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EDITORIAL

Natural Colouring Matters

COLOUR has been the topic of the Chemistry Section of the British Association at this year's meeting at Leicester. It was an occasion when real progress could be reported though, as always, the clearing up of one point has brought fresh complexities in its train. As was expected Prof. Robinson, the President of the Section, gave a summary of his anthocyan work which we are able to print in full elsewhere in this issue. He has, as everyone knows, succeeded in establishing the nature of the coloured anthocyans in the various plants and effecting the synthesis of most of them, but it now transpires that a particular anthocyan alone does not determine the colour of the petal for there are also other factors concerned. The anthocyanins are amphoteric substances so that cyanin, for example, is red in acid and blue in alkaline solution: Willstätter in consequence assumed that the sap of the red rose was acid and that of the blue cornflower alkaline, for both flowers contain cyanin. In point of fact all cell-saps are well on the acid side of the neutral point, and the explanation of the blue of the cornflower must apparently be sought in the colloidal state of the cyanin which is present in a complex form giving a stable aggregate with a negative charge that is perhaps further stabilized by the presence of xylan or other polysaccharides in the cornflower. Prof. Robinson quotes experimental evidence for this assumption in his address, and for the moment it would appear that all blue flowers owe their colour to the presence of colloidal solutions of their respective pigments. It will be remembered that a variety of compounds, grouped together as co-pigments, have also been shown by Robinson to influence the colour of anthocyanin solutions, particularly in acid solutions. It is thus evident that flower coloration is not quite so simple as one had hoped and that other factors besides the nature of the specific anthocyanin come into play. Although this discovery involves more problems for the chemist to solve, mankind is perhaps the gainer in having a much wider range of colour to admire, for we see why no two flowers of different species ever have quite the same colour. It is perhaps all the more amazing that such subtle differences are constant year after year for each individual species. Carotene, once merely regarded as the pigment of the humble carrot, is proving to be a substance of unique interest. It is one of several similar compounds, each with a skeleton of forty carbon atoms which are now regarded as among the first products of synthesis in plants, though there is no clue how this is achieved: they have some relation to phytol. By a process of oxidative disintegration, which appears to be highly selective in character, these long carbon chains may be split in a variety of ways forming so-called carotenoids. Thus from carotene there result two molecules of vitamin-*A* with twenty carbons each; lycopene, the red colouring matter of the tomato, breaks up into bixin with twenty-four atoms of carbon and two molecules of methylheptenone containing C_8; protocrocin of saffron yields crocin with C_{20} and two molecules of picrocrocin (C_{10}): whilst protoazafrin is oxidized to azafrin (C_{27}) and ionone (C_{13}). These transformations are quite amazing in their complexity, particularly in compounds containing so many double bonds and therefore specially liable to oxidation at a number of points. The production of vitamin-*A* in this way links up colour with vitamin activity. The flavines are certain new yellow dyestuffs, soluble in water and widely distributed in nature: among them are ovoflavin and lactoflavin from egg albumin and milk respectively with the formula $C_{17}H_{20}O_6N_4$. They are in many respects complementary in properties to the carotenes and Kuhn has suggested the terminology lyo- and lipochromes for the two classes. The lyochromes are shown to be biologically related to vitamin-B_2 and, more interesting still, when combined with carriers of high molecular weight, they appear to act as oxidation enzymes. Such is in essence the story Prof. Kuhn of Heidelberg unfolded: only the few grasped its import; there were no headlines in the press report nor indeed any report at all and yet it was probably the most outstanding communication of the whole British Association meeting. We are gaining a hint as to the significance of the natural colouring matters, one which may carry us far in the understanding of vitamins and enzymes. Few recent discoveries have been more exciting in their import.

Gold in Canada

We have seldom read a more interesting pamphlet than "Gold in Canada," by Mr. A. H. A. Robinson, published rather more than a year ago by the Canada Department of Mines and now republished and brought up to date to include the year 1932; it may be obtained at the low price of twenty cents from the King's Printer in Ottawa. In addition to statistics concerning the many mines in Canada, there are valuable discussions or accounts of the properties of gold, its occurrence, its history, the gold standard, and the production of gold in the world in general and in Canada in particular. Gold has a peculiar position among the elements and its singular use is due to its chemical characteristics. It is found in small quantities in many countries; its unusual colour, its great density, and its freedom from corrosion have enabled people, during seven thousand years or more, to collect small quantities; it is too soft to be of much value as a metal and it forms few compounds that are required by mankind and these are wanted only in small quantities; it is attacked by a few chlorides and iodides but remains unaffected by air or water. If it were far commoner it would not be greatly needed by industry and it has come to be used chiefly as a symbol of prosperity, an outward and visible sign that the possessor is worthy of credit. The bank that shuts up in its vaults a quantity of gold has credit not merely for an equal amount, but for two or three times the value of the gold. Gold is unique in this respect, but in former years in several countries silver possessed a similar charm. Moreover gold retains this singular property whether the country in which the gold lies locked up adheres to a gold standard or not. The total quantity of gold in the world is small: that which has already been extracted could all be contained in the lecture room of the Chemical Society in Burlington House, and its annual production is measured by a few million ounces. There has been much romance and much disappointment in the search for gold and different countries at different times have contributed to the world's supply. The pamphlet in question gives details of the production of gold since the year 1840 when the bulk of the gold came from Russia. In 1848 and 1849 the United States began to produce gold in quantity, attaining after a few years a production of 3,000,000 ounces a year. In 1852 the production of Australia attained an equal volume. The production of South Africa began about the year 1886 and has unsteadily grown until it is now nearly twelve million ounces a year, about half the production of the world. Canada began to produce about the year 1858 but its production remained quite small until about the year 1896: it now amounts to three million ounces a year and Canada is the second largest producer of gold in the world. There have been gold standards and silver standards and in many European countries a double standard of gold and silver remained in vogue from the middle ages until the latter half of the nineteenth century. The fact that several countries have for the time being discontinued the use of a gold standard seems hitherto to have had no effect on the demand for gold and its price still remains high. Gold still remains a sign of respectability and so long as there is a profit to be made by gold-mining so long will that industry endure. We have called attention to some introductory pages in "Gold in Canada"; the main part is a statistical account, with several maps, of the production of the principal Canadian mines: this part though very useful and important does not so readily provide matter for a discursive editorial comment. We think that everyone interested in the chemistry, the use, or the history of gold, including gold coinage and the gold standard, should read this admirable publication.

Cider

We print this week summaries of two papers on that old and old-fashioned industry, the manufacture of cider. The industry has long flourished in the south and west parts of England, in Normandy, and in other countries. Only during recent years has it received careful scientific investigation. The gradual ripening of apples after they have been gathered from the tree is still the subject of research and has been referred to in these columns quite recently. Such ripening is essential to the production of good cider. The part played by the chemist in the manufacture of any fermented or spirituous liquor is essentially the same; his duty is not to introduce synthetic chemicals to replace those so ingeniously put together by Nature in the fruits and grains that are the foundation of these beverages. His part is to ensure that so far as is humanly possible the customer will receive a liquor of the colour, appearance, and taste that is desired. There are fashions in all these things: our grandfathers drank port, but we prefer a lighter wine; our fathers liked strong beer and porter, but the modern taste is for lighter, clear, or sparkling beers: there was a time when many people preferred whisky with a flavour suggesting the smoke of a peat fire, now a smoother whisky with a less pronounced taste is in demand: the rough, slightly turbid ciders of a few years ago are being replaced by transparent liquors with a smaller percentage of malic acid and tannins. It is the duty of the chemist by careful analysis of the apple juices to ensure that the blended liquor is of the proper character and by careful control of the yeasts engaged in the process to obtain a fermentation which will be suitable for the particular variety of cider that is being made. How the fruit is selected and the juices blended, how the cider is filtered and stored, and other details of the manufacture are explained in these articles. A great deal of valuable scientific work on apples and cider has been carried on at the Agricultural Research Station at Long Ashton and the papers we publish this week were delivered to members of the Society of Chemical Industry in connexion with a very pleasant and instructive visit to that research station. We do not remember hearing of the preparation of a spirit by the distillation of cider, like the Calvados that is sold in northern France; the experiments we have personally made convinced us that good Calvados is very good but uncommon and that bad Calvados is one of those things, like lectures, that it is better to give than to receive. Perhaps Mr. Pickford and Mr. Charley have some exact methods that enable them to prepare a really satisfactory product of this nature.

NATURAL COLOURING MATTERS AND THEIR ANALOGUES*

By PROF. R. ROBINSON, F.R.S.

Although the subject which I have selected for my address is necessarily somewhat technical, it occurred to me that the problem of flower colour is of general interest, and the gist of what I have to say is a contribution to the answer to the question: Why are some flowers *blue* and others, containing the same pigment, red? In the interests, too, of members of this audience who are not organic chemists I propose to allow the token to diverge from the written word, and I shall venture also to attempt the performance of a few simple experiments.

In every country and throughout the ages emotions have been stirred and curiosity aroused by the display of colour in nature, but it is perhaps not generally realized that the *ready availability of artificial colouring* matters suitable for every kind of tinctorial purpose, from boot polish to finger-nails, is a *comparatively* recent development. We read of the ancient Tyrian purple, the purple of kings, and of the red cosmetic pigments of natives of the Orinoco, so rare that they were used as the basis of exchange: in contrast, at the present time dyes of all shades may be indulged in to a great extent controlled certainly by individual courage, taste, and discretion, but hardly at all by limitations of purse or social status. It may be that this "freedom of the hues" has been enjoyed for so brief a period that a state of equilibrium has not yet been reached, and we are not using our privileges in this matter either as wisely as possible or as wisely as possible.

It is not, however, for an organic chemist to discuss such problems as that of masculine sartorial conservatism on the one hand, or to attempt an estimate of the æsthetic value of the film-fan magazine cover on the other.

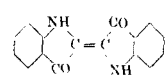
The chemist has been attracted to the investigation of natural and artificial colouring matters for a variety of reasons, including not only colour-pleasure, the incentive of the knowledge that chlorophyll and hæmoglobin perform some of the most important functions in vital processes, and the industrial importance of dyestuffs and pigments, but also on account of the fact that visible colour more than any other property facilitates the experimental study of organic substances, whether by analysis or synthesis. It furnishes a standard of homogeneity or a measure of concentration, is an invaluable guide in the search for methods of separation and purification, and it at once indicates, by its appearance or disappearance, the occurrence of a chemical reaction. Small wonder that the successful outcome of the investigation of many colourless substances has awaited the discovery of some characteristic colour reaction, a noteworthy example being vitamin-*A*. Colour is a more specific property than colour as judged by the eye, and in a more limited field it has proved usually useful to chemists who prefer to follow their senses. However, we cannot yet resolve odours in a spectrum.

* Presidential Address to the Chemistry Section of the British Association for the Advancement of Science, at Leicester, September 7, 1933.

Thus the pursuit of a fascinating object has been along a path of relatively low resistance, and the pioneers *have been richly rewarded. Like a list of best books*, a catalogue of outstanding achievements invites destructive criticism. I do not fear this, however, in recalling the researches of Laurent, Kekulé, Baeyer, and Heumann on indigo; of Sir William Perkin, Hofmann, Otto and Emil Fischer, Meldola, and many others on the basic dyes; of Griess and his host of followers on the azo-compounds; of Arthur Perkin and of Kostanecki on the flavones and flavonols; of Willstatter on the respiratory pigments and the anthocyanins; and, not least, of Hans Fischer on the synthesis of the prosthetic group of the blood pigment.

No attempt can be made to cover this vast field, but the mere mention of these topics serves to prove the immense theoretical and practical value of a study of organic colouring matters. The work proceeds and a long chapter on the natural carotinoid pigments is even now being written by Karrer, Kuhn, and others; it is of great chemical and biological interest.

Before dealing with the special group of the anthocyanins, some aspects of which have recently been studied at Oxford, attention may be directed to the analogies in constitution existing between natural colouring matters and artificial dyestuffs. As the result of the researches of Baeyer, *indigotin is generally* regarded as having the formula I, but a technical digression may be made to the effect that the formula II has not yet been completely disproved.



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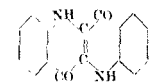

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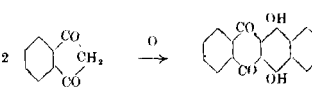
The oxidation of indoxyl to indigotin appears to favour I, but then Gabriel has shown that the oxidation of diketohydrindene (III) by means of alkaline persulphate furnishes dihydroxynaphthacenequinone (IV).

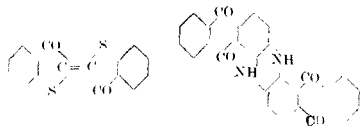


(III) (IV)

All the indigotin syntheses can give II just as well as I, and II can yield isatin on oxidation. The recent researches of E. Hope prove that some of the products of the action of benzoyl chloride on indigotin possess the skeleton of II, but of course this may arise from an intramolecular rearrangement. The chief argument against II is derived from a consideration of the numerous classes of indigoid dyestuffs which are easily formulated on the model of I.

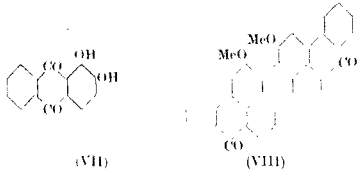
The industrial analogues of indigo are its substituted derivatives, the thioindigos (*e.g.*, V) and similar indigoid dyes, and indanthrone (VI). The first-mentioned classes were made in imitation of the indigotin structure, but in the case of indanthrone flattery was unconscious.

Both indigotin and indanthrone contain the chromophoric quinone group —CO—Ċ=Ċ—CO— and closely situated auxochromic —NH— groups.



(V) (VI)

Graebe and Liebermann's recognition of the constitution of alizarin (madder) (VII) led, as in the case of indigo, to the industrial synthesis of the colouring matter itself and of numerous derivatives and analogues.



(VII) (VIII)

At the present time we recognize in retrospect that the most important outcome of the work on madder was the attention focussed on the study of anthraquinone and its derivatives. It may seem a far cry from the adjective natural dyestuff to the modern vat dyestuff *Caledon Jade Green* (VIII), *but the descent is in the* direct line—alizarin, Alizarin Blue, benzanthrone, dibenzanthrone, Jade Green. Technical analogues of the anthocyanidins are to be found in the phthaleins, pyronines, and rhodamines, and some more or less close dyestuff analogy can be found to correspond with most of the series of natural colouring matters.

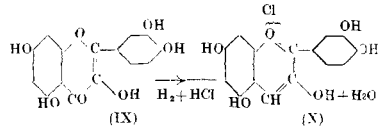
The most recent, and certainly one of the most interesting, examples of this kind is found in the phthalocyanines which contain a porphyrazine structure, that is the porphin skeleton of the natural porphyrins in which some —CH— groups are replaced by —N=. Dr. Linstead will shortly give an account of his investigations of these substances and of their remarkable *properties. It was primarily with cognisance of Dr.* Linstead's work that I ventured to direct your attention to *analogues* of natural colouring matters; this is at the technical end of the scale, and in contrast Professor Kuhn has kindly consented to describe some novel natural colouring matters of high biochemical interest. The following sections of this address deal with develop*ments of the chemistry of the red, blue, and violet* colouring matters of flowers and blossoms.

Structure and Synthesis of the Anthocyanins

A brief description of the chemistry of the anthocyanins is necessary at this stage. The brilliant and pioneering researches of Richard Willstätter and his co-workers (1914—) *established the main features of* the chemistry of the anthocyanins which were recognized as saccharides, occasionally acylated, of the *anthocyanidins.* They exhibit amphoteric character, forming salts with both acids and bases. Thus the violet pigment *cyanin*, which can be isolated from blue cornflowers, red roses, deep red dahlias, and other flowers, forms a blue sodium salt and a red hydrochloride. The hydrolysis of the latter by means of hot aqueous hydrochloric acid into cyanidin chloride and glucose is represented by the equation:

$$\underset{\text{cyanin chloride}}{C_{\mathbf{27}}H_{31}O_{16}Cl} + 2H_2O = \underset{\text{cyanidin chloride}}{C_{15}H_{11}O_6Cl} + 2\underset{\text{glucose}}{C_6H_{12}O_6}$$

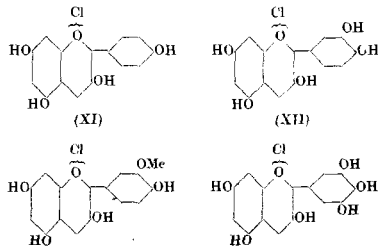
The constitution of cyanidin chloride (X) has been established by analysis and numerous syntheses: the first of these (Willstätter and Mallison) utilized the reduction of quercetin (IX) by means of magnesium in aqueous methyl alcoholic hydrochloric acid solution.



(IX) (X)

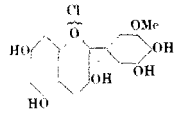
In this process a widely distributed anthoxanthin yields a widely distributed anthocyanidin, and the temptation to assume that similar reactions occur in the plant laboratory is very great. There is, however, very little justification for this view and the experimental support brought forward in its favour will not survive careful scrutiny. The alleged crystalline anthocyans prepared by the reduction of natural flavones or plant extracts containing them are nothing but the said flavones with a small proportion of adsorbed colouring matter of anthocyanidin type. It seems much more probable that the flavones and anthocyanins are independently synthesized, although perhaps from a common starting point. The existence of genetic factors which control the occurrence of anthoxanthins independent of that of anthocyanins is strong evidence in favour of this view.

The anthocyanidins which have been isolated are the following: pelargonidin (XI), cyanidin (XII), peonidin (XIII), delphinidin (XIV), petunidin (XV), malvidin (XVI), and hirsutidin (XVII), represented as chlorides.



(XI) (XII)

(XIII) (XIV)



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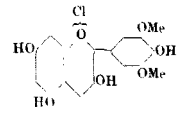

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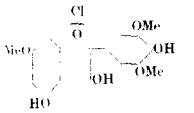

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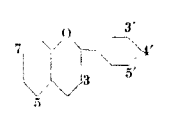
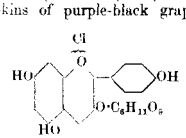


Numbering scheme

All have been synthesized by unambiguous methods and the synthetic specimens have been carefully compared and identified with the natural products. It will be observed that pelargonidin, cyanidin, and delphinidin are the fundamental types, peonidin being a methyl ether of cyanidin and petunidin, malvidin and hirsutidin being, respectively, the mono-, di-, and trimethyl ethers of delphinidin.

The greater number of the anthocyanins fall into a *comparatively restricted number of categories, including*: (*a*) the 3-monoglucosides and 3-monogalactosides; (*b*) the 3-rhamnoglucosides and other 3-pentoseglycosides; (*c*) the 3-biosides; (*d*) the 3:5-diglucosides; and (*e*) the acylated anthocyanins. It is unnecessary to recount the steps taken in reaching these conclusions, but they have been finally justified by synthesis in many instances.

In group (*a*) we find callistephin (XVIII), the monoglucoside of pelargonidin occurring as one of the pigments of the aster and as the main pigment of scarlet carnations and many other flowers; the related galactoside, fragarin, is the colouring matter of the strawberry. In the cyanidin series the corresponding pair is chrysanthemin and idæin (XIX), the former of wide distribution and the latter occurring in the skins of cranberries and in the leaves of the copper beech. Peonidin 3-monoglucoside (XX), termed oxycoccicyanin, is found in the skins of the larger American cranberries and œnin or malvidin 3-monoglucoside (XXI) is the colouring matter of the skins of purple-black grapes, as well as of certain



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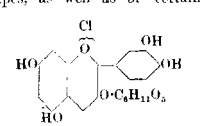

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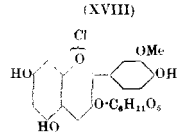

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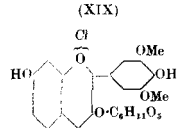
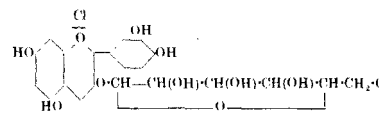


(XXI)

cyclamen and primulæ. The delphinidin representative undoubtedly occurs in bilberries in admixture with other pigments, and it has not yet been fully examined: the petunidin and hirsutidin representatives have not been isolated from natural sources, although there is reason to believe that the former occurs in the berries of the Darwin barberry and the latter has been synthesized.

In groups (*b*) and (*c*) we find large classes of anthocyanins of which only a few representatives have been closely studied. These include keracyanin (cyanidin 3-rhamnoglucoside), probably identical with antirrhinin (isolated by Miss R. Scott-Moncrieff), and mecocyanin (XXII), a pigment of red poppies which is now recognized by synthesis as cyanidin 3-gentiobioside

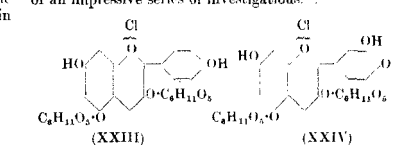


(XXII)

There is very little doubt that pelargonidin 3-rhamnoglucoside colours the scarlet gloxinia and that pelargonidin 3-biosides are of widespread occurrence, for example, in the ordinary orange-red nasturtium and in the flowers of the scarlet runner bean.

The anthocyanins of groups (*a*), (*b*), and (*c*), when derived from the same anthocyanidin, exhibit similar behaviour as indicators. Thus chrysanthemin, keracyanin, and mecocyanin all give a violet solution in aqueous soda and this becomes blue on the addition of caustic alkali. On partial hydrolysis mecocyanin and *antirrhinin actually yield chrysanthemin.*

The anthocyanins of class (*d*) are the most widely distributed and best-known members of this series—*natural pigments*; they include pelargonin (XXIII), the colouring matter of the scarlet pelargonium and possibly the first anthocyanin to be obtained in crystalline condition (Molisch's experiment), also cyanin (XXIV), the isolation of which from the blue cornflower by Willstätter and Everest in 1914 was the first of an impressive series of investigations.

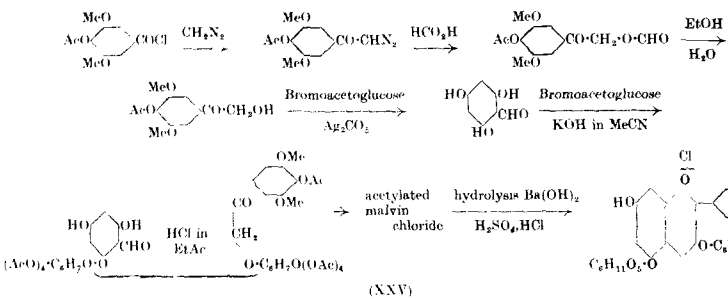


(XXIII) (XXIV)

Peonin from the deep red peony and malvin (XX from the wild mallow or from certain primulæ, are t peonidin and malvidin representatives in this grou which is completed by petunin and hirsutin. Qui recently the delphinidin member has been isolated fro *Salvia patens*.

The anthocyanins of group (*d*) differ from those groups (*a*), (*b*), and (c) in their alkali-colour-reactions a in their marked instability to aqueous sodium hydroxi

Thus cyanin, which compares with mecocyanin in group (c), gives a pure blue solution in aqueous soda and the dilute solution becomes very quickly yellow on the addition of sodium hydroxide (demonstration). Pelargonin, cyanin, peonin, malvin, and hirsutin have been synthesized and an example of the methods adopted may be schematically indicated in the case of malvin.



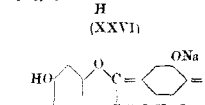
(XXV)

The anthocyanins can be characterized and qualitatively distinguished by their distribution between immiscible solvents, and in the case of disaccharides the use of n-butyl alcohol is convenient (demonstration). Acylated anthocyanins occur in all the anthocyanidin series; thus, on hydrolysis, delphinin, the pigment of species of delphinium, furnishes *p*-hydroxybenzoic acid as well as glucose and delphinidin.

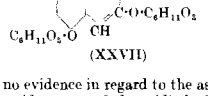
Many other delphinidin derivatives are acylated by *means of p-hydroxycinnamic acid, probably attached* to the sugar hydroxyls, and pelargonin and cyanin also occur in acylated forms. These so-called *complex* anthocyanins are characterized by high distribution *numbers; they are usually acylated 3 : 5-dimonosides*, but in the delphinidin series, gentianin and violanin appear to be *p*-hydroxycinnamates of delphinidin monoglucoside and rhamnoglucoside respectively (Karrer). There is also some evidence of another type of depside anthocyanin in which the acyl group is directly attached to the anthocyanidin molecule and the glucoside group is borne by the hydroxyl of the acid residue.

Anthocyanins as Indicators and the Causes of Variations of Colours of Flowers (With Mrs. G. M. Robinson)

The amphoteric character of the anthocyanins accounts for the exhibition of a wide variety of colours in a range of solutions of graded p_H, and this method (demonstration), using buffered solutions, can be employed for the characterization of anthocyanidins and anthocyanins. Under the specified conditions the results are fully reproducible and the p_H values have been controlled by electrical methods as well as by the use of indicators. Thus, if the p_H of an acid cyanin solution is increased until the violet tone matches that of an alkaline cyanin solution, the p_H of which is decreased in order to reach the same condition, then the p_H of the violet solution will be found to be 7·0—9·0, depending on the shade of violet produced. Cyanin is red in solutions of p_H 3·0 or less, violet at p_H 8·5, and blue at p_H 11·0. The red, violet, and blue forms are the oxonium salt (XXIV), the colour-base (XXVI), and the salt of the colour-base (XXVII).



(XXVI)



(XXVII)

(There is no evidence in regard to the assumed position of the quinonoid group and the acidic hydroxyl.)

Now cyanin was isolated by Willstätter and his colleagues from the blue cornflower and from the red rose, and it seemed quite a simple step to assume that the cell-sap in the cornflower was alkaline and that in the rose acid, particularly in view of the fact that the absorption spectra of the coloured aqueous extracts correspond with these conditions.

It has indeed been generally assumed that the indicator colour of the anthocyanin will give a measure of the p_H of the cell-sap, but unfortunately this method cannot be relied upon for several reasons. In the first place there is a glaring anomaly in the fact that direct measurement by electrical methods (glass electrode as arranged by Mrs. Kerridge) shows that the cell-saps are all well on the acid side of the neutral point. Thus the conventional view for red flowers may well be correct, but some special circumstances must be invoked in the case of blue flowers.

Turning at once to the blue cornflower (the cultivated annual kind), a *blue* filtered extract made with distilled water was found to be sufficiently acid to turn blue litmus red. Using 3 g. of petals in 14 c.c. of distilled

water (p_H 6·3 owing to dissolved CO_2), the p_H was 4·9. (These quantities were used throughout the experiments and the use of larger relative quantities of the petals did not alter the p_H appreciably.) Addition of a buffered solution of p_H 4·4 did not affect the colour, but the colour changed to violet when the B.D.H. Universal Buffer, p_H 9·0, was added. It was at once apparent that the only simple explanation is that the cyanin anion is present in a complex form, giving a stable aggregate with a negative charge; in some way the strength of cyanin colour-base as an acid must be vastly increased.

Some form of colloidal solution was considered most likely to fulfil the necessary conditions, and Dr. Conmar Robinson, of the chemistry department, University College, London, kindly examined a filtered, distilled-water extract of blue cornflowers and reported as follows: "The solution contains ultramicrons easily visible in the slit ultra-microscope, but small enough to be in fairly rapid Brownian movement. Microcataphoresis showed them to be negatively charged. Without more quantitative work it is impossible to say if these particles can represent the bulk of the material present, but this seems probable if the solution is very dilute; the possibility of observing a colloidal impurity is always a trap. The visibility of the ultramicrons suggests a lyophobic colloid. It is, however, not precipitated even by 2N NaCl, which indicates that a protective colloid is also present."

Our next step was to attempt the production of blue cyanin sols stable in neutral or weakly acid solution, and some measure of success was achieved, although the solutions are by no means so stable as those from the blue cornflower.

If a little crystalline cyanin chloride is added to boiling tap-water (p_H 8·0) then the usual violet solution results (see above), the colour being what we consider "normal." If, however, the cyanin is tritnrated in the cold for a minute with the water and gradually heated to boiling with shaking, then a beautiful *blue* solution results. The fact that the same materials can be used to produce two entirely different results shows that it can only be the state of aggregation of the cyanin which can have stabilized the anionic charge and hence produced a blue colour under the conditions that normally produce a violet solution. If very small quantities of cyanin chloride are employed, this phenomenon can be reproduced using distilled water. Willstätter and Everest found that their cornflower extracts contained xylan and other polysaccharides, and we have attempted to produce blue acid cyanin solutions in the preseuce of various polysaccharides. The addition of dispersed xylan and various kinds of starch, also agar-agar, makes the preparation of blue solutions of p_H about 7·5 a very simple matter (demonstration), but we have not yet found a way of imitating the cornflower solution in respect to its stability at p_H 5·0.

Probably these colloid associations are much more readily formed at values of p_H between 5·5 and 6·5, and on the whole the blue flowers have less acid cell-saps than the red flowers. The petals of the rose in contrast with the cornflower constitute an exception (p_H 5·6), and the following further provisional results may be quoted although no great accuracy can be claimed for a method which involves the destruction of the petals. The pigment of the orange-red polyantha rose "Gloria Mundi" is found to be pelargonin and the p_H was 5·5. On the same plant some flowers had reverted to the cyanin type. The red-flowered hydrangea had petal p_H 3·75, whilst the blue flowers gave p_H 4·9; similarly the red-flowered linum (anthocyanin based on delphinidin) gave petal p_H 4·6, and the blue variety p_H 5·9. Blue anchusa, 6·2: *Meconopsis Baileyi*, 5·3 (Miss R. Scott-Moncrieff found that blue and violet flowers had the same petal p_H): sweet-peas, all about 5·3; delphiniums, 5·6 (most violet shade), 5·8 (most blue shade): clematis (blue), 5·4: viola, 6·2 (blue violet), 6·0 (reddish violet): lobelia (blue), 5·7.

It must be emphasized that these variations of p_H are quite insufficient in themselves to account for the colour changes and it is evident that the most important single factor for flower colour, given the nature of the anthocyanin, is the question of the condition of the pigment in solution, and it would appear that *all blue flowers are coloured by colloidal solutions of their respective pigments.*

Methods for the determination of the p_H of the cell-sap of flowers depending on the use of the flower colours as indicators may be sound, but only if it can be guaranteed that the colloidal condition of the pigment solution is not altered by the extraction with the buffered solutions which are employed. In any case the results bear no relation to the colours observed *in vitro* using isolated anthocyanins, and they cannot be transferred from flower to flower; *the colour series depends almost* as much on the other conditions in the cell-sap as on the p_H and on the nature of the anthocyanin. Another aspect of p_H of the cell-saps is that the higher values appear to be associated with the formation of delphinidin derivatives. The remarkable distribution in the tropæolum—Empress of India—is as follows: leaf, delphinidin diglycoside (p_H 5·6); calyx, cyanidin 3-bioside (p_H 5·0); flower, pelargonidin 3-bioside (p_H 4·5). On the other hand, three scabious with anthocyanins based respectively on pelargonidin, cyanidin, and delphinidin had all the same petal, p_H 5·0.

We have already discussed elsewhere the influence of certain substances termed co-pigments on the colour of anthocyanin solutions: these effects are to be detected in strongly acid solution, and the presence or absence of these substances is undoubtedly a factor to be taken into consideration. The extent to which the co-pigment effect is bound up with colloid phenomenon is a matter for future experiment and discussion, but it is convenient to maintain the term co-pigment for the present.

Dr. E. A. H. Roberts has observed the shift of the absorption bands of chrysanthemin and œnin chlorides on the addition of papaverine (strongly blueing effect) and narcotine (weak effect), and correlated this with a corresponding change (lowering) of the distribution number of the anthocyanin using amyl alcohol (demonstration). It seems clear that papaverine salts and œnin salts combine in solution. The relation between the distribution number of œnin chloride and the concentration of the pigment seem to require the assumption that the molecules of the anthocyanin are

associated (2 mol.) in aqueous solution and free in amyl alcohol. Chrysanthemin and idæin behave similarly, also malvidin 3-galactoside. This phenomenon appears to be related to that of co-pigmentation. The naturally occurring co-pigments include the anthoxanthins (flavone and flavonol saccharides etc.) and tannins and some efficient substances not yet identified. The justification for assuming the operation of this factor can best be indicated by an example. Certain herbaceous phlox contain pelargonin, but have a much bluer red colour than other flowers coloured by this anthocyanin. But the same observation applies to the extract in 1% hydrochloric acid, and moreover, the presence of much anthoxanthin is noted. Hence, all the circumstances point to co-pigmentation of the pelargonin salt in the flower petal.

Finally, we do not know whether or not traces of iron and other inorganic substances may affect flower colour. In this connexion the case of the blue hydrangea is always quoted, and we have observed that when the stalks of red hydrangea flowers are immersed in very dilute aqueous ferric chloride, the flowers slowly become blue. The ashes of many flowers contain 1 - 2% Fe_2O_3, and the anthocyanin test for iron is one of the most delicate known.

Summarizing, the main factors affecting flower colours are:

(1) The nature and concentration of the anthocyanins and other coloured substances present; (2) the state of aggregation of the anthocyanin in solution—the p_H of the cell-sap is one of the subsidiary factors affecting this, and naturally the presence or absence of protective colloids is another; (3) the presence or absence of co-pigments and, problematically, the effect of traces of iron and other complex forming metals.

Time does not permit me to deal with other anthocyanin types such as gesnerin, the leuco-anthocyanins, the yellow anthocyanin of *Papaver nudicaule*, or the nitrogenous beet-pigment and its analogues; I will close, appropriately I hope, on an experimental note by attempting a demonstration of some of the tests which we employ for the recognition of anthocyanidins.

(1) The oxidation test—addition of 10% aqueous sodium hydroxide to a dilute solution shaken with air—petunidin and delphinidin are at once destroyed, the other anthocyanidins are relatively stable.

(2) Extraction with amyl alcohol, addition of sodium acetate, and then of a trace of ferric chloride. Characteristic colour reactions are observed, and in particular, if cyanidin is present the violet amyl alcoholic solution changes to pure blue in the last stage. Pelargonidin, peonidin, and malvidin give no ferric reaction.

(3) Distribution between 1% aqueous hydrochloric acid and a mixture of anisole (5 vol.) and ethyl *iso*amyl ether (1 vol.) containing 5 g. of picric acid in 100 c.c. Delphinidin is not extracted by the organic layer, petunidin is taken up to a slight extent, cyanidin to a considerable extent, and malvidin, peonidin, and pelargonidin are completely extracted if the solution is sufficiently dilute.

(4) Distribution between 1% hydrochloric acid and a mixture of cyclohexanol (1 vol.) and toluene (5 vol.). Delphinidin and petunidin are not extracted at all; malvidin gives the organic layer a faint lilac tint; cyanidin a pale rose tint; peonidin, and still more pelargonidin, are extracted by the organic layer to a considerable extent.

The deductions are confirmed by a study of the colour reactions of the anthocyanins.

In conclusion I must express my very deep indebtedness to all co-workers in these fields, and especially to Dr. D. D. Pratt, Prof. A. Robertson, Dr. W. Bradley, and Dr. A. R. Todd on the synthetic aspects of the work, and to my wife, without whose co-operation a survey of natural anthocyanins could not have been attempted.

PROBLEMS OF THE CIDER MAKER

The following papers were read by Mr. P. T. H. Pickford and Mr. V. L. S. Charley on April 6, before a joint meeting of the Bristol Section and the Food Group of the Society, after members had visited the Agricultural Research Station (The National Fruit and Cider Institute), at Long Ashton.

Mr. Pickford's contribution to the subject of "The Problems of the Cider Maker" was as follows:

Source of supply.—The farm orchards are the main source of supply of vintage fruit, the type giving the necessary characteristic flavour to cider. Standard trees of vintage varieties are grown in orchards which are grassed down and the land used for grazing. The majority of these orchards are of very old neglected trees, little attention being given to them until recent years, when the more attractive prices for cider fruit has warranted the renovation of old orchards and the development of new orchards. The varieties of vintage fruit are so very numerous, and as they vary to a great extent in the quality of juice they produce and in the type of tree they make, the problem here is to find good-quality sorts which make strong growing trees, unsusceptible to disease and capable of bearing heavy crops regularly. This problem is dealt with, first, by cider-making trials from single varieties in order to select those which produce the best quality cider, and secondly, by planting trial orchards of trees of these selected sorts to determine their suitability as orchard trees.

The culls of market varieties as a rule produce a rather thin, coarse cider, lacking in character. As considerably large quantities are available for cider-making, the problem is to utilize them without deterioration of the quality of the juice. The juice from this type of fruit is generally low in sugar content, too high in acidity, and too low in tannin content. Some success has been brought about by blending this with bitter-sweets. Bitter sweet type of fruit producing a juice of low acid and high tannin content balances the excess of acidity and lack of tannin in the juice from market fruit.

Storage of the fruit.—In order to obtain satisfactory results the fruit must be stored in bulk to ripen evenly prior to milling. Sound storage is a very difficult problem where, as in the majority of cases, the fruit is from orchards which are planted with numerous small lots

of different varieties coming into ripeness at varying periods. The remedy for this problem lies in confining the number of varieties to sorts which ripen at the same period.

Washing of the fruit.—This problem now applies only to the small maker who finds it difficult to adopt an efficient method of washing fruit without the expense of an elaborate apparatus such as is used by the larger makers. Good storage conditions will make this operation lighter.

Milling and pressing.—Here the object is to get the biggest possible return from the fruit without detriment to its quality. The fineness of grinding together with the efficiency of the press are all-important for obtaining a high yield of juice. Whether the return from the second pressing of the pomace after it has been re-soaked with water is worth while is a point in question. Better results in the quality are obtained by a second pressing of the pomace where the method has been to break it up again and press a second time without the addition of water.

Fermentation of the juice.—A slow type of fermentation is the object in view, as this results in the best quality cider. Three main factors governing the rate of fermentation are: (1) variety of fruit used, (2) district in which the fruit is grown (soil conditions), (3) temperature during the fermentation period. Methods such as "keeving" and "racking" and sulphuring the juice are employed to meet this problem of quick-fermenting juices. Checking the fermentation at the desirable stage in order to retain natural sweetness is brought about by filtration, pasteurization, and centrifugation. The problem here is to arrest fermentation without detriment to the juice. Filtration through the ordinary pulp filter is not a complete control, although it is effective for a short period. Centrifuging alone does not give perfect clarification; pasteurization tends to affect the flavour.

Seitz filtering in conjunction with pulp filtering gives a complete control, although it is felt that a slight alteration of the flavour is affected by this method. The problem of producing a cider of the type demanded by the public taste and of a standard possessing good keeping quality has to be dealt with by judicious blending.

Storage and distribution.—For storage the cheapest and most commonly used containers are wooden vats and casks. Storage in wood leaves much to be desired in the way of liability to acetification and loss due to evaporation.

The problem is how to improve on this method without the increased initial expense of glass and "ebon" lined tanks. In the bottling of cider a problem arises from the fact that, as the bulk of this type of cider is sterilized and carbonated to meet the demand for a sparkling non-deposit bottled cider, no change takes place to give maturity with age. The deposit which is the objection in naturally after-fermented bottled cider can be removed by the "disgorging" process as is practised in the champagne industry, but at a considerably increased cost.

Mr. Charley dealt with "The Chemistry of Cider," and said:

The composition of cider apples may be approximately represented as:

Pulp	...	92%
Peel	..	7%
Pips	..	1%

From the cider-making point of view the soluble constituents of the pulp (amounting to 90% of the total) will represent the bulk of the juice obtained by pressing the crushed apples, and whilst it is difficult to give figures which would represent an average juice, the following data show the percentages of the main constituents of the juice, and the variations that may occur between various varieties.

Composition of juice from cider apples
(Figures as percentages)

Water	Invert sugar	Sucrose	Malic acid	Tannin	Nitrogen	Pectin
83	11	1·5	0·2–1·2	0·07–0·5	0·01–0·07	0·3
		Ash 0·2–0·4		Starch 0·5		

A classification based on these figures has been used for separating juices into three main types:

(*a*) Sharp juices — Malic acid greater than 0·45%
(*b*) Sweet juices — .. .. less than 0·45%, tannin less than 0·2%
(*c*) Bittersweet juices — Malic acid less than 0·45%, tannin greater than 0·2%

The substances whose percentages are given above play an important part in the subsequent history of the juice during fermentation and storage of the cider. The sucrose is slowly inverted and fermented and is reduced to a mere trace by the completion of fermentation. Malic acid, present either as calcium or potassium bimalate or as free acid, is the characteristic acid of apples and is important from the flavour point of view. It is usual to blend ciders until the acidity is about 0·5%, for should the acidity fall far below this figure cider is prone to attack from various disorders which will be mentioned later. For blending with sharp apples, bittersweet varieties are desirable, but at the present time there is a deficiency of these low acid fruits. The deacidifying of the sharp culinary types of juices is limited by considerations of flavour, as the addition of such chemicals as calcium carbonate, lime, and sodium and potassium hydroxide is liable to affect the pure fruit flavour adversely. The effect of acidities of approximately 0·5% in stabilizing the tannin and preventing its oxidation and subsequent precipitation is of importance. Apple tannin is akin to coffee and cachou tannins. Intense green solutions are given with iron salts, whilst vegetable albumins, gelatin, and some mineral salts are precipitated by tannin solutions. In the presence of air, tannin is oxidized and precipitated by an oxidase to an indeterminate compound "tannin oxide," but this action is inhibited by sufficient amounts of fruit acid.

The presence of high percentages of tannin in a juice inhibits the action of sucrase and pectase, enzymes which materially assist in fermentation and the natural clarification of the juice. Tannin is responsible for the

astringent bitter taste in cider and its presence is desirable, and indeed essential. Owing to the shortage of bitter-sweet fruit, attempts have been made to supply the deficiency in flavour by the addition of various tannin preparations, but in no case has the result been satisfactory.

The nitrogen compounds belong to two classes, albuminoids and amides, the latter of which supply the necessary yeast food for the fermentation. The influence of nitrogen is discussed later. The colloidal pectous material in the juice is derived from the insoluble *pectose in the cell wall. Pectin, the final product*, conveys viscosity and "body" to the juice, and is responsible for a mellow flavour entirely distinct from that due to *sugar*. The *rôle of pectin in ciders is still little appreciated*, but it is certain that problems of clarification and deposition of flocculent material in bottled cider are *intimately associated with the pectic constituents*. Minerals present in apple juice include calcium, potassium, and iron, in the form of chlorides, sulphates, and *phosphates*.

Apple juices contain many volatile principles giving rise to the characteristic aroma of the apple. Ethers *of formic, acetic, caproic, and caprylic acids have been* identified, together with acetaldehyde.

Some degree of control is obtainable over many of *these constituents by orchard and cultural practices*. For example, the nitrogen content of apples is affected by the mode of orcharding adopted. High nitrogen *(and quick fermentation) is associated with trees grown* on ploughed land, whilst from trees grown in a grass orchard the fruits will be low in nitrogen and the fermentation of the juice correspondingly retarded.

Action of apple juice and cider on metals.—The actions are given below in tabular form:

Iron	Strong action with formation of green and brown tannates
Tin	Slight action
Copper	Badly attacked
Aluminium	Slight action
Zinc	Badly attacked
Lead	" "
Stainless steels	No action
Austenitic cast iron	" "

Heavily-tinned copper is generally used at present for filters etc. which come into contact with cider for prolonged periods.

The washing of apples.—Experience has shown that very little loss of flavour or fruity character is experienced in ciders made from washed apples. A loss of 0·05% of sugar has been observed in some cases, but the chief effect of the washing process is to slow down the fermentation of the expressed juice. This is due to removal of natural yeasts from the surface of the apple; a number of yeasts sufficient to secure fermentation are too deeply embedded in the surface of the fruits to be removed by this process.

Fermentation.—Fermentation is caused by the natural yeasts on the surface of the apples which are typical for cider fruit. The yeasts vary in size, an average being about 5—10 μ in diameter. The same orchards afford the same type of yeasts year after year, and the many varieties of cider apples are associated with a definite yeast which may be isolated from the ciders with annual regularity. The problem in fermentation is to secure *a fairly slow but steady fermentative* action. The various factors concerned in this process are:

Temperature.—Fermentation is stopped at 0°—2° C. and reaches maximum velocity at 20°—30° C. Yeasts are killed by exposure to temperatures above 38° C.

Air.—In the aerobic state yeast increases in weight, feeds on sugar but forms little or no alcohol, but in anaerobic state yeasts do not appreciably gain in weight, and ferment the sugar to alcohol.

Acidity.—Normal acidities do not affect cider yeasts, but they are adverse to the development of wild yeasts and bacteria.

Antiseptics.—Sulphur dioxide (maximum dose permitted 14 grains per gal.) is the only antiseptic allowed, and the addition of the full dose to a fresh apple juice will considerably reduce the rate of fermentation.

Nitrogen.—Cider apples in general contain very small amounts of nitrogen and fermentation is accordingly slow. *But the increasing use of culinary* apples with considerably higher nitrogen contents, has introduced the problem of dealing with the very high rates of fermentation correlated with these percentages of nitrogen. Very quickly fermenting juices will yield poor quality ciders, whilst juices which undergo protracted *fermentations will be prone to attack from bacterial* disorders such as sickness and acetification. Fermentation can be hastened by addition of 2 oz. ammonium phosphate per 100 gal. of juice, and retarded by passing the juice through a super-centrifuge previous to fermentation.

The use of special yeasts.—Special yeasts have been extensively studied in connexion with cider manufacture, but the benefits which accrue from their use do not appear to be sufficiently important to warrant any departure from the present method of natural fermentation. The initial pasteurization of the juice, previous to inoculation with the selected yeast culture is liable to impart a "cooked" flavour to the cider, and if on the other hand, a vigorous culture is added to the cider to dominate the natural yeasts, a violent fermentation may ensue in which the delicate flavour and aroma may be vitiated.

Filtering and centrifuging of cider.—These two processes represent an example of the effect of mechanical processes on the final character of the product. Centrifnged ciders are considerably more fruity and mellow than the corresponding filtered samples. The fullness of flavour and "body" is accentuated in the former case, and the general character of similar ciders submitted to filtration and centrifugation are often so widely different that it is difficult to recognize that the samples were each derived from the same original juice. Fermentation is practically completely stopped by both processes if the specific gravity of the cider is below 1·030, but at higher gravities the control is not quite so successful. It is worthy of note that centrifnged ciders contain considerable numbers of yeasts, and the absence of further fermentation points to their inactivation. The nature of this action is not yet elucidated.

the drawback associated with the use of the centrifuge is the slight haze which permeates the cider. Attempts to remove this with various reagents, including pectin-decomposing enzymes, have failed to produce the desired effect.

Disorders of Cider

Acetification.—This disorder is due to bacterium xylinum and other associated micro-organisms which convert alcohol to acetic acid, with the simultaneous development of a yellow leathery fibre, characteristic of the disorder. Acetification is by far the most common of cider troubles, and is largely due to the access of air to the cider at some stage during making or storage. Prevention of this disorder is largely a matter of using sound casks and vats, and reducing to a minimum any contact between the cider and air.

Cider sickness.—Slow fermenting ciders with acidities below 0·45% are liable to sickness. The cider becomes opaque and undergoes a violent fermentation prominent amongst the products of which is acetaldehyde. Subsidiary products with unpleasant odours are associated with the disorder. *There is very little chance of remedying* a badly attacked cider, but ciders in which the bacteria have only recently been established can generally be saved by an increase in acidity, either by blending with sharp ciders, or addition of tartaric or citric acids. Ciders with more than 0·5% of malic acid rarely suffer from this bacterial disorder.

Ropiness.—This disorder is not so common as the above two types, and its prevention is largely a matter of maintaining the acidity above 0·5%. Long strings of deposit are formed in the bottle and the cider becomes viscous. The disorder is dangerous for the reason that it does not become obvious nntil the bacteria have become very active. A violent agitation of the affected cider is the only remedy which can be suggested.

OCCURRENCE AND INDUSTRIAL POSSIBILITIES OF MONAZITE IN THE BLACK SANDS ON THE ORISSA COAST

By S. B. ROY, B.Sc.*

A sample of black sand from Satvaya on the Orissa Coast sent by the Director of Agriculture, Bihar and Orissa, in December, 1922, for analysis and report, was on microscopic examination found to contain small crystals having black, red, yellow, and other tints. The black particles constituting the major part of the sand were found by Mr. C. S. Taylor, agricultural chemist, to be ilmenite (ferrous titanate). The search for any other interesting ingredient was taken up by the author. In course of analysis, the sulphuric acid extract of the sand was found to contain thorium and rare-earths. As phosphoric acid was also found, there was a strong presumption of the presence of monazite.

Ilmenite is more strongly magnetic than monazite and there was found a third portion in the sand not magnetic at all, a fraction consisting mainly of yellow sand yielding 60% of rare-earth oxides and thoria which could be separated by the crude electro-magnetic device set up in the laboratory. This answered closely the description of monazite given in Schoeller & Powell's Analysis of Ores and Minerals of Rare Elements (page 105). The presence of monazite in the sample of black sand was thus confirmed. The total percentage of rare-earths in the sample of yellow sand separated was found to be 61·14 and the percentage of thoria 7·9. The sand is therefore richer in thoria than many other sources of this substance; for instance, the Brazilian sands (concentrated for export) which before the discovery of the monazite beds in Travancore and Ceylon were the chief source which supplied almost all the world's necessary thoria, contain only 6·5% thoria.

The importance of the monazite industry in India would be apparent from the fact that during the period 1914 to 1921 the annual output of monazite from Travancore varied roughly between 1200 and 2000 tons, valued at £45,000 to £60,000.

Following this discovery a survey of the whole tract was undertaken by the Department of Geological Survey of India in January, 1924. The deposits on the mainland coast appear to be the most important, extending over 23 miles in length, 70 ft. breadth, and 10 in. thickness. The average content of monazite in this sand varies between 2% and 3% (richest sample 11%), against Travancore sands with average 10% (richest sample 60%). The low figure of this black sand would not, I believe, be so serious a hindrance to the development of this source of monazite as the mineral found in the sand is a fairly high-grade one containing 7·9% of thoria (Travancore monazite contains 8% to 10% of thoria), the source to work upon is fairly large, and the separation of monazite from the sand ("concentration" as it is called for export) requires no skill of the operators and is inexpensive but for the initial outlay of the plant. Further there is the possibility of utilization of some by-products. The chief commercial use of monazite is at present in the preparation of thorium nitrate for incandescent gas mantles. The English patent 124 of 1893 describes the most successful mixture for gas mantles as containing 99% to 98% of thoria and 1% to 2% of ceria. The gas mantle industry is likely to extend further, and this Orissa deposit may serve as a profitable source of supply for the future.

By-products.—(1) The large quantity of ceria left behind with the rare-earths, when monazite is worked for thoria, may be used for manufacture of pyrophoric alloys, of which about 2000 tons per annum are used.

(2) Ilmenite constituting about 75% of the sand can be utilized for (*a*) preparation of ferro-alloys for use in final purification of steel and cast iron. The use and manufacture of the alloy is protected by a large number of U.S.A. patents.

(*b*) Tanning. Ti salts unite with the tannin matter of leather giving a yellow to brown colour which is fast to light and soap.

(*c*) Production of pigments. Of late titanium dioxide has been more generally used as a very desirable substitute for white lead or zinc oxide, as it is stable, resists the attack of sulphuric acid and other corrosive substances, is not discoloured by sulphuretted hydrogen, has a low specific gravity and an opacity higher than that of many other pigments.

I wish to convey my best thanks to Mr. Taylor and the authorities of the Agricultural Department for facilities afforded in carrying on this investigation.

* Asst. Director of Agriculture, Bihar & Orissa, India.

PROF. F. G. DONNAN

Prof. Frederick George Donnan, C.B.E., D.Sc., LL.D., F.R.S., etc. was educated at the Universities of Belfast, Leipzig, Berlin, and London, his teachers in chemistry being Letts, Ostwald, van't Hoff, and Ramsay. Having worked with Sir William Ramsay from 1898 to 1903 and held the post of Assistant Professor at University College, London, he went to the Royal College of Science, Dublin, where he acted as Lecturer in Organic Chemistry during the period 1903—1904. In the latter year he was called to Liverpool University as the first Sir John Brunner Professor of Physical Chemistry. In Liverpool Prof. Donnan had the honour of designing and directing the Laboratory of Physical and Electro-Chemistry, presented to the University by Dr. Edmund Muspratt, Pro-Chancellor of the University and Chairman of the United Alkali Company. In 1913 Prof. Donnan was called to London to succeed Sir William Ramsay at University College, and in 1928 he became Director of

the Chemical Laboratories on the retirement of Prof. John Norman Collie, F.R.S.

His researches have dealt mainly with physical chemistry, including amongst others the following topics: colour and ionization in aqueous solutions, heterogeneous equilibria in salt solutions, osmotic pressure, the Hall Effect in solutions of electrolytes, the interfacial tension between two fluid phases, the surface tensions of liquefied gases at low temperatures, adiabatic condensation of organic vapours, the effusion of gases, the theory of colloids, emulsions and the theory of emulsification, standard reference electrodes, the operation of alkali-chlorine electrolysers, surface-concentration at air-liquid interfaces, electrical potentials at air-liquid interfaces, the electrical charges and stabilities of hydrocarbon oil emulsions in water, ionic equilibria and potential differences across semi-permeable membranes, the theory of counter current gas scrubbing towers, the caking of powders, etc., etc. The theory of ionic membrane equilibria developed by Prof. Donnan has found many important applications in colloid chemistry and in physiology and medicine. Both at Liverpool and London he has been successful in organizing and directing important schools of research. Thirty of his former research students now hold professorships in many parts of the world.

He has always had a deep interest in the technical applications of chemistry. In 1918—19 he visited Chile and wrote a valuable report on the Chilean nitrate industry, whilst he was instrumental in the foundation of the Department of Chemical Engineering at University College, London. In 1925 he investigated certain phases of the German potash industry.

Prof. Donnan has received honorary degrees from the Universities of Liverpool, St. Andrews, Belfast, Edinburgh, Durham, Princeton, Johns Hopkins (Baltimore), and Oberlin College (Ohio). He holds the Longstaff Medal of the Chemical Society and the Davy Medal of the Royal Society, and is an honorary member of the American Chemical Society, the Dutch Chemical Society, the German Bunsen Society, and the Institution of Chemical Engineers. He is a Foreign Member of the Royal Academy of Sciences, Amsterdam, and the Royal Society of Sciences, Upsala. In 1923 he was President of the Chemical Section of the British Association, during 1924—26 President of the Faraday Society. For many years he was Foreign Secretary of the Chemical Society, whilst he has also served on the Councils of the Royal Society and the Society of Chemical Industry. His only contribution to book literature has been the monograph on Copper in Abegg's Handbook of Inorganic Chemistry.

Prof. Donnan has had the honour of close association with Messrs. Brunner Mond & Co., and later with Imperial Chemical Industries. Together with the late Lord Moulton he was successful in initiating the extremely valuable financial help which Messrs. Brunner Mond & Co. soon after the war gave, and continued yearly to give, to the research Departments of Chemistry and Physics at the British Universities. This important aid has been continued and developed in most liberal fashion by Imperial Chemical Industries, and has been one of the principal factors in the development of chemical and physical research in this country, and in the training of University men for the needs of British chemical industry.

SHIPPING, ENGINEERING, AND MACHINERY EXHIBITION, 1933

The two years which have passed since the last Shipping, Engineering, and Machinery Exhibition have been years of great anxiety for those industries for which the Exhibition caters; yet the exhibition shows a very healthy state of progress in the design and methods of construction, of industrial plant, and much progress too in the selection of the materials used in such plant.

The exhibition opened at Olympia on September 7, and will remain open until September 23. Users of plant and equipment will need no exhortation to go to the exhibition, but many others concerned less directly with industrial practice and development will find much to interest them. In the first place the exhibition includes what is a notable innovation, a collection of exhibits by the Department of Scientific and Industrial

Research. This endeavour to bring home to the public the practical aspects of research work cannot be too well commended, and as to the public interest it is sufficient to note that the *D.S.I.R.* stands are well filled with visitors even at those times when the public attendance is relatively sparse. The exhibits shown have been provided by the William Froude Laboratory and the *Engineering* and *Metrology Departments* of the National Physical Laboratory, the Fuel Research Station, the Chemical Research Laboratory, the Industrial Research Council of the National Federation of Iron and Steel *Manufacturers*, the British Cast-Iron Research Association, the British Non-Ferrous Metals Research Association, and the British Scientific Instrument Research Association. It would be impossible here even to mention, much less comment on, the vast number of these exhibits. Members of the Society will no doubt be particularly interested in the exhibits illustrating the work which has been proceeding at Teddington on salt-water corrosion of metals, and a scale model of the "Grid" short-flame pulverized-fuel burner developed at the Fuel Research Station is of much interest. There are some excellent exhibits showing the examination and characteristics of steel ingots, and the work of the British Non-Ferrous Metals Association on lead alloys, electro-deposition, copper, aluminium, and alloys for high-temperature service is well displayed.

In other parts of the exhibition probably the most notable developments to be seen are in connexion with internal-combustion engines and welding technique. Twenty-four stands occupying 13,000 sq. ft. are concerned with engine exhibits, and there are many stands showing developments of the Diesel engine. About a dozen firms, notably the British Oxygen Co., Ltd. and Murex Welding Processes, Ltd. have exhibits of welding plant and accessories, but in addition the extension of welding practice is to be seen in constructional work in other parts of the exhibition.

Wild-Barfield Electric Furnaces, Ltd. have a good range of exhibits, amongst which two furnaces with forced-air circulation are of special interest; the company's range of "Telcon" alloys is also to be seen. The stands of Bradley & Foster, Ltd., the Mond Nickel Co., Ltd., and Henry Wiggin & Co., Ltd. show many examples of the wide range of uses to which nickel alloys are being put in various engineering fields, and the Mond Nickel Co. is distributing a useful rotating chart which provides information of castings in nickel-cast iron with correct foundry mixtures and physical properties of the alloys. The stands of Philips Lamps, Ltd. (Industrial Section) show a number of interesting radiographs illustrating the headway made in recent years in the application of *X*-rays to industrial testing; this firm also shows a welding rectifier which renders the welding of thin plates a more simple matter than hitherto.

Other stands show marine equipment, air compressors, anti-corrosion compounds, scientific instruments, and every type of equipment used in industry. A plastic moulding press is at work on the stand of the Hydraulic & Engineering Co., Ltd., and CO_2 compressors and refrigerating machinery is to be seen on the stand of J. & E. Hall, Ltd. Possibly one of the most notable features of the exhibition is the excellent layout and design of the stands. The palm must go to the Yorkshire Copper Works, Ltd. for the imposing design contrived by a simple arrangement of copper and aluminium-brass tubes.

CORRESPONDENCE

A HUNDRED YEARS AGO

SIR,—Your editorial in last week's issue with the title "A Hundred Years Ago" mentions the names of many people but says very little about any of them. You might have referred also to Prof. T. C. Hope of Edinburgh (1766—1844) who proved that strontia differed from baryta and determined the point of the maximum density of water, and to Sir Goldsworthy Gurney (1793—1875) who invented the oxy-hydrogen blow-pipe, and to William Brockedon (1787—1854), who invented many things, including india-rubber corks and compressed lozenges. I think your long list might have included Gilbert White, the naturalist (1720—1793) and his correspondent Daines Barrington (1727—1800), lawyer and antiquary, and George Barrington (1755—

) the pickpocket who practised his art in Queen Charlotte's drawing room and was transported to Australia where he wrote a prologue to a play, containing the well-known lines "True patriots we, for, be it understood, We left our country for our country's good." You might have referred to Chevreul in your list of old people, and to Fontenelle who, when a hundred years old, apologized for not stooping to pick up a lady's fan, saying "Ah, que n'ai-je plus mes quatre-vingt ans." Cavour, Brougham, and Westbury are mere names to me.

I am, Sir, etc.,

ANALYST

London, E.
Sept. 11, 1933

VEGETABLE PARCHMENT FOR FOOD WRAPPING

SIR,—Our attention has been drawn to some remarks on the subject of vegetable parchment by Dr. Charles J. J. Fox (Messrs. Cross & Bevan) at the meeting of the Food Group of the Society of Chemical Industry, recently held in Blackpool, in which he stated that: "Vegetable parchment is commonly treated with a deliquescent agent, such as magnesium, zinc or calcium chloride, glycerine or glucose, and the presence of one or other of them must always be expected in vegetable parchment."

This statement may have been true fifty years ago, when the manufacture of vegetable parchment was in its infancy.

Vegetable parchment, as manufactured to-day for the wrapping of foodstuffs, is the purest product of the paper industry. It is composed of pure bleached vegetable fibre subjected to the parchmentizing process. For general use in the wrapping and packing of foodstuffs, it is made absolutely free from additions of loading, sizing, or softening agents of any kind. The use of softening agents referred to by Dr. Fox is limited to treatment of vegetable parchment used for special purposes, but is absolutely excluded from the manufacture of food wrappers of any kind, unless specially

specified by the consumer. In modern vegetable parchment the degree of pliability is obtained without the use of softening agents.

I am, Sir, etc.,

For BRITISH VEGETABLE PARCHMENT MILLS, LTD.,
JAMES STRACHAN,
Director and General Manager

Northfleet, Kent
Sept. 9, 1933

PERSONAL AND OTHER ITEMS

Sir William Hardy, F.R.S. has been elected president of the British Association for the Advancement of Science for the year 1933–34, when the annual meeting is to be held in Aberdeen. Sir William, who was for some time secretary of the Royal Society, is at present Director of *Food Investigation, Department of Scientific and* Industrial Research. It will be remembered that he delivered the Hurter Memorial Lecture in November *last before the Liverpool Section of the Society, his* subject being "Some Recent Developments in Low Temperature Research." The paper was published in CHEMISTRY AND INDUSTRY on *January 20*, 1933.

We regret to announce the death at the age of 63 of Sir Gilbert Vyle, the well-known industrialist of the Midlands. Sir Gilbert was at one time a consulting *industrial engineer, before joining the firm of* W. & T. Avery & Co., of which he became managing director. During the war he organized the design and manufacture of aircraft and was also responsible for munition factory equipment. During the Ottawa Conference last year he acted as trade advisor to the British Government Delegation.

We regret to learn of the death on September 6 of Dr. Ramsay Wright, the distinguished biologist, at the age of 83. Dr. Wright was professor of biology at Toronto University for more than twenty years, and was vice-president of the University from 1901 to 1912, the year of his retirement.

We regret to record the death on September 6 of Mr. E. P. Potter one of the original members of the Society. Mr. Potter founded the Bolton firm of E. P. Potter & Co., which manufactures bichromates and other chemicals. He was a notable benefactor in the district.

Import Duties on Dyestuffs

In December last it was decided to extend the operation of the Dyestuffs (Import Regulation) Act, 1920, until December 31, 1933, and in the meantime the Import Duties Advisory Committee was asked to consider the position which would arise on the expiry of the Act, and to advise whether the interests of trade and industry in the United Kingdom would best be served by the further continuance of the Act or its discontinuance.

The report of the committee is now available (H.M.S.O., 2½d. post free). The main recommendation is that the prohibition of importation of dyestuffs and intermediates except under licence should be continued, but that colours and colouring matters such as lake pigments, artists' colours, and printing inks should be exempt from the import prohibition. The import goes on to say that if this recommendation is accepted, the committee recommends the exemption of dyestuffs from the 10% duty to which they are liable under the Imp Duties Act, but that intermediates should not exempt from this duty.

The view is expressed that complaints by any respo sible body of consumers of exploitation in respect dyestuffs and intermediates should be considered *an independent authority with powers of investigatio* The committee itself is prepared to undertake th duty if requested to do so. The further recommendatio *is made that the industries concerned should set up* standing joint committee of makers and users to a as a consultative body on questions of prices an supplies.

Post-Advanced Introduction in Chemistry

The joint advisory committee, representative of th Board of Education, local education authorities, tec nical colleges, and the Manchester and Liverpool Section of the Society of Chemical Industry and of the Institu of Chemistry, which was set up in 1931 with the obje of arranging a scheme of courses of a post-advance *character in chemistry, has recently issued its* 1933 syllabus of classes to be held at the College of Tec nology, Manchester; the Central Technical School an *the City Bacteriological Laboratory, Liverpool*; an the Technical College, Widnes. Particulars of the classes, which include bacteriology, modern organ syntheses and methods of synthesis (Liverpool), son applications of physical chemistry in textile industrie modern aspects of surface chemistry, principles costing as applied to the chemical industry (Manchester chemical engineering, and fuel technology (Widnes), c be obtained from the above-mentioned institutions.

Manufacture of Plaster Boards

In his speech at the last annual meeting of Imperi Chemical Industries, Ltd., Sir Harry McGowan me tioned research work carried out by some of the I.C subsidiary companies on building materials, particular *with reference to the manufacture of products fro* Billingham anhydrite. It is now reported that t company is contemplating the erection in the ne future of a factory in London for the manufacture building blocks and an improved plaster board.

It is also reported in the *Financial Times* that Briti Plaster Boards, Ltd. of Liverpool has decided commence manufacture in the London area. Althou the use of plaster boards is on the increase, the amou at present employed in building is stated to be abo 1%, as *compared* with 99% lathes and plaster.

Plastics at the Borough Polytechnic

Classes for instruction in the subjects of synthet resins, moulding materials, and adhesives are held The Borough Polytechnic, Borough Road, Lond S.E.1, and an illustrated leaflet, which gives details the arrangements for the 1933—34 session, has recen been published. *The course in the manufacture, p* perties, and uses of synthetic resins is intended to exte over two years, and in the first year students attend lecture, and two hours practical work each week, a classes are also held in the design and manufacture moulds, and workshop practice. The classes are un the direction of the head of the chemistry departme Dr. E. C. Pickering, from who full particulars can obtained.

New Siemens Melting Plant

The English Steel Corporation, which was formed in 1929 to take over the steel interests of the three steel manufacturing concerns—Vickers, Ltd., Sir W. G. Armstrong Whitworth, Ltd., and Cammell Laird & Co., Ltd.—has recently completed the building of a Siemens melting department embodying the most modern improvements. With this plant the corporation will be able to manufacture special steels, such as those required by the Vickers works for the manufacture of hollow forgings for use in chemical and oil engineering plant at high temperature and pressure.

Rayon Production in Japan

It is reported that the output of rayon rose during the first six months of the year from 12,000,000 to 18,000,000 kg. The increase makes Japan the second largest producer in the world, taking the place of Great Britain.

Production of Acetone and Butyl Alcohol in Italy

In the case of butyl alcohol a maximum production was attained in 1929 (600 tons), according to figures published in *Die Chemische Industrie*. In 1930 the output slumped to 180 t., and in 1932 had recovered to 400 t. For acetone the figures for 1930 and 1931 were 520 t. and 900 t. respectively, whilst the 1932 production is stated to have shown a further increase.

Production of Solid CO_2 in U.S.A.

The production of solid carbon dioxide has increased enormously in the United States during the last four years. In 1928 production was estimated at 6000 tons; by 1932 production had reached 61,000 t., and 70,000 t. have already been manufactured this year.

"Achema" Exhibition, 1934

The Deutsche Gesellschaft für Chemisches Apparatewesen E.V. intends to publish, as in former years, a catalogue giving information with regard to the seventh exhibition of chemical apparatus and plant ("Achema") which is to be held in Cologne next May. The Achema Annual will also contain accounts of the present stage of development of plant and apparatus, and will give precise details of what may be seen at the exhibition. Although the ordinary price of this publication is 10 m. members of the Society may obtain copies gratis on application to the Deutsche Gesellschaft für Chemisches Apparatewesen E.V., Seelze bei Hannover.

Granulated Ammonium Nitrate

According to *L'Industrie Chimique* ammonium nitrate is being produced in Holland in granulated form, the fertilizer containing about 20·5% of nitrogen. The ammonium nitrate is agitated in contact with gaseous ammonia in a revolving drum after the addition of about 40% of such diluents as kieselguhr and calcium sulphate. The stability of the granules is said to be better than that produced by any other method.

A Denaturant for Alcohol

The authorities in Italy have recently made an order by which alcohol which is intended for use in the production of transparent liquids may be denatured with the following mixture: 1 kg. pine oil, 1 kg. rice oil, 1 kg. caustic potash (36° Bé.) per hectolitre of alcohol.

REVIEWS

EINFÜHRUNG IN DIE TONPHOTOGRAPHIE: PHOTOGRAPHISCHE GRUNDLAGEN DER LICHTTON-AUFZEICHNUNG. By Dr. J. Eggert and Dr. R. Schmidt. Pp. vi + 137. Leipzig: S. Hirzel, 1932. 7 rm.

There are doubtless many people who feel more than a passing interest in the methods of sound reproduction used in their favourite cinema; there are also those whose interest is of a more intimate nature, who in some way or another are interested in the cinema *industry*. If *all* these people could but read German, here is the book which will explain in the clearest possible manner not only the *actual methods* of sound photography but also describe the details in such a way that *any intelligent person can follow* them.

Commencing with the simplest case of the mechanical reproduction of sound, the authors develop their theme in such a way that every step in the photographic reproduction of sound is clearly described and illustrated. Not merely is there a clear exposition of sound reproduction by photographic methods, but the control of such processes by sensitometry is equally explained, and the various arrangements of apparatus are admirably illustrated by diagrams. When it is remembered that in this book of 137 pages the diagrams and illustrations number 122, it will be realized how much the authors have used graphic methods as an aid to their textual description. From this it might be thought that the main appeal of the book is to the intelligent outsider. This is not so; to those actually employed in the cinema industry the book will prove of exceptional value, as no clearer account of the methods, principles, and control of sound films exists. That is not to say that every system is described, but the examples given are so fully explained that the principles involved are capable of general application to any system.

H. W. G.

QUALITATIVE ANALYSE AUF PRÄPARATIVER GRUNDLAGE. By Dr. W. Strecker. 3rd enlarged ed. Pp. viii + 203. Berlin: J. Springer, 1932. 8 rm.

This book is not limited to the essential processes of qualitative analysis, but forms a course of practical work, complementary to the students' reading in inorganic chemistry, which is calculated to make him familiar with the various forms of manipulation likely to be encountered in laboratory work. Especially is this true of the preparations, which cover a whole range of laboratory processes.

The sections dealing with the reactions of the ions are very complete and up-to-date, particularly in regard to "spot" tests with organic reagents, although the only organic acids dealt with are the hydrocyanic acid group, acetic, oxalic, and tartaric, which is not in keeping with the comprehensiveness of the book in other respects.

General subjects such as ionization, spectrum analysis, complex ions, etc. are briefly discussed at suitable intervals in the text, with reference to their bearing on qualitative analysis.

The scheme for the separation of the metals would not appear to be of great value to the English student, as

it differs essentially from that to which he will have been accustomed, but there are several separations, such as alternative methods for the separation of phosphoric acid in the ammonium sulphide group, which might be helpful in cases of difficulty. The preliminary tests, the treatment of insoluble substances, and the examination for acids are dealt with clearly and thoroughly, while the reactions of the less common elements are given in brief at the end of the book.

The chief feature of the book is the detailed simplicity with which all experiments are described. It should be useful to students who wish to combine a thorough grounding in practical chemistry with a revision of their German.

W. E. G.

DER EINFLUSS DER HANDELSDÜNGER AUF DAS PFLANZENWACHSTUM UND AUF VERSCHIEDENE EIGENSCHAFTEN KALKARMER MINERALBÖDEN. By Dr.-Ing. L. Schmitt. Pp. 186. Berlin: Verlagsgesellschaft für Ackerbau, 1932. 9 rm.

The book presents in a clear and attractive way the results of long period field and pot experiments at the Darmstadt Agricultural Experiment Station to determine the effect of artificial fertilizers on plant growth and soil reaction. The experiments were mainly concerned with potassic fertilizers, and were carried to a conclusion with the assistance of the Kali Syndikat. The experiments were begun in 1925 after an attack of scab on potatoes. The soil was lime-deficient and sandy (*i.e.*, poorly buffered and of very high exchange acidity), and it was thought that acidity changes would be reflected in crop yields in a relatively short time. The results of the field experiments, which are supported by numerous laboratory data including determination of p_H, exchange acidity, buffer capacity, lime status, etc. of similar soil in pot cultures, lead the author to the following conclusions: (1) that potassic fertilizers have a physiologically neutral reaction; (2) that most phosphatic fertilizers, including superphosphate, are physiologically neutral; basic slag and Rhenania phosphate are physiologically alkaline; (3) that ammonium sulphate has a considerable acidifying effect on the soil in question, whilst sodium nitrate and cyanamide are physiologically alkaline.

The author's conclusions are somewhat sweeping, and it must be remembered that the data relate only to one particular soil. They differ from results of previous experiments such as Nehring's on well-buffered soil in which the effect of fertilizer salts on soil reaction was not pronounced. Further, whilst there is evidence of much careful laboratory work, there is no indication that the field data (mean of 3 plots, 10 treatments) have been examined statistically and there is accordingly no guide to the experimental error and the degree of significance of the results.

The author claims to have demonstrated the superiority of kainit, rich in magnesium, to other forms of potash on this acid soil. The effect is more apparent on the rye plots than on the potato plots. Field experiments to elucidate this matter point to the beneficial effect of the Mg ion, but its precise action is not determined.

K. J. S.

COMPANY NEWS

BOOTS PURE DRUG CO., LTD.

The board of directors of the company has passed resolution to convene a meeting of the shareholders bring into effect a resolution to divide the £1 ordin shares into shares of 5s. The appointment of th new directors, Viscount Mersey, Viscount Wolmer, M. and Col. F. P. Braithwaite, is announced, bringing total number of members of the board to twelve.

BRITISH PORTLAND CEMENT MANUFACTURERS, L

The company announces an interim dividend of actual, less tax, on the ordinary shares, payable October 14. This is at the same rate as the inte dividend last year, when with a final dividend of 1 the total distribution was 15%.

INDESTRUCTIBLE PAINT CO., LTD.

The directors of the company have declared interim dividend of 5% on the ordinary shares, whic at the same rate as last year. The dividend is paya on October 2 to shareholders registered on September

The company has made progress during the last y in the home market and sales have increased, wh attention has been given to business on the Contin and it is hoped that, in spite of difficulties, the results 1933 will be equal to those of 1932.

UNITED INDIGO AND CHEMICAL CO., LTD.

The directors of the company have recommende dividend of 5% on the ordinary shares for the y ended June 30, 1933. No dividend on the ordin shares was paid for the year 1931—32. The profit the company for the year was £7539, as compared w £5426 last year.

CELANESE CORPORATION OF AMERICA

The corporation has declared a quarterly dividend $1·75 per share on the 7% series prior preferred sto payable on October 1, and a dividend of $4 per sh on the cumulative first participating preferred sto as against $5 last year.

GENERAL MINING AND FINANCE CORPORATION

The corporation is resuming payment of inter dividend with a payment of 7½% actual. The l interim dividend was in 1928, when 5% was paid, i in 1932, although no interim distribution was ma 10% was paid in one sum after the closing of the accou in December.

LOVERING CHINA CLAYS, LTD.

The fourth annual meeting of the company was h on September 7, when the chairman, Mr. John Laws referred to the amalgamation with English China Cla Ltd., and H. D. Pochin & Co., Ltd. The effective d of the amalgamation was September 30, 1932, and t accounts submitted consequently embraced only t previous half-year. In this six months the compa showed a profit of £8176, which was a distinct impro ment on the £7235 earned in the previous twel months. The valuations made under the amalgamati agreement totalled £2,686,562, of which Lovering Chi Clays, Ltd., contributed £528,335. The chairman stat that considerable benefits were to be looked for fr the amalgamation.

MARKET REPORT

Market Report is compiled from special information received from the manufacturers concerned.

Unless otherwise stated, the prices quoted below cover fair quantities net and naked at sellers' works.

The following alterations in prices are reported since publication of the last Market Report (cf. CHEM. & IND. Sept. 1, p. 702 1933).

RUBBER CHEMICALS

Antimony Sulphide.—2s. 8d.—3s. per lb.

Carbon Black.—3d.—4½d. per lb., ex wharf.

TAR PRODUCTS

Benzole.—90%, 2s. 4d. per gal. Pure, 2s. 9d. per gal.

PHARMACEUTICAL AND PHOTOGRAPHIC MATERIALS

Gelatine Resub., B.P.—9s.—11s. per lb.

ESSENTIAL OILS

Almond.—Foreign S.P.A., 9s. per lb. Anise.—2s. 1d. per lb. Bergamot.—7s. per lb. Bourbon Geranium.—24s. 9d. per lb.

Eucalyptus, Australian B.P., 70/75%.—1s. 2d. per lb. Lavender.—Mont Blanc, 38/40%.—10s. 9d. per lb. Lemon.—5s. per lb. Lemongrass.—4s. per lb. Orange, Sweet.—6s. 6d. per lb. Otto of Rose.—Anatolian, 35s. per oz.; Bulgarian, 50s. per oz. Palma Rosa, 8s. per lb.

PATENT LIST

The following is a list of complete specifications of chemical interest which open for inspection under Section 91 (4) (*a*) of the Patent Acts. Printed copies are not available, but photographic copies may be obtained at a charge of 2s. per page (minimum 1s.) from the Patent Office, Chancery Lane, W.C.2.

20,851 (1932). Dorr Co. Sedimentation apparatus.

5456 (1933). Chamayon. Tubular heat exchangers.

5534 (1933). Munters. Heat insulation.

5688 (1933). Electric Furnace Co. Heating materials.

5737 (1933). Schone. Production of foam for fire-extinguishing purposes.

5782 (1933). New York Hamburger Gummiwaaren Co. Production of porous materials.

I. 4421 (1933). Bataafsche Petroleum Maats. Removal of acetylene from gases.

5905—6 (1933). I. G. Farbenind. Producing flash light.

II. 5556 (1933). I. G. Farbenind. Manufacture of anthraquinone derivatives.

5865—6 (1933). Brachfeld and Smola. Concentrating volatile fatty acids.

5900 (1933). Soc. Chem. Ind. in Basle. Manufacture of intermediate products and dyestuffs therefrom.

5931 (1933). Du Pont de Nemours & Co. Manufacture of oxalic acid and esters thereof.

V. 5900 (1933). Soc. Chem. Ind. in Basle. *See* III.

5901 (1933). I. G. Farbenind. Manufacture of azo dyestuffs.

VI. 16,243 (1932). Norsk Hydro-Elektrisk Kvaelstofakt. Manufacture of potassium nitrate.

16,244 (1932). Norsk Hydro-Elektrisk Kvaelstofakt. Production of potassium nitrate and calcium chloride.

5348 (1933). Ges. f. Kohlentechnik. Production of sodium cyanide.

5422 (1933). Du Pont de Nemours & Co. Manufacture of colloidal sulphur.

5821 (1933). I. G. Farbenind. Manufacture of alkali hydroxide solutions.

5864 (1933). Brachfeld and Smola. Obtaining inorganic acid gases from gaseous mixtures.

5865—6 (1933). Brachfeld and Smola. *See* III.

VIII. 5617 (1933). Fechoz. Glass-working processes and furnaces.

IX. 4969 (1933). Fibroplast Ges. Manufacture of building slabs.

5534 (1933). Munters. *See* I.

X. 2573 (1933). Soc. d'Electro-Chimie, d'Electrométallurgie, et des Aciéries Electriques d'Ugine. Manufacture of steel.

5537 (1933). Verein. Stahlwerke. Reducing or eliminating internal stresses in cold-worked metal articles.

5823 (1933). Fink. *Aluminium-coated metal.*

XII. 5340 (1933). Konstandt. *See* XX.

XIII. 5960—1 (1933). Armstrong Cork Co. Decorating *surface-covering material.*

5347 (1933). Raschig Ges. Production of press-moulding masses by condensation of phenols with formaldehyde etc.

XIV. 1900 (1933). Goodyear Tire & Rubber Co. Vulcanization of rubber.

5543 (1933). Du Pont de Nemours & Co. Vulcanization of rubber.

5658 (1933). Du Pont de Nemours & Co. Production of rubber having age-resisting properties.

5698 (1933). I. G. Farbenind. Manufacture of rubber solutions and rubber conversion products.

5782 (1933). New York Hamburger Gummiwaaren Co. *See* I.

XIX. 5915 (1933). Brit. Thomson-Houston Co. Preserving food.

XX. 3762 (1933). Vorschütz. Production of immunizing substances.

5340 (1933). Konstandt. Production of saponaceous pastes, salves, creams, or the like.

XXI. 2184—5 (1933). Nordmann. Colour photography.

5306 (1933). I. G. Farbenind. Anti-halation layers for photographic plates and films.

5905—6 (1933). I. G. Farbenind. *See* II.

XXII. 5544—5 (1933). Du Pont de Nemours & Co. Manufacture of explosive compositions of the character of dynamite.

GENERAL NOTES

Official Trade Intelligence

The Department of Overseas Trade (Development and Intelligence), 35, Old Queen Street, London, S.W.1, has received the following inquiries for British goods. British firms may obtain further information by applying to the Department and stating the specific number. *Argentina:* Brass, copper, white metal (278). *Belgium:* Artificial silk (261 and 262). *British Guiana:* Condensed and evaporated milk, paper (240). *Finland:* Leathers (F.Y. 1849). *Holland:* Paper (272). *Rumania:* Industrial chemicals, dyes, metal goods (277). *South Africa:* Brass bars (G.Y. 12915); Copper conductors (A.Y. 11960); Aluminium (257).

Dyestuffs (Import Regulation) Act, 1920

The following statement relating to applications for licences under the Dyestuffs (Import Regulation) Act, 1920, made during August has been furnished to the Board of Trade by the Dyestuffs Advisory Licensing

Committee. The total number of applications received during the month was 575, of which 503 were from merchants or importers. To these should be added the 7 cases outstanding on July 31, making a total for the month of 582. These were dealt with as follows: Granted 563 (of which 557 were dealt with within 7 days of receipt); referred to British makers of similar products 13 (of which 10 were dealt with within 7 days of receipt); outstanding on August 31, 6. Of the total of 582 applications received, 567 or 97% were dealt with within 7 days of receipt.

New I.C.I. Dyestuff

Imperial Chemical Industries has added a new colour to its range of fast to light Solway dyestuffs, called Solway Blue AS, which yields pure blue shades of very good fastness to light, perspiration, and salt water. It is suitable for dyeing all forms of woollen materials, but on account of its very good level-dyeing properties and light fastness, is of particular interest for the dyeing of piece goods.

Humidity Determination

There are a number of industrial operations in which it is necessary or advisable to keep a check on humidity of the atmosphere. For such purposes the "Humatagraphs" made by A. Gallenkamp & Co., Ltd., of Sun Street, London, E.C.2, will be found very suitable. The instrument depends for its operation on the sensitivity of an absorbent fibre, and it is claimed that results are as accurate or more accurate than those obtained with expensive hygrometers. A reading can be obtained in two minutes in the atmosphere, whilst the design is sufficiently robust for the humatagraph to be placed between bales of material etc. The humatagraph is made as a pocket model, costing 15s., or in various designs for industrial purposes.

Welding

The August number of *The Welder*, which is published by Murex Welding Processes, Ltd., contains a useful article on butt-welding that outlines the considerations which must be borne in mind in obtaining the strongest possible welds of this type. Other interesting articles deal with welding of boiler drums, stress distribution in angle-joints and tar-still maintenance by means of arc-welding. *The Welder* continues to be an excellent source of information on welding practice. Copies can be obtained free from the editor, Ferry Lane Works, Forest Road, London, E.17.

Industrial Instruments

Notable advances have been made in recent years in the accuracy and dependability of industrial instruments and the extent to which they are employed. A publication entitled "Some Industrial Instruments" recently issued by Negretti & Zambra, of 38, Holborn Viaduct, London, provides a good account of the design and usefulness of many instruments. Some indication of the dependability of these instruments is given in the statement that in recent years the firm has supplied 20,000 mercury filled instruments. The booklet describes dial thermometers, recording thermometers, electrical thermometers, multi-point recording pyrometers, automatic and air-operated temperature controllers, draught gauges, and pressure recorders. Information is also given regarding flush mounting and bulb fittings available. Negretti & Zambra's works at Barnsbury, North London, employs 230 persons there is no piece-work or mass production, although all employees participate in profits, and all the instruments produced receive individual care and attention during production, calibration, and testing.

"Elo" Synthetic Resin Products

Birkbys, Ltd., of Liversedge, Yorkshire, are specialists in the manufacture of synthetic resins for insulation purposes, moulding powders, and varnishes. A recent publication by this firm (List B, Issue 2) deals particularly with the use of "Elo" phenol-formaldehyde resins in the engineering and electrical trades. Many excellent illustrations are shown, amongst which may be mentioned one of a moulded wireless switch part produced for the Air Ministry, which weighs 10 oz. and contains 13 brass insets, 7 of which protrude on both sides of the moulding. Another interesting production is a transformer tapping switch prepared for Ferranti, Ltd., designed for a current of 200 amps. and voltages up to 50,000, the flash-over voltage between adjacent contacts being 75,000 volts. Another little booklet (List C, Issue 2) deals with varnishes and moulding powders produced by the firm.

PUBLICATIONS RECEIVED

KOKEREI U. TEERPRODUKTE DER STEINKOHLE. By Dr. A. Spilker. Revised by Dr. O. Dittmer and Dr. O. Kruber. 5th ed. Monographien über Chemisch-Technische Fabrikations-Methoden. Vol. XIII. Pp. viii + 198. Halle (Saale): W. Knapp, 1933.

QUALITATIVE ANALYSIS. By H. S. Moodey, M.A. Pp. ix + 182. London: Wm. Heinemann, Ltd., 1933. 5s.

APPLICATION OF PHENOLIC CONSTITUENTS OF TARS AS WETTING AGENTS. By G. T. Morgan, D. D. Pratt, and A. E. J. Pettet. Pp. 11. Reprinted from the Journal of the Society of Dyers and Colourists. May, 1933.

REPORT OF THE COUNCIL OF THE MALTA CHAMBER OF COMMERCE FOR THE 83RD YEAR ENDING DECEMBER, 1932. Pp. 203. Valletta, Malta: Lux Press.

COLLECTED RESEARCHES OF THE NATIONAL PHYSICAL LABORATORY. Pp. 28. London: H.M. Stationery Office, 1933.

FIFTY-SEVENTH ANNUAL REPORT OF HIS MAJESTY'S INSPECTORS OF EXPLOSIVES: BEING THEIR ANNUAL REPORT FOR THE YEAR 1932. Pp. 54. London: H.M. Stationery Office, 1933. 9d.

HANDBUCH DER BIOLOGISCHEN ARBEITSMETHODEN. Edited by Prof. Dr. E. Abderhalden. DAS CO-ENZYM DER ALKOHOLISCHEN GÄRUNG, DIE CO-ZYMASE, IHRE BESTIMMUNG UND ISOLIERUNG. By K. Myrbäck and H. v. Euler. EINE ENZYMATISCH-CHEMISCHE METHODE ZUR BESTIMMUNG VON ZITRONENSÄURE. By T. Thunberg. KARBOHYDRASEN. By R. Weidenhagen. Abt. IV, Angewandte chemische und physikalische Methoden, Teil 1, Heft 7. Lieferung 414. Pp. 2009—2068. Berlin and Vienna: Urban & Schwarzenberg, 1933. 4 rm.

TEXTBOOK OF ELEMENTARY QUALITATIVE ANALYSIS. By C. J. Engelder, Ph.D. 2nd ed. Pp. viii + 243. New York: J. Wiley & Sons; London: Chapman & Hall, Ltd., 1933. 13s. 6d.