Recent Industrial Research in Cotton.[1]

THE British Cotton Industry Research Association, the non-confidential work of which is published yearly in this form, is pursuing a very steady policy. Nearly all of the fifteen researches described in the volume under notice are extensions of previous work, and nearly all aim at establishing on a scientific basis the many phenomena observed by the practical textile technologist in his daily work, which he has learned to use in controlling the quality of his productions. If their immediate value to the industry is not apparent, they are invaluable as records and as information available to all who follow their profession earnestly. Much of the instinctive genius which has guided the textile technologist in the past comes only of long and patient practice. Many of these technologists are men whose senses are highly developed in limited directions, with the result that they are capable of controlling complex processes in a strongly subjective way. They cannot pass on their acquired skill to their colleagues, for they never measure in units. Their skill dies with them, and educationally their activities are wasted. The reviewer looks to these published researches as a means of overcoming this difficulty and thus providing for a greater body of men whose interest in textile technology is more than a means of earning their daily bread. Unfortunately, technical scientific literature is hard reading to those in the textile industry who would profit by a more thorough understanding of its phraseology; and it is only through the efforts of textile colleges and schools that its value can be appreciated. The language barrier between the scientific textile technologist and the practical textile technologist has yet to be broken down, and one feels that these Memoirs will be better appreciated in years to come than they will be now.

The work on mildew in cotton goods has been carried to a very definite stage. With a given mould fungus, the rate at which growth proceeds is shown to be a function of the starch used in sizing and finishing; while under the same conditions of steeping, if wheat flour is used, the rate is found to vary with the type of fungus. It appears to be impossible to make generalisations, and a grouping system has been adopted.

The hygroscopic properties of scoured cotton and mercerised cotton have been compared; and, using this comparison, a method of measuring the degree of mercerisation has been established, though the reviewer is doubtful as to the possibility of its extended application. The mercerisation process continues to absorb the interest of textile scientific men, and a discussion on the rôle of the cuticle during the swelling of the cotton hair, illustrated by some excellent photomicrographs, has indicated that a final solution of the problem can only be reached by a detailed study of the micro-structure of the hair. Most workers have felt the need of more information about the cuticular structure, and some have even doubted the existence of a cuticle at all, but those who have been guided by faith and analogy with other plant structures will find this paper very interesting reading.

The problem of the swelling of cotton hairs has been attacked from a different direction. The dimensional changes have been measured after immersion of the hairs in sodium, potassium, lithium, rubidium and cæsium hydroxides of varying concentration. Unfortunately the relation between the maximum swelling and maximum electrical conductivity has not been established with all these metallic hydroxides, though earlier work had indicated a correlation. The textile industry has always employed sodium hydroxide in the mercerising process; and it is interesting to find that once more commercial practice is right, for with this hydroxide the change in diameter of the hair is found to be about twice that with any of the others, thus suggesting its specific action on cellulose.

Earlier work on moisture absorption by cotton has been responsible for a widespread impression that Indian, American and Egyptian cottons differ in their moisture-absorbing capacity; but a careful study has failed to confirm these earlier results. A suggestive comment on the acquired skill of practical textile technologists is found in the researches on the lustre of yarns and fabrics, in which it has been considered necessary to employ the Lummer Brodhun photometer, the most accurate instrument available, in order to compete with the acute observation of those employed in the finishing trade.

The mixing of different varieties of cotton is shown to cause variation in shade during dyeing, and a purely geometrical reason is given for this inter-varietal variation.

A study of the surface tension of various starch pastes used in sizing yarns has revealed an interesting analogy with viscosity determinations. The rate at which size permeates cotton is found to increase much more rapidly with increasing temperature than the lowering of the surface tension would indicate. The temperature should be carefully controlled during the sizing process if a level result is to be obtained, a conclusion which commercial practice has been slow to appreciate in England, though the advantages of thermostatic control have long been known in the United States.

Contributions to our knowledge of the chemical constituents of cotton are made in papers on the waxes of cottons of different origin and their characteristics, on the identification of fatty ingredients in sized goods, and on the ash content and ash alkalinity of typical cottons.

The photographic reproductions, graphs, tables and general lay-out of this volume are excellent. The inclusion of a short summary under the title of each paper in the table of contents is a welcome innovation.

F. P. SLATER.

[1] Shirley Institute Memoirs, vol. 4, 1925. Pp. vii+182+iv. Didsbury, Manchester: Shirley Institute, 1926.

The Function of Chlorophyll.

SINCE the chemistry of chlorophyll was elucidated by the researches of Willstätter, very little progress has been made in the interpretation of its function. Recently Noack has attempted an experimental attack upon the problem along a new line, and a general account of his experiments which appeared in *Die Naturwissenschaften* for April 30, 1926, provides a convenient opportunity to review his results.

Stern has provided experimental grounds for the conclusion that chlorophyll, as present in the living plant, is fluorescent. Noack's investigations concern themselves directly with the photo-oxidative effects produced by fluorescent pigments. A saturated aqueous solution of benzidin undergoes oxidation in light, in the presence of eosin 1 in 30,000. In the absence of eosin, or in the dark, it is quite unaffected, but the light change is materially accelerated if salts of iron, manganese, or copper are present in addition to the eosin. In alcoholic solution, benzidin similarly undergoes photo-oxidation in the presence of eosin,

the process being again accelerated by the presence of manganese or iron. In alcoholic solution it is possible to replace eosin by chlorophyll or by the methyl and ethyl chlorophyllides. Photo-oxidation again occurs, but is not produced if the non-fluorescent copper compound is used instead of the magnesium-containing chlorophyll compounds, which are fluorescent in alcoholic solution.

Water plants, living or dead, immersed in aqueous solutions of benzidin produce brown oxidation products of benzidin in the neighbourhood of the chloroplasts when exposed to the light. There is no such reaction in the dark, or in dead plant tissue which has been boiled in copper sulphate, so that the fluorescent pigment is replaced by the presumably non-fluorescent copper derivative. Dead green cells, which bleached in a few minutes in a strong light, could be kept green by the addition of neutral sodium sulphite. Noack considers that this is evidence that under certain conditions the photo-oxidative change results in the destruction of the pigment. Dead green tissues in the dark showed no absorption of oxygen in twelve hours, but in a strong light at 10° strong oxygen absorption took place, proportional to the oxygen pressure.

There is an obvious difficulty in associating these photo-oxidative changes with the photo-synthetic reduction of carbonic acid. Noack and Metzner have shown their close connexion with the so-called photo-dynamic action by which species of Paramœcia, normally insensitive to light, in the presence of very dilute solutions of fluorescent pigment and oxygen, become photo-tactic in the light, showing positive or negative movements according to the strength of the light or variation in oxygen pressure or pigment concentration whilst under stronger photo-dynamic action, they are killed. Metzner (*Ber. der Deutsch. Bot. Ges.* 41, pp. 268-274, 1923) has even extended this work to root systems growing in dilute solution of fluorescent pigments, which have thus been rendered photo-tropically sensitive, a phenomenon which he describes as induced photo-tropism.

From this point of view, Noack argues that in normal photo-synthesis the photo-oxidative change must hand energy on to carbonic acid, and he points out the interesting bearing in this connexion of the toxic action of sunlight on leaves, in the absence of carbon dioxide. This phenomenon was reported long ago by Jost. Noack now explains it as a photo-dynamic effect of the fluorescent pigment upon the surrounding protoplasm, produced in the absence of carbon dioxide. He also thus explains the death and bleaching of Fontinalis when exposed to sunlight in the presence of phenyl urethane, a substance which, as Warburg has shown, hinders photo-synthesis. Noack also offers a similar explanation of the toxic action of sulphur dioxide upon green tissues; the sulphite hinders photosynthesis and under these conditions photo-dynamic destruction of the protoplasm occurs in the light. This interpretation does not seem quite in harmony with the demonstration of the effect of sulphites in hindering photo-oxidation.

Noack adds some further experiments as to the rôle of the yellow pigments in the leaf plastids. In experiments *in vitro*, these carotinoids were bleached by photo-oxidation in sunlight in less than an hour in the presence of chlorophyll (1 in 100,000); without this trace of chlorophyll they remained unaltered after six hours' exposure.

Stern explains chlorophyll fluorescence as due to its solution in lipoids, but Noack finds that dry leaf tissue from which lipoids and carotinoids have been removed by 24 hours' extraction with petrol ether, still retain their chlorophyll and still show the photo-oxidation of benzidin and bleach as the result of photo-oxidation. These experiments seem in closer agreement with Willstälter's view that chlorophyll is adsorbed on some substance of high molecular weight, although in agreement with Stern's view that the pigment itself is in the fluorescent condition.

It must be admitted that the theoretical interpretation of these experiments of Noack is still far from clear, but they seem well worth consideration as suggesting yet another line of experimental approach to a very fundamental problem, the function of chlorophyll.

Tide-predicting Machines.

THE simplicity of the harmonic methods of analysis and prediction of tides is very fascinating, and the invention of the tide-predicting machine by Lord Kelvin almost ensured the success of the methods. A predicting machine sums a number of harmonic variations, transmitted vertically to pulleys, round which passes a wire or chain which is fixed at one end and carries a recording pen at the free end. For the majority of ports the harmonic method of analysis is unrivalled in accuracy and cheapness; consequently we find machines in active use in the following countries: Great Britain (one at Broadstairs and one at Bidston Observatory), France, Germany, Portugal, United States, Argentina, Brazil, India, and Japan (2). In addition to these, three machines are no longer used: one was destroyed at Tokyo, and the Brazilian machine is being replaced by a model under construction at the present time. It is noteworthy that since the War five machines have been built at Glasgow by Messrs. Kelvin, Bottomley, and Baird.

The number of harmonic variations utilised by the machines varies from ten to thirty-seven, and much ingenuity has been practised, especially in connexion with devices to reduce the cost of predictions. Considering that a port cannot do business without tide predictions, it is remarkable that 10*l*.-20*l*. should be considered excessive cost, and that too often accuracy is subordinated to price. For the more important ports, however, accuracy is increasingly demanded. Considering only prediction, accuracy depends upon the number of constituents incorporated in the machine, and also upon the performance of the machine. For some ports, especially those situated in estuaries, a machine with, say, eighty constituents would be required; the initial cost would be very great and the difficulties of operation enormously increased.

The present writer has had actual experience with five of the latest machines; he has carried out tests on two others, and has witnessed the performance of another one. There is no possible doubt but that the principal source of error in performance is that of friction. A change in tension of 1 per cent. at each pulley means a considerable average change over of tension throughout the wire under certain conditions. This leads either to stretching with a soft wire or to 'bowing' from the vertical with a resilient wire, and it seems impossible to find a wire of circular cross-section that will satisfy all conditions. A chain is used on two machines (United States and Germany), and a flexible tape of relatively large cross-section is used on the Liverpool Tidal Institute machine at Bidston. The machine now under construction for Brazil is being fitted with ball-bearings for each pulley.

Even if a perfect machine, with a large number of