

JOURNAL

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OIL AND COLOUR CHEMISTS' ASSOCIATION



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Papers from the Midlands Symposium

The development of training in the chemical industry
D. G. Worthy

The application of the Industrial Training Act
C. G. Lebetter

Problems of management in the smaller business
A. E. B. Perrigo

Preferential deposition of pigment during electro-deposition
F. D. Robinson and B. J. Tear

An electron microscope examination of the "clear layer" at the surface of gloss paint films
R. D. Murley and H. Smith

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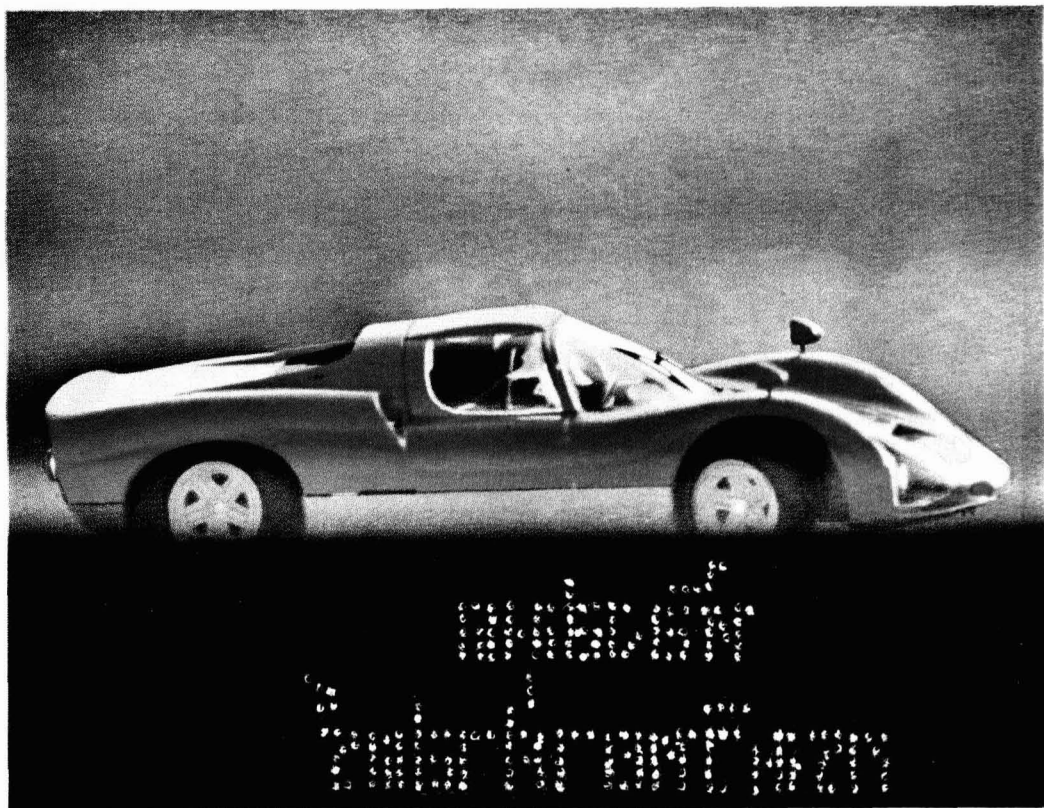
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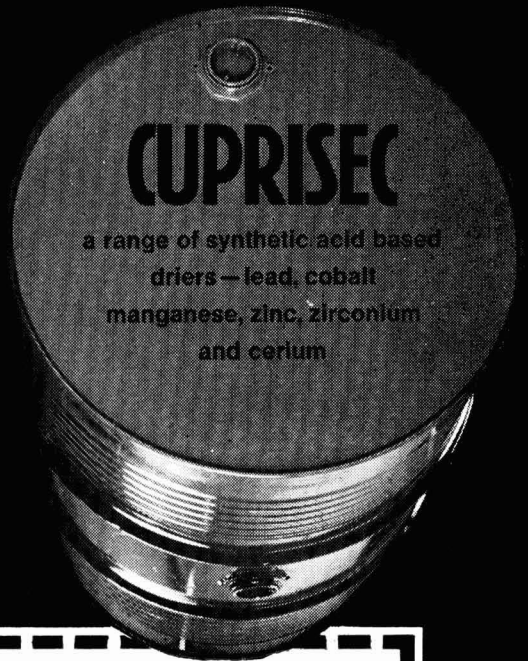
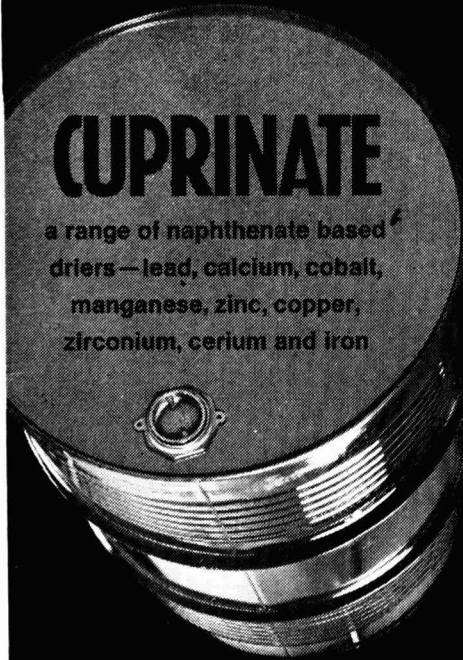
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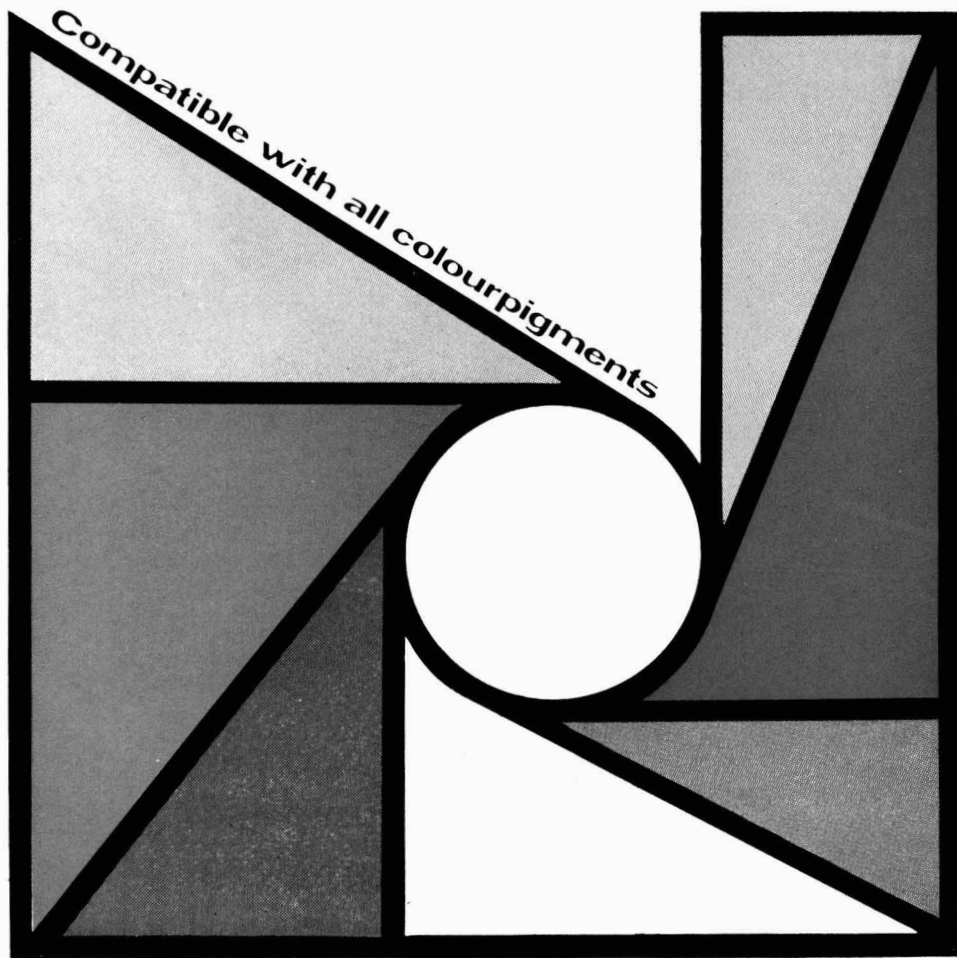
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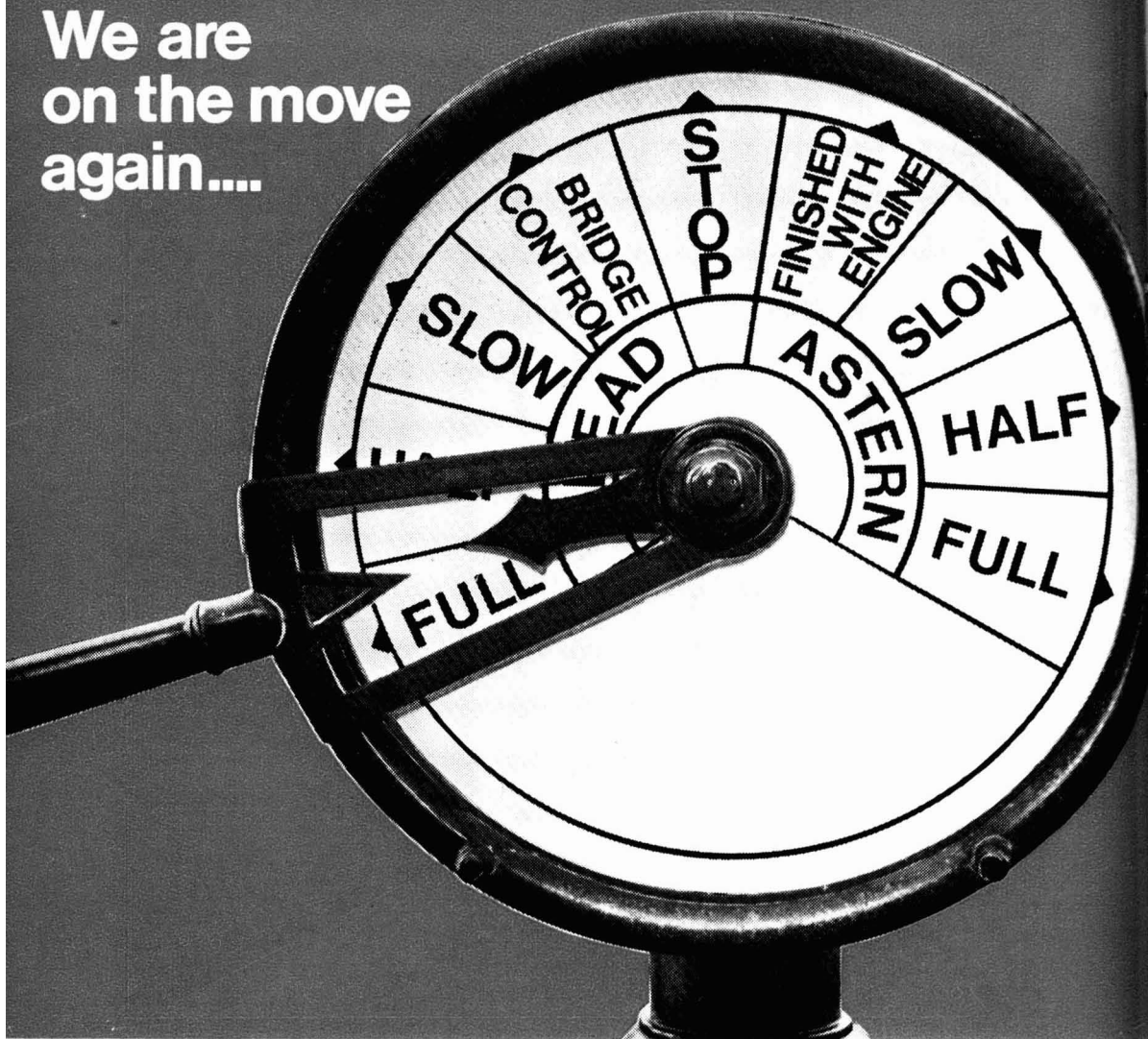


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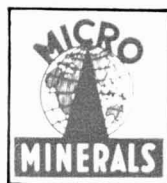
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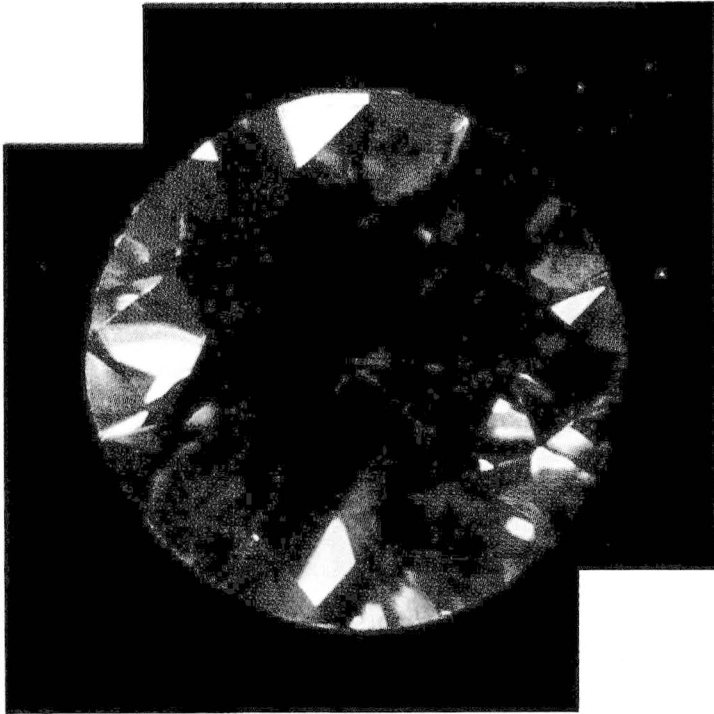
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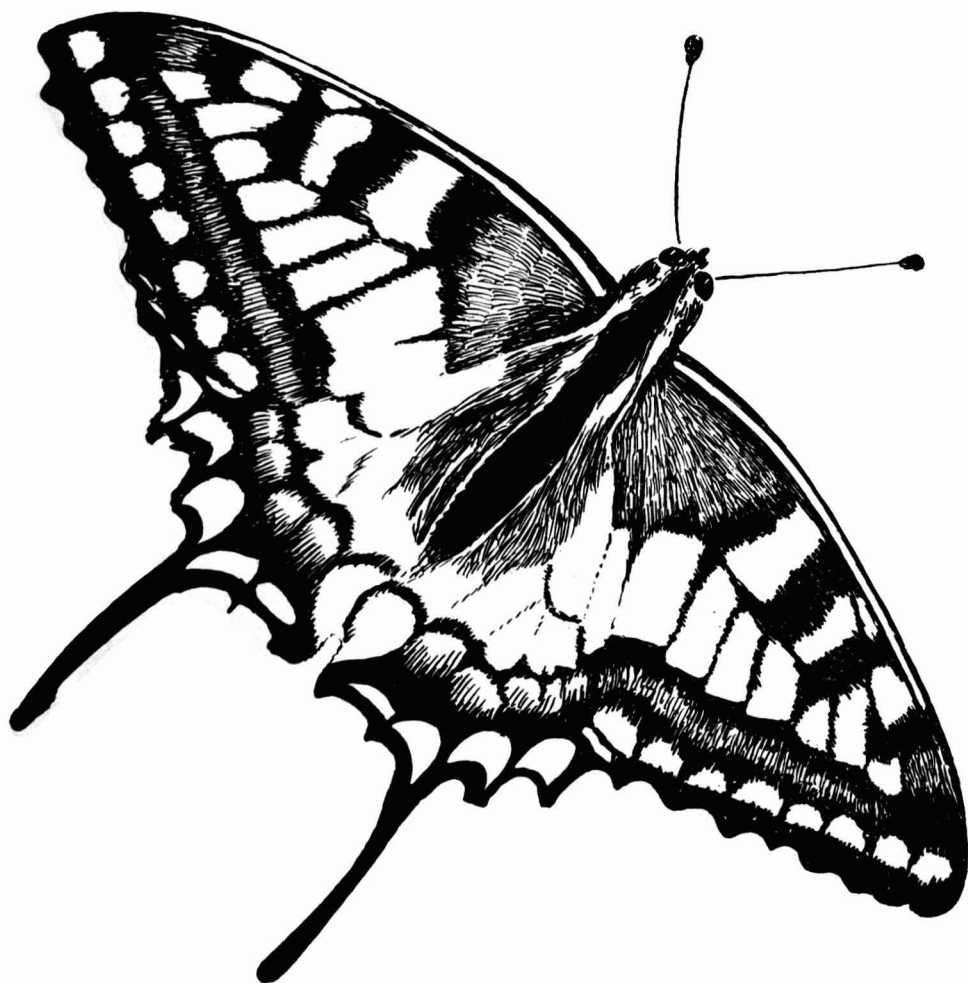
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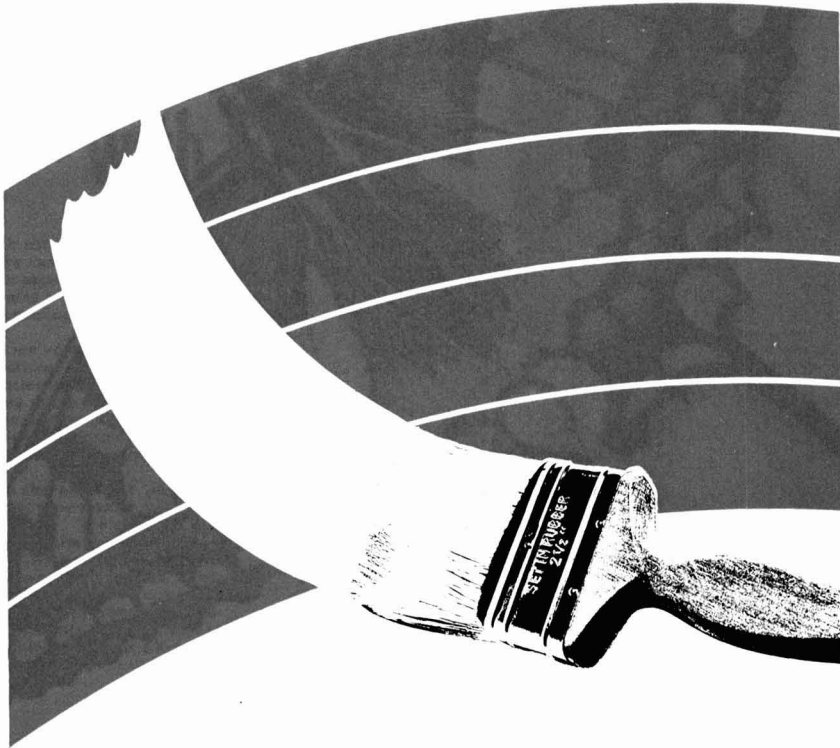
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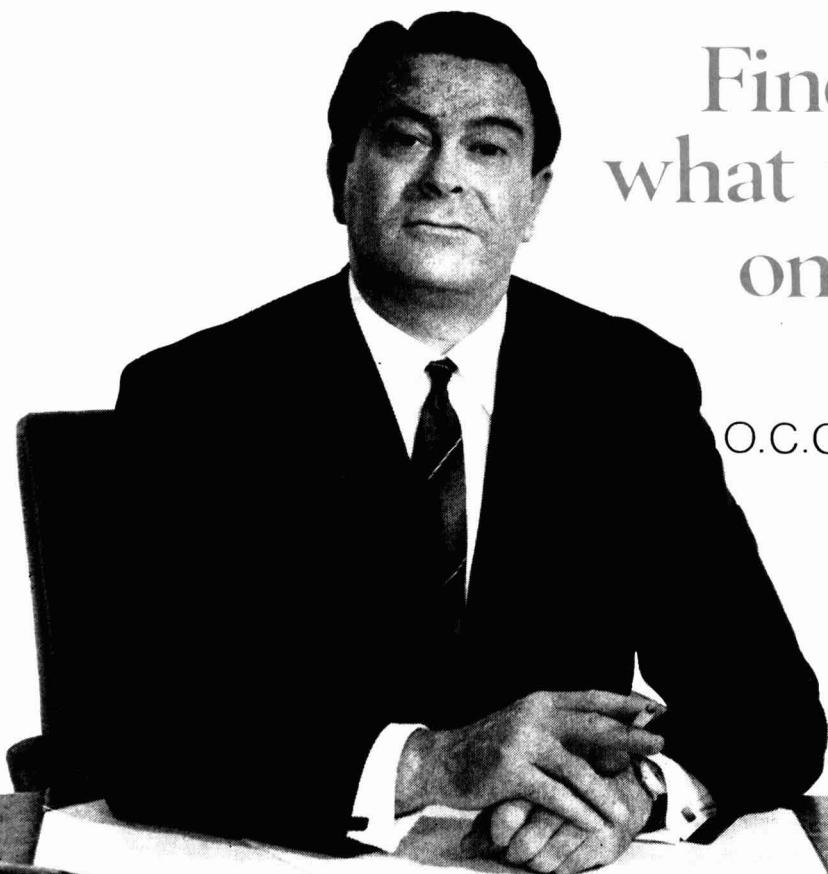
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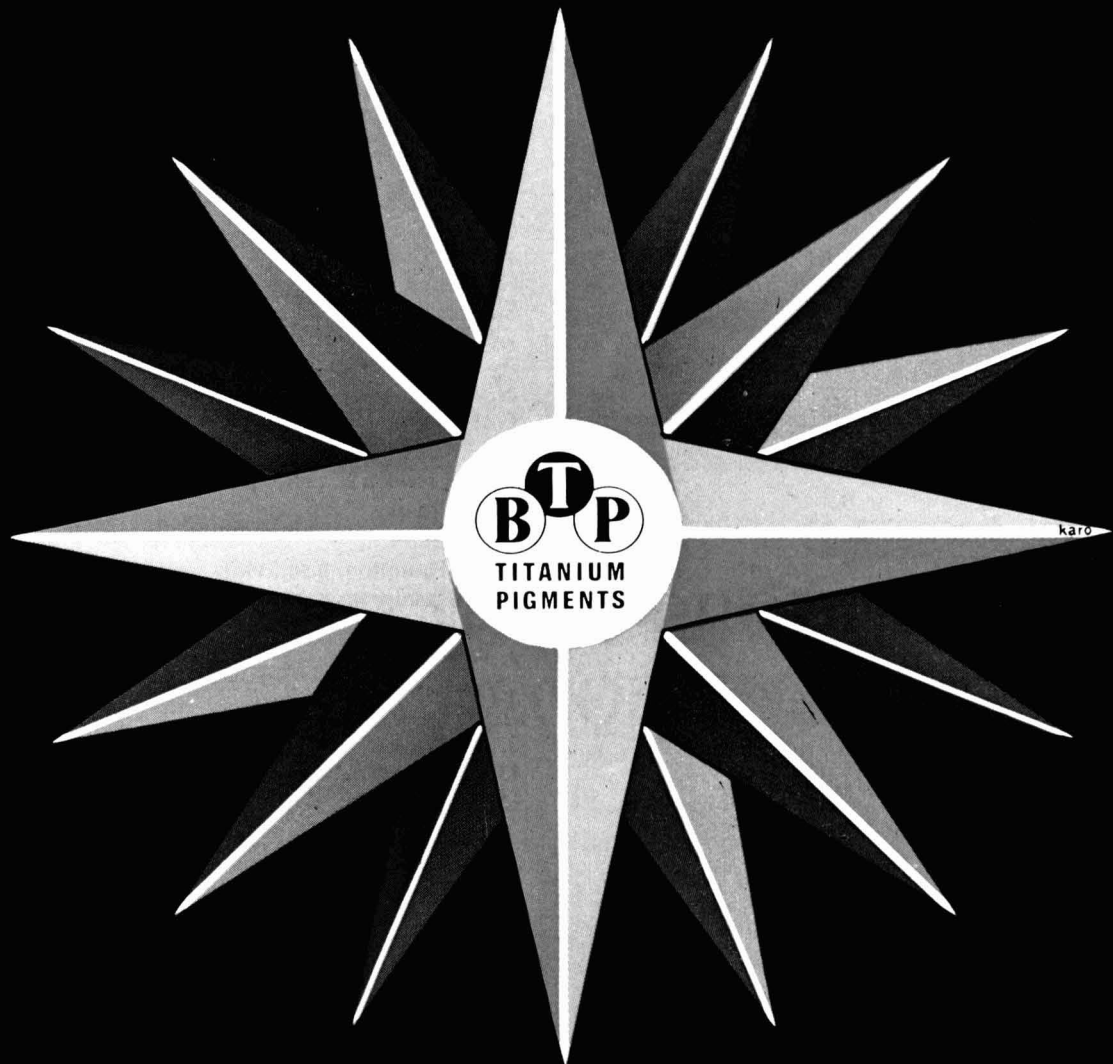
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Transactions and Communications

The development of training in the chemical industry*

By D. G. Worthy

Chemical Industries Association, Alembic House, 93 Albert Embankment, London, S.E.1

Summary

A new approach to training in the chemical industry is described, and the activities of the CAPITB in this field outlined.

Keywords

Miscellaneous
training

Le développement de la formation de personnel dans l'industrie chimique

Résumé

L'auteur décrit un nouvel abord à la formation de personnel dans l'industrie chimique, et il mentionne les fonctions du "CAPITB" dans ce domaine.

Die Entwicklungen in der Ausbildung für die Chemische Industrie

Zusammenfassung

Beschreibung einer neuen Ausbildungsmethode in der chemischen Industrie und Umriss der Initiative des Chemical and Allied Products Training Board auf diesem Gebiete.

Развитие тренировки и обучения в химической промышленности

Резюме

Описывается новый подход к вопросу тренировки и обучения в химической промышленности и дается обзор деятельности САПИТВ (Комитета по Тренировке и Обучению в Химической и Смежных Промышленностях) в этой области.

The basic philosophy which underlies training in this country has been significantly affected by the developments in training over the last five years. It is in the light of the training revolution which has taken place that all the progress which is being made in the chemical and allied industries must be viewed.

It is true that in the past a great deal of training was done either on a haphazard basis or for perhaps altruistic motives. Companies considered, for example, that a particular man or woman ought to receive training simply because he or she had been in service with the company for a number of years or was generally thought to deserve being sent on a course. In the past, training often tended not to be purposeful but rather to be very mixed in its reasons. The result was a pattern of very patchy training—excellent in parts but not consistent throughout industry. This was the reason for the Industrial Training Act.

*Presented to the Midlands Section Symposium, 23 October 1969.

A new approach to training

It is the author's belief that one must start off with the firm proposition that the reasons for training in any company are not any abstract thoughts that may arise in people's minds, but are certain, definite and very precise. The reasons for training are to enable a company to improve its productivity and hence its profitability, and to develop the individual employees within this context. No longer should training be carried out simply because it seems a nice thing to do. Training in the future should be carried out for very definite reasons which are closely linked to a company's general policies in other fields. This approach to training is now very much more widely acceptable and is being followed by all the progressive companies in the industry who are involved in training.

The next important point is that of where the responsibility for training lies. It must be said most strongly that the responsibility for training lies, and must always lie, with line management. The appointment of a training officer should not be the signal for the abandonment of line management responsibility and for the handing over of such responsibility to the training officer. Training officers are appointed as technical advisers and not in order that they shall take over the entire responsibility of training. It is for the line manager, in whatever department he is employed, to identify what training is required by his subordinates. It is for the training officer to advise him as to the techniques available and perhaps in certain cases to carry out the training for the job under the directions laid down by the line manager.

Proper training, as now being organised, must be run on the basis of job analyses. Such job analyses are the absolute number one priority in any review of training requirements in a company. Even these are not the start of the operation, since companies ought initially to be looking at their whole manpower situation in the light of the overall company policy as regards expansion, future markets, etc. Manpower policy should be firmly placed as an important element in company planning, and it is in the light of such policy that the analysis of jobs ought systematically to be carried out so as to enable the line manager to identify more accurately the particular areas of training which he may deem necessary to stimulate.

Policy of the CAPITB

What has been mentioned so far is an outline of the new approach to training, an approach which represents a considerable improvement on much that has gone before.

Clearly, not every chemical firm has adopted all of these points, but it has been most encouraging to note that the Chemical and Allied Products Industry Training Board (CAPITB), which was established two years ago, in October 1967, has adopted much the same policy. They have spoken out firmly against the purely mechanical approach to training and have said that they believe in training based upon the concepts of higher productivity and profitability. Such an approach can, of course, only be welcomed.

They have also spoken about the long term objectives, which are to get away from the levy arrangements towards a system where the primary consideration

is not the raising of levies and the payment of grants, but rather the giving of advice to companies. It is the author's view that the Board has started off extremely well. There has been very close co-operation with industry, a fact which is not unconnected with the fact that many of the officers of the Board are, in fact, directly from the chemical industry and are well aware of the real problems involved. The co-operation which has begun has been fostered by the approach adopted with regard to the preparation of any proposals by the Board. The Board has gone out of its way in this regard to ask companies to appoint representatives on working parties and committees so that the proposals put up by the industry can really represent the views of a considerable part of the industry as to what is the existing good practice.

The author hopes and believes that the path which the Board will take in the future will be a path leading progressively to smaller levies, a policy already adopted by the Board in principle, but one which ought to be accelerated insofar as the time scale is concerned. He would like to see also a much greater emphasis being placed on the advisory services of the Board and, in this connection, the situation where the local officials of the Board are not in any way involved with any claim forms that may be necessary. One must, as far as possible, avoid the position where the Board's officials become inspectors. The author hopes that the services offered by the Board will become so good that the advice will be widely sought by companies, and believes that the time is not very far off when the present system of levies will be superfluous. In the meantime, he would hope that the Board would concentrate its grants in a limited number of priority areas and leave out of grants those areas of training where a reasonably satisfactory level has already been achieved.

Finally, the very close co-operation which has existed ever since the Board has been set up between the Association and the Board should be re-emphasised publicly. The Association is very grateful for this, and such co-operation on the basis of a realistic training policy and in sharp distinction to what has happened in other areas is the only real way to achieve progress in training.

[Received 20 November 1969]

Discussion at the Midlands Symposium

THE FIRST SPEAKER asked what place liberal studies should have in industrial training.

MR D. G. WORTHY replied that he thought it was essential that in all further education given at technical colleges and similar institutions as the academic support for industrial training, there should be an adequate element of liberal studies. There had been criticism of liberal studies in recent years because sometimes the courses were perhaps not very inspired, but this did not detract from the basic underlying principle, which was that young people receiving further education ought not to be merely directed into a narrow mould but ought also to have an opportunity for broadening their outlook. This was, however, a matter for further education rather than internal company industrial training.

THE SECOND SPEAKER asked Mr Worthy to comment upon the establishment of local training schemes and asked whether a training officer appointed for such a local training scheme should be a man with first-hand knowledge of the industry or a professional training officer.

MR WORTHY pointed out that a good man, whether he was from the industry or a professional training officer, would probably succeed anyway. However, in difficult

circumstances such as must attend the setting up of a new scheme, it was very likely that there would be advantages in appointing a man with first-hand knowledge of the industry. He was a strong advocate of the policy whereby managers became training officers as part of their career development rather than moving into training as a lifetime vocation. Thus one might hope to get a good type of man who was genuinely interested in the problems of the industry. There were now very good training courses available for training officers, and these would give the background to any man about to do such a job. He was sure also that the Training Board would assist to give special guidance to such a group training officer when he was first appointed.

THE THIRD SPEAKER asked about training ability in the industry and particularly in the light of the Treaty of Rome and possibility of entry into the common market. Was non-transferability of pension rights a major factor operating against mobility, and what was the CIA doing about it?

MR WORTHY said that there was general agreement that greater mobility was what was required in management as well as in labour, and clearly the issue of transferability of pensions was a crucial issue.

(Author's Note. Since my original comments made at the meeting the publication of Mr Crossman's white paper has thrown a completely different light on the issue and I think that any elaboration of this particular question and answer would only lead to greater confusion.)

The application of the Industrial Training Act*

By C. G. Lebeter

Carr's Paints, Ltd., Artillery Street, Birmingham 9

Summary

The Industrial Training Act is discussed as an incentive to companies to match their manpower requirements to the supply of people adequately trained to execute their job.

The benefits which can be obtained by training schemes for laboratory staff, management, and sales staff are outlined, using the author's company as an example. Finally, the importance of discussion of requirements with the CAPITB is stressed.

Keywords

Miscellaneous
training

L'opération de "l'Industrial Training Act"

Résumé

On discute "l'Industrial Training Act" au point de vue d'un encouragement aux entreprises industrielles de faire marier leurs besoins de personnel au nombre de personnes suffisamment bien instruites pour achever leur tâche particulière.

On mentionne les bénéfices que l'on peut toucher à l'aide des projets d'instruction pour le personnel des laboratoires, des services de ventes, et de l'administration, en se servant de l'entreprise de l'auteur par exemple. Enfin, on souligne l'importance d'établir les conditions nécessaires auprès du "CAPITB."

Anwendung des Industrie Ausbildungsgesetzes

Zusammenfassung

Der Industrial Training Act wird von dem Gesichtspunkte aus besprochen, dass er als Ansporn für die Firmen dienen sollte, ihren Bedarf an Arbeitskräften der Anzahl der zur Verfügung stehenden, genügend für ihre Aufgaben vorgeschulten Leute anzupassen.

Die durch Ausbildungsprogramme für Laboratoriumspersonal, Management und Verkaufskräfte erzielbaren Vorteile werden auseinandergesetzt, wobei die Gesellschaft, für welche der Vortragende arbeitet, als Beispiel benutzt wird. Schliesslich wird betont, wie wichtig es sei, die Anforderungen mit dem Chemical and Allied Products Training Board zu besprechen.

Применение акта промышленной тренировки и обучения

Резюме

Обсуждается акт промышленной тренировки и обучения в качестве поощрения компаниям согласовать свою рабочую силу с наличием людей достаточно хорошо подготовленных для исполнения своей должности.

Перечисляются преимущества осуществляемые тренировочными проектами для лабораторного персонала и управляющего и коммерческого штатов, цитируя компанию автора в качестве примера. В заключение подчеркивается важность обсуждения возникающих требований с САРИТВ (Комитетом по Тренировке и Обучению в Химической и Смежных Промышленностях).

*Presented to the Midlands Section Symposium, 23 October 1969.

The Industrial Training Act was, to the author, an excellent incentive to do something that should have been done anyway and, in ninety-nine cases out of a hundred, wasn't being done.

This was the need to match a company's manpower requirements with the supply of people adequately trained to execute their job. This, in itself, requires an objective decision by the company's policy makers on what will be their needs over the next five years, asking such questions as, "What markets will we be selling into? Will our research become more, or less, sophisticated as a result?", and determining the likely content and structure of each department.

Having done this, one can then check the suitability of existing manpower against the requirements. During this evaluation process it is felt to be of benefit to appoint a qualified training manager, probably from outside the company, because at this stage it is essential for the analysis to be entirely objective and it is very difficult for a person from inside the company to see clearly the true value of people with whom he has been working for some time, and also because training is a very emotive situation.

The first point, then, in the application of the Training Act is: appoint a qualified training manager, or form a consortium to share one, and then let him, in conjunction with all the section managers and the managing director, carry out an absolutely objective analysis of the company's needs and assets.

Most companies that have not done this have excused themselves on the grounds of cost, so let it be said that training need not be expensive. Remember that the Chemical and Allied Products Industry Training Board (CAPITB) pay 50 per cent of the salaries of training managers and instructors. Having said this, the author urges a note of caution—any company embarking on a purely grant-worthy training programme is taking a very short-term approach.

When this investigation was undertaken at Carr's Paints, training needs were arranged in order of priority. At the top of the list was the laboratory—the problem being as shown below.

The company's technology had become very specialised. It is a marketing orientated company and it makes what it can sell, which is what the customers want. The marketing strategy has deliberately lead into specific markets:

- electrodeposition,
- domestic appliances,
- motor industry and its component suppliers, and
- die cast toys.

Even within these market segments, the company's knowledge is fairly specific and, therefore, it was unrealistic to expect external organisations or institutions and their courses to equip young people with the knowledge necessary to play a worthwhile role in the company. However, if training were to be entirely organised and administered from within, this would be a very inbred sort of tuition which would mean that trainees would learn only as much as their tutor could tell them.

Incidentally, the author would not wish his earlier remarks about institutions and organisations to be interpreted as a slight against technical colleges and

further education—it is just that a company cannot expect an outside body to teach a syllabus around its needs—indeed, if this were so, a company whose markets were predominantly decorative would have every reason for complaint.

For the laboratory juniors at Carr's, it was, therefore, decided to embark on an internal technical training programme. The first move was to plan a syllabus designed entirely round Carr's own needs, utilising all the resources available. To this end the larger suppliers were extremely helpful in providing lecturers who gave very specific tuition in subjects exactly relevant to the company's technology, but also showing a wider perspective than Carr's own senior chemists could have been expected to impart. What was presented, then, was a balanced course using internal and external resources.

This initial course achieved a useful and measureable result but still less than ideal. The explanation was a simple one of commitment and, in point of fact, the basic error was that of allowing the training manager to plan the actual training. For this training year a training instructor has been appointed in the laboratory, provided with his own training laboratory, and the practical content of the training has been increased still further. Juniors do not join in the day to day work in the laboratory until they have reached a specific and tested level of competence.

As a result, it has been found that six months' continuous training brings juniors to a level of competence previously needing two years of watching and helping as laboratory assistants. The other result is that the turnover of juniors has not gone down, but the unsatisfactory people are lost much sooner because performance at any point in time can now be measured and compared with a satisfactory norm.

This then is the second application of the Training Act—do your own technical training, be very critical of your own schemes and do measure what you are doing. As measurement factors in Carr's laboratory, learning curve against tuition hours and labour turnover against time employed are used. Finally, let the laboratory organise and administer its own training—by this one can obtain a complete commitment as opposed to passive acceptance.

The second priority was management training or, rather, development. Here the problem is rather different—whatever the technical bias or market, every company has the need for sophisticated managers using the advanced management techniques mentioned earlier today. Most of the techniques, like discounted cash flow or stock control, are taught by external organisations and the author is 100 per cent in favour of using this form of training. There is, however, an additional essential if the maximum benefits are to be obtained, and this is the right attitude of mind in the manager which, in turn, is dependent on the environment existing in the company.

At Carr's, a management by objectives scheme has been introduced following an internal behavioural science course, taking up more than 2,000 man-hours—regarded by the CAPITB as entirely claim-worthy.

The benefits to the company have been such that it should have been done anyway—without the Act it might have been done, because of the Act it certainly was. The magazine *Industrial Society* is serialising Carr's "adventures" in this field.

Management by objectives is, to the author, the most complete technique or system, it uses to the full each manager's individual skills, it makes everyone performance conscious, but it relies heavily upon the right environment existing in the company and this cannot be taught by an outside course and must be developed from within. The point behind all this, is that here was a vital need of the company, it was fulfilled by the sort of course that is not mentioned in any pamphlet issued by the Industrial Training Board but, in spite of this, it was, in the event, entirely claim-worthy.

Moving to the subject of sales training, the author divides this into two sections: first recruiting and training young potential representatives. This is a long but rewarding training function—starting with the recruitment which, if properly done, is a lengthy task, using group interviews, psychological tests and judgment. There follows a lengthy programme dealing with market research, territory planning, analysing the interview opening—closing etc., plus, of course, actually visiting accounts in conjunction with a sales trainee and also allowing him to handle smaller accounts on his own. All this, of course, is usually willingly received and the young impressionable men can be moulded into profit-making representatives.

Section two is the development of senior representatives or sales managers who are profit earners on a large scale. Carr's have found management games a valuable aid in this direction.

On the subject of training administrative staff, the author admits that he is still searching for the right answer. Indeed, he is now of the opinion that there is here a problem to which training is not the answer. People can be taught how to use a piece of equipment, be it a computer, typewriter or accounting machine—the methods are well known. What one cannot do is to teach someone to enjoy operating the machine.

The author's feeling is that one must re-structure the jobs, introducing job enlargement before any real benefit is seen from training other than the fleeting Hawthorne effect.

The only division unmentioned now is the production department. This, at Carr's, is not a problem. By a capital investment programme, they are mechanising out the mundane and dirty jobs—the jobs done in the past by discontented, untrainable labourers. Statistically, there is evidence that the production departments of British paint companies employ more people than their American, Swedish and French counterparts.

The company's more skilled paint makers have learned their skills in the past at technical colleges and in the laboratory, and there is no evidence that this formula should be changed.

What is being done, which is becoming more important, is training foremen and first line managers in the arts and sciences of man management. These are skills that no manager can be without and particularly now that the old fashioned disciplines are less valuable and less effective.

As a final comment, the author would like to mention the relationship between the application of the Act, the CAPITB and the companies coming under their

influence. He has pursued a vigorous dialogue with the CAPITB and benefited enormously from this: he would strongly recommend all companies to adopt a similar approach.

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Discussion at the Midlands Symposium

MR D. R. GRAY pointed out that the CAPITB were prepared to assist in appointing a shared training officer for a group of small and medium-sized companies, but the appointment must be agreed by a committee of management from the companies concerned.

MR C. G. LEBETER commented that it was important that the committee determined and agreed on the objectives to be achieved, and from that agreed on the qualifications and experience needed by the man they required.

MR G. S. TANSLEY asked if Mr Lebeter could give the development of Carr's ideas on the approach to supervisory training.

MR LEBETER said that the supervisors were taught man management skills, including behavioural science tuition in assumptions, pressures, conflict situations, and resistance to change. They were shown the effects and effectiveness of differing management styles, from autocratic to passive. Finally, they read case studies, analysed them and drew conclusions.

Problems of management in the smaller business*

By **A. E. B. Perrigo**

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Summary

The place of the small firm in industry is discussed. The advantages of management in small firms are shown, and the problems involved listed with suggestions for improvement.

Keywords

Miscellaneous
management

Problèmes administratifs de l'entreprise assez petite

Résumé

On discute le rôle industriel de la petite entreprise. On démontre les avantages de bonne administration dans une telle entreprise et l'on énumère les problèmes qui suit, et en même temps suggérant certains moyens de les résoudre.

Management Probleme in Kleineren Firmen

Zusammenfassung

Der Platz für kleinere Industrieunternehmen wird besprochen. Es werden die Vorteile der Geschäftsführung bei kleinen Firmen dargelegt, und die dabei auftretenden Probleme mit Vorschlägen für ihre Lösung aufgezählt.

Задачи в области управления в более мелких предприятиях

Резюме

Обсуждается роль более мелкой фирмы в промышленности. Указываются преимущества управления мелкой фирмой и цитируются возникающие задачи с советами для усовершенствования.

Introduction

It gives the author great pleasure, as a one-time engineering scientist, to be addressing members of an Association who in the main are scientifically trained persons, and who therefore share with him a common experience of the degree to which original training prepares one for exposure to the problems of management.

Initially, one must consider the significance of the small-business sector to the national economy. It has been assessed, for example, that, in terms of manufacturing concerns, even ignoring the very small firms under ten employees, there are 48,000 out of 55,000 employing less than 250 people. Furthermore, 97 per cent of all manufacturing establishments in the UK have less than 500 employees. They embrace 50 per cent of the manufacturing labour force and are responsible

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for 45 per cent of the total value of industrial sales. Furthermore, as was pointed out recently in a CBI publication, "if Britain's 80,000 small firms were to close down tomorrow, 2½ million workers would lose their jobs, over £6,000 million of annual industrial output would vanish, and most of the larger firms would grind quickly and painfully to a halt."

This pattern is so even in all the industrially advanced economies (and here, in parenthesis, one may note that in the United States, the home of giant enterprises, 65 per cent of the country's 250,000 manufacturing concerns have less than 50 employees, 70 per cent of its 275,000 wholesale firms employ ten or less, and over 70 per cent of its almost two million retail firms employ no more than 3 people).

It therefore follows that the small business sector has an important part to play in the national economy. This has long been recognised by the US Government which, with Federal Government funds, set up the Small Business Administration—a Government Agency which, through a nation-wide network of field offices, provides an increasingly wide range of services (including advice, a series of management services, help to obtain a fair share of Government contracts, and the arranging of loans) to improve the efficiency of small businesses in the USA.

In this country, the Department of Economic Affairs has sponsored a Small Business Centre at the University of Aston in Birmingham, which has been charged with a number of the above functions. It is possible that, in due course, such work will be extended throughout the country. Other countries, notably Japan, Germany and the Netherlands, have also developed agencies to assist their respective small-business sectors.

Reasons for scarcity of research information on small businesses

Despite the significance of the small-business sector, and of the high proportion of the total labour force engaged therein, there is remarkably little fundamental internal knowledge (although there have been many industry studies) which has, as yet, been obtained regarding small businesses, compared with that which has been made available on larger businesses.

It may be that researchers find it more fruitful to pursue their investigations into the problems and practices of management from within the larger companies. Therein, it is somewhat easier to obtain reliable and representative information. The degree of management and specialist sophistication is such that it facilitates communication between members of the company and the investigators. For example, the language, jargon and background of the investigator is likely to be much more akin to that of the members of the upper- and mid-management structure of the large company than of the small company. This disadvantage of the smaller company is accentuated by the much heavier day-to-day pressures on its members, which make it more difficult for them to give adequate time and attention to the investigator's requirements.

Furthermore, the smaller company is usually less organised. This can militate against fruitful enquiry, since information is often more difficult to obtain and, even where it is available, frequently requires a considerable amount of "digging" or reconstitution. This frequently has to be undertaken by the investigator without assistance.

Finally, for the deployment of any given research resources, the general significance is likely to be less when focussed on the small-business than on the large-business sector, and the findings are also likely to take longer to disseminate. This is probably due in part to the greater variety in the small-business sector, and the possible greater diversity in motivation and objectives of owner-managers of the small firms than of the professional salaried managers of the large companies and corporations.

The advantages of the small company

Smaller companies have certain advantages over larger firms. They are particularly suited to the provision of specialist products for which there is a relatively small market. For example, custom-built or short-run products. They are also essential suppliers of component-parts to larger organisations, as well as the providers of local needs.

Due to their flexibility and initiative, they are able to produce quality and custom-built goods at prices which compete favourably with those of the larger companies, and to meet short-run delivery dates which the larger firm would find it more difficult to achieve.

In the smaller company, the general manager has an opportunity of knowing all employees intimately. He is, therefore, in a much better position to assess their respective contributions, and to reward each member of the company accordingly. Furthermore, each employee is much more likely to see the effect of his own contribution on the welfare of the company, and he has a greater opportunity of utilising his skills and knowledge to the mutual interests of himself and the company. This leads to much greater job satisfaction than, in general, it would be possible to achieve in the larger organisation.

Furthermore, the channels of communication are short, so that decision can be based on close personal knowledge, and there can be speedy resultant action. Communications with the customer can also be quicker, better informed, and on a more personal basis. In consequence, particularly in short-run jobs and custom-built orders, the smaller firm can offer a service which would not be economically possible from the larger organisation. Its flexibility is often an important and even essential contribution to the implementation of the production programme of the larger company. Without this contribution, the operations of the larger company would often be significantly less efficient.

The main problems of the smaller company and their solutions

The smaller firms, of course, also have their disadvantages. It may, therefore, be worth our while considering the main problems which beset them.

Day-to-day pressure on top management

Probably the greatest cross which the smaller company has to bear, and from which stem many of its other problems, is that the chief executive is usually so preoccupied with the events and chores of the day that he gives little or no time to the conscious planning and shaping of its future, and to the assessment of present performance.

It is almost a vicious circle. The less management gave thought in its yesterdays to its needs of today, the more likely is it to be carrying routine burdens and be living from crisis to crisis today and, in consequence, the less likely is

the chief executive to sit back for a while today and determine what the company should be doing now in preparation for the future.

And yet this hard, cold, unhurried and detached look at itself, its strength and weaknesses, and its potential future markets is essential if, when tomorrow arrives, the company's task is then to be as easy and fruitful as management can make it.

It is not an easy thing for the chief executive of a small business to withstand the day-to-day pressures which he faces, and to set aside sufficient time to ensure that, in terms of our national summer game, the company will be "batting on a better wicket" in future than it is at present.

The importance of this will be appreciated when one pauses to realise that, no matter how efficiently a company may manufacture a product, it will (again in cricket parlance) be batting on a sticky wicket if the outside world no longer requires the item, or if management does not know how, or where, or at what price to sell it.

On the other hand, if there is a market for the product, and management knows how to promote its sale, the company will still be in trouble if its production efficiency is significantly below that of its competitors.

From the above, it will be clear that the function of the chief executive is to secure balance—balance of resources with sales, balance of effort between the routine needs of today and the probable requirements of tomorrow, balance of attention and effort between design of product, production, marketing, and service of the product—so that the company's entrepreneurial activities might flourish.

It has been said that the most important nut on an aeroplane is the loose one. Similarly, in business, the most important part is that which is receiving insufficient attention and consideration. Therefore, a paramount function of the chief executive (particularly in a smaller firm where he has not the subordinates to whom he could delegate such tasks) is the regular scanning of his organisation to ascertain what aspects of the business are receiving insufficient attention, and then to take the necessary steps to remedy the situation.

We will now consider the various other, though related, problems which most generally occur in the smaller business.

Organisation

One of the main reasons for the pressure on top management is the lack of organisation and effective delegation. Top management feels that any organisational change will inevitably result in extra staff, and therefore more overheads. They see the costs, but not the financial benefits which would be derived.

Very often, rationalisation and re-grouping of activities make a tremendous difference to efficiency. The owner-manager, or chief executive, may well have been doing many things (rightly carried out by him when the firm was smaller) which did not require his level of experience, but which had assumed importance merely because he alone did them. On the other hand, other more vital duties, not realised as being of great importance to the well-being of the company, might have been indifferently carried out by a junior.

Where responsibility for some area of the business has nominally been delegated by the chief executive, there is frequently a lack of appreciation of the need for an equal authority and accountability. Furthermore, the chief executive only too frequently complains that he cannot rely upon his subordinates to make the right decisions, when the real problem is that he has spent insufficient time in teaching them the criteria against which the decisions have to be made.

Written job descriptions, on which a number of the training boards rightly lay great store, can do much to improve the effectiveness of organisation of even quite small companies.

Liquidity and finance

Particularly in the very small business, there is often a lack of understanding of the difference between profit and cash. Management often assumes that the increase in profit from the growth in sales volume will automatically show itself in the bank account as cash. The consequence is that the company, in aiming at growth, is liable to overtrade in its efforts to obtain business which, in circumstances where cash was available, would be desirable and profitable. Only too late does management realise that growth necessitates additional possessions in the form of inventory and work-in-progress, etc., which have to be paid for at a greater rate than cash at that stage can be generated from profit.

The firm could frequently overcome this situation if it would prepare a cash flow statement covering forward operations. Such a statement is of great value to management in making decisions. The company then knows well in advance of its likely short- and longer-term financial requirements. This paves the way for a sound investment policy, and management is able to approach the appropriate sources of short-or longer-term capital with a more convincing case than otherwise would be possible.

Control information

In many companies, the lack of adequate control information gives rise to an unawareness of the potential of the company. For example, they know too little about their costs, and which of these are relatively fixed and which vary with volume. They cannot, therefore, predict with any reliability or confidence the effect upon profitability of the decisions which they are called upon to make. In consequence, they are unaware of the potential of the company—they only see investment cost of improvement and not the financial benefit which will be derived.

The introduction of some simple cost control and marginal costing procedures—plus the use of the profit graph—often opens the eyes of management for the first time to the real potential of the company and, if it has a product mix, which lines should be discarded and which should be developed.

Specialist staff

A large proportion of businesses started with a “product man,” and the smaller business only too frequently remains product-orientated. In consequence, it will usually pay for product knowledge—often over the odds compared with the larger firm—but does not like to pay for anything else. For example, it

would generally rather recruit another man with product knowledge—even when it already has sufficient of such “know-how” within the company—than recruit a man with some other specialism which it does not have, but sorely needs.

Often, the first need is a conscientious and developing young cost accountant—the very small business may well not be able either to attract or economically support a more experienced man. Figures then often reveal the impact which more effective planning and/or greater sales volume would have on profitability.

This opens the way for a production planner and controller (who, in a small firm, may also have to carry out other duties).

Lack of market knowledge

Many small firms are “order takers.” When things begin to look bleak, it is not unknown for the owner-manager to telephone around his business friends and acquaintances in search of orders and, as a last resort, to go out into the cold hard world on a totally unprepared and unplanned sales hunt.

As an order taker, he has been accustomed to obtaining sales at little or no selling expense. As the firm grows, he has to learn that the more sales the company needs to obtain, the more expensive they are likely to become—the payback being in increased unit profitability or overall profit from the greater volume. Furthermore, he has to give more thought as to what market he actually is in, and whether other markets exist for his products.

The advent of production planning and control eventually forces management to plan across the board, as well as for production, and this sets the scene for the introduction of simple budgetary control measures—which set out, in the least common denominator of money, management’s objectives and intent for the months ahead, for the various areas of activity allotted to individual members of the management and supervisory team.

Once budgetary control—however simple—is introduced, it is usually soon realised that its corner-stone is sales volume and its product mix. Pressure is then focused on the sales function.

- to know its market
- to forecast future sales levels
- to support selling with adequate publicity and sales promotional literature
- to plan the effective use of the sales force
- to explore the merits of all available distribution channels, e.g.
 - face-to-face selling
 - middlemen
 - retail
 - direct mail.

At this stage, profit planning and marketing (in its broadest sense) become meaningful activities within the company. It will also have developed a firm

conviction that its survival, growth, and well-being depend upon the skills of its managers and supervisors, and it will find that these skills can be developed by sound training—an investment which will be more than recovered in increased profitability.

Training

Managers, like other practitioners, can benefit from training—i.e., from a systematic exposure to the considerable corpus of knowledge and experience which has been built up over the years by others who have studied and practised management in depth.

This training may be informal within the day-to-day activities of the company (and one must never underestimate the great value of tutelage under a first-class manager who has the willingness, ability, and time—and here I would like to emphasise the importance of available time—to explain his actions and processes of thought to his subordinates). It may, on the other hand, be transmitted during a consultancy assignment, where a person has the opportunity to work alongside the consultant.

The trainee, however, will only blossom forth if he is of the right potential and is given the opportunity to carry out specific tasks of gradually increasing complexity and responsibility. If given good supervision, and “stretched” progressively to his limits, his progress will be rapid and enjoyable.

The alternative, of course, is formal training, which may be in-plant or at external courses and seminars. With either form of training, it is of great importance that it is systematic. There is, as one can appreciate, a greater risk that informal “on-the-job” training will become subordinated to the day-to-day requirements of the company and, instead of being systematic, will be fortuitous and leave gaps within the gamut of knowledge and experience which the fully-trained person requires.

Whilst formal training, either at in-plant or outside courses, has the great advantage that it can be pursued systematically, the smaller company finds it very difficult indeed—if not impossible—to release its managers for courses of very long duration. As more than one chief executive has remarked “If I could release the man for three months, I would not require him at all.” This may sound short-sighted, but it has to be remembered that, in the smaller firm, when one manager is away, the few remaining ones have to close their ranks and share his load between them. One can therefore sympathise with his reactions.

In view of this, courses for the manager of the smaller business have tended to consist of a few hours one day per week, for around 8 to 12 weeks’ duration; these being fortified by one-day seminars on special subjects and, occasionally, the weekend residential course. Managers of small businesses profit greatly from these residential courses—probably as much from the evening discussions with members of other companies “over a pint” as from the course itself. It tends to widen their horizons and, in discussion, they find that other firms also have their problems, no less demanding than their own, and that many problems of the various firms represented on the course have a lot in common, and have to be overcome in a similar manner in quite different industries.

Discussion at the Midlands Symposium

MR G. S. TANSLEY asked if Mr Perrigo would comment on the dangers in the selection of consultants facing the manager of the small firm, and on the need for the development of skill in recognising the appropriate source of outside help.

MR A. E. B. PERRIGO agreed that there were dangers in the choice of consultants, since consultancy was wide open to charlatans. When selecting a consultant for the first time, it was best to ask the advice of business acquaintances, particularly from suppliers and customers held in respect, as to whom they would recommend. The advice of the British Institute of Management could also be sought.

When, say, two had been chosen from the names recommended, a representative from each should be interviewed, and the final choice made with the proviso that if the man sent to do the job did not gain the employer's confidence, the assignment would terminate.

Once confidence had been developed with one consultant, this acquaintance could be used as a basis for finding further outside help, always remembering not to expect a day or more of free service in deciding who to bring in for a few days' help.

MR H. J. CLARKE requested Mr Perrigo's views on the merits or otherwise of a training officer shared between a group of companies. Also, would interchange of works visits between companies to improve training be a reasonable proposition?

MR PERRIGO replied that if the company was too small to carry a full-time training officer, as many were, then a group scheme had merit. However, to make full use of such a scheme, a full-time member of the company should be made responsible for training within the firm. In a very small firm, this was often the general manager. This person should become familiar with the fundamentals of training, perhaps by a brief appreciation course, and with the training needs within the company.

Exchange of visits between companies was beneficial on all counts, including that of training. It was also of value to contact the local training officer of the Industry Training Board.

MR L. H. SILVER asked what the role of the consultant was, and when they were called in. Was not the use of a consultant a sign of defeat of the existing management?

MR PERRIGO said that the role of the consultant was to provide a fresh look at the company, from his experience to advise as to the strength, and weaknesses it had, and, as a skilled purveyor of change, to recommend how the strengths could be exploited and the weaknesses removed, and with what priority. He should also make available, if required, the skilled temporary help necessary to implement the changes agreed upon.

In some cases, of course, he might only be needed to examine a limited area of the company, or to confirm or disprove a contemplated course of action.

It was not a sign of defeat of existing management to call in consultants. It was a sign that they recognised that in every company there was a time when temporary outside skilled help was highly necessary, or even essential.

MR F. J. MORAN requested comments on the effect of incentive schemes on quality. Also, how would the speaker dissuade a company's sales force from acceptance of relatively unprofitable products.

MR PERRIGO replied that incentive schemes should be planned to meet the needs of the situation. Where quality was important, the minimum standards should be specified in the job description and be allowed for in the payment scheme. This might mean no payment for sub-standard units, or the bringing of the units up to standard with no payment for the time involved.

In the case of the sales force, the incentive should be based on the element of gross margin (or profitability) in the sale. For example, if two products each sold at £100 provided gross margins (after direct costs have been paid) of £40 and £10 respectively, it was better to pay a percentage commission on the gross margin of each, say 10 per cent.

e.g. 10 per cent of £40 + 10 per cent of £10 = £5

then a percentage of the total sales value of the products, say $2\frac{1}{2}$ per cent

e.g. $2\frac{1}{2}$ per cent of £100 + $2\frac{1}{2}$ per cent of £100 = £5

This would give the salesman the incentive to go for the more profitable orders in preference to the less profitable.

Preferential deposition of pigment during electrodeposition*

By F. D. Robinson and B. J. Tear

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Summary

During the electrodeposition of films from pigmented water soluble resin systems, the pigment concentration of the film is usually found to be higher than the pigment concentration in the electrodeposition bath. Both primer and gloss paint coatings give preferential pigment deposition.

In the case of white gloss paints, the relationship between the PVC of the bath and film is discussed with respect to the isoelectric point of the titanium dioxide pigment. Film characteristics are shown to be a function of the rate of pigment deposition arising from differences in the type of surface coating on the pigment.

For electrodeposition primers, the effect of the addition of a synthetic swelling clay to the electrodeposition bath has been studied. Evidence of improved pigment suspension, the maintenance of equal pigment volume concentrations between the bath and the film, and improved corrosion resistance is presented.

Key words

Types and classes of coating

gloss finish
primer

Extender pigments

clay

Binders—resins etc

water soluble resin

Process and methods primarily

associated with application of coatings
electrocoating

Déposition préférentielle de pigment pendant l'électrodéposition

Résumé

Pendant l'électrodéposition de feuillets à partir des systèmes pigmentés de résines solubles dans l'eau, la concentration pigmentaire du feuillet se trouve en général plus élevée que celle dans la cuve. Les primaires et les peintures-brillantes démontrent à la fois une déposition préférentielle de pigment.

Dans le cas des peintures-brillantes blanches, le rapport entre les concentrations pigmentaire en volume de la cuve et du feuillet est-il discuté à l'égard du point isoélectrique du pigment de l'oxyde de titane. On démontre que les caractéristiques de feuillet se dépendent du taux de déposition pigmentaire en provenance de différents types d'enrobement du pigment.

On a étudié, dans le cas des primaires pour électrodéposition, l'effet de l'addition d'argile foissannante synthétique à la cuve. On présente quelque évidence d'une amélioration de la suspension pigmentaire, de la conservation d'une pareille concentration pigmentaire en volume dans la cuve et à la fois dans le feuillet, et de l'amélioration de la résistance à corrosion.

Bevorzugter Pigmentniederschlag bei der Elektrotauchlackierung

Zusammenfassung

Es wird im allgemeinen gefunden, dass die Konzentration von Pigment in einem aus pigmentierten, wasserlöslichen Systemen beim Elektrotauchlackieren niedergeschlagenen Film höher ist, als die im Elektrophoresebad. Sowohl Primer, als auch Glanzlack weisen Niederschläge mit höherem Pigmentgehalt auf.

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Das Verhältnis zwischen dem PVK in der Badflüssigkeit und im Film wird unter Inbetrachtung des isoelektrischen Punktes des Titanweisses anhand weisser Glanzemaillen besprochen. Aufgezeigt wird, dass die Filmcharakteristika eine Funktion der sich aus den Unterschieden in der Art des Bindemittels ergebenden Geschwindigkeiten sind, mit der das Pigment niedergeschlagen wird.

Es wurde untersucht, wie sich die Zugabe eines synthetischen, quellenden Tons in das Elektrottauchbad bei Anwendung eines für Elektrophoreseauftrag bestimmten Primers auswirkt. Dass sich der Schwebezustand des Pigmentanteils verbesserte, die gleichen Pigment Volumen Konzentrationen zwischen Bad und Film aufrechterhalten werden konnten, und sich der Korrosionswiderstand verbesserte, wird bewiesen.

Предпочтительное отложение пигмента в электролитическом осаждении

Резюме

В электролитическом осаждении пленок из пигментированных водорастворимых смольных систем, пигментная концентрация пленки обычно оказывается выше чем пигментная концентрация в электролитической ванне. Оба покрытия, как грунтовки так и глянцевой краски, дают предпочтительное осаждение пигмента.

В случае белых глянцевых красок, рассматривается зависимость между пигментной объемной концентрацией ванны и пленки по отношению к изоэлектрической точке пигмента двуокиси титана. Показано что характеристики пленок являются функцией скорости пигментного осаждения, возникающего в результате различий в типе поверхностного покрытия на пигменте.

В случае электролитических грунтовок, изучается влияние добавки синтетической разбухающей глины в электролитическую ванну. Дается основание предполагать наличие более усовершенствованной пигментной суспензии, сохранения одинаковых пигментных объемных концентраций между ванной и пленкой и более высокого сопротивления против коррозии.

Introduction

One problem in the electrodeposition of paints from pigmented water soluble resins is that the deposition of the pigment and binder takes place at different rates. That is, the pigment volume concentration of the film is different from that of the bath from which it is deposited. O'Neill¹, in a recent survey of water soluble resin systems, commented that, "One essential problem in electropainting is to deposit a film from a paint consisting of a mixture of pigment and resin components in such a way that the composition of the film is the same as that of the bath." Selier et al² when determining film compositions by a current yield method found a zinc free surface coated rutile titanium dioxide pigment contained 23 per cent more pigment in the film than expected from the bath composition. At high PVC levels, Tasker and Taylor³ concluded that, whilst the resin deposited at a fixed rate, the rate of paint deposition increased with increasing PVC. The increase was proportional to the additional pigment in the formulation. However, they further stated that they found that the film PVC equalled the bath PVC for anticorrosive pigments, such as strontium chromate and lead silico-chromate, for carbon black and also for extenders when used in iron oxide primers.

Differences in the rate of deposition of pigments and resins during electrodeposition are not surprising, since the technique of electrophoresis has been a valuable tool in medicine and in analysis to separate biological and chemical fractions into pure components. For example, in electrophoretic work on proteins, the direction and rate of migration is dependent upon the charge of

the particle. In sufficiently basic solutions, proteins migrate to the anode, and to the cathode in sufficiently acidic solutions. At the isoelectric point, the point of zero surface charge, the electrophoretic effect is nil.

Particle mobility

The mobility of colloidal particles in suspension in a medium depends upon the pH of the solution. The mobilities of colloidal particles are generally less than the mobilities measured for simple ions and have electrophoretic velocities, for a potential gradient of 1 volt cm^{-1} , of about 20×10^{-5} cm sec^{-1} .

The Helmholtz-Smoluchowski equation⁴ relates the electrophoretic mobilities of the suspended particles to the applied potential and particle electrokinetics.

$$E.M. = \frac{\zeta \epsilon}{4\pi \eta}$$

Where $E.M.$ = electrophoretic mobility of the suspended particles in cm sec^{-1} per esu volt cm^{-1} .

ϵ = dielectric constant of the medium.

ζ = zeta potential.

η = viscosity of the medium.

For most applications, the Smoluchowski 4π multiplication factor can be employed with sufficient accuracy when the electrical double layer is small with respect to the particle, i.e. in suspensions with moderate to high concentrations of electrolyte. At low electrolyte levels, or in the absence of electrolyte, the factor approaches Henry's 6π value.

From the H/S equation, the electrophoretic mobilities of pigment particles through the bath, under the influence of an applied potential between the electrodes, are affected by several factors.

The applied voltage. Changes in voltage will alter the potential gradient between electrodes set at a fixed distance apart in the bath.

Bath temperature. This will produce changes in the viscosity of the bath together with small changes in the dielectric constant.

pH of the bath. The zeta potential, dielectric constant and possibly viscosity will alter as the bath pH increases or decreases.

In order to study these variables, and to attempt to optimise the bath conditions so that there will be a minimum difference in mobility between the resin and pigment particles, titanium dioxide pigmented water soluble acrylic electro-deposition paints were prepared and evaluated for the following conditions:

- effect of applied voltage,
- effect of pH changes,
- effect of temperature,
- effect of PVC of bath,
- effect of resin solids at constant bath PVC,
- effect of substrate.

Experimental

Paint formulation

The electrodeposition paints were prepared by ball milling for 16 hours. The base paints were diluted with resin solution and distilled water to give the required PVC and bath solid content.

Mill charge

Titanium dioxide pigment	300g.
Water soluble acrylic resin (70 per cent non volatile)	43g.
Distilled water	107g.

Rutile titanium dioxide pigments

Coating

Pigment A.	Al_2O_3 , SiO_2 , ZnO	no organic treatment.
Pigment B.	Al_2O_3 , SiO_2 , ZnO	amine treatment.
Pigment C.	Al_2O_3 , SiO_2 , ZnO	polyol treatment.
Pigment D.	Al_2O_3 , SiO_2 , ZnO	amine treatment.
Pigment E.	Al_2O_3 , SiO_2 , ZnO	polyol treatment.

Method

The paint, at 10 per cent resin solids adjusted to the required PVC, was placed in a half gallon capacity bath containing a fixed cathode. The steel strip cathode was surrounded by a membrane to contain the foam developed during deposition. The anode panel was set at a fixed, known, distance from the cathode. Constant voltage conditions were used throughout the experiments, covering the range 50—200 volts. The changes in current that occurred during the deposition period were recorded on an XY plotter. The bath was stirred when not in use. During deposition the agitator was stopped. Excessive agitation reduces the effectiveness of deposition at a given amperage.³

Constant voltage was maintained for one or two minutes. Slight adjustments could be made manually, if the voltage drifted due to increasing film resistance. The anode was coated to give an area of 100cm². After the deposition period, the panels were removed from the bath, washed with a jet of distilled water to remove the surface dip coat, shaken to remove surface water, and finally stoved in an oven to the recommended schedule.

Analysis of pigment/resin ratio in the deposited film

The washed, deposited film was carefully removed from the panel by washing with acetone. The collected pigment/resin suspension was evaporated to dryness at 120°C in a tared silica crucible and weighed. This weight is that of the pigment and resin solid. Ashing the dried residue in a muffle furnace at 600°C and reweighing, gave the pigment weight. From these weights the pigment/binder ratio and the pigment volume concentrations of the deposited film were calculated. Each test was made in duplicate and averaged. The pigment/binder ratio and PVC of the bath were determined at the same time by the same method, in duplicate.

It was found that the gravimetric analysis of the bath and the film were prerequisites for accurate measurements of the pigment/binder ratio. The gravimetric P/B results were usually lower than those calculated directly from the paint formulation.

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Reproducibility of analysis and effect of longer deposition times

A paint of P/B ratio 0.54/1 (from bath analysis determination), and resin solid content of 10 per cent by weight was used for depositing a series of panels at 90 volts for 60 seconds and another at 120 seconds.

The P/B ratios of the washed deposited films are shown in Table 1.

Table 1
P/B ratios of washed deposited films

Panel	Films deposited for 60 sec P/B ratio	Films deposited for 120 sec P/B ratio
1	0.598/1	0.645/1
2	0.600/1	0.638/1
3	0.626/1	0.638/1
4	0.621/1	0.630/1
5	0.617/1	0.634/1
6	0.626/1	0.632/1
7	0.629/1	0.640/1
8	0.617/1	0.626/1
9	0.623/1	0.634/1
10	0.626/1	0.636/1
Average	0.620/1	0.636/1

The reproducibility is good. The longer deposition time gives a slightly higher P/B ratio in the film. The increase in P/B ratio is 0.08/1 at 60 seconds, and 0.096/1 at 120 seconds deposition times. This represents an increase in pigment concentration of the film compared to that of the bath of 15 per cent and 18 per cent respectively.

Effect of applied voltage

Fig. 1 shows the ratio of PVC film/PVC bath for rutile pigment A for two bath PVCs. (10.4 per cent and 13.2 per cent), at applied voltages of 50 to 180 volts.

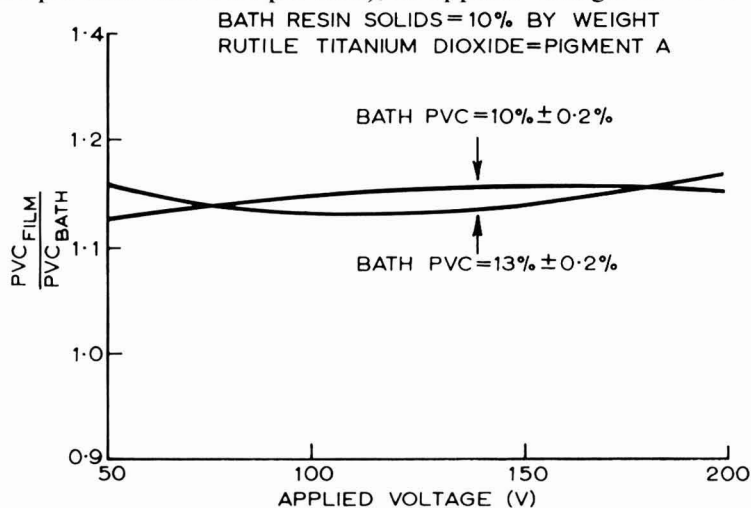
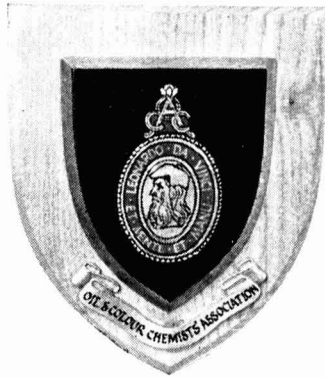
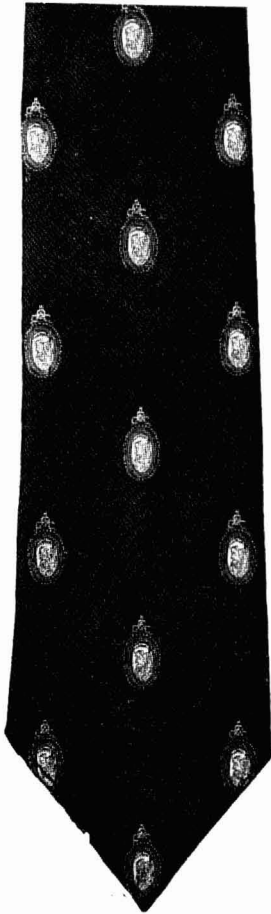


Fig. 1. Effect of bath PVC on the PVC_{film}/PVC_{bath} ratio



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Within experimental error, the PVC ratios are constant over the voltage range, and at the two bath PVCs evaluated. The higher PVC in the film indicates preferential deposition of the pigment with respect to the resin component.

Further rutile titanium dioxide pigmentations are shown in Fig. 2. These were deposited from a bath PVC of 10 per cent \pm 0.2 per cent and all give preferential titanium dioxide pigment deposition. In no case has the PVC of the film equalled the PVC of the bath. The effect of applied voltage with pigments A, B, C and D has been negligible in changing the PVC ratio. Pigment E comes close to non-preferential deposition at low voltages, but at normal working voltages, 100-200 volts, it is equivalent to the other rutile grades.

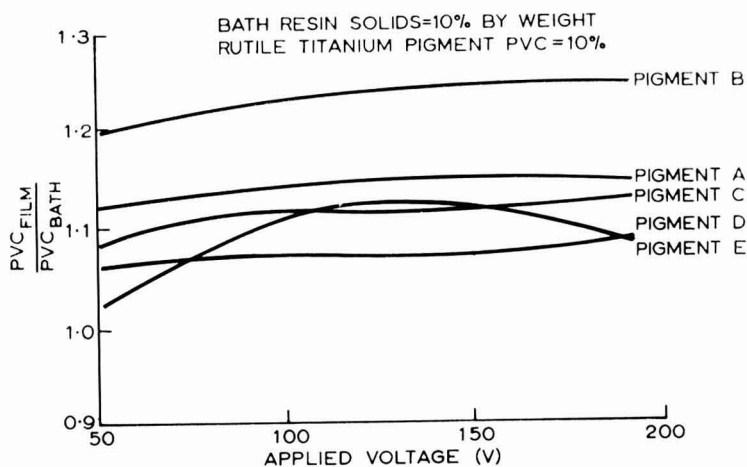


Fig. 2. Effect of bath PVC on the $PVC_{\text{film}}/PVC_{\text{bath}}$ ratio

Effect of bath pH on PVC film/bath ratio

Pigment B was chosen to study the effect of changes in bath pH on the rate of deposition of the pigment phase. This pigment sample gave the greatest difference between the bath and the film. Conditions for the deposition were 170 volts for two minutes.

Limitation of the available pH range was governed by the solubility of the resin, the buffering action, (pH 9.8-10.0) when ammonia was used to increase the pH level, and the poor films developed at the higher levels. These factors restrict the pH range from 9.4 to 10.0. Attempts to lower the pH by careful addition of dilute acetic acid precipitated the resin from solution.

Fig. 3 indicates that, as the pH increases from 9.4 to 10.0, the ratio of pigment/binder in the film increases. The mobilities of the titanium dioxide particles have been enhanced. The addition of OH^- ions to the completely ionised resin solution cannot cause further resin ionisation. The surplus OH^- ions are thus available for adsorption on to the TiO_2 surface. This increase in the negative charge at the pigment surface increases the mobility of the pigment particles which are then even more preferentially deposited at the anode with respect to the ionised resin phase.

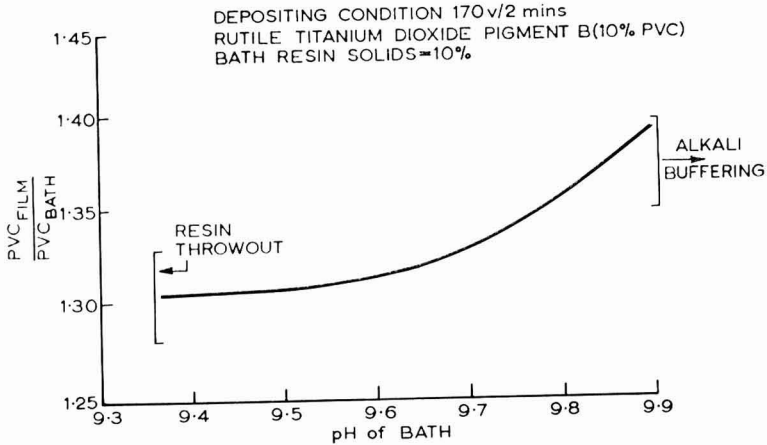


Fig. 3. Effect of bath pH on PVC_{film}/PVC_{bath} ratio

Effect of temperature

The temperature was varied from 10°C up to 40°C using a temperature controlled bath. The PVC of the bath was 10 per cent using pigment B. Resin solids were 10 per cent and deposition conditions 170 volts for two minutes. Fig. 4 shows

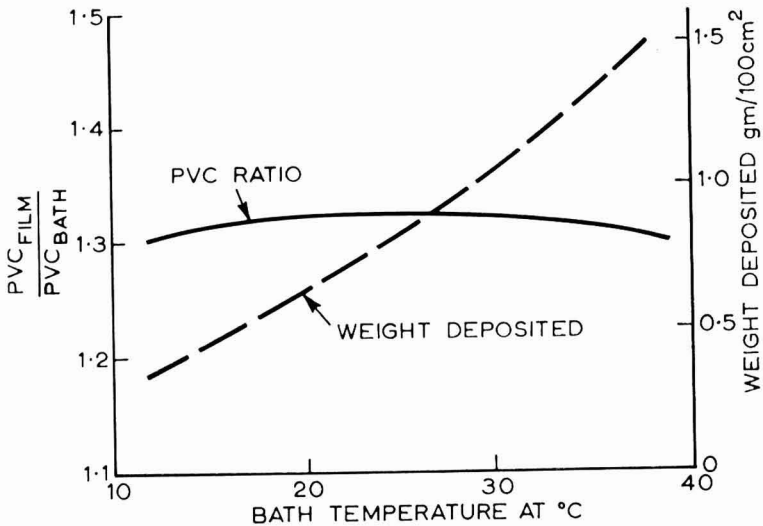


Fig. 4. Effect of bath temperature on PVC_{film}/PVC_{bath} ratio and weight of coat deposited

the effect of the bath temperature on the PVC of the film and on the weight deposited in g/100cm² of panel surface. The temperature effect on the film PVC is negligible, ranging from 14.1 per cent to 14.4 per cent compared to the bath PVC at 10 per cent. Film weight increases steadily as the temperature increases, passing from acceptable films at ambient temperature to pinholed, spongy films at temperatures above 30°C. Gloss measurements on the stoved films show a maximum in the range 19-22°C (see Table 2).

Table 2
Effect of bath temperature on deposition

Bath temperature °C	% 45° gloss	Wt. deposited g/100cm ²	Thickness mil	Appearance
12	46	0.353	1.25	good
23	61	0.640	1.87	good
26	49	0.734	2.6	fair
33	10	1.248	4.0	poor
39	6	1.523	—	poor

The increase in film weight with increasing temperature is related to the lowering of bath resistance. Secondary effects, such as decrease in viscosity and changes in dielectric constant, also contribute to the film weight increase. The relative magnitudes of the mobilities vary with temperature in a complicated manner, and will account for some part of the recorded changes.

Effect of PVC bath on the PVC film

A range of paints was prepared to give bath PVCs ranging from 6 per cent to 20 per cent. The PVC was determined by gravimetric analysis. Pigments A, B, and E were evaluated. Depositing conditions were 170 volts for two minutes. Fig. 5 gives a linear relationship for the PVC of the film compared to the bath PVC. The ratio remains constant over the range studied. The relationship holds for the three pigments, and the relative preferential depositions agree with those in Fig. 2.

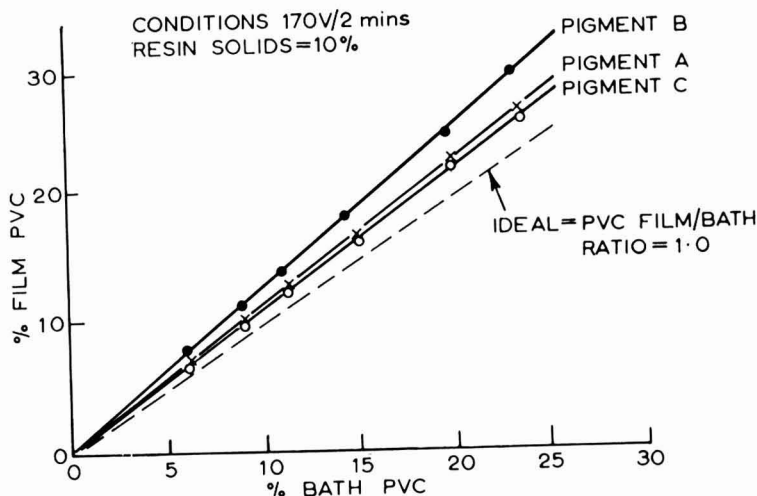


Fig. 5. Effect of PVC_{bath} on deposited film PVC

The 1:1 straight line gradient is the ideal situation where pigment and resin are deposited in the same ratio as that in which they are present in the bath.

In all the pigmented systems that have been investigated in the laboratory in the absence of additives, whether these are one coat gloss finishes, or red oxide or grey primer paints, the pigment/binder ratio in the film is greater than that of the bath.

Knowing this ratio, a calibration curve can be constructed from which the desired film composition can be obtained by adjusting the bath PVC. The make-up for the bath would require a slightly higher pigment loading to counter the pigment deficiency developed in the bath with time of deposition.

Repeat runs using different batches of the same resin gave identical results. Changing from the water soluble acrylic to a water soluble alkyd resin over the same PVC range again gave a linear ratio of bath/film PVC. In this case the pigment increased in the film to a greater extent than with the acrylic system (Fig. 6). It is therefore necessary to evaluate the whole system, rather than calibrate for the individual components of resin and pigment. The information gained from these performances can be a guide to the mobility of the pigment in a particular film, to the potential gloss in one coat gloss finishes and to the make-up requirements for the exhausted bath.

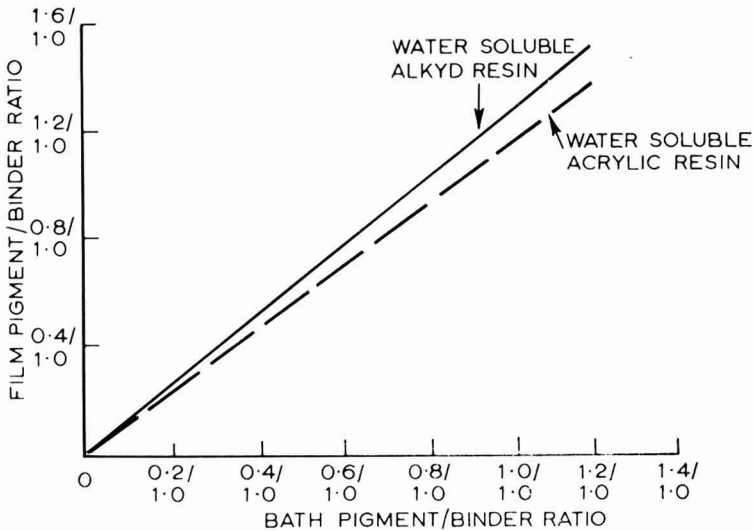


Fig. 6. Relationship between P/B ratio of bath and film for a water soluble acrylic and alkyd resin

Calibration curves for pigments A, B and E gave the following factors for the water soluble acrylic paint.

Pigment A:	$PVC_{film} = 1.16 PVC_{bath}$
Pigment B:	$PVC_{film} = 1.37 PVC_{bath}$
Pigment E:	$PVC_{film} = 1.16 PVC_{bath}$

Effect of bath solids at constant pigment volume concentration

Paints were prepared at a PVC of 8.8 per cent with pigment A and 10.75 per cent with pigment B in the water soluble gloss resin. The base paints were diluted with demineralised water to give the maximum solids concentration commensurate with a workable bath viscosity. The maximum solids content

to meet this requirement was 20 per cent resin solids. Panels were deposited at this bath solids and at each stage as the bath was diluted in steps of approximately $2\frac{1}{2}$ per cent solid decrements to 5 per cent resin solids. The results of the gravimetric values for the bath and film P/B ratio are given in Fig. 7. There is a linear relationship between the film resin solids in the bath and the P/B ratio in the film.

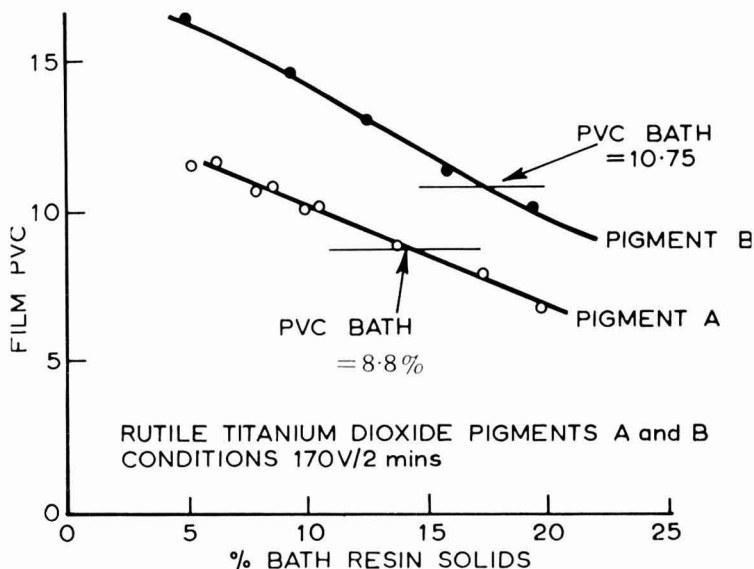


Fig. 7. Effect of bath resin solids at constant bath PVC

At the highest bath solids, the pigment is not deposited preferentially with respect to the resin and the films show equal PVC to that of the bath. As the solids are reduced, the pigment mobility with respect to the resin increases, leading to the greatest divergence between the two PVC levels at the lowest concentration. With this water soluble acrylic resin system, the equilibrium point occurs at $13\frac{1}{2}$ per cent resin solids with pigment A, and $18\frac{1}{2}$ per cent resin solids with pigment B. Both of these concentrations are higher than that at which films of acceptable appearance are deposited. At the high bath solids the films are coarse, uneven and would be rejected as very poor decorative coatings. The limiting concentration at which this resin system will produce acceptable finishes was between 10 per cent-12 per cent. It is likely that other resins could be handled at higher concentrations. Where information has led to the conclusion that pigment and resin deposit at the same rate, it is probable that the bath concentration could have been a controlling factor in obtaining this result.

Effect of substrate

All the information reported so far was obtained using tinplate panels. Further work shows that the same preferential pigment deposition applies to deposits on aluminium and bonderised steel panels. Fig. 8 shows the agreement for PVC film compared to PVC bath over a range of bath PVC values for the three substrates. The panel has no effect on the preferential deposition of pigment, although, as Table 3 indicates, the film properties are very dependent

upon the metal substrate. The conditions of deposition were 170 volts for two minutes.

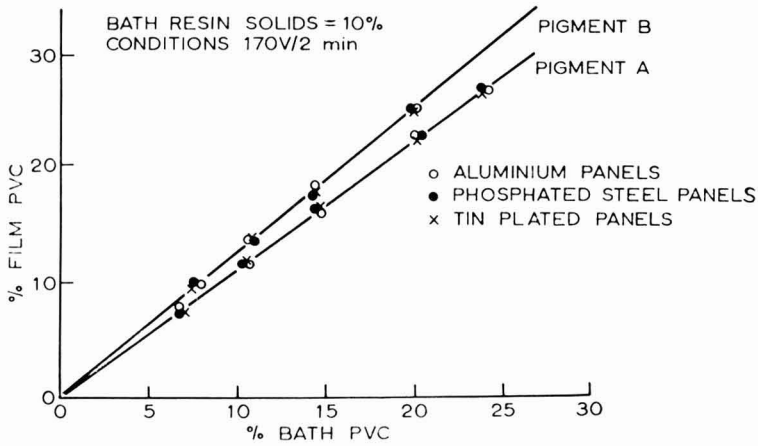


Fig. 8. Effect of substrate on PVC_{film}/PVC_{bath} ratio over range of bath PVC values

Table 3

Variations in properties of films deposited on different substrates

Pigment	Substrate	PVC Bath	PVC film	PVC f	Weight deposited gm.	% 45° Gloss	Appearance
				PVC b			
A.	Aluminium	7.1	8.2	1.16	0.6398	71	Trace Yellow
	Tin	7.1	8.2	1.16	0.5179	84	
	Steel	7.1	8.2	1.16	0.4291	44	
	Aluminium	22.6	26.2	1.16	0.8723	Matt	Yellow
	Tin	22.6	26.6	1.16	0.9696	Matt	
	Steel	22.6	26.2	1.16	0.7469	Matt	
B.	Aluminium	13.7	18.7	1.37	0.5918	35	Yellow
	Tin	13.7	18.7	1.37	0.4521	38	
	Steel	13.7	18.7	1.37	0.4015	12	
	Aluminium	20.6	28.0	1.36	0.7146	Matt	Yellow
	Tin	20.6	28.0	1.36	0.8620	Matt	
	Steel	20.6	28.0	1.36	0.5427	Matt	
E.	Aluminium	14.4	16.7	1.16	0.6642	55	Yellow
	Tin	14.4	16.7	1.16	0.6011	62	
	Steel	14.4	16.7	1.16	0.5612	37	
	Aluminium	20.7	24.0	1.16	0.6661	Matt	Yellow
	Tin	20.7	24.0	1.16	0.7466	Matt	
	Steel	20.7	24.0	1.16	0.6118	Matt	

Pigments A and E have given films of good gloss and general appearance on both aluminium and tin substrates. The depositions on bonderised steel have discoloured, and are of lower gloss. The gloss differences between the pigments are more a function of the titanium pigment concentration in the films than of any intrinsic difference between the pigments themselves.

White one coat glossy electrodeposition paints

It was shown earlier in this paper that titanium dioxide pigments in a water soluble acrylic electrodeposition one coat gloss system deposit preferentially with respect to the resin. The rate at which the pigment deposits leads to film PVCs higher than that of the bath. If the requirement is for a full gloss film, then comparative tests between different titanium dioxide pigments could give gloss rankings which are more a function of the PVC of the deposited film than any real pigment quality affecting film gloss.

Premium gloss grade pigments from the sulphate process are used very successfully in conventional air-drying and stoving decorative and industrial finishes. These same pigments formulated into electrodeposition paints at equal weight replacement will not necessarily give gloss rankings in the same order. But, if the bath is adjusted to compensate for the preferential pigment deposition so that the final coatings are compared at the same film PVC level, then the rankings fall into line. This point should be borne in mind when any such series is evaluated.

Whilst carrying out the gravimetric analysis of the films, it was observed that the vapours from the acetone used to wash off the film produced a re-flow in the deposited coating. This suggested that exposing the deposited films to solvent vapour after washing might increase the gloss of the stoved finish.

Films were deposited on aluminium, tinplate and bonderised steel panels from a bath at 10 per cent resin concentration, containing 9.4 per cent PVC of pigment A. The film PVC was 10.9 per cent, and the deposition condition 170 volts for two minutes. The films were first washed, surface dried to remove excess water, and then exposed to acetone or trichlorethylene vapour for approximately 30 seconds. The development of film surface gloss was readily discernible before stoving. The films were cured at 180°C for 30 minutes. Gloss and colour measurements were made on the solvent vapour treated and untreated films.

In all cases the gloss was improved by the vapour treatment. The figures were increased by about 10 per cent on both aluminium and tinplate, from 75-80 per cent up to 85-90 per cent. On bonderised steel the increase was 40 per cent, from 35 per cent to 75 per cent. The low initial value for the bonderised panels is related to the film profile following the fine surface imperfections of phosphate coating. In the case of the trichlorethylene solvent treatment, the final films were slightly yellow. This is the result of film contamination with the chlorinated hydrocarbon.

Electrodeposition primer paints

At the present time the greatest volume of coatings applied by industry using the electropainting technique is in the primer field. The requirements for these primers are good appearance, uniform film thickness, good throwing power, complete bath stability and good weathering properties. In particular, the corrosion resistance of these coatings to high humidity and salt spray conditions, together with bath stability, is the paramount property required by the automobile industry. The water soluble resin component plays the major role in determining whether or not these requirements are attainable with a particular formulation. The extensive range of water soluble resins that are available

on the market for these applications is a true witness of the considerable development work which the raw materials companies have undertaken to meet the exacting requirements of specifications laid down by the car industry. In the same way, the types of pigments used in this application have an influence on the film characteristics, the bath stability, and the corrosion resistance of the coatings. To this end, red oxide pigments of low water soluble content have been developed, carbon black pigments of controlled particle size are now available, and anti-corrosive pigments are constantly under review.

Primer paint formulation

The initial experiments with primer paints in the electrodeposition bath indicated that pigment settlement was taking place on storage. The rate of settlement at the low viscosity of the bath solids concentration was significant with respect to deposition periods without agitation. During daily periods of shut down, and over weekends, the bath contents were stirred to maintain a uniform dispersion. During the deposition period, however, no agitation was applied to the bath. The addition of a synthetic swelling clay, Laponite*, was considered to aid pigment suspension in the bath. The synthetic clay was prepared as a 10 per cent concentration sol in demineralised water. The required quantity of the sol was added directly to the diluted paint in the bath.

Formulation

Water soluble alkyd resin 75% N.V.	60.0g
Red oxide Ferroxit OI	41.4g
Blanc fixe	22.8g
Norwegian Talc ATI	22.8g

This mill base was passed through a triple-roll mill three times. Additional resin and distilled water were added to give the required PVC and resin solids for the electrodeposition primer paint bath. All the primer paints were prepared in this manner. Where the resin manufacturers' instructions recommended a different procedure, these recommendations were strictly followed using the technique, solubilising agent and bath constants stated.

Concentration of synthetic swelling clay (Laponite S)⁵

The anti-settling properties of Laponite synthetic swelling clay have been established in previous laboratory work on aqueous pigment dispersion in a range of surface coating media. Concentration within the range 0.1 per cent to 2 per cent had been found effective depending upon the particular system under review. For the electrodeposition primer, 0.1 per cent to 1.0 per cent of Laponite S solid was added to the bath, as a 10 per cent sol, calculated on the total bath weight. (With bath resin solids at 10 per cent and a P/B ratio of 0.8:1 this gives 0.5 per cent to 5 per cent synthetic clay on the total paint solids).

Three sets of samples were prepared, deposition conditions being at constant voltages of 160, 180 and 200 volts respectively for 2 minutes on to Pyrene Gold Seal bonderised panels to give a coated area of 240cm².

Throwing power was measured by the double plate method. For this method, one side of each of two panels is coated with Bedacryl 122X resin solution.

*Laponite is the registered trade mark of Laporte Industries Limited.

The dried panels are weighed before placing them in the bath, back to back, so that the uncoated faces are exposed parallel to the cathode. After deposition, washing, stoving, and reweighing, the relative coating weights of the two panels indicate the throwing power of the paint.

The bath temperature was maintained at 22°C-23°C, the pH was adjusted to 8.4-8.5 with dilute ammonia solution, and the panels were stoved at 180°C for 30 minutes. Pigment settlement was measured by storing the dispersion in 100ml cylinders for 24 hours. The nature of the sediment, the sediment volume, and the ease with which it could be re-incorporated were determined (Table 4).

The texture of the sediment has been improved by the clay addition. Re-constitution of the sediment is easier with increasing clay proportions. At higher levels, in excess of 0.4 per cent synthetic clay, there was evidence of slight pigment flocculation in the bath. The flocculation did not affect the

Table 4
Effect of Laponite on bath sediment

% Laponite S (calc. on total bath weight)	Nature of sediment	% volume of sediment	Bath conductance (micromhos)	Film appearance	No. of inversions of cylinder to resuspend solid
None	Hard	8.1	1400	Matt	> 1000
0.1	Soft	14.0	1450	Matt	100-150
0.2	"	20.0	1500	Matt	120-140
0.3	"	24.5	1550	Semi gloss	110-130
0.4	"	26.0	1600	Gloss	100-120
0.5	"	30.0	1650	Gloss	100-120
0.6	"	33.5	1750	Gloss	80-100
0.7	"	40.5	1800	Gloss	60-80
0.8	"	49.0	1850	Gloss	60-80
1.0	"	64.0	1900	Gloss	10-30

appearance of the stoved primer films, but the films at higher clay concentrations, greater than 0.6 per cent, were softer after stoving.

The change from matt films to glossy films as the Laponite concentration increased was a phenomenon of great interest. Electronmicrographs of cross-sections of these films showed that in the glossy films the pigment concentration per unit area was lower than that in the matt film. Also, the pigment particles were better dispersed and not flocculated, as seen in the bath. The increased apparent resin content of the electrodeposited films of higher Laponite content pointed to either an increase in the mobility of the colloidal resin particles through the bath, or a reduction in the pigment deposited at the anode.

The film thickness of the coatings increases with Laponite concentration. The throwing power decreases slightly, as expected, and is in line with the increasing conductance of the bath. Gravimetric analysis of the films confirmed that the increased weight of the deposited films resulted from increased rate of deposition of the resin component. In the following table the P/B ratios of the films for synthetic clay 0-0.4 per cent concentrations are given.

Table 5
Effect of Laponite on film thickness

% Laponite	Deposition voltage	Film thickness (thou)	
		Front panel	Back panel
0	160	0.85	0.76
	180	0.90	0.85
	200	0.90	0.85
0.2	160	1.0	0.9
	180	1.1	1.0
	200	1.3	1.2
0.3	160	1.7	1.6
	180	2.2	2.0
	200	2.2	2.0
0.5	160	1.0	1.0
	180	1.3	1.3
	200	1.6	1.5

Table 6
Effect of Laponite on P/B ratio

% Laponite S (on total bath weight)	P/B ratio of deposited film
0	0.845/1
0.004	0.844/1
0.04	0.853/1
0.16	0.830/1
0.32	0.62/1
0.40	0.525/1

The gravimetric P/B ratio of the bath was 0.73/1. The results show that this primer system is behaving in exactly the same manner as the one coat gloss titanium dioxide pigmented water soluble acrylic electrodeposition paints. The red oxide pigment/extenders have deposited preferentially compared to the resin deposition. As the synthetic clay concentration is increased, however, the P/B ratio of the film reduces to a point where it is equal to the P/B ratio of the bath. The inclusion of the synthetic swelling clay (Fig. 9) at 0.23 per cent gives equivalence at this concentration between the bath and the film. The increase in film thickness at higher clay concentrations has been related to the increase in conductance of the bath.

A repeat experimental series of this primer system deposited on to tinplate panels gave similar results. The manner in which the coating developed on the panel was followed over shorter time intervals and indicated that the centre of the panel opposite the anode received the first deposition. The coating moved out from the panel centre to the edges of the panel, and then from the edges back to the centre again. It is suggested that it is this second, thinner, coating which gives an increase in film weight and film thickness in the presence of Laponite. In the absence of Laponite, the second coating is not deposited.

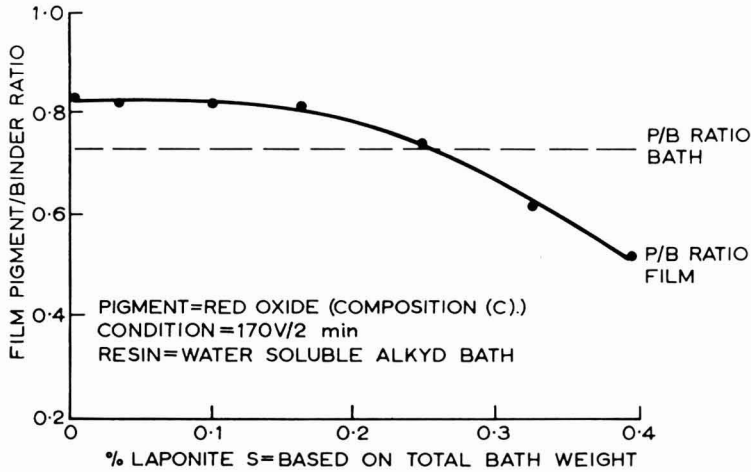


Fig. 9. Effect of synthetic swelling clay on preferential pigment deposition in a red oxide primer

Effect of Laponite on other primers for electropainting

A range of primer paints was prepared. The paints were based on two different water soluble alkyd resins and two water soluble epoxy ester resins. The primers were pigmented with red oxide and with titanium dioxide/carbon black pigments, (grey primers).

Water soluble resins

- | | |
|-------------------------|--|
| 1. Alkyd resin 1. | 75% solid content of a thermohardening synthetic resin in a mixture of alcohol solvents. |
| 2. Alkyd resin 2. | 80% solid content of a succinic modified phthalic/linseed half ester. |
| 3. Epoxy ester resin 1. | 75% solid content epoxy ester water soluble resin. |
| 4. Epoxy ester resin 2. | Epoxy ester water soluble resin. |
| Pigments: Red oxide | Eisenoxidrot 160 (Bayer) |
| | Red oxide Ferroxite Ol (Golden Valley) |
| Carbon black | Rajah carbon black |
| Titanium pigment | Pigment A. |
| Extenders | Norwegian Talc AT1. |
| | Barytes |
| | Blanc fixe |
| | Phthalocyanine Blue LBXS. |

In all cases, the resin solids in the bath were kept at 10 per cent by weight. The calculated pigment/binder ratio of the bath was either 0.8/1.0 or 0.4/1.0. The true P/B ratio, by gravimetric analysis, is given in Table 7. Deposition was at 170 volts for 2 minutes. The P/B ratio in the deposited film for increasing Laponite concentration for these systems is given in Fig. 10. The bar across the lines on the graphs indicates the point at which the P/B ratio of the film is equal to the P/B ratio of the bath.

Table 7
 Primer paint compositions—Effect of Laponite on P/B film ratio

Ref	Resin	Pigment	Primer	Effect of Laponite S	Bath P/B ratio
a.	Alkyd 1	Eisenoxidrot 180	Red oxide	P/B ratio of film decreases	0.82/1.0
b.	Alkyd 1	Eisenoxidrot 180 Norwegian Talc Blanc fixe	Extended red oxide	P/B ratio of film decreases	0.78/1.0
c.	Alkyd 1	Ferroxite OI Norwegian Talc Blanc fixe	Extended red oxide	P/B ratio of film decreases	0.73/1.0
d.	Alkyd 1	Eisenoxidrot 180	Red oxide only	P/B ratio of film decreases	0.39/1.0
e.	Alkyd 1	Titanium dioxide Carbon black Phthalo blue Barytes	Extended grey primer	P/B ratio of film decreases	0.34/1.0
f.	Alkyd 2	Titanium dioxide Carbon black Phthalo blue	Extended grey primer	P/B ratio of film increases	0.39/1.0
g.	Epoxy ester 1	Titanium dioxide Carbon black Phthalo blue Norwegian Talc	Extended grey primer	No effect on P/B of film	0.39/1.0
h.	Epoxy ester 2	Titanium dioxide Carbon black Phthalo blue Barytes	Extended grey primer	P/B ratio of film decreases	0.37/1.0

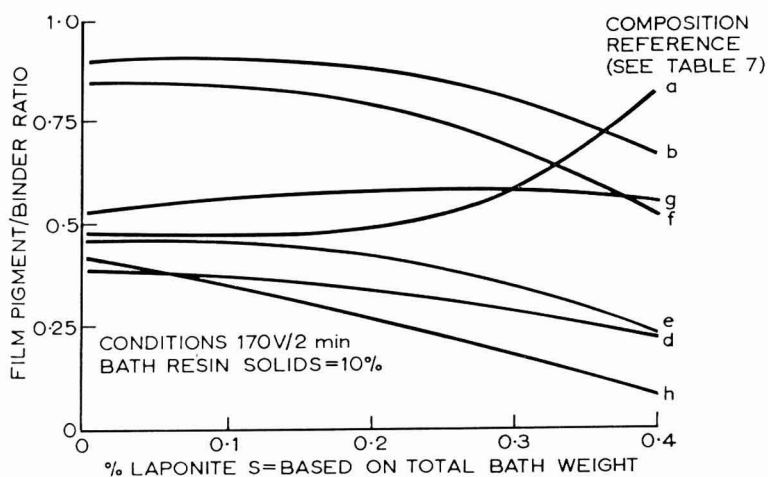


Fig. 10. Effect of Laponite on a range of electrodeposition primer compositions

Reference to Fig. 10 and Table 7 illustrates the effect Laponite can have on the deposited pigment and resin content in the film. In the cases of alkyd resin 1 and epoxy ester resin 2, there is a Laponite concentration where the bath and film P/B ratio are identical. With alkyd resin 1 this relationship holds for the different pigmentations studied. Whilst there are marginal differences in performance between the primers of different pigment and extender content, the alkyd resin is the controlling factor in determining the film composition. Alkyd resin 2 increases in film pigment content, whilst with epoxy ester resin 1 there is no significant change over the clay range studied.

The success in the use of Laponite to reduce the preferential deposition of pigments in certain primer formulations suggests that this synthetic clay might be a possible additive to counteract the preferential pigment mobility in one coat white acrylic electrodeposition paints. Additions over the range 0.1-0.4 per cent Laponite S were not successful in this application.

Effect of prolonged deposition on the P/B ratio of the film when Laponite synthetic swelling clay is present

In this experiment a bulk quantity of red oxide primer was prepared. The primer was divided into two equal portions. To one half, successive quantities of 10 per cent Laponite S sol were added to cover the range 0.01-0.6 per cent calculated on the total bath weight. Electrodeposition conditions were 180 volts for 1 minute. The bath contents and deposited films were analysed, and the results are shown in Fig. 11. The concentration of Laponite at which the P/B

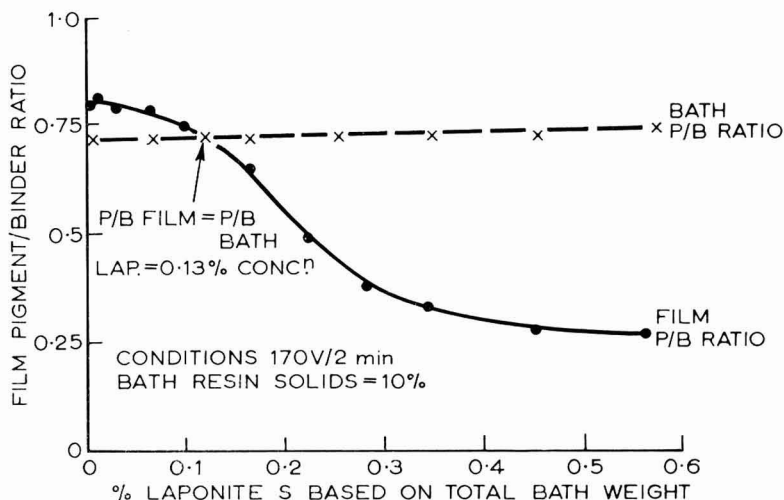


Fig. 11. Effect of Laponite on P/B ratio of film in red oxide primer

ratio of the bath equalled P/B ratio of the film occurs at 0.13 per cent. This quantity was added to the second portion of the bulk paint. Deposition of panels from this bath over a period of time gave constant P/B film and bath values. The relative deposition area covered, when calculated for a 5,000 gallon tank capacity unit, was 124,000ft² (Fig. 12).

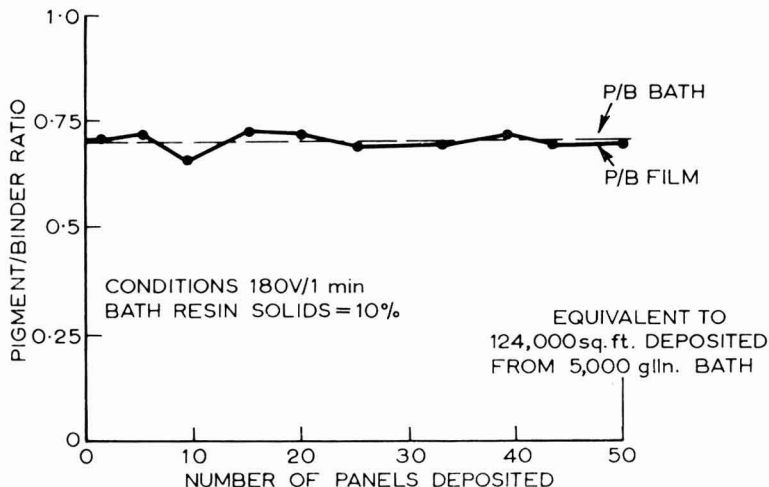


Fig. 12. Absence of preferential pigment deposition in presence of "calculated" synthetic clay level. (Red oxide primer)

The addition of Laponite has successfully prevented preferential pigment deposition. The control on resin and pigment exhausted from the bath will simplify the bath make-up operation to topping up the bath with the original P/B ratio composition. Even after an extended run the synthetic clay is effective in its action. It is not itself being deposited at such a rate that its effectiveness in controlling the rate of resin and pigment deposition is lost. Replenishment of the synthetic clay will be necessary over a period of time, depending upon the throughput from the bath.

The effect of bath conductance on the P/B ratio and weight of the deposited film

In Table 4, it was shown that the conductance of the bath increases linearly with Laponite concentration. If this increase in conductance were the only attribute conferred on the system by the synthetic swelling clay, then it might be possible to increase the conductance by the addition of electrolyte and obtain the same film increase and P/B equality in the bath and the film. To investigate the conductance effect, a grey primer based on the water soluble epoxy resin 2 was prepared and split in two parts. To one portion, 0.4 per cent Laponite S was added to the bath and subsequently increased to 0.8 per cent. To the second portion, increments of a 2 molar solution of sodium chloride solution were added to give a bath conductance range from 1200 to 1850 micromhos, equal to the Laponite half of the experiment. Panels were deposited and analysed between the incremental additions.

These results are illustrated graphically in Fig. 13. It can be concluded that the conductance has no effect on the relative mobilities of the resin and pigment particles. The constancy of the P/B ratio of both the bath and the film in the instances where an electrolyte was added to the system confirms this fact. There is, however, a decrease in the weight of the material deposit on the anode. The electrical double layer associated with the charged particles will be less diffuse as the ionic concentration increases. The mobilities of both the pigment

Table 8
Grey primer—Conductance effects

Additions	Bath conductance (micromhos)	P/B ratio bath	P/B ratio film	Weight deposited g/100cm ²
None	1200	0.32/1.0	0.43	1.130
6 ml 2M NaCl	1500	0.32/1.0	0.43/1.0	0.7520
7 " "	1550	" "	" "	0.708
8 " "	1650	" "	" "	0.727
10,, "	1850	" "	" "	0.816
0.4% Laponite	1500	0.34/1.0	0.25/1.0	1.61
0.8% Laponite	1700	0.36/1.0	0.25/1.0	1.63

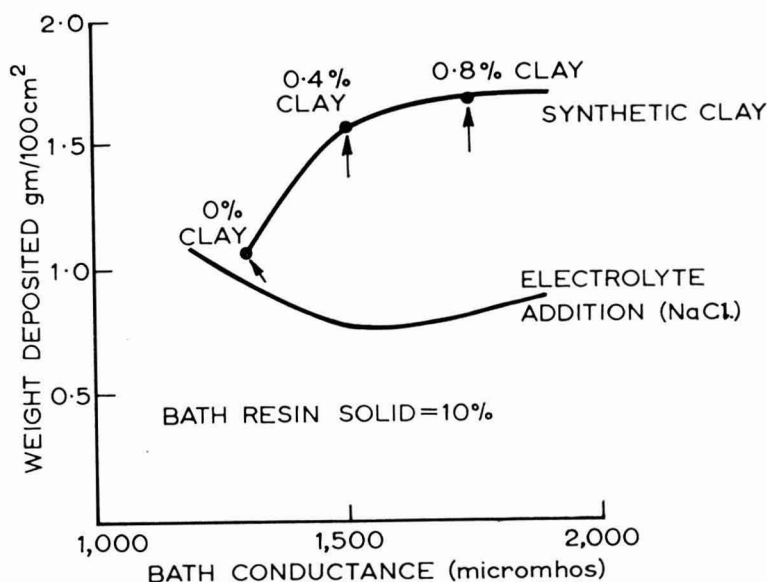


Fig. 13. Effect of conductance on weight deposited. Grey epoxy primer

and the resin particles will be affected, giving rise to the linear decrease in weight of material deposited between 1,200 and 1,500 micromhos. The increase in weight between 1,500 and 1,850 micromhos is not readily explainable.

The conductivity of the double layer at the pigment and resin particle surfaces is not known, but at high ionic concentrations it is probably the same as that of the surrounding liquid. The following equation⁶ takes account of the conductivity of the liquid phase K , and the conductivity of the solid phase, K' , for dispersions of spheres.

$$\text{Electrophoretic velocity (V.E.)} = \frac{3K}{2K + K'} \frac{2\xi\epsilon}{6\pi\eta}$$

The equation reduces to the 4π form if K' , the conductivity of the solid moving particles is zero, and to the 6π form if $K' = K$.

The shape of the particles has little effect experimentally on the mobility and so this equation can be applied to the paint system in its simplest form.

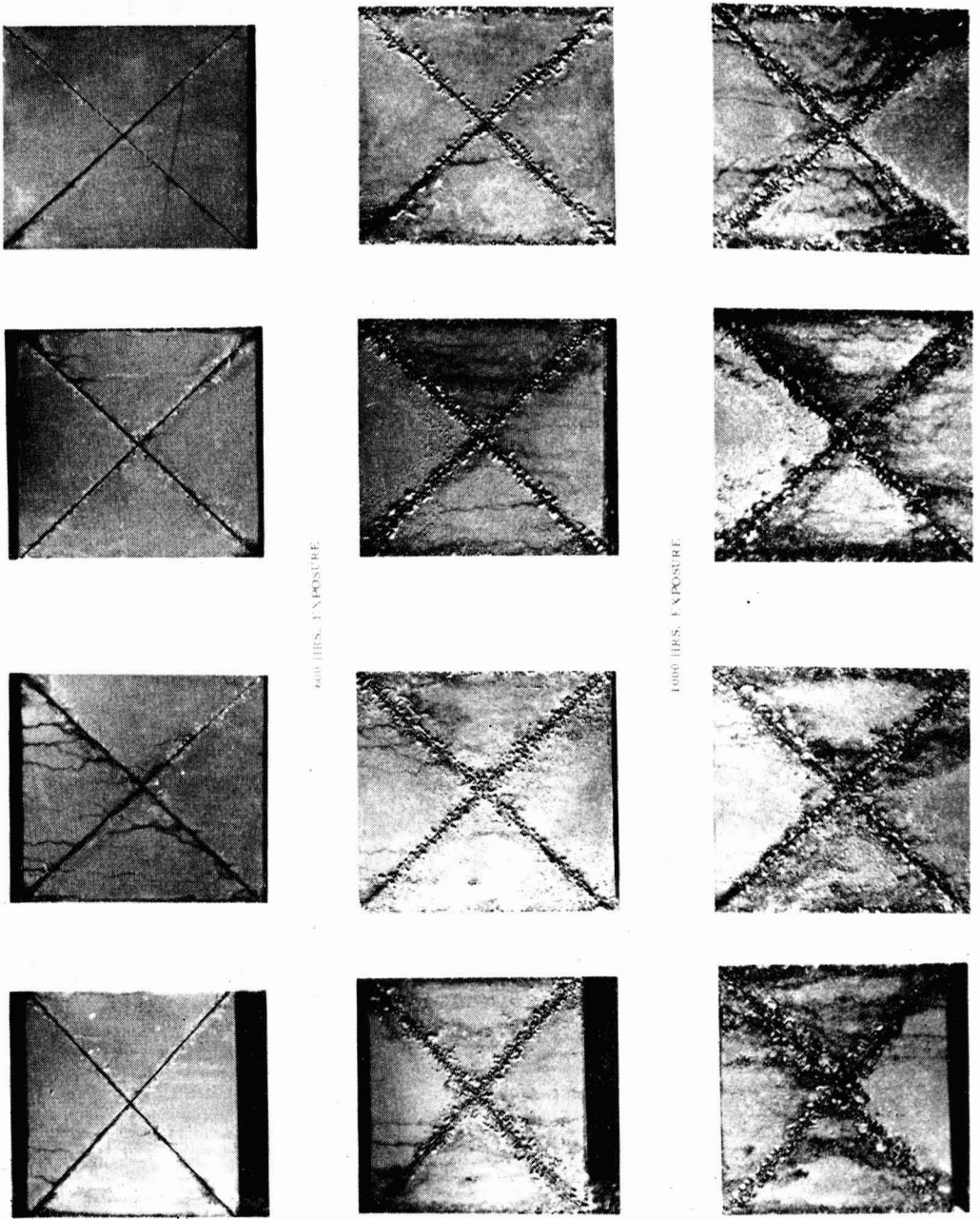
The decrease in weight of film as the electrolyte level is increased can be seen to be in line with the equation variables. At low solid ionic concentration, the electrophoretic mobility will be obtained from the 4π form, moving slowly to the 6π form as K' approaches K . Hence there is a drop in the mobility of the dispersed solid particles. The P/B ratio of the deposited film remains constant at all electrolyte levels. This implies that the decrease in mobility is the same for the moving pigment particles as it is for the moving resin particles.

Increase in ionic concentration occurs naturally in industrial electrodeposition baths running on continual production. The sources of these ions arise from the water solubles, from the pigmentation, from the reaction products at the cathode and the anode, and from the water used for the bath. As the ionic concentration increases, the throwing power and the weight of coating deposited in unit time decreases and loss of efficiency results. Most industrial baths recirculate the bath content through dialysers to remove the excess concentration of water soluble products in the bath. This enables a positive control of the water soluble constituents to be maintained at a fixed level for maximum bath efficiency.

Corrosion resistance of electrodeposition primer paints containing Laponite

Whilst the use of Laponite synthetic swelling clay as an additive to electro-painting baths has been demonstrated to have the advantages of improving pigment suspension and, in some water soluble resin systems, reducing the preferential deposition of the pigment phase, these advantages would be of little use if the corrosion resistance of the coatings were inferior. The resistance to salt spray corrosion of primer films containing Laponite has been determined on a range of coatings according to the British Standard Methods of Test for Paint, method BS. 3900, Part F4, 1968 (Salt Spray). The burnished steel panel substrates were prepared to method BS. 3900, Part A3. Four primer paints, containing 0 per cent, 0.05 per cent, 0.1 per cent and 0.2 per cent Laponite S respectively, calculated on the total bath weight, were electrodeposited on the panels at 160 volts for 2 minutes. The deposited films were sprayed with demineralised water to remove the surface dip coat, dried and stoved at 180°C for 30 minutes. Diagonal score marks to the metal were made on each panel with a sharp knife. The non-coated section at the top of each panel was protected with adhesive tape. The panels were removed from the salt spray cabinet after 300, 600 and 1,000 hours, washed and dried. The degree of corrosion was assessed and the panels photographed at each stage. Duplicate panels were tested (Fig. 14).

The effect of the Laponite addition is shown as an improvement in the salt spray resistance of the films. After 300 hours the blank primer panel had corroded at the score mark. The penetration of corrosion into the film extended for $\frac{1}{4}$ in in either direction. Traces of blistering, (corrosion eruption), were seen over the panel surface. At increasing Laponite concentrations the corrosion from the score line diminished. It was almost completely absent at 0.2 per cent. The general appearance of the films, absence of staining etc., were also superior



0.2% "LAPONITE"

0.1% "LAPONITE"

0.05% "LAPONITE"

NO "LAPONITE"

Fig. 14. Salt spray corrosion test panels: Red oxide electropainted primer

to the control film. The improved salt spray resistance continued throughout the exposure period. After 1,000 hours the primer coating containing 0.2 per cent Laponite was still the best.

A second primer series based on a different water soluble resin confirmed the results. Again, the film appearance was greatly improved, although the corrosion emanating from the scored lines was not so marked as in the case of the previous series. After 1,000 hours salt spray, the primer films containing Laponite were similar to the blank film in corrosion creep from the scratches. It could be suggested that, as the Laponite increased the film thickness of the primer coatings, the corrosion resistance was a function of this film thickness increase and might not be a function of the synthetic clay content. Primer coatings at equal film thickness (0.0004in) indicated that the improvement was maintained and can only result from the effect of the synthetic clay.

Migration of titanium dioxide in an aqueous suspension under the influence of an applied electric field

It can be shown that the migration of titanium dioxide pigment particles in an aqueous suspension under the influence of an applied electric field is a function of the pH of the pigment suspension. At high pH values, the pigment particles acquire a negative charge and migrate towards the anode, and at low pH values they acquire a positive charge and migrate towards the cathode. At an intermediate point in the pH range the nett charge on the pigment surface is zero and no migration takes place. This neutral point is called the isoelectric point.

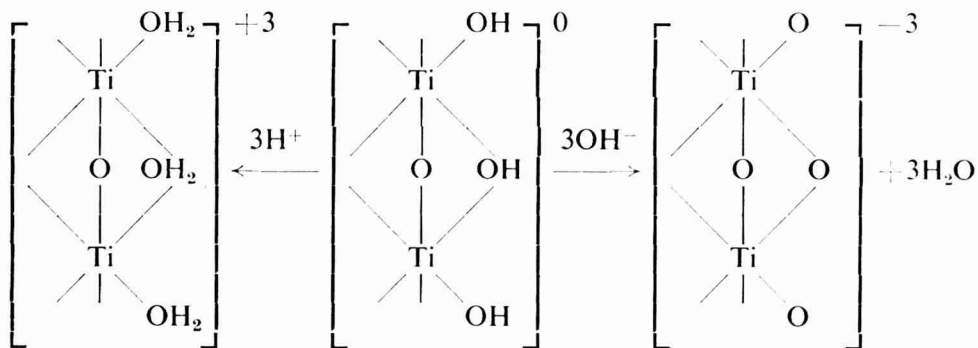
When titanium pigments are slurried in water of known pH, either acid or alkaline, and allowed to equilibrate before remeasuring the pH, it is found that changes in pH occur which are characteristic for each pigment. By plotting these changes throughout a pH range, plots are obtained from which the isoelectric point and proton affinity values for the pigment can be determined.

- The mechanism by which the particles acquire a formal charge can be explained in terms of adsorption and/or neutralisation at sites on the pigment surface. The nett effect is probably a function of both these parameters.

The process by which the surface charge is established may be viewed either as an adsorption of H^+ and OH^- ions, or as a dissociation of surface sites which assume a positive or negative charge. This mechanism has been represented schematically for iron oxide and may be reasonably applied to titanium dioxide.

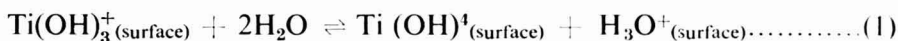
Since adding OH^- to the uncharged surface would increase the Ti (4) co-ordination number to seven, which is not likely to occur, the negative surface charge probably results from the removal, (desorption), of H^+ from the surface.

Similarly, the positive surface results from desorption of OH^- ions. Experimentally one cannot distinguish between the adsorption of OH^- ions, or desorption of H^+ ions.



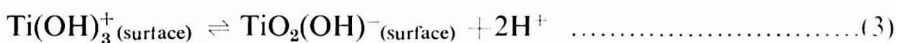
This model suggests that the metal ion, (Ti or Fe), plays no active potential determining role, as it is buried beneath the surface. Only when the protective layer is stripped off at high acid concentrations will the concentration of Ti^{4+} ions become appreciable. When an equal number of negative and positive sites are exposed at the pigment surface, the isoelectric point will be reached.

Surface reactions involved in the establishment of the surface charge and the electrical double layer may be represented formally for TiO_2 pigment as:



In these reactions, $\text{Ti}(\text{OH})_4^+(\text{surface})$ represents the uncharged surface adsorption site. By adsorbing a proton, this site becomes positive, $\text{Ti}(\text{OH})_3^+$; or, by desorbing a proton, $(\text{H}_3\text{O})^+$, it becomes negative, $\text{TiO}_2(\text{OH})^-$.

From (1) and (2), it follows that the surface sites, $\text{Ti}(\text{OH})_3^+$, may be regarded as the conjugate acid of the base, $\text{TiO}_2(\text{OH})^-$. Adding (1) and (2) gives:



for which the equilibrium constant, K , equals:

$$K = \frac{[\text{TiO}_2(\text{OH})^-(\text{surface})]}{[\text{Ti}(\text{OH})_3^+(\text{surface})]} \times \frac{\gamma^-}{\gamma^+} \times a_{\text{H}^+}^2 \dots \dots \dots (4)$$

where γ^- and γ^+ are the activity coefficients of the two surface sites, and $a_{\text{H}^+}^2$ is the activity of the hydrogen ion. K measures the strength with which the TiO_2 surface binds the protons.

If the ratio of the activity coefficients (γ^+ , γ^-) of the two surface sites is unity, then it follows from (4) that the value of K is determined by the pH of the isoelectric point.

The modification of the surface of the titanium dioxide by adsorption of the hydrous oxides used in surface treatment will alter the proton binding strengths. Changes in the isoelectric point between uncoated and coated titanium dioxide pigments can indicate differences which have practical implications in their industrial uses.

Measurement of proton adsorption of titanium dioxide pigments in aqueous suspensions

5.0g of titanium pigment was dispersed into each of a number of 50ml samples of water of known pH covering the pH range 1.5- 7.0. The suspensions were tumbled on rollers for 16 hours to achieve equilibrium. A graph of the final pH (pH_f), against initial pH, (pH_i), was plotted. The flat horizontal part of the curve gives the isoelectric point pH of the pigment.

Fig. 15 shows the curves which are obtained for an untreated rutile pigment and for the surface treated rutile pigments A, B, C, D and E used in the electro-deposition experiments. The isoelectric pH of the untreated pigment at 6.3 agrees with the published value⁷ for the same pigment type at 6.0 ± 0.3 . The method used in this case was microelectrophoresis. The agreement between the two methods of determining the isoelectric point has been confirmed in the cases of aqueous dispersions of aluminium oxide and silica. The simple pH technique is considered to be sufficiently accurate for most investigations.

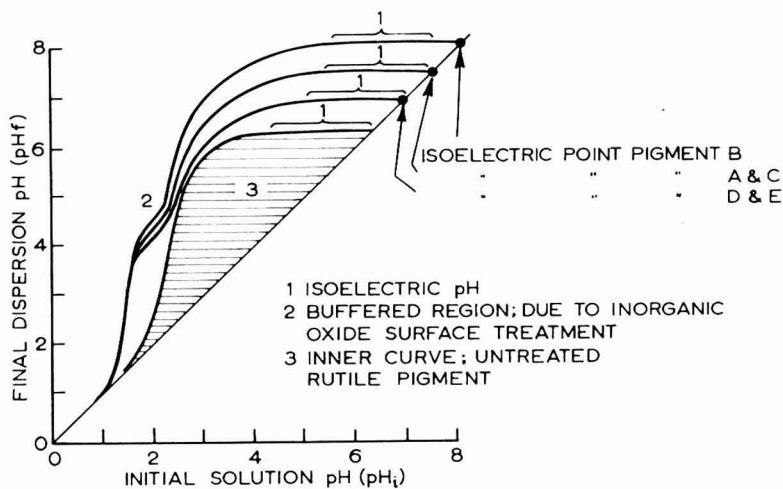


Fig. 15. Proton (H^+) adsorption curves/isoelectric points for rutile titanium pigment

The results in Table 8 compare the isoelectric pH of pigments in the aqueous solution to the P/B ratio measured for these pigments in the electro-deposition bath and the deposited film. The conditions of deposition were 50, 90, 130 and 170 volts for 21 minutes at a bath pigment volume concentration of 10 per cent and 10 per cent bath resin solids. In general, the correlation is good. The lower the isoelectric pH, the less preferentially is the pigment deposited with respect to the resin.

It is certain that the difference in the surface charges on the pigment is one of the controlling factors in determining the rate of mobility of the dispersed pigment through the bath. The differences between the isoelectric points and the bath pH with respect to the amount of ionised resin adsorbed at the solid surface will determine the ratio of pigment and resin deposited in the film. The role played by the synthetic clay is not clearly understood. Solomon⁸ has

Table 8

Comparison of isoelectric pH of pigments in aqueous solution to P/B ratio in bath and film

Pigment	pH (iso)	PVC film/bath ratio			
		50 Volts	100 Volts	130 Volts	170 Volts
A	7.5	1.14	1.18	1.19	1.18
B	8.1	1.25	1.28	1.31	1.31
C	7.5	1.10	1.15	1.15	1.15
D	7.0	1.02	1.12	1.16	1.12
E	7.0	1.08	1.09	1.09	1.10

shown that in polymerisation reactions, the behaviour of clay particles can be seen to be associated with either electron acceptor or electron donating sites.

The electron acceptor sites are at the crystal edges; these can be neutralised by the addition of polyphosphates, as in the case of Laponite S. The phosphate is stripped from the clay when pigment is present. The electron donating sites occur on the faces of the clay particles and result from the occurrence of transition metals in the lower valency states in the silica layers. The low transition metal content of Laponite suggests that reactions will involve the edge charges more than the face charges. The ability of the synthetic clay to change the relative proportions of resin and pigment deposited is likely to be a function of the electron acceptor sites at the edges of the clay. Fig. 16 shows the weight

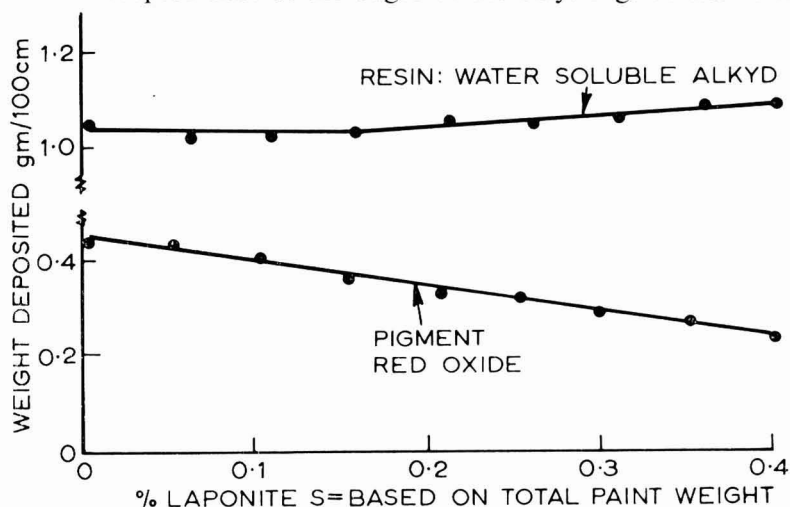


Fig. 16. Weight of resin and pigment deposited with increasing Laponite concentration

of resin and pigment deposited in the presence of increasing quantities of the synthetic swelling clay. The weight of resin deposited is constant up to a clay concentration of about 0.2 per cent. Thereafter there is a slight weight increase.

With respect to the iron oxide pigment, there is a linear decrease in the weight of pigment deposited as the clay content increases. This suggests that the mechanism is a clay/pigment interaction. This interaction is, however, dependent upon the resin species in the formulation. Competition for the active clay sites is the most probable explanation of the failure to alter the P/B film/P/B bath ratio in the case of the water soluble acrylic resin system.

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An electron microscope examination of the "clear layer" at the surface of gloss paint films

By R. D. Murley and H. Smith

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Summary

The titanium dioxide pigment distribution at the surface of a gloss paint film has been examined with an electron microscope. The results confirm the fact that the pigment concentration is lower at the surface than in the bulk of the paint film, but the structure of the surface layers is more complex than is commonly envisaged. It is shown theoretically that the observed facts can be accounted for satisfactorily on the assumption that particle movement from the surface is due to the electrical charges carried by the pigment particles.

Key words

Types and classes of coating
gloss finish

Prime pigments and dyes
titanium dioxide

Equipment primarily associated with analysis, measurement and testing
electron microscope

Properties, characteristics and conditions primarily associated with:

Materials in general
particle charge

Dried or cured films
pigment dispersion

Un examen par microscope électronique de la "Couche Claire" à la surface des feuil de peintures brillantes

Résumé

Au moyens d'un microscope électronique, on a examiné la répartition du pigment du dioxyde de titane à la surface d'un feuil de peinture brillante. Les résultats confirment que la concentration pigmentaire à la surface est plus faible que celle au coeur du feuil de peinture, et également que la structure de la couche superficielle est plus complexe que l'on prévoit d'habitude. On a démontré au point de vue théorique que les données mises en évidence peuvent s'expliquer dans une manière satisfaisante en supposant que le mouvement particulière à l'écart de la surface du feuil se dépend des charges électriques qui se trouvent sur les particules pigmentaires.

Eine Elektronenmikroskopische Prüfung der "Klaren Schicht" auf der Oberfläche von Glänzenden Anstrichfilmen

Zusammenfassung

Mit Hilfe eines Elektronenmikroskopes wurde die Verteilung des Titanweisspigmentes an der Oberfläche eines glänzenden Anstrichfarbenfilms geprüft. Die Ergebnisse bestätigen, dass die Pigmentkonzentration an der Oberfläche geringer, als in der Masse des Farbfilms ist; allerdings ist die Struktur der obersten Schicht komplizierter, als gewöhnlich angenommen wird. Theoretisch wird aufgezeigt, dass die Beobachtungen befriedigend auf die Annahme zurückgeführt werden können, dass die von den Pigmentpartikeln getragene elektrische Ladung die Teilchen veranlasst, sich von der Oberfläche wegzubewegen.

Электронно-микроскопическое изучение «прозрачного слоя» на поверхности пленок глянцевых красок

Резюме

Изучается, при помощи электронного микроскопа, распределение пигмента двуокиси титана на поверхности пленки глянцевой краски. Результаты подтверждают, что концентрация пигмента оказывается более низкой на поверхности чем в массе красочной пленки, но структура поверхностных слоев является более сложной чем обычно предполагалось. Показано теоретически, что наблюдаемые явления могут быть удовлетворительно объяснены если предположить что движение частиц от поверхности происходит за счет электрических зарядов пигментных частиц.

Introduction

It has long been suspected that the surface of gloss paint films is deficient in pigment, and that the presence of this clear layer has a profound influence on a variety of film properties. In the field of durability, this is likely to be especially important for the newer organic resins with a very slow rate of photoactivated breakdown. The thin top layer of the film may well have a very different rate of degradation from the remainder of the paint, and this may give rise to incorrect assessment of durability if film erosion rates measured in short period accelerated weathering tests are taken to be representative of the behaviour of the film for the greater part of its lifetime.

Experimental method and results

The only method of showing directly the existence of a surface clear layer is to cut a section and examine it microscopically. The conventional method of doing this is to embed the film in resin, which is then polymerised. With this method, however, there is a very real danger that the resin and/or solvent may attack the surface of the paint film and give an erroneous picture. The following method eliminates this possibility.

Part of the circumference of a cylinder (3mm diameter) of hardened araldite is filed flat, and the paint is applied to this flat area and allowed to dry and harden. The block is then trimmed to the size and shape suitable for insertion in the microtome. When slices of the paint are cut thin enough for examination in the electron microscope, a rather ragged top surface is liable to be produced. This is obviated by dipping the trimmed block in a mixture of filtered paraffin and carnauba wax (in the proportions 1:2) at 80° for three minutes and cooling, before mounting in the microtome. Fig. 1 shows an electron micrograph of a section prepared in this manner and a clear layer of about 0.2 μ m in depth is evident.

To confirm and follow up this observation in greater detail, a second paint was prepared. This was done by ballmilling a coated rutile pigment of high opacity overnight in a pentaerithrytol modified long-oil linseed alkyd. Further similar photographs were obtained, and some simple measurements made in an attempt to give a quantitative representation of the surface layers. First, the shortest distance between the film surface and a given particle surface was measured. Secondly, the diameter of each crystal was measured using a transparent sizing graticule. Details of this latter technique have been published previously¹. The results of these measurements are given in Figs. 2 and 3. Fig. 2



Fig. 1. Section of gloss paint film showing the structure of the paint/air interface

shows the number distribution of crystals against their depth below the surface, while Fig. 3 shows the mean crystal size against the same variable. The results are somewhat scattered in view of the statistical nature of the experiment and the relatively small amount of data, but they do illustrate a deficiency of crystals near the paint surface and demonstrate the major features of this "clear" layer.

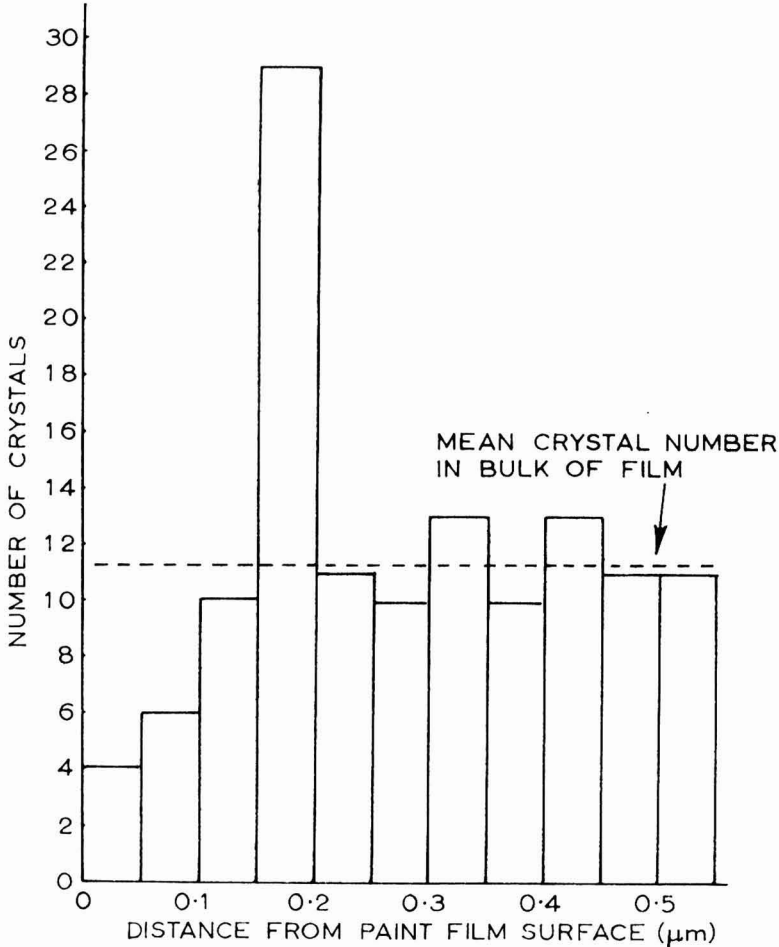


Fig. 2. Results of measurements on gloss paint sections, showing the distribution of the number of crystals as a function of their distance from the surface

As shown by Fig. 2 and the micrographs, the top 0.1-0.15 μm of the film is deficient in pigment. This is not a true "clear layer," entirely devoid of titanium dioxide, but rather a statistical distribution of pigment with a decreased probability of pigment particles occurring closer to the surface. Below this layer of reduced concentration lies a layer, roughly 0.15-0.20 μm from the film surface, which contains a higher concentration of pigment particles than the bulk of the film. It is significant that the excess number of particles in this second layer roughly equals the deficiency in the surface layer when the numbers in each layer are compared with the bulk concentration. This suggests that during

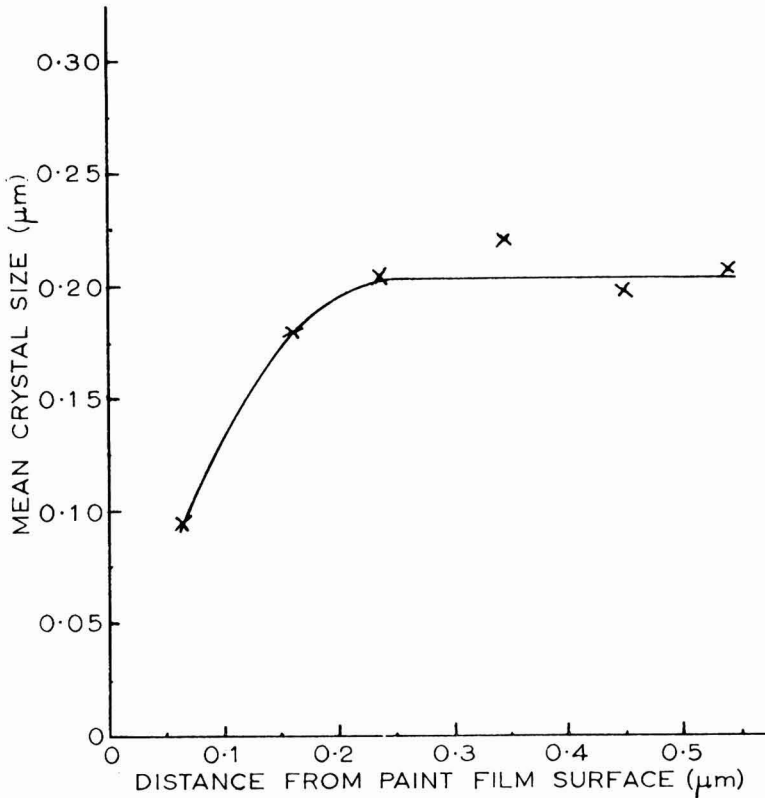


Fig. 3. Results of measurements on gloss paint film sections showing average crystal size as a function of crystal distance from the surface

application the pigment is uniformly distributed throughout the paint, and during film formation the titanium dioxide particles close to the surface experience a force driving them away from the surface.

Fig. 3 shows the interesting fact that the particles close to the film surface have a smaller size than average; in other words, the larger particles tend to be more strongly repelled from the film surface.

Theory

It appears that electrostatic forces due to the charge carried by the pigment particles may well give rise to this particle movement at the paint surface. A point charge lying near a plane boundary between two media with differing dielectric constants experiences a force given by the following equation.

$$F = (q^2/16\pi a^2 K_0 K_1) [(K_1 - K_2)/(K_1 + K_2)]$$

Where F = force experienced by particle (Newtons)

q = charge on particle (Coulombs)

a = distance from particle to boundary, measured normal to the boundary (metre)

K_1 = dielectric constant of medium surrounding particle.

K_2 = dielectric constant of second medium

K_0 = permittivity of free space, 8.85×10^{-12} farad/metre.

This effect is often termed rather loosely "an image force." For $K_1 > K_2$, as at the paint film air boundary, the force is repulsive and the charge moves away from the boundary. For paint systems, zeta-potential measurements can be used to determine particle charge², using the relationship.

$$q = 2\pi K_1 K_0 dz$$

here, d = particle diameter (metre).

z = zeta potential (volt).

For particle movement, the electrical force may be equated to the Stoke's force on the particle, thus giving:

$$\frac{\pi K_0 K_1 d^2 z^2}{4a^2} \frac{K_1 - K_2}{K_1 + K_2} = 3\pi v d \frac{da}{dt}$$

where, da/dt = particle velocity (m.s^{-1}) and

v = suspension viscosity (Ns.m^{-2}).

Rearrangement gives

$$\frac{K_0 K_1 dz^2}{12v} \frac{K_1 - K_2}{K_1 + K_2} = a^2 \frac{da}{dt}$$

Assuming, for the purposes of simplicity, that viscosity does not vary with time the integration of this equation gives

$$a^3 - a_0^3 = \frac{K_0 K_1 dz^2 t}{4v} \frac{K_1 - K_2}{K_1 + K_2}$$

Here a is the particle distance from the boundary at time t ; a_0 being the initial distance at time $t = 0$.

This equation shows that larger particles move further than small ones, which agrees with experiment. Also, it shows that particle movement is smaller the larger the initial distance from the surface. This implies an increase in particle concentration beyond the "clear layer," again in agreement with experiment.

In order to make a numerical comparison with practical work, suitable representative values can be inserted. For an alkyd paint, the following values may be assumed. $K_1 = 3$, $K_2 = 1$, $d = 0.25\mu\text{m}$, $z = 30 \text{ mv}^2$; but a problem arises in selecting a drying time and viscosity. The weight loss of a paint film was followed immediately after application, and it was found that in ten minutes approximately 15 per cent of the total solvent in the film had evaporated. This suggested that the solvent loss in the film surface would be high enough to render the particles more or less immobile, and, as an approximation, a constant paint viscosity of 1 Nsm^{-2} (10 poise) and a time of ten minutes were taken. This gives a particle movement of $0.7\mu\text{m}$ from the surface. This figure is about the right order of magnitude, being some 5-7 times too high. However, the simple theory given here neglects some of the factors which will operate in a practical paint system. The layer of high concentration which will quickly build up in a practical paint may well impede further particle movement, owing to steric hindrance, or electric potential effects. Also, particle movement from the film surface will be counteracted by random Brownian motion and any gross convective flow of the paint due to surface evaporation.

Discussion

As a result of this simple theoretical approach, it is evident that electrostatic image forces due to the charges on the pigment particles are sufficiently large to account for the observed clear layer at the paint surface. The actual dimensions of the clear layer are, however, probably controlled by factors not considered in this approach, and which would in any case be extremely difficult to state quantitatively.

Further evidence supporting the existence of a clear layer in gloss paints formulated at high pigment levels comes from the work of Armstrong and Ross,³ who studied the reflectance of such paints. The effect they noted was that the specular reflection of a white light from the surface of such a paint film is coloured. This is almost certainly due to interference between the light reflected at the paint/air interface (i.e. at the top of the clear layer) and light reflected at the bottom of the clear layer. The effect is easily visible to the naked eye, and has been used in the authors' laboratories⁴ to measure the average thickness of the clear layer. The method and results may be published in the future, together with related optical work. At the present time, it can be stated that this independent method confirms quantitatively the thickness of the clear layer established by the electron microscope work reported here.

Although results have only been quoted for one air-drying finish, clear layers with similar characteristics have been observed in gloss acrylic stoving paints.

Acknowledgments

The authors wish to thank the Directors of British Titan Products Co. Ltd. for permission to publish this paper.

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Next month's issue

The Honorary Editor has accepted the following papers for publication, and these are expected to appear in the May issue.

"A proposal for the adoption of the British Standard artificial weathering test by ISO," by *H. A. Hipwood and W. R. Weaver.*

"Room temperature curing electrodeposited coatings," by *A. G. North.*

"Aqueous dispersions of polymeric ionomers," by *D. Dieterich, W. Keberle and R. Wuest.*

"The development of water-thinnable gloss paints based on air drying water-soluble resins," by *T. Hunt.*

"Vinyl acetate/ethylene copolymer emulsions in technical perspective," by *G. E. J. Reynolds.*

Review

DISPERSION OF POWDERS IN LIQUIDS WITH SPECIAL REFERENCE TO PIGMENTS
Edited by G. D. PARFITT. London: Elsevier Publishing Company Ltd., 1969.
Pp. v+354. Price £6

Pigment technologists and all concerned with manufacture of pigmented coatings will appreciate the motives behind the publication of this book. As stated by the editor in the short introduction: "As time passes empiricism gives way to sound principles based on accurate scientific experiments." Dr. Parfitt goes on to suggest that the pigment technologist in the last decade has experienced the greatest influences of science on an art which has developed over centuries. Those members of the Association who are able to recall a dispersion symposium of some 30 years ago when a member, subsequently President, summarised the state of the art as being like using a steam hammer to crack a nut, will be ready to agree that it is comparatively recently that dispersion machinery has been designed rather than merely evolved and that the "nut," with closer study, has proved to be held together with complex forces.

The book consists of nine sections or chapters, each written with the authority of an expert. Dr. Parfitt has gathered together a formidable team. The dissection of the total problem into the component parts seems to this reviewer to give the reader an opportunity to select isolated chapters according to his own interest and he may even use the book as an encyclopaedia—over 500 references are provided—although this use is disclaimed as the authors' intention.

The first chapter, "The solid-liquid interface" by M. J. Jaycock, discusses the nature of forces between atoms, ions and molecules moving on to surface tension, interfacial tension, adhesion and adsorption. This is lucidly written, developed logically from comparatively simple arguments which make the subsequent complex presentation all the more convincing. A reminder to think of boundaries as a separate surface phase of definite thickness, rather than a phase of zero thickness, is given and there is much consideration of properties of solid surfaces and calculation of surface energies, including the edges and corners, or irregular shapes and heterogeneous surfaces.

Electrical phenomena associated with the solid-liquid interface is dealt with in the second chapter by A. L. Smith. Various experimental techniques and theoretical approaches are analysed to explain manifestations of behaviour derived from the electric double layer, and electrokinetic properties of dispersions are discussed.

The aspect of dispersions most familiar to the coatings technologist is dealt with in chapter 3 by G. D. Parfitt. This is a particularly satisfying exposition because it plunges straight into the definitions used for colloidal behaviour and clears up ambiguities surrounding the true nature of lyophilic and lyophobic systems, particularly where the nature of the surface is averse to the disperse phase. The distinction drawn between solutions and dispersions should be clear to ink chemists and others applying coatings of macromolecules or association colloids where a third phase, the substrate, influences transition from solution to dispersion.

Dispersion is here considered to have three stages, wetting, conversion of aggregates and agglomerates to form colloidal particles, and stability. Justification of the term flocculation in relation to stability is discussed and some workers, who have disagreed on the degree of dispersion in certain systems, can be reconciled by recognising the conditions governing observations of what are truly unstable systems. (A high degree of flocculation exists in certain printing inks except at extremely high rates of shear accompanying film splitting in the press distribution chain). Dr. Parfitt goes on to review the forces involved in dispersion. The explanation of degree of dispersion falling at a point where aggregates are held together with water, the Reh binder effect, and the discussion of forces of interaction, both attractive and repulsive, between particles, link well with the exposition given in the previous chapters. The whole chapter is so much a key chapter to the whole book that readers will constantly refer back to its explanations and the 100 references supplied.

The components of dispersed systems are dealt with under four distinct chapters. Chapter 4, "Precipitation" by A. G. Walton. Chapter 6, "Surface active compounds" by W. Black. Chapter 8, "Inorganic pigments" by H. D. Jefferies and Chapter 9, "Organic pigments" by H. D. Brearley and F. M. Smith.

Each of these authors treats his subject from the peculiar standpoint of his raw material. Theories discussed in earlier chapters are echoed in these treatises and interpretations are given in terms of materials familiar to the coatings technologist. Only a few examples can be mentioned in this review, and the effect of environment on crystal shape and rate of growth, covered in some detail in the chapter on precipitation, seems particularly relevant. Other areas of practical significance concerning surface active agents deal with surface treatment of pigments, the difficulty of selection in non-aqueous systems, flushing, and the requirements for systems such as lithographic and textile printing.

There is much of practical application in the two pigment chapters; both give consideration to techniques of dispersing and evaluation of resultant dispersions by rheological or optical characteristics.

A survey of dispersing techniques in industrial processing is given in Chapter 7, "Technical aspects of dispersion" by I. R. Sheppard, in which the author aims at interpreting the theoretical considerations of earlier chapters in terms of practical application. Beginning with class of machine and type of industrial product, a classification leading to the best product in terms of economics and reliability is attempted. After a description of the machines and their particular features, the different products are discussed. Inevitably, in view of the broad field, there is some over-simplification, but nothing misleading except, perhaps, the description "water proofing processing requirement" where water resistant requirements of ink in the lithographic process was obviously intended. Illustrations of optimisation experiments are given together with relatively simple methods of assessment.

A more comprehensive list of assessment techniques can be extracted from Chapter 5 on "Assessment of dispersion" by S. H. Bell and V. T. Crowl. The methods of assessment are preceded by re-defining the nature of powders and the stages in the process of dispersing. The rheological section is distin-

guished by the clarity of the description and illustration of rheological behaviour related to particle behaviour. In discussing particle size assessment, various techniques are outlined; these range from simple controls where the risk of poor interpretation and recognition of limitations are implicit, to sedimentation and optical methods of greater refinement. The implications of dispersion characteristics in application and film properties involving, in addition to rheology, factors governing sedimentation, flooding, flotation, opacity and gloss, are extensively discussed. Since, in our technology, the end product is the film, it is very satisfying to be able to relate the conclusions in this chapter to the many problems associated with all the parameters covered in the book and leading the reader to return to the opening chapter dealing with forces associated with the smallest entities.

None of the excellent studies of the peculiarities of carbon black pigments and investigation of carbon dispersing techniques carried out in recent years are reflected in the book. Carbon is dismissed in a single paragraph and does not merit a place in the index.

Apart from these omissions, the book is well indexed, it has none of the disagreeable changes of style so often encountered with a collection of authors and should become the standard text book on the subject for many years to come. It is difficult to fault the work in any way, although readers may feel that the order of chapters would be more logical if presented in the sequence followed in this review.

J. A. L. HAWKEY

London

Southern Branch

Student Symposium

On Wednesday 11 February, the Southern Branch held a Student Symposium, which was their first venture of the kind. The Committee of the Southern Branch have long felt that there were many students in Colleges in the area whose interest in the Association could best be stimulated by a function of this nature and it was also felt that the Borough Polytechnic and East Ham College of Technology students who frequently attend London Section meetings would appreciate such an event. Students from the Slough College of Technology were also invited to attend. They, of course, being under the care of the Thames Valley Section.

The total number attending the Symposium, which was entitled "Ships' paints and compositions" was 135, 80 of whom were students from the various Colleges, and this party included 19 students from the Portsmouth Polytechnic and 2 students from the Chichester College of Technology.

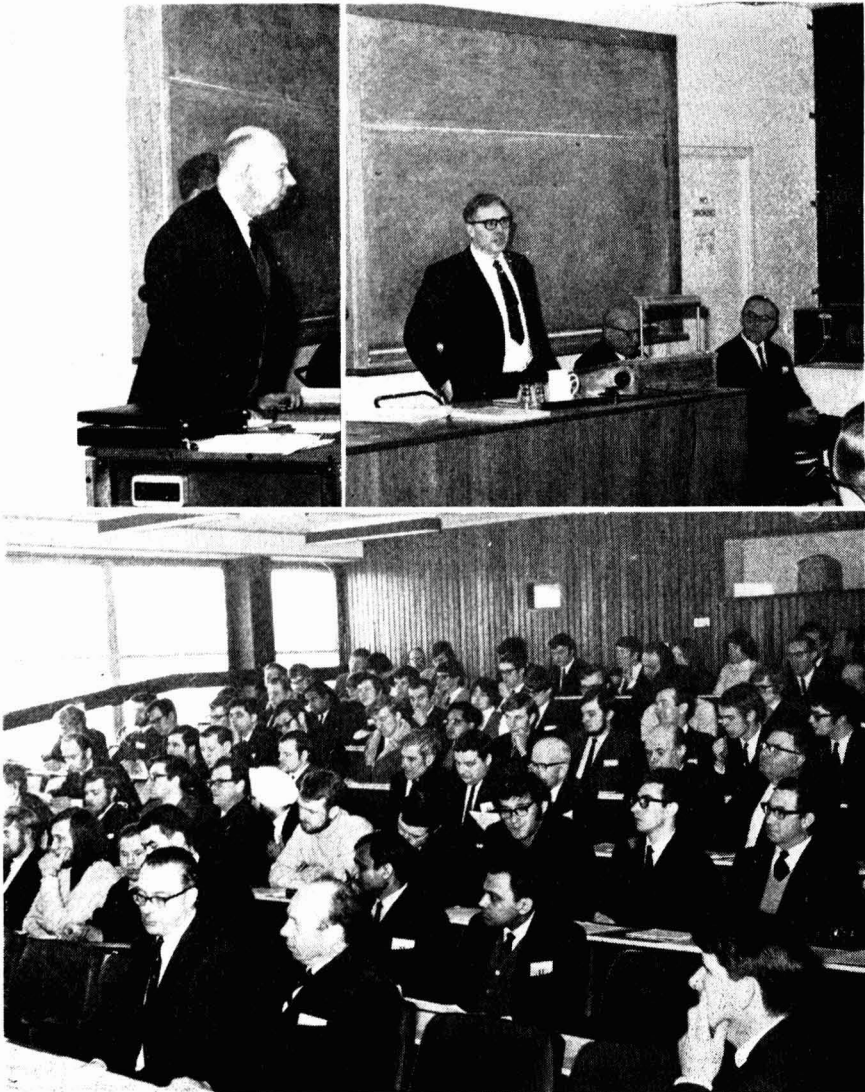
After an introduction by the Branch Chairman, Mr J. Tooke Kirby, the three speakers were Dr E. N. Dodd, the Superintendent Scientist of the Central Dockyard Laboratory, who gave a very interesting talk on the functions of his Department, Mr J. Smith, also from HM Dockyard, who talked on primer systems for marine applications and Dr T. A. Banfield, of British Paints Limited, who talked on the subject of marine paints and illustrated the problems which had to be dealt with from the manufacturer's point of view.

The organisers were very much obliged to Dr Banfield for travelling down from Newcastle upon Tyne to lecture in Portsmouth at this function.

Everyone at the Symposium was given identity badges, and it was obvious during the buffet lunch which took place subsequently and the afternoon technical visits to HM Dockyard and the Eastney Testing Station that full advantage was taken of this facility. Everyone connected with OCCA, and the lecturers, were asked questions, and the latter were given the opportunity of meeting students who were interested in their subject.

The weather was extremely kind and this was fortunate, since part of the afternoon was spent on exposure rafts in Langston Harbour, to which a ten minute journey by fast motor launch was necessary.

The organisers of the Symposium had some difficulty in obtaining security clearance for some of the students and visitors who attended. This perhaps may best be illustrated by the fact that two holders of Rhodesian Passports were revealed at the last moment. One of the college tutors was kind enough to provide what was virtually a "headmaster's report" on two suspect students and one of the overseas students refused to take part in the buffet lunch on religious grounds. It was, however, discovered that we had a "passenger" who had turned up in order to see everything he could and to eat the lunch of the



Photographs from the Southern Branch Student Symposium. Above (left to right) Mr J. Tooke-Kirby (Chairman, Southern Branch), Mr J. Smith (Central Dockyard Laboratory), Dr E. N. Dodd, Superintending Scientist, Admiralty, and Dr T. A. Banfield (British Paints Ltd.). Below, a general view, with Mr J. E. Pooley (Chairman, London) front row, centre.

student who was making 11 February a fast-day! During the visit to HM Dockyard shot-blasting of steel plates was shown and it was possible to see the Matapan, which was in the course of conversion into an aircraft carrier, in the dry dock. The ship's bottom was inspected very closely and without any verbal explanation the need for anti-fouling and anti-corrosion paints was demonstrated. The lesson was a little spoilt by one of the guides who said that really it was in remarkably good condition, and it was felt that this was a point which only an expert who was able to draw comparisons between this ship's bottom and another could appreciate.

Since this event took place, indications have been received that a further Symposium would be welcome for 1971 and it is intended to spread the net a little bit further to other Universities and educational establishments in the South. Apart from the general stimulation of interest which one gets from meeting and hearing the views of students, it is felt that much latent interest in our Association exists which can be suitably aroused by such events.

J.T.K.

Manchester Section

Metal organic compounds in surface coatings

The first of this year's lectures to Student Members was given on 14 January 1970 by Mr W. K. H. Lakin, of Hardman & Holden Ltd., who presented a paper entitled "Metal organic compounds in surface coatings." The meeting, attended by about 40 members and visitors, was held at the Manchester Literary and Philosophical Society, and was under the chairmanship of Mr J. Mitchell (Hon. Student Activities Officer).

Mr Lakin began his lecture by explaining that the role of metal organic compounds in surface coatings was not restricted to the use of metal soaps as driers, but when taken in its broadest sense could include their use as gellants, wetting agents, fungicides, slip agents, stabilisers (for pvc) and various other applications. Indeed many of the so-called organic pigments were, in fact, metal organic compounds of one type or another. In developing this theme, reference was made to each group of the periodic table in turn, describing the applications which organic compounds of metals from within each group found in the field of surface coating technology.

A section of the lecture, however, was more specific and dealt with the use of metallic soaps as driers, referring to both the oxidation/reduction reactions associated with the oxidation of drying oils and media, and also the effects on drying of the orientation of metallic soap molecules.

At the conclusion of the lecture, copies of two booklets were distributed to members of the audience, one of which listed in some detail the various metal organic compounds finding use in surface coatings whilst the other amounted to a monograph on the drying processes associated with surface coating media. These booklets were extremely well received.

The interest in the subject was reflected in the many and varied questions which Mr Lakin kindly offered to answer.

A vote of thanks was proposed by Mr R. Scharosch.

C.R.T.

Information Received

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

Johnson Matthey Metals Limited has recently announced the introduction of a new type of "bursting disc" for the protection of pressure vessels and chemical processing plant. The new reversing type of bursting disc is said to be complementary to the existing conventional bursting disc, and to be more robust, less prone to damage, to have a longer life, to require no vacuum supports and to be produced to closer bursting tolerances.

Unlike the conventional bursting disc, the reversing type is mounted with its convex surface facing the pressure. When the pressure limit is exceeded the disc reverses and is cut open by a knife-edged cruciform set behind it.

It has recently been announced that agreement has been reached between **Farbenfabriken Bayer AG, Veba-Chemie AG, and Farbwerke Hoechst AG** for Bayer and Veba-Chemie to acquire half of Hoechst's 51.42 per cent interest in **Chemie-Verwaltungs-AG** of Frankfurt. In return, Hoechst received 25.1 per cent of the capital of **Cassella Farbwerke Mainkur AG**, which was Bayer's property, plus a further 25.39 per cent of Cassella, which Bayer obtained from **Badische Anilin und Soda-Fabriken AG**, and a cash payment of DM 280 million.

Both Bayer and Veba-Chemie now possess direct interests of 25 per cent of **Chemische Werke Huels AG** and a joint 70 per cent of **Chemie Verwaltung**, which itself holds 50 per cent of **Chemische Werke Huels**. It will thus be possible for Bayer and Veba-Chemie to continue to develop Huels as an independent industrial group.

Huels and Veba-Chemie are to pool their common interests in the polyolefin field in **Vestolen GmbH**, to be established in the near future.

As a further result of the transaction, Hoechst now holds 75.59 per cent of the capital of Cassella.

The companies involved feel that this re-arrangement will not only enable them best to maintain their position in the face of world-wide competition, but also benefit West Germany as a whole.

Queensgate Whiting Co. Limited has issued a new booklet giving technical data on all its products. Copies are available on request.

New arrangements are now in force for the marketing of *Cab-o-Sil* fumed silica, announce **Cabot Corporation. Cabot SA**, Santure, Spain, are now directly responsible for sales throughout Spain and Portugal, previously handled directly by the European Sales Manager in Milan. **Cabot Italiana** is dealing with sales in Italy, **Cabot Carbon Ltd.** in Britain, and all other areas on the continent will be administered by the European Sales Manager.

These changes are part of Cabot's long term plans for marketing *Cab-o-Sil* in Europe, and the announcement of a new plant and distribution network is expected soon.

A high-build epoxy coating designed specifically for application to wet surfaces of ships above the waterline is now available from **International Red Hand Marine Coatings**. The new coating, *Wet Surface Intergard*, was originally evolved to solve

production difficulties in the shipyard, but has now enabled blasting and painting of the deck during the voyage, saving time in dock. It is also said to be suitable for boottop, topsides and superstructure.

The coating is applied in two stages following blasting. First, *Wet Surface Intergard Pretreatment Solution* is applied, which displaces the bulk of the water, the remainder evaporating through the first coating of *Wet Surface Intergard*, which should be applied by airless spray.

The binder of the new "brush-on wallcovering" introduced by **Berger J & N Paints**, *Magicote Vinyl*, is a special vinyl copolymer emulsion developed by **Vinyl Products Limited**, the latter company has announced. This emulsion is said to make an essential contribution to the finish, in particular its easy cleaning properties, and also its excellent water resistance.

Polyart, a thermoplastic polymer film said to have all the properties of best quality art paper, is now available from **L. S. Dixon & Co. Ltd.**, it was recently announced. It is claimed that sharper images can be obtained with *Polyart*, which has been developed by **Bakelite Xylonite Ltd.**, than with paper, using most printing processes, while durability is obviously increased.

The Pyrene Company Limited has recently issued two new information leaflets. One gives full details of *Pyroclean* industrial metal cleaners, while the other is a re-print of a paper written by the Technical director of Pyrene's French associate, **Société Continental Parker**, and deals with the *Parco Lubrite* process for improving the lubrication properties of ferrous metals.

It has recently been announced that Messrs **Otto Krahn**, of Hamburg, have been appointed sole agents in the Federal Republic of Germany and West Berlin for the sale of titanium dioxide produced by **Laporte Industries Limited**.

International Colloids Limited has increased its range of *Microperse* aqueous pigment dispersions by the addition of *Microperse 7*, a channel black dispersion for the colouring of leather.

The new *Gardner XL-10* colorimeter is now available from **Stanhope-Seta Limited**, the UK representative of the manufacturer, **Gardner Laboratory Incorporated**, it was recently announced.

It is claimed that the new instrument can be operated by non-technical personnel after a few minutes demonstration. CIE, L, a, b, and Rd, a, b, scales can be used, with read-out by digital computer, and push button operation to obtain instant readings.

The reliability and sensitivity of earlier models have been increased by use of solid-state components.

Bahrain Atomisers International Limited is the name of a new company set up by **Johnson & Bloy Limited** and **Eckart-Werke** of West Germany, by grant of a Royal Charter from his Highness the Ruler of Bahrain.

The new company will produce aluminium powder by atomising aluminium smelter from the **Aluminium Bahrain (ALBA)** plant, and is said to be the first step in the establishment of an ancillary industry based on the **ALBA** smelter.

Allied Chemical Corporation has recently announced the introduction of two new products.

Nacconate H-12 is a cycloaliphatic diisocyanate, 4, 4' -methylene bis (cyclohexyl isocyanate) said to have promising applications in the field of formulation of urethane resins where outstanding colour and gloss retention are required with good chemical and solvent resistance.

Theic, tris (2-hydroxyethyl) isocyanurate, is a unique symmetrical triol, said to have outstanding thermal and chemical resistance, and improved weather resistance and adhesion in enamels, varnishes, adhesives, alkyds and similar systems.

The *RT type Dry Feeder* is now available from **Paterson Candy International Ltd.**, it was recently announced.

The unit operates on the principle of a rotating table below a stationary feed hopper. Three adjustable knives extend into the material on the table, and deflect a constant volume into a dry feed chute or vortex mixer below.

Two sizes are available, each with two different hopper capacities ranging from 2.5 to 16 cu.ft.

Section Proceedings

London

New resin systems for use in coil coating applications

A meeting of London Section was held on 12 February 1970 at University College London WCI, with Mr J. Pooley in the Chair. Mr L. A. Tysall, of Shell Research Ltd., gave a paper with the above title.

Mr Tysall said that the Cardura type of resin was developed with coil coating in mind. Mainly tertiary acids were present, having improved stability and chemical resistance. These resins were either cured with melamine resins or with a thermosetting acrylic. The problem was that such resins were poor on impact resistance and in the mandrel bend test, and attempts were made to improve these without loss of other properties. These acids were much less reactive than normal, and the resins were made by reaction of the acid with a glycidyl ester, with an epoxy group at the end of the molecule to react at lower temperatures.

Mr Tysall described briefly their work in partially or completely replacing phthalic by acids such as adipic, tetrahydrophthalic, etc., which resulted in a choice of hardness or flexibility in the resins. Finally, a series of resins was formulated replacing diols by triols in various proportions. The curing time for these resins was 30 minutes. The next step was to develop a method of rapid cure, which could be used with coil coating. A double propane burner was used, about one foot away from the surface, and this enabled a cure to be obtained in about 60 seconds. An American Blue M oven was used in later experiments; this gave a lower rate of rise in temperature. Mr Tysall then went through the results in detail, with a novel diagrammatic method of displaying the results of König, pencil, Erichsen, and impact tests etc. It was eventually found possible to reduce the curing temperature from 150°C to 120°C, with only slight loss in storage properties.

The lecture was followed by an interesting discussion, and a vote of thanks to the speaker was proposed by Mr A. G. North.

V.T.C.

Southern Branch

Chemical solvents for paint

The first meeting of the 1969-70 session was held on 21 October at the new venue of the Pendragon Hotel, Southsea, with Mr J. T. Tooke Kirby in the chair. Unfortunately, fog in the home counties interfered with travelling, and the attendance was well below the usual level and did not do justice to the excellent talk by Mr D. Sephton of Shell Research on chemical solvents for paints.

Mr Sephton briefly reviewed the various types of chemical solvents that were commonly available and commented on their individual reactivity, which sometimes resulted in solvent-solvent and solvent-binder interactions. Three major divisions in the properties of solvents were presented, the quantitative, where factors such as flash point and boiling range were important, the semi-quantitative, where molecular interaction was of importance, and the subjective properties, such as colour and odour.

The semi-quantitative properties were examined in great detail, particularly the work of the Shell Research Laboratories with the Shell evaporometer, which could be used to quantify the solvent-solvent and solvent-binder interactions. Mr Sephton gave examples of unexpected effects due to interaction, described work being done

on the evaporation characteristics of blended solvents for paint films, and commented upon methods to quantify the solvent interaction for particular solvent-resin systems.

Question time produced a number of interesting points and showed that there is still much to be learned in this interesting field of work.

B.A.R.

Midlands

The significance of particle size, shape, and packing in emulsion paints

The first meeting of the Midlands Section in 1970 was held at the Winston Restaurant on Friday 16 January, and was preceded by dinner. Mr H. Griffith, the Chairman Designate, was in the chair and over 50 Members were present to hear a very interesting paper presented by Dr C. Bondy, entitled "The significance of particle size, shape and packing in emulsion paints," in which the accent was on the factors involved in the optimum formulation of emulsion paints.

The importance of relative particle sizes of the emulsion and pigment particles was considered and it was illustrated that if the emulsion particles were small enough they could arrange themselves around and between the pigment particles and thus assist in the spacing of those particles necessary to obtain optimum opacity. Emulsions at present in use were generally too coarse to avoid the crowding of TiO_2 particles into clusters. Thus neither maximum binding efficiency nor optimum pigment utilisation was obtained. Fine particled emulsions could readily be prepared but they imparted undesirable flow properties, notably poor levelling, to emulsion paints.

The rheological behaviour of dispersed systems was greatly influenced by packing factors. The viscosity rose with increasing volume concentration (φ) of the disperse phase and became infinite at the concentration of closest random packing (φ_{\max}) in accordance with the following equation:

$$\eta = \eta_0 \cdot e^{\frac{2.5\varphi}{1 - \varphi/\varphi_{\max}}}$$

η = Viscosity of dispersed system, e.g. paint

η_0 = Viscosity of water phase

e = Base of natural logarithms

φ_{\max} for homodisperse emulsions was 0.64 (i.e. 64 per cent), while for pigments, it could be calculated with good approximation from their oil absorption as determined by the centrifuge method.

$$\varphi_{\max} = \frac{100/d}{100/d + \text{oil absorption}}$$

where d = density of pigment. φ_{\max} was approximately 0.47 for china clay and some highly modified grades of rutile, while more commonly used rutilites give a φ_{\max} of 0.56 and whiting a value of 0.70.

The lower the φ_{\max} of an emulsion paint, the greater was the danger of mud-cracking, poor coalescence and the formation of porous films. By blending coarse and fine particles (pigments, extenders and emulsions) higher packing factors (φ_{\max}) could be achieved. Optimum ratios were approximately 2:1 by volume of coarse to fine materials.

Thickeners influenced the viscosity of emulsion paints not only by raising the viscosity of the water phase but also by virtue of their adsorption at the pigment and resin particle surfaces. The adsorbed colloid layers effectively increased the volume

of the disperse phase. This increase was much more pronounced with fine than with coarse particles. Assuming a thickness of the adsorbed layer of 10nm, the effective volume of a 500nm particle would be increased by only 12 per cent while the same adsorbed layer would raise the effective volume of a 100nm particle by about 70 per cent. It was thus not difficult to see why fine particles could upset the rheology of emulsion paints so much. In the presence of adsorbed cellulosic colloids, they could undergo complete gelation at an apparent volume concentration of less than 50 per cent and give high yield values at much lower concentrations still. Paints containing ultrafine emulsion, pigment, or extender particles could lose mobility while still containing 50-60 per cent by volume of water, and this would lead to shrinkage cracking.

By preventing or reversing the adsorption of thickener on to emulsion and pigment particles it was possible to modify rheological properties in the direction of better levelling, controlled spreading rates, etc, even using fine particled emulsions. Certain dispersants and surfactants, e.g. sulphated or sulphonated non-ionics, were able to displace adsorbed cellulosic thickener molecules from the surface. Alternatively, improvements could be obtained by the use of colloids which gave adsorbed layers of much lower effective thickness, probably by being wrapped in a more compact sheath, rather than as coiled molecules, round the dispersed particles. Certain alkali-soluble acrylics, half esters of maleic anhydride copolymers, modified polyvinyl alcohols, and starches, appeared to be of this type.

For the design of emulsion gloss paints, packing considerations might be of particular importance if major improvements in wet-edge, levelling, opacity and gloss were to be achieved. Ideally, binder particles should be at least five times smaller than the pigment, and adsorbed layers of thickeners should be absent, or of the compact type. An alternative to the use of fine particled emulsions might be the encapsulation of completely deflocculated pigment particles in binder resin which would ensure greater spacing of the opacifying pigment. According to Steig¹ hiding power = $ks/(1+s)$ where k is a constant and s is the spacing in multiples of pigment particle diameter, so that pigment utilisation should be enhanced by using the binder resin as a spacer.

Reference

1. Steig, F., OCCA, Manchester Symposium, September 1969.

Newcastle

The prevention of bacterial corrosion of mild steel with paint films

The fourth meeting of the present session was held on 8 January 1970 at the Royal Turks Head Hotel, Newcastle on Tyne, when a paper was presented by Mr A. V. Robinson entitled "The prevention of bacterial corrosion of mild steel with paint films."

Mr Robinson began by saying that several cases of severe corrosion in the form of pitting on ships' hulls were investigated, in which the normal red iron rust corrosion was absent, and in its place was a heavy black deposit of ferrous sulphide. This corrosion was found to be due to sulphate reducing bacteria (*Desulphovibrio Desulphuricans*), which were able to utilise cathodic hydrogen and thus contribute to a process which caused severe corrosion in the form of pitting. These bacteria were found in many river muds, and a series of simple experiments was carried out to study the effect of these bacteria on paint films, and also to find out what effect, if any, chemical inhibitors might have on the anti-corrosive effect of these films. The mud samples used did show the characteristic pitting associated with bacterial corrosion, and the neutrality, varying sulphur contents and the apparent inactivity of the samples at low temperatures typical of muds containing sulphate reducers were found.

It was shown that some systems would protect immersed steel without inhibitors, but that these systems must be intact, a difficult thing to achieve on a ship's hull. Several chemical inhibitors, when added to various systems, were able to protect damaged areas. Solid and liquid inhibitors were used, and rather better results were obtained with the liquid ones. Twelve inhibitors were used in the test and three of these performed well in a plasticised coal tar pitch/aluminium paint. Protection was afforded by six inhibitors when included in low and high build pitch epoxy schemes. An oleoresinous and an epoxy paint were rather poor in the tests.

Mr Robinson concluded by saying that much more detailed work needed to be carried out before any one inhibitor or paint scheme might be said to give complete protection against bacterial attack. Fortunately, this type of attack was not too widely encountered in the marine environment, but with the advent of larger vessels more cases might arise. When it did occur the remedial work could be very expensive.

After question time the Meeting was closed by the Chairman, Mr Tate, who thanked Mr Robinson for his excellent, well prepared, paper.

A.L.

Scottish

Corrosion in the papermill

The December meeting of the Scottish Section, held on 11 December in the St. Enoch Hotel, Glasgow, took the form of a joint meeting with the Technical Section of the British Paper and Board Makers' Association. Three papers were presented on the topic "Corrosion in the papermill" and these provided an interesting range of viewpoints.

Mr M. D. Keith, of Caldwells Ltd. opened by describing the problems met by the mill engineer in countering corrosive attack by steam, water and chemical conditions. A typical plant was considered, showing how conditions varied at pulpers and refiners, the paper-making machine itself and in the pressing and drying sections, so that different problems were met at each stage. Water treatment in the boiler house by precipitation, ion exchange, re-use of condensate or a combination of these was essential, but care had to be taken on the cooling water side of condensers where raw water might be used. In pulpers and refiners, materials of construction were chosen to suit the conditions—for example stainless steel for alkaline conditions and lead, rubber or fibreglass for acid. Wood was a very versatile and resistant material but liable to failure through dehydration. Plant design had to avoid high velocities or turbulence, or failure by erosion might occur. In pulpers using a backwater system for economy, high concentrations of sulphite could be met, and overcome by additions of sodium aluminate. On the paper-making machine itself, and in the pressing and calendering areas, wet conditions could be very severe on structural steelwork. Modern developments included the use of plastic-covered wire frames and chromium plated or nylon rolls. Even in the finishing house, the need to maintain a relative humidity of 65 per cent encouraged rusting of steelwork. Mr Keith closed by emphasising that corrosion prevention was very much a matter of correct preventive maintenance.

The second paper, by Messrs G. Melvin and J. Haswell, of Bertrams Ltd., was presented by the latter gentleman and dealt with the efforts of machinery manufacturers to overcome corrosion problems. Modern high output, high cost, machinery made downtime losses and replacement costs very high, so that the prevention of corrosion had never been of greater importance. In plant used for stock preparation, pipework materials had evolved from cast iron and developed through copper to glass-lined and stainless steels, the latter being particularly attractive economically if spiral welded. New types of pipework in plastic materials looked encouraging, especially for resistance to abrasion. Stainless steel was replacing cast iron for vessel

fabrication, but concrete and tile-lined tanks were still popular. Fibreglass tanks were in increasing use and costs continued to fall. On the paper-making machine, wide use was now made of stainless steel and nickel or chromium on the wire part and epoxy resin coatings on the structural steel. Here and in the press and closer areas, cast iron had been replaced as a structural material by prefabricated steelwork with consequent increased liability to rusting, which made protection by correct painting more important.

In addition to nickel and chromium plating of rolls, Mr Haswell mentioned the use of PTFE coatings to reduce both corrosion and adhesion of unwanted material. He closed by noting that the recent price and delivery difficulties with nickel had stimulated the search for alternative materials.

Mr A. Pisacane, of Craig Hubbock Ltd., then spoke on the use of paint in corrosion prevention, and pointed out that modern surface coatings could greatly improve the performance of an economic but corrodable material. The significance of the electro-chemical series and its relation to anti-corrosive pigmentations was described. Two types of paint systems were distinguished, the traditional, based on linseed oil or a linseed oil/resin combination, and the modern inert insulating coating based on epoxy, polyurethane, chlorinated rubber or polyester binders. In the former case, an anti-corrosive pigment could be used, suitably chosen for the substrate, for example red lead for steel or zinc chromate for aluminium. Acid and alkali resistance could be poor, so that a typical use was on structural steelwork with normal weathering and no severe chemical attack. Moderately good surface preparation was required, and although the tolerance to adherent rust was good, performance did improve with the standard of surface. Such coatings were always subject to maintenance in the long term. With the modern inert coatings, the pigment needed only to be inert to the same degree, and acid and alkali resistance were generally good, so that outstanding durability could be attained and was, theoretically, permanent. Chlorinated rubber was particularly recommended for acid conditions, and epoxy for alkali. However, a thicker coating than with traditional materials was required and complete coverage was absolutely essential; hence surface preparation had to be of the highest standard. The needs of the papermill were not fundamentally different from those of other industries and were to be met by using surface coatings of adequate cohesion and adhesion, water and chemical resistance, with the correct application technique.

During the discussion which followed these papers, many points were taken up from the floor for further information, and it was clear that the papers had been of great interest to the audience. Mr Farquer of BPBMA, in a closing speech, thanked the committee of the Scottish Section for arranging the meeting and expressed the view that it had been a most successful venture. Dr Easton, of the Section, in proposing the vote of thanks to the speakers, agreed with this and felt that this type of meeting between specialists in different fields was always useful and stimulating.

J.L.H.

Management by objectives in research and development

The January meeting of the Scottish Section was held on Thursday 15 January in the St. Enoch Hotel, Glasgow where a large audience assembled to hear Mr E. W. Huggins, of Urwick Technology Management Limited, lecture on "Management by objectives in research and development."

Mr Huggins first dealt with the relationship between research and development and general management, and, in particular, with the problem of budgeting. Whereas at one time the tendency was to finance R & D by means of an arbitrary percentage of profits, the increase in size and importance, and thus of cost, of R & D had resulted in purely technical people being involved in management of finance to a much greater degree, and having to know much more about budgeting to achieve any success in



OCCA 22

27-30 April 1970

Raw Materials for Coatings and Adhesives

Polyacrylates and polyvinyl propionates, polymers of styrene, vinylidene chloride, vinyl ether, isobutylene and ethylene, melamine- and urea-formaldehyde condensation products, unsaturated polyesters, polyamides, resins soluble in ketone and spirit; solvents (including tetrahydrofuran), polyamines, plasticizers and numerous auxiliaries.

Pigments and Dyes

Phthalocyanine, azo and polycyclic pigments, colour lakes of basic dyes, luminous pigments, basic and acid dyes, metal-complex dyes and dyes soluble in hydrocarbons; pigment dispersions for printing inks, paints, plastics, rubber, emulsion paints and other aqueous media.

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*Corinac is the new anti-corrosive pigment that makes paints cheaper and longer lasting.

Prove it for yourself!

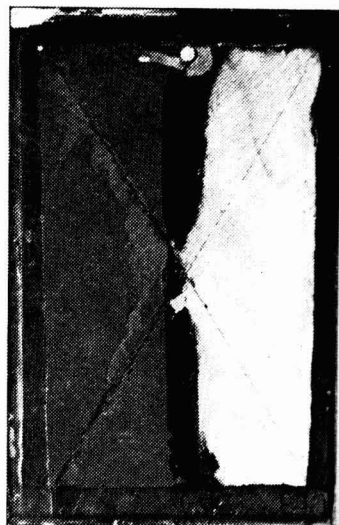
Now see it for yourself
at OCCA '70 on Stand 69

Performance of Corinac A in air-drying alkyd primer formulations showing the marked improvement obtained against the established anti-corrosive primer as shown in Panel A. Panel B has been coated with a primer containing Corinac A at a CrO_3 content of 1.5% on total paint solids.

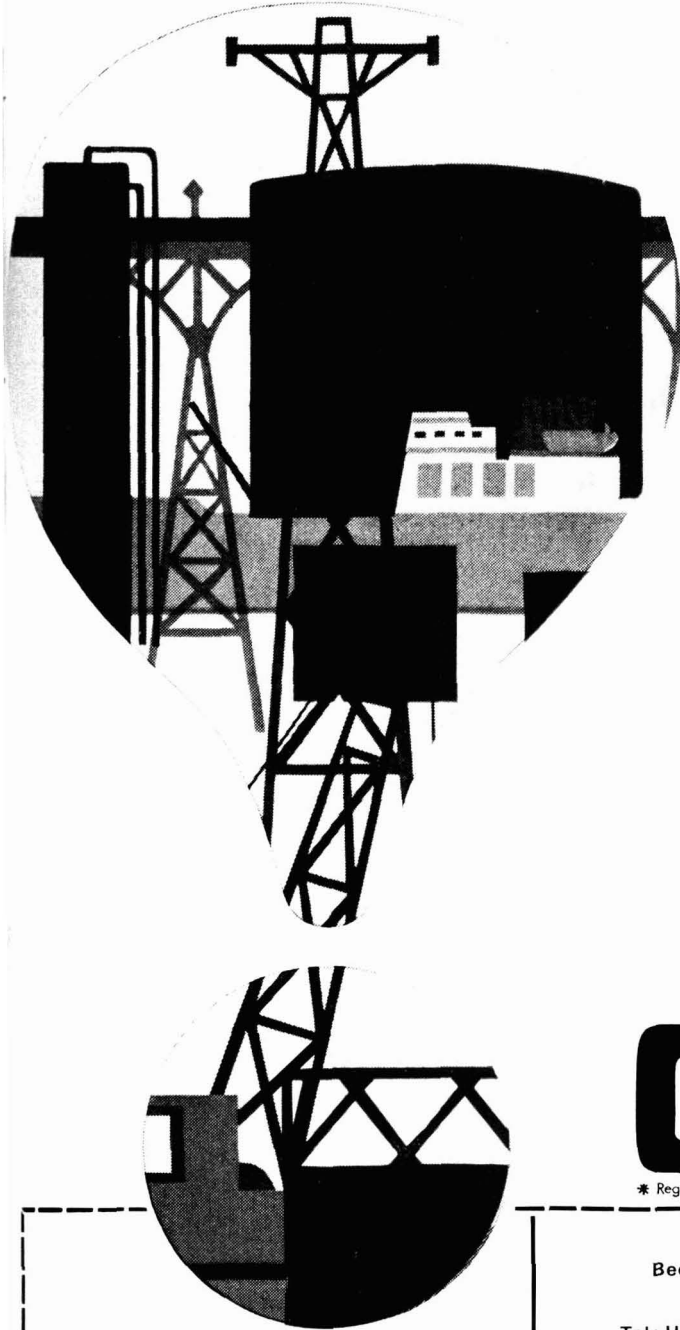
Both panels have been exposed for 300 hours under the standard conditions of salt spray test (DEF. 1053 method 24.)



PANEL A



PANEL B



Corinac has been developed following seven years' intensive research and development effort at the Harrogate laboratories of the Associated Chemical Companies Division of Albright & Wilson Limited.

Corinac has been designed for use as the sole corrosion inhibitor in a wide range of priming systems. Following accelerated and long-term exposure testing, Corinac has been found to be particularly effective in air-drying formulations. Testing has shown that optimum corrosion performance in any given system is achieved by the incorporation of Corinac at a level equivalent to 1 to 2% CrO₃ on total paint solids.

Corinac offers the paint manufacturer:

Improved corrosion performance.

Economies in raw material costs.

Primers that can be effectively applied over clean and partially rusty steel.

Primers that can be sprayed.

The wide ranging evaluation programme instituted by ACC Division has demonstrated the technical and economic advantages of Corinac.

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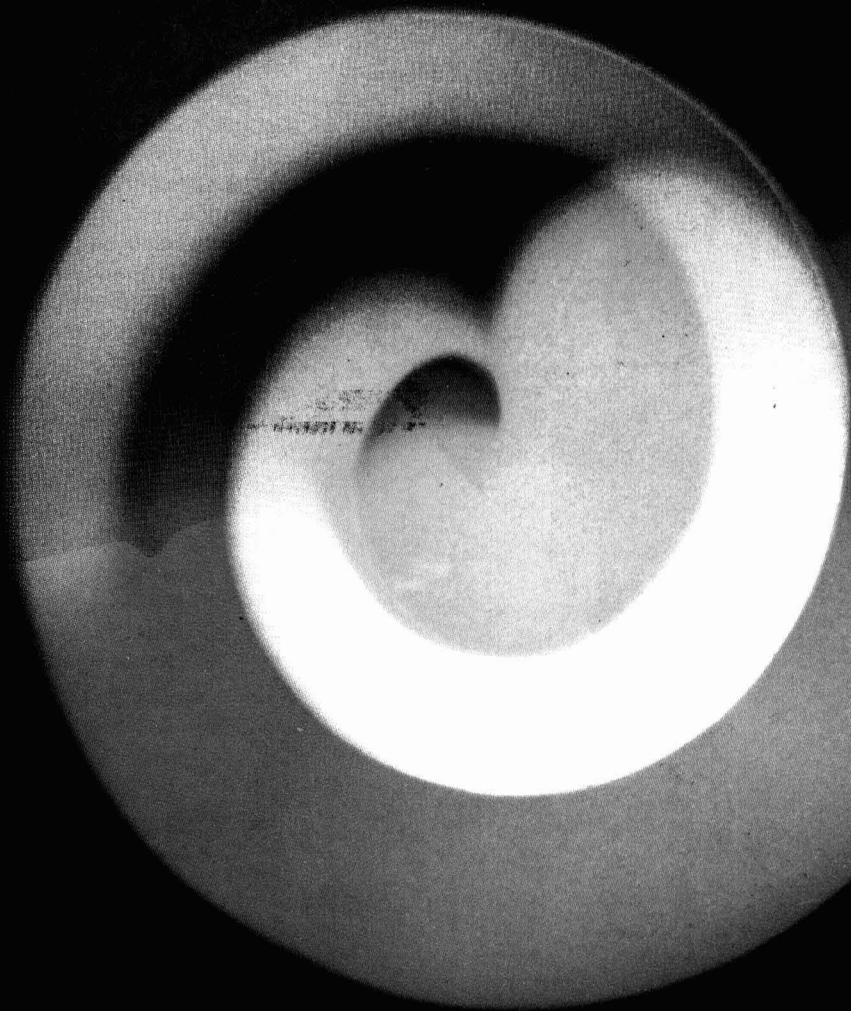
A Corinac expert

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Empire Hall
Olympia

OCCA'22

Stand 82

April 27-30·70



FARBWERKE HOECHST AG

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the battle for an increased cash allocation. This led on to consideration of R & D expenditure, which was largely in salaries, although some depreciation of plant and equipment must be taken into account, and the PPBS—the project programme budgeting system postulated by MacNamara, the US Secretary of State, was outlined, whereby to decide on a budget one had to decide on what one wanted to achieve—i.e. the objectives, and from these the cash requirement to achieve them. Thus, the budget became clear. The various aspects of company policy must be considered and the production/marketing resources, and operating plans, taken into account before R & D plans could be formulated which would cover: new product research, improved process research, and technical service, giving the R & D strategy and objectives.

Having thus clearly defined the objectives, the system of “management by objectives” could come into operation. The system was somewhat different from the established company or corporate strategy techniques, where annual management appraisal schemes had tended to have limitations, and job appraisal, and from this job specification, techniques were stagnating. Management by objectives was designed to replace job appraisals and specifications by key target area and key result area systems, which were relatively short term and could be quantified. The system of operation using the management guide layout was described, and examples of its adaptation to various objectives were detailed. Mr Huggins closed by listing the advantages accruing from MBO which were:

- improved communication,
- better team management,
- improved operation and co-ordination,
- better morale and sense of purpose,
- better assessment of managers, and
- more profit.

During the discussion which followed there was agreement that there was some danger of a lack of flexibility in an unexpectedly rapidly changing situation in this system, which was more easily applied to stable product situations and process development.

An enthusiastic response was made by the audience to the vote of thanks proposed by Mr T. B. Hannah.

J.L.H.

West Riding

The second technical meeting of the Session was held at Griffin Hotel, Leeds, on Tuesday 14 October, 1969, when Dr L. A. O'Neill of the Paint Research Association spoke on “Future developments in paints.”

Dr O'Neill prefaced his remarks with the comment that it apparently took 20 years for the original concept of a patented idea to become commercially viable, and he instanced the alkyds, patented in the thirties but not used widely until the fifties; vinyl acetate emulsions, patented in the mid-thirties but not of widespread use until mid-fifties; epoxy resins patented 1938/43 and only beginning to be exploited commercially in the early sixties; and finally the polyurethane resins which were made known in the UK with the examination of the BIOS reports at the end of the war, but were shelved on the grounds that they were inferior to alkyd-types and the two-pack system would never catch on—which it did not do until the late sixties.

Thus, to foresee the commercial ideas of the next decade it was worth checking the patent literature of the late 1950/early 1960 period.

With the alkyds, there was a wide range of combinations to look at and any developments were likely to be tied in with economics, although one field still open for exploration was in regulation of the molecular weight distribution of the alkyds. This had been difficult mainly because there had been no method for determining such distribution without several months of tedious work. Now, however, the gel permeation chromatography technique reduced this time to hours at a reasonable cost, and an instrument was in use at the PRS.

The vinyl copolymers had originally been maleates, then acrylates, now pva-ethylene copolymers and vinyl acetate/versatate copolymers were joining battle for the business, while from America pvc/acrylic copolymers were putting in an appearance. However, new developments could also be expected from experiments with varying pigment volume concentrations.

In the field of anti-corrosive finishes, there was likely to be some delay in producing new developments because, to date, no one had given a really satisfactory reason why lead inhibited corrosion and, until this was established, any attempts at developing new techniques were based on empirical guess-work. Dr J. E. O. Maynes' work on lead soaps came the nearest to explaining the reaction, but the discovery was made in 1951 and there ought to have been some advance from that by now.

Dr L. A. Jordan, about 20 years ago, had said that there was no reason for only using carbon as the basic element for coating polymers, there were a hundred other elements in the table to try. Dr O'Neill said that at last this point was being taken up and work was now in hand on aluminium-, boron-, nitrogen-, and phosphorus- based polymers as well as silicon, alone or in combination, although the results in inorganic polymers for coatings had been somewhat disappointing to date, apart from a reputation for good heat stability.

Fluorinated aromatic materials had been produced in experiments at Birmingham e.g. fluorophthalic acids, but they had produced probably the most expensive, useless alkyds. However, if the pattern continued, they would probably be in vogue in 1984.

Dispersymers—emulsions in non-aqueous continuous phases—or emulsions in aliphatic hydrocarbons had opened up a new range of chemistry. The first products of this type were polymethylmethacrylate in white spirit, stabilised with crepe rubber. Later work established that the stabilising agents were really graft polymers, and the Paints Division of ICI Ltd. had now put in about 12 years' work on the subject, so commercial exploitation should follow in the mid-seventies.

From types of coating, Dr O'Neill moved on to discuss future types of curing of coatings e.g. high-energy irradiation, electron-beam curing, and UV irradiation.

The lecture was concluded with illustrations of projects which had been the subject of study at the PRS over the last few years.

In the discussion period which followed, some light-hearted questions on "bubble-coating" paints were interspersed with more serious inquiries on conductive paints—well publicised on BBC-TV—and alternative raw materials.

Contributors were Mrs Driver, and Messrs T. R. Smith, Bartram, Drew, McKean, Gray, Cochrane, Morris, Hargreaves, DuRieu and Dr Watkinson.

J.N.MCK.



Technical Exhibition Preview

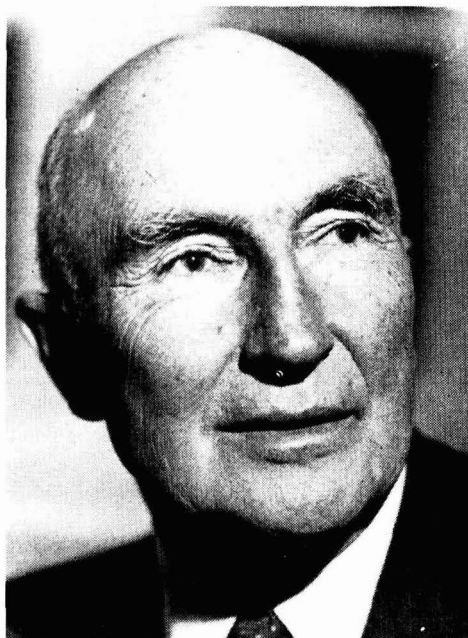
The Twenty-Second OCCA Technical Exhibition will be held at the Empire Hall, Olympia, London, W14 from 27-30 April and will be by a factor of 30 per cent the largest ever staged since the inauguration of the Technical Exhibition in 1949. There will be 107 stands, with a total of 180 companies involved, and of the companies showing, 11 have never shown previously, while 24 others did not show at the 1969 Exhibition. Amongst the overseas countries from which products will be shown are Belgium, Denmark, Finland, France, Germany, Holland, Italy, Norway, Sweden, Switzerland and the United States of America.

In view of the easier access to Olympia than to the previous venue, the Exhibition Committee has decided to extend the hours of opening as follows:

Monday	27 April	15.00—18.30hr
Tuesday	28 April	09.30—18.30hr
Wednesday	29 April	09.30—18.30hr
Thursday	30 April	09.30—18.30hr

Plans of the ground and first floors of the Empire Hall can be found on pages 324/5, and a numerical list of exhibitors on page 320. A diagrammatic map of the area around Olympia is printed on page 323, showing car parking and travel facilities. An underground train service to Olympia will be in operation at 10

to 15 minute intervals from Earls Court (District and Piccadilly lines), the first train leaving Earls Court at 09.00 and the last train leaving Olympia at 19.00.



Lord Sherfield, GCB, GCMG

The Exhibition Luncheon, for which the closing date for application for tickets is Monday 13 April, will be held at the

Savoy Hotel at 12.45 on Monday 27 April when Lord Sherfield, GCB, GCMG, will reply to the Address of Welcome by the President, Mr A. S. Fraser. Lord Sherfield will open the Exhibition at 15.00 and afterwards make a tour of some of the stands.

Copies of the *Official Guide*, which has already been sent to all Members of the Association and exhibitors, will be available free of charge at the Empire Hall. Advance copies may be obtained from the Association's offices.

To cater for the needs of the increasing numbers of overseas visitors, interpreters will again be in attendance on Stand 30, or at the Information Centre on Stand 31. As a service to both visitors and exhibitors, a visitor's card has been inserted into each copy of the *Official Guide* for personal use.

Facilities available at the Empire Hall include the Empire Restaurant, which will serve lunches from 11.30 to 15.30, and two licensed buffets. Escalators to and from the first floor will be operating throughout the hours of opening, and attractive seating areas have been provided.

As in previous years, a stand is devoted to Technical Education, the theme of which is "Newer methods of paint application," and invitations have been extended to parties of senior science students from local colleges and schools to visit Olympia. They will be given a short introductory lecture before touring the Exhibition.

In conjunction with Grand Metropolitan Hotels Ltd. the Association has made arrangements for hotel accommodation for visitors to the Exhibition. All persons overseas receiving the *Official Guide* will find a form enclosed; others wishing to avail themselves of this service should apply to the Association's offices.

BUPA has now been allocated Stand 101A to discuss the facilities available to members of the Association's group.

Further information may be obtained from the Association's offices.

Latest Information

Several exhibitors have made available more detailed information on the products to be shown, or increased the range of exhibits, since the *Official Guide* was printed. Latest information is given below.

Stand 35—Morris Ashby Ltd.

As well as the products already listed, Morris Ashby are to introduce a new range of black melamine pastes, first grade channel black 50M14, high colour channel black 50M18, medium colour channel black 51M37, and black melamine tinting paste 51M50, and three coloured pastes, pigmented with a phthalocyanine blue (*Melamine Paste 51M46*), a yellow oxide (*Melamine Paste 51M44*), and a red oxide (*Melamine Paste 51M45*) respectively.

All the pastes are said to be dispersed to a high degree, and to have maximum strength and compatibility with a wide range of other media.

Stand 46—Laporte Industries Ltd.

The Laporte stand will be closely allied with the opening of the new £7½ million chloride process titanium dioxide plant at Stallingborough, Lincs., this spring. Video tape recordings of the operation of the new plant, which will produce 40,000 tons of pigment per year, will be shown on closed circuit TV, and visual presentations of technical performance data will be featured, together with test panels of various formulations.

Research, technical and marketing personnel from the company's organics and pigments division will be on the stand throughout the Exhibition to provide full details on commercial applications and detailed information on durability, opacity and dispersibility of the new pigments. Visitors will also be able to discuss their sample requirements for testing.

Stand 57-58—Molteni Off Mecc.

As announced in the March issue of this *Journal*, this exhibitor's agent for

the UK, Commonwealth and Eire, G. J. Erlich Limited, is now acting in a similar capacity for Pressindustria SpA. A model of Pressindustria's plant for ethylene oxide condensation reactions to produce modified fatty acids suitable for use in alkyd manufacture will be shown on the stand. Full information on the absorption process utilised in the plant will also be available.

Stand 79—Vinyl Products Ltd.

The company's *Vinamul* and *Vinacryl* ranges will be featured, with particular emphasis to two products.

The first, *Vinamul 6705*, is a new ethylene grafted vinyl acetate copolymer emulsion for paint manufacture, developed from *Vinamul 6700*, the first ethylene-derived emulsion produced in the UK, which was shown at OCCA 19. *Vinamul 6705* is said to replace readily conventional vinyl acetate copolymer emulsions on a straight weight-weight basis to give paints with lower cost and excellent water and alkali resistance, and to be suitable particularly for general purpose interior-exterior paints, while usable in speciality exterior paints and good quality interior paints.

The second product is *Vinacryl 7172* (formerly *4172*), featured with particular reference to its role in emulsion paints. It is claimed that the outstanding pigment binding power and high degree of chemical inertness of the product, a styrene/acrylic copolymer emulsion, make it an ideal medium for highly loaded interior paints, good quality interior paints, and speciality exterior paints.

Stand 34—Amalgamated Oxides (1939) Ltd.

In the editorial in the *Official Guide*, it is stated that primers based on alkyd silicate derivatives will be shown. This should read primers based on alkyl silicates.

The particular alkyl silicates to be featured will include partially hydrolysed or polymerised methyl, ethyl or *iso*-propyl silicates, which have previously presented difficulties in formulation. The

availability of a range of products of suitable characteristics has made possible their use in a wider range of climatic conditions than that in which alkali silicates are used.

A special grade of zinc dust, *Zincoli 615*, has been developed for use with alkyl silicates. This has been available to certain selected customers for three years, but increased demand has necessitated a change in production techniques to make the grade generally available. A special supplement to the booklet "*Zincoli* zinc dusts," dealing with *Zincoli 615*, will be available on the stand.

Stand 25—Degussa

Owing to the interest which it has aroused in the 18 months since its introduction to the market, Degussa is to feature the product *OK 412* in a display of its matting agents.

Also, the hydrophobic *Aerosil R 972* will be shown in printing ink applications as well as in paints for corrosion resistance.

Stand 56—Berk Ltd.

Particular features of Berk's range of gellants will be two new products, *Redi-gel Bentone 38 WA*, and *Bentone LT*.

Redi-gel Bentone 38 WA is an organic modified magnesium aluminium silicate, completely dispersed in a long oil alkyd and white spirit. It has been designed for use where high-shear dispersion equipment is not available to incorporate dry *Bentone 38* gellant, and can be added after dispersion of the pigment and before the base is added to the let-down tank to complete the paint. It is claimed that *Redi-gel Bentone 38 WA* imparts improved suspension and thixotropy, and increased viscosity, and is compatible with all solvent-thinned trade paints.

Bentone LT is a highly efficient gelling and pigment suspending agent for latex paints. It is an organic modified magnesium montmorillonite clay designed to give maximum thickening per pound of gellant. Particular benefit is obtained, it is claimed, in polyvinyl acetate and

acrylic latex systems, gains being made in levelling and uniform appearance.

The results of laboratory work on the use of *Bentone* gellants in polysulphide resins will also be shown.

Two of Berk's *Oncor* range of pigments will be featured, *Oncor M50* in water-based primers for steel, giving good corrosion protection, and *Oncor F31* for electrocoating.

Amongst the range of filtering equipment handled by the company, the GAF filter bag pressure vessel system will be given particular emphasis.

Stand 70—BIP Chemicals Ltd.

The main exhibit on the stand will be a display demonstrating the versatility of an isobutylated melamine resin, one of the latest additions to the *Beetle* range.

The compatibility of *Beetle* resins *BE610*, *BE646*, *BE615* and *BE672* with various film-formers will be demonstrated by use of an enlarged calculator chart, which has been designed to solve the problems which the paint manufacturer meets in deciding between the large number of film formers now available.

Stand 62—British Celanese Ltd.

A further part of the British Celanese stand will be a display highlighting the wide range of applications for acetyl acetone. In particular, its uses as an intermediate in the manufacture of arylamide pigments, as a solvent in printing inks used on difficult surfaces, and as an ingredient in the manufacture of metal chelate polymerisation catalysts will be emphasised.

Stand 83—Geigy (UK) Ltd.

Geigy are to have two exhibits on the stand in addition to those mentioned in the *Official Guide*.

The first will be a new β -phthalocyanine blue with good flow properties, strength and brightness of shade. The pigment is claimed to be non-flocculating, and it is considered that it should prove very economical, particularly in decorative paints.

Secondly, the results of an investigation into the comparative efficiencies of ball milling and sand grinding will be shown, with particular reference to a number of well known pigments.

Stand 13—Union Carbide Europe SA

Since printing of the *Official Guide*, Union Carbide have decided to exhibit several new products and these are listed below:

Caprolactone polyols

The new *NIAX* caprolactone polyols combine the advantages of polyether and polyester polyols, having low viscosity, acid number, and colour, and controlled functionality. They produce urethane coatings of outstanding weathering characteristics with both aromatic and aliphatic isocyanates. Coatings can be made that have excellent chemical and physical properties, that are hard or elastomeric, or tough and wear resistant.

Silicones

Two reactive silicone resins will be presented as new additions to the Union Carbide range of silicones and silanes for the coatings industry.

Polycyclol 1222

This is a cyclic polyol suitable for alkyd modification, and application information will be available drawing comparisons between up-graded and conventional alkyds. *Polycyclol 1222* also offers interesting possibilities for the preparation of electrocoating resins.

Liquid epoxy resin ERL 2773

New technology for the preparation of water dilutable epoxy esters for electrocoatings.

Ester-diol 204

A new intermediate for the preparation of high performance oil-free film-forming polyesters.

Coalescing agents

The results of recent work on Union Carbide coalescing agents for latex paints will be shown.



evergreen

Irgalite Green
GLN

CI Pigment
Green 7:
halogenated
copper
phthalocyanine

for all paint
applications

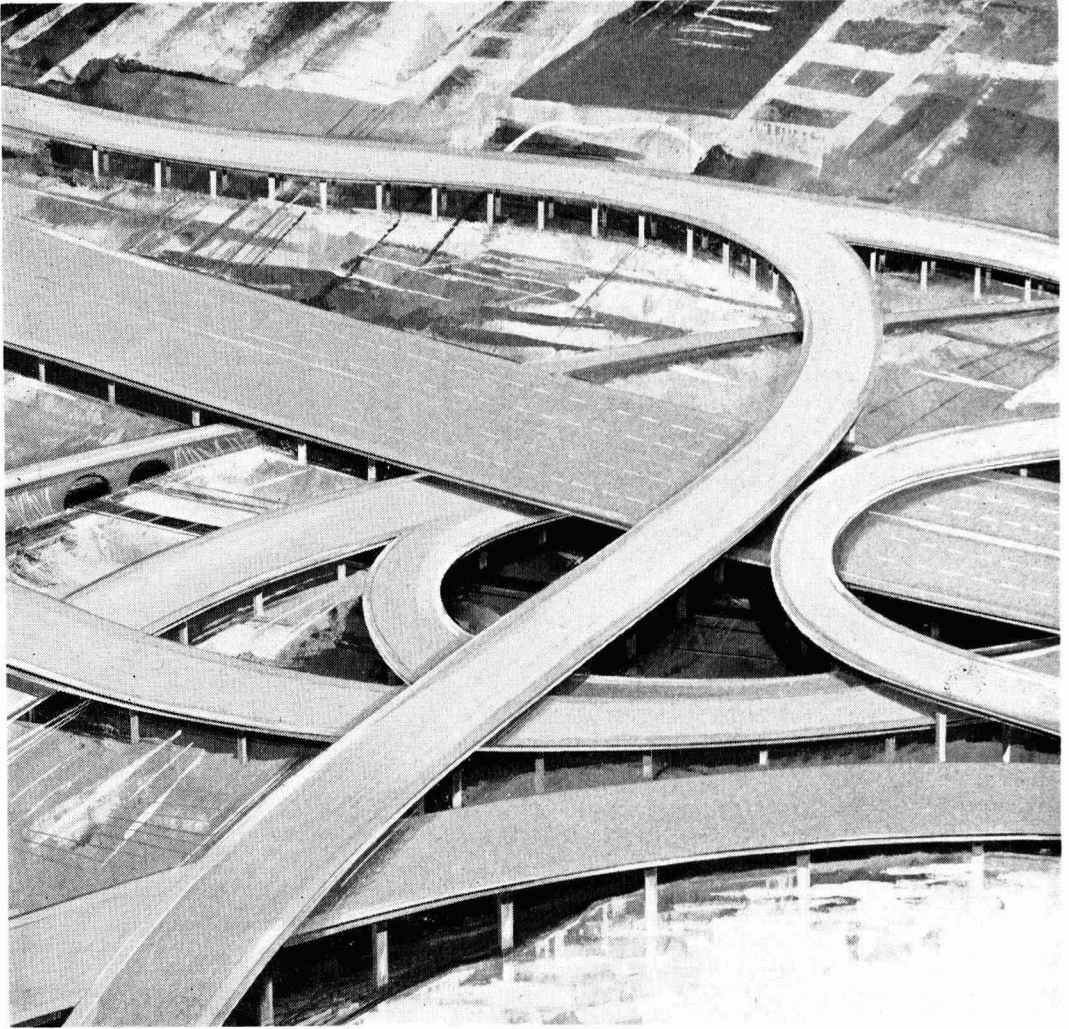
excellent
fastness

excellent
durability

clean mid-green
hue

Geigy

Geigy (U.K.) Limited
Pigments Division
Wythenshawe
Manchester M23 9ND



Gravelly Hill Midland Motorway Link.
 Consulting Engineers: Sir Owen Williams and Partners
 Main Contractors: A. Monk & Co. Ltd.
 Steel Fabricators: The Cleveland Bridge & Engineering Co. Ltd.
 Paint Supplier: British Paints Limited

Metallic Lead Primers Protecting the Seventies

Growing awareness of the rust inhibiting properties of Metallic Lead Primers has been further acknowledged by its specification for the Gravelly Hill Midland link motorway. Approximately twenty-five tons of metallic lead will be used on this project where the primer paint usage will be in excess of 10,000 gallons.

Metallic Lead Primers are proven throughout the world on a wide range of steel and galvanised structures, ships and chemical plant. According to site conditions, metallic lead primers can be formulated on oil, alkyd, epoxy, rubber or emulsion.

Available from leading Paint Manufacturers.

For further details contact :

SPELTHORNE METALS LIMITED

Manufacturers of Metallic Lead Pigment,

Church Street, Rickmansworth, Herts. WD3 1JQ Rickmansworth 73686.

U.K. Sales: Witco Chemical Co. Ltd. Bush House, Aldwych W.C.2. and Selling Agents throughout the world.



Stand 11—Paint Research Association

We regret that in the *Official Guide* this exhibitor was incorrectly stated to occupy Stand 10.

SCC Colours Ltd.

The telephone number of this company is incorrect in the *Official Guide* advertisement. It is 01-534 4151.

New Exhibitors

As noted in the February issue of the *Journal*, space was allocated by the Exhibition Committee to a late applicant. At this stage it was not possible to insert a mention of the company in the *Official Guide* and, accordingly, a description of the stand is given below.

Stand 12—Instrumental Colour Systems Ltd., 42 Kennet Side, Reading, Berks.

Instrumental Colour Systems Limited has recently been appointed exclusive UK distributors for the range of Pretema Colour Instrumentation. A model of the new *Pretema FS3A Spectromat* will be displayed. This instrument is a high quality precision spectrophotometer and contains a built-in tristimulus integrator. It gives an output of reflectance data and also computes CIE tristimulus values directly for illuminants A, C, D, and E. This instrument contains many features which are not available on other commercial equipment and visitors to the exhibition are particularly requested to bring along any samples which they would like measured, or indeed any of their other problems relating to the measurement, control and formulation of colour. Instrumental Colour Systems will also be showing the latest *MEECO Colormaster Model V*. The *Colormaster* is probably the best known of the low-cost precision colorimeters available in the world today and is extensively used in industry. It is ideally suited to the rapid measurement of colour difference and to the rapid correction of shades in production.

It is also hoped to have installed at the Exhibition a computer time-sharing terminal which will permit the demonstration of many techniques for calculation

of colour difference, batch correction etc. Again, visitors are welcome to bring any sample problems with them for evaluation on our stand.

Stand telephone numbers

Since the printing of the *Official Guide*, further stand telephone numbers have been allocated by the Post Office, and these are listed below:

Stand 33—Beck, Koller & Co. (England) Ltd.— 01-931 3980

Stand 76—British Titan Products Co. Ltd.— 01-931 3004

Stand 81—Ciba (ARL) Ltd.— 01-931 5712

Stand 80—Ciba Clayton Ltd.— 01-931 5638

Stand 93—Cornelius Chemical Co. Ltd.— 01-931 1770

Stand 16—Dow Chemical Europe SA— 01-931 5740

Stand 103—Du Pont Company (UK) Ltd.— 01-931 1199

Stand 106—Elcometer Instruments Ltd.— 01-931 3550

Stand 9—Grilon and Plastic Machinery Ltd.— 01-931 3984

Stand 82—Hoechst UK Ltd.— 01-931 4745 and 4940

Stand 63—Imperial Smelting Corporation (Alloys) Ltd.— 01-931 4377

Stand 47—Kingsley and Keith (Chemicals) Ltd.— 01-931 7440 and 4638

Stand 20—Mo och Domsjo AB— 01-931 5114

Stand 86—Paint Technology— 01-931 5254

Stand 51—Rhone Poulenc/Redis— 01-931 4995

Stand 88—Bernd Schwegmann KG/E. J. R. Lovelock— 01-931 5427

Stand 84—VVB Lacke und Farben— 01-931 5616

Numerical List of Exhibitors—OCCA 22

Stand

- 1 DH Industries Ltd.
- 2 Anchor Chemical Co. Ltd.
- 3 Cabot Carbon Ltd.
- 4 The Baker Castor Oil Company
- 5 Winkworth Machinery Ltd.
- 6 R. H. Chandler Ltd.
- 7 Redifon Ltd.
- 8 Hygrotherm Engineering Ltd.
- 9 Grilon & Plastic Machinery Ltd.
- 10 Byk-Mallinckrodt Chemische Produkte GmbH
- 11 Paint Research Association
- 12 Instrumental Colour Systems Ltd.
- 13 Union Carbide Europe SA
- 14 Peter Silver & Sons (Engineers) Ltd.
- 15 Veba Chemie AG
- 15a Chemische Werke Høuels AG
- 16 Dow Chemical Europe SA
- 17 Cox's Machinery, Ltd.
- 18 Chemical Industry of the Federal Republic of Germany
- 19 Kronos Titanium Pigments Ltd.
- 20 Mo och Domsjö AB
- 21 Lennig Chemicals Ltd.
- 22 Research Equipment (London) Ltd.
- 23 Diaf A/S
- 24 Wacker-Chemie GmbH
- 25 Degussa
- 26 Jenag Equipment Ltd.
- 27 RK Chemical Co. Ltd.
- 28 Dunlop Chemical Products Division
- 29 Silverson Machines Ltd.
- 30 Interpreters
- 31 Oil and Colour Chemists' Association Information Centre
- 32 Technical Education
- 33 Beck, Koller & Co. (England) Ltd.
- 34 Amalgamated Oxides (1939) Ltd.

Stand

- 35 Morris Ashby Ltd.
- 36 August's Ltd.
- 37 Ferranti Ltd.
- 38 Scott Bader Co. Ltd.
- 39 Torrance & Sons Ltd.
- 40 Amoco Chemicals Europe
- 41 Unitechna GmbH
- 42/43 Marchant Brothers Ltd.
- 44 Joseph Crosfield & Sons Ltd.
- 45 Electricity Council
- 46 Laporte Industries Ltd.
- 47 Kingsley and Keith (Chemicals) Ltd.
- 48 Durham Raw Materials Ltd.
- 49 NV Tiofine
- 50 Farbenfabriken Bayer AG
- 51 Rhone-Poulenc/Redis
- 52 Henkel & Cie GmbH
- 53 Rudolph Meyer's Inc.
- 54 Carless, Capel & Leonard Ltd.
- 55 Buhler Brothers Ltd.
- 56 Berk Ltd.
- 57/58 Molteni Off. Mecc. of Milan
- 59 National Westminster Bank Ltd.
- 60 Mastermix Engineering Co. Ltd.
- 61 Sterling Colour Co. Ltd.
- 62 British Celanese Ltd.
- 63 Imperial Smelting Corporation (Alloys) Ltd.
- 64 British Oxygen Chemicals Ltd.
- 65 Sachtleben AG
- 66 Scado-Archer-Daniels NV
- 67 Imperial Chemical Industries Ltd.
- 68 Shell International Chemical Co. Ltd.
- 69 Albright & Wilson Ltd.
- 70 BIP Chemicals Ltd.
- 71 Grace GmbH
- 72 Churchill Instrument Company Ltd.

<i>Stand</i>	<i>Stand</i>
73 <i>Paint, Oil and Colour Journal</i>	89 Cray Valley Products Ltd.
74 Dynamit Nobel AG	90 Polyvinyl Chemie Holland NV
75 Harlow Chemical Co. Ltd.	91 BASF United Kingdom Ltd.
76 British Titan Products Co. Ltd.	92 Vuorikemia Oy
77 Titanium Intermediates Ltd.	93 Cornelius Chemical Co. Ltd.
78 Eastman Chemical International AG	94 Daniel Products Company
79 Vinyl Products Ltd.	95 Winn & Coales
80 Ciba Clayton Ltd.	96 Longfield Chemicals Ltd.
81 Ciba (ARL) Ltd.	97 Unilever-Emery NV
82 Hoechst UK Ltd.	98 Cassella Farbwerke Mainkur AG
83 Geigy (UK) Ltd.	99 Styrene Co-Polymers Ltd.
84 VVB Lacke und Farben	100 John L. Seaton & Co. Ltd.
85 Sandoz Ltd.	101 A/S Norwegian Talc
86 <i>Paint Technology</i>	102 Sheen Instruments (Sales) Ltd.
87 Microscal Ltd.	103 Du Pont Company (UK) Ltd.
88 E. J. R. Lovelock	104 Torsion Balance Co. (Great Britain) Ltd.
88 Bernd. Schwegmann KG	105 <i>Paint Manufacture</i>
	106 Elcometer Instruments Ltd.

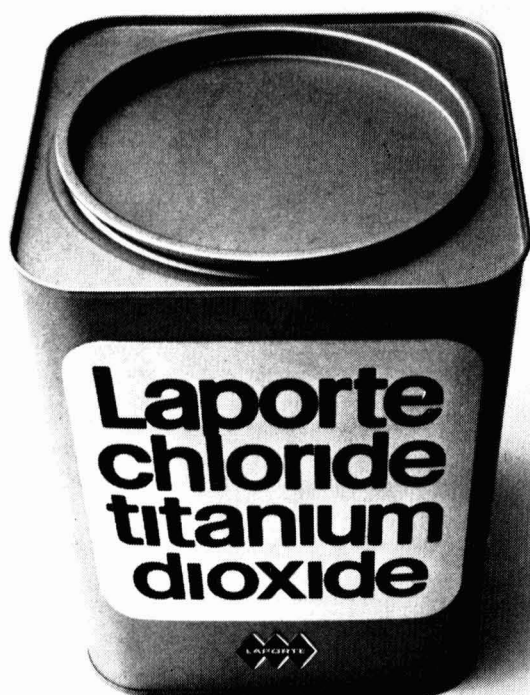
In addition to the exhibitors listed above, reference is also made in the *Official Guide* to the following companies.

<i>Stand</i>	<i>Company</i>	<i>Official Guide Page No.</i>	<i>Stand</i>	<i>Company</i>	<i>Official Guide Page No.</i>
47	Acima SA	115	8	Dansk Sojakagefabrik	120
47	Allied Chemical Corporation	115	18	DEGA GmbH	79
1	Ateliers Sussmeyer	87	19	Derives du Titane SA	116
88	Barlow, Henry, & Sons (Manchester) Ltd.	120	47	Diamond Shamrock Chemical Co	116
10	Bayer Chemicals Limited	67	16	Dow Chemical Company (UK) Ltd.	90
20	Berol	128	96	Drew Chemical Company Inc.	121
24	Bush, Beach & Segner Bayley Ltd.	84, 174	94	Dusseck Brothers, Ltd.	87
10	Byk-Gulden Lomberg	67	78	Eastman Kodak Co.	94
4	Campbell, Rex, & Co. Ltd	58	96	Dr M. Ebnother AG	121
19	Canadian Titanium Pigments Limited	116	9	Emser-Werke AG	103
34	Canadian Zincoli Pigment Ltd.	50	106	Erickson GmbH	95
80/81	Ciba Limited	76, 77	57	Erlich, G. J., Limited	127
47	Cooppal SV	115	35	Fabriques de Produits Chimiques de Thann et de Mulhouse	56
62	Courtaulds Group	65	96	Fairmount Chemicals	121
94	Daniel Products (Europe) NV	86			

<i>Stand</i>	<i>Company</i>	<i>Official Guide Page No.</i>	<i>Stand</i>	<i>Company</i>	<i>Official Guide Page No.</i>
96	Gema AG	121	1	Pamasol Willi Mader ..	88
96	Gerbstoffchemie Franz Mar- gold	121	51	Pechiney-Saint-Gobain ..	144
20/51	Greeff, R. W., & Co. Ltd.	130, 143	69	Pfizer, Charles, & Company Inc.	49
15	Hibernia Chemie AG ..	171	96	Pigmentos & Oxidos ..	121
15a	Huels UK Ltd.	72	96	Rasquin, Franz, GmbH ..	121
15	Industria (Chemical Services) Ltd.	171	82	Reichhold-Albert-Chemie AG	108
73	Industrial Newspapers Ltd. ..	135	93	Roehm & Haas GmbH ..	80
47	Jones, Ellis, & Co. (Stock- port) Ltd.	116	63	RTZ Britain Ltd.	110
1	Kupper, Peter	88	15	Ruhrloel AG	171
51	KW Chemicals Limited ..	143	15	Saltzgitter AG	171
46	Laporte-Synres Limited ..	118	88	Sanyo Chemical Industries ..	120
62	Leek Chemicals Limited ..	65	86	Sawell Publications Limited	138
52	Little, J. H., & Co. Ltd. ..	106	15	Scholven Chemie AG ..	171
96	LNP Plastics NV	121	38	Scott Bader Sturge	152
10	Mallinckrodt Chemical Works	67	47	Sherwin-Williams Co. ..	115
2	Marbon Chemical Division of Borg Warner Corporation	54	20	SOAB	128
96	Millmaster-Onyx Inter- national	121	47	Staperm Limited	115
20	Modo Products (Chemicals) Ltd.	130	106	Stierand GmbH	95
48	Morehouse-Cowles Inter- national	92	34	Stolberger Zincolli GmbH ..	50
105	Morgan-Grampian (Publi- shers) Ltd.	135	1	Sussmeyer/Battle	87
19	National Lead Company ..	116	19	Titan Co. AS	116
96	Nordmann Rassmann ..	121	19	Titangesellschaft mbH ..	116
			41	Unitechna GmbH	123
			18	Verband der Chemische In- dustrie eV	79
			36	Vickers Limited	58
			1	Vollrath, Paul	87
			1	Vree, J. De, & Co. ..	88

**No need to mob our
stand at the O.C.C.A. exhibition.**

They'll all have it one day.





**Who says,
'Beetles aren't
compatible'?**

They are with the Paint Industry!

Beetle amino resins are compatible with a wide variety of other film formers used by the Paint Industry – and we demonstrate this at O.C.C.A.

Since more than 50% of the amino resins used by the U.K. surface coating industry are supplied by BIP, the new Beetle compatibility wall chart is an essential part of your laboratory equipment.

Please visit our stand at O.C.C.A. to discuss your coating resin problems with our technical staff and collect your own wall chart.

STAND 70/O.C.C.A.



a plus for plastics

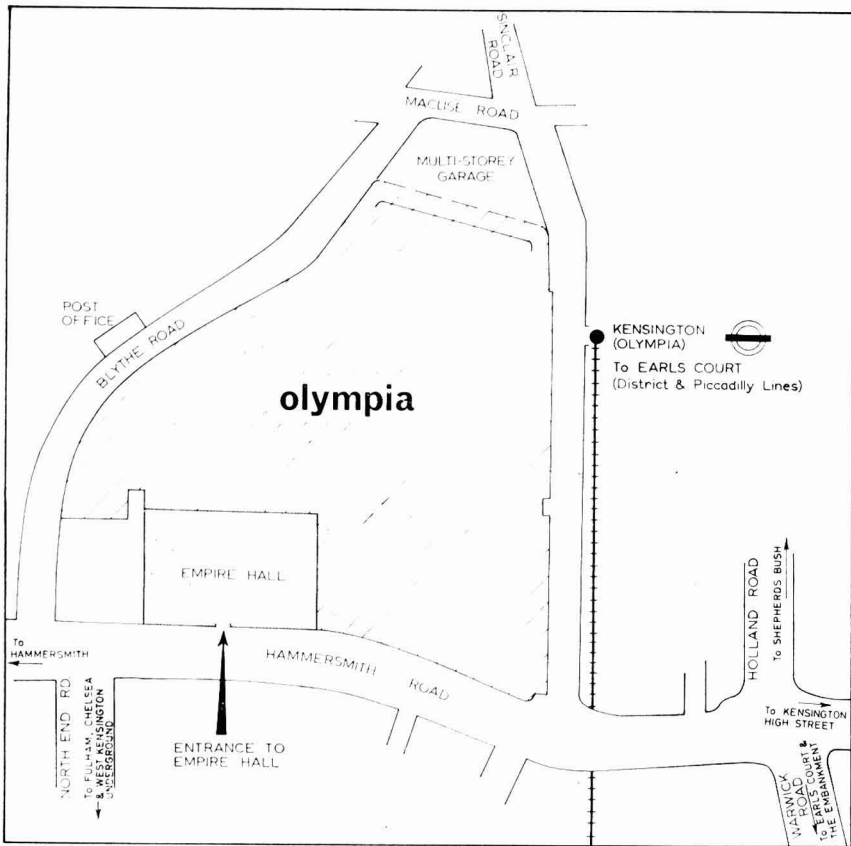
BIP Chemicals Limited

TURNER
& NEWALL
LIMITED



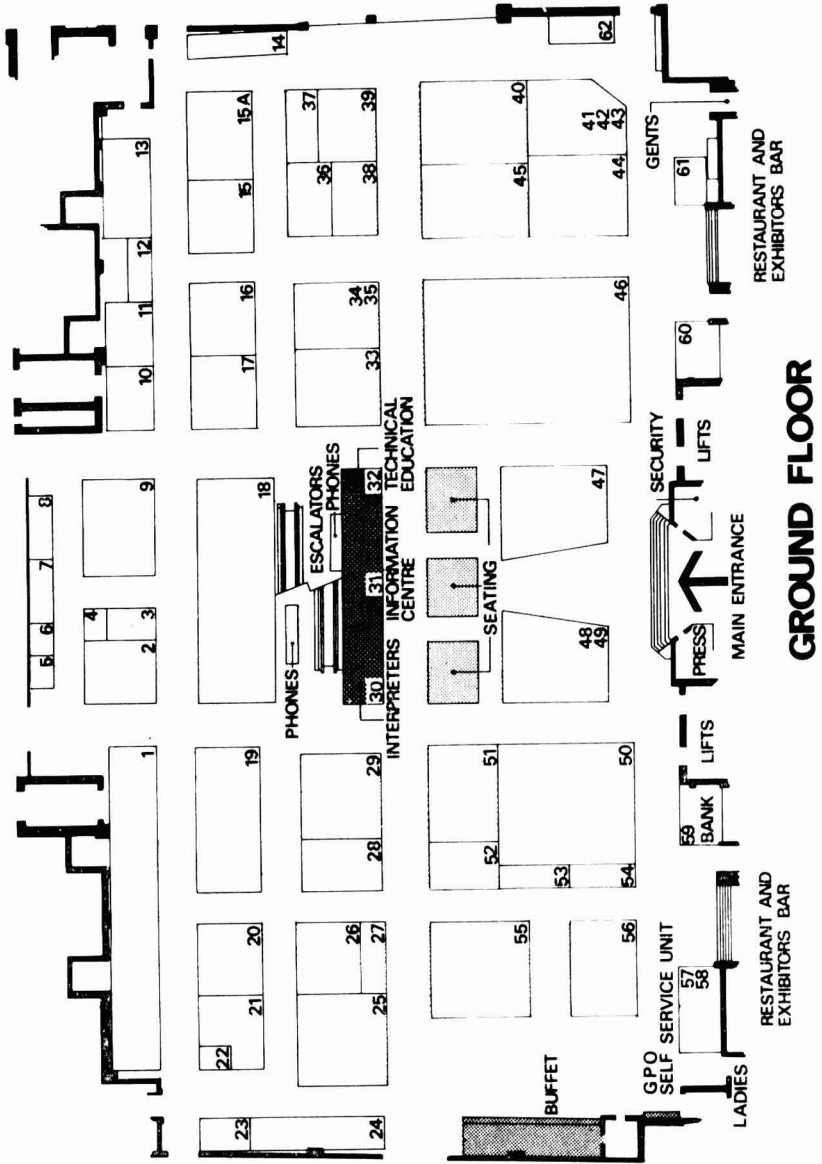
Popes Lane, Oldbury, P O Box 6, Warley Worcs
Telephone 021-552 1551 Telex 33-347

Plan of Olympia

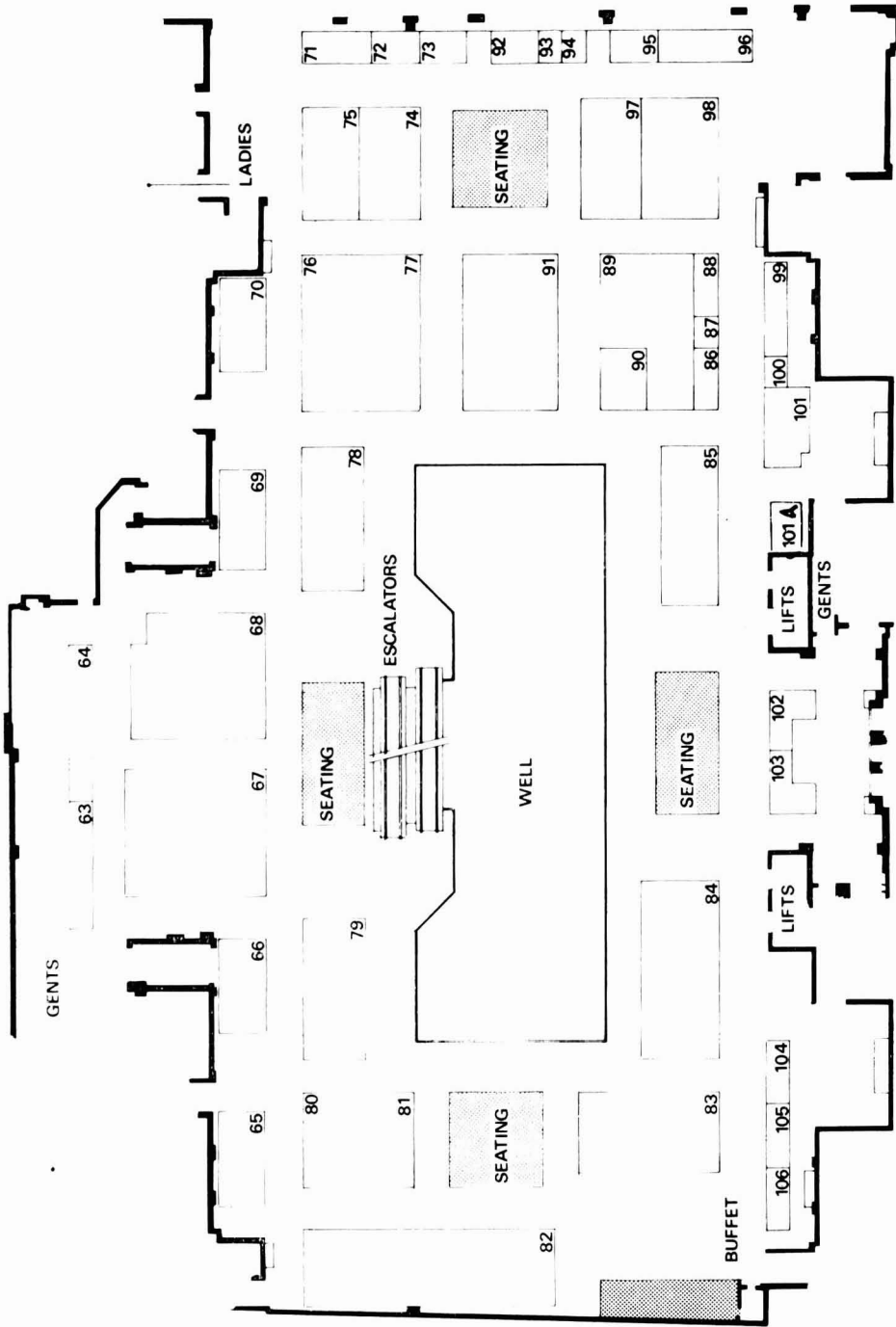


1. For those travelling by road, there are car parking facilities available in the multi-storey garage, the entrance to which is from Maclise Road.
2. Visitors arriving at the West London Air Terminal may board District Line trains at Gloucester Road Underground Station to Earls Court from which station a special Underground train is available to Olympia.
3. Olympia can be reached from main line stations by travelling on the Underground to Earls Court, which is on the District or Piccadilly Line, and changing to the special train.
4. There are a number of bus routes which also serve Olympia:
 Bus Nos.: 9, 27, 28, 49, 73, 91, 207A and 270.
 Green Line Coaches Nos.: 701, 702, 704, 705, 714 and 716A.
5. There is a Motorail Terminal at Olympia and those wishing to transport their cars should contact British Rail.

Plan of Exhibition



GROUND FLOOR



FIRST FLOOR

Exhibitor	Stand No.	Resins	Pigments	Extenders	Additives	Solvents	Oils	Machinery	Lab. Machinery	Instruments	Misc.
Chandler, R. H., Ltd. ..	6										Publications
Chemical Industry of the Federal Republic of Germany	18										Various plastics
Chemische Werke Huels AG	15A	●									
Churchill Instrument Co. Ltd.	72									●	
CIBA (ARL) Ltd. ..	81	●									
CIBA Clayton Ltd. ..	80		●								
Cornelius Chemical Co. Ltd.	93	●	●		●						
Cox's Machinery, Ltd. ..	17							●			
Cray Valley Products Ltd.	89	●									
Crosfield, Joseph, & Sons Ltd.	44			●	●						Matting agents, antiblocking agents
Daniel Products Company	94				●						Dispersions
Degussa	25		●	●							
D. H. Industries Ltd. ..	1							●	●		
Diaf A/S	23							●	●	●	
Dow Chemical Europe SA	16	●			●						
Dunlop Chemical Products Division	28	●									
Du Pont Company (UK) Ltd.	103	●									
Durham Raw Materials Ltd.	48		●		●			●			
Dynamit Nobel	74	●									Titanium, zirconium and vanadium esters

Exhibitor	Stand No.	Resins	Pigments	Extenders	Additives	Solvents	Oils	Machinery	Lab. Machinery	Instruments	Misc.
Eastman Chemical International AG ..	78	•			•	•					Coalescing agents
Elcometer Instruments Ltd.	106									•	
Electricity Council ..	45							•			Process heating. Industrial Information Centre
Farbenfabriken Bayer AG	50	•	•								
Ferranti Ltd.	37								•	•	
Geigy (UK) Ltd. ..	83		•		•						
Grace GmbH	71		•	•	•						
Grilon & Plastic Machinery Ltd. ..	9	•									Powder coatings
Harlow Chemical Co. Ltd.	75	•									
Henkel & Cie GmbH ..	52	•			•						Plasticisers
Hoechst UK Ltd. ..	82	•	•		•	•			•		
Hygrotherm Engineering Ltd.	8							•			
ICI Ltd.	67	•	•		•	•					
Imperial Smelting Corporative (Alloys) Ltd.	63		•								
Instrumental Colour Systems Ltd.	12									•	
Jenag Equipment Ltd. ..	26							•			
Kingsley & Keith (Chemicals) Ltd. ..	47	•	•		•	•					
Kronos Titanium Pigments Ltd.	19		•								
Laporte Industries Ltd. ..	46	•	•								Raw materials for resins

Exhibitor	Stand No.	Resins	Pigments	Extenders	Additives	Solvents	Oils	Machinery	Lab. Machinery	Instruments	Misc.
Lennig Chemicals Ltd. . .	21	•									
Longfield Chemicals Ltd.	96	•	•		•			•			Plasticisers, powder coatings
E. J. R. Lovelock . .	88				•		•				Fatty acids
Marchant Brothers Ltd. . .	42/ 43							•	•		
Maschinenfabrik Heidenau, Veb. . .	41							•	•		
Mastermix Engineering Co. Ltd.	60							•	•		
Meyer's, Rudolph, Inc. . .	53								•	•	
Microscal Ltd.	87								•	•	
Molteni Off. Mech. . .	57							•			
Mo och Domsjo AB . .	20	•			•	•					
Norwegian Talc A/S . .	101			•							
<i>Paint Manufacture</i> . .	105										Technical journal
<i>Paint Oil and Colour Journal</i>	73										Technical journal
Paint Research Associa- tion	11										Research Association
<i>Paint Technology</i>	86										Technical journal
Polyvinyl Chemie Holland NV	90	•									
Redifon Ltd.	7								•		
Research Equipment (London) Ltd.	22									•	
Rhone Poulenc/Redis . .	51	•			•						
RK Chemical Co. Ltd. . .	27									•	
Sachtleben AG	65		•	•							

Exhibitor	Stand No.	Resins	Pigments	Extenders	Additives	Solvents	Oils	Machinery	Lab. Machinery	Instruments	Misc.
Sandoz Ltd.	85		•								
Scado-Archer-Daniels NV	66	•									
Schwegmann, Bernd., KG	88				•						Textiles for sieving/ filtration
Scott Bader Co. Ltd. . .	38										PVDC emulsions for paint
Seaton, John L., & Co. Ltd.	100						•				
Sheen Instruments (Sales) Ltd.	102									•	
Shell International Chemical Co. Ltd. . .	68	•				•					
Silver, Peter, & Sons (Engineers) Ltd. . .	14							•	•	•	Vessels, benches
Silverson Machines Ltd.	29							•	•		
Sterling Colour Co. Ltd.	61		•								
Styrene Co-Polymers Ltd.	99	•									
Tiofine NV	49		•								
Titanium Intermediates Ltd.	77										Metal organic compounds
Torrance & Sons Ltd. . .	39							•	•		
Torsion Balance Co. (GB) Ltd.	104									•	
Unilever-Emery NV . .	97	•			•						Polyols and polyol systems for urethane foam applications Polymerisable plasticiser for metal coatings

Exhibitor	Stand No.	Resins	Pigments	Extenders	Additives	Solvents	Oils	Machinery	Lab. Machinery	Instruments	Misc.
Union Carbide Europe SA	13	•			•						
VVB kombinat Lacke und Farben	84	•	•	•	•						
Veba-Chemie AG ..	15	•			•	•					
Vinyl Products Ltd. ..	79	•									
Vuorikemia Oy	9		•								
Wacker-Chemie GmbH ..	24	•									
Winkworth Machinery Ltd.	5							•	•		
Winn & Coales								•			

Scottish Symposium and Association AGM

Dispersion in theory and practice

The programme for the Symposium "Dispersion in theory and practice," to be organised by the Scottish Section at East Kilbride, near Glasgow, in conjunction with the Association's Annual General Meeting, has now been arranged.

Careful selection of lecturers and subjects has been made, so that the Symposium committee's stated object, that of bringing together research workers carrying out fundamental studies and technologists and managers concerned with dispersion as an industrial operation in a commercial context, can best be achieved.

A panel of speakers of recognised authority has been assembled to cover the various aspects of the subject. After each lecture, about thirty minutes has been allocated for discussion, and at the close of the Symposium, an overall

summary will be made, and a longer and more general discussion will take place.

The detailed programme is given below.

Thursday 21 May

- 10.30 Opening address.
- 11.00 "Some aspects of pigment dispersion, with particular emphasis on carbon black," by Mr W. M. Hess and Mr M. D. Garret, of Columbian Carbon Co. Ltd.
- 12.30 Lunch.
- 14.00 "Dispersion in aqueous media" by Dr W. Carr, of Geigy (UK) Ltd.
- 15.30 "The influence of non-aqueous media on dispersions," by Mr K. Pond, of Lorilleux & Bolton Ltd.
- 17.30 Annual General Meeting of the Association.

Friday 22 May

- 09.30 "Some aspects of dispersion in relation to titanium dioxide," by Dr R. Amberg, of Kronos Titanium Pigments Ltd.
- 11.00 "The influence of interfacial activity in paint films on their properties," by Dr W. Funke, of the Forschungsinstitut für Pigmente und Lacke EV.
- 12.30 Lunch.
- 14.15 "Dispersion machinery" by Dr J. B. Slinger of ICI Ltd.
- 15.45 Summing up by Dr S. H. Bell, of the Paint Research Association, followed by a general discussion.

All lectures will be held in the Ballerup Hall, in the Civic Centre, East Kilbride. Lunch will be served to all registrants in the Bruce Hotel, East Kilbride. Morning and afternoon coffee will also be supplied.

Association AGM and Dinner

The Association's Annual General Meeting will be held in the Ballerup Hall at 17.30 on Thursday 21 May, and will be followed (19.30 for 20.00) by a dinner at the Bruce Hotel. All registrants, whether members of the Association or not, will be welcome at the dinner, the charge for which will be £2 10s inclusive of wines. Dress will be informal.

Accommodation

All bedrooms at the Bruce Hotel have been reserved for the Symposium for the nights of Wednesday 20 and Thursday 21 May, and the charge has been agreed at 55s per night for bed and breakfast. Participants wishing to extend their stay over the weekend may do so at the same rate, if the reservation is made on the Symposium reservation form.

Arrangements have also been made to provide additional accommodation in other hotels of comparable standard within easy reach of the Ballerup Hall, should bookings exceed the capacity of the Bruce Hotel. Payment in all cases will be direct to the hotel in question.

Transport

East Kilbride is within easy reach of Glasgow, local trains departing at regular intervals from Glasgow Central Station, which is close to the terminus for airport coaches in St. Enoch Square, and thus convenient for both air and rail travellers. If there is sufficient demand, the Bruce Hotel will provide transport direct from Glasgow Abbotsinch Airport.

Exhibition

A small exhibition of the latest developments in industrial dispersion equipment will be held in the foyer of the Ballerup Hall during the Symposium.

Social Programme

A programme of outside activities has also been arranged, primarily for the benefit of the families of delegates. All-day tours, to the Loch Lomond area on the Thursday, and to Edinburgh on the Friday, will take place, and a conducted tour of the East Kilbride fashion goods factory of Lerosé is to be organised. Numbers on some excursions may have to be limited, and applications should be made as early as possible to ensure a place.

All delegates and their guests will have the use of the excellent local golf course, and it will be possible for those interested to visit the National Engineering Laboratory at East Kilbride.

Fees

Fees for the Symposium, which will include a set of short summaries of all the papers to be presented, will be as follows:

Members	£5
Student Members	£1 10s
Non-members	£7 10s

Application forms have been dispatched to all UK, Irish and General Overseas Members, and any other interested person should contact the Symposium Secretary, Mr I. R. McCallum, P. W. Hall Ltd., Woodilee Industrial Estate, Kirkintilloch, Glasgow, **immediately**.

Association Dinner Dance 1970

As reported in the January Journal, Council has approved the arrangements for the Association's Biennial Dinner Dance, to be held at the Savoy Hotel, London WC2. This will be held on Friday 29 May with the reception at 7.00 p.m. prior to dinner at 7.30.

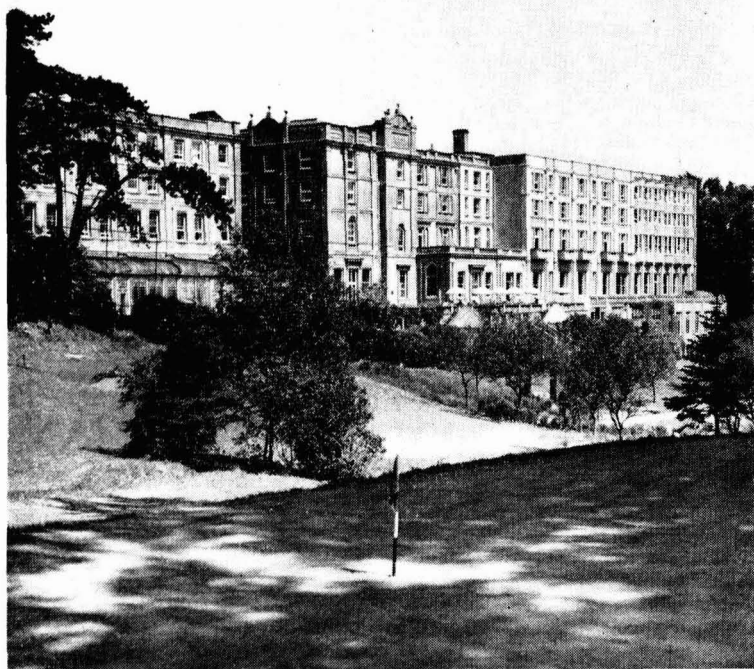
After dinner there will, on this occasion, be three short speeches, so that dancing to the Jerome Orchestra may begin as soon as possible, and this will continue until 1 a.m. There will be an interval

at 11.30 p.m. for refreshments, and a cabaret has been arranged to take place at this time also.

Applications for tickets (at £4 4s 0d each) were circulated to Members early in January, and non-members wishing to attend should apply to the Director and Secretary, at the Association's offices.

Early application is advised, as a considerable number of requests has already been received.

Association Conference, 4-8 May 1971



The Palace Hotel, Torquay

Surface properties and appearance

Council has decided that the theme of the 1971 Association Conference shall be "Surface Properties and Appearance."

It is intended to hold four technical sessions, each of three papers, on the three mornings of the Conference and one afternoon. The other two afternoons will

be devoted to workshop sessions and the Annual General Meeting of the Association. It is also intended, on this occasion, to hold a session on "The Management of Innovation," to run parallel with the afternoon technical session.

Submission of papers for the technical sessions

An invitation is now extended to any person, whether or not a member of the Association, who feels that a report of his work in this field may be suitable to be one of the 12 technical papers, to submit a synopsis (of approximately 250-500 words) to the Honorary Research and Development Officer of the Association (Mr A. R. H. Tawn, 34 Crest View Drive, Petts Wood, Kent) **not later than Friday 17 April 1970**. A few authors have already been invited to submit papers, but the remainder will be chosen from those synopses received. Papers selected for presentation at the Conference will be required in final draft by 1 September 1970. It will be appreciated that, on this occasion, the Association's Conference is being held earlier than usual, i.e. 4-8 May 1971,

and it is necessary to prepare full pre-prints to be sent to all those who have registered at least one month before the conference.

It will be recalled that it is the custom at the Association's Conferences for the authors merely to outline their papers, highlighting points of interest, and for a general discussion of the paper to follow. The author will not be expected to deliver the paper *in toto*, since the object of sending out the pre-prints in advance is that delegates may read these thoroughly before the Conference.

Venue

The venue for the Conference will be the Palace Hotel, Torquay, which has been the venue for three previous Association Conferences, in 1957, 1961, and 1965.

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

News of Members

Mr F. Brooks, an Ordinary Member attached to the Manchester Section, has been appointed to the board of Cornbrook Resin Co. Ltd. Mr Brooks is Director and General Manager of Foscolor Ltd. It is stated that this move has been made to improve the liaison and co-operative effort between the two sister companies, enabling an improved and more comprehensive service to be given to the printing ink industry.

Mr H. A. Idle, an Ordinary Member attached to the London Section, has retired from his position as chief chemist to Ault & Wiborg Ltd., it was recently announced.

A Member of the Association since 1925, Mr Idle has served with Ault & Wiborg for nearly 50 years, and has written many authoritative works on printing ink, being one of the editors of the "Printing Ink Manual," and consultant editor of the "British Ink Maker." He was responsible for the war-time development of the "window material", the conducting coating for paper strip which replaced aluminium foil as a means of confusing enemy radar on bombing raids.

With his active participation in British Standards committees and many of the associations connected with the ink industry, Mr Idle can be said to have played an important part in its development.

West Riding Section

Annual Dinner and Dance

A photograph taken at this event is shown below. Owing to an oversight, this was not published with the report in the February issue of the *Journal*.



Left to right: Mr K. R. W. Chitty (Chairman, Thames Valley), Mr J. E. Pooley, (Chairman, London), Mrs Chitty, Mrs Pooley, Mr J. N. McKean (Hon. Publications Officer, West Riding), Mrs McKean, Mr D. Morris (Hon. Secretary, West Riding), Mrs Morris, Mr D. J. Morris (Chairman, Midlands), Mrs Morris, Mrs Watson, Mr V. H. Watson, Mrs Watkinson, Dr L. J. Watkinson, (Chairman, West Riding), Mrs Fraser, Mr A. S. Fraser (President), Mr A. W. Blenkinsop (Hon. Treasurer), Mr D. H. Tate (Chairman, Newcastle), Mrs Tate, Mrs Blenkinsop, Mrs Young and Mrs K. Driver (Vice Chairman, West Riding) (partly obscured).

FSPT Annual Meeting

The 48th Annual Meeting of the Federation of Societies for Paint Technology and the 35th Paint Industries' Show are to be held in Boston, Mass. from 28-31 October 1970. The Sheraton Boston and Statler Hilton Hotels will be used as the headquarters for the meeting, and the Paint Industries' Show will be held at the John B. Hynes Civic Auditorium. The host Society will be the New England Society for Paint Technology.

The theme of the meeting is "Paint technology 1970" and emphasis will be placed on paint manufacture and production presentations.

Application forms were to be sent out by the FSPT in March.

North Dakota Symposium

The 12th Annual Symposium on "New

coatings and new coatings raw materials" sponsored by the Polymers and Coatings Department of North Dakota State University, is to be held at Fair Hills Resort, Pelican Lake, Detroit Lakes, Minnesota, from 2-5 June 1970.

A full programme of papers has been arranged, both in the main symposium, and the sub-symposium on "Fire retardancy and flammability."

Enrolment fee is \$60.00, including transport between Fair Hills and Fargo. Accommodation will be \$60.00, including all meals and recreational facilities.

Full details are available from: Polymers and Coatings Department, College of Chemistry and Physics, North Dakota State University, Fargo, North Dakota 58102.

SCI Meeting

On Monday 13 April, at 5.45 p.m. Professor J. H. de Boer of the Netherlands will give a lecture entitled "Some old and new excursions in two-dimensional molecular world." This meeting is organised by the Colloid and Surface Chemistry Group of the Society of Chemical Industry, and will be held at 14 Belgrave Square, London, SW1. Members of the Association are cordially invited to attend.

Fibre optics colorimeter from PRA

A colorimeter designed specifically for measuring colour during paint manufacture, based on the use of fibre optics "light pipes," has been developed by the Paint Research Association. Whereas conventional colorimeters require the sample to be presented to an illuminated porthole in the instrument, which is usually fixed, the PRA instrument utilises fibre optics to separate a small viewing probe from the bulk of the apparatus. The light pipes can carry both illuminating beams and reflected light for distances of several yards without significant loss in intensity. Hence the assembly, encased in a plastic sheath with transparent window, can be immersed in paint or other liquids without damage, and the colour of the liquid can be monitored on the body of the tristimulus colorimeter some distance away. Operating temperatures are limited solely by the properties of the optical cements used in the fibre optics; at present the upper limit is 60°C.

The design of the instrument can be altered for individual applications; the probe can be taken to any part of a process tank or surface, or can be traversed, continuously if necessary, to sample or average the colour across a surface. Automatic correction of batch colours or continuous processing can be controlled from the output of the

colorimeter by comparison with established standards.

The preferred arrangement of the optics for paint testing is to have one bundle of fibres passing the light from the source, surrounded by six bundles picking up the light reflected around a 60° cone. The use of six fibre optics all viewing the same illuminated spot is said to result in great flexibility in the choice of filters to modify the colour sensitivity of the colorimeter, and thus enable any significant "colour blindness" to be avoided, something never before achieved in a photoelectric instrument.

While the colorimeter has been developed for the paint industry, in particular with aim of automated control of tinting processes, the PRA believe that the invention, which is now covered by a patent application, could be used to advantage in many other industries.

It is hoped that a paper dealing with the instrument will be published in a later issue of the *Journal*.

OCCA tie and other articles

It is regretted that, owing to increased costs of production, the prices for the articles bearing the OCCA crest have had to be increased. The new prices are: Tie 26s 0d (including postage: airmail 6s 6d extra), Car badge 44s 0d, Wall plaque 44s 0d, and Blazer badge 75s 0d. All are still available from Thresher and Glennly Ltd., Lancaster Place, Strand, London, WC2.

Erratum

We regret that, in the February issue, page 161, there is an error in the report of Mr G. Willison's lecture to the Scottish section. We have been asked to point out that the coated pigments referred to in the second paragraph are not dry milled, as stated, but wet treated.

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

- BARRATT, LESLIE, 259 Broadbottom Road, Mottram. (*Manchester*)
 CRAWFORD, RAYMOND VINCENT, BSc, PhD, 6 Beech Park, Liverpool 12. (*Manchester*)
 FENWICK, FREDERICK JOHN, BSc, Ivy Mount, Newby Bridge, Ulverston, Lancs. (*Manchester*)
 JONES, JOHN STANLEY, 1 Haverstock Road, Fairfield, Liverpool 6. (*Manchester*)
 LUNT, WALTER RICHARD, LRIC, Molecular Metals Group Limited, Claro Road, Harrogate, Yorks. (*West Riding*)
 MANLOW, ALEXANDER, 6 Sheredes Drive, Hoddesdon, Herts. (*London*)
 McDONNELL, CHRISTOPHER, ARIC, Molecular Metals Limited, Claro Road, Harrogate, Yorks. (*West Riding*)
 REES, DAVID WALTER, BSc, R. W. Greeff & Co. Limited, 31/45 Gresham Street, London EC2. (*Thames Valley*)
 REILLY, IAN STEPHEN, BSc, Research and Development Department, The International Paint Co. Limited, Stonegate Lane, Felling, Gateshead 10, Co. Durham. (*Newcastle*)
 SANKARAN, SS, BSc, 72/721 MIG Colony, Gandhi Nagar, Bandra East, Bombay 51 AS, India. (*Overseas*)
 SHIRT, JOHN MICHAEL, ARIC, Rowling House, Cawthorne, Barnsley, Yorks. (*Hull*)
 TINGEGATE, JOHN RAYMOND, 3 Briarfield Road, National Avenue, Hull. (*Hull*)
 WANNOP, GUY LAWRENCE, BSc, 28 Birch Way, Chesham, Bucks. (*London*)

Associate Members

- BOND, JOHN WALTER, 15 Nine Stiles Close, New Denham, Nr. Uxbridge, Middx. (*Thames Valley*)
 JACKSON, TREVOR, 4 Palmerston Road, Denton, Lancs. (*Manchester*)
 NICHOLS, DONALD LOUIS, "Upway," Priory Lane, Prestbury, Cheshire. (*Manchester*)
 WOOD, DONALD, 40 Chadderton Hall Road, Chadderton, Oldham, Lancs. (*Manchester*)

Student Members

- MCDERMOTT, PETER, 24 Campania Street, Royton, Oldham, Lancs. (*Manchester*)
 OWENS, PAUL ANTHONY, 59 Windsor Road, Howden Clough, Birstall, Nr. Leeds, Yorks. (*West Riding*)
 PARR, GEORGE MARTIN, Holy Trinity Vicarage, College Road, Ripon, Yorks. (*West Riding*)
 YOUNG, DAVID DESMOND, 34 Cathkin Road, Langside, Glasgow S.2, Scotland. (*Scottish*)

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.

Thursday 2 April

Newcastle Section: Annual General Meeting to be held at the Royal Turks Head Hotel, Grey Street, Newcastle upon Tyne at 6.30 p.m.

Wednesday 8 April

Manchester Section—Student Group. "Laboratory environmental tests—correlation with practice," by Mr A. Hipwood, of the Chemical Inspectorate, Woolwich Arsenal, to be held at the Manchester Literary and Philosophical Society, 36 George Street, Manchester 1, at 4.30 p.m.

West Riding Section: Annual General Meeting to be held at the Griffin Hotel, Boar Lane, Leeds 1, at 7.30 p.m.

Thursday 9 April

Midlands Section—Trent Valley Branch. Annual General Meeting. "Paint, art, colour and heraldry," by Dr S. H. Bell, of the Paint Research Station, to be held at the British Rail School of Transport, London Road, Derby, at 7.00 p.m.

Friday 10 April

Scottish Section. Annual General Meeting followed by the Smoker. To be held in the St. Enoch Hotel, Glasgow, at 6.00 p.m.

Tuesday 14 April

London Section—Southern Branch. Annual General Meeting, to be held at the Pendragon Hotel, Clarence Parade, Southsea, at 7.00 p.m.

Wednesday 15 April

Thames Valley Section. Annual General Meeting followed by a talk and films: "China clays in pottery," by Mr M. A. Hurst of English China Clays Sales Co. Limited, to be held at the Manor Hotel, Datchet, Bucks. at 7.00 p.m.

Thursday 16 April

Irish Section. Annual General Meeting, preceded by a buffet and followed by a Social, to be held at the Clarence Hotel, Wellington Quay, Dublin, at 8.00 p.m.

Friday 17 April

Manchester Section. Annual General Meeting to be held in the Pavilion Suite, Lancashire County Cricket Club, Old Trafford, Manchester 16, at 6.30 p.m.

Wednesday 22 April

Scottish Section—Eastern Branch. "Science and the rule of thumb approach," by Mr G. H. Hutchinson, of A. B. Fleming & Co. Limited, to be held at the Carlton Hotel, North Bridge, Edinburgh 1, at 7.30 p.m.

Thursday 23 April

London Section. Annual General Meeting, to be held at the Criterion-in-Piccadilly, London W1, at 6.30 p.m.

Midlands Section—Trent Valley Branch. "The operating & design principles of high speed dispersers" by F. K. Daniels, of Daniel Products Co., New Jersey, USA. To be held in the T1 Main Lecture Theatre in the Applied Science Building, Nottingham University, at 7.00 p.m.

Friday 24 April

Bristol Section. Annual General Meeting, to be held at the Royal Hotel, Bristol, at 7.15 p.m.

Midlands Section. Annual General Meeting, to be held at the Winston Restaurant, Birmingham, at 6.30 p.m.

West Riding Section. Luncheon Lecture "The operating and design principles of high speed dispersers" by F. K. Daniel, of Daniel Products Co., to be held at the Astoria Restaurant, Roundhay, Leeds 1, at 12.00 p.m.

Friday 15 May

London Section—Southern Branch. Social Evening visit to the Roman Palace at Fishbourne, followed by dinner at the Dolphin and Anchor Hotel, Chichester. During the evening the film "Adventure in colour" will be shown.

Transport will be available from Chichester Station, leaving at 4.45 p.m. Party will assemble in the car park of the Roman Palace at 5.30 p.m. Dinner will be at 7.00 p.m.

Thursday 21 May

Scottish Section. Symposium "Dispersion in theory and practice," to be held in the Ballerup Hall, East Kilbride, at 10.30 a.m.

Association AGM, to be held in the Ballerup Hall, East Kilbride, at 5.30 p.m.

Friday 22 May

Scottish Section. Symposium "Dispersion in theory and practice." Second day.

London Section AGM, 23 April

This year, for the first time, the London Section is extending an invitation to Members' ladies to attend the AGM. A fashion show, kindly provided by Courtaulds Ltd., will follow the AGM, followed in turn by an informal meal.

Oil and Colour Chemists' Association

President: A. S. FRASER

The Oil and Colour Chemists' Association was formed in 1918, to cover paint, printing inks, pigments, varnishes, drying and essential oils, resins, lacquers, soaps, linoleum and treated fabrics, and the plant, apparatus and raw materials useful in their manufacture. In 1924 it absorbed the Paint and Varnish Society. The stated purpose of the Association is to promote by discussion and scientific investigation the technology of the industries concerned with the above-mentioned products, and to afford members opportunity for the interchange of ideas. This is achieved by the regular holding of ordinary meetings at which papers are presented, and the organisation of annual technical exhibitions, biennial conferences, educational activities and practical co-operative experimental work. Details of these activities are given in the *Journal of the Oil and Colour Chemists' Association*, which is published monthly, and whose pages are open to receive communications and other pronouncements on scientific and technical matters affecting the members of the Association and the industries concerned. The Association's meetings also afford opportunities for members to meet informally and socially.

There are Sections of OCCA in Auckland, Bristol, Hull, Ireland, London, Manchester, the Midlands (with a Trent Valley Branch), Newcastle upon Tyne, Scotland (with an Eastern Branch), South Africa (with Branches in the Cape, Transvaal and Natal), Thames Valley, Wellington, and the West Riding, and these are responsible for the conduct of their own local affairs. There is also a General Overseas Section. There is also a close alliance between the Association, the Federation of Societies for Paint Technology in the United States, and the Fédération d'Associations des Techniciens de l'Industrie des Peintures, Vernis, Emaux et Encres d'Imprimerie de l'Europe Continentale (FATIPEC). The Association also maintains cordial relations with the Scandinavian Federation of Paint and Varnish Technicians (SLF).

The five Sections previously maintained by the Association in Australia formed (1.1.68) the Oil and Colour Chemists' Association Australia, having the same aims and activities as, and working in close liaison with, the parent body.

Ordinary Membership is granted to scientifically trained persons, and Associate Membership to others interested in the industries covered. Student Membership, which is intended primarily for students, is open without restriction to persons under the age of 21 and to those up to 25 who are following a course of technical study. The annual subscription in each case is five guineas, except for Student Members whose subscription is one guinea. An entrance fee of 10s. is payable by all members. Applications for membership are invited from suitably qualified persons who are engaged or otherwise interested in the industries noted above. Applications, which should be supported by two members of the Association (one of whom must be an Ordinary Member), should be forwarded to the Director & Secretary at the address given below. Application forms and full details of membership may be obtained from the offices of the Association.

PUBLICATIONS

Journal of the Oil and Colour Chemists' Association. Published monthly. Subscription rate to non-members in UK and abroad, £7 10s. p.a. post free; payable in advance.

An Introduction to Paint Technology (Second Edition with additional chapter). Pp. 187, illustrated, with index, £1 (including postage).

Paint Technology Manuals

Part 1: "Non-convertible Coatings," Second Edition, Pp. 343, 36s.

Part 2: "Solvents, Oils, Resins and Driers," Second Edition, Pp. 268, 36s.

Part 3: "Convertible Coatings," Pp. 318, 35s.

Part 4: "The Application of Surface Coatings," Pp. 345, 35s.

Part 5: "The Testing of Paints," Pp. 196, 35s.

Part 6: "Pigments, Dyestuffs and Lakes," Pp. 340, 35s.

Director & Secretary: R. H. Hamblin, M.A., F.C.I.S., F.C.C.S., Wax Chandlers' Hall, Gresham Street, London, E.C.2.

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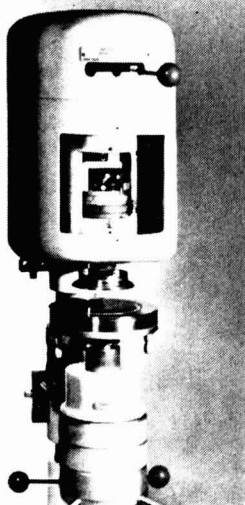
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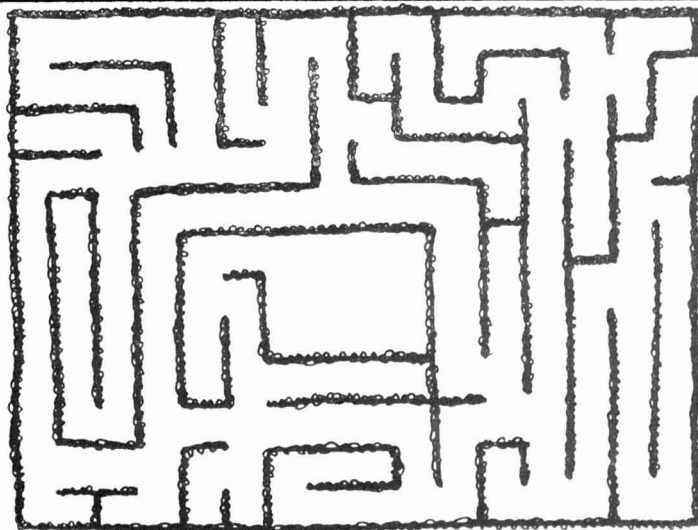


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It is, therefore, intended not only for scientists and technicians in research laboratories and enterprises in the field, but also for suppliers of raw materials and manufacturers of materials.

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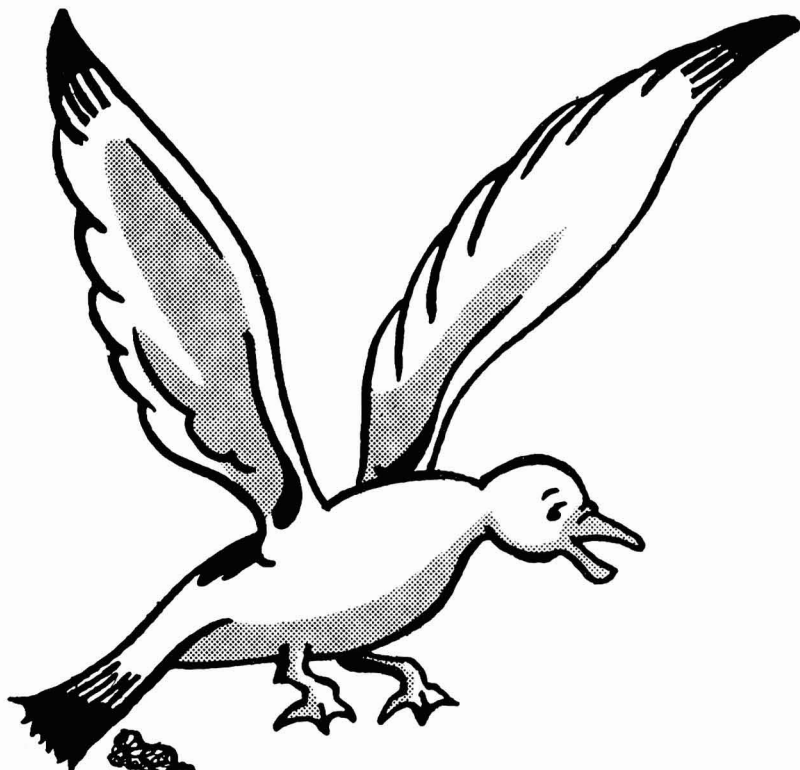
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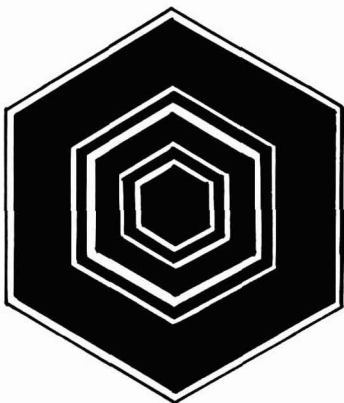
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4 - 8 May 1971

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We shall be displaying the following items at the 22nd OCCA, to be held in London from 27th to 30th April 1970.

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—Alkyd resins for acid-hardening wood lacquers;

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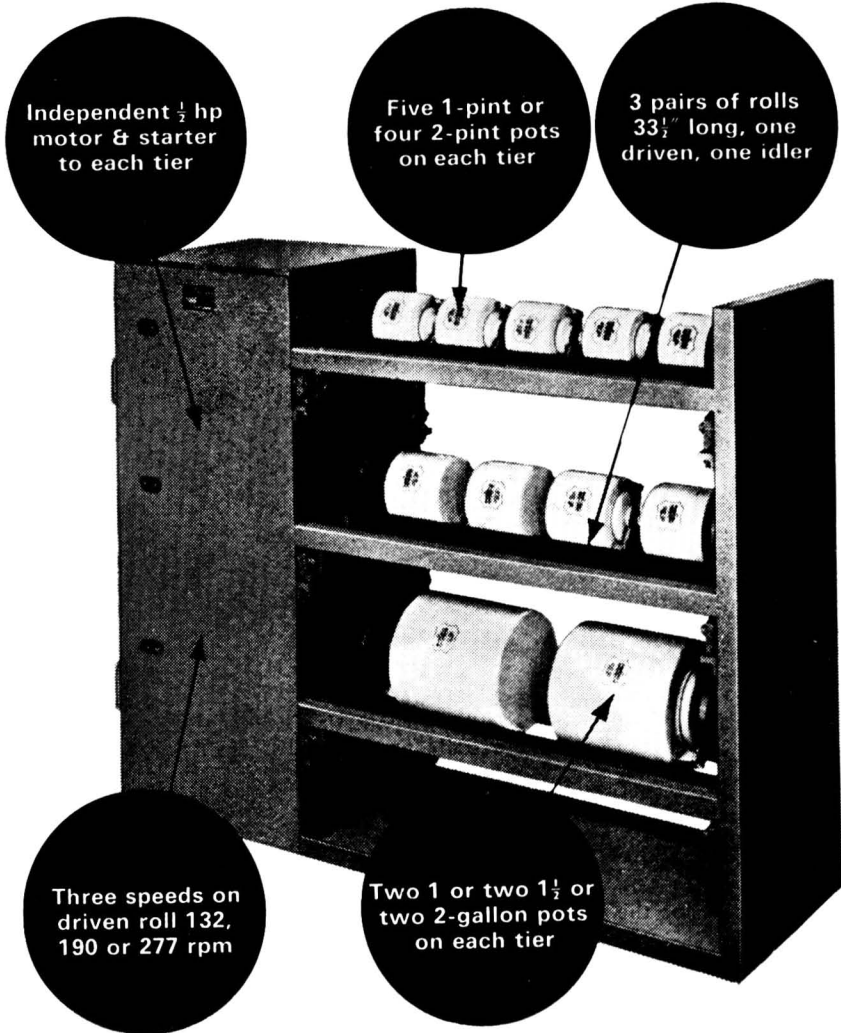
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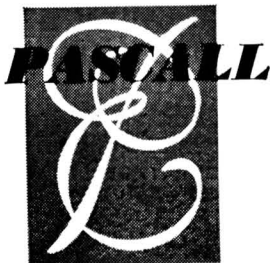
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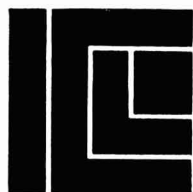
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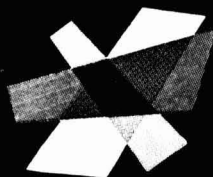
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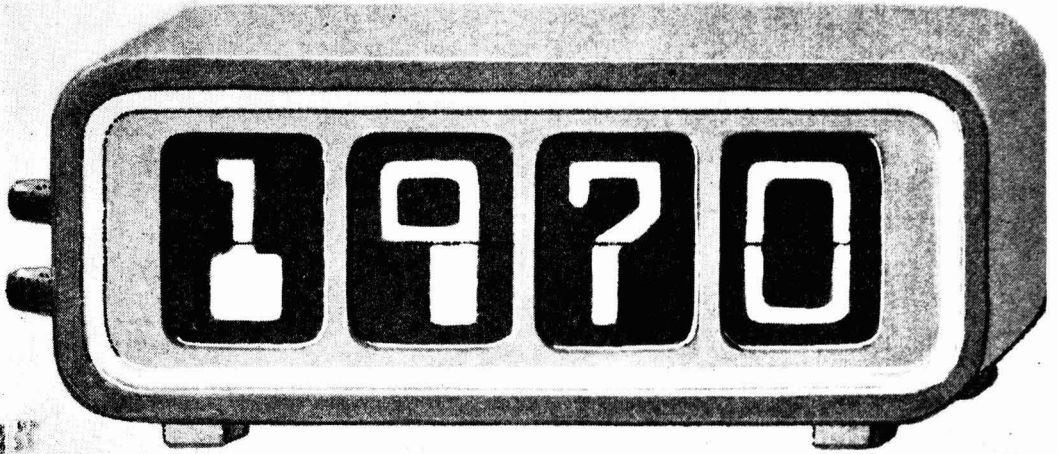


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