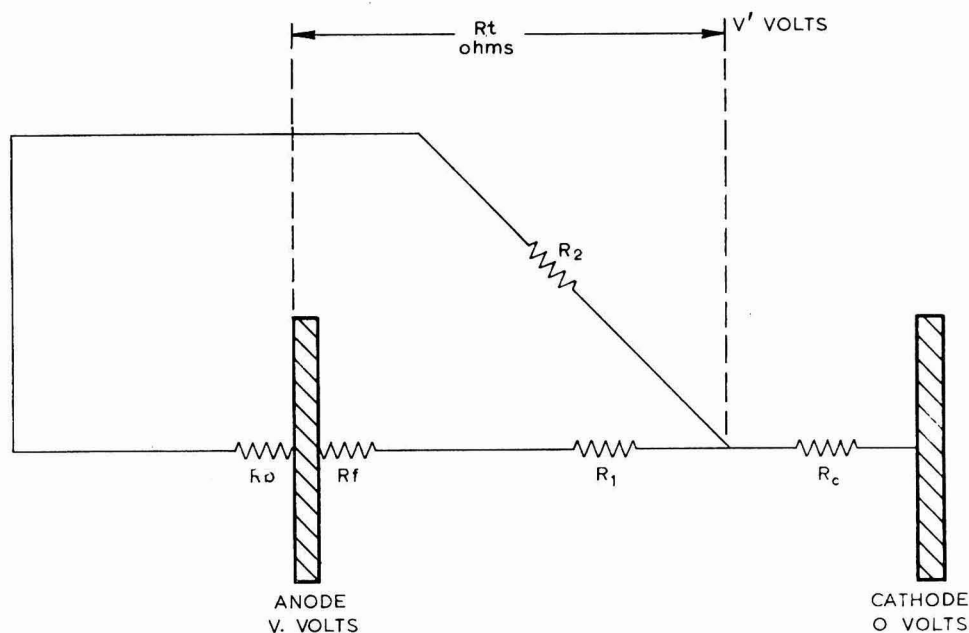


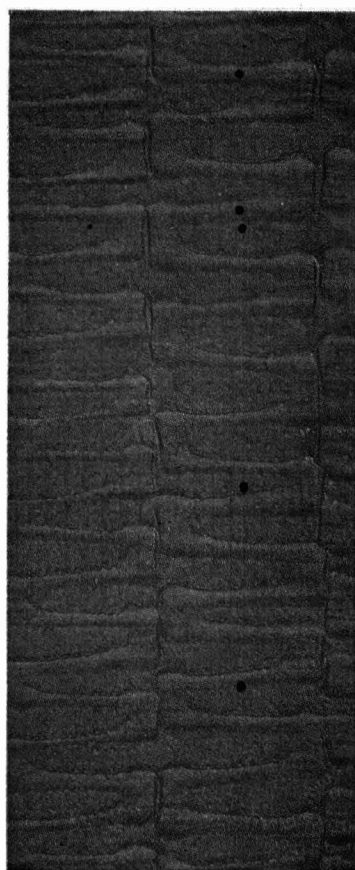
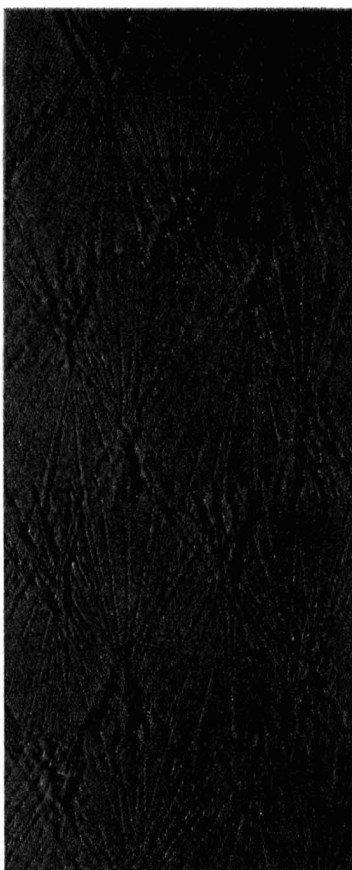
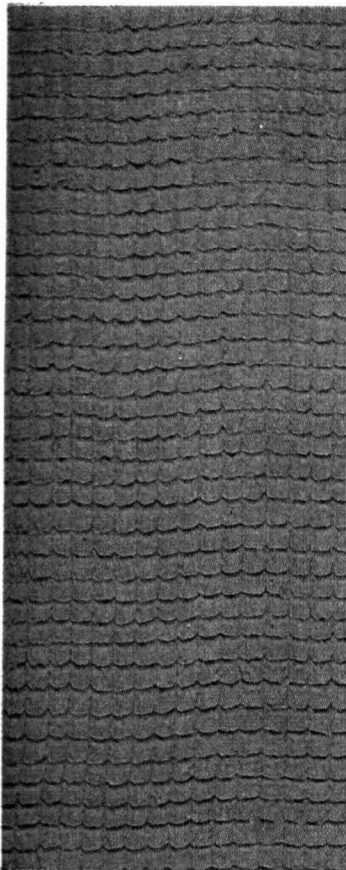
Fig. 3. A simple electrical model representing the electrodeposition circuit

final expressions are given in equations (11) and (12), the meaning of the various quantities in these equations being :

- c_f, c_b currents flowing to the front and back faces of the anode.
- p_f, p_b resistances of films deposited by 1 coulomb in each case at the front and back face.
- p resistance per unit area of film deposited at the combined faces by 1 coulomb.
- R_c total resistance of the volume elements of liquid carrying current to both faces.
- R_1, R_2 total resistance of the volume elements of liquid carrying current to the front and back faces respectively.
- R_t the electrical sum of the parallel resistances R_1, R_2 .
- V the potential difference between the electrodes.

To test the validity of these equations, it is necessary to measure the current flowing separately to the front and the back of the anode and also to measure the resistances R_1, R_2 and R_c . This has been done experimentally by using a double anode consisting of two similar steel plates, each insulated on one face and at the edges and placed back to back with the insulated sides together, the current flowing to each face simultaneously being measured by placing separate ammeters in each circuit. The two sides of the anode are maintained at the same potential by using a common lead from each ammeter to the source of power.

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The bath resistance, before any film has been formed upon the anode, was determined by means of an AC conductivity bridge. The pigmented black paint referred to in Fig. 2 gave the following results :

Specific conductivity of the paint	=	26.2×10^{-2} mhos
Conductivity to " front " of anode alone	=	160×10^{-2} mhos
Conductivity to " back " of anode alone	=	110×10^{-2} mhos
Conductivity to both sides simultaneously	=	163×10^{-2} mhos

The corresponding resistances of the three paths are thus : to the front alone 62.6 ohms, to the back alone 90.9 ohms, and to the two sides simultaneously 61.3 ohms.

If a potential of 40 volts is applied, the currents flowing initially would be :

Front of anode only exposed	..	..	..	0.640	amps
Back of anode only exposed	..	..	..	0.440	amps
Both faces of anode exposed	..	..	..	0.652	amps

The effect of the " common path " in the particular bath arrangement in use is quite marked, since if it did not exist, the current flowing to the two sides of the anode simultaneously would be $0.640 + 0.440 = 1.080$ amps.

When the above resistances are expressed in terms of the model (Fig. 3) it is seen that :

$$R_1 + R_c = 62.5 \text{ ohms}$$

$$R_2 + R_c = 90.9 \text{ ohms}$$

$$R_t + R_c = 61.3 \text{ ohms}$$

$$\text{Initially } R_f = 0 = R_b$$

R_t can be expressed as $\frac{R_1 \times R_2}{R_1 + R_2}$, so the simultaneous equations can be resolved to give :

$R_1^2 + 2.2R_1 = 31.2$ whence $R_1 = 6.67$ ohms (neglecting the negative root). So that it is finally found that $R_2 = 35.1$ ohms and $R_c = 55.8$ ohms. Thus as deduced above R_c is a surprisingly high proportion of $(R_1 + R_2)$.

When a potential of 40 volts is applied to the electrodes the currents flowing when both front and back of the anode are connected should be :

Total initial current	..	..	..	..	0.651	amps
Initial current to front	..	..	..	..	0.547	amps
Initial current to back	..	..	..	..	0.104	amps

The currents found experimentally with the same paint in the same cell when 40 volts were applied are given in Table 1.

Table 1

Time, secs	Current in amps			
	To front (c_f)	To back (c_b)	Total (c_t)	$\frac{1}{(c_t)^2}$
"0"	0.42	0.21	0.63	2.5
10	0.11	0.14	0.25	1.6×10
15	0.09	0.11	0.20	2.5×10
30	0.076	0.062	0.138	5.26×10
45	0.069	0.052	0.121	6.85×10
60	0.062	0.046	0.108	8.55×10
75	0.057	0.041	0.098	1.04×10^2
90	0.053	0.036	0.089	1.26×10^2
120	0.046	0.029	0.075	1.78×10^2
150	0.039	0.023	0.062	2.60×10^2
180	0.033	0.019	0.052	3.70×10^2
240	0.023	0.013	0.036	7.70×10^2
300	0.016	0.009	0.025	1.60×10^3
360	0.011	0.0066	0.0176	3.23×10^3

The initial readings are described as being at time "0," since they are not the true initial currents, due to instrumental lag and other reasons, and should more accurately be taken as the current at about one second after the true start.

In order to use the equations (11) and (12) to calculate the currents passing to the front and the back of the anode, it is necessary to determine the value of p , the resistance of the film formed by the passage of one coulomb of electricity. One way of doing this is by determining the slope of the line obtained by plotting $\frac{1}{c^2}$ against time. If p is constant, the slope is equal to $\frac{2p}{A \cdot V}$, where A is the immersed area of the anode. The data in Table 1, from which Fig. 2 was constructed, give a value of $\frac{p}{A}$ of 32 ohms per coulomb for the initial 120 seconds, during which a linear relation holds.

It is also necessary to make some estimate of $\frac{p_f}{A_f} \times \frac{A}{p}$ and $\frac{p_b}{A_b} \times \frac{A}{p}$, and in the absence of definite information to the contrary it is assumed that the specific resistance of the film is constant over all elements of area of the anode. For a given

quantity of electricity the films deposited in single-sided deposition will have half the area and double the resistance of a film deposited in double-sided deposition, so that $p_f = p_b = 2p$ and therefore, since $A = 2A_f = 2A_b$, then:

$$\frac{p_f}{A_f} \times \frac{A}{p} = 4 = \frac{p_b}{A_b} \times \frac{A}{p}$$

The value of u in equations (11) and (12) will be:

$$u = \frac{2p}{A} \cdot t \cdot V_j + (R_t + R_c)^2 = 2560t + 3760 \quad (R_t + R_c) = 61.35 \text{ ohms}$$

The data required for the calculation of the current flowing to the front and back of the anode are, therefore, available and the results obtained on making the calculations are given in Table 2 and shown in Fig. 4.

It is of interest to note that the ratio of the currents flowing to the front and the back of the anode is initially 5.2, but that the current to the front

Table 2

Time, secs	c_f (calc)	c_f (observed)	c_b (calc)	c_b (observed)
0	0.547	—	0.104	—
" 0 "	—	0.42	—	0.21
0.5	0.294	—	0.190	—
1	0.256	—	0.206	—
2	0.214	—	0.194	—
5	0.156	—	0.151	—
10	0.117	0.11	0.116	0.14
15	0.097	0.09	0.097	0.11
30	0.071	0.076	0.070	0.062
45	0.058	0.069	0.058	0.052
60	0.050	0.062	0.050	0.046
75	0.045	0.057	0.045	0.041
90	0.041	0.053	0.041	0.036
120	0.036	0.046	0.036	0.029
150	0.032	0.039	0.032	0.023
180	0.029	0.033	0.029	0.019
240	0.025	0.023	0.025	0.013
300	0.023	0.016	0.023	0.009
360	0.021	0.011	0.021	0.0066

falls off very rapidly whilst to the back it actually rises. The observed values do not agree initially with the calculated values, owing to the instrumental lag, but if the experimental $t=0$ is taken as corresponding to 0.5 second agreement becomes reasonably close. The existence of the initial rise in current to the back of the anode has been confirmed by the use of a recording ammeter, but instrumental lag still prevented accurate comparison with the calculated values on a time basis.

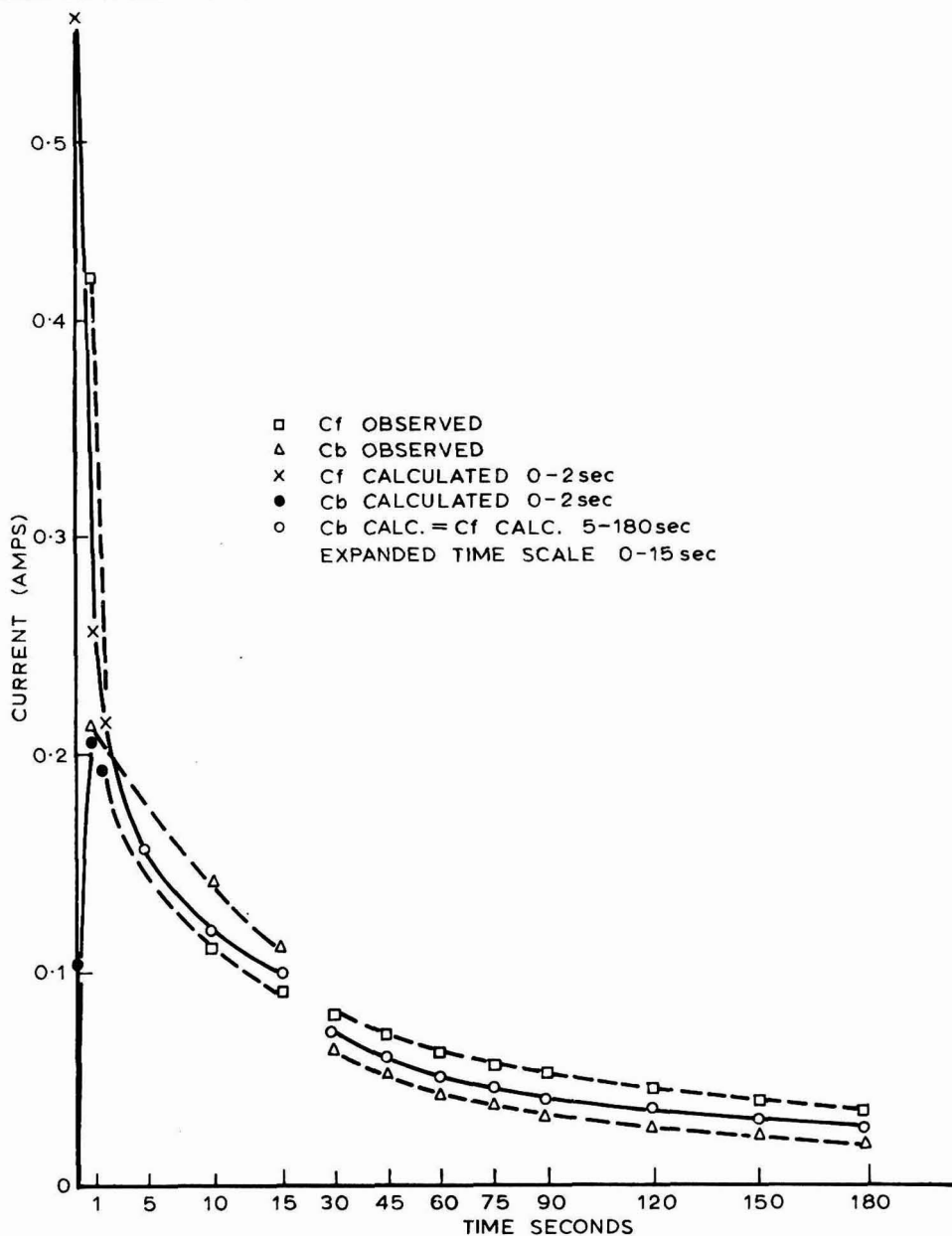


Fig. 4. Comparison of currents to front and back of anode

There is fair agreement between the calculated and observed currents to the two faces of the anode for the first 30-60 seconds, after which the discrepancy increases. This is, no doubt, due to the assumption that the specific resistance of the deposit remains constant during the deposition period.

Fig. 5 shows a plot of $\frac{1}{C^2}$ against time for the front and the back of the anode. The departure of these curves from linearity shows that some form of film compaction is taking place with the particular paint in use. It is of interest to note that this occurs earlier and to a greater extent at the back than at the front of the anode.

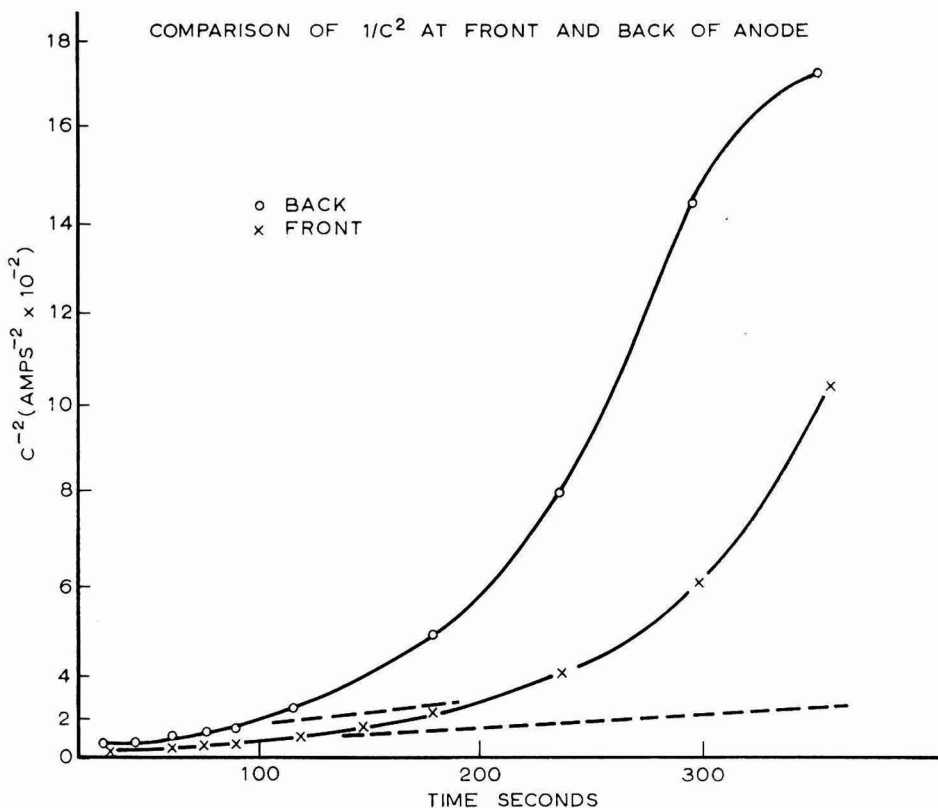


Fig. 5. Comparison of $1/C^2$ at front and back of anode

During the latter stages of the deposition the film resistances R_f and R_b are very great compared to $(R_1 + R_c)$ and $(R_2 + R_c)$, so that the film becomes the controlling factor in the current flow. The current found experimentally to be flowing to the front of the anode is greater, and that to the back is less than predicted. This indicates a greater film resistance and thus a greater extent of film compaction at the back of the anode; the reason for this difference is not yet clear.

Conclusions

The equations derived enable an approximate relationship between current and time to be deduced, without postulating any mechanism by which the process takes place. It is believed, however, that the results are consistent with the ionic mechanism suggested previously⁴. The form of the $\frac{1}{c^2}$ curves suggests that initially a somewhat loose coagulum is formed which becomes compacted, possibly by electro-endosmosis, as the process proceeds.

The simple electrical analogue introduced enables the relative currents flowing to the two sides of the anode to be calculated with reasonable accuracy, at least for the early stages of deposition.

It is realised that the results obtained are somewhat crude and represent only a first attempt to express the process on a quantitative basis. It is hoped that as knowledge accumulates it will become possible to refine and extend the equations.

Acknowledgments

The authors desire to thank the Directors of Blundell-Permoglaze Ltd. for permission to publish this paper and Mr. C. C. Mell in particular for his encouragement and support.

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Appendix

Extension of the principle to two faces of an anode

Suppose that the anode and cathode are still represented by two parallel plates, but that both sides of the anode are now exposed. The situation may be represented by the simple model electric circuit shown in Fig. 3. It is evident that some elements of the volume of the deposition bath will carry current passing from the cathode to both sides of the anode, whilst other elements of the volume will carry current solely to the front or to the back of the anode respectively. The sum of the resistances of each of these three kinds of element, may each be represented in the model by the single resistances R_c , R_1 and R_2 respectively. R_f and R_b represent the resistances of the films formed on the front and the back of the anode respectively, but initially before any film is formed $R_f=R_b=0$.

It will again be assumed that the area of each face of the anode is unity, and let :—

p_f = resistance of the film deposited by 1 coulomb at the front face.

p_b = resistance of the film deposited by 1 coulomb at the back face.

and p = resistance of the film deposited by 1 coulomb per unit area of combined faces.

The resistance R_c will be referred to as the resistance of the "common path," and since R_1 and R_2 are resistances in parallel, R_t , the sum of the "non-common path" resistances will be :

$$\frac{1}{R_t} = \frac{1}{R_1} + \frac{1}{R_2} \quad \text{or} \quad R_t = \frac{R_1 \times R_2}{R_1 + R_2} \tag{1}$$

so that the total effective resistance of the bath will be $R_t + R_c$.

Applying Kirchoff's laws to obtain the proportion of the total current flowing to the front of the anode, it is evident that :

$$c_f = \frac{R_2}{R_1 + R_2} .c. \tag{2}$$

Let the current flowing to the front of the anode be defined in the way as in the general equation, namely :

$$c_f = g(t)$$

The number of coulombs carried by the current flowing to the front face of the anode after any time, t , as before is equal to :

$$\int_0^t g(t).dt = G(t) - G(0) = G(t) \tag{3}$$

The general equation previously developed showed that the total current flowing through the system at time, t , which in this case is the current flowing through the "common path," is given by :

$$c = \frac{V}{[2p.V.t + (R_t + R_c)^2]^{\frac{1}{2}}} \tag{4}$$

Let the potential drop between the anode and the junction of R_1 , R_2 R_c at the same time, t , be represented by V_j , so that :

$$V_j = V - c.R_c = V - \frac{V.R_c}{[2p.V.t + (R_t + R_c)^2]^{\frac{1}{2}}} \tag{5}$$

Equating the current, voltage and resistance after a time, t , over the path between the junction and the front face of the anode, gives :

$$g(t) = \frac{V_j}{R_1 + R_f} = \frac{V_j}{R_1 + p_f \int_0^t g(t).dt}$$

and from (3)

$$g(t) = \frac{V_j}{R_1 + p_f.G(t)} \tag{6}$$

this can be rearranged to :

$$R_1 + p_f.G(t) = \frac{V_j}{g(t)} \tag{7}$$

Differentiating with respect to time, gives :

$$p_f \cdot g(t) = \frac{g(t) (V'_j) - V_j \cdot g'(t)}{g(t)^2} \tag{8}$$

where : $(V'_j) = \frac{d}{dt}(V_j)$ and $g'(t) = \frac{d}{dt} g(t) = \frac{dc_f}{dt}$

Differentiating with respect to time to obtain (V'_j) from (5) gives :

$$\begin{aligned} (V'_j) &= \frac{V \cdot R_c \times p \cdot V [2p \cdot V \cdot t + (R_c + R_t)^2]^{-\frac{1}{2}}}{2p \cdot V \cdot t + (R_c + R_t)^2} \\ &= \frac{p \cdot V^2 \cdot R_c}{[2p \cdot V \cdot t + (R_c + R_t)^2]^{3/2}} \end{aligned} \tag{9}$$

Rearranging (8) :

$$p_f \cdot g(t)^3 = g(t) (V'_j) - V_j \cdot g'(t)$$

and since $g(t) = c_f$ and $g'(t) = \frac{dc_f}{dt}$

we have : $V_j \cdot \frac{dc_f}{dt} - (V'_j) \cdot c_f = - p_f \cdot c_f^3$

or $\frac{dc_f}{dt} - \frac{(V'_j)}{(V_j)} = - \frac{p_f}{V_j} \cdot (c_f)^3$ (10)

The differential equation (10) is of the Bernoulli type and can be solved by reduction to linear form (e.g. division throughout by c_f^3 and the substitution $c_f^{-2} = y$). The final solution of (10), after determining the constant of integration, is given by :

$$(c_f)^2 = g(t)^2 = \frac{(u^{\frac{1}{2}} - R_c)^2 \cdot u^{-1} \cdot V^2}{R_t^2 + \frac{p_f}{p} \left[(u^{\frac{1}{2}} - R_c)^2 - R_t^2 \right]} \tag{11}$$

where u is defined as :

$$u = 2p \cdot V \cdot t + (R_c + R_t)^2$$

From the symmetry of the system, the current to the back of the anode can be written as :

$$(c_b)^2 = \frac{(u^{\frac{1}{2}} - R_c)^2 \cdot u^{-1} \cdot V^2}{R_2^2 + \frac{p_b}{p} \left[(u^{\frac{1}{2}} - R_c)^2 - R_t^2 \right]} \tag{12}$$

These expressions for c_f and c_b obtained above can be checked mathematically and some idea of their adequacy obtained also by tabulating calculated values of c_f and c_b for comparison with observed values.

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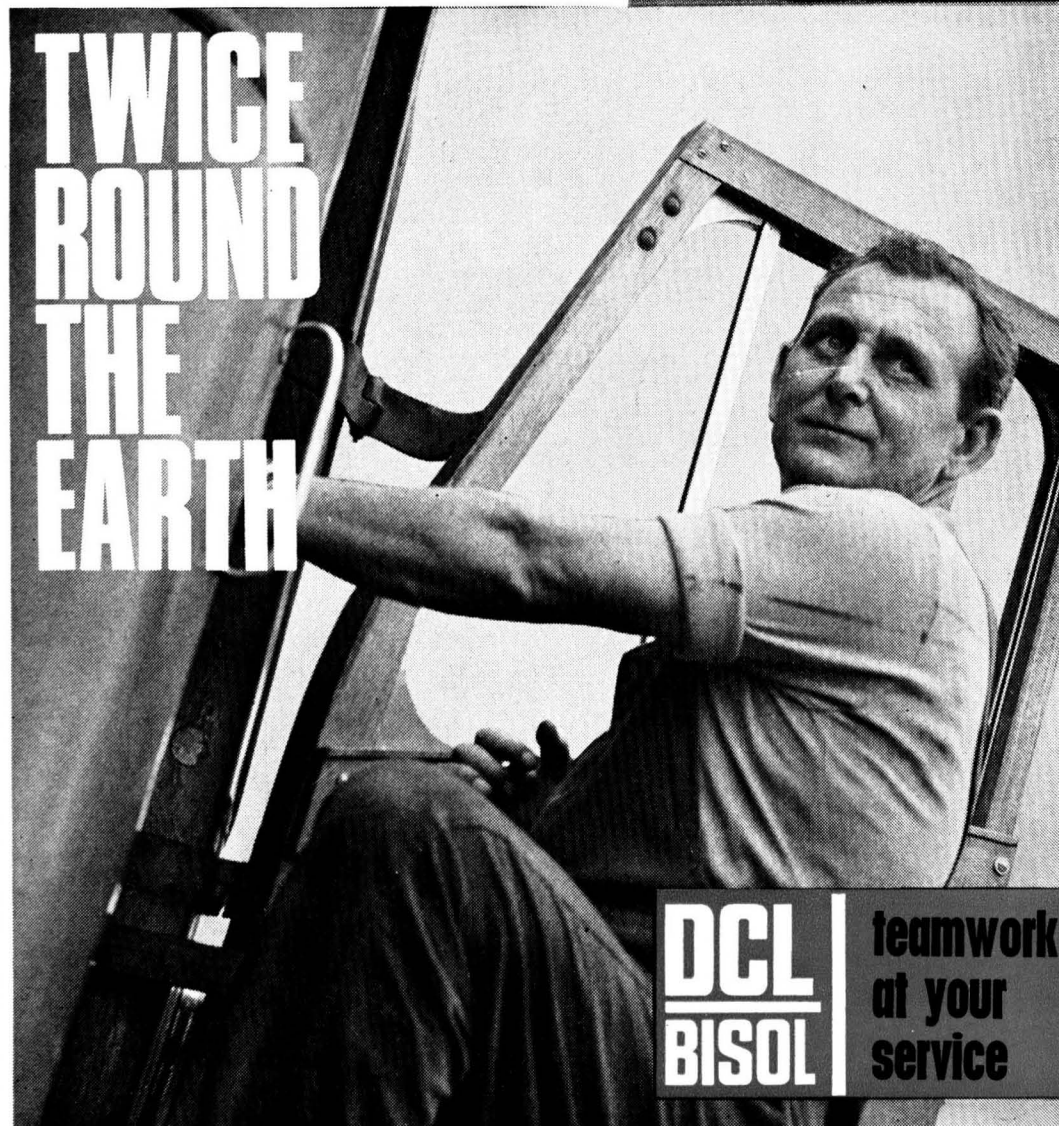
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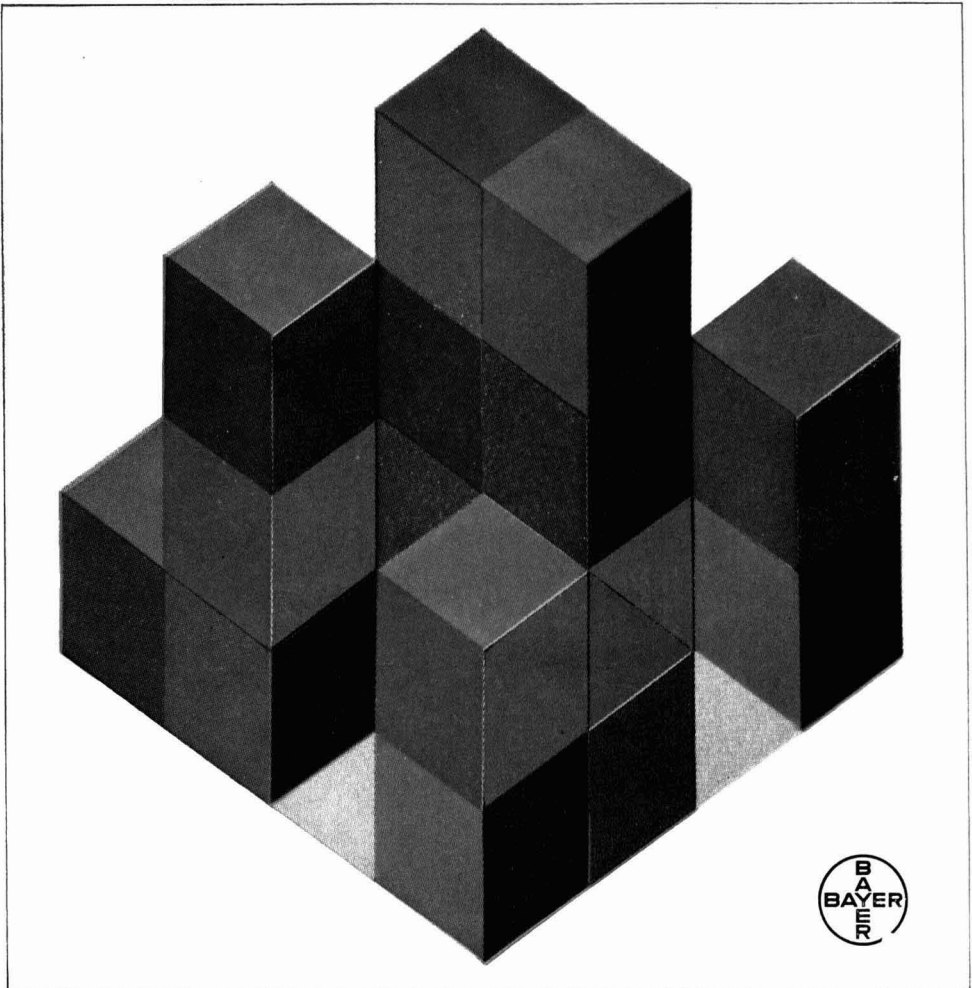
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Mathematical check of equation (11)

Equations (5) and (7) may be rewritten as :

$$V_j = V - \frac{V \cdot R_c}{u^{\frac{1}{2}}} \tag{13}$$

$$p_f \cdot G(t) = \frac{V_j}{g(t)} - R_1 \tag{14}$$

Substituting the value of V_j from (13) and of $g(t)$ from (11) gives :

$$\begin{aligned} p_f \cdot G(t) &= \frac{V \left(1 - \frac{R_c}{u^{\frac{1}{2}}} \right) \left[R_1^2 + \frac{p_f}{p} \left\{ (u^{\frac{1}{2}} - R_c)^2 - R_t^2 \right\} \right]^{\frac{1}{2}}}{(u^{\frac{1}{2}} - R_c) \cdot u^{-\frac{1}{2}} \cdot V} - R_1 \\ &= \left[R_1^2 + \frac{p_f}{p} \left\{ (u^{\frac{1}{2}} - R_c)^2 - R_t^2 \right\} \right]^{\frac{1}{2}} - R_1 \end{aligned}$$

Differentiating both sides with respect to time :

$$\begin{aligned} p_f \cdot g(t) &= \frac{du}{dt} \times \frac{d}{du} \left[\left\{ R_1^2 + \frac{p_f}{p} \left[(u^{\frac{1}{2}} - R_c)^2 - R_t^2 \right] \right\}^{\frac{1}{2}} - R_1 \right] \\ &= \frac{p_f \cdot V(u^{\frac{1}{2}} - R_c) \cdot u^{-\frac{1}{2}}}{\left[R_1^2 + \frac{p_f}{p} \left\{ (u^{\frac{1}{2}} - R_c)^2 - R_t^2 \right\} \right]^{\frac{1}{2}}} \end{aligned}$$

Dividing both sides by p_f and squaring :

$$g(t)^2 = \frac{V^2 \cdot (u^{\frac{1}{2}} - R_c)^2 \cdot u^{-1}}{R_1^2 + \frac{p_f}{p} \left[(u^{\frac{1}{2}} - R_c)^2 - R_t^2 \right]}$$

which is the same as (11) and evidence that no algebraic error has arisen.

Reviews

HOUBEN-WEYL'S METHODEN DER ORGANISCHEN CHEMIE, VOL. X, PART III NITROGEN COMPOUNDS I

Edited by E. MÜLLER. Fourth edition. Stuttgart : Georg Thieme Verlag, 1965. Pp. xlviii+971. 300DM. In German.

Houben-Weyl is a name as familiar to chemists as Heilbron and Gmelin : to those less familiar with it, the title of this series may be misleading. It conjures up a vision of a German analogue to *Organic Syntheses* but nothing could be further from the facts. There is a fair amount of experimental descriptive matter, lifted, it seems, straight from the original literature, but the bulk of the text is straight organic chemistry. There is hardly any theoretical matter, the physical chemistry is relegated to a separate volume, nothing is said about characterisation, and the fact that many of the compounds considered have considerable industrial or other interests is rarely referred to. This is the essential chemistry—how compound A can be converted to compound B.

The scope of this fourth edition is exhaustive and the treatment vast but the layout is not made clear : presumably, *Nitrogen Compounds II* deals with amines, for X/1 and 2 deal with nitro and nitroso compounds, oximes, hydrazines and aliphatic azo compounds, and X/3—the volume under review—with aromatic diazo and related compounds and nitriloxides. Other volumes in this series have already been reviewed in this journal—XII/1 and 2 (phosphorus compounds) in August 1963 and June 1965, and VI/2 (oxygen compounds 2) in August 1964.

The nine chapters of Volume X/3 were written by Drs. Pütter, Schündehütte, Enders and Süling, all with Farbenfabriken Bayer AG, and by Professor Grundmann of the Mellon Institute. R. Pütter discusses the preparation and reactions of aromatic diazo compounds (213 pages). About half the chapter describes the diazotisation of amines and substituted amines, the oxidation or reduction of suitable nitrogen groups, and reactions of diazonium salts which do not affect this functional group. Other reactions of the diazo group are treated elsewhere in this and other volumes so that the rest of this chapter discusses only the replacement of the diazo group by hydrogen or aromatic residues.

The next chapter (260 pages) by K. H. Schündehütte discusses the coupling of diazo compounds—the products being of particular interest to readers of this journal. This subject is dealt with in great detail, there being only some 40 pages on the reduction, addition and ring closure reactions of diaryl diazo compounds and on their metal complexes.

The other chapters are briefer. E. Enders deals with the preparation and reactions of aromatic-aliphatic azo and azoxy compounds and the preparation of aromatic hydrazones by coupling; R. Pütter describes diazotates, diazo ethers and sulphides, diazo sulphonates and sulphones, dialkyl aromatic azophosphoric esters, and other azo derivatives; Pütter and C. Süling discuss formazanes and triazenes, tetrazenes, etc. respectively. The final chapters are on

azoxy compounds, nitriles and nitriloxides, the last two by C. Grundmann who includes aliphatic compounds in his treatment. The nitriloxide is the only group considered in this volume which does not contain the $-N=N-$ grouping.

It is clearly not the editor's intention that this volume should furnish details as to how a desired compound is to be prepared but to show the various known routes to its synthesis. These should not be difficult to find for the index is excellent and there is a special index for routes to diarylazo compounds, aromatic-aliphatic azo compounds, formazanes and metal complexes from azo compounds.

The price works out at about £25 which is on the high side and the reviewer's usual comments as to who should buy it—i.e. whether the private buyer or a library—are superfluous. These 860 pages of text were published in a most handsome format at the end of August 1965, but the first seven chapters review the literature to the *end* of 1964 (indeed, there is a reference to the 1965 *Chemical Abstracts*) and the other two chapters include matter abstracted up to June, 1964.

A hundred years of organic chemistry will be found in these pages. There surely cannot be a more up-to-date organic chemistry review available and the publishers and editor are to be congratulated on the speed with which they must have worked. The German text is most lucid ; the language must not deter the appropriate libraries from buying this work.

K. GRAUPNER.

METALL-LACKE—VOLUME 5 OF LACKTECHNISCHE SCHRIFTEN

W. A. RIESE (ergänzt und überarbeitet von Dr. Hans Kittel), Verlag W. A. Colomb, Stuttgart, 1965, Pp. 545. Price DM78. In German.

This book deals with paints for metals, and with methods of application. It is divided into sections, thus : simple lacquers and dispersions, and reaction lacquers, arranged according to the principal resin used as film-former ; anti-corrosive paints specifically (fundamentals of corrosion theory, pigments and media) ; some miscellaneous topics such as paints for copper, brass, aluminium and zinc-sprayed steel, and the swelling of paint films in water ; stoving, aerosol, and hammer-effect finishes, and solvent-type paint removers ; accounts of application methods, *viz.* electrophoretic, electrostatic and conventional spray systems, the fluidised bed process, roller coating, dip application and flow coating ; and ovens for baking finishes. Most space in the application methods section is given to the newer processes.

It is a comprehensive work indeed, suitable above all for the paint formulator, for the sections on surface pretreatment and corrosion theory are very short. The account given of chemical conversion coatings is trivial.

The sections on media are very systematically arranged and the amount of information is considerable. Resin structure, properties, and use in lacquers, are covered for each material, with typical formulations. The information is well presented, up-to-date, and interesting to read.

The index appears to be indifferent, as will be apparent. It was noticed that no entry appears for "Spritzverzinkung" although a very short account of paints for sprayed metal in underwater structures appears in the text.

A minor criticism may be made of the chapter on acrylate lacquers. This contains a discussion—an excellent one—of both simple solution-type acrylates and of thermosetting acrylics, the two subjects alternating rather confusingly. For example, under the heading of “Wärmehartende Acrylharze” one suddenly finds oneself reading an account of the pigmentation difficulties of thermoplastic acrylate resins with TiO_2 and a comparison of advantages and disadvantages of their use. If one wished to return to this section after reading the book, consulting the Index will be of no help, for the only entry for “Polyacrylatlacke” is for page 46, the chapter on thermoplastics, which ends, supposedly, on page 54 where a discussion on thermosetting acrylics commences; the TiO_2 pigmentation of the thermoplastic resin is dealt with on page 61. By the way, there is no Index entry for acrylate resins under “Pigmentierung” nor is there an entry for “Titandioxid”

It would have been more logical to put thermosetting acrylics separately. In fact, a chapter heading, “Acrylharz-Basis Einbrennlacke” is provided, but you are simply referred back to the chapter on thermoplastics.

The book is attractively bound in a grained silver-grey plastic, but in the Reviewer's copy at least, some pages are detaching from the backing.

The value of the book to this Reviewer, is in the amount and systematic presentation of its subject matter, especially in the discussion of resin properties, which is particularly well done.

J. L. PROSSER.

Editorial

In the realm of chemistry

Advertising, trade literature and other company publications take many forms which are acceptable or repulsive according to the skill of the promoter and the mood of the recipient. Advertising to and by paint people is, we thankfully conclude, at least as tolerable as most, and as effective *pro rata*, otherwise responsible sales executives would hardly invest in it and this *Journal* for one would be the poorer. Much the same may be said of trade literature : from the severe duplicated leaflet to the glossy "Guide to our wonderful products" (dare we resurrect "Bolonium"?) this is generally as useful as it is factually informative and those would-be vendors guilty of imaginative fiction are likely to reap scant reward from their efforts.

We have recently been led to contemplate company publications of another kind—those which we are supposed to accept as industry's gift to mankind, presented from motives of the purest altruism. Like the rest these vary from good, through indifferent, to downright bad and, whereas to the cynic their object is solely to promote the company image, some can be very good indeed. For example, we would doubt if anywhere there is to be found a finer journal of general scientific interest than *Endeavour* and, if its sponsors derive kudos from its publication, this is no more than their vision and their outlay deserve.

The immediate stimulus to our contemplation was provided by an image-builder in a somewhat different form.

In the Realm of Chemistry, published to commemorate the centenary of Badische Anilin-und Soda-Fabrik AG, is not unique in kind, but it must rank as one of the finest examples of company histories ever produced. Beautifully illustrated in black and white, it tells the story of BASF from its foundation in 1865 by Friedrich Engelhorn, through the rise and fall of the IG "empire" to the present day, with a wealth of detail which is refreshingly candid, always fascinating, often human and sometimes moving.

Naturally, much is made of technical achievement. We read of the early manufacture of aniline and soda, and of Knietsch's development of Winkler's ideas which led to the contact process for sulphuric acid, of the collaboration between Haber and Bosch leading to the fixation of atmospheric nitrogen and to synthetic methanol, and of the disastrous explosion of 1921 when the nitrogen plant was lost along with 561 souls and thousands of homes. Bosch's moving speech after this catastrophe is reproduced in full—and then we are told of the rebuilding.

Organic chemical development receives its full share of attention. The association of Caro with Adolf von Baeyer, culminating in the commercial production of synthetic indigo in 1897, is illustrated by a facsimile of von Baeyer's letter providing the first written record of the indigo structure. Similarly reproduced is Bohn's letter to his management reporting the discovery of the first indanthrene vat dye. Then there are glimpses of Meyer and Mark struggling with the mysteries of polymer chemistry in 1927, of Wulff synthesising styrene in 1935 and of the subsequent developments in synthetic rubbers, plastics and Reppe chemistry.

Of more human interest is a reproduction of a notice "An unsere Arbeiter," dated 1907, announcing the then exceptional privilege of a week's holiday after ten years' unbroken service, the comment that in 1923 the price of butter was six *billion* marks a pound, the introduction of Badische's own currency, the "Anilin-dollar," the intriguing link between the sales of fuchsine and the Chinese harvest, and the method by which 10,500 employees were photographed in two days for the French occupation

authorities in 1919. The devastation of two wars is shockingly depicted, but with no more pathos than humanity warrants, and the story of recovery is told with understandable pride.

Facts, figures and impressive photographs are all there, for this is a company publication which none will believe to be entirely disinterested. It is, nevertheless, a documentary of unique value to chemist, industrialist and historian alike, and one which other companies with a similar story to tell can doubtless equal but will have a hard job to better.

Correspondence

Unreacted isocyanate groups in cured polyurethane lacquers

SIR,—With reference to Dr. A. S. Freeborn's paper (*JOCCA*, **48**, 539) and subsequent correspondence (*JOCCA*, **48**, 882) it may be of interest that the presence of unreacted isocyanate groups can readily be demonstrated in moisture-curing polyurethanes, after months of indoor aging, by IR spectrometry.

Films of about 30 microns thickness were applied to polythene foil and spectra were run at intervals. Even in the case of films which were kept with the rear surface of the polythene foil in contact with an outside window, and which were subject to heavy moisture condensation at intervals, a 10 per cent absorption peak at 2270 cm^{-1} was still to be found after four months.

These experiments were carried out purely out of curiosity and no attempt was made to obtain quantitative results. However, with a few refinements in technique it should be a relative simple matter to obtain quantitative results for residual -NCO groups by IR spectrometry (see also Hebermehl, R. *FATIPEC* book 1957, p. 85).

In the case of two-component urethanes, having nearly equivalent amounts of -NCO and -OH groups, the final elimination of -NCO by reaction with the -OH groups is a process which would only go to completion, if ever, after very protracted time periods. In practice, as Hebermehl has shown, the competing reaction with atmospheric water as a reagent accounts for a considerable proportion of the loss of -NCO groups.

The evidence cited above shows that in the case where water (and possibly ammonia) is the only active reagent, the final disappearance of -NCO groups, even in the presence of considerable amounts of water, only occurs after very prolonged exposure. This appears to me to be a convincing demonstration that, in a film where the degree of reaction is very high, the residual -NCO groups are very difficult to approach, even for such small molecules as water.

Hence the final elimination of isocyanate groups must occur through the ingress of small molecules such as water and ammonia. How difficult it is even for such small molecules to contact the embedded isocyanate groups is amply demonstrated by the experimental evidence cited above.

Yours faithfully,
E. SUNDERLAND

Aktiebolaget Alfort and Cronholm
Saltmätargatan, 7
Stockholm, 45, Sweden.

Section Proceedings

Bristol

Chairman's address

The 142nd Ordinary Meeting of the Bristol Section was held at the Royal Hotel, Bristol, at 7.15 p.m. on Friday, 24th September 1965.

Twenty-five members attended to hear the Chairman's Address by Mr. R. J. Woodbridge, this being the first Ordinary Meeting during his term of office.

It is customary for the Hon. Secretary to take the Chair on this occasion, but as Mr. D. N. Fidler was in hospital the immediate past Chairman, Mr. L. J. Brooke, officiated.

"The effect of Pigment Volume Concentration on Emulsion Paint Performance" was the title of the Chairman's paper and was an abbreviated interim report on results obtained from a programme of work which has been in progress for about three years.

Emulsions of various polymer types including vinyl acetate copolymers, vinyl propionate, acrylates and styrene/acrylates were examined at PVC's ranging from 30 to 75 per cent using rutile titanium dioxide as pigment and talc as extender. Water vapour permeability, water absorption, scrub resistance, exterior weathering, contrast ratio and spreading rates of the paints were examined.

Mr. Woodbridge dealt in some detail with the curves obtained on plotting vapour permeability against PVC illustrating with slides that most of the systems exhibit a minimum at about 40-45 per cent PVC and an increase in slope after about 60 per cent PVC. The correlation of these results with scrub resistance and exterior weathering was demonstrated.

The relationship between numbers of particles of pigment and particles of polymer of various particle sizes at various pigment volume concentrations was illustrated by calculations.

The paper stimulated a lively discussion and it is hoped that it will be published in full in the *Journal* in due course.

L.T.

Irish Branch

Technical experiences gathered with polyurethane coatings

A special Summer Meeting was held at the South County Hotel Stillorgan on 29 June 1965 when Dr. Eugen Pfluger presented a paper entitled "Technical Experiences Gathered With Polyurethane Coatings"

Dr. Pfluger opened his lecture outlining in principle, the crosslinkage of isocyanates with polyester resins of varying hydroxyl content and the properties of the resultant coatings, also numerous applications made possible by variations in formulae. Interesting references were made to adhesion, chemical resistance, light stability and abrasion resistance of properly formulated polyurethane lacquers.

A general discussion then took place and the many questions asked indicated the interest in this subject of those present. The vote of thanks to the speaker was proposed by Mr. Shoemaker and seconded by Mr. M. O'Callaghan.

Developments in metal pretreatment

The first meeting of the 1965/66 Session was held in the Dolphin Hotel, Essex Street, Dublin, at 8 p.m., on the evening of Friday 24 September, when a paper was presented by R. E. Shaw, entitled "Developments in Metal Pretreatment."

The advances made during the last few years in the field of metal pretreatment for painting were outlined and phosphating solutions modified to produce lighter and smoother coatings regardless of the type of cleaner employed, combined degreasing and phosphating processes used in plants with three or four stages to suit small production and one or two stage plants operated with automatic solution changes, were described in detail.

Wide strip lines now working in the United Kingdom with automatic control of chemical treatments and rinses to safeguard production quality and the special processes available for the treatment of steel, galvanised iron, and aluminium in strip form, were described and illustrated also a non-aqueous phosphating solution was described, together with details of its development and application.

Questions relative to the lecture and various questions regarding metal pretreatment before painting were asked by Mr. Quick, Mr. O'Callaghan, Mr. O'Connor, Mr. Somerville and Mr. McKernan. The meeting was well attended, 23 Members and seven Visitors, and a special welcome was given to the Belfast members who had made the journey to Dublin in spite of the inclement weather.

The vote of thanks to the Speaker was proposed by Mr. G. Blomley and seconded by Mr. T. C. Byrne.

Hull

Developments in media for paints and printing inks

The first lecture of the current session was held in the Royal Station Hotel, Hull, on 4 October, at 7 p.m. The Chairman, Mr. A. J. Ford, introduced Mr. G. H. Hutchinson who spoke on "Developments in Media for Paints and Printing Inks."

The speaker said that trends in printing ink manufacture had been influenced by the need for inks to print on an increasing variety of papers, boards and films and the demand for higher production rates on faster running printing presses. Fortunately many of the developments in surface coating resins and polymers had been of value to the ink-maker, providing him with a variety of materials from which to formulate his ink vehicles.

Developments in letterpress and lithographic ink vehicles were classified in relation to four main methods of printing ink drying (a) Penetration (b) Oxidation (c) Precipitation (d) Evaporation.

Inks drying mainly by penetration, on absorbent papers, included conventional mineral-oil based news inks, reference also being made to the special requirements of vehicles for news inks printed by the web-offset process, and to recent developments in water-based inks.

Linseed lithographic varnishes (stand oils) were next discussed: Factors affecting the pigment dispersing properties of these vehicles included the degree of refining of the crude linseed oil and the method of processing whether open pot, closed pot, or vacuum bodied oils. With the aid of simple molecular models constructed from pipe-cleaners, the deficiencies in the film-forming properties of stand oils were described and also the improvements that could be expected from the use of alkyds, styrenated alkyds and urethane oils in terms of drying, chemical resistance and rub-resistance

properties. Resistance to emulsification was a special requirement of vehicles for lithographic inks.

Techniques used for the preparation of oleoresinous gloss varnishes and quick set vehicles were outlined and the influence of molecular structure of rosin modified phenolic resins on gloss, was discussed.

The problem of odour from oxidation drying inks had to be given special attention where food and confectionery wrappers were concerned and here moisture-set inks found application. More recent developments were water-miscible letterpress inks of low odour, which could be washed off the press rollers with water yet dried quickly to give water-resistant prints on the paper or board.

Heat set inks drying by evaporation and used for web-fed letterpress and lithographic processes were of increasing interest and here special attention had to be given to the melting point and solvent release characteristics of the resin and to the boiling range and KB value of the aliphatic solvent.

In conclusion Mr. Hutchinson referred to newer developments in surface coating resins and described the derivatives of diphenolic acid including air-drying co-esters, polyamides and polyesters, with applications in paints and printing inks.

At the conclusion of the lecture a lively discussion took place in which the following speakers took part : Mr. A. J. Ford, Mr. J. E. Gilroy, Mr. N. Lythgoe, Mr. C. C. Mell, Mr. P. Mell, Mr. S. J. Reed and Mr. W. A. Rutherford.

Mr. J. E. Gilroy, in proposing a vote of thanks to Mr. Hutchinson, referred to his excellent lecture and said those present were very pleased to be addressed by a former member of the Hull Section.

W.A.R.

London

Rheological properties of paint and two new instruments for measuring them

The second technical meeting of the 1965-66 session was held on 20 October in the Physics Lecture Theatre, Imperial College, with Mr. C. R. Pye in the chair. Mr. P. Fink-Jensen, of Denmark, gave the second European liaison lecture organised by the London Section in conjunction with continental societies. Earlier this year Mr. M. R. Mills had given an exchange lecture in Copenhagen to the Danish Varnish and Paint Chemists Association.

Mr. Fink-Jensen described the importance of rheological measurements in relation to application and subsequent flow and levelling of the paint. Most methods of application were associated with very high shear rates, e.g. for brushing, of the order of $10,000-20,000 \text{ sec}^{-1}$, equivalent to stresses of $10,000-100,000 \text{ dynes/cm}^2$. After application, during flow out, the stresses may be of the order of a few dynes/cm^2 . Most viscometers made measurements at stresses of about $1,000 \text{ dynes/cm}^2$, which was well away from both practical conditions.

Mr. Fink-Jensen then described two new instruments which had been developed, to make measurements under these shear stress conditions. The first, for high shear conditions, consisted of a co-axial cylinder modification of the *Emila* rotational viscometer, which was designed to operate at about $5,000 \text{ sec}^{-1}$. Certain modifications to the cylinder suspension had to be made to make the cylindrical rotor self-centring. This modified instrument was considered to be highly satisfactory.

The second instrument was developed for measurements under low shear stress conditions. In these conditions a build-up of thixotropic structure occurred. It was decided that it was preferable to make measurements under conditions of constant

stress, rather than constant shear rate, and in the technique developed this shear stress was provided by gravity. The instrument consisted of a narrow bore (2 mm) tube 60 cm long containing the paint. The tube was enclosed in a thermostat jacket, and by varying the inclination of the tube varying shear stresses could be applied. An example of typical conditions gave a shear stress of 5 dynes/cm² with the tube at 10 per cent slope, and a 10 poise liquid moved at the rate of 7 mm/minute. The effects of differences in the advancing and receding menisci, leading to surface tension effects, were avoided by pre-wetting the tube with the medium. The apparatus could be used down to shear stresses of 0.25 dynes/cm².

In the discussion which followed the paper, Mr. R. K. Khanna, Dr. L. Valentine, Mr. D. J. Leach, Mr. P. Whiteley, Mr. M. J. Zissell and Mr. R. G. Kinsman took part. Dr. L. Valentine, proposing a vote of thanks to the lecturer, said that Mr. Fink-Jensen was well known to OCCA audiences, and again on this occasion he had presented a very entertaining and instructive lecture, which was a well thought out example of the combination of theory and practice.

V. T. C.

Thames Valley Branch

Recruitment, training and career development

The first technical meeting of the 1965-66 session was held on 29 September at the Royal White Hart Hotel, Beaconsfield, when Mr. J. S. Read spoke on "Recruitment, Training and Career Development."

Mr. Read said that we were living in an age of rapid technological change and of increasing rate of change. Acceptance of change must be developed as an attitude of mind and this involved training.

On recruiting, he said that there was more blind prejudice and muddled thinking on this subject than on anything else. Recruiters ought to ask themselves what they were recruiting for and whether or not a broad spectrum of types of recruit would not be best.

Training was an "OK word" these days, although there had been little deep thinking on the subject. Managers should ask themselves what training their staff needs, what the objectives of the training should be, and how the effectiveness of the training should be evaluated.

In career development, Mr. Read suggested that firms should consider two stand points, the firm's and the man's. It was probably in the firm's interest that there should be job continuity ; in the man's that there should be job rotation.

In answer to a question about the usefulness of programmed learning, Mr. Read gave his impression that it worked very well as a means of conveying factual information and could be profitably used for perhaps 15 per cent of teaching in industry. A lot of time could be spent on preparing programmes (about 100 hours for one hour's instruction), but this was justified for recurring operations.

To a question about how the paint industry could increase its skill in recruiting, Mr. Read replied that there should be clearer thinking about the type of people wanted ; these people should be told about the sort of things to expect when they come in and the range of careers available to them.

A vote of thanks for an interesting and stimulating evening was proposed by Mr. Bowerman, who suggested that the main purpose would be served if the audience went away thinking.

W. S.

Manchester

New developments in carbon black technology in relation to pigment applications

The first meeting of the session was held on 8 October in the Manchester Literary and Philosophical Society, when Mr. N. Scott presented a paper entitled "New Developments in Carbon Black Technology in Relation to Pigment Applications." Before the lecture the Chairman commented on the recent death of Dr. T. P. Hilditch, a member of the Section and Honorary Member of the Association, and members stood in silent tribute.

The lecturer first dealt with the significance of the particle size distribution of carbon blacks in relation to structure, potential jetness and undertone. Surface area was shown to affect the amount of protective colloid type dispersing agents as well as the pigment-to-binder ratio to ensure stability in mill pastes. Conversely the minimum requirement of ionic dispersant was influenced by the concentration of acidic oxygen on the carbon black surface, whilst oil absorption was governed by the superficial surface area independent of porosity.

Mr. Scott said that characteristic differences in the proportions of different oxidised groupings on the black surface were indicated for carbon blacks manufactured by different processes. Carboxylic groupings played a major part in determining the rheology of dispersion in polar media. Thermal aftertreatment increased the amount of oxygen on the surface at the expense of increased porosity evidenced by high nitrogen surface areas. Newer methods of aftertreatment allowed relatively high proportions of strongly acidic surface groups without appreciable increase in porosity producing better dispersion properties and enhanced optical properties in the dry film.

The lecturer then referred to the application of some of these characteristics in the case of the formulation of a mill base for maximum colour development of a ball milled stoving enamel. Finally the vehicle itself was shown to influence dispersibility, rheology and colour development as exemplified in a series of linseed stand oil lithographic inks.

Mr. Scott suggested it was worthwhile making a thorough technical evaluation to make the most of the newer type blacks now available.

The discussion that followed covered various aspects of dispersion, including the effect of surfactants, variations in grinding media, and loss of drying properties in air drying oxidising finishes.

In proposing a vote of thanks Dr. F. M. Smith referred to the lecturer mentioning that he had presented the paper to the Trent Valley Branch the previous evening as his "maiden lecture," and suggested he had showed a proficiency in the art belying his experience. He thought the lecturer was brave to talk about black (even with such regal names) to oil and colour chemists, but thought Mr. Scott was more fortunate than others to have the opportunity to study one class of pigment.

W. F. MCD.

Midlands

Advertising—A means of communication

On 15 October the Section met in the lecture room of BIP Chemicals Ltd., Oldbury, to hear Mr. G. S. Worrall give a talk entitled "Advertising—A Means of Communication."

Mr. Worrall said that although advertising was often considered a dirty word it played a vital role as a means of communication between producer and consumer.

Advertising ensured that products reached the intended market and reduced marketing risks. The distinction sometimes made between informative and persuasive advertising was not valid as the aim of all advertising was to persuade. However, with some well-established products, advertising was directed at merely reminding the consumer.

An advertising campaign comprised six stages. First, the audience was selected using information from the manufacturer or market research, then the message had to be determined and the most economic media chosen. The timing, frequency and impact had to be decided upon and then a budget could be worked out. Finally, the effect of the campaign was measured. Effective advertising overcame inertia, antipathy memory lapse and market attrition. The recipient passed through the successive stages of unawareness, awareness, comprehension, conviction and action.

The speaker then showed a film produced by The Goodyear Rubber Company, illustrating the importance of co-ordinating a sales image throughout the world.

A number of interesting points were raised during the discussion. Mr. R. D. Calvert expressed the appreciation of the Section to the speaker and to the directors of BIP Chemicals Ltd.

L.R.S.

Newcastle

The use of microscopy in the investigation of paint defects and failures

The first meeting of the session was held on 14 October 1965 at the Central Laboratories of British Titan Products Ltd., Billingham. Before the meeting, members were taken on a tour of the Research and Technical Service Laboratories. The lecture, by Mr. H. Wells (Chemical Inspectorate, Woolwich), entitled "The Use of Microscopy in the Investigation of Paint Defects and Failures," was devoted to the special techniques used by his laboratory to obtain useful information from small samples of paint collected, preferably by the investigator, in the field.

Whilst much useful information could be obtained with quite simple equipment, Mr. Wells explained how quite elaborate physical and chemical tests could be carried out on prepared sections under the microscope, for example melting points by means of a heated stage, refractive indices of crystalline material, chemical reactions between pigments and reagents seen as visible staining or fluorescence under ultra-violet illumination. Crystals and liquids from blisters could be introduced into capillary tubes and subjected to conventional chemical tests on the microscopic scale.

Useful aids in this work which were commended were micromanipulators and tungsten wire probes sharpened in molten sodium nitrite. The lecture was amply illustrated with slides of photomicrographs showing how some typical problems had been elucidated, in particular cases where it had been required to ascertain whether a specification had been adhered to with respect to type of paint and number of coats.

The proceedings continued with a short lecture by Mr. Smith, of British Titan Products Ltd., who described in some detail their method of preparing thin sections of material for electron microscopy by means of a glass knife.

A vote of thanks to the lecturers was proposed by Mr. Farrow.

Following the lecture, the members were guests of British Titan Products to dinner at Highfields Hotel, Middlesbrough, a function which was greatly enjoyed by those present.

F. R. B.

Scottish

Processed oils, alkyds, varnishes and printing ink media

The first meeting of the session was held in More's Hotel, Glasgow, at 6.30 p.m. on Thursday 14 October 1965.

Although the subject of the meeting was to have been a lecture on "Aerosols in the Paint Industry," by Mr. D. Thomas, the lecture had to be called off at very short notice and alternative arrangements made. Only the graciousness of Mr. G. H. Hutchinson saved the situation when, at the notice of literally a day or so, he delivered a fascinating lecture on "Processed Oils, Alkyds, Varnishes and Printing Ink Media."

Factors influencing the pigment wetting and dispersing properties of stand oils and lithographic varnishes were discussed, these including the source and degree of refining of the crude linseed oil and method of processing, whether open pot, closed pot or vacuum-bodied system. Useful information had been obtained as to the trace non-glyceride impurities in crude linseed oil, and the work utilising the technique of thin layer chromatography was mentioned. In the preparation of linseed lithographic varnishes, the influence of oxygen on the heat-bodding rate of linseed oil had been studied and improvements in pigment dispersing properties for carbon-black had been obtained by utilising degummed oil processed under conditions of high oxygen partial pressure.

The improvements to be expected in the properties of paints and printing ink from the use of alkyds (including isophthalic, styrenated and urethane modifications) were described and the film forming properties of these media illustrated by means of molecular models. Some alkyds tended to produce scumming in lithographic inks and this was probably connected with the presence of low molecular weight polar materials in the resin ; it was suggested that the application of solvent fractionation techniques would be a useful method of determining possible emulsification tendencies of printing ink alkyds.

The specialised conditions of time and temperature in the processing of printing ink varnish media were outlined with emphasis on the need to maintain hold-out and gloss properties on a variety of papers of differing absorbency.

Proposing a vote of thanks, Mr. A. McGuire said that he was doubly grateful to Mr. Hutchinson. As Programmes Officer he had been placed in an extremely difficult situation and it was his wish that full appreciation should be expressed to Mr. Hutchinson for coming to the aid of the Section at what must have been some considerable inconvenience. Further sincere thanks were, however, due to Mr. Hutchinson for a lecture of the highest possible calibre in its own right. The Scottish Section must regard itself as extremely fortunate to have a lecturer of Mr. Hutchinson's knowledge and talents within its membership.

The company joined in a very warm vote of thanks.

A. MCL.

Notes and News



Top table (left to right) Mr. F. Sowerbutts (*Hon. Treas.*), Mr. D. S. Newton (*Hon. Ed. 1962-65*), Dr. J. Newton Friend (*Pres. 1922-24, Hon. Mem.*), Dr. S. H. Bell (*Pres.*), Dr. J. E. Arnold (*Immed. Past Pres.*), Mr. G. A. Campbell (*Pres. 1934-36, Hon. Mem.*), Mr. I. C. R. Bews (*Hon. Sec.*), Mr. G. Copping (*Hon. Mem.*)

Standing at rear of top table (left to right) Dr. J. E. O. Cutter (*Hon. Res. and Dev. Off. 1941-43*), Dr. H. W. Keenan (*Pres. 1944-47*), Mr. T. E. Johnson (*El. Mem.*), Mr. J. Smethurst (*Vice-Pres.*), Dr. T. Banfill (*El. Mem.*), Mr. N. Cochrane (*Ch. West Riding*), Mr. A. R. H. Tawn (*Hon. Ed.*), Mr. H. D. Jefferies (*Rep. Newcastle*), Mr. R. P. Bell (*Ass. Sec.*), Mr. R. H. Hamblin (*Gen. Sec.*)

Left-hand table, left side (left to right) Mr. T. Hedley-Barry (*Hon. Ed. 1924*), Mr. A. Z. Molteni (*Fdr. Mem.*), Mr. P. J. J. Gay (*Pres. 1959-61*), Mr. A. J. Ford (*Ch. Hull*), Mr. N. H. Seymour (*El. Mem.*), Mr. H. F. Clay (*Ch. Manchester*), Mr. R. D. Calvert (*Ch. Midlands*), Mr. A. J. Ford (*Ch. Hull*), Mr. N. H. Seymour (*El. Mem.*), Dr. H. A. Hampton (*Pres. 1961-63*), Mr. G. N. Hill (*Hon. Ed. 1937-47, Hon. Mem.*), Right-hand table, left side (left to right) Mr. A. J. Gibson (*Pres. 1938-40*), Mr. A. S. Fraser (*Vice-Pres.*), Mr. R. N. Wheeler (*El. Mem.*), Mr. A. T. S. Rudram (*Hon. Res. and Dev. Off.*), Mr. L. J. Brooke (*Rep. Bristol*), Mr. D. J. Silsby (*Rep. Midlands*), Mr. W. E. Worrum (*Pres. 1940-44*), Mr. S. G. Clifford (*Hon. Treas., Hon. Sec. 1924-29*), Mr. A. A. Drummond (*Hon. Ed. 1929-31*), Right-hand table, right side (from nearest camera), Mr. H. Gosling (*Pres. 1953-55*), Mr. C. W. A. Mundy (*Pres. 1955-57*), Mr. N. A. Bennett (*Pres. 1957-59*), Mr. L. O. Kekwick (*Pres. 1951-53*), Mr. C. R. Pye (*Ch. London*), Mr. J. E. Pooley (*Rep. London*), Mr. J. A. L. Hawkey (*Rep. Wellington*), Mr. H. C. Worsdall (*El. Mem.*)

Present but not in photo Mr. R. P. L. Britton (*Hon. Treas. 1919 and Fdr. Mem.*)

Reunion Dinner of Past Presidents, Past Honorary Officers, Founder Members and Council



In the above photograph the President (right) is seen making a presentation to Mr. D. S. Newton in recognition of his work as Honorary Editor

The Reunion Dinner of Past Presidents, Past Honorary Officers, Founder Members and Council took place on 13 October at Wax Chandlers' Hall.

Prior to the dinner a reception was held at which guests were able to renew old friendships. Twelve Past Presidents (of whom two are Honorary Members),

eight past Honorary Officers and one Founder Member, together with 23 members of Council, were present.

After proposing the loyal toast, the President presented a short review of Association events at home and abroad including developments under the Australian Federal Committee.

He was sure that the company would be saddened to hear of the deaths since that time of two Honorary Members, Dr. L. A. Jordan (President 1947-49) and Prof. T. P. Hilditch.

He stressed that judgement of the success of the Association was not just a matter of statistics but of the further fulfilment of aims and functions.

The year had, however, been a year of many "firsts." At home, for example, in March the Association's Technical Exhibition was held at Alexandra Palace for the first time and undoubtedly this had proved to be a most successful venture, attracting 11,000 visitors including representatives from 27 overseas countries. As a measure of the success of the 17th Technical Exhibition, the President stated that at the Exhibition Committee meeting in September it had been reported that applications for the 1966 Exhibition had exceeded the area allocated at the 1965 Exhibition by over 20 per cent.

The Association had elected a Vice-President from the Overseas Section, Dr. H. W. Talen.

For the first time also the Association had the pleasure of entertaining members of the Board of Directors of the Federation of Societies for Paint Technology of the United States to dinner at the Wax Chandlers' Hall in March; members of Council were also pleased to see several members of the Board at the Exhibition Luncheon and at the Exhibition. Arising from the visit of the Federation Directors, the Council was able to borrow a copy of their film on careers in the American paint industry and this was shown after the June Council meeting. It was hoped that the Association would be able to develop the co-operation between the two societies

further in future years and Council was notified at its meeting in the afternoon of the message which would be borne on its behalf by Dr. Valentine to the Federation's Annual Meeting.

Another notable "first" was at the Torquay Conference in May when Workshop Sessions were introduced on the Friday afternoon, and—from comments received—these were found to be both stimulating and instructive; so much so that it had been suggested that this venture might be extended for future Conferences.

For the first time members had received a Joint Programme Card for the current session for the eight United Kingdom Sections, together with the Branches, Student Groups, etc. This innovation, authorised by the Council at the June meeting, had proved popular with members and it was hoped would increase attendance at meetings.

Another project of direct interest to the Sections would be the provision of a Badge of Office for each Section Chairman and also for the Chairman of the Australian Federal Committee. It had been hoped to have these ready in time for the commencement of the session, but unfortunately delays had occurred; it was hoped that the Badges would all be in the hands of Section Chairmen before the end of the calendar year.

With regard to publications during the year, the President informed the company that Council had decided to defer the publication of the History of the Association until the Fiftieth Anniversary in May 1968, when a copy would be sent free to all members; Dr. Newton Friend had made suggestions regarding a frontispiece in colour which were much appreciated. Already the arrangements for commemorating the Fiftieth Anniversary were being considered, and details would be submitted to Council in due course. At the same time the President felt that, with this milestone approaching, it was important to have in mind the development of the Association for the next 50 years. He was pleased to be able to report at the Council meeting



ON THE MOON ?

No, this is not a recently released close-up of the moon. It is an electron microscope photograph of an adhesive surface, and illustrates a technical article by Hercules' Charles W. Hock entitled "What Makes It Stick?" which is available for the asking.

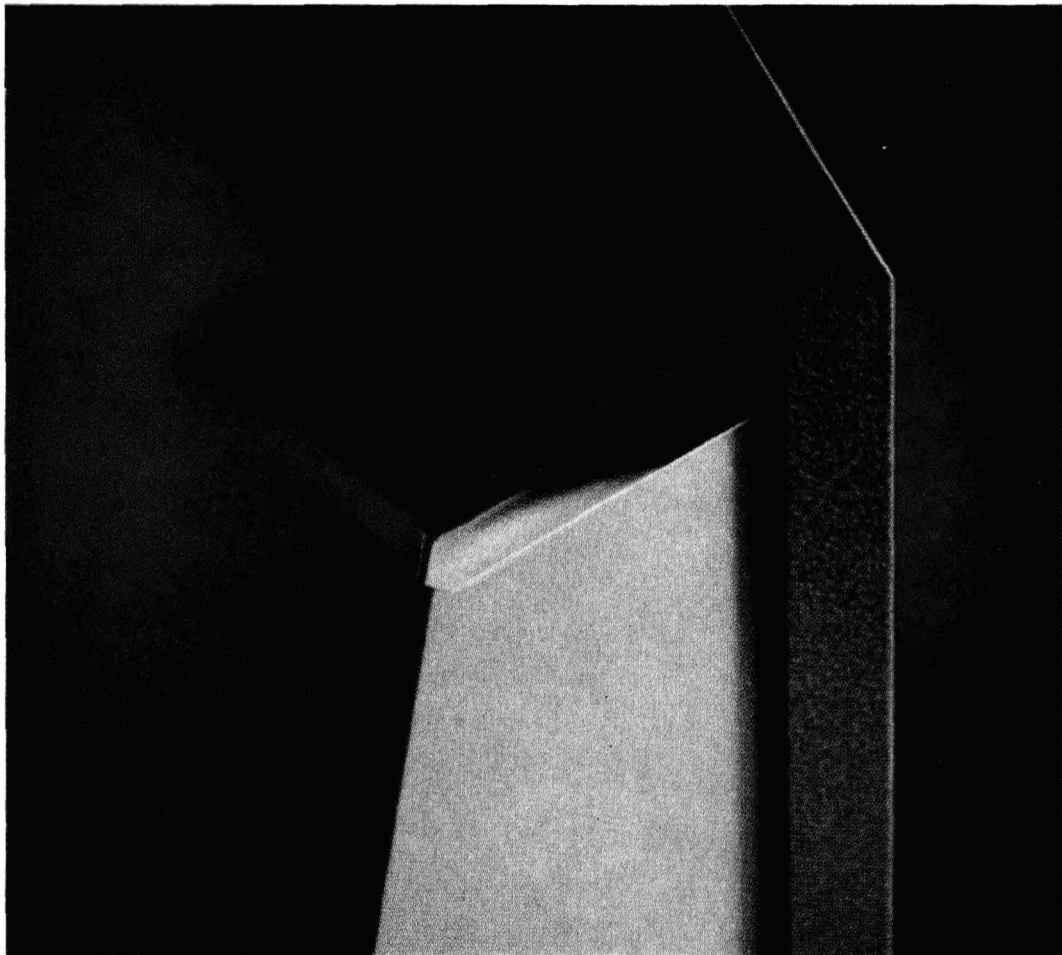
Hercules produces a series of hydrogenated rosin esters for use as tackifying agents which offers the formulator versatility in adhesives compounding. Pentalyne® H, Staybelite® Ester 10, and Staybelite®

Ester 3 are but a few of the resins which possess outstanding pale color characteristics, hardness, resistance to oxidation, and excellent tack retention, and are widely available at low cost. Where a wide range of compatibility with natural and synthetic elastomers is important, Hercules® resins are the accepted standard of quality. Write to: Hercules

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(Oh, yes, Hercules has been to the moon, but that's another story.)



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earlier in the day that a resolution had been passed to reprint the *Introduction to Paint Technology* with a further chapter on recent developments. It would be recalled that 10,000 copies had been printed of the original edition and 3,000 copies of the revised edition.

The President was also very pleased to state that three further volumes of the Paint Technology Manuals would appear before March 1966. Volume IV, *Application of Surface Coatings*, had already appeared, Volume V, *The Testing of Paints*, would appear in November, and Volume VI, *Pigments, Dyestuffs and Lakes*, would appear just before the Exhibition in March 1966. He felt sure that everyone present would welcome the appearance of these Manuals, which had involved a great deal of effort by many members.

Finally, on publications, the President stated that Mr. D. S. Newton, who had been the Association's Honorary Editor since 1962, had been forced through increasing business commitments to relinquish the editorship, and Council were pleased to appoint as his successor Mr. A. R. H. Tawn. One of the reasons which gave rise to Mr. Newton's decision to retire had been that he was about to embark on extensive travelling on behalf of his company, and he had expressed the wish to receive as a gift to mark his retirement a travelling case. In making the presentation to Mr. Newton, the President stated that the Council were certainly not "sending Mr. Newton

packing," but hoped to see him at many future Reunion Dinners!

Mr. Newton, in a brief reply, said what a great privilege it had been to serve as Honorary Editor of the Association, and how much he was indebted to all members of the Publications Committee, those members who had helped with the assessment of papers, and the General Secretary and his staff for their support during his term of office. He felt sure that Mr. Tawn would enjoy his period of service as much as he had done.

After a short break, the President entertained the company with a most interesting talk entitled *A Chevron Argent Between Three Mortcours*. The title is taken from the description of the coat of arms of the Worshipful Company of Wax Chandlers, and from this starting point the President proceeded to show the origin of coats of arms, their evolution through the ages to their uses in the present day. The talk, which was illustrated by many colour slides taken by the President, was an absorbing one.

After the President's talk, Dr. J. E. Arnold (Immediate Past President) expressed the thanks of the company to Dr. Bell and congratulated him on taking up so ably the challenge which he had made on the last occasion to his successor to entertain the company.

Finally, Dr. J. Newton Friend, the Senior Past President, expressed the appreciation of the guests to the Council and Mr. Hamblin and his staff for a most enjoyable evening.

Association Dinner Dance 1966

As members will be aware, from the Joint United Kingdom Section and Branch Programme, the Association Dinner-Dance will be held at the Savoy Hotel, London, W.C.2, on Friday 15 April 1966. Invitations will be extended to principal officers of other organisations

to be present and a form of application for tickets (which are priced at 3½ guineas per person) will be circulated to members early in the New Year. Non-members wishing to attend should apply to the General Secretary, at the address shown on the front cover, as soon as possible.

Association Conference 1967

As already announced in the August issue of the *Journal*, the next Association Conference will take place at Scarborough from 20 to 24 June 1967. Council has now decided that the title of the Conference will be "Interfacial Behaviour" and that the three main technical sessions will be concerned with (a) air/film, (b)

pigment/medium and (c) film/substrate interfaces. Following the successful innovation of Workshops Session at the Conference this year, it has been decided to continue this practice at Scarborough. Further details of the Conference will appear in this *Journal* from time to time.

Hull Section



Photograph by

Hull Daily Mail

A welcome to the Hull Section Annual Dinner Dance for Mr. and Mrs. S. Done from the Chairman, Mr. A. J. Ford, with Mrs. Ford and the President, Dr. S. H. Bell, looking on

Annual Dinner Dance

The 22nd Annual Dinner Dance was held in the New York Ballroom, Hull, on 8 October 1965. There was a slight reduction in attendance this year, but

no reduction in enjoyment of the occasion by the 101 members and guests, due to the extremely efficient arrangements made by the Honorary Social Secretary, Mr. T. A. Fillingham.

At a reception before dinner, the Chairman, Mr. A. J. Ford, and Mrs. Ford welcomed the President of the Association, Dr. S. H. Bell, who joined with them in receiving the official guests, members, their wives and friends.

Official guests were Mr. C. A. Carey, Chairman of the Southern Branch of the London Section, and Mrs. Carey; Mr. N. Cochrane, Chairman of the West Riding Section, and Mrs. Cochrane; Mr. S. Norton, Chairman of the local branch of the National Federation of Master Painters and Decorators, and Mrs. Norton; Mr. R. Bailey, representing the President of the Hull Chemical and Engineering Society, and Mrs. Bailey. Also present was Mr. R. H. Hamblin, General Secretary of the Association, and Mrs. Hamblin.

The toast to the ladies and guests was proposed by Mr. Ford and replied to by the President. In his reply, Dr. Bell said the next 50 years would be a challenge technically, scientifically and economically. In two years' time the

Association would be 50 years old, and it was hoped to publish a history which would show the remarkable development of the Association in keeping with the leading scientific and technological changes during the period.

Dr. Bell also showed an illustration of the insignia which was to be incorporated in a new badge of office to be worn in the near future by all Section Chairmen, and said the suggestion for such a badge had been made to the Council by a representative of the Hull Section. The insignia would be a copy of that worn by the President of the Association.

Dr. Bell went on to explain some of the symbols which made up the badge, saying that one of these was a stone of Lapis Lazuli, used by the ancient masters to provide a bright blue pigment. The actual stone used in the President's insignia was provided by the late Mr. Pryce Jones, a former Chairman of the Hull Section.

W. A. R.

Manchester Section

Annual Dinner and Dance

The Annual Dinner and Dance of the Section took place at the Midland Hotel, Manchester, on Friday 22 October, when approximately 350 members and guests were present.

This year the principal guests were the President, Dr. S. H. Bell, and Mr. V. Watson and Miss Watson. Mr. Watson is the Works Director of Cromford Colour Company, a member of the SCC Group and a past Committee member of the Section, who is well known for his service on BSI and ISO Committees.

The Section was also pleased to have as its guests Mr. and Mrs. N. Cochrane, of the West Riding Section, Dr. and Mrs. D. Atherton, of the Scottish Section, and the General Secretary, Mr. R. H. Hamblin, and Mrs. Hamblin.

The top table was completed by the Chairman, Mr. H. F. Clay, and his wife, Mr. and Mrs. H. G. Clayton, Mr. and Mrs. I. S. Moll and Mr. and Mrs. M. J. Heavers. The traditional welcome was given to the officials of the Section and the guests as they made their way to the top table.

Unfortunately, Mr. Watson, the principal guest, had been attending an International Standards meeting at Wiesbaden, and although he cut short the conference and set out early from Frankfurt, he was delayed by the fog and arrived during the speeches, having completed the journey by train.

The President, therefore, at very short notice, proposed the toast to the Section in an amusing speech, during which he paid tribute to the vigour of the Section and pointed out it was the first Section



From left to right : Mr. I. S. Moll (Vice-Chairman), Mrs. Clay, Mr. H. F. Clay (Chairman), Miss V. F. Watson, Mrs. Moll, Dr. S. H. Bell (President)

and, as such, had laid down principles which had resulted in the framework of OCCA as it is today.

The Chairman thanked Dr. Bell for proposing the toast to the Section in such a competent manner. He said the health of the Section depended upon the energy and capabilities of its officers and thanked them for keeping it in such good health. He especially thanked Mr. Heavers and his helpers for the excellent arrangements they had made for the function. Mr. Clay then related further experiences that had befallen him since last year and a zoological story.

In proposing the toast to the guests, the Chairman said that he was sorry Mr. Watson had been delayed in spite of the detailed precautions he had taken. He welcomed Miss Watson, who had travelled from Bergen by sea and was there in good time! Mr. Clay also welcomed Dr. and Mrs. Atherton, Mr. and Mrs. Cochrane and Mr. and Mrs. Hamblin. He hoped the ladies, who as

usual added colour and beauty to the occasion, were enjoying themselves.

Mr. Clay then suggested that as the principal guest had arrived in time to spend the rest of the evening with them that he respond to the toast to the guests.

Mr. Watson said he was very sorry to have arrived so late and apologised for being in "fancy dress"—his evening clothes he thought were at London Airport. He gave the best wishes of Dr. Nijveld, President of FATIPEC, to the Section and to Dr. Bell. He then told some stories which were well received and snapped up by the "Elephant and Mouse" collectors. The speeches were concluded by the presentation of a brooch to Mrs. Clay by the Vice-Chairman, Mr. Moll, on behalf of the Section.

The evening then continued with dancing to a lively band, obtained through the agency of Mr. J. J. Kavanagh, until the early hours.

W. F. MCD.

Annual lecture

On 7 October at the Royal Institution, the annual lecture of the Technical Training Board for the printing ink and roller making industry entitled "Pigment Particles and Film Properties", was given by Dr. S. H. Bell, and was enthusiastically received by an audience of 220.

The lecturer was introduced by the Chairman of the Board, Dr. G. L. Fuchs.

At the conclusion, Dr. Bell was thanked by the President of the Society of British Printing Ink Manufacturers, Mr. S. C. Biggs, who then announced the award of the Board's Diplomas of competence in printing ink technology to the following former students :—

Mr. T. A. Cox

Mr. J. E. Reynolds

Mr. P. B. Thompson

These three awards bring the total of these Diplomas to 29 since they were introduced in 1951.

F. W. Clark Memorial Medal and Prize

The late Mr. F. W. Clark was a chemist and chemical engineer. During the war he was sent on a technical mission to the United States, but the boat in which he travelled was torpedoed and it was briefly announced that a British chemist was missing and believed dead. One of his friends, closely connected with technical education, Mr. G. Copping, felt that the name of F. W. Clark should be commemorated and he raised the sum of approximately £250 from friends in the Paint Industries Club, in which he and F. W. Clark worked as colleagues, G. Copping being Hon. Secretary and F. W. Clark Hon. Treasurer.

That fund was handed to the Oil and Colour Chemists' Association who, in turn, passed it to the City and Guilds of London Institute to provide the F. W. Clark Memorial Medal and Cash Prize value £5.

The 1964 prize has been awarded to Peter Edward Daly, Borough Polytechnic, London.

Visit to H. J. Heinz & Co. Ltd., Kitt Green, Lancs

On the afternoon of 29 October 1965, 25 members of the Manchester Section visited the works of H. J. Heinz & Company Limited, at Kitt Green.

This visit was a repeat of a successful visit made in 1959 and was the second visit of the session following discussion at the last Section AGM.

The modern factory, opened in 1959, is the largest of its type in the Commonwealth and employs between 2,500 and 3,000 employees. As might be anticipated the factory is light, scrupulously clean and highly mechanised, and has a very high standard of welfare facilities.

Members were impressed by the stringent testing and quality control arrangements and fascinated by the bean processing operation involving grading, inspecting, storing, washing, blanching and baking operations. In addition to beans, spaghetti, tomato ketchup and soups are also prepared.

The tin manufacturing unit was also visited and the automatic cleaning, filling, sterilising, labelling and packing of tins at rates of up to 750 tins per minute were followed to the warehousing stage. Members were then given tea in the canteen and a "food parcel" to take home.

After the visit the evening was completed by a social evening and meal at the Bowling Green Inn, Charnock Richard, when some members demonstrated their sporting limitations.

W. F. MCD.

News of Members

Mr. Peter Walker, Ordinary Member attached to and Hon. Treasurer of the Thames Valley Branch, has been awarded Second Prize in the 1965 Roon Foundation Awards Competition for his paper entitled "The Effect of Water on the Adhesion of Surface Coatings" which he presented at the 43rd Annual Meeting of the Federation of Societies for Paint Technology at Atlantic City, New Jersey, U.S.A.

Association Notices

Applications for membership

It is felt that members would like to be reminded of the standard of competence for the election of candidates to Ordinary Membership of the Association, as laid down by the Council, when they are sponsoring candidates for election. The qualifications for the granting of Ordinary Membership at the present time are :

1. A degree in a scientific subject or any generally accepted equivalent qualification ; or an approved technological qualification in a subject covered by the Association.

2. Or where there is adequate evidence of the technical competence of the candidate other than the obtaining of the qualifications mentioned above, the qualifying period of practice in the industries covered by the Association shall be normally not less than seven years.

Associate Membership is open to those employed in the industries who do not qualify for Ordinary Membership.

The Council has further resolved that Junior Membership should be open without restriction to the age of 21 years and may be extended to 25 years of age, where candidates are following courses of technical study to the satisfaction of their employers or technical college lecturers.

Retired members

Council also wishes it to be widely known that in 1962 it introduced a reduced membership subscription rate for members who have retired from business. This applies to a member who has completed 20 years as an Ordinary or Associate Member and has retired from business, and normally has reached the age of 60 ; he may apply for his name to be retained on the Register of Members at an annual subscription rate of £1 1s. and he will retain the same rights of membership as the class of membership to which he was attached upon retirement.

Members wishing to avail themselves of this concession should write, in confidence, to the General Secretary at the address shown on the front cover of this *Journal*, giving the relevant information under the four headings : (a) name, address and Section, (b) date of election, (c) date of retirement, (d) age.

Change of address

Members changing their address are urged to inform the General Secretary's office immediately so as to avoid any misdirection of mail. This is particularly important as far as the *Journal* is concerned.

Will members please note that since membership of the Association is entirely on an individual basis, if notification of the change of an address for a company is sent to the Association's office this will not necessarily guarantee the change of address in the Association's records of the member concerned unless the name of the member is stated on the communication.

Binding of the " Journal "

Members will be pleased to know that W. Heffer & Sons Ltd., Hills Road, Cambridge, will undertake the binding of back volumes of the Association's *Journal* sent in by individual members, at a cost of 25s. per volume.

Members wishing to avail themselves of this facility should send the parts direct to W. Heffer & Sons Ltd., enclosing a remittance of 25s. and ensuring that notes bearing their names and addresses are enclosed with the parcels.

1966 members' subscriptions

Members are reminded that 1966 Membership Subscriptions to the Association are payable on 1 January 1966. Forms have already been despatched to all members.

New members may like to know that the Commissioners of Inland Revenue had approved of the Association for the purpose of the Finance Act, 1958, Section 16, so that a member subject to United Kingdom income tax is entitled to a deduction from the amount of his emoluments assessable to income tax under Schedule E for the whole of his annual subscription to the Association,

provided the subscription is defrayed out of the emoluments of his office or employment and that the interests covered by the objects of the Association are relevant to such office or employment.

Claims for adjustment of PAYE code numbers should be made on form P.358, copies of which may be obtained from local tax offices.

Register of Members

The following elections to membership have been approved by Council. The Sections to which the new members are attached are given in italics.

Ordinary Members

- BULMER, GRAEME RICHARD, Flat 36, 233 Canterbury Road, St. Kilda, Victoria, Australia. (*Victorian*)
- CRITCHELL, PETER LYNE, Doonside Crescent, Doonside, New South Wales, Australia. (PO Box 128, Blacktown) (*New South Wales*)
- GUT, THEODORE ROLF, Henry H. York, GPO Box 3957, Sydney, New South Wales, Australia. (*New South Wales*)
- HODGSON, JOHN, A.R.A.C.I., Australian Titan Products Pty. Ltd., Burnie, Tasmania, Australia. (*Victorian*)
- LANNEN, WILLIAM JOSEPH, Works Research Dept., Broken Hill Proprietary Co. Ltd., PO Box 196, Newcastle, New South Wales, Australia. (*New South Wales*)
- PRITCHARD, COLIN WILLIAM, M.SC., c/o Philips Electrical Industries Ltd., Box 5023, Nae Nae, Wellington, New Zealand. (*Wellington*)
- RAWLINSON, JOHN ALFRED, 6 Kerrs Road, Castle Hill, New South Wales, Australia. (*New South Wales*)
- SOLOMON, DAVID HENRY, PH.D., M.SC., B.SC., 14 Alimar Road, Glen Waverley, Victoria, Australia. (*Victorian*)
- WILLIAMS, JOHN GAVIN, M.SC., "Epikote" Laboratory, Shell Refinery, Granville, New South Wales, Australia. (*New South Wales*)

Associate Members

- BATEMAN, WILLIAM RHODES, 15 Parade, Norwood, Adelaide, South Australia. (*South Australian*)
- LODER, GARY ROBERT, Henry York & Co. Pty. Ltd., 150 Stirling Hwy., Claremont, Western Australia. (*Western Australian*)

Junior Members

- MCDONALD, DOUGLAS ROSS, B. F. Goodrich C.S.R. Chemicals Pty. Ltd., Box 253B, GPO, Melbourne, Victoria, Australia. (*Victorian*)

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 after publication.

Thursday 2 December

Newcastle Section. "Car Finishes: Present Position and Future Trends," by G. Hind, to be held at the Royal Turk's Head Hotel, Grey Street, Newcastle upon Tyne, at 6.30 p.m.

New South Wales Section. Annual Dinner at "Amory," Ashfield.

Monday 6 December

Hull Section. "The Glyceride Composition of Cottonseed Oils," by Dr. M. L. Meara. Joint Meeting with SCI Oils and Fats Group, to be held at the Royal Station Hotel, Hull, at 7 p.m.

Western Australian Section. Annual Golf Day, then dinner at night.

Tuesday 7 December

West Riding Section. "Advertising—Salesmanship Magnified," by J. C. Wells, to be held at the Great Northern Hotel, Leeds, at 7.30 p.m.

Wednesday 8 December

London Section. "The Use of Computers in Process Control," by T. B. H. Rybak, in the Small Physics Lecture Theatre, Imperial College of Science and Technology, South Kensington, London, S.W.7, at 7 p.m.

Thursday 9 December

Bristol Section—Irish Branch. Annual Dinner and Dance at South County Hotel.

London Section—Thames Valley Branch. "Aerosols," by W. H. Brown, to be held at the Royal White Hart Hotel, Beaconsfield, Buckinghamshire, at 7 p.m.

London Section—Southern Branch. "Decorating Plastics," by S. E. Francis, at the Chemistry Department Lecture Theatre, Southampton University (Joint Meeting with Southern Section of the Plastics Institute), at 7.30 p.m.

Scottish Section. "The Place of Computers in the Paint Industry," by T. Henegan, to be held at More's Hotel, India Street, Glasgow, at 6.30 p.m.

Friday 10 December

Manchester Section. "Powder Technology," by J. C. Williams, to be held at the Manchester Literary and Philosophical Society, George Street, Manchester, at 6.30 p.m.

Saturday 11 December

Scottish Section—Student Group. Film Show to be held at More's Hotel, India Street, Glasgow, C.2, at 10.30 p.m.

Wednesday 15 December

Scottish Section—Eastern Branch. "Advantages of Epoxy Marine Paints," by A. McIntosh, to be held in the North British Hotel, Princes Street, Edinburgh, at 7.30 p.m.

Monday 3 January

Hull Section. "Recent Development in Water-based Resins," by Dr. H. Warson, to be held at Royal Station Hotel, Hull, at 7 p.m.

Thursday 6 January

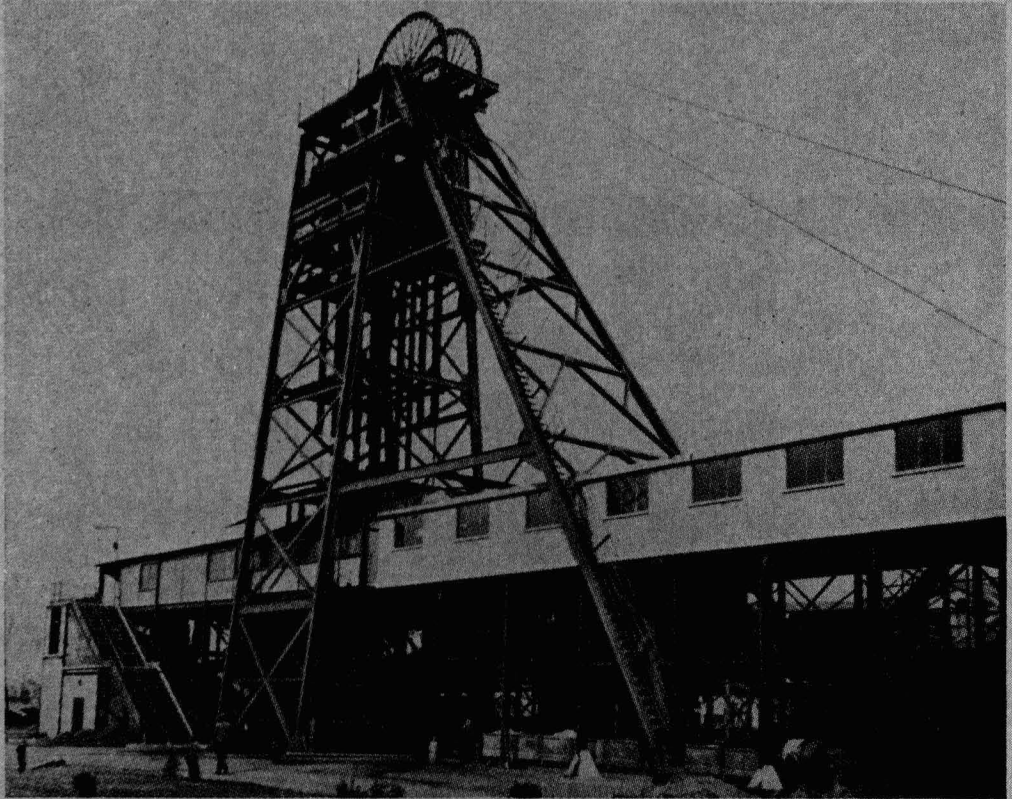
Midlands Section. Annual Ladies' Evening to be held at George Hotel, Solihull, at 7 p.m.

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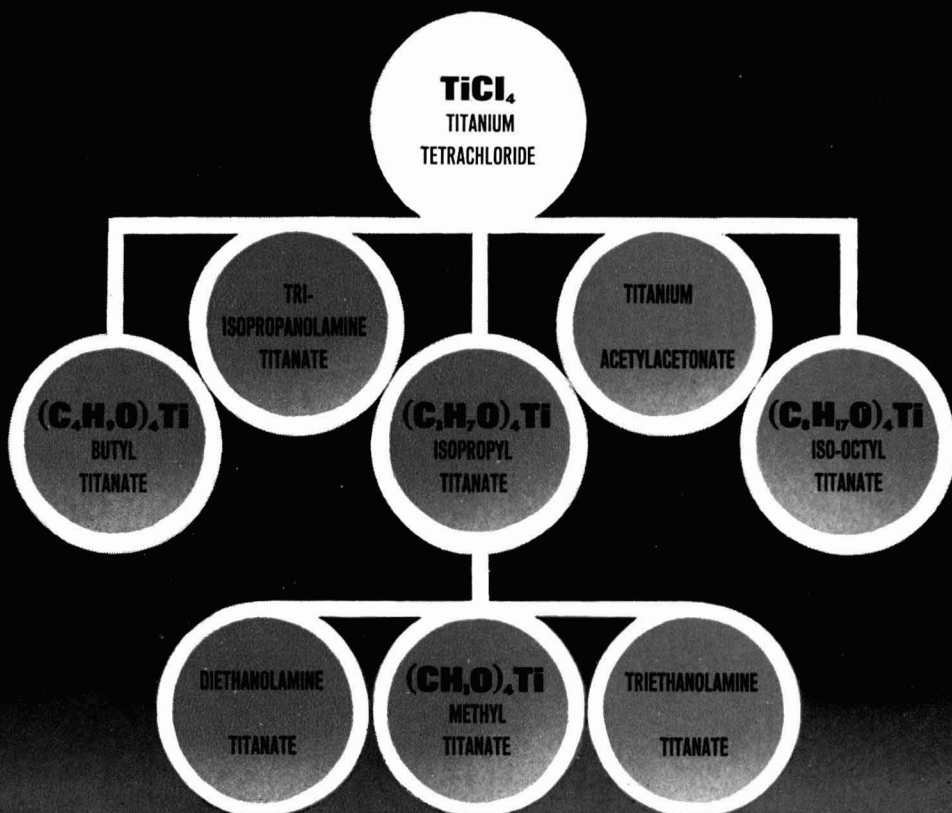
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Newcastle Section. "Costing in the Paint Industry," by P. R. Rodger, to be held at Royal Turk's Head Hotel, Grey Street, Newcastle upon Tyne, at 6.30 p.m.

Manchester Section. "Market Research, A Science or a 'Craft'?", by J. P. Phoenix, at Manchester Literary and Philosophical Society, at 6.30 p.m.

Scottish Section. Annual Dinner-Dance at Central Hotel, Glasgow, at 6.30 p.m.

Friday 7 January

Bristol Section. "Coloured Pigmentation for Electrodeposition," by J. R. Taylor and L. Tasker, to be held at Royal Hotel, Bristol, at 7.15 p.m.

Monday 10 January

London Section. "Surface Properties of Titanium Dioxide Pigments," by Mrs. S. M. Rybicka and A. F. Sherwood (Joint Meeting with Society of Chemical Industry, Colloid and Surface Chemistry Group at 14 Belgrave Square, London, S.W.1), at 7 p.m.

London Section—Southern Branch. "Corrosion Mechanisms and Prevention," by Dr. G. Butler, at the Queen's Hotel, Southsea, at 7.30 p.m.

Tuesday 11 January

West Riding Section. "Water-based Metal Powder Pigmented Paints," by Dr. Troll, to be held at Great Northern Hotel, Leeds, at 7.30 p.m.

Thursday 13 January

Midlands Section—Trent Valley Branch. "The Impact of Plastics on the Paint Industry" (provisional title), by Dr. H. W. Keenan, to be held at the British Railways School of Transport Lecture Theatre at 7.30 p.m.

Scottish Section. "Micronised Pigments in Paint Manufacture," by W. G. Wade, to be held at More's Hotel, India Street, Glasgow, at 6.30 p.m.

Friday 14 January

Hull Section. Chairman's New Year Party. Time and venue to be decided.

Saturday 15 January

Scottish Section—Junior Group. Tutorials: (1) "Paint Manufacture," by D. M. Stewart, (2) "Oils and Varnishes," by G. H. Hutchinson, (3) "Phthalocyanine Pigments," by J. D. Easton, to be held at More's Hotel, India Street, Glasgow, C.2; at 10.30 a.m.

Thursday 20 January

London Section—Thames Valley Branch. "International Paint Test Methods," by T. R. Bullett, to be held at the Royal White Hart Hotel, Beaconsfield, Buckinghamshire, at 7 p.m.

Wednesday 26 January

Scottish Section—Eastern Branch. "Micronised Pigments in Paint Manufacture," by W. G. Wade, to be held at North British Hotel, Princes Street, Edinburgh, at 7.30 p.m.

Friday 28 January

Bristol Section. "Crystal Form and Particle Size of Organic Pigments," by Dr. Gerstner, to be held at Royal Hotel, Bristol, at 7.15 p.m.

Bristol Section—Irish Branch. "Plaster-board, Its Manufacture and Uses," by A. Brioscu, to be held at the Dolphin Hotel, Essex Street, Dublin, at 8 p.m.

Thursday 17 February

New South Wales Section. Annual General Meeting to be held at the Theatrette, MLC Building, Miller Street, North Sydney, at 8 p.m.

Index to volume 48—1965

Key :

- (C) — Correspondence
 (D) — Discussion
 (E) — Editorial and Comment
 (N) — Notes and News
 (R) — Reviews
 (S) — Section Proceedings
 (T) — Transactions and Communications

Authors

	A	PAGE
Adomenas, A. Epoxy Anticorrosive Priming Systems (T)		423
Allen, R. G. Surface Coatings in Atomic Energy Installations (D)		85
Armitage, F. Water Soluble Resins in Industrial Finishing. (D)		147
————— New Leadless Anti-corrosive Primers (D)		345
————— Allyl Ethers in Solventless and Water-based Coatings (D)		1040
Arnold, J. E. Surface Coating of Metals in a Glow Discharge (D)		954
Arnot, W. J. Surface Coatings in Atomic Energy Installations (D)		85
B		
Barker, C. Water Soluble Resins in Industrial Finishing (D)		148
Barraclough, J., and Harrison, J. B. New Leadless Anti-corrosive Primers (T)		341
Barraclough, J. K. The Protection of Ferrous Metal by Zinc Dust Primers (D)		401
Barrett, G. E. Surface Coating of Metals in a Glow Discharge (D)		955
Barrett, R. L. Water Soluble Resins in Industrial Finishing (D)		149
Bell, S. H. The Laboratory Evaluation of the Behaviour of Coloured Pigments on Ball-Milling (D)		38
————— Polarisation Techniques for the Study of Corrosion Inhibitions and their Application to Painted Specimens (D)		381
————— The Protection of Ferrous Metal by Zinc Dust Primers (D)		402
Beresford, J., Carr, W., and Lombard, G. A. Surface Area of Pigments (T)		293
Berry, J. R. Water Soluble Resins in Industrial Finishing (D)		148
Berry, J. R. <i>see</i> Tawn, A. R. H.		
Bews, I. C. R. The Laboratory Evaluation of the Behaviour of Coloured Pigments on Ball-Milling (D)		40
Blakeway, J. W. The Laboratory Evaluation of the Behaviour of Coloured Pigments on Ball-Milling (D)		37
Blechta V., and Lavicka, M. The Influence of Additive and Calcination on the Pigment Properties of Titanium Dioxide, Part I (T)		455
Bondy, C. Inherent Properties of Paint Latex Films (D)		280
Bowerman, D. F. The Laboratory Evaluation of the Behaviour of Coloured Pigments on Ball-Milling (D)		39
Brasher, D. M. Polarisation Techniques for the Study of Corrosion Inhibition and their Application to Painted Specimens (D)		380
Brett, R. A. The Electrodeposition of Paint : Some Basic Studies (D)		834
Brett, R. A. <i>see</i> O'Neill, L. A.		

Brown, J. F. C. Polarisation Techniques for the Study of Corrosion Inhibitions and their Application to Painted Specimens (D)	381
Bullett, T. R. Inherent Properties of Paint Latex Films (D)	280
Bult, R. The Electrodeposition of Paint : Some Basic Studies (D)	833
Byrens, G. B. New Leadless Anti-corrosive Primers (D)	353

C

Carey, C. A. The Laboratory Evaluation of the Behaviour of Coloured Pigments on Ball-Milling (D)	40
Carr, W. Water Soluble Resins in Industrial Finishing (D)	146
Carr, W. <i>see</i> Beresford, J.	
Chandler, R. H. Polarisation Techniques for the Study of Corrosion Inhibition and their Applications to Painted Specimens (D)	381
Cherry, J. The Protection of Ferrous Metal by Zinc Dust Primers (D)	402
Cohen, J. D. The Laboratory Evaluation of the Behaviour of Coloured Pigments on Ball-Milling (D)	37
Clay, H. F. New Leadless Anti-corrosive Primers (D)	355
———— Polarisation Techniques for the Study of Corrosion Inhibition and their Application to Painted Specimens (T)	356
———— The Laboratory Evaluation of the Behaviour of Coloured Pigments on Ball-Milling (D)	42
Cook, G. The Laboratory Evaluation of the Behaviour of Coloured Pigments on Ball-Milling (T)	17
Copping, G. The Story of OCCA (T)	659
Culemyer, K. Polyurethane Systems for Solventless Finishes (D)	1088
Curtis, W. B. <i>see</i> Fry, P. J. (D)	

D

Davidson, R. R. Inherent Properties of Paint Latex Films (D)	280
Day, K. J. New Leadless Anti-corrosive Primers (D)	354
Donovan, P. D. New Leadless Anti-corrosive Primers (D)	351
———— Polarisation Techniques for the Study of Corrosion Inhibition and their Application to Painted Specimens (D)	379
———— The Protection of Ferrous Metal by Zinc Dust Primers (D)	401
Duckworth, S. The Laboratory Evaluation of the Behaviour of Coloured Pigments on Ball-Milling (T)	41
Duligal, E. A. Alkali Silicates in Surface Coatings (D)	934
———— Surface Coating of Metals in a Glow Discharge (D)	953
———— Polyurethane Systems for Solventless finishes (D)	1089
Dunning, W. J. Theoretical Aspects of Adhesion (T)	509
Dunster, R. F. New Leadless Anti-corrosive Primers (D)	353

E

Ellinger, M. L. Surface Coatings in Atomic Energy Installations (D)	85
———— New Leadless Anti-corrosive Primers (D)	353
———— The Protection of Ferrous Metal by Zinc Dust Primers (D)	401
———— The Electrodeposition of Paint: Some Basic Studies	835

F

Filson, A. C., and Jolly, A. C. Unreacted Isocyanate Groups in Cured Polyurethane Lacquer (C)	882
Finke-Jensen, P. The Electrodeposition of Paint: Some Basic Studies (D)	833
Finn, S. R. and Hasnip, J. A. Electrodeposition, a Current-Time Relationship (T)	1121
Franic, B. Allyl Ethers in Solventless and Water-based Coatings (D)	1042

	PAGE
Freeborn, A. S. Unreacted Isocyanate Groups in Cured Polyurethane Lacquers (T)	539
————— Unreacted Isocyanate Groups in Cured Polyurethane Lacquers (C)	882
French, E. L. Surface Coating of Metals in a Glow Discharge (D)	954
————— Characteristics of Electrostatic Powder Spraying (D)	992
————— Polyurethane Systems for Solventless Finishes (D)	1090
Fry, P. J., and Curtis, W. B. Pigmentation of Finishes for Electrodeposition— Information at low PVC's (C)	883
Funke, W. The Chemistry of the Vinyl Cyclic Acetals and their Air Drying Reactions (D)	1067

G

Garland, J. New Leadless Anti-corrosive Primers (D)	355
Gebauer, H. On the Influence of the Surface Treatment of Titanium Dioxide Pigments on Electrocoating (D)	878
Gruber, H. Polyurethane Systems for Solventless Finishes (T)	1069

H

Haken, J. K. Use of the CSIRO Viscosity Ratiometer with Resinous Materials (T)	663
Hall, R. W. The Electrodeposition of Paint : Some Basic Studies (D)	834
————— Surface Coating of Metals in a Glow Discharge (D)	954
————— The Chemistry of the Vinyl Cyclic Acetals and their Air Drying Reactions (D)	1066
Hampton, H. A. Polyurethane Systems for Solventless Finishes (D)	1089
Harrison, J. B. <i>see</i> Barraclough, J.	
Hasnip, J. A. <i>see</i> Finn, S. R.	
Hawkey, J. A. L. The Laboratory Evaluation of the Behaviour of Coloured Pigments on Ball-Milling (D)	37
Henderson, G. M. Surface Coatings in Atomic Energy Installations (D)	85
Hendey, I. A Tropical Testing Cabinet for Anticondensation Fungicidal Paints (T)	1111
Hill, R. F. Phthalocyanine Pigments and their Application (T)	603
Hippe, Z. S., Jablonski, H. T., and Krzyzanowska, T. B. Photochemistry of Vinyl/ Chloride/Vinyl-iso-butyl Ether Copolymer: Part I (T)	447
————— Photochemistry of Vinyl Chloride/Vinyl-iso-butyl Ether Copolymer: Part II (T)	613
————— Photochemistry of Vinyl Chloride/Vinyl-iso-butyl Ether Copolymer: Part III (T)	1117
Hoar, T. P. New Leadless Anti-corrosive Primers (D)	352
Hochberg, S. The Chemistry of the Vinyl Cyclic Acetals and their Air Drying Reactions (D)	1043
Hopwood, J. J. Water Soluble Thermosetting Organic Polymers (T)	157
Howarth-Williams, J. Powder Coatings—Adhesion and Permeability Studies (D) ..	1024

J

James, D. M. Alkali Silicates in Surface Coatings (D)	933
————— Powder Coatings—Adhesion and Permeability Studies (D)	1022
Jablonski, H. T. <i>see</i> Hippe, Z. S.	
Jolly, A. C. <i>see</i> Filson, A. C.	

K

Kavanagh, J. J. The Laboratory Evaluation of the Behaviour of Coloured Pigments on Ball-Milling (D)	42
Keenan, H. W. Progress of Water Soluble Resins in Industrial Finishing (D)	147
————— Polyurethane Systems for Solventless Finishes (D)	1090
Kershaw, R. Surface Coating of Metals in a Glow Discharge (D)	955
Key, R. F. The Laboratory Evaluation of the Behaviour of Coloured Pigments on Ball-Milling (D)	38
Krzyzanowska, T. B. <i>see</i> Hippe, Z. S.	

L		PAGE
Laar, J. A. W. van Characteristics of Electrostatic Powder Spraying (D)		991
———— Powder Coatings—Adhesions and Permeability Studies		1023
Landon, G. The electrodeposition of Paint: Some Basic Studies (D)		832
———— On the Influence of the Surface Treatment of Titanium Dioxide Pigments on Electrocoating (D)		879
Lavicka, M. <i>see</i> Bletcha, V.		
Lombard, G. A. <i>see</i> Beresford, J.		

M		
Major, T. P. The Laboratory Evaluation of the Behaviour of Coloured Pigments on Ball-Milling (D)		40
Mayne, J. E. O. New Leadless Anti-corrosive Primers (D)		352
———— Polarisation Techniques for the Study of Corrosion Inhibition and their Application to Painted Specimens (D)		378
———— The Protection of Ferrous Metals by Zinc Dust Primers (D)		401
———— Alkali Silicates in Surface Coatings (D)		932
———— Surface Coating of Metals in a Glow Discharge (D)		953
Meason, M. J. F. <i>see</i> Pass, A.		
Mills, M. R. The Laboratory Evaluation of the Behaviour of Coloured Pigments on Ball-Milling (D)		36
Mitchell, J. The Laboratory Evaluation of the Behaviour of Coloured Pigments on Ball-Milling (D)		41
Moll, I. S. The Chemistry of the Vinyl Cyclic Acetals and their Air Drying Reactions (D)		1068
Monk, C. J. H., and Wright, T. A. A Pneumatic Micro-indentation Apparatus for Measuring the Hardness of Paint Coatings (T)		520
Monk, C. J. H., Measurement of Viscosity at High Rates of Shear: A Cone and Plate Attachment for the "ICI Rotothinner" (T)		150

Mc		
Mackinlay, J. The Laboratory Evaluation of the Behaviour of Coloured Pigments on Ball-Milling (D)		40
McDonnell, W. F. Water Soluble Resins in Industrial Finishes (D)		146
McFarlane, D. Surface Coating of Metals in a Glow Discharge (D)		952

N		
Newton, D. S. The Interior Gloss Retention of Water Enamels (T)		52
———— New Leadless Anti-Corrosive Primers (D)		354
———— Polarisation Techniques for the Study of Corrosion Inhibition and their Application to Painted Specimens (D)		381
———— and Sampson, F. G. The Protection of Ferrous Metal by Zinc Primers (T)		382
———— Surface Coating of Metals in a Glow Discharge (D)		955
———— Powder Coatings—Adhesion and Permeability Studies (D)		1023
North, A. G. On the Influence of the Surface Treatment of Titanium Dioxide Pigments on Electrocoating (D)		880
Nutt, W. O. Inherent Properties of Paint Latex Films (D)		279
———— The Laboratory Evaluation of the Behaviour of Coloured Pigments on Ball-Milling (D)		37

O		
O'Neill, L. A. Inherent Properties of Paint Latex Films (D)		280
———— Surface Coating of Metals in a Glow Discharge (D)		953
———— The Chemistry of the Vinyl Cyclic Acetals and their Air Drying Reactions (D)		1067
———— and Brett, R. Allyl Ethers in Solventless and Water-based Coatings (T)		1025

	PAGE
Oesterle, K. M. The Electrodeposition of Paint : Some Basic Studies (D)	832
——— and Szasz, I. Characteristics of Electrostatic Powder Spraying (T)	956
——— Powder Coatings, Adhesion and Permeability Studies (D)	1020
——— The Chemistry of the Vinyl Cyclic Acetals and their Air Drying Reactions (D)	1065
Oosterhof, H. A. Inherent Properties of Paint Latex Films in Relation to their Performance (T)	256
Orman, S., and Walker, P. The Corrosion of Uranium and its Prevention by Organic Coatings (T)	233
Orsini, L. Polyurethane Systems for Solventless Finishes (D)	1088

P

Pass, A. Polarisation Techniques for the Study of Corrosion Inhibition and their Application to Painted Specimens (D)	380
——— The Protection of Metals by Zinc Dust Primers	401
——— and Meason, M. J. F. Alkali Silicates in Surface Coatings (T)	897
Peacock, E. A. Surface Coatings in Atomic Energy Installations (D)	86
Pearson, L. L. Surface Coatings in Atomic Energy Installations (D)	85
Plant, D. A. Water Soluble Resins in Industrial Finishes (D)	146
Pond, K. The Laboratory Evaluation of the Behaviour of Coloured Pigments on Ball-Milling (D)	37
Pritchard, E. J. The Printability of Paper and Board (T)	529
Pye, C. R. Allyl Ethers in Solventless and Water-based Coatings (D)	1042
——— The Chemistry of the Vinyl Cyclic Acetals and their Air Drying Reactions (D)	1066

R

Rechmann, H. On the Influence of the Surface Treatment of Titanium Dioxide Pigments on Electrocoating (T)	837
Reynolds, G. E. J. Inherent Properties of Paint Latex Films in Relation to their Performance (D)	279
Rogers, J. Alkali Silicates in Surface Coatings (D)	932
Rose, S. P. Selection of Research and Development Projects	620
Rudram, A. T. S. The Protection of Ferrous Metal by Zinc Dust Primers (D) ..	403
——— The Laboratory Evaluation of the Behaviour of Coloured Pigments on Ball-Milling (D)	39
Rule, J. F. Water Soluble Resins in Industrial Finishes (D)	146

S

Sampson, F. G., <i>see</i> Newton D. S.	
Sathaye, S. V. Powder Coatings, Adhesion and Permeability Studies (D)	1022
Smethurst, J. Water Soluble Resins in Industrial Finishes (D)	145
Solomon, D. H. The Influence of Molecular Weight on the Properties of Acrylic and Alkyd Polymers (T)	282
——— Vinyl and Acrylic Modified Alkyds : Part V (T)	440
Stevenink, A. W. de R. van. On the Influence of the Surface Treatment of Titanium Dioxide Pigments on Electrocoating (D)	880
——— Alkali Silicates in Surface Coatings (D)	933
——— Allyl Ethers in Solventless and Water-based Coatings (D)	1040
——— The Chemistry of the Vinyl Cyclic Acetals, and their Air Drying Reactions (D)	1064
Sunderland, E. Characteristics of Electrostatic Powder Spraying (D)	991
——— Powder Coatings—Adhesion and Permeability Studies (D)	1023
——— Allyl Ethers in Solventless and Waterbased Coatings (D)	1039
——— The Chemistry of the Vinyl Cyclic Acetals and their Air Drying Reactions (D)	1064
——— Unreacted Isocyanate Groups in Cured Polyurethane lacquers (C)	1140
Szasz, I., <i>see</i> Oesterle, K. M.	

	PAGE
T	
Talen, H. W. Powder Coatings, Adhesion and Permeability Studies (D)	1021
Tasker, L., and Taylor, J. R. Progress of Water Soluble Resins in Industrial Finishes (T)	121
———— Pigmentation of Finishes for Electrodeposition (T) ..	462
———— Pigmentation of Finishes for Electrodeposition—Further Information (C)	550
Tawn, A. R. H., and Berry, J. R. The Electrodeposition of Paints—Some Basic Studies (T)	790
———— Surface Coating of Metals in a Glow Discharge (D)	952
———— Allyl Ethers in Solventless and Water-based Coatings (D)	1041
Topham, W. G. Water Soluble Resins in Industrial Finishes (D)	146
Touchin, H. R. The Laboratory Evaluation of the Behaviour of Coloured Pigments on Ball-Milling (D)	42
———— Further Investigation of Short Oil Lactic Pentaerythritol Alkyds (T)	587
Tucker, D. R. Surface Coating of Metals in a Glow Discharge (D)	935
Tysall, L. A. Characteristics of Electrostatic Powder Spraying (D)	990
———— and Weber, J. R. Powder Coatings Adhesion and Permeability Studies (T)	1007

V	
Valentine, L. The Laboratory Evaluation of the Behaviour of Coloured Pigments on Ball-Milling (D)	38
———— New Leadless Anti-corrosive Primers (D)	354
———— The Chemistry of the Vinyl Cyclic Acetals and their Air Drying Reactions (D)	1065
Vogel, P. Pit Corrosion in Internally Painted Cargo and Cargo/Ballast Tanks of Ocean-going Crude Oil Tankers (T)	597

W	
Walker, A. D. The Protection of Ferrous Metal by Zinc Dust Primers (D)	402
Walker, P. New Leadless Anti-corrosive Primers (D)	353
———— Surface Coatings in Atomic Energy Installations (D)	86
———— <i>see</i> Orman, S.	
———— Powder Coatings—Adhesion and Permeability Studies (D)	1022
———— Polyurethane Systems for Solventless Finishes (D)	1090
Wall, J. A. Inherent Properties of Paint Latex Films (D)	281
Webb, W. H. New Leadless Anti-corrosive Primers (D)	353
Weber, J. R., <i>see</i> Tysall, L. A.	
Wells, H. Surface Coatings in Atomic Energy Installations (T)	76
Wheeler, R. N. New Leadless Anti-corrosive Primers (D)	354
———— Surface Coatings in Atomic Energy Installations (D)	86
Whiteley, P. Surface Coatings in Atomic Energy Installations (D)	86
———— Mould Resistant Decorative Paints for the Tropics (T)	172
Wild, G. L. E. Metallic Lead Pigment for Anti-Corrosive Protection (T)	43
Wilska, S. On the Influence of the Surface Treatment of Titanium Dioxide Pigments on Electrocoating (D)	881
Wilson, R. W. Powder Coatings—Adhesion and Permeability Studies (D)	1024
Wilkinson, E. N. The Protection of Ferrous Metal by Zinc Dust Primers (D)	402
Williams, T. Surface Coating of Metals in a Glow Discharge (T)	936
Wright, J. The Use of Mechanical Tests in Predicting Surface Coatings Performance	670

Z	
Zonsveld, J. J. The Protection of Ferrous Metal by Zinc Dust Primers (D)	403

Subjects

A		PAGE
Acetals, Vinyl Cyclic and their Air Drying Reactions, the Chemistry of the (T)		1043
Acrylic and Alkyd Polymers, The Influence of Molecular Weight Distribution on the Properties of (T)		282
Additives and Calcination on the Pigment Properties of Titanium Dioxide, The Influence of, Part I (T)		455
Adhesion, Theoretical Aspects of (T)		509
Adhesion and Permeability Studies—Powder Coatings (T)		1007
Advances in Polymer Science and Technology (N)		639
Air Drying Reactions, The Chemistry of the Vinyl Cyclic Acetals and their, (T)		1043
Alkyds, Vinyl and Acrylic Modified: Part V (T)		440
All the Building over (S)		209
Alkali Silicates in Surface Coatings (T)		897
Alkyds, Further Investigation of Short Oil Pentaerythritol Lactic (T)		587
Allyl Ethers in Solventless and Water-based Coatings (T)		1025
Annual General Meeting, Proceedings of (N)		762
Annual Reports, Section and Branch (N)		722
Anticorrosive Priming Systems, Epoxy (T)		423
Anticondensation Paints, A Tropical Testing Cabinet for Fungicidal (T)		1111
Anti-corrosive Protection, Metallic Lead Pigment for (T)		43
Antimony Oxide Flame Retardant Paints (S)		93
Association Honorary Editor (N)		1099
Atomic Energy Installations, Surface Coatings in (T)		76
Australian OCCA Convention, 7th (N)		505, 418, 225
Australian Convention Diary, 7th (N)		883
Automate, To, to Speculate? (S)		1094
B		
Bailey's Industrial Oil and Fat Products (R)		481
Ball Milling, The Laboratory Evaluation of the Behaviour of Coloured Pigments on (T)		17
Bristol Section—Annual General Meeting (N)		778
Bristol Section—Irish Branch, Annual Dinner-Dance (N)		226
Board and Paper, The Printability of (T)		529
Bonding, Chemical and Geometry of Molecules (R)		634
British Joint Corrosion Group (N)		115
British United Provident Association (N)		336
C		
Chemical Bonding and the Geometry of Molecules (R)		634
Chemical Constitution of Natural Fats, The (R)		205
Characteristics of Electrostatic Powder Spraying (T)		956
Chemistry in Non-Aqueous Solvents (R)		633
Chemistry of the Vinyl Cyclic Acetals and their Air Drying Reactions (T)		1043
Coatings, Emulsion and Water Soluble Paints and (R)		308
Coatings, Fluidised Bed (S)		636
Coatings and Plastics Anniversary (N)		336
Colour of Pigment Crystals, The (S)		100
Coloured Pigments on Ball-Milling, The Laboratory Evaluation of the Behaviour of (T)		17
Colour Matching—Practical Instrumental, Spectrophotometry and Colorimetry (S)		557
Colorimetry and Spectrophotometry, Practical Instrumental Colour Matching (S)		557
Commemorative Dinner (N)		501
Conference, Torquay (N)		333
Conference 1967, OCCA (N)		777
Corrosion of Uranium and its Prevention by Organic Coatings, The (T)		233
Corrosion Inhibition and their Application to Painted Specimens, Polarisation Techniques for the Study of (T)		356

Corrosion, Pit in Internally Painted Cargo and Cargo/Ballast Tanks of Ocean-going Crude Oil Tankers (T)	597
Coulometric Analysis (R)	1093
Council 1965	645
Courses in Surface Coatings (N)	891
CSIRO Viscosity Ratiometer with Resinous Materials, Use of (T)	663
Current Developments in Dispersion (C)	317
Cybernetics (S)	216

D

Daniel Flowpoint Technique—The Use of (S)	557
Decoration of Plastics (S)	1094
Decorative Paints for the Tropics, Mould Resistant (T)	172
Developments in Vehicles for Printing Inks (S)	496
Development of Water Soluble Resins, The (S)	97
Dispersing and Wetting Equipment, Mixing (S)	91
Dirt Pick-up of Paints (S)	406
Discussion Evenings (S)	311
Dispersion, Stabilisation Mechanisms in Paint Systems (S)	93
Driers 1965 (S)	318
Durability Testing of Titanium Oxide Pigments (S)	92

E

Electrophoresis (S)	406
Electrocoating, On the Influence of the Surface Treatment of Titanium Dioxide Pigments on (T)	837
Electrodeposition, Pigmentation of Finishes for (T)	462
Electrodeposition, Pigmentation of Finishes for—Further Information (C)	550
Electrodeposition, Pigmentation of Finishes for, Information at low PVC/S (C)	883
Electrodeposition—A Current-Time Relationship	1121
Electrodeposition of Paint, The : Some Basic Studies (T)	790
Emulsion and Water-Soluble Paints and Coatings (R)	308
Epoxy Anticorrosive Priming Systems (T)	423
Epoxy Resins (S)	767
Ethers, Allyl, in Solventless and Water-based Coatings (T)	1025

F

FATIPEC Congress, VIII (N)	225, 1001
Ferrous Metal by Zinc Dust Primers, The Protection of (T)	382
Finishes, Pigmentation of, for Electrodeposition—Further Information (C)	550
Finishes, Industrial (S)	97
Fish Oils, their Composition, Processing and some Industrial Applications (S)	213
Fluidised Bed Coatings (S)	636
Fluorescent Pigments and Coatings (S)	215
Forgotten Aston Manor in Birmingham (N)	583
Formulation and Testing of Paints for Use in Radioactive Areas, The (S)	218
Fourth Congress of the Scandinavian Federation (N)	114
Fungicidal Anticondensation Paints, A Tropical Testing Cabinet for (T)	1111
Further Investigations of Short Oil Lactic Pentaerythritol Alkyds	587

G

Glow Discharge, Surface Coating of Metals in a (T)	936
--	-----

H

Hardness of Paint Coatings, A Pneumatic Micro-Indentation Apparatus for Measuring the (T)	520
Heterocycles en Chimie Minerale, Les (R)	405
Hull Section—Dinner Dance (N)	889, 1152

	PAGE
I	
ICI Rotothinner, Measurement of Viscosity at High Rates of Shear : A Cone and Plate Attachment for the (T)	150
Industrial Finishes (S)	97
Industrial Finishes, Progress of Water Soluble Resins in (T)	121
Industrial Paints : Basic Principles (R)	485
Industrial Water Thinnable Coatings (S)	767
Influence of Molecular Weight Distribution on the Properties of Acrylic and Alkyd Polymers, The (T)	282
Influence of Additives and Calcination on the Pigment Properties of Titanium Dioxide Part I, The (T)	455
Infrared Band Handbook, Supplements 1 and 2 (R)	634
Inherent Properties of Paint Latex Films in Relation to their Performance (T)	256
Interaction Between Paint and Varnish and the Substrate (S)	487
Interior Gloss Retention of White Enamels, The (T)	52
International Bibliographie der Farbenlehre Und Ihrer Grenzgebiete, Vol. 2. Period 1950-54 (R)	87
Introduction to Molecular Kinetic Theory (R)	633
In the Realm of Chemistry (E)	1139
Isocyanate Groups—Unreacted in Cured Polyurethane Lacquers (T)	539
Isocyanate Groups in Cured Polyurethane Lacquers, Unreacted (C)	882
K	
Khan Rahim Bux Khan Paint Research Hall, The (N)	584
Kinetics, Modern Chemical (R)	633
Kinetic Theory, An Introduction to Molecular (R)	633
L	
Lactic Pentaerythritol Alkyds, Further Investigation of Short Oil (T)	587
Leadless Anti-corrosive Primers, New (T)	341
London Section—Twenty-Seventh Annual General Meeting 1965 (N)	580
London Section—Liaison with European Associations (N)	334
London Section—Ladies Night (N)	111
London Section—Southern Branch, Annual General Meeting (N)	418
London Section—Thames Valley Branch, Visit to Vauxhall Motors Ltd. (N)	889
M	
Manchester Section—Visit to Ford Motor Company (N)	112
Manchester Section—Annual General Meeting (N)	581
Manchester Section—Symposium on the Recent Technology of Emulsions and Emulsion Paints (N)	639
Manchester Section—Conversazione on Modern Instrumentation in the Surface Coating Industry (N)	1103
Manchester Section—Visit to I.C.I. Mond Division (N)	1104
Manchester Section—Annual Dinner and Dance (N)	1154
Mattiello Lecture 1965 (N)	583
Measurement of Viscosity at High Rates of Shear : A Cone and Plate Attachment for the "ICI Rotothinner" (T)	150
Mechanical Tests, The Use of, in Predicting Surface Coating Performance (T)	670
Metals, Surface Coating of, in a Glow Discharge (T)	936
Metallic Lead Pigment for Anti-corrosive Protection (T)	43
Metall Lacke (R)	1137
Methoden der Organische Chemistry Vol. X, Part III (R)	1136
Midlands Section—Trent Valley Branch Junior Meeting (N)	419
Midlands Section—Ladies Evening (N)	226
Midlands Section—Annual General Meeting (N)	582
Midlands Section—Annual Ladies Evening (N)	1105
Mixing, Dispersing and Wetting Equipment (S)	91
Modern Chemical Kinetics (R)	633
Modern Chromatographic Methods (S)	216
Modern Plant for Finishing and Painting Automobiles (S)	209
Molecular Kinetic Theory, An Introduction to (R)	633

	PAGE
Molecular Weight Distribution on the Properties of Acrylic and Alkyd Polymers, The Influence of (T)	282
Mould Resistant Decorative Paints for the Tropics (T)	172
Mould Resistance of Paint in the Tropics (S)	91, 92
N	
Native Irish Timber (S)	212
Natural Fats, The Chemical Constitution of (R)	205
Newcastle Section—Golf Tournament (N)	890
New Organic Pigments : The Chemistry and Properties of Derivatives of 4, 5, 6, 7— Tetrachlorisoindolin-1-one (S)	316
New South Wales Section—Past Chairman's Dinner (N)	778
New South Wales Section—Wine Tasting Evening (N).. .. .	778
New South Wales Section—Annual Ball (N)	999
News of Members	
S. Duckworth	641
L. Bowden	1106
F. G. Delaney (N)	891
H. A. Hampton	1106
V. G. Jolly	1106
S. W. Kettle	1106
W. F. McDonnell (N)	892
H. Nicholson (N)	892
New Developments in the Field of Polyurethane Lacquers (S)	559
New Leadless Anti-corrosive Primers (T)	341
New Zealand Convention, Third (N)	996
Newton-Friend Lecture, The (S)	560
Newcastle Section—Ladies' Night	583
Non-Aqueous Solvents, Chemistry in (R)	633
Notes on the Use of Optical Brightening Agents in Emulsion Paints Containing Tioxide Pigments (C)	1092
O	
Obituary (N)	
W. Pollard	116
K. L. Jones	892
T. P. Hilditch	1000
M. E. Dougherty	1106
L. A. Jordan	102
Objective Approaches to Colour Matching and Control (S)	313
OCCA Conference 1967 (N)	777
OCCA 17 (N)	498
OCCA 18 (N)	638, 777, 1101
OCCA, The Story of (T)	659
On the Influence of the Surface Treatment of Titanium Dioxide Pigments on Electrocoating (T)	837
Optical Brightening Agents in Emulsion Paints Containing Tioxide Pigments, Notes on the Use of (C)	1092
Organic Coatings, The Corrosion of Uranium and its Prevention by (T)	233
Organic Polymers, Water Soluble Thermosetting (T)	157
P	
Paint, The Electrodeposition of : Some Basic Studies (T)	790
Paint Coatings—Hardness of—A Pneumatic Micro-Indentation Apparatus for Measuring the (T)	520
Paint Latex Films in Relation to their Performance, Inherent Properties of (T)	256
Paint Film Defects : Their Causes and Cure (R)	483
Paint Versus Corrosion (S)	311
Paint in the Tropics, Mould Resistance of (S)	91, 92
Paint Research Hall—The Khan Rahim Bux Khan (N)	584

	PAGE
Paint Systems, Dispersion, Stabilisation Mechanism in (S)	93
Painted Specimens, Polarisation for the Study of Corrosion Inhibitions and their Application to (T)	356
Paints and Coatings, Emulsion and Water-Soluble (R)	308
Paper and Board—the Printability of (T)	529
Paper and Board, Printability of (S)	91
Paper/Printing Ink Relationships (S)	221
Pentaerythritol Alkyds, Further Investigations of Short Oil Lactic (T)	587
Permeability of Polyvinyl Acetate Film (S)	994
Permeability Studies, Adhesion and, Powder Coatings (T)	1007
Photochemistry of Vinyl Chloride/Vinyl-iso-Butyl Ether Copolymer Part I (T)	447
Photochemistry of Vinyl Chloride/Vinyl-iso-Butyl Ether Copolymer Part II (T)	613
Photochemistry of Vinyl Chloride Vinyl-iso-Butyl Ether Copolymer, Part III (T)	1117
Phthalocyanine Pigments and their Application (T)	603
Pigment Crystals, The Colour of (S)	100
Pigmentation of Finishes for Electrodeposition—Information at low PVC's (C)	883
Pigment Dispersion and Pigmentation Structure (S)	561
Pigment Dispersion, The Principles and Techniques of (S)	558
Pigments for Printing Ink (S)	97
Pigments, Phthalocyanine, and their Application (T)	603
Pigments, Surface Areas of (T)	293
Pigmentation of Finishes for Electrodeposition—Further Information (C)	550
Pigmentation Structure and Pigment Dispersion (S)	561
Pigmentation of Finishes for Electrodeposition (T)	462
Pit Corrosion in Internally Painted Cargo and Cargo/Ballast Tanks of Ocean-going Crude Oil Tankers (T)	597
Plastics, The Decoration of	1094
Pneumatic Micro-Indentation Apparatus for Measuring the Hardness of Paint Coatings, A (T)	520
Polarisation Techniques for the Study of Corrosion Inhibitions and their Application to Painted Specimens (T)	356
Polymers, The Influence of Molecular Weight Distribution on the Properties of Acrylic and Alkyd (T)	282
Polymer Science and Technology, Advances in (N)	639
Polyurethane Lacquers—New Developments in the Field (S)	559
Polyvinyl Acetate Film, Permeability of (S)	994
Polyurethane Systems for Solventless Finishes (T)	1069
Polyurethane Lacquers, Cured, Unreacted Isocyanate Groups in (T)	539
Polyurethane Lacquers, Cured, Unreacted Isocyanate Groups in (C)	882
Possibilities with Emulsions in the Paint Field (S)	313
Powder Coatings (S)	494
Powder Coatings—Adhesion and Permeability Studies (T)	1007
Powder Spraying, Characteristics of Electrostatic (T)	956
Preparation of Steel Sheet for Protection Against Corrosion (R)	481
Primers, New Leadless Anti-corrosive (T)	341
Principles and Techniques of Pigment Dispersion, The (S)	558
Printability of Paper and Board (S)	91
Printability of Paper and Board (T)	529
Printing and Coating of Plastic Films (S)	311
Programme Liaison Committee (N)	890
Programmes, Section and Branch	780
Progress of Water Soluble Resins in Industrial Finishes (T)	121
Protection of Ferrous Metal by Zinc Dust Primers, The (T)	382
Priming Systems, Epoxy Anticorrosive (T)	423
Printing and Coating on Aluminium Foil (S)	487
Putting a Figure to it (E)	90
PVC's, Pigmentation of Finishes for Electrodeposition, Information at Low (C)	883

R		PAGE
Raw Material Trends (S)		407
Recent Progress in Surface Science, Volume I (R)		484
Report of Council 1964 (N)		712
Research and Development Projects, Selection of (T)		620
Resins, Epoxy (S)		767
Resins in Industrial Finishes, Progress of Water Soluble (T)		121
Resinous Materials, Use of the CSIRO Viscosity Ratiometer with (T)		663
Retardant Paints, Antimony Oxide Flame (S)		93
Reunion Dinner of Past Presidents, Past Honorary Officers, Founder Members and Council (N)		1149
<i>Rotothinner</i> , Measurement of Viscosity at High Rates of Shear : A Cone and Plate Attachment for the ICI (T)		150

S		
Scottish Section—Annual Dinner-Dance (N)		335
Scottish Section—Essay Competition 1965 (N)		506
Scottish Section—Essay Competition (N)		112
Scottish Section—Eastern Branch Skittles Match (N)		890
Scottish Section—New Times of Technical Meetings		999
Section and Branch Annual Reports (N)		722
Section and Branch Programmes		780
Selection of Research and Development Projects (T)		620
Seminar on Fatty Acids (N)		115
Seventeenth Technical Exhibition 1965 Report (N)		563
Seventh Australian Convention Diary (N)		885
Shear : A Cone and Plate Attachment for the ICI <i>Rotothinner</i> , Measurement of Viscosity at High Rates of (T)		150
Short Oil Lactic Pentaerythritol Alkyds, Further Investigations of (T)		587
Silicates in Surface Coatings, Alkali (T)		897
Study Tour of Japan (N)		1001
Solvent Balance (S)		414
Solvents, Non-Aqueous, Chemistry in (R)		633
Solventless Finishes, Polyurethane Systems for (T)		1069
Solventless and Water-based Coatings, Allyl Ethers in (T)		1025
Some Effects of Pigmentation of Paints Applied by Electrodeposition (S)		495
Some Marine Coating Problems (S)		408
Spectrophotometry and Colorimetry—Practical Instrumental Colour Matching (S)		557
Speculate?, to, To Automate (S)		1094
Stock Exchange in Everyday Life, The (S)		219
Surface Area of Pigments (T)		293
Surface Coatings, Alkali Silicates in (T)		897
Surface Coatings in Atomic Energy Installations (T)		76
Surface Coating of Metals in a Glow Discharge (T)		936
Surface Coating Performance, The Use of Mechanical Tests in Predicting (T)		670
Surface Coating Resin Index, a New Edition (N)		779
Surface Treatment of Titanium Dioxide Pigments on Electrocoating, On the Influence of (T)		837
Symposium on Wetting (N)		584

T		
Techniques and Principles of Pigment Dispersion, The (S)		558
Technological Education and the Paint Industry (S)		489
Technical Exhibition, 17th (N)	108, 223,	322
Terminology for the Paint Industry (N)		891
Tests, Mechanical, The Use of, in Predicting Surface Coating Performance (T)		670
Theory and Practice in the Use of Colour (S)		221
Theoretical Aspects of Adhesion (T)		509
Thermosetting Organic Polymers, Water Soluble (T)		157
Third New Zealand Convention (N)		996

Titanium Dioxide, The Influence of Additives and Calcination on the Pigment Properties of Titanium Dioxide, Part I (T)	455
Titanium Oxide Pigments, Durability Testing of (S)	92
Titanium Dioxide Pigments on Electrocoating, On the Influence of Surface Treatment of (T)	837
Torquay Conference (N)	105, 224, 333, 417, 505
Torquay Diary (N)	769
Tropical Testing Cabinet for Fungicidal Anti-condensation Paints (T)	111
Tropics, Mould Resistant Decorative Paints for the (T)	172

U

Unreacted Isocyanate Groups in Cured Polyurethane Lacquers (T)	539
Uranium, The Corrosion of and its Prevention by Organic Coatings (T)	233
Unreacted Isocyanate Groups in Cured Polyurethane Lacquers (C)	882
Use of Mechanical Tests in Predicting Surface Coating Performance, The (T)	670
Use of Furoic Acid in Alkyds, The (S)	214
Use of Furoic Acid in Alkyds, The (S)	414

V

Vinyl and Acrylic Modified Alkyds, Part V (T)	440
Vinyl Chloride/Vinyl-iso-Butyl Ether Copolymer, Part I, Photochemistry of (T)	447
Vinyl Chloride/Vinyl-iso-Butyl Ether Copolymer, Part II, Photochemistry of (T)	613
Vinyl Chloride/Vinyl-iso-Butyl Ether Copolymer, Part III, Photochemistry of (T)	1117
Vinyl Cyclic Acetals and Their Air Drying Reactions, The Chemistry of (T)	1043
Viscosity at High Rates of Shear: A Cone and Plate Attachment for the <i>ICI Rotathinner</i> , Measurement of (T)	150
Viscosity Ratiometer with Resinous Materials, CSIRO, Use of (T)	663

W

Water-based Coatings, Solventless and, Allyl Ethers in (T)	1025
Water Soluble Resins in Industrial Finishes, Progress of (T)	121
Water Soluble Thermosetting Organic Polymers (T)	157
Water Thinnable Coatings, Industrial (S)	767
West Riding Section—Chairmen's Golf Trophy Competition (N)	113
West Riding Section—Dinner and Dance (N)	227
West Riding Section—Annual Works Visit (N)	779
Wetting Equipment, Mixing, Dispersing and (S)	91
Wetting—Symposium on (N)	584
What is Pigment Dispersion? (S)	95
White Enamels, The Interior Gloss Retention of (T)	52
Work Study (S)	99

Z

Zinc Dust Primers, The Protection of Ferrous Metal by (T)	382
Zinc Dust and Flake Pigments (S)	410

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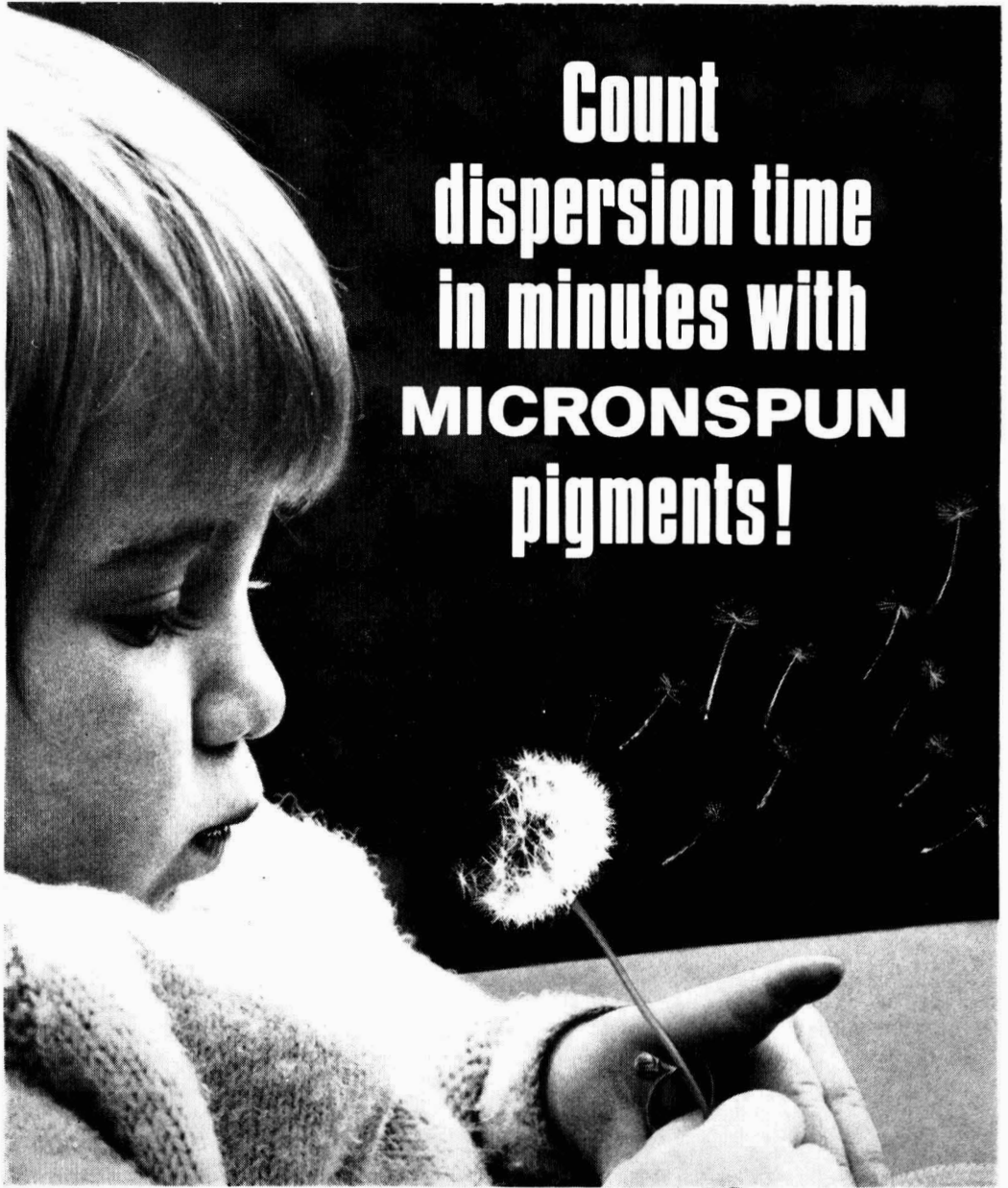
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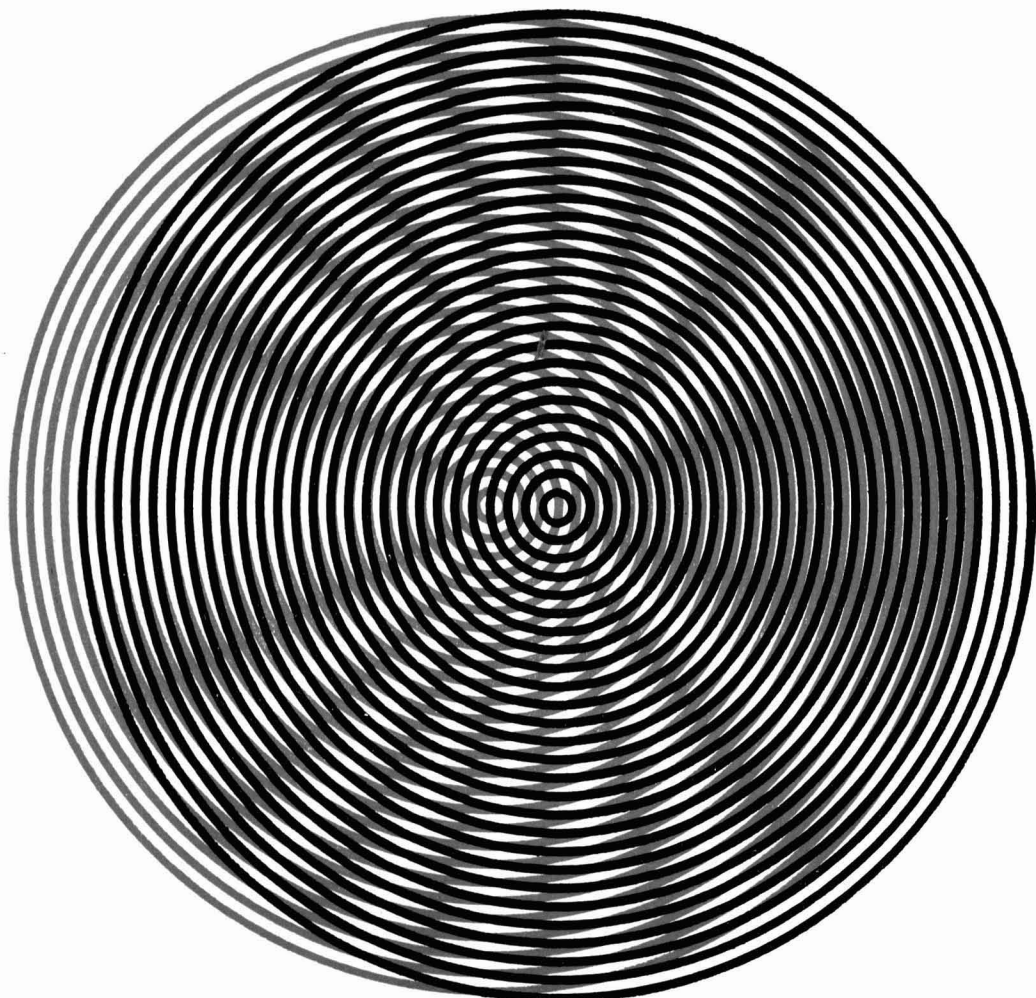
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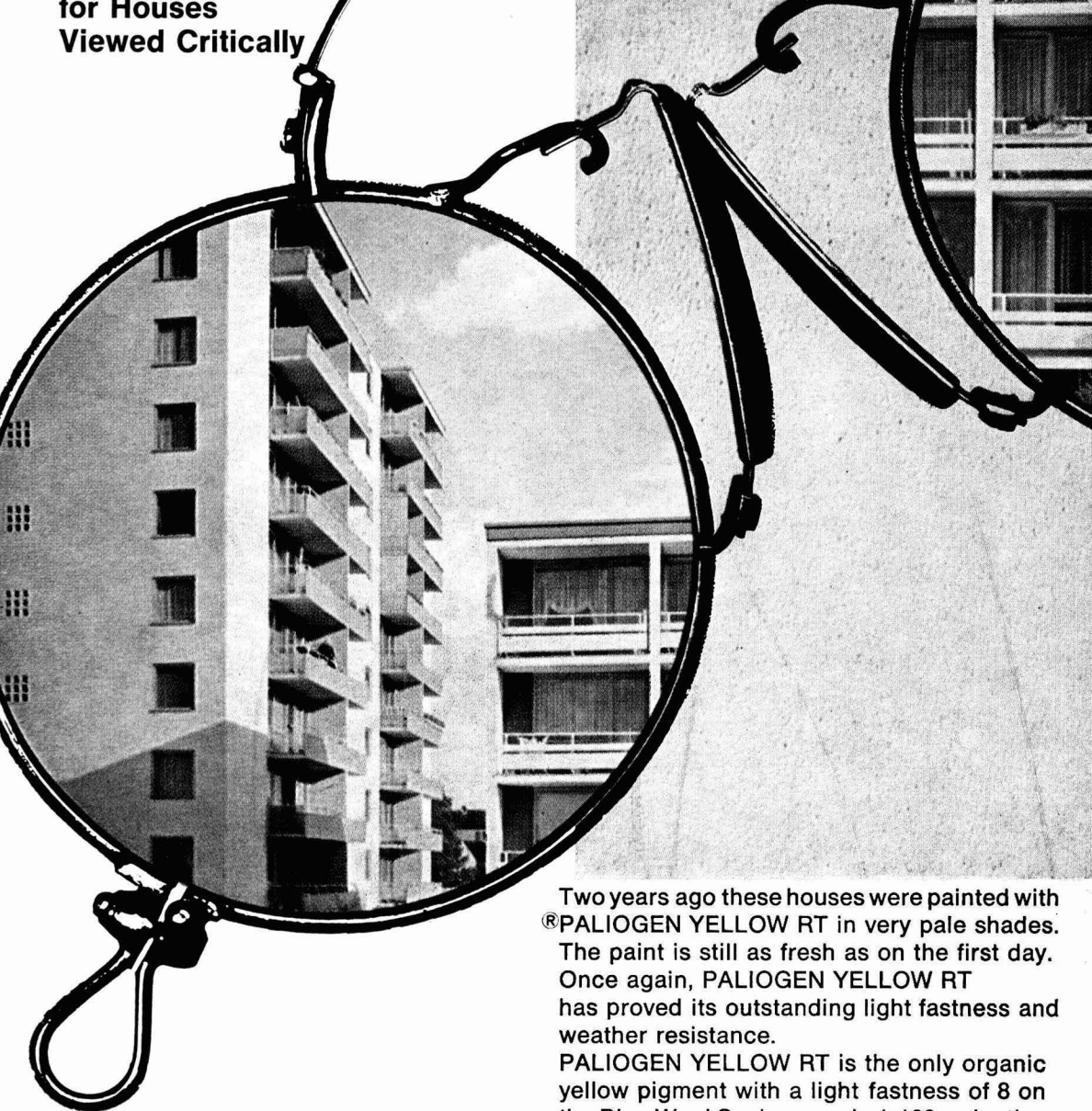
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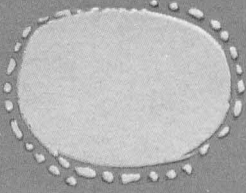
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